

MUIbase

A relational programmable database
Version 1.5

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1 MUIbase Copying Conditions

MUIbase is © 1998-2000 Steffen Gutmann. All rights reserved.

MUIbase is not public domain or free software. If you use MUIbase then you have to register your copy after a short while. You are allowed to install and run MUIbase without registration for a period of 4 weeks. After that time you have to register your copy of MUIbase or delete it from your system. Reinstalling MUIbase does not extend the license.

After registration you receive your personal MUIbase key-file which enables all crippled features of MUIbase.

Reverse engineering of the MUIbase software protection is strictly forbidden.

1.1 Registration

The unregistered MUIbase version is crippled in several ways:

- Only up to 5 tables per project.
- Only up to 10 attributes per table.
- Only up to 30 function definitions for programming per project.
- No preprocessing for programming (`#`-directives).
- No remembering of window dimensions in projects.
- No images for structure editor.
- No register groups for structure editor.

In the author's opinion the absence of these features doesn't make MUIbase unusable. You should be able to see the power of MUIbase within the 4 weeks testing period without these features.

After registration you will receive a key-file which enables the disabled features. The key-file is expected to work with all future versions of MUIbase.

1.1.1 Registration fee

The registration fee for MUIbase is DEM 60. Registration fee is accepted **only in these currencies**:

- 40 USD (US dollar)
- 30 EUR (Euro)
- 60 DEM (Deutsche Mark)

The registration fee does not include a printed hard-copy of the manual. Please print the documentation on your own printer or use the online help (AmigaGuide or html) while working with MUIbase.

1.1.2 Payment methods

Cash This is one of the preferred payment method and maybe the cheapest for you and me. Enclose the cash in two pieces of nonwhite paper to disguise it. **Do not send coins.**

Eurocheque

Write the cheque for 60 DEM or 30 EUR. **Other currencies than DEM and EUR are not accepted here!** You must write your card number on the back of the cheque, otherwise I can't cash it in.

Money transfer

Transfer 60 DEM or 30 EUR to my bank account Bank 24, Germany, BLZ 380 707 24, account number 314 726 100.

If you have internet access then you can also transfer the money to my account and send me the registration by email or use the registration interface on the MUIbase home page <http://www.amigaworld.com/support/muibase>. This is probably the best way to register your MUIbase copy. I am checking my bank account almost every day, thus I will see your money pretty fast.

Postal Money Order

You can pay using postal money order, but you must mail or email me the registration form because it's possible that only your name is included with the PMO when I receive it, so I also need your address. Ask your local post office for more information.

Credit card via ShareIt.

This might be a good option for you if you want to order MUIbase by internet. Please see the instructions on the MUIbase web page <http://www.amigaworld.com/support/muibase> on how to use this registration method.

1.1.3 Ordering

The easiest way for ordering MUIbase is to fill in a registration form or to use the 'Register' program, which asks you all the necessary information and creates an ASCII registration form. Blank registration forms are available in these formats:

- Final Writer
- ASCII

You'll find these files in the 'Register' directory.

If you don't have a printer then create an ASCII registration form with the 'Register' program and copy the necessary information to a piece of paper. The information I need is:

- your name
- address
- email address (if available)
- payment method and currency
- method of delivery

When you have filled in the registration form, please send it to me with your payment. My address is:

Steffen Gutmann
Orleanstr. 47
81667 Munich
GERMANY

Or send it by email to:

gutmann@ieee.org

1.1.4 Method of delivery

If you have an Internet email address, I will email you the key-file. Otherwise I will send you a 3.5" disk by post with the key-file and the latest version of MUIbase.

The latest version of MUIbase can always be down-loaded from Aminet or from <http://www.amigaworld.com/support/muibase>.

1.2 Distribution

You are granted the right to share MUIbase with others, as long as you distribute the MUIbase archive exactly as you received it, with all associated files included. **Registered users may not distribute their private file "MUIbase.key"**.

Under no circumstances may you charge more than a normal copying fee and shipping costs for distributing the MUIbase archive without express written consent from the copyright holder.

Permission is hereby granted, without written agreement and without license fees, to copy and distribute the MUIbase archive, provided that the above conditions are met, to

- All who will distribute this software for free!
- All free accessible INTERNET servers and PHONE boxes!
- All Aminet sites
- All others who do NOT take more than \$5.- for one disk that includes this software!
- All others who do NOT take more than \$20.- for one CD that includes this software!

Distributing beta-versions of MUIbase is strictly prohibited.

1.3 Disclaimer

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1.4 MUI

This application uses

MUI- MagicUserInterface

(c) Copyright 1993-2000 by Stefan Stuntz

MUI is a system to generate and maintain graphical user interfaces. With the aid of a preferences program, the user of an application has the ability to customize the outfit according to his personal taste.

MUI is distributed as shareware. To obtain a complete package containing lots of examples and more information about registration please look for a file called "muiXXusr.lha" (XX means the latest version number) on your local bulletin boards or on public domain disks.

If you want to register directly, feel free to send

DM 30.- or US\$ 20.-

to

Stefan Stuntz
Eduard-Spranger-Straße 7
80935 München
GERMANY

Support and online registration is available at

<http://www.sasg.com/>

1.5 BetterString & TextEditor

MUIbase uses BetterString.mcc & TextEditor.mcc, (c) 1997-2000 by Allan Odgaard. See <http://www.diku.dk/students/duff/> for more info or latest version.

1.6 Additional custom classes

MUIbase uses NList.mcc (C) 1996-2000 Gilles Masson.

1.7 Icons

Some icons used in the MUIbase distribution are copied from the DefaultIcons set which is distributed e.g. on the Meeting Pearls CD 3, directory 'Contrib/DefaultIcons'. These icons are Copyright by Michael-Wolfgang Hohmann and Angela Schmidt (for a more detailed Copyright description see MP3).

2 Welcome to MUIbase

MUIbase is a fast and very flexible database for the Amiga. It is for users who want to manage data in a comfortable and easy way. MUIbase is able to manage any kind of data, e.g. addresses, CD series, movies, or your income and expense. The power of MUIbase lies in its clear and powerful graphical user interface and its programming capabilities. The latter makes it possible to automatically calculate and maintain nearly everything, starting from automatically summing up values, e.g. for calculating the total amount of income or the total amount of recorded time of a CD, up to automatically creating and printing letters for any purpose.

MUIbase is the successor of AmigaBase, a hierarchical programmable database which is still available but considered obsolete with the appearance of MUIbase. All registered users of AmigaBase can get a free upgrade to MUIbase by sending their AmigaBase registration number and return address to me (Email preferred).

MUIbase offers the following features:

- Handling of multiple projects at the same time.
- Attributes can be of type string, memo (multi line text), integer, real, date, time, bool, choice (one item out of many items), reference (easy way to reference a record of another table), button (for starting MUIbase programs), and virtual (compute value on the fly).
- The string type can also manage lists of strings, files, and fonts. An OS 3.x datatype gadget allows displaying external images.
- Unlimited number of records.
- Dynamic loading of records. Records which are not needed may be flushed from memory (e.g. when memory is low).
- Programmability. With the easy and powerful MUIbase programming language complex tasks can be implemented. The language also includes a SELECT FROM WHERE query for easy and fast data retrieval.
- Ordering of records by any combinations of attributes.
- Flexible and powerful search and filter facility.
- Query editor which allows entering and managing of SELECT FROM WHERE queries. The queries can be saved and the results can be printed.
- Import and export facility.
- Uses MUI as user interface. The interface is highly customizable. External images can be included in the user interface.
- Portability. MUIbase development has been done under the idea of easy portability. The system/gui part has been separated from the ANSI/C part such that porting MUIbase will result in only porting the system/gui part. The author is currently investigating a Java implementation of the user gui. This would make the database available for nearly all computer systems, including Linux, Windows, and MacOS.

The unregistered version of MUIbase is crippled in several ways. See Section 1.1 [Registration], page 1, for a list of limitations in the unregistered version.

3 Getting started

This chapter describes how to install MUIbase on your computer, what the hard- and software requirements are, and how to start MUIbase.

3.1 Installing MUIbase

For installing MUIbase on your hard disk you need the Commodore Installer. This tool can be found in the Aminet under directory `'/pub/aminet/util/misc'`. The Installer may also be included in the MUIbase archive. Be sure to use Installer version 43.3 or up, otherwise the installation script may fail.

Before beginning the installation, make sure that your computer and your system software is compatible to MUIbase. See required hardware and required software sections.

3.1.1 Required hardware

You need an Amiga with an 68020 processor or higher, 2 MB of ram, and a hard disk with at least 2 MB of free space on it. For larger applications more hard disk space and ram is necessary.

3.1.2 Required software

MUIbase needs OS version 3.0 or up. It may also run under OS 2.x but there is no guarantee that all features will work properly there.

Additionally, MUIbase requires that MUI version 3.8 or higher is installed on your system.

3.1.3 Starting the installation

If you have received MUIbase as an archive file, unpack the archive to a temporary directory. Do not unpack it to the target directory!

Double click the MUIbase installer script `'Install-MUIbase'` and follow its instructions. The script asks for a directory where the software should be copied to. Do not enter the directory where you have unpacked the MUIbase archive to.

The script is also capable of updating an existing MUIbase installation. In this case enter the directory where you have previously installed MUIbase. When updating an existing MUIbase installation all necessary files are replaced by new ones. This includes the sample projects in the `'Demos'` directory. Therefore do not place projects into this directory nor use one of the sample projects for managing your own data!

After a successful installation you can remove the MUIbase archive from your system and store it elsewhere, e.g. on a floppy disk.

3.1.4 Key-file

If you are a registered user of MUIbase and have received a key-file, you should move the key-file to one of the following directories:

- `'directory-containing-the-MUIbase-executable'`
- `'MUIbase:'`
- `'KEYS:'`
- `'KEYFILES:'`
- `'S:'`

MUIbase will search in these directories for the file ‘`MUIbase.key`’ and if found (and the key-file is valid) enable all crippled features.

Remember that the key-file contains your personal data and you are not allowed to give it away. Also do not modify the file in any way or MUIbase is likely to crash.

Please keep a safety copy of your key-file on one or two diskettes.

3.2 Starting MUIbase

MUIbase can be started from Workbench or from CLI. From Workbench double click the MUIbase icon. You can also double click a MUIbase project icon. This starts MUIbase and the selected project is automatically loaded by MUIbase. It’s also possible to mark several MUIbase projects by shift clicking them and double click the last project.

From CLI type `MUIbase [file1 ...]`, where `file1 ...` are optional projects to be loaded by MUIbase.

3.3 Quitting MUIbase

To quit MUIbase select menu item ‘`Project - Quit`’ or close all opened projects.

4 Tutorial

The making of a family-tree database.

This chapter is a small tutorial describing how the basic things of MUIbase work. Within the tutorial a small project is developed that allows managing of your family tree. The project that results after applying all steps in this tutorial can be found in the ‘Demos’ directory of your MUIbase installation.

4.1 How MUIbase works

MUIbase could be said to operate in two different modes, record-editing and structure-editing mode.

The record-editing mode is where you change, add, or delete your records.

The structure-editor lets you edit how your database should look like and what tables and attributes it contains.

Besides this there is the program-editor where you write program functions that are executed either automatically when entering some data in an attribute or when pressing a program button.

4.2 Starting with a project, the structure-editor

To create a database you first of all need to define it’s contents. In MUIbase this is done in the structure-editor. To enter the structure-editor you either press *RAMIGA-s* (Right Amiga button and the letter ‘s’) or by choosing ‘Structure Editor’ from the ‘Project’ menu. There you will find three different sections:

‘Tables’ In ‘Tables’ you change, add, or delete the tables you need.

‘Attributes’

In ‘Attributes’ you change, add, or delete attributes. These attributes each belong in one of the above mentioned tables.

‘Display’ In ‘Display’ you design the looks of your database, how it should be displayed.

4.3 Adding a table

First we need a table, press the ‘New’ button just below the list view in the ‘Table’ section. You will then get a requester which asks you to enter some data:

‘Name’ This is where you enter the name of a table. The name must start with an uppercase letter and can consist of up to 20 characters. The name can be changed later. In this tutorial we set the name to ‘Persontable’ since it’s going to hold all the persons names in this database.

‘Number of records’

A table can either consist of only one or of an unlimited number of records. In this case it should be set to unlimited since we are going to add more than one person.

‘Trigger functions’

Any call from the user to add or delete records can be controlled by a program function, this is where you set which function to call. Since we don’t have written any program functions yet, a look in any of the list-views will not show anything.

When this is done, just press the ‘OK’ button and we have our first table, Persontable.

4.4 Adding an attribute

Then we need a string attribute for that table, press ‘New’ in the attributes-section. Attributes also need some settings:

- ‘Name’ The same as for a table, first letter an uppercase one and altogether a maximum of 20 characters. This attribute we will set to ‘Name’ since it’s to contain the names of the persons we are about to add.
- ‘Type’ Here we choose what type this attribute should be. There are a couple of different ones but for this attribute we use a string attribute.
- ‘Max length’
 Here you can define the maximum number of characters a user can enter for the string. We set this to 30.
- ‘Initial value’
 It’s possible to have some attributes to use an initial value for every new record you add, here is where you enter what it should contain. Leave this line blank.
- ‘Trigger’ An attribute could also trigger a program function to be executed. For example, if you enter a name then you can have a program to check if this name already exists.

4.5 Displaying the project

After pressing ‘OK’ you now should notice some changes in the display section. Change the choice button on the top of the display section to ‘Root window’. There you see what the root window holds, currently ‘Persontable’. If you change the choice button back to ‘Table mask’ you can see how this table, ‘Persontable’, is presented. Currently it’s displayed as one panel with one attribute.

Now double-click on ‘Panel(Persontable)’ at the top of the list in the display section and a window should appear, allowing you to set how this panel should be displayed:

- ‘Title’ The title of a table can be different than what it’s real name is. Our table is called ‘Persontable’ but here we could set it to be ‘THIS IS THE TABLE PERSONTABLE!’ if we prefer that better.
 - ‘Background’
 The background can be changed to whatever suits your taste.
 - ‘Gadgets’ Here we can define what gadgets we want the panel to have.
- Press ‘OK’ and then double-click on ‘Name’ in the list-view in the display section. That should bring up the window that contains the settings for how to display the string attribute ‘Name’.
- ‘Title’ The same as for the panel. The string you enter here is what is really displayed when in record-editing mode.
 - ‘Shortcut’
 Here you can set a letter that should be used together with *RAMIGA* to jump to this attribute, when in record-editing mode.
 - ‘Home’ Makes the cursor to jump to this attribute whenever a new record is added. In our case we will always or most of the time enter the name first in a new record, so set it.
 - ‘Read only’
 Set this if the attribute should be read only. Leave it unset.

‘Weight’ Decides how much of this attribute should be visible when competing for the space with other attributes. For example, if three 50-character strings resides in a window that only has room for 100 characters, then this number decides how much space the string gets relatively to the other ones. Leave it at 100.

‘Background’
The same as for the panel.

‘Bubble help’
Here you enter any text you think would be helpful to the user. The bubble help appears after holding the mouse still over an attribute for some seconds. Set this to **‘If you need help, call the author at 112’**.

Leave the structure-editor (*RAMIGA-s* or **‘Structure Editor’** in the **‘Project’** menu) and go to record-editing mode, to see how the database looks in real life. You’ll see the headline which is the string you may have entered in the display section for the panel. The record counter should say **‘#0/0’** since we haven’t added any records yet. Thereafter is the filter button and the two step-buttons. Below all this you should have **‘Name’** and the text you may have entered in the display section for this attribute. If you haven’t changed any text at all when in the display section then the panel should be named **‘Persontable’**, and the string attribute **‘Name’**. Move the mouse above the string attribute **‘Name’** and leave it there for a couple of seconds. If you entered something in the bubble help above then this text should appear in a bubble.

4.6 Adding two reference attributes

Now we will add two reference attributes. Reference attributes are a bit different than other attributes. As their name might imply they refer to records. This will get more understandable as you try it out for yourself in just awhile.

Enter the structure-editor again and add two more attributes to **‘Persontable’**. Press **‘New’** in the attributes section, name it **‘Father’**, and change it’s type to **‘Reference’**. A reference attribute has only one setting:

‘Set reference to’
Tells which table the attribute it’s about to refer to. Should already be pointing to **‘Persontable’**, leave it that way and press **‘Ok’**.

Add another attribute by pressing **‘New’** in the attribute section and call it **‘Mother’**. The attributes type should also be set to reference and point to table **‘Persontable’**.

As you may have noticed there are now three attributes in the display section. Click on **‘Father’** and then on the buttons up and down located just to the left. This will change where **‘Father’** is positioned when looking at it while in record-editing mode. Put **‘Father’** at the top, **‘Name’** in the middle, and **‘Mother’** at the bottom.

Then we just have to set what contents the reference attributes **‘Father’** and **‘Mother’** should display from the referenced records. Double-click on **‘Father’** in the display section and then click on **‘Extras’**. There we choose to display the string attribute **‘Name’**, then we press **‘Ok’** and repeat the procedure for **‘Mother’**.

4.7 Adding records

Now we should add some records. Leave the structure-editor and enter record-editing mode. To add a new record you simply press *RAMIGA-n* or choose **‘New record’** from the **‘Table’** menu. The cursor should now automatically jump to the attribute we have set to **‘Home’** earlier in the display section in the structure-editor. Add two records, one with your fathers name in **‘Name’** and another one with your mothers name in **‘Name’**. Thereafter you add another record with your own name in **‘Name’**.

Now it's time to understand those reference attributes. By pressing on the list-view button on **'Father'** we get a list of all records this reference attribute could refer to. Choose your fathers name and do accordingly down below on the mothers list-view.

Now you should have three records, you, your father and your mother. In your record, your fathers name should be visible in **'Father'** at the top and your mothers name should be in **'Mother'** at the bottom. You can browse through the records by pressing *ALT* together with *Cursor up/down*.

But hey! My parents also has/had parents you say! So let's add another four records, the third generation. Just add the records one by one and write their names in **'Name'**. If you don't remember their names then just enter **'fathers father'**, **'mothers father'** or something like that instead. Then you browse through all the records and set **'Father'** and **'Mother'** to what they should contain. When this is done you should have at least seven records, your record, your parents records and your grandparents records.

4.8 Filter

Since we now have some records to work with, we could try out the filter function. The filter can sort out records you don't want to display, they will still remain in the database itself but they will not be displayed.

To edit the filter you press *LAMIGA-f* or choose **'Change filter'** from the **'Table'** menu. When you have done so a strange looking window with loads of operators will appear. This is where you set what conditions a record must fulfill to get displayed.

In this small example we will use the **LIKE** command, which lets you do a joker comparison of an attribute. Press once on the **LIKE** button to the right and then double-click on **'Name'** in the list to the left and (**LIKE Name**) should appear in the string just above the **'Ok'** and **'Cancel'** buttons. Thereafter you type **"*a*"** so the whole string shows (**LIKE Name "*a*"**). This means that MUIbase should display all records that contain the letter **'a'** anywhere in **'Name'**.

Press **'Ok'** and you may notice that records with no **'a'** in **'Name'**, no longer are visible. Since the letter **'a'** is quite common in most languages and names, all records might still be visible but you can try other letters to make the filter function more clear. When you're done, go to record-editing mode.

As mentioned earlier there is a button on the panel that says **'F'**. This **'F'** indicates if the filter is on or off. Finally when you're done testing, turn the filter off so that all records are visible.

4.9 Queries

Now that we have played with the filter function a bit, we might as well play around with the query feature that's in MUIbase. Queries can be used to display information from a database matching certain criteria.

Choose **'Queries'** from the **'Program'** menu or press **'RAMIGA-*** to open the query editor. Now a window with some buttons on the top and two larger areas below appear. The string to the upper left is where you enter the name of what you want to call the query you make.

'Run' Compiles and runs the query. It goes through the database and then displays the info according to your specifications.

'Print' Prints out the result of the query.

'Load and Save'
 Lets you load and save each of the queries.

The first large area is where you enter the query. The second large area is where the result is displayed.

Now let's produce a list of all those persons we tried to filter out previously. Type 'Persons with an a in their name' in the string to the upper left. This is the title for this query. In the upper large area, type:

```
SELECT Name FROM Persontable WHERE (LIKE Name "*a*")
```

Now when you run this query, either by *RAMIGA-r* or by pressing the 'Run' button, it will produce a list of all persons with the letter 'a' in their name. Try changing the letter to see different results.

At this time we can introduce the AND command. Press the list-view button just to the left of the 'Run' button, in the query editor. Then choose 'New' and name it 'Persons with both letter a and s in their names'. Then type

```
SELECT Name FROM Persontable WHERE
(AND (LIKE Name "*a*") (LIKE Name "*s*"))
```

Note that we are still using the LIKE command for choosing records containing the letters 'a' or 's' in their names, but the AND command requires that BOTH LIKE criteria are met. Therefore, only records with BOTH the letters 'a' and 's' in their name are displayed when the query is run.

4.10 Adding a table with a memo and a button attribute

This was two ways of selecting and displaying the database. Another way of displaying data can be done by a program. In order to display data we can use an attribute type called memo.

Enter the structure-editor and press 'New' in the table section. Name the new table 'Controltable' and set it's number of records to 'Exactly one'. Click and hold down the mouse button on the new table. Now drag it just a bit above the middle of 'Persontable' and release the button. In the table section, 'Controltable' should now be on top, and 'Persontable' below of it.

Make sure that 'Controltable' is activated, then press 'New' in the attribute section. Set this new attributes type to 'Memo' and give it the name 'Resultmemo'. Press 'Ok' and then add another attribute to 'Controltable' by once again pressing 'New' in the attribute section. This time, set it's type to 'Button' and name it 'Pedigree'.

To give the database a better look, click once on 'Pedigree' in the display section and push it to the top by pressing the 'Up' button once.

4.11 Programming MUIbase to do a pedigree

Ok so now we have a button that can start a program and a memo to display data in. It's therefore time to enter the program-editor. This is done either by pressing *RAMIGA-p* or by choosing 'Edit' from the 'Program' menu. The editor has three buttons:

'Compile & Close'

Which does just that. It compiles the program and leaves the program-editor.

'Compile' Compiles the programs but stays in the program-editor.

'Undo' Undo all changes from the time you entered the program-editor.

As all program functions you write will reside in this one window, we will need to separate them from each other. In MUIbase this is done by the DEFUN command. Everything between the two parenthesis will be a part of the function `pedigree` in this example:

```
(DEFUN pedigree ())
```

```
  ; This is DEFUN's end parenthesis
)
```

With this in mind we now type in the first function which will produce a family tree of the current person in the database and place the result in 'Resultmemo'. This `pedigree` function is in fact three functions:

- `pedigree` which sets 'Controltable.Resultmemo' by calling another function.
- `getpedigree` which collects the pedigree to a list.
- `pedigree2memo` which converts this list to the memo.

```
  ; The program pedigree
```

```
(DEFUN pedigree ()
  (SETQ Controltable.Resultmemo (pedigree2memo (getpedigree Personstable NIL) 0 3))
)
```

```
  ; The program getpedigree
```

```
(DEFUN getpedigree (person:Personstable level:INT)
  (IF (AND person (OR (NULL level) (> level 0)))
    (LIST person.Name
          (getpedigree person.Father (1- level))
          (getpedigree person.Mother (1- level)))
    )
  )
)
```

```
  ; The program pedigree2memo
```

```
(DEFUN pedigree2memo (pedigree:LIST indent:INT level:INT)
  (IF (> level 0)
    (+
      (pedigree2memo (NTH 1 pedigree) (+ indent 8) (1- level))
      (IF pedigree (SPRINTF "%*s%s\n" indent "" (FIRST pedigree)) "\n")
      (pedigree2memo (NTH 2 pedigree) (+ indent 8) (1- level))
    )
    ""
  )
)
```

Ok, so here we have the final program functions. Type this in and make sure that all the parenthesis are where they should be. Too many or too few parenthesis is the most common fault you'll get when MUIbase is pre-compiling your programs. The error message from MUIbase will probably be 'Syntax Error', in that case. Press 'Compile & Close' and hopefully the window will close, which means that MUIbase couldn't find any faults in it while pre-compiling.

Don't worry too much if you don't understand all the commands at first. As with all programming languages it requires some time and practice to master.

Now we have a program to run, but first we have to assign the program function to the 'Pedigree' button. This is done by entering the structure-editor, selecting 'Controltable' in

the table section and double-clicking on the 'Pedigree' attribute in the attribute section. Then open the list-view 'Trigger'. In this list, all your program functions will be listed, currently there should be three functions: `pedigree`, `getpedigree` and `pedigree2memo`. Double-click on `pedigree` as the program function the 'Pedigree' button will trigger, then press 'Ok' and leave the structure-editor.

Now if everything is done correctly, pushing the 'Pedigree' button will produce a pedigree of the current person. Try changing person to see some different pedigrees.

4.12 Programming MUIbase to list a person's children

As the next addition to this database requires some more records, you should add your brothers and sisters. If you don't have any then write 'My faked sister 1', 'My faked brother 1' which of course should be set to have the same parents as you.

Then go to the program-editor and type the following for creating another program.

```

; The program children counts how many children a person has.
; First we define the variables we will use, i.e "children" is set to contain "\n\n"

(DEFUN children ()
  (LET ( (children "\n\n") (nrofchildren 0) (currentperson Persontable) )

    ; For all records in Persontable do the following:
    ; If the current person appears as father or mother in any of the records then:
    ;   add the name to the variable children
    ;   increase the nr of children - counter with 1.

    (FOR ALL Persontable DO
      (IF (OR (= currentperson Father) (= currentperson Mother))
        (
          (SETQ children (+ children Name "\n"))
          (SETQ nrofchildren (+ nrofchildren 1))
        )
      )
    )

    ; Then we write the result into the Controltable memo, Resultmemo.
    ; If the current person doesn't have any children then write one string.
    ; If he/she has children then write another string.

    (SETQ Controltable.Resultmemo
      (+ Persontable.Name (IF (> nrofchildren 0)
        (+ " is the proud parent of " (STR nrofchildren) " children(s).")
        " does not have any children (yet :-).")
      ))
    )

    ; If the current person has children then add their names.

    (IF (<> nrofchildren 0)

```

```

      (SETQ Controltable.Resultmemo
        (+ Controltable.Resultmemo "\n\n"
          (IF (= nrofchildren 1)
              "The child's name is:"
              "The children names are:")
          )
        children
      )
    )
  )

; This is the end parenthesis of the LET-command.
)

; This is the end parenthesis of DEFUN children.
)

```

To create variables, we use the LET command. Variables created with the LET command are local and only visible within the 'LET' commands open and closing parenthesis. So any command that want to access these variables will have to be within these parenthesis.

All we need to execute this program is a new program button, so enter the structure-editor and add a button attribute in 'Controltable'. Call it 'Children' and choose children as the program function it should trigger.

To bring some order in the mask of 'Controltable' it's now time to introduce groups. All objects can be ordered into vertically or horizontally aligned groups.

In the display section, click on 'Pedigree' and shift-click on 'Children', thereafter you click on the 'Group' button to the left. Now the two program buttons will be together in a vertically aligned group. However, we want this one to be horizontally aligned so double-click on the 'VGroup' that has appeared in the display section. This will open a window that lets you change the settings for this group. Set the title to 'Programs' and check the 'Horizontal' button.

At this time we can remove the name of 'Resultmemo' in 'Controltable'. Double-click on 'Resultmemo' in the display section and remove the name. 'Resultmemo' will still exist but it's name won't be shown anymore.

To make things easier if we add more programs or attributes in the 'Controltable', we should place 'Resultmemo' and the 'Programs' group in a vertical group. Be sure of that you only have marked the group 'Programs' and 'Resultmemo' and then press on 'Group'. This will put 'Programs' and 'Resultmemo' into a vertical group.

Leave the structure-editor and take a look at the result. Then press the 'Children' button to see the number of children and their names of the current person.

This example could very well be extended into a full-grown pedigree-program. The only real limits are your fantasy and the size of your hard drive.

5 Basic concepts

Before you start setting up your own database projects and entering data for them, you should now about some basic concepts MUIbase is built on.

5.1 Projects

A MUIbase project consists of all relevant information you need for managing your data. This includes the project's user interface, the project's data you entered and the programs you wrote for the project.

A project can be loaded from, saved to, and deleted from disk. Any change you make to a project is only done in memory. At any time you can go back to the state of the last saved project by reloading it.

MUIbase is able to handle multiple projects at a time. Therefore it is not necessary to start MUIbase twice just to load another project.

5.2 Tables

MUIbase manages data in tables. A table is organized in rows and columns, where rows are called records and columns are called attributes.

See the following table for an example on how to structure a set of addresses in a table.

Name	Street	City
Steffen Gutmann	Wiesentalstr. 30	73312 Geislingen/Eybach
Charles Saltzman	University of Iowa	Iowa City 52242
Nicola Müller	21W. 59th Street	Westmont, Illinois 60559

There exists a special table kind which can hold exactly one record. A table of this kind is sometimes useful for controlling the database project, e.g. you can put buttons into this table for executing various actions, or a read-only attribute for displaying project related information. For an example suppose you have an account database where you store all your income and expense. An exactly-one table now could have a read-only attribute of type real for displaying the total balance.

Each table has two record pointers, a pointer to the record that is currently displayed in the user interface (called *gui record pointer*) and a pointer to the record that is the current one while executing a MUIbase program (called *program record pointer*).

You can define any number of tables for a MUIbase project. (Note: in the unregistered MUIbase version there is a limitation of 5 tables per project).

Tables can be added to, renamed, and deleted from a project.

5.3 Records

A record is one row of a table. It holds all information about one set, e.g. in a table that manages addresses, one record holds one address.

Each record has a record number that reflects the record's position in the table. This number may change when you add or delete records.

For each table a record called *initial record* exists that holds the default values for initializing new records. The initial record always has a record number of 0.

Records can be added to, changed, and deleted from a table. There is no upper limit on the total number of records for a table. The records are not necessarily held in memory but are loaded from and stored to disk when needed. Ok, there are two upper limits for the total number of records of one table. One comes from the fact that the record number must fit into a `long` value, which limits the total number of records to 4294967295. Another limitation is that for each record a small record is kept in memory. These limitations should make MUIbase still be usable for record numbers of 10,000 and more.

5.4 Attributes

An attribute defines one column of a table. It specifies the type and appearance of the corresponding column.

Attributes can be added to, renamed, and deleted from a table. There is no upper limit on the number of attributes per table. (Note: in the unregistered MUIbase version there is a limitation of 10 attributes per table).

For each attribute you have to specify a type that restricts the contents of this attribute. See the next section for a list of available attribute types.

5.5 Attribute types

Attributes can be of type string, integer, real, bool, choice, date, time, memo, reference, virtual, or button. The types are described in more detail below.

Some of the attribute types support a special value called NIL. This special value has the meaning of an undefined value, e.g. for a type of date it means an unknown date. The NIL value is similar to the NULL value of other database systems.

Please note that once you have set the type of an attribute, you cannot change it later.

5.5.1 String attributes

String attributes can store any single line of text. Strings are the most often used attribute type in a database project. For example an address database will store the name, street, and city of a person each in its own string attribute.

For a string attribute you have to specify the maximum number of characters allowed in the string. This number does not directly affect the amount of memory or disk space that is used by this attribute because only the actual string contents are stored (other databases have called this feature compressed strings). If necessary the number can be changed after you have installed a string attribute.

String attributes can also be used to store font- and filenames. For filenames external viewers can be launched to display the file contents. Furthermore an in-line image class allows displaying the image of a file.

String attributes do not support the NIL value.

5.5.2 Integer attributes

Integer attributes store integral values in the range of -2147483648 to 2147483647. They are mostly used for storing quantities of any kind, e.g. the number of children of a person, or the number of song titles on a CD.

Integer attributes support the NIL value representing an undefined integer value.

5.5.3 Real attributes

Real attributes store floating point values in the range of -3.59e308 to +3.59e308. They are used for storing numbers of any kind, e.g. the amounts of money in an income/expense project.

For each real attribute you can specify the number of decimal places used for displaying the real value, though internally always the full precision is stored.

Real attributes support the NIL value representing an undefined real value.

5.5.4 Bool attributes

Bool attributes store one bit of information. They are used for storing yes/no or true/false values, e.g. in a project managing invoices a bool attribute could store the 'has paid?' information.

Bool attributes use TRUE and NIL as bool values. NIL in this case stands for a value of FALSE.

5.5.5 Choice attributes

Choice attributes store one item out of an enumeration of items. For example, in an address project a choice attribute can be used for storing the state, where state is one out of 'USA', 'Canada', 'Germany', or 'others'.

A choice attribute does not store the whole item string but the item number (index) in a record. The number of items and the items itself can be modified after the attribute has been created. However when making changes to a choice attribute, values in existing records are not changed to reflect the new situation.

Choice attributes do not support the NIL value.

5.5.6 Date attributes

Date attributes store ... ehm ... dates. For example, a date attribute can be used for storing birthdays.

The format for entering and displaying date values can be one of 'DD.MM.YYYY', 'MM/DD/YYYY', or 'YYYY-MM-DD', where 'DD', 'MM' and 'YYYY' are standing for two and four digit values representing the day, month and year of the date respectively.

Date attributes support the NIL value representing an undefined date.

5.5.7 Time attributes

Time attributes store times or periods of time. For example, a time attribute can be used for storing the durations of music titles on a CD.

The format for entering and displaying time values is fixed to 'HH:MM:SS' where 'HH' is a two digit value in the range of 0 to 23 representing the hours, 'MM' a two digit value in the range of 0 to 59 representing the minutes, and 'SS' a two digit value in the range of 0 to 59 representing the seconds.

Time attributes support the NIL value representing an undefined time.

5.5.8 Memo attributes

Memo attributes store multi-line text of any size. Text size is handled dynamically which means that memory is only allocated for the actual text size. In a project managing movies for example, a memo attribute can be used to store summaries of the movies.

Memo attributes do not support the NIL value.

5.5.9 Reference attributes

Reference attributes are a special type of attributes, normally not found in other database systems. Reference attributes store a pointer to another record. The referenced record may reside in the same or in any other table than the reference attribute belongs to.

For example in a pedigree project two reference attributes can be used for storing pointers to the father and mother record. Or in a project managing CDs and music titles, a reference attribute in the table holding the music titles can be used to point to the records of the corresponding CDs.

For displaying a reference attribute, any attributes of the referenced record can be specified. Entering a reference attribute can be done by selecting a record from a list of records.

Reference attributes support the NIL value. Here a value of NIL stands for a pointer to the initial record of the referenced table.

5.5.10 Virtual attributes

Virtual attributes are a special type of attributes that do not store any information in the database itself, but compute them on the fly when needed.

For example, in a project managing invoices where a real attribute holds the amounts of money excluding tax, a virtual attribute can be used to "store" the amounts of money with tax. Every time the value of the virtual attribute is needed, e.g. for displaying it, it is computed from the corresponding value without tax.

For displaying virtual attributes three kinds exists: bool, string and list. These three kinds allow showing the value of the virtual attribute as a TRUE/FALSE value, as a single line of text including numbers, dates, and times, or as a list of several single lines, e.g. for listing all music titles of a CD.

Virtual attributes support the NIL value standing for FALSE (bool kind), undefined (string kind), or empty (list kind).

5.5.11 Buttons

Actually, buttons are not a real attribute type as they cannot store or display any information. Buttons are just used for triggering MUIbase programs.

The reason to keep them as an attribute type is because as an attribute buttons can be accessed by their attribute name. This allows to use the name of a button in a MUIbase program, e.g. to disable or enable the button. Another reason is that buttons have similar properties as attributes, e.g. trigger functions.

5.6 Table of attribute types

The following table summarizes all available attributes types:

Type	Description	Nil allowed?
String	For strings of lengths 1..999. A string can also be used for storing filenames, font-names or one-string-out-of-n-strings. For filenames you can add a field where the contents of the file are displayed as an image.	No
Integer	For storing integer values.	Yes

Real	For floating point numbers.	Yes
Bool	TRUE or NIL.	Yes (NIL = FALSE)
Choice	One number out of n numbers. Numbers are represented by label strings.	No
Date	For storing a date value (1.1.0000 - 31.12.9999).	Yes
Time	For storing time values (00:00:00 - 23:59:59)	Yes
Memo	Multi-line text of unlimited length.	No
Reference	For storing a reference to a record of another table.	Yes (NIL means initial record)
Virtual	For displaying results from a MUIbase program.	Yes
Button	For triggering a program function	No (N/A)

5.7 Memory consumption

Each attribute type needs a certain amount of memory for storing one value in a record. All types except virtual and button have in common that they need a 2 bytes header holding internal information. Additionally, type dependent space is needed for storing the actual value. The following table lists how much memory including a possible 2 byte header one value of the given type needs in memory and on disk.

Type	Memory space	Disk space
String	$2 + 4 + \text{string-length} + 1$	$2 + \text{string-length} + 1$
Integer	$2 + 4$	$2 + 4$
Real	$2 + 8$	$2 + 8$
Bool	$2 + 0$	$2 + 0$
Choice	$2 + 2$	$2 + 2$
Date	$2 + 4$	$2 + 4$
Time	$2 + 4$	$2 + 4$
Memo	$2 + 4 + \text{memo-length} + 1$	$2 + \text{memo-length} + 1$
Reference	$2 + 4$	$2 + 4$
Virtual	0	0
Buttons	0	0

Here *string-length* stands for the length of the string to be stored and *memo-length* for the text size of the memo to be stored.

5.8 Relationships

Up to now you know how to organize your information into tables with records and attributes. But you may also want to setup relationships between tables.

For example if you want to collect CDs in a database project you would have two tables, one for the CDs them-self and one for the music titles of the CDs. Of course you could also have all music titles within the CD table but then you would have a fixed number of music titles for each CD.

So having these two tables, you now need a link for each music title to the CD containing this title. This is called a *relationship* between the two tables. Normally you use a reference attribute for setting up such a relationship.

By installing a reference attribute into a table you automatically have a relationship between the table the attribute resides in and the table it refers to.

5.8.1 One to one relationships

One to one relationships are very simple relationships where for each record you have one or zero partners in another or in the same table.

For example in a database project that manages your favorite movie actors you could setup a reference attribute called `'married with'` that shows the person the actor is married with. An actor that is currently not married does have a NIL value for this reference field.

Of course, no one prevents the user to set the `'married with'` references of several actors all to the same person. However by programming MUIbase it is possible to detect such cases and handle accordingly.

5.8.2 One to many relationships

One to many relationships are useful for connecting a set of records to one record in another or the same table.

For example in a project managing your bank accounts you could have one table for all bank accounts and one table for all transactions. Now you surely want to know which transaction belongs to which account so you setup a reference attribute in the transaction table referring to the account table.

One to many relationships are the most often used ones. You can use them for managing any hierarchical-like structures, e.g. CDs with music titles, bank accounts with transactions, family trees, etc.

One to many relationships are also the basis for realizing many to many relationships as described in the next section.

5.8.3 Many to many relationships

Many to many relationships are used when you want a set of records to refer to another set of records.

For example in a project that manages movies and actors you would have two tables, one for the movies and the other one for the actors. Now for each movie you want to know the actors that took part in the movie. So you might think to setup a reference attribute in the actor table that refers to the movie table. But when doing this you could only have one movie referenced for each actor because there is only one reference field in the actor table. So what you need is an unlimited number of references from the actor table to the movie table.

This is done by adding a new table that just has two reference attributes, one pointing to the actor table and the other to the movie table. Now you can enter the relationships by adding new records to this table. For each movie-actor constellation you add a new record and specify the movie and actor by setting the corresponding reference fields.

If you want to know in which movies an actor took part then you only have to search for all records in the new table that refer to the actor in question and look at the movie records the found records refer to. Such a search can be done automatically by MUIbase and the result can be displayed in a list-view.

The following tables show an example of how to connect a set of actors to a set of movies.

	Title	Country
m1:	Batman	USA
m2:	Batman Returns	USA
m3:	Speechless	USA
m4:	Tequila Sunrise	USA
m5:	Mad Max	Australia
m6:	Braveheart	USA

	Name
a1:	Michael Keaton
a2:	Jack Nicholson
a3:	Kim Basinger
a4:	Danny DeVito
a5:	Michelle Pfeiffer
a6:	Geena Davis
a7:	Christopher Reeve
a8:	Mel Gibson
a9:	Kurt Russell
a10:	Sophie Marceau
a11:	Patrick McGoochan
a12:	Catherine McCormack
a13:	Christopher Walken

MovieRef	ActorRef
m1	a1
m1	a2
m1	a3
m2	a1
m2	a4
m2	a5
m2	a13
m3	a1
m3	a6
m3	a7
m4	a8
m4	a5
m4	a9
m5	a8
m6	a8
m6	a10
m6	a11

From these tables you can find out for example that Mel Gibson took part in the movies Tequila Sunrise, Mad Max, and Braveheart, or that in movie Batman the actors Michael Keaton, Jack Nicholson, and Kim Basinger took part.

5.9 User interface

MUIbase uses a graphical user interface (gui) organized in a hierarchical way for displaying record contents and for letting the user enter new data. Each project owns its own root window in which further gui elements (including sub windows) can be placed. The gui elements are also called *display objects*.

A table is displayed in an own gui element called *mask*. A mask can display only one record at a time. Its layout and the attributes included in the mask are customizable by the user.

The following sections describe MUIbase's gui elements for designing a project's layout.

5.9.1 Windows

Windows can be used to spread information of a project across several independent areas.

Each project automatically has its own root window. If needed, e.g. if the space of the root window exceeds, additional sub windows can be created. Sub windows can also have further sub windows.

For each sub window a window button is placed into the parent window allowing to open and close the sub window. The window button looks like a normal text button but has a small window icon showing the open/close state of the corresponding sub window.

Root windows do not have a parent window and therefore have no window button. Closing a root window means closing the whole project.

A window can have any other gui elements (except panels) as children. If no child has been added to a window then an 'empty display' image (see Section 7.18 [Empty display image], page 32) is shown.

5.9.2 Masks

A mask is used to display the contents of a table. Only one record of the table can be shown at a time.

The mask may include a panel (see next section) for controlling the table. Other gui elements like attribute or text objects can be placed into a mask to show the record contents.

Masks cannot be placed inside other masks as this would lead to a hierarchy of masks and therefore to a hierarchy of tables which is not supported in MUIbase. If you want to setup a hierarchy of tables, use an 1:n relationship between two tables.

5.9.3 Panels

A panel is a small rectangular area placed at the top edge of a mask. A panel can display a title, e.g. the name of the corresponding table, a pair of numbers showing the record number of the current record and the total number of records, and several buttons for controlling the table, e.g. for displaying the next or previous record.

Only one panel can be defined for a mask. If you setup a panel for a mask then an additional border is drawn around the mask, otherwise no border is drawn.

5.9.4 Attribute objects

Attribute objects are used to display the contents of one item of a record.

Depending on the type of the attribute the gui element is either a string gadget (types string, integer, real, date and time), a check-mark gadget (type bool), a cycle gadget or a set of radio buttons (type choice), an editor gadget (type memo), a pop-up list-view (type reference), a text, check-mark, or list-view gadget (type virtual) or a text or image button (type button). In some cases the gui element may also be a simple text gadget if the attribute object is set to read-only.

5.9.5 Text objects

Text objects are used for describing the various field elements of a record mask or just to display some static text like copyright information somewhere in a window.

5.9.6 Images

Images can be displayed anywhere in a window. An image can be an internal MUI graphic, a simple color field, or a pictures from an external file. The image size can be set to resize-able or fixed.

The image is static. If you would like to store images in a table you should use a string attribute (see Section 5.5.1 [String type], page 17).

Please note that images are not available in the unregistered version of MUIbase.

5.9.7 Space objects

Space objects are used to insert space in the layout of a window or a table mask. A space object can have a vertical (or horizontal) bar for delimiting other gui elements.

5.9.8 Groups

Gui elements can be grouped into horizontal or vertical groups. A group places its children from left to right (horizontal group) or from top to bottom (vertical group).

A group can surround its child objects with a rectangular frame, an optional title can be displayed to the top of a group, and a flag controls whether space is inserted between the child objects or not.

5.9.9 Balance objects

Balance objects can be placed anywhere between other child objects into a window, mask, or group object. A balance object allows the user to control the weight values of the other child objects and therefore how much space each child gets.

5.9.10 Register groups

A register group can be used to layout some gui elements into several pages that can be activated one at a time. This is useful if the user interface becomes large and you don't want to spread it over several windows.

6 Managing projects

In this chapter you find how MUIbase organizes projects, how to open, save, delete, and close them, how to check data integrity and how swapping works.

6.1 File format

A MUIbase project consists of several files stored under its own directory. From Workbench you will not notice the directory structure since double clicking a project icon will not open the directory but start MUIbase loading the project. From CLI however you can see the directory structure of a MUIbase project.

All files of a project are put into one directory which is created by saving a project. Do not remove or place any files or further directories in this directory! They will get lost when reorganizing the project.

The directory contains a file called `Structure.mb` where the descriptions of all tables, attributes, filters, etc. are stored. The record headers are also placed here. For each table you will find a file with the table's name. Here all records of a table are stored. Last but not least there is a file called `.lock`. Do not remove this file. If you did it by accident then simply recreate it, the file contents are not important. This file is used for locking a project, that is, MUIbase first locks this file exclusively and then opens other files. If the locking fails, MUIbase knows that there is already a MUIbase application working on this project. Only one MUIbase application is allowed to work on the same project at a time since record files are opened in read/write mode and we don't want to have mixed data written by two or more applications. ;-)

6.2 Info

MUIbase keeps some information about each project. Select menu item `Project - Info` to get information about the current project. The information you get consists of the project's name, the number of tables, the total number of records in all tables, and a value that shows how many bytes a reorganization of this project would gain. The gain is however only a rough estimate and should not be treated as an exact number. Especially if you have made many changes to the structure of the project (adding or removing attributes) then this value is far from accurate.

6.3 Clear project

To begin a new project select menu item `Project - Clear - Project`. This clears the current project and MUIbase opens an empty window displaying the MUIbase logo. After starting MUIbase without any projects you are automatically in this mode.

By selecting menu item `Project - Clear - Records` you start a new project using the structure of the current one. This means that everything except the record data of the current project is used for the new project.

If the current project at the time you selected one of the clear menu items has not been saved to disk then a safety requester appears asking for confirmation of the operation.

6.4 Open project

MUIbase can handle any number of projects at a time. You are only limited by the size of your available memory. If you want to edit another project, select menu item `Project - Open new`. This opens a new project root window. You can now load a project for this window.

To load a project select menu item **‘Project - Open - Project’**. This opens a file-requester where you can choose a project from. It’s also possible to only load the structure of a project, that is, the whole project is loaded except the record data. To do this, select menu item **‘Project - Open - Structure’**.

If you were editing a project at the time of choosing any of the above menu items and the project has not been saved then a safety requester appears asking for confirmation.

6.5 Save project

All changes you make to a project are only done in memory. Thus if you want to make them permanent you have to save the project to disk. This is done by choosing menu item **‘Project - Save’**. If your project doesn’t have a name yet then a file-requester appears first asking for a filename.

The reason why MUIbase does not automatically save a project when you change it is that this way it is you who decides when to save a project and you can always go back to the last saved version of your project. This mechanism is similar to the **‘COMMIT’** and **‘ROLLBACK’** commands in SQL database systems.

If you save a project, all modified records are written to disk and the file **‘Structure.mb’** is recreated. Before creating the new **‘Structure.mb’** file, MUIbase first renames a possibly existing **‘Structure.mb’** file to **‘Structure.old’** to have a safety copy in case the save operation fails.

This mechanism guarantees fast load & save operations but it is not reorganization free. If you have modified many records then the physical place where the records lie and the resulting fragmentation may become disadvantageous. Therefore a menu item **‘Project - Save & Reorg’** exists that does a save & reorganize operation. This operation may take some time depending on the number and size of the records. The save & reorganize operation creates a new directory and rewrites all project related files. The old directory is deleted on success.

Another good place to execute a reorganization is when you have done changes to the data-structure of a project, e.g. after you have installed a new attribute in a table. These changes are not applied immediately to all records because it would take too much time to load each record, modify it, and save it back to disk. Therefore these changes are put on an internal **‘todo’** list which is applied after loading a record. Applying this list to a record takes only little time. However the longer the list gets the more time it needs. Reorganizing a project causes the **‘todo’** list to be applied to all records, so if you have made many changes to the project structure then reorganizing a project will shorten the time for loading records.

You can also save & reorganize a project to a new filename keeping the old project untouched. To do this select menu item **‘Project - Save & Reorg As’**. MUIbase will prompt you to enter a new name for the project.

6.6 Delete project

MUIbase offers a menu item to delete a project. If you select **‘Project - Delete’**, enter a filename in the file-requester and confirm the deletion in an additional safety requester then the specified project is deleted from disk.

MUIbase does nothing special here, it simply deletes the directory with all files in it. It is safe to do this in any other way, e.g. by using Workbench or an Amiga Shell.

6.7 Close project

If you are done with a project you can close it by selecting menu item **‘Project - Close’**. This removes the project from memory and closes all windows belonging to it. If the project

contains changes that have not been saved then a safety requester appears offering to save, continue or cancel the operation.

For closing a project you can also select menu item **‘Project - Save & Close’** which saves the project first if there were any changes and then closes it.

6.8 Check data integrity

MUIbase can verify if all data in your project is still valid and not corrupted by programs trashing your project files or by system crashes. Choose menu item **‘Project - Check data integrity’** for starting this process.

Usually you should never need this functionality and MUIbase should always report that data integrity is perfect. But if it ever happen to you that your project contains **‘internal errors’**, that is, some records can’t be loaded anymore, then you can repair your project by using this menu item.

MUIbase will write a log file of all affected records and you can save and reorganize the project afterwards. In the log file, records that might be corrupted and records that are not accessible anymore and therefore have been deleted are listed by their record number in the old (corrupted) project and by their record number (in parenthesis) in the reorganized project.

Note: Prior to MUIbase V1.4 there was a bug that caused writing corrupted project files. You should be able to repair these projects with this menu item. Since MUIbase V1.4 this bug has been fixed and you should never get corrupted projects anymore and checking data integrity should always report that data integrity is perfect.

6.9 Swap records

MUIbase doesn’t need to keep all records of a project in memory. Thus loading and saving of projects is much faster. When loading a project a record header is allocated for each record. The data itself is only loaded when needed, e.g. when it is displayed on the screen. The total number of records is still limited by available memory since each record header needs some few bytes of memory.

You can specify how much memory MUIbase should use for the records of a project. Choose one of the predefined values found in menu item **‘Preferences - Record memory’**. MUIbase will not preallocate a block of the specified memory size, it only checks from time to time if the current size of allocated memory is larger than the specified value. The specified value is not a hard limit, only a suggestion. If MUIbase needs more memory then it will ignore the upper bound and allocate it.

If MUIbase runs out of memory or if the upper limit for the record memory size has been reached then MUIbase tries to free as much record memory as possible. In this case MUIbase may write modified records to disk to get the maximum available memory possible. You can also force MUIbase to do this by choosing menu item **‘Project - Swap records’**.

If there is enough memory to hold all records in memory and you have specified an upper memory limit that is high enough (e.g. **‘unlimited’**) then MUIbase never needs to swap out records.

MUIbase maintains a free list for each record file. If you delete a record then the record’s file space is added to the free list. Also if you change a record and the record needs to be written to disk then the old file space is added to the free list. However MUIbase makes sure that by reloading you can always go back to the point of the last save operation. MUIbase will not trash areas which are free but where a record still sits that could be reached by reopening the project.

7 Preferences

MUIbase offers several preferences items the user can set to his likes. This chapter shows what preferences items are available and gives general information about how the preferences system works.

7.1 Record memory

MUIbase does not need to keep all records of a project in memory. Instead it uses a buffer for holding only a small number of records. By choosing a value from menu item **‘Preferences - Record memory’** you can set the size of this buffer. Each project has its own buffer, so if you have opened two projects each having a record buffer size of 1MB, MUIbase will use up to 2MB for the records of both projects.

MUIbase will not allocate the memory a priori, it uses a dynamic allocation scheme. Also, the buffer size you specify is not a hard limit. If MUIbase decides it needs more memory then it will try to allocate it.

Once the buffer gets full, or if MUIbase runs out of memory, all records are flushed from the buffer. This means that unchanged records are simply freed and changed records are first written to disk and then freed.

By giving MUIbase a higher value for the record buffer you will notice a speed increase in accessing the records because now since more records are held in memory fewer records have to be loaded from disk. If you set the record memory size to **‘unlimited’** and all records fit into memory then MUIbase operates with optimal speed.

7.2 Record delete requester

You should check menu item **‘Preferences - Record delete requester’** if you want MUIbase to pop up a safety requester asking for confirmation whenever you try to delete a record. Leave the item unchecked if records should be deleted silently. Default is checked.

7.3 External editor for programming

You can check menu item **‘Preferences - External editor for programming’** if you always want to use the external editor for editing MUIbase programs. This means that whenever you open the program editor, the external editor is also started automatically. If you don't check this field then you can still launch the external editor by choosing the corresponding item in the editor's context menu. Default is unchecked.

7.4 Icon creation

Check menu item **‘Preferences - Icon creation’** if you want MUIbase to create an icon for each project. You can still paint and use your own icon for a project. MUIbase will not overwrite existing icon images as long as they are project icons. Default is checked.

7.5 Formats

By selecting menu item **‘Preferences - Set formats’** you can specify the formats used when displaying or printing real and date values. After selecting the menu item a new window appears containing the following items:

- a field **‘Real format’** for setting the decimal character of real values. You can choose between **‘Decimal point’** and **‘Decimal comma’**.

- a field ‘Date format’ for specifying how date values are output. You can choose between ‘Day.Month.Year’, ‘Month/Day/Year’ and ‘Year-Month-Day’.
- two buttons ‘Ok’ and ‘Cancel’ for leaving the window.

The initial values for real and date formats are determined according to the information found in the operating system’s ‘Locale’ library.

When you are done with all settings, press the ‘Ok’ button to leave the window and update the display.

7.6 Icon tool name

By selecting menu item ‘Preferences - Icon tool name’ you specify the tool name that should be executed when you double click a project icon. Normally you should specify the path to the MUIbase program, e.g. ‘MUIbase:MUIbase’ which is the default.

7.7 External editor

MUIbase’s editor fields offer a special menu item where you can call an external editor for editing the text contents. The name of the editor and its parameters must be specified by selecting menu item ‘Preferences - External editor’. You should enter a command string that gets executed when calling the external editor. Use ‘%f’ at the place where the filename normally stands. The ‘%f’ string is replaced with the actual filename of the temporary file MUIbase creates before executing the command.

For example you can use ‘CED %f -keepio’ for using CED as external editor (make sure that your default stack size is at least 8192 bytes in size, otherwise CED might crash).

Default is ‘Ed %f’.

7.8 External viewer

In MUIbase you can use strings for storing filenames. For displaying the contents of such a filename, an external viewer is needed. Normally this viewer uses the Amiga-OS datatype system for displaying pictures, showing animations, or playing music. To specify this viewer select menu item ‘Preferences - External viewer’.

Like for the external editor (see Section 7.7 [External editor], page 29) you have to specify a command string here. Default is ‘Multiview %f’.

7.9 Popups in cycle chain

In the graphical user interface entered in the structured editor there might exist popup buttons, e.g. file, font or listview popups beneath a string gadget. These buttons are usually not included in the cycle chain, that is, you can’t use the *Tab* key to activate them. However if you check menu item ‘Preferences - Popups in cycle chain’ then all popup buttons are include in the cycle chain.

Please note that changing the status of this menu item has only an effect after rebuilding the user interface, e.g. by switching to the structure editor and back to the user interface.

7.10 Confirm save & reorg

Saving and reorganizing a project can take quite some time depending on the size of the project. Therefore, if you select menu item ‘Project - Save & Reorg’ or ‘Project - Save & reorg as’, a safety requester pops up asking for confirmation of this operation.

The requester only appears if menu item ‘Preferences - Confirm save & reorg’ is checked, thus you can disable this requester by de-selecting the menu item.

7.11 Confirm quit

If you try to quit MUIbase and there are unsaved projects then MUIbase pops up a safety requester asking for confirmation. However if all projects have been saved, the program usually quits silently.

If you want MUIbase to always pop-up a requester when quitting then check menu item **‘Preferences - Confirm quit’**. In this case you always get a safety requester when selecting menu item **‘Project Quit’**. Nevertheless it is still possible to quit MUIbase silently by closing all projects.

7.12 Program include directory

The programming feature of MUIbase allows to include external sources within the project’s program (see Section 15.2.3 `[#include]`, page 60 for more information). Menu item **‘Program - Include directory’** allows to set a directory where MUIbase should search for such include files. Default is `‘MUIBase:Include’`.

7.13 Program debug information

For compiling a project’s program, you can choose whether debug information should be included in the executable or not. If you compile without debug information and a run-time error occurs then an error discription is generated but there is no information about where exactly the error occurred. If you compile with debug information then you also get the exact error location.

Use menu item **‘Program - Debug information’** to turn debug information for compilation on and off. After changing this state, don’t forget to recompile the project’s program by choosing menu item **‘Program - Compile’**.

7.14 Program output file

When executing a MUIbase program all output which is directed to `‘stdout’` can be printed to a file. The filename has to be entered in the requester that appears when choosing menu item **‘Program - Output file’**. Here, you can also specify if the file should be opened in appended mode or if it should be cleared before the first output happens. Besides traditional files, the Amiga-OS system allows several special filenames here, e.g.:

- `‘PRT:’` prints the output on your printer.
- `‘CON:////MUIbase output/CLOSE/WAIT’` prints the output in a Shell window.
- `‘CONSOLE:’` prints the output in the Shell window where MUIbase has been started from.

7.15 Project dependent settings

MUIbase can manage several projects and for each project you can have your own set of preferences. Sometimes however it is desirable to have all projects sharing the same setting for one of the preferences items. This is realized by using a status flag for each preferences item which indicates whether each project has its own value for this field or if the value is shared among all projects.

By choosing menu item **‘Preferences - Project dependent settings’** a window with a list of several preferences items appears. All items in this list can be set either project dependent or global. The list contains the following items:

- Record memory

- Record delete requester
- Formats
- Confirm save & reorg
- Program include directory
- Program debug information
- Program output file

The status flag of preferences items not included in this list cannot be changed and is either project dependent or global, e.g. the setting of preferences item ‘icon tool name’ is always global since it doesn’t make sense to have different icon tool names for different projects.

If you check the box to the right of a preferences item then this item is made project dependent, otherwise it is global. Project dependent settings are stored in the project file ‘Structure.mb’, whereas global settings are stored in a global preferences file.

7.16 MUI

Since MUIbase is a MUI application you can also specify the MUI preferences for this application by choosing menu item ‘Preferences - MUI’.

7.17 Loading and Saving of preferences

The global preferences can be loaded and saved to disk. When MUIbase is started, it automatically loads its preferences from ‘ENV:MUIbase.prefs’.

MUIbase doesn’t save its global preferences automatically. Thus, if you make changes to the global preferences and you want MUIbase to remember them after a restart then you have to save them by choosing menu item ‘Preferences - Save preferences’. The global preferences are written to both ‘ENVARC:MUIbase.prefs’ and ‘ENV:MUIbase.prefs’. The following items are stored:

- Record memory size
- Record delete requester
- External editor for programming
- Icon creation
- Icon tool name
- Formats
- External editor
- External viewer
- Confirm save & reorg
- Confirm quit
- Program include directory
- Program debug information
- Program output file
- Project dependent settings
- Directory names for several file requesters
- Default max length for new string attributes
- Default text format for new attribute objects
- Cursor position of program editor
- Name of help file

There is also a menu item called **‘Preferences - Load preferences’**. Choose this menu item in case you made changes to the preferences and want to go back to the previously saved version.

7.18 Empty display image

If you start MUIbase without loading any projects then MUIbase opens a window with an empty display. The empty display usually consists of a image which is loaded from the file `‘MUIbase:Images/EmptyWindow.iff’`.

By default this image is the MUIbase logo but you can replace it by copying your favorite picture to `‘MUIbase:Images/EmptyWindow.iff’`. It is also possible to have no image for the empty display window, just make sure that the above filename doesn't exist. In this case MUIbase only prints the text `‘Empty display’` in the window.

8 Record-editing

This chapter describes how to add, change, delete, and browse records of a database table.

8.1 Active object

MUIbase uses a cursor for displaying which object is the active one. If the active object is a string object then a normal block cursor appears, other objects get a special frame around them. You can cycle through the active objects by pressing the *Tab* or *S-Tab* keys.

The table in which the active object resides is called the *active table*. The panel of a table can be set to the active object. This ensures that you can always set a table to be the active one, although the table may not contain any other activate-able objects.

8.2 Adding records

If you select menu item ‘**Table - New record**’ a new record is allocated in the active table. The record is initialized with the initial values for all attributes. It is also possible to duplicate the current record of the active table by selecting menu item ‘**Table - Duplicate record**’.

If you have installed a trigger function for adding a new record (see Section 14.1.1 [Creating tables], page 48) then this trigger function is called for creating the record. For more information on this mechanism, See Section 15.27.4 [New trigger], page 115.

8.3 Changing records

To change the current record in a table you can activate any attribute object within the table’s mask and enter a new value. For string, integer, real, date, time, and memo attributes you can use the usual editing commands.

An attribute object may have been configured as read-only. In this case you can’t change its value (exception: string attribute with pop-up button).

8.4 String attributes with pop-up button

If a string attribute has a pop-up button attached to it then you can press the pop-up button and get a requester to set the string contents, e.g. a file-requester for choosing a filename, or a list of strings to choose one from. The pop-up button can always be used to set the string attribute’s value even if the attribute is set to read-only.

Right to the string field a ‘V’ button might appear. Pressing this button calls an external viewer to display the file specified in the string field.

8.5 Entering bool values

The checked state of bool attribute can be toggled with the left mouse button, or with the space bar if the object is the active one.

8.6 Entering choice values

For choice attributes you can choose a value by clicking onto it, or by using the *Cur-Up* and *Cur-Dn* keys to browse through all choice labels.

8.7 Entering date values

Date values can be entered in the format ‘DD.MM.YYYY’ where ‘DD’, ‘MM’ and ‘YYYY’ are standing for two and four digit values representing the day, month and year of the date respectively. It is possible to omit the year value of a date. In this case the current year is appended to the input string.

By inserting a single integer value, a date value relatively to the current date can be specified, e.g. when entering ‘0’ the today’s date is used, or when entering ‘-1’ yesterday’s date is used.

8.8 Entering time values

Time values can be entered in the format ‘HH:MM:SS’ where ‘HH’ is a two digit value in the range of 0 to 23 representing the hours, ‘MM’ a two digit value in the range of 0 to 59 representing the minutes, and ‘SS’ a two digit value in the range of 0 to 59 representing the seconds.

It is possible to omit the number of hours and the number of minutes. In this case a value of 0 is used. E.g. if you enter ‘6:30’ it is automatically expanded to ‘00:06:30’.

8.9 Memo context menu

Memo attributes have a context menu that offers further editing possibilities:

- ‘Cut’, ‘Copy’, and ‘Paste’ allow exchanging data with the clipboard.
- ‘Clear’ deletes all text in the memo.
- ‘Undo’ and ‘Redo’ allow going back and forth the changes you made to the memo contents.
- With ‘Open text’ and ‘Save text’ you can load and save the memo contents from/to a disk file.
- ‘External editor’ launches an external editor for editing the memo. See Section 7.7 [External editor], page 29, for more information about the external editor.

8.10 Entering reference values

For reference attributes there are several options to enter a value:

- To the right of a reference attribute you find a pop-up button which if pressed opens a list of records and two further buttons. Choose a record from the list to set the reference to this record, ‘Initial’ to set the reference to the NIL value, or ‘Current’ to set the reference to the current record of the referenced table.
- Use the context menu of the reference attribute to see further options to set the reference. You also find the corresponding shortcuts there.
 - The ‘Previous’ and ‘Next’ menu item set the reference to the previous or next record.
 - The ‘Backward’ and ‘Forward’ menu items will let you go 10 records backward or forward.
 - The ‘Search for...’ menu item pops up a requester to enter a pattern for searching a record. If you don’t check the ‘All fields?’ box then the search is only done in the attribute which is first in the list of attributes that is used for ordering the referenced table. The reason why only this attribute is examined is because prefix searching can be done very efficient on this attribute as the attribute acts like an index. For more information about the search requester, see Chapter 11 [Search for], page 41.
 - Once you have entered a search pattern in the search requester, ‘Search backward’ and ‘Search forward’ can be used to find the previous or next matching record.

- If the reference attribute object is the active object, you can enter a character to search for a record that has its contents of the first order attribute of the referenced table starting with this character. The search is done case insensitive. E.g. if you enter 'l' then a search pattern of 'l*' is used for searching the record. You can append further characters to the search buffer by typing them in uppercase, e.g. 'lASSIE' would search for a record matching the string 'Lassie*'.

8.11 Entering NIL value

To enter the NIL value enter any invalid string for the given attribute type, e.g. if you enter 'xyz' in an integer attribute then the value of this attribute is set to NIL. Please note that not all attribute types support the NIL value. See Section 5.6 [Table of attribute types], page 19 for an overview of all attribute types.

8.12 Deleting records

To delete the current record chose menu item 'Table - Delete record'. Before deleting the record a safety requester may appear asking you for confirmation. You can enable and disable this requester in the preferences settings (see Section 7.2 [Record delete requester], page 28).

If you have installed a trigger function for deleting records (see Section 14.1.1 [Creating tables], page 48) then this trigger function is called for deleting the record. For more information on this mechanism, See Section 15.27.5 [Delete trigger], page 116.

It's also possible to delete all records of a table by choosing menu item 'Table - Delete all records'. Only records matching the record filter of the corresponding table are deleted. Before deletion a safety requester appears, if enabled. No trigger function is called when deleting all records.

8.13 Browsing records

To view other records than the currently displayed one, select one of the sub menu items in menu item 'Table - Goto record'. You can go to the previous, next, first, or last record, jump several records backward or forward, or enter the record number of the record you want to view. The record number in this context is the number that is displayed in the corresponding panel for that record (see Section 5.9.3 [Panels], page 23). The panel may also include two arrow buttons for going to the previous and next record.

Record browsing can be easily done using the *CurUp* and *CurDn* keys in combination with the *Shift*, *Alt*, and *Ctrl* keys. All possible combinations are listed in menu item 'Table - Goto record' and in the following table:

	<i>Alt</i>	<i>Ctrl-Alt</i>	<i>S-Alt</i>
<i>CurUp</i>	Previous record	First record	Jump backward
<i>CurDn</i>	Next record	Last record	Jump forward

9 Filter

Filters can be used to hide records. This chapter describes what types of filters are available and how to use them.

MUIbase knows two types of filters, record filters and reference filters.

9.1 Record filter

A record filter can be installed into a table to filter out records that are not of interest to you. Records that are filtered out are excluded in the table mask and thus the user can't see or browse to them.

9.1.1 Filter expression

A filter is defined by specifying a boolean expression that may contain calls to MUIbase programming functions. For each record of the table the filter is specified for, this expression is evaluated. If it returns NIL then the record is filtered out, otherwise it is included in the table mask.

Each table can have its own filter expression.

9.1.2 Changing filters

To change the filter of the current table select menu item 'Table - Change filter'. This will open a window containing

- the name of the table you install the filter for in the window title.
- a list of all attributes of the table that can be used in the filter expression. This list is placed in the left part of the window. If you double click a name then the name will be inserted into the filter expression at the current cursor position.
- a cascade of buttons displaying MUIbase programming functions and operators. It is placed in the right part of the window. Click on one of the buttons to enter the corresponding function in the filter expression. Please note that the presented list of functions and operators is not complete. Other MUIbase functions not shown in one of the buttons must be entered by hand. Only those MUIbase functions can be used that don't have side effects, e.g. it is not possible to write data to a file within a filter expression.
- a string input field to enter the filter expression. The attribute and function/operator names are inserted here. You can also directly input your filter expression.
- two buttons 'Ok' and 'Cancel' to leave the window.

After you are done with the specification of the filter expression click on the 'Ok' button to leave the window. The entered expression is now compiled and, if successful, the expression is evaluated for all records. Those records for which the boolean expression doesn't hold are then discarded in the table mask.

In case the expression doesn't compile you will get an error message displayed in the window title bar.

A filter can be turned on and off by clicking on the 'F' button in the table's panel (if it is installed), or by pressing the *F* key when the panel is the active object. After you have specified a filter expression for a table the filter for this table is turned on automatically.

If you (re-)activate a filter then all records of the table are checked whether they match the filter or not.

If a filter is currently active and you change a (filter relevant) attribute in a record of this table then the match-filter state of this record is not recomputed and stays unchanged.

If you allocate a new record in a table with an activated filter then there is no check if the new record matches the filter and the new record has its match-filter state set to TRUE.

9.1.3 Filter examples

Here are some examples for valid filter expressions:

- ‘NIL’ filters out all records.
- ‘TRUE’ doesn’t filter out any record.
- ‘0’ same as ‘TRUE’ as for MUIbase all expressions not equal to NIL are considered as TRUE.
- ‘(> Amount 100.0)’ only displays records where the ‘Amount’ attribute is greater than 100.0 (we assume here that the table has an attribute ‘Amount’ of type real).
- ‘(NOT (LIKE Name "*x*))’ filters out all records that have the letter ‘x’ in the ‘Name’ attribute (a string attribute).

Please note that MUIbase’ programming language uses a lisp-like syntax. For more information about the programming language, see Chapter 15 [Programming MUIbase], page 59.

9.2 Reference filter

Reference attributes can also have a filter behavior. This is useful e.g. for building a hierarchy of tables (like it is hard-wired in AmigaBase). As an example see the project ‘Albums’.

If the filter of a reference attribute is turned on then the following features are activated:

1. The user can only access records in the attribute’s table that have the reference set to the current record of the referenced table.
2. If the referenced table changes its current record then also a new current record is searched and set for the attribute’s table.
3. When allocating a new record the reference is automatically set to the current record of the referenced table.

Note: Cascading delete (like it is automatically done in AmigaBase) has to be implemented by the user himself (by using a delete trigger function).

Do not use the reference filter on cyclic graphs, e.g. self-referencing tables. It doesn’t make sense and will only confuse the user.

10 Order

For each table in your database you can specify in which order its records should be displayed. This chapter describes how you can specify an order and what consequences it has.

10.1 Empty order

By default each newly created table has an empty order. This means that if you enter a new record, the created record is inserted at the current position, that is, behind the current record of the table. If you change some fields of a record, the position of the record within the table leaves unchanged.

10.2 Order by attributes

Sometimes it is useful to have the records sorted by a certain attribute, e.g. by the 'Name' attribute if the table has such one.

In MUIbase you can specify for each table a list of attributes by which its records should be sorted. All records are first sorted by the first attribute in this list. If two records are equal in an attribute then the next attribute in the list determines the order. For each attribute you can specify if the records should be sorted ascending or descending.

For determining the order of attributes the rules of the following table are used:

Type	Order relation
Integer Choice	NIL < MIN_INT < ... < -1 < 0 < 1 < ... < MAX_INT (Choice values are treated as integers)
Real	NIL < -HUGE_VAL < ... < -1.0 < 0.0 < 1.0 < ... < HUGE_VAL
String Memo	NIL < "" < ... < "a" < "AA" < "b" < ... (String comparison is done case insensitive)
Date	NIL < 1.1.0000 < ... < 31.12.9999
Time	NIL < 00:00:00 < ... < 23:59:59
Bool	NIL < TRUE
Reference	NIL < any_record (Records itself are not comparable for ordering)

If you have specified an order for a table then the records are automatically rearranged whenever you add a new record or change an order relevant field of a record.

10.3 Order by a function

Sometimes you want a more complex ordering scheme than a simple attribute list as described in the last section. For example, an attribute list can't hold reference attributes, so it is not possible to sort your records by a reference field. The reason for this is that with reference

attributes MUIbase is not able to keep your records ordered at all times (see Section 15.27.6 [Comparison function], page 116 in the MUIbase programming chapter for more details).

However, MUIbase also offers the possibility to specify a comparison function for sorting your records. You can specify any function that you have written using the MUIbase program editor. The function will be called with two record pointers and the returned value should reflect the order of the two records. The function can use any operations for comparing the records, thus it can e.g. compare records using reference attributes. For more information on this mechanism, see Section 15.27.6 [Comparison function], page 116.

If you decide to use a comparison function for ordering a table then please note that MUIbase cannot always detect when records of the table have to be reordered since the dependencies are unknown. Use menu item **'Table - Reorder all records'** when records are becoming unsorted.

10.4 Changing orders

To specify an order for the current table select menu item **'Table - Change order'**. This will open a window containing

- the name of the table in the window title.
- a choice field **'Type'** where you specify whether the table should be ordered by using an **'Attribute list'** or by using a **'Comparison function'**. Depending on the state of **'Type'** you can enter the data into the following items.

For an order using an attribute list, the following items exist:

- a list of all attributes of the table that can be used in the order list. This list is placed in the left part of the window. If you double click a name then the name will be inserted into the order list at the current cursor position.
- the current list of attributes used for ordering. This list is placed in the right part of the window. The top item in this list is the first attribute of the order list. You can rearrange items by dragging them to other positions in the list. To add further attributes drag them from the attribute list to the order list. You can remove an attribute from the order list by dragging the item out of the order list and dropping it onto the attribute list.

Each entry in the order list has an arrow symbol pointing up or down on the left side. You can toggle the state of the arrow by double-clicking it. If an arrow is pointing up then the sorting order for this attribute is done ascending, if it is pointing down, it is done descending.

For an order using a comparison function, there is the following item:

- a field **'Function for comparing records'** where you can enter the name of a function that should be called for comparing two records of the table. You can use the pop-up button to the right of the string field for choosing a name from a list of all function names. If you leave the field empty then an empty order is used. For more information on how to use a comparison function, including the arguments that are passed to it, see Section 15.27.6 [Comparison function], page 116.

Furthermore, the following buttons exist:

- a **'Clear'** button that clears all fields for an empty order.
- two buttons **'Ok'** and **'Cancel'** for leaving the window.

To enter a new attribute order list, choose **'Attribute list'** in the **'Type'** field and press the **'Clear'** button. Then use drag & drop as described above to build up a new list of attributes. If you want to have an empty order then just don't add any attributes to the order list.

When you are done specifying the order, press the **'Ok'** button. MUIbase will then reorder all records of the table. As this can need some time, a busy mouse pointer will appear.

10.5 Reorder all records

If you ever think that some records of a table became unsorted, e.g. when using a comparison function for ordering then you can choose menu item 'Table - Reorder all records' for sorting all records.

11 Search for

For record browsing you can use a search requester to search for a specific record. The search feature uses a search pattern that you provide and checks all records for a successful match with this pattern. If it finds one then this record will be displayed in the table mask.

11.1 Search requester

To open the search requester select menu item **Table - Search for**. This will open a window containing

- a string field for entering the search pattern. Use the characters ***** and **?** as jokers. The character ***** matches any number of characters (including zero characters) whereas **?** matches exactly one single character.
- a field **Case sensitive**. If you check it, search for uses case sensitive string comparison, otherwise case insensitive string comparison is used.
- a field **All fields**. If checked then all fields of a record are tested for a successful match with the search pattern. Otherwise only the attribute which has been the active one when the search requester has been opened is tested. In case the active object at the time when opening the search requester has not been an attribute object, this field is checked and disabled automatically.
- two radio buttons for the search direction, **Forward** and **Backward**.
- two radio buttons for specifying from which record the search should be started. **First/last record** will start the search from the first or last record depending on the search direction. **Current record** starts the search from the current record.
- two buttons **Search** and **Cancel** for leaving the window.

After you have entered a search pattern and left the requester with the **Search** button MUIbase starts searching for a matching record. The comparison of an attribute field with the search pattern is always done string based, attribute fields of non-string types are therefore converted to strings first.

If a matching record is found, it is displayed as the current record in the table mask. Otherwise an **Search pattern not found** message appears.

If you search on an attribute that is used as the first attribute for ordering and your search pattern doesn't start with a joker (***** or **?**) then an improved search algorithm (binary search) is used that makes use of the record order. This can speed up the search drastically.

11.2 Forward/backward search

Two further menu items allow to search for the next and the previous occurrence of the search pattern. Select menu item **Table - Search forward** for browsing to the next record that matches the search pattern, and **Table - Search backward** to go to the previous matching record.

11.3 Search pattern examples

Here are some search pattern examples:

- **Lassie** searches for records that have the string **Lassie** in one of the search attributes.
- ***x*** searches for records that have the letter **x** in one of the search attributes.
- **???** searches for records that have exactly three characters in one of the search attributes, e.g. a record with an entry **UFO**.

12 Import and Export

To share your records with other databases MUIbase offers a way to import and export records to and from other databases. Import and export is done by reading and writing ASCII files. Therefore the data you want to import must be in a special format described in the following section.

12.1 File format

For importing records into MUIbase all records of a table must be available in a single ASCII file. If you want to import records of several tables you must have several import files, one for each table.

An import file consists of lines and columns. Lines are separated by a record delimiter, columns by a field delimiter. The delimiters can be specified in the import and export requesters. As the record fields itself may already contain these delimiters it is possible to use double quotes around all fields to protect them.

The import file must have the following structure:

- The first line contains the field names. For each name there must be an attribute with exactly the same name in the table where the records are imported to. If there is a name where no matching attribute can be found, an error message is generated.
- The following lines contain one record each. As all fields must be given as ASCII strings they are automatically converted to the type of the destination attribute. For attributes of type boolean, the field must be either NIL or TRUE (case insensitive), otherwise an error message is generated. For attributes of type choice the exact label string must be specified (case sensitive). For reference attributes you have to specify the record number starting with 1. For all other types a value of NIL is used if the field cannot be converted to the required type.
- If you decide to use double quotes then all record fields including the line with the field names must be surrounded by double quotes.

12.2 Sample import file

The following sample import file uses `\n` and `\t` as record and field delimiter and double quotes around all fields. The file can be imported into a table with the following attributes:

- Name (string)
- NumChildrens (integer)
- Feminine (bool)
- Job (choice)
- Notes (memo)

```
"Name" "NumChildrens" "Feminine" "Job" "Notes"
"Janet Jackson" "???" "TRUE" "Musician" "Latest CD: The velvet rope"
"Bernt Schiele" "???" "NIL" "Scientist" "Research interests:
Robotics, Autonomy and Computer Vision"
"Gerhard" "0" "NIL" "Precision mechanic" ""
```

12.3 Importing records

To import records into the active table select menu item **'Table - Import records'**. This will open a window containing

- a string field for entering the import filename. Right to this field you find three buttons. Click on the first one to open a file requester for choosing the filename. The **'V'** button starts an external viewer to view the entered filename, and the **'E'** button starts an editor to edit the file contents.
- two string fields for entering the record and field delimiter. You can enter a single character here or an escape code by typing **\n**, **\t**, **\f**, **\????** (octal code), or **\x??** (hex code).
- a field **'Double quotes'** that can be checked to specify that the fields are surrounded by double quotes.
- two buttons **'Import'** and **'Cancel'** for leaving the window.

If you press the **'Import'** button, MUIbase will load the specified file and import all found records. If everything is going fine, MUIbase will ask you after the import process if you really want to add the imported records to the table. At this point you can still cancel the operation.

If an error occurs while reading the import file then an error message is generated.

If you need a more sophisticated import routine it is recommended to write your own import routine as a MUIbase program.

12.4 Exporting records

To export records from the active table select menu item **'Table - Export records'**. This will open a window containing

- a string field for entering the export filename. Right to this field you find a pop-up button to open a file requester for choosing the filename.
- two string fields for entering the record and field delimiter. You can enter a single character here or an escape code by typing **\n**, **\t**, **\f**, **\????** (octal code), or **\x??** (hex code).
- a field **'Double quotes'** that can be checked to specify that the fields should be surrounded by double quotes.
- a field **'Filter'**. If checked only the records that match the currently installed record filter are written to the export file.
- two buttons **'Export'** and **'Cancel'** for leaving the window.

After you pressed the **'Export'** button, MUIbase will open the specified file and write out the records including a header line containing the attribute names. The export feature always writes all attribute fields of a table to the export file.

For a more customized export routine, you can use MUIbase' query editor (see Chapter 13 [Data retrieval], page 44) or you write your own export function as a MUIbase program.

13 Data retrieval

For data retrieval MUIbase offers two ways: the programming feature and the query editor.

The programming feature allows you to install buttons in table masks which, when pressed, call program functions. The usage of this feature is described in the structure editor chapter (see Chapter 14 [Structure editor], page 48) and in the chapter about programming MUIbase (see Chapter 15 [Programming MUIbase], page 59).

This chapter describes the usage of the query editor, a requester where you can enter queries and view the output in a scrolling list-view.

13.1 Select-from-where queries

MUIbase offers a select-from-where query similar to the one in SQL database systems. The query allows you to list the record contents from one or more tables. Only records matching certain criteria are included in the output. The (incomplete) syntax of an select-from-where query is

```
SELECT explist FROM tablelist [WHERE test-expr]
[ORDER BY orderlist]
```

where *explist* is a comma separated list of expressions to be printed (usually the attribute names) or a simple star * matching all attributes of the specified tables, *tablelist* is a comma separated list of tables whose records are examined, *test-expr* is the expression that is tested for each set of records to be included in the output, and *orderlist* is a comma separated list of attributes that defines the order for listing the output. Please note that the WHERE and ORDER BY fields are optional, denoted by the brackets [].

For example, the query

```
SELECT * FROM table
```

lists the attribute contents of all records in the given table.

```
SELECT attr1 FROM table WHERE (LIKE attr2 "*Madonna*")
```

lists the value of the *attr1* field in all records of *table* where the contents of field *attr2* contain the word 'Madonna'.

For more information about the select-from-where query including its full syntax, see Chapter 15 [Programming MUIbase], page 59, for more example see Section 13.4 [Query examples], page 46.

13.2 Query editor

For entering and running queries, open the query editor by choosing menu item 'Program - Queries'. The query editor is able to manage several queries, however only one query is displayed at a time. The query editor window contains the following items:

- a string input field with an attached pop-up button. The edit-able string field displays the name of the current query. By pressing the pop-up button, a list with further query names together with several buttons appear. You can select one of the listed queries to make it the current one, press the 'New' button to create a new query, press the 'Duplicate' button to get a copy of the activated query, click on the 'Sort' button to sort the list of queries, or press the 'Delete' button to delete the selected query. For leaving the pop-up window without changing anything, click on the pop-up button again.
- a 'Run' button that compiles and runs the query program and displays the output in the output list-view.
- a 'Print' button that opens a requester (see Section 13.3 [Printing queries], page 45) for printing the results.

- two buttons ‘Load’ and ‘Save’ for loading and saving the current query program. If you save a query, the program text is written out in ASCII format and the first line holds the query name as a comment. The load function assumes the same format when reading a file. It is also possible to load and save queries by using the menu items in the context menu of the editor field for the query program. However, these menu items only save the program text and do not include the name of a query.
- an editor field for entering the query program. Here you usually enter a select-from-where query. However, it is also possible to enter any expression of MUIbase’ programming language. This can be useful if you want to do simple computations or update some fields of a table by using a simple program. Please note that MUIbase automatically surrounds your program expression with a pair of parenthesis, thus you can omit the outermost ones.
- a list-view that displays the output after running the current query. The output is formatted into rows and columns. The title row holds the field names of the select-from-where query (usually the attribute names). The other rows hold the contents of the query result, one set of records per row. Each field entry is displayed in its own column. If you double click an entry in the list and this entry was generated by an attribute of type string or type reference then the selected record is displayed in the corresponding table mask. This is an easy way to jump to a certain record in a table mask.

The query editor is a non-modal requester. This means that you can leave the query editor open and still work with the rest of the application. You can close the query editor at any time by clicking on the close button in the window title bar.

13.3 Printing queries

After you have run a query you can print the result to a file or printer by clicking on the ‘Print’ button in the query editor. This will open a print requester containing the following items:

- a field ‘Delimiter’ where you specify how the columns should be separated. ‘Spaces’ pads the fields with space characters. Padding is done on the left or on the right side depending on the type of the field (numbers are padded on the left, text on the right side). ‘Tabs’ inserts exactly one tab character between the columns. This can be useful if you want to use the print requester for exporting records (see below).
- a field ‘Font’ where you specify which font should be used for printing the output. ‘NLQ’ stands for near letter quality which should print the output in better quality than ‘Draft’.
- a field ‘Size’ where you define the character size. ‘Pica’ prints in a large font (10 cpi), ‘Elite’ in a medium font (12 cpi) and ‘Condensed’ in a small font (17 cpi).
- a string field ‘Init sequence’ where you can enter a string for initializing your printer. The contents of this field are written directly after opening the printer. For example you can use ‘\33c’ as init sequence which resets your printer.
- a field ‘Indent’ where you can enter a number of spaces that are used for indenting each output line.
- a field ‘Headline’ that, if checked, prints the field names in the first line.
- a field ‘Escape codes’. If not checked the output of all escape codes is suppressed which means that the settings of the fields ‘Font’ and ‘Size’ are ignored and the contents of ‘Init sequence’ are not printed. Suppressing the output of all escape codes is useful if you want to generate an ASCII file, e.g. for exporting records.
- a field ‘Quotes’ that, if checked, surrounds all fields with double quotes.
- a field ‘After printing’ where you can specify how the output should be finished. ‘Form feed’ prints a form feed character `\f`. ‘Line feeds’ prints a number of line feed characters `\n`. The number of line feeds can be entered in the string field to the right of the ‘Line feeds’ button. ‘Nothing’ doesn’t write anything to the printer.

- a string field 'Output' with an attached pop-up button. You can use the pop-up button to open a file requester for choosing a filename or directly enter the filename into the string field. For writing the output to your printer enter 'PRT:', for printing to a window enter 'CON:////MUIbase output/CLOSE/WAIT' into the string field.
- two buttons 'Ok' and 'Cancel' for leaving the print requester.

After you are done with all settings, click on the 'Ok' button to start the print job.

The print requester can also be used for exporting records to an ASCII file. To do this, specify 'Tabs' in the 'Delimiter' field, set the number of spaces in the 'Indent' field to 0, check 'Headline', un-check 'Escape codes' to suppress the font, size and init sequence settings, optionally check 'Quotes' if you want the field contents to be surrounded by double quotes, check 'Nothing' in the 'After printing' field, and enter the output filename in the 'Output' field. Using the query editor together with the print requester for exporting records can be much more powerful than using MUIbase' import/export feature (see Chapter 12 [Import and Export], page 42) since in the query editor any query can be entered whereas the export requester only uses a fixed query.

13.4 Query examples

To give you an impression of the power of the select-from-where queries this section gives you some sample queries.

Suppose we have two tables 'Person' and 'Dog'. 'Person' has a string attribute 'Name', an integer attribute 'Age', and two reference attributes 'Father' and 'Mother' that refer to the father and mother records in table 'Person'. The table contains the following records:

	Name	Age	Father	Mother
p1:	Steffen	26	p2	p3
p2:	Dieter	58	NIL	NIL
p3:	Marlies	56	NIL	NIL
p4:	Henning	57	NIL	NIL

'Dog' has a string attribute 'Name', a choice attribute 'Color' and a reference attribute 'Owner' that refers to the owner in the 'Person' table. The table contains the following records:

	Name	Color	Owner
d1:	Boy	white	p3
d2:	Streuner	grey	NIL

Given these data the following sample select-from-where queries can be run:

```
SELECT * FROM Person
```

results to:

Name	Age	Father	Mother
Steffen	26	Dieter	Marlies
Dieter	58		
Marlies	56		
Henning	57		

(For the reference attributes the 'Name' field of the referenced record is printed.)

```
SELECT Name "Child", Age,
       Father.Name "Father", Father.Age "Age",
       Mother.Name "Mother", Mother.Age "Age"
FROM Person WHERE (AND Father Mother)
```

results to:

Child	Age	Father	Age	Mother	Age
Steffen	26	Dieter	58	Marlies	56

```
SELECT Name, Color,
       (IF Owner Owner.Name "No owner") "Owner"
FROM Dogs
```

results to:

Name	Color	Owner
Boy	white	Marlies
Streuner	grey	No owner

```
SELECT a.Name, a.Age, b.Name, b.Age FROM Person a, Person b
WHERE (> a.Age b.Age)
```

results to:

a.Name	a.Age	b.Name	b.Age
Dieter	58	Steffen	26
Marlies	56	Steffen	26
Henning	57	Steffen	26
Dieter	58	Marlies	56
Henning	57	Marlies	56
Dieter	58	Henning	57

14 Structure editor

MUIbase has two different operating modes, the record-editing mode, where you enter and browse records, and the structure-editing mode where you define the structure, that is, the tables, attributes and appearance of a project. This chapter describes the structure editor and explains how to manage the structure of a project.

To switch from record-editing to structure-editing mode select menu item **Structure editor** in the **Project** menu. This will close all windows and open the structure editor window. To switch back to record-editing mode select menu item **Project - Exit structure editor** or simply close the structure editor by clicking on the close button in the window title bar.

The structure editor window is divided into three parts: in the upper left part there is a field **Tables** for managing the tables of the project, the lower left part is occupied by a field **Attributes** for managing the attributes of a table, and the right part is used by a field **Display** for managing the project's gui elements.

14.1 Table management

In the **Tables** field of the structure editor you can create, change, delete and sort tables.

14.1.1 Creating tables

To create a new table press the **New** button in the **Tables** field. This will open the **New table** requester containing

- a string field for entering the name of the table. Each table must have a unique name that starts with an uppercase letter followed by further letters, digits or underscore characters. Non-ASCII characters like German umlauts are not allowed. Please note that in the user interface for the table it is still possible to display any strings including strings with non-ASCII characters.
- a field **Number of records** where you specify how many records the table is going to hold. **Unlimited** means that the table can hold any number of records, **Exactly one** means that the table can have only one record. The latter one is sometimes useful for controlling the project (see Section 5.2 [Tables], page 16).
- a field **Trigger functions** where you can enter the names of two functions. In the **New** string field you enter the name of the function that should be called whenever the user wants to create a new record, the **Delete** string field holds the name of the function that should be called whenever the user wants to delete a record. You can use the pop-up buttons to the right of the string fields for choosing a function name from a list of all names. If you leave a field empty then default actions are executed (records are created automatically and records are deleted after an optional safety requester). For more information on how to use the trigger functions, including the arguments that are passed to them, see Chapter 15 [Programming MUIbase], page 59.
- two buttons **Ok** and **Cancel** for leaving the requester.

When you are done with all settings, press the **Ok** button to create the new table. If you made an error somewhere, e.g. you entered an invalid name, a message window pops up giving you more information about the error you did. If everything goes fine, the **New table** requester will be closed and the new table is displayed in the structure editor's table list.

14.1.2 Changing tables

After you have created a new table you can still change it. Just double-click on the table's name and the 'Change table' requester pops up. This requester is similar to the one when creating a table (see Section 14.1.1 [Creating tables], page 48) and allows you to make changes in any field by entering a new value.

When you are done with all changes, press the 'Ok' button to leave the requester.

Please note that you can't change the number of records from 'Unlimited' to 'Exactly one' if the table already contains more than one record.

14.1.3 Deleting tables

To delete a table, click on the table's name in the structure editor's table list, then press the 'Del' button below the list. Before the table is actually deleted a safety requester pops up asking for confirmation. If you confirm this requester by pressing the 'Delete' button, the table is deleted.

A problem occurs if the table is used somewhere in the project's program. In this case the table can't simply be deleted but all references to the table must be removed from the program. If the table you want to delete is used in the project's program then the program editor pops up and displays the first occurrence to the table. You should now modify the program such that no references to this table remain in the program. After you removed a reference you can jump to the next one by pressing the 'Compile' button. At any point you can still cancel the whole operation by pressing the 'Undo' button and closing the program editor.

14.1.4 Sorting tables

For sorting the tables in the 'Tables' field of the structure editor you have two choices. You can either order them by hand, that is, you use drag & drop to rearrange a table, or you use the 'Sort' button below the list-view which orders the tables alphabetically.

14.2 Attribute management

In the 'Attributes' field of the structure editor you can create, copy, change, delete and sort the attributes of the active table in the 'Tables' field.

14.2.1 Creating attributes

To create a new attribute for the active table press the 'New' button in the 'Attribute' field. This will open the 'New attribute' requester containing

- a string field for entering the name of the attribute. Each attribute in a table must have an unique name that starts with an uppercase letter followed by further letters, digits or underscore characters. Non-ASCII characters like German umlauts are not allowed. Please note that in the user interface it is still possible to display any strings including strings with non-ASCII characters for the attribute.
- a choice field 'Type' where you specify the type of the attribute. For more information on attribute types, see Section 5.5 [Attribute types], page 17.
- a section below the 'Type' field for specifying type specific settings. For more information about this section, see Section 14.2.2 [Type specific settings], page 50.
- a field 'Trigger' where you can enter the name of a function that should be called whenever the user wants to change the contents of the attribute field in a record. You can use the pop-up button to the right of the string field for choosing a name from a list of all function names. If you leave the field empty then a default action is executed, that is, the entered

value is simply stored in the attribute field. For more information on how to use the trigger function, including the arguments that are passed to it, see Chapter 15 [Programming MUIbase], page 59.

- two buttons ‘Ok’ and ‘Cancel’ for leaving the requester.

When you are done with all settings, press the ‘Ok’ button to create the new attribute. If you made an error somewhere, e.g. you entered an invalid name, a message window pops up giving you more information about the error you did. If everything goes fine, the ‘New attribute’ requester will be closed and the new attribute is displayed in the structure editor’s attribute list.

14.2.2 Type specific settings

In the type specific section the following settings can be specified:

- For attributes of type string you have
 - an integer field ‘Max length’ for entering the maximum string length for this attribute field.
 - a string field ‘Initial value’ for specifying the value that is used for initializing the attribute field. Any string up to the specified maximum length can be entered here.
- For attributes of type integer, real, date, and time the type specific section offers
 - a field ‘Initial value’ where you specify the value for initializing the attribute field. You can choose between ‘NIL’ and ‘other’. If you select ‘other’ then you should enter the initial value into the string field to the right of ‘other’.
 - a string field ‘NIL string’ where you enter the string that should be displayed when the attribute field holds the NIL value.
- For bool attributes the type specific section contains a field ‘Initial value’ where you can choose between ‘NIL’ and ‘TRUE’ for the initial value.
- The type specific section for choice attributes offers
 - a button ‘Edit labels’ for opening the ‘Edit labels’ window where you can enter the label strings for the choice field (see Section 14.2.3 [Label editor], page 50).
 - a choice field ‘Initial value’ for specifying the value for initializing the attribute field.
- For reference attributes the type specific section contains
 - a list-view displaying all tables for specifying to which table the reference should be made. Click on the table the attribute is going to reference.
 - a field ‘Filter’. If checked the reference filter of this attribute is turned on. See Section 9.2 [Reference filter], page 37, for more information about this feature.

Reference attributes always have the NIL value as initial value.

- The type specific section for virtual attributes contains a string field ‘Compute’ where you enter the name of a function that should be called for calculating the value of the attribute. You can use the attached pop-up button for selecting a name from a list of all function names.
- Memo and button attributes do not have any type specific settings. The initial value for memo attributes is an empty string.

14.2.3 Label editor

Whenever you have to define a list of labels, e.g. the list of labels for a choice attribute, the label editor comes into place. The label editor is a window containing:

- a list-view displaying the current list of labels. You can click on a label to make it the active one. The active label is also displayed in the string field below the list-view. You can use drag & drop to rearrange the labels.
- a string field 'Label' that displays the active label and allows changing it. The changes do only have effect after you pressed the **Return** key. If there is currently no active label then pressing **Return** inserts new labels into the list.
- a button 'New' that deactivates the current label which allows entering new labels into the 'Label' string field.
- a button 'Remove' that removes the active label from the list.
- a button 'Sort' for ordering the list of labels alphabetically.
- two buttons 'Ok' and 'Cancel' for leaving the label editor.

After you entered all labels or made changes to them, press the 'Ok' button to leave the window.

14.2.4 Copying attributes

In case you need a lot of similar attributes, it is possible to copy an attribute. Just select the desired attribute and press the 'Copy' button below the attribute list. This opens the 'Copy attribute' requester where the settings of the selected attribute are displayed. Change some of the fields, e.g. the name, and then press 'Ok' for creating a copy of the attribute.

14.2.5 Changing attributes

After you have created a new attribute it is still possible to change some settings of it. Just double-click on the attribute's name and the 'Change attribute' requester pops up. This requester is similar to the one when creating an attribute (see Section 14.2.1 [Creating attributes], page 49) and allows you to make changes in some fields. The fields that cannot be changed, e.g. the attribute type, are displayed ghosted.

The following notes should be taken into account when changing an attribute.

- The type of an attribute cannot be changed. If you ever want to change the type of an attribute, it is best to create a new one of the desired type and copy the record contents from the old attribute to the new one by entering a simple MUIbase program in the query editor (see Section 13.2 [Query editor], page 44).
- If you change the initial value of an attribute then only new records will get the new value for initializing the record.
- For choice attributes you should be careful when changing its labels. The labels are only used for displaying the choice field contents, internally, numbers are stored that are used as an index into the list of labels. Thus, if you change the order of labels, you actually don't change the internal number but the label which is displayed for it! Therefore you should not change the order of labels after you created a choice attribute. Appending new labels to the end of the label list, however, doesn't make any problems. For a more flexible way of having a choice-like field where you can also change the order of labels, use a string attribute together with the 'List-view pop-up' feature (see Section 14.3.3 [Attribute object editor], page 53).
- The referenced table of a reference attribute cannot be changed.

When you are done with all changes, press the 'Ok' button to leave the requester.

14.2.6 Deleting attributes

To delete an attribute, click on it's name in the structure editor's attribute list and press the 'Del' button below the list. Before the attribute is actually deleted a safety requester pops

up asking for confirmation. If you confirm this requester by pressing the ‘Delete’ button, the attribute is deleted.

A problem occurs if the attribute is used somewhere in the project’s program. In this case the attribute can’t simply be deleted but all references to it must be removed from the program. If the attribute you want to delete is used in the project’s program then the program editor pops up and displays the first occurrence to this attribute. You should now modify the program such that no references to this attribute remain in the program. After you removed a reference you can jump to the next one by pressing the ‘Compile’ button. At any point you can still cancel the whole operation by pressing the ‘Undo’ button and closing the program editor.

14.2.7 Sorting attributes

For sorting the attributes in the ‘Attributes’ field of the structure editor you have two choices. You can either order them by hand, that is, you use drag & drop to rearrange an attribute, or you use the ‘Sort’ button below the list-view which orders the attributes alphabetically.

14.3 Display management

In the ‘Display’ field of the structure editor you specify how the database elements should be arranged in the user interface. The field consists of a choice field, a list-view and several buttons.

14.3.1 Display field

The display field contains the following items:

- a choice item with two settings, ‘Table mask’ and ‘Root window’. In ‘Table mask’ you specify how the attributes of the active table are arranged in the user interface. In ‘Root window’ you specify how the tables are arranged.
- a list-view that displays the current specification of the user interface. The list is organized as a tree. Items that have an arrow to its left are composite gui objects and can be opened and closed by double-clicking on the arrow symbol. A double-click on the item itself opens a window for editing its settings. All gui objects that have the same parent object are layed out in the same way (either vertically or horizontally). How the layout is done is determined by the parent gui object: tables, panels and windows layout their elements vertically, groups layout their elements according to the settings in the group editor (see Section 14.3.8 [Group editor], page 57).
- a button ‘Panel’ for adding a panel to the table. See Section 14.3.2 [Panel editor], page 53, for more information about setting up a panel.
- a button ‘Add’ for adding the active table or the active attribute (depending on the state of the display choice field) to the display list-view. Usually tables and attributes are added to the display list-view automatically when you create them.
- a button ‘Rem’ for removing the active item from the display list-view. If you remove a table then the whole table form is removed from the user interface, thus you can’t see the table in the project’s gui. If you remove an attribute from the display list-view then the attribute doesn’t appear in the project’s gui. This is useful for hiding attributes.
- two buttons ‘Up’ and ‘Down’ for moving the active item one field up, respectively down, in the display list-view.
- two buttons ‘In’ and ‘Out’ for moving the active item one hierarchical level down or up in the display list-view.
- a button ‘Text’ for adding a text object to the display list-view. See Section 14.3.5 [Text editor], page 56, for more information about setting up a text object.

- a button ‘Image’ for adding an image object (see Section 14.3.6 [Image editor], page 56).
- a button ‘Space’ for putting space between the other objects (see Section 14.3.7 [Space editor], page 56).
- a button ‘Balance’ for adding a balance object to the display list-view. The balance object is useful for controlling the size of the other gui objects.
- a button ‘Group’ for adding a group object to the display list-view. Before you press the ‘Group’ button you can multi-select the items in the list-view that should be moved into the new group. See Section 14.3.8 [Group editor], page 57, for more information about setting up a group object.
- a button ‘Window’ for adding a new window to the display list-view. As for group objects, you can multi-select the gui objects that should be moved into the new window. For more information about setting up a window, see Section 14.3.10 [Window editor], page 57.

For more information about the gui elements, including their usage, see Section 5.9 [User interface], page 23.

14.3.2 Panel editor

When you add a panel to a table’s mask, or when you double click an existing panel object in the display list-view, the ‘Panel’ window pops up. This window contains the following items:

- a string field ‘Title’ for entering a title that should be displayed in the panel header.
- a string field ‘Font’ with a pop-up button for selecting a font for the title. If you leave the field empty, a default font is used.
- a field ‘Background’ with a check-mark field ‘Default’ for specifying the background of the panel header. If you check the ‘Default’ field then a default background is chosen. Otherwise you can click on the ‘Background’ button to open a window for specifying the background setting (see the MUI docs for a description of this window).
- a field ‘Num/All’. If checked the number of the current record and the number of all records are displayed in the right part of the panel header.
- a field ‘Filter’ that, if checked, adds a filter button to the panel header. With the filter button you can turn on and off the record filter of the table. If you don’t check this field then the menu item ‘Table - Change filter’ will also be disabled for this table, thus you can’t enter a filter expression for the table. For more information about record filters, see Section 9.1 [Record filter], page 36.
- a field ‘Arrows’ for adding two arrow buttons to the table mask. The arrow buttons allows you to browse through the records of the table. If you don’t check this field then you can’t browse the records of this table and all sub menu items of menu item ‘Goto record’ and the menu items ‘Search for’, ‘Search forward’, and ‘Search backward’ in menu ‘Table’ are disabled.
- two buttons ‘Ok’ and ‘Cancel’ for leaving the window.

After you are done with all settings, click on the ‘Ok’ button to close the window.

14.3.3 Attribute object editor

When you add an attribute to the display list-view, a default gui object is created for it. To change the settings of the attribute object, double click on it and the ‘Display attribute’ window is opened. This window contains several items depending on the type of the attribute. The following items are included for most attribute types:

- a string field ‘Title’ for entering a title that is displayed near the attribute object (or, for buttons, in the object itself). If you leave this field empty then no title is displayed.

- a choice field ‘**Title position**’ for specifying where the title (if any) is placed relative to the attribute object. You can choose between ‘**Left**’, ‘**Right**’, ‘**Top**’, and ‘**Bottom**’.
- a string field ‘**Shortcut**’ for entering a letter than can be used together with the *Amiga* key to activate the object.
- a field ‘**Home**’. If checked, this attribute object becomes the home object. The home object is used as the object where the cursor is set on whenever a new record is allocated. This is quite useful if you always want to start entering data into the same attribute whenever you create a new record. If you mark an attribute object as the home object then all other attribute objects in the same table are unmarked.
- a field ‘**Read only**’ that, if checked, gives the object a read only status. This means that you can only read its contents but can’t edit them. If you check this field then the settings of the fields ‘**Shortcut**’ and ‘**Home**’ are ignored.
- a choice field ‘**Format**’ for specifying how the attribute contents should be presented in the object. You can choose between ‘**Center**’, ‘**Left**’ and ‘**Right**’ for displaying the contents centered, flushed left, or flushed right.
- a numerical field ‘**Weight**’ for specifying the weight of the object. The value of this field determines how much space, relatively to the other objects, the object gets in the final window layout. Usually the value of this field only affects the horizontal size of the object as the vertical one is fixed for most attribute types.
- a field ‘**Font**’ for selecting the font used for displaying the attribute contents. If you leave the field empty, a default font is used.
- a field ‘**Background**’ with a check-mark field ‘**Default**’ for specifying how the background of the attribute should look like. If you check the ‘**Default**’ field then a default background is used, otherwise you can click on the ‘**Background**’ field to open a window for specifying the background settings (see the MUI docs for a description of this window).
- an editor field ‘**Bubble help**’ where you can enter text that should be displayed as the bubble help information for this attribute object.
- two buttons ‘**Ok**’ and ‘**Cancel**’ for leaving the window.

If you are done with all settings, press the ‘**Ok**’ button to leave the window.

14.3.4 Type specific settings

Besides the above items, the following type-specific items are present:

- for attributes of type string there is an ‘**Extras**’ page which contains:
 - a field ‘**Display picture**’ that, if checked, attaches an image field to the string attribute for displaying the image whose filename is taken from the attribute contents. The image field is put above the string field. If you don’t check this item then the settings of the fields ‘**Title at string field**’, ‘**Hide string field**’, and ‘**Size**’ are meaningless.
 - a field ‘**Title at string field**’. If checked, the title of the attribute object is placed to the left of the string field, thus the image field gets more space in the window. If you don’t check this field then the title is placed to the left of the image field.
 - a field ‘**Hide string field**’ for removing the string field from the user interface. If checked, only the image field is displayed.
 - a field ‘**Size**’ for specifying how size-handling is done for the image area. If ‘**Resize-able**’ is active then the object can be resized and the object can become larger than the size of its image. ‘**Fixed**’ sets the object’s size to the size of the image. If the image sizes vary from record to record then the object is resized accordingly. ‘**Scroll-able**’ adds two scrollers to the object allowing to view images that are larger than the visible region. If ‘**Scaled**’ is activated then the image is scaled to the size of the display object.

- a field **'File pop-up'** that, if checked, adds a pop-up button to the right of the string field. This buttons serves to open a file requester for choosing a filename.
- a field **'Font pop-up'** for adding a pop-up button that opens a font requester. This feature has been added according to a suggestion from Ralpie. Blame him if you find this feature useless. :-)
- a field **'List-view pop-up'**. If checked, a pop-up button is attached to the right of the string field for opening a list-view pop-up where you can choose a string from a list of strings. The list of strings can be specified in the label editor which is opened after pressing the **'Edit labels'** button to the right of the **'List-view pop-up'** field. For more information about the label editor, see Section 14.2.3 [Label editor], page 50.
Only one of the fields **'File pop-up'**, **'Font pop-up'** and **'List-view pop-up'** can be made active (MUI programmers know why).
- a field **'View'** that, if checked, adds a button to the right of the string field for launching an external viewer with the attribute contents as argument. This can be useful if you store filenames in the attribute and want to display the contents of a file by starting an external viewer. The external viewer can be specified in menu item **'Preferences - External viewer'** (see Section 7.8 [External viewer], page 29).
- for attributes of type choice there is a field **'Kind'** where you choose whether the attribute contents should be displayed by a **'Cycle button'** or by a set of **'Radio buttons'**. If you select **'Cycle button'** then you can set the title position to one of **'Left'**, **'Right'**, **'Top'**, or **'Bottom'**. If you select **'Radio buttons'** then two check mark items **'Frame'** and **'Horizontal'** allow drawing a border around the radio buttons and the specification of an horizontal layout.
- for attributes of type real there is an integer field **'Num decimals'** where you can enter the number of decimals for displaying the floating point values.
- for reference attributes there is an **'Extras'** page that contains the following items:
 - a list-view field **'Contents'** where you specify which contents of a referenced record should be displayed. You can multi-select several items in this list. If you select **'Record number'** than the record number of a referenced record is included in the display. The other items are the names of attributes in the referenced table.
 - a text field **'Items selected'** that displays how many items have been selected in the above list-view.
 - a field **'Show'**. If checked then the gui object for displaying the reference is created as a button. Clicking on this button will show you the referenced record in the table mask of the referenced table.
 - a field **'Filter'** that, if checked, adds a button to the right of the reference field for turning on and off the reference filter for this attribute. See Section 9.2 [Reference filter], page 37, for more information about reference filters.
- for virtual attributes the attribute object editor contains:
 - a choice field **'Kind'** where you specify how the contents of the virtual attribute should be displayed. You can choose between **'Bool'** that uses a check-mark field for displaying boolean values, **'Text'** that uses a text field for displaying one line of text (including date, time, and numerical values), and **'List'** which uses a list-view for displaying a list of lines (e.g. the result of a select-from-where query).
 - if you set the **'Kind'** field to **'Text'** then two further fields are available: **'Format'** for specifying how the attribute contents should be presented and **'Num decimals'** for entering the number of decimals that should be used if the attribute contents are of type real.
 - if the **'Kind'** field has been set to **'List'** then a field **'Show titles'** is available. If checked, the first line of the attribute contents is displayed as a title row in the list-view. Otherwise no title row is displayed and the first line is ignored.

- a field `'Immediate'` that, if checked, causes the virtual attribute to recompute its value whenever you switch the active record to another one. If not checked then the value of the virtual attribute is only computed when a MUIbase program needs its value, e.g. when you have installed a button somewhere in the user interface that reads the value of the virtual attribute when the button is pressed.
- For buttons there are the following additional fields:
 - a choice field `'Kind'` where you choose between `'Text button'` and `'Image button'`.
 - if you set the button kind to `'Text button'` then further fields `'Title'`, `'Font'`, `'Background'` and `'Default'` appear for entering the text to be displayed in the button, the font used for displaying the text, and the background settings.
 - if the button kind has been set to `'Image button'` then a field `'Image'` for specifying the image to be displayed and a field `'Size'` for specifying the size-handling of the image button are offered.

14.3.5 Text editor

When you add a text object to the display list-view, or when you change one by double clicking on it, a window `'Text'` is opened. This window contains the following items:

- a string field `'Title'` for entering the text that should be displayed.
- a numerical field `'Weight'` for specifying the horizontal weight of the text object.
- a choice field `'Font'` for specifying the font of the text. If you leave this field empty, a default font is used.
- two fields `'Background'` and `'Default'` for specifying the background settings of the text object.
- two buttons `'Ok'` and `'Cancel'` for leaving the window.

When you are done with all settings, press the `'Ok'` button to leave the window.

14.3.6 Image editor

The image editor appears when you add a new image object or double click on an existing one. It contains the following items:

- a field `'Weight'` for specifying the weight of the image object in the final window layout.
- a field `'Image'` for specifying the image that should be displayed.
- a field `'Size'` where you specify how resize-handling should be done. If you select `'Resize-able'` then the image object can be resized. `'Fixed'` sets the object size to the size of the displayed image.
- two buttons `'Ok'` and `'Cancel'` for leaving the window.

When you are done with all settings, click on the `'Ok'` button to close the window.

14.3.7 Space editor

After you have added a space object to the display list-view, you can change its default settings by double clicking on it. This will open the `'Space'` window containing the following items:

- a field `'Delimiter'` that, if checked, displays a vertical or horizontal bar (depending on the layout of the parent object) in the center of the space object. This is useful for separating parts in the window layout.
- a numerical field `'Weight'` for specifying the weight of the object.

- two fields ‘Background’ and ‘Default’ for specifying the background settings.
- two buttons ‘Ok’ and ‘Cancel’ for leaving the window.

After you are done with all settings, press the ‘Ok’ button to close the window.

14.3.8 Group editor

After you have added a group object to the display list-view, you can change its settings by double clicking on it. This will open the ‘Group’ window offering the following items:

- a string field ‘Title’ for entering a title string that should be displayed centered above the group. If you leave this field empty then no title is displayed.
- a numerical field ‘Weight’ for specifying the weight of this object.
- two fields ‘Background’ and ‘Default’ for specifying the background settings.
- a field ‘Border’ that, if activated, draws a border frame around the group.
- a field ‘Horizontal’. If checked, the layout of the group is done horizontally and the group is listed in the display list-view as ‘HGroup’. Otherwise the group is organized vertically and the display list-view will show a ‘VGroup’ for this group.
- a field ‘Spacing’ that, if checked, adds some space between the group’s child objects. Otherwise no space is put between the objects.
- two buttons ‘Ok’ and ‘Cancel’ for leaving the window.

When you are done with all settings, press the ‘Ok’ button to leave the window.

14.3.9 Register group editor

Double click on a register group object in order to change its settings. This will open the ‘Register group’ window offering the following items:

- a numerical field ‘Weight’ for specifying the weight of this object.
- two fields ‘Background’ and ‘Default’ for specifying the background settings.
- an area ‘Labels’ for specifying the label of each register page. You should specify exactly the same number of labels as there are elements in the register group. For more information on how to enter and edit the labels, see Section 14.2.3 [Label editor], page 50.
- two buttons ‘Ok’ and ‘Cancel’ for leaving the window.

When you are done with all settings, press the ‘Ok’ button to leave the window.

14.3.10 Window editor

To change the settings of a window object, double click on it. This will open the window editor containing the following items:

- a string field ‘Title’ where you enter a string that should be displayed in the window title bar and in the window button.
- a string field ‘Shortcut’ where you enter the shortcut for activating the window button.
- a numerical field ‘Weight’ for specifying the weight of the window button.
- a field ‘Font’ for selecting the font of the window button. If you leave the field empty, a default font is used.
- two fields ‘Background’ and ‘Default’ for specifying the background settings of the window button.
- a field ‘Disabled’ that, if checked, creates the window button with a disabled state, that is, you can’t click on it and therefore cannot use it to open or close the window. This can be useful if you don’t want the user to open windows by himself but want to open them from within a MUIbase program.

- two buttons 'Ok' and 'Cancel' for leaving the window.

When you are done with all settings, press the 'Ok' button to close the window.

14.4 Print structure

Sometimes it is useful to get an overview of all tables and attributes of a project, e.g. when you want to write a MUIbase program. You can do this by selecting menu item 'Project - Print structure'. This will ask you for a filename where the list of tables and attributes should be written to.

The output will first list the project name, followed by all tables in this project. For each table all attributes including their types are listed.

15 Programming MUIbase

This chapter describes the programming language of MUIbase, including all available functions. This chapter, however, is not intended as a general guide about programming. You should be familiar with the basics about programming and should already have written some small programs.

15.1 Program editor

To enter a program for a project, open the program editor by selecting menu item ‘Program - Edit’. This will open the ‘Edit program’ window containing:

- a text editor field where you edit the project program.
- a button ‘Compile & close’ for compiling the program and, on successful compilation, leaving the program editor.
- a button ‘Compile’ to compile the program. If your program contains an error somewhere then an error description is put into the window title and the cursor is set on the faulty location.
- a button ‘Undo’ that undos all changes since the last successful compilation.

The program editor is an asynchronous requester. You can leave the window open and still work with the rest of the application. You can close the editor at any time by clicking into its window close button. If you have done changes since the last successful compilation then a safety requester pops-up asking for confirmation to close the window.

You can also compile a project’s program without opening the program editor by choosing menu item ‘Program - Compile’. This can be useful if you e.g. do changes to an external include file and want to incorporate these changes in the project’s program.

15.2 Preprocessing

MUIbase programs are pre-processed similar to a C compiler preprocessing a C source file. This section describes how to use the preprocessing directives.

All directives start with a hash symbol # which should be the first character on a line. Space or tab characters can appear after the initial #.

15.2.1 #define

```
#define name string
```

Defines a new symbol with the given name and contents. The symbol *string* can be any text including spaces and ends at the end of line. If *string* does not fit on one line you can use further lines by using a backslash character \ at the end of each line (except for the last one). If the symbol *name* does occur in the remaining source code then it will be replaced by the contents of *string*.

Example: ‘(PRINTF "X is %i" X)’ prints ‘X is 1’ (Occurrences of *name* in strings are not altered.)

The replacement of defined symbols is done syntactically which means that you can replace symbols with any text, e.g. you can define your own syntax like in the following example:

```
#define BEGIN (
#define END )
```

```
BEGIN defun test ()
```

END

The replacement string of a definition may contain another symbol that has been defined with the `#define` directive to allow nested definitions. However there is an upper limit of 16 nested definitions.

See also `#undef`, `#ifdef`, `#ifndef`.

15.2.2 `#undef`

`#undef name`

Removes the definition of symbol *name*. If *name* has not been defined, nothing happens.

See also `#define`, `#ifdef`, `#ifndef`.

15.2.3 `#include`

`#include filename`

Reads in the contents of *filename* (a string surrounded with double quotes) at this location. MUIbase searches in the current directory and in the directory specified in the preferences (see Section 7.12 [Program include directory], page 30) for loading the file. The file contents are processed by the compiler as if they were part of the current source code.

An external file may include one or more other external files. However there is an limit of 16 nested `#include` directives. To protect files from including them more than once, you can use conditional compilation.

Be careful when moving source code to external files! Debugging and tracking down errors is much harder for external files. Move only well tested and project independent code to external files.

15.2.4 `#if`

`#if const-expr`

If the given constant expression results to non-NIL then the text up to the matching `#else`, `#elif`, or `#endif` is used for compilation, otherwise (the expression results to NIL) the text up to the matching `#else`, `#elif`, or `#endif` is discarded for compilation.

Currently you can only use TRUE and NIL as constant expressions.

See also `#ifdef`, `#ifndef`, `#elif`, `#else`, `#endif`.

15.2.5 `#ifdef`

`#ifdef name`

If the given symbol has been defined with a `#define` directive then the text up to the matching `#else`, `#elif`, or `#endif` is used for compilation, otherwise it is discarded.

See also `#if`, `#ifndef`, `#elif`, `#else`, `#endif`.

15.2.6 `#ifndef`

`#ifndef name`

If the given symbol has not been defined with a `#define` directive then the text up to the matching `#else`, `#elif`, or `#endif` is used for compilation, otherwise it is discarded.

See also `#if`, `#ifdef`, `#elif`, `#else`, `#endif`.

15.2.7 #elif

`#elif const-expr`

Any number of `#elif` directives may appear between an `#if`, `#ifdef`, or `#ifndef` directive and a matching `#else` or `#endif` directive. The lines following the `#elif` directive are used for compilation only if all of the following conditions hold:

- The constant expression in the preceding `#if` directive evaluated to NIL, the symbol name in the preceding `#ifdef` is not defined, or the symbol name in the preceding `#ifndef` directive was defined.
- The constant expression in all intervening `#elif` directives evaluated to NIL.
- The current constant expression evaluates to non-NIL.

If the above conditions hold then subsequent `#elif` and `#else` directives are ignored up to the matching `#endif`.

See also `#if`, `#ifdef`, `#ifndef`, `#else`, `#endif`.

15.2.8 #else

`#else`

This inverts the sense of the conditional directive otherwise in effect. If the preceding conditional would indicate that lines are to be included, then lines between the `#else` and the matching `#endif` are ignored. If the preceding conditional indicates that lines would be ignored, subsequent lines are included for compilation.

Conditional directives and corresponding `#else` directives can be nested. However there is a maximum nesting count limit of 16 nested conditional directives

See also `#if`, `#ifdef`, `#ifndef`, `#elif`, `#endif`.

15.2.9 #endif

`#endif`

Ends a section of lines begun by one of the conditional directives `#if`, `#ifdef`, or `#ifndef`. Each such directive must have a matching `#endif`.

See also `#if`, `#ifdef`, `#ifndef`, `#elif`, `#else`.

15.3 Programming language

MUIbase uses a programming language with a lisp-like syntax. Indeed several constructs and functions have been adopted from standard lisp. However, MUIbase is not fully compatible to standard lisp. Many functions are missing (e.g. destructive commands) and the meaning of some commands is different (e.g. the `return` command).

15.3.1 Why lisp?

The advantage of a lisp-like language is that you can program in both, a functional and an imperative way. Functional languages are getting quite popular in mathematical applications. The basic concept in functional languages is the use of expressions. Functions are defined in a mathematical way and recursion is used heavily.

Imperative programming languages (e.g. C, Pascal, Modula) use an imperative description on how to compute things. Here, the state is the basic concept (e.g. variables) and a program computes its output by going from one state to another (e.g. by assigning values to variables).

Lisp combines both techniques and therefore you can choose in which way you want to implement things. Use the one which is more appropriate for the specific problem or which you like more.

15.3.2 Lisp syntax

A lisp expression is either a constant, a variable, or a function application. For calling functions, lisp uses a prefix notation. The function and its arguments are surrounded by parenthesis. For example, to add two values **a** and **b**, you write

```
(+ a b)
```

All expressions return a value, e.g. in the above example the sum of **a** and **b** returned. Expressions can be nested, that is, you can place an expression as a sub-expression into another one.

Function evaluation is done by using a call-by-value scheme, this means that the arguments are evaluated first before a function is called.

If not stated otherwise, all functions are strict, that is, *all* arguments of a function are evaluated before the function is called. Some functions, however, are non-strict, e.g. **IF**, **AND** and **OR**. These functions may not evaluate all arguments.

15.3.3 Kinds of programs

MUIbase knows three kinds of programs. The first one is the project program kind. In a program of this kind you can define functions and global variables. The functions can be used as trigger functions for attributes. You define a project program in the program editor (see Section 15.1 [Program editor], page 59).

The second kind is the query program kind. For this kind you can enter expressions only. An expression is allowed to contain global variables and calls to functions that are defined in the project program. However, you cannot define new global variables or functions in a query program. Query programs are entered in the query editor (see Section 13.2 [Query editor], page 44).

The third kind of programs are filter expressions. Here you can only enter expressions that contain calls to pre-defined MUIbase functions. Not all pre-defined functions are available, only those that don't have a side effect, e.g. you cannot use a function that writes data to a file. Filter expressions are entered in the change filter requester (see Section 9.1.2 [Changing filters], page 36).

15.3.4 Name conventions

In a MUIbase program you can define symbols like functions and local or global variables. The names of these symbols must follow the following conventions:

- the first character of a name must be a lowercase letter. This distinguishes program symbols from table and attribute names.
- The following characters can be any letters, digits or underscore characters. Other characters like German umlauts are not allowed.

15.3.5 Accessing record contents

To access tables and attributes in a MUIbase program, you have to specify a path to them. A path is a dot separated list of components where each component is the name of a table or an attribute.

Paths can either be relative or absolute. Absolute paths are specified with a table name as the first component, followed by a list of attributes that lead to the final attribute you want to access. E.g. the absolute path `'Person.Name'` accesses the `'Name'` attribute in the current record of table `'Person'`, or the absolute path `'Person.Father.Name'` accesses the `'Name'` attribute in the record referenced by the `'Father'` field (a reference attribute to table `'Person'`).

Relative paths already have a current table to which they are relative. For example in a filter expression the current table is the table for which you write the filter expression. The relative path for an attribute in the current table is simply the attribute name itself. For attributes that are not directly accessible from the current table but indirectly via a reference attribute, the same rules as for absolute paths apply.

It is not always clear if a specified path is a relative or an absolute one, e.g. suppose you are writing a filter expression for a table 'Foo' that has an attribute 'Bar' and there also exists a table 'Bar'. Now entering 'Bar' would be ambiguous, what is meant, the table or the attribute? Therefore all paths are first treated as relative ones. If no attribute is found for the specified path than the path is treated as global. In our example the attribute would be preferred.

But now, what if you want to access the table in the above example? Therefore the path must be given absolute. To indicate that a path is global you have to insert two colons in front of the path. In our example you would have to type '::Bar' for accessing the table.

To give you a better understanding of paths and their semantics, consider in our example that the 'Bar' attribute in the 'Foo' table is a reference to the 'Bar' table, and the 'Bar' table has an attribute 'Name'. Now you can access the 'Name' attribute by typing 'Bar.Name' or '::Bar.Name'. Both expressions have a different meaning. '::Bar.Name' means to take the current record of table 'Bar' and return the value of the 'Name' attribute of this record, whereas 'Bar.Name' takes the current record of table 'Foo', extracts the record reference of the 'Bar' field and uses this record for getting the value of the 'Name' attribute.

To make a more complete example, consider that table 'Bar' has two records. One that contains 'Mats' and one that contains 'Steffen' in the 'Name' field. The first record should be the current one. Furthermore table 'Foo' has one record (the current one) whose 'Bar' field refers to the second record of table 'Bar'. Now '::Bar.Name' results to 'Mats' and 'Bar.Name' to 'Steffen'.

15.3.6 Data types for programming

The programming language of MUIbase knows of the following data types:

Type	Description
Bool	all expressions. Non-NIL expressions are treated as TRUE.
Integer	long integer, 32 bit, choice values are automatically converted to integers
Real	double, 64 bit
String	strings of arbitrary length
Memo	like strings but line oriented format
Date	date values
Time	time values
Record	pointer to a record
File	file descriptor for reading/writing
List	list of items, NIL is empty list.

All programming types support the NIL value.

15.3.7 Constants

The programming language of MUIbase can handle constant expressions which can be entered depending on the type of the expression:

Type	Description																						
Integer	Integer constants in the range of -2147483648 to 2147483647 can be specified as usual.																						
Real	Floating point constants in the range of -3.59e308 to 3.59e308 can be specified as usual, in scientific or non-scientific format. If you omit the decimal point then the number may not be treated as a real number but as an integer instead.																						
String	String constants are any character strings surrounded by double quotes, e.g. "sample string". Within the double quotes you can enter any characters except control characters or new lines. However there are special escape codes for entering such characters: <table border="0" style="margin-left: 40px;"> <tr> <td style="padding-right: 20px;">\n</td> <td>new line (nl)</td> </tr> <tr> <td>\t</td> <td>horizontal tabulator (ht)</td> </tr> <tr> <td>\v</td> <td>vertical tabulator (vt)</td> </tr> <tr> <td>\b</td> <td>backspace (bs)</td> </tr> <tr> <td>\r</td> <td>carriage return (cr)</td> </tr> <tr> <td>\f</td> <td>form feed (ff)</td> </tr> <tr> <td>\\</td> <td>backslash character itself</td> </tr> <tr> <td>\"</td> <td>double quote</td> </tr> <tr> <td>\e</td> <td>escape code 033</td> </tr> <tr> <td>\nnn</td> <td>character with octal code <i>nnn</i></td> </tr> <tr> <td>\xnn</td> <td>character with hex code <i>nn</i></td> </tr> </table>	\n	new line (nl)	\t	horizontal tabulator (ht)	\v	vertical tabulator (vt)	\b	backspace (bs)	\r	carriage return (cr)	\f	form feed (ff)	\\	backslash character itself	\"	double quote	\e	escape code 033	\nnn	character with octal code <i>nnn</i>	\xnn	character with hex code <i>nn</i>
\n	new line (nl)																						
\t	horizontal tabulator (ht)																						
\v	vertical tabulator (vt)																						
\b	backspace (bs)																						
\r	carriage return (cr)																						
\f	form feed (ff)																						
\\	backslash character itself																						
\"	double quote																						
\e	escape code 033																						
\nnn	character with octal code <i>nnn</i>																						
\xnn	character with hex code <i>nn</i>																						
Memo	There are no constant values, just use a constant string instead.																						
Date	Constant date values can be specified in one of the formats 'DD.MM.YYYY', 'MM/DD/YYYY', or 'YYYY-MM-DD', where 'DD', 'MM' and 'YYYY' are standing for two and four digit values representing the day, month and year of the date respectively.																						
Time	Constant time values can be entered in the format 'HH:MM:SS', where 'HH' is a two digit value in the range of 0 to 23 representing the hours, 'MM' a two digit value in the range of 0 to 59 representing the minutes, and 'SS' a two digit value in the range of 0 to 59 representing the seconds.																						

For some other pre-defined constant values, see Section 15.23 [Pre-defined constants], page 112.

15.3.8 Command syntax

In the remainder of this chapter, you will find the description of all commands and functions available for programming MUIbase. The following syntax is used for describing the commands:

- text written in brackets `[]` is optional. If you omit the text inside the brackets then a default value is assumed.
- text separated by a vertical bar `|` denotes several options, e.g. `'a | b'` means that you can specify either `'a'` or `'b'`.
- text written in a font like *var* indicates a place-holder that can be filled with other expressions.
- dots `...` indicate that further expressions can follow.
- all other text is obligatory.

15.4 Defining commands

This section lists commands for defining functions and global variables. The commands are only available for project programs.

15.4.1 DEFUN

DEFUN defines a function with the specified name, a list of arguments that are passed to the function, and a list of expressions to evaluate.

```
(DEFUN name (varlist) expr ...)
```

The name of a function must start with a lowercase character, followed by further characters, digits or underscore characters (see Section 15.3.4 [Name conventions], page 62).

The parameters *varlist* specifies the arguments of the function:

```
varlist: var1 ...
```

where *var1* ... are the names for the arguments. The names must follow the same rules as the function name.

It is also possible to add type specifiers to the arguments (see Section 15.25 [Type specifiers], page 113).

The function executes the expressions *expr*, ... one by one and returns the value of the last expression. The function may call further functions including itself. A self defined function can be called like calling a pre-defined function.

For example to count the number of elements of a list, you can define the following function:

```
(DEFUN len (l)
  (IF (= l NIL)
    0
    (+ 1 (len (REST l))))
)
```

Functions defined with DEFUN are listed in the pop-up list-views of table and attribute requesters (see Section 14.1.1 [Creating tables], page 48 and Section 14.2.1 [Creating attributes], page 49).

This command is only available for project programs.
See also DEFUN*, DEFVAR.

15.4.2 DEFUN*

DEFUN* is the star version of DEFUN and has the same effect as DEFUN (see Section 15.4.1 [DEFUN], page 65). The only difference is that functions defined with DEFUN* are not listed in the pop-up list-views when creating or changing tables and attributes. However, it is still possible to enter the function name in the corresponding string fields.

This command is only available for project programs.
See also DEFUN, DEFVAR.

15.4.3 DEFVAR

(DEFVAR *var* [*expr*])

Defines a global variable with initial value of *expr* or NIL if *expr* is missing. The name of the variables must start with a lowercase letter followed by further letters, digits or underscore characters (see Section 15.3.4 [Name conventions], page 62).

You can also add a type specifier to the variable name (see Section 15.25 [Type specifiers], page 113).

DEFVAR is only available for project programs. All DEFVAR commands should be placed on top of all function definitions.

Example: '(DEFVAR x 42)' defines a global variable 'x' with value 42.

There are some pre-defined variables in MUIbase (see Section 15.22 [Pre-defined variables], page 111).

See also DEFUN, DEFUN*, LET.

15.5 Program control functions

This section lists functions for program control, e.g. functions for defining local variables, loop functions, conditional program execution, loop control functions and more.

15.5.1 PROGN

To evaluate several expressions one by another the PROGN construction can be used.

(*expr* ...)

executes *expr* ... one by one. Returns the result of the last expression (or NIL if no expression has been specified). In Lisp this construct is known as (PROGN [*expr* ...]).

Example: '(1 2 3 4)' results to 4.

See also PROG1.

15.5.2 PROG1

Another way, besides the PROGN function, to evaluate several expressions one by another is the PROG1 expression.

(PROG1 [*expr* ...])

executes *expr* ... and returns the value of the first expression (or NIL if no expression has been specified).

Example: '(PROG1 1 2 3 4)' results to 1.

See also PROGN.

15.5.3 LET

LET defines a new block of local variables. This is useful, e.g., for defining local variables of a function. The syntax is

```
(LET (varlist) expr ...)
```

where *varlist* is a list of local variables.

```
varlist: varspec ...
```

```
varspec: (var expr) | var
```

Here *var* is the name of the variable and must start with a lowercase character, followed by further characters, digits or underscore characters (see Section 15.3.4 [Name conventions], page 62).

In the case of a (*var expr*) specification, the new variable is initialized with the given expression. In the other case the new variable is set to NIL.

It is also possible to add type specifiers to the variables. (see Section 15.25 [Type specifiers], page 113).

After initializing all variables the list of expressions *expr ...* are evaluated and the value of the last one is returned.

For example, the following LET expression

```
(LET ((x 0) y (z (+ x 1)))
      (+ x z)
    )
```

results to 1.

See also DOTIMES, DOLIST, DO, DEFVAR.

15.5.4 SETQ

The SETQ function sets values to variables, attributes and tables.

```
(SETQ lvalue1 expr ...)
```

Sets *lvalue1* to the value of *expr*. The dots indicate assignments for further lvalues. An lvalue is either a variable, an attribute in a table, or a table. In case of a variable, the variable must have been previously defined (e.g. by a LET expression).

Setting the value of a table means setting its program or gui record pointer: '(SETQ *Table expr*)' sets the program record pointer of *Table* to the value of *expr*, '(SETQ *Table* expr*)' sets the gui record pointer of it and updates the display. For more information about program and gui record pointers, see Section 5.2 [Tables], page 16.

SETQ returns the value of the last expression.

Example: '(SETQ a 1 b 2)' assigns 1 to the variable 'a', 2 to the variable 'b' and returns 2.

See also SETQ*, LET, DEFVAR, Tables, Semantics of expressions.

15.5.5 SETQ*

SETQ* is the star version of SETQ (see Section 15.5.4 [SETQ], page 67) and has similar effects. The difference is that when assigning a value to an attribute, SETQ* calls the trigger function of that attribute (see Section 15.27.7 [Attribute trigger], page 117) instead of directly assigning the value. In case no trigger function has been specified for an attribute, SETQ* behaves like SETQ and simply assigns the value to the attribute.

Example: '(SETQ* Table.Attr 0)' calls the trigger function of 'Table.Attr' with an argument of 0.

Warning: With this function it is possible to write endless loops, e.g. if you have defined a trigger function for an attribute and this function calls **SETQ*** to set a value to itself.

See also **SETQ***, **LET**, **DEFVAR**.

15.5.6 FUNCALL

FUNCALL is used to call a function.

```
(FUNCALL fun-expr [expr ...])
```

Calls the function *fun-expr* with the given arguments. The expression *fun-expr* can be any expression whose value is a pre-defined or user-defined function, e.g. a variable holding the function to call. If the number of arguments is not correct, an error message is generated.

FUNCALL returns the return value of the function call or **NIL** if *fun-expr* is **NIL**.

For more information about functional expressions, see Section 15.24 [Functional parameters], page 112.

15.5.7 IF

IF is a conditional operator.

```
(IF expr1 expr2 [expr3])
```

The expression *expr1* is tested. If it results to non-**NIL** then the value of *expr2* is returned else the value of *expr3* (or **NIL** if not present) is returned.

This function is not strict, that is, only one expression of *expr2* or *expr3* will be evaluated.

See also **CASE**, **COND**.

15.5.8 CASE

CASE is similar to the **switch** statement in the C language.

```
(CASE expr [case ...])
```

Here *expr* is the selection expression and *case ...* are pairs consisting of:

```
case: (value [expr ...])
```

where *value* is a single expression or a list of expressions and *expr ...* are the expressions to be executed if one of the case expression matches.

The **CASE** expression first evaluates *expr*. Then each case pair is checked whether it (or one of the expressions in the list) matches the evaluated expression. If a matching case expression is found then the corresponding expressions are executed and the value of the last expression is returned. If no case matches, **NIL** is returned.

Example: '(CASE 1 ((2 3 4) 1) (1 2))' returns 2.

See also **IF**, **COND**.

15.5.9 COND

COND is, like **IF**, a conditional operator.

```
(COND [(test-expr [expr ...]) ...])
```

COND test the first expression of each list one by one. For the first one that does not result to **NIL**, the corresponding expressions *expr ...* are evaluated and the value of the last expression is returned.

If all tested expressions result to **NIL** then **NIL** is returned.

Example

```
(COND ((> 1 2) "1 > 2")
      ((= 1 2) "1 = 2")
      ((< 1 2) "1 < 2")
      )
```

results to "1 < 2".

See also IF, CASE.

15.5.10 DOTIMES

For simple loops the DOTIMES command can be used.

```
(DOTIMES (name int-expr [result-expr ...]) [loop-expr ...])
```

Here *name* is the name of a new variable which will be used in the loop. The name must start with a lowercase character, followed by further characters, digits or underscore characters (see Section 15.3.4 [Name conventions], page 62).

The number of times the loop is executed is given in *int-expr*. In *result-expr ...* expressions can be specified that are executed after terminating the loop. In *loop-expr* you specify the body of the loop, that is, the expressions that are evaluated in each loop run.

Before executing the loop, DOTIMES computes the value of *int-expr* to determine the number of times the loop gets executed. Here *int-expr* is evaluated only once at the start of the loop and must result to an integer value. Then DOTIMES sets the loop variable to the values of 0 to *int-expr*-1 one by one for each loop run. First, the variable is initialized with zero and checked if it is already greater or equal to the value of *expr*. If *int-expr* is negative or NIL or if the variable is greater or equal to the value of *expr* then the loop is terminated and the result expressions are evaluated. Otherwise the loop expressions are evaluated and the variable is incremented by one. Then the execution returns to the termination test and, possibly, does further loop runs.

The DOTIMES expression returns the value of the last result expression or NIL if no result expression has been given.

Example

```
(DOTIMES (i 50 i) (PRINT i))
```

Prints the numbers from 0 to 49 and returns the value 50.

See also DOLIST, DO, FOR ALL, LET.

15.5.11 DOLIST

For loops through lists the DOLIST expression can be used.

```
(DOLIST (name list-expr [result-expr ...]) [loop-expr ...])
```

Here *name* is the name of a new variable which will be used in the loop. The name must start with a lowercase character, followed by further characters, digits or underscore characters (see Section 15.3.4 [Name conventions], page 62).

In *list-expr* you specify the list over which the loop should be executed, *result-expr ...* are expressions which are evaluated after terminating the loop, end *loop-expr ...* build the body of the loop.

Before executing the loop, DOLIST computes the value of *list-expr*. This expression is evaluated only once at the start of the loop and must result to a list value. Then DOTIMES sets the loop variable to the nodes of the list one by one for each loop run. First the loop variable is initialized to the first node of the list. If the list is already empty (NIL) then the loop is terminated

and the result expressions are evaluated. Otherwise the loop expressions are evaluated and the variable is set to the next node of the list. Then the execution returns to the termination test and, possibly, does further loop runs.

The DOLIST expression returns the value of the last result expression or NIL if no result expression has been given.

Example

```
(DOLIST (i (SELECT * FROM Accounts)) (PRINT i))
```

Prints all records of table 'Accounts' and returns NIL.

See also DOTIMES, DO, FOR ALL, LET.

15.5.12 DO

With the DO expression arbitrary loops can be programmed.

```
(DO ([binding ...]) (term-expr [result-expr ...]) [loop-expr ...])
```

where *binding ...* are the variable bindings, each of which is either:

- a new name for a variable (which is initialized to NIL)
- a list of the form: (*name init [step]*) where *name* is a name for the new variable, *init* is the initial value of the variable, and *step* is a step expression.

Furthermore, *term-expr* is the termination test expression, *result-expr ...* are the result expressions (the default is nil) and *loop-expr ...* build the body of the loop.

The DO loop first initializes all local variables with the init expressions, then tests the termination expression. If it results to TRUE, the loop is terminated and the result expressions are evaluated. The value of the last result expression is returned. Otherwise the body of the loop (*loopexpr ...*) is executed and each variable is updated by the value of its step expression. Then the execution returns to test the terminating expression and so on.

Example

```
(DO ((i 0 (+ i 1))) ((>= i 5) i) (PRINT i))
```

Prints the values 0, 1, 2, 3 and 4 and returns the value 5. Of course this is a quite complicated way to build a simple FOR loop. Therefore a simpler version exists, the DOTIMES expression.

See also DOTIMES, DOLIST, FOR ALL, LET.

15.5.13 FOR ALL

The FOR ALL expression is used to loop over a list of records.

```
(FOR ALL table-list [WHERE where-expr] [ORDER BY order-list] DO expr ...)
```

Here *table-list* is a comma-separated list of tables, *where-expr* an expression to test each set of records, *order-list* a comma-separated list of expressions by which the record sets are ordered, and *expr ...* are the expressions that are executed for each record set.

FOR ALL first generates a list of all record sets for which the loop body should be executed. This is done like in the SELECT expression. Please see Section 15.18.12 [SELECT], page 107, for more information about how this list is generated. For each element of this list the loop body *expr ...* is executed.

For example, summing up an attribute of a table can be done in the following way:

```
(SETQ sum 0)
(FOR ALL Accounts DO
  (SETQ sum (+ sum Accounts.Amount))
)
```

The FOR ALL expression returns NIL.

See also SELECT, DOTIMES, DOLIST, DO.

15.5.14 NEXT

NEXT can be used for controlling DOTIMES, DOLIST, DO and FOR ALL loops.

Calling NEXT in the body of a loop will jump to the next loop iteration. This can be used for skipping non-interesting loop runs, like e.g. in the following example:

```
(FOR ALL Table DO
  (IF not-interested-in-the-current-record (NEXT))
  ...
)
```

See also EXIT, DOTIMES, DOLIST, DO, FOR ALL.

15.5.15 EXIT

EXIT can be used to terminate a loop.

```
(EXIT [expr ...])
```

EXIT within a loop body will terminate the loop, execute the optional expressions *expr ...*, and return the value of the last expression (or NIL in case of no expression) as the return value of the loop. Possible return expressions of the loop as for example in

```
(DOTIMES (x 10 ret-expr ...) ...)
```

are not executed.

You may use the EXIT function for example to end a FOR ALL loop when you found the record you are interested in:

```
(FOR ALL Table DO
  (IF interested-in-the-current-record (EXIT Table))
  ...
)
```

See also NEXT, RETURN, HALT, DOTIMES, DOLIST, DO, FOR ALL.

15.5.16 RETURN

Within a function definition you can return to the caller by using the RETURN command.

```
(RETURN [expr ...])
```

terminates the function, executes the optional expressions *expr ...*, and returns the value of the last expression (or NIL in case of no expression).

Example

```
(DEFUN find-record (name)
  (FOR ALL Table DO
    (IF (= Name name) (RETURN Table))
  )
)
```

The example searches a record whose Name attribute matches the given name. The function returns the first record found or NIL in case of no record found.

See also HALT, EXIT.

15.5.17 HALT

HALT can be used to terminate program execution.

(HALT)

stops program execution silently.

See also ERROR, EXIT, RETURN.

15.5.18 ERROR

For aborting program execution with an error message the ERROR function can be used.

(ERROR *fmt* [*arg* ...])

stops program execution and pops up a requester with an error message. The error message is generated from *fmt* and the optional arguments *arg* ... like in the SPRINTF function (see Section 15.11.28 [SPRINTF], page 86).

See also HALT, SPRINTF.

15.6 Type predicates

For each type a predicate is defined that returns TRUE if the supplied expression is of the specified type and NIL otherwise. The predicates are:

Predicate	Description
(STRP <i>expr</i>)	TRUE if <i>expr</i> is of type string, NIL otherwise.
(MEMOP <i>expr</i>)	TRUE if <i>expr</i> is of type memo, NIL otherwise.
(INTP <i>expr</i>)	TRUE if <i>expr</i> is of type integer, NIL otherwise.
(REALP <i>expr</i>)	TRUE if <i>expr</i> is of type real, NIL otherwise.
(DATEP <i>expr</i>)	TRUE if <i>expr</i> is of type date, NIL otherwise.
(TIMEP <i>expr</i>)	TRUE if <i>expr</i> is of type time, NIL otherwise.
(NULLP <i>expr</i>)	TRUE if <i>expr</i> is NIL (an empty list), NIL otherwise.
(CONSP <i>expr</i>)	TRUE if <i>expr</i> is a non-empty list, NIL otherwise.
(LISTP <i>expr</i>)	TRUE if <i>expr</i> is a list (may be NIL), NIL otherwise.
(RECP <i>table expr</i>)	TRUE if <i>expr</i> is a record pointer of the given table. If <i>expr</i> is NIL then TRUE is returned (initial record). If <i>table</i> is NIL then a check is done whether <i>expr</i> is a record pointer of any table.

15.7 Type conversion functions

This section lists functions for converting values from one type to another one.

15.7.1 STR

STR can be used to convert an expression into a string representation.

(STR *expr*)

converts *expr* into a string representation. The type of *expr* determines the conversion:

Type	Return string
String	The string itself.
Memo	The whole memo text in one string.
Integer	String representation of integer value.
Real	String representation of real value. If <i>expr</i> is an attribute then the number decimals specified for this attribute are used, otherwise 2 decimals are used.
Choice	Label string of the choice attribute.
Date	String representation of date value.
Time	String representation of time value.
Bool	The string "TRUE"
NIL	User defined nil string if <i>expr</i> is an attribute, the string "NIL" otherwise.
Record	String representation of record number.
Others	String representation of internal address pointer.

See also MEMO, SPRINTF.

15.7.2 MEMO

MEMO can be used to convert an expression into a memo.

(MEMO *expr*)

converts *expr* into a memo representation. It treats the expression like the STR function (see Section 15.7.1 [STR], page 73) but returns a memo text instead of a string.

See also STR.

15.7.3 INT

INT is used to convert an expression into an integer.

(INT *expr*)

converts *expr* into an integer value. Possible conversions are:

Type	Return value
String	If the whole string represents an integer value then the string is converted into an integer. Leading and following spaces are ignored. If it does not represent an integer value, NIL is returned.
Memo	Same as for string.
Integer	The value itself.
Real	If the value lies within the integer range than the real value is rounded and returned, otherwise NIL is returned.
Choice	The internal number (starting with 0) of the current label.
Date	Number of days since 01.01.0000.
Time	Number of seconds since 00:00:00.
Record	Record number.
NIL	NIL
Others	An error message is generated and program execution is aborted.

See also REAL, ASC.

15.7.4 REAL

REAL is used to convert an expression into a value of type real.

(REAL *expr*)

converts *expr* into a real. It treats the expression like the INT function (see Section 15.7.3 [INT], page 73) but returns a value of type real instead of an integer.

See also INT.

15.7.5 DATE

DATE is used to convert an expression into a date (with your best girl friend :-).

(DATE *expr*)

converts the given expression into a date (only one date guys, needs two good girl friends for getting more dates!) Possible conversions are:

Type	Return value
String	If the whole string represents a date value then the string is converted into a date value. Leading and following spaces are ignored.

	If it does not represent a date value, NIL is returned.
Memo	Same as for string.
Integer	A date value is generated where the given integer represents the number of days since 01.01.0000. If the integer value is too great (date value would be greater than 31.12.9999) or negative then NIL is returned.
Real	Same as for integer.
Date	The value itself.
NIL	NIL
others	An error message is generated and program execution is aborted.

15.7.6 TIME

TIME is used to convert an expression into a time value.

(TIME *expr*)

converts the given expression into a time value. Possible conversions are:

Type	Return value
String	If the whole string represents a time value then the string is converted into a time value. Leading and following spaces are ignored. If it does not represent a time value, NIL is returned.
Memo	Same as for string.
Integer	A time value is generated where the given integer represents the number of seconds since 00:00:00. The integer value is taken modulo the number of seconds per day, e.g. '(TIME 86400)' results to 00:00:00.
Real	Same as for integer.
Time	The value itself.
NIL	NIL
others	An error message is generated and program execution is aborted.

15.8 Boolean functions

This section lists boolean operators.

15.8.1 AND

AND checks if all of its arguments are TRUE.

```
(AND [expr ...])
```

checks *expr* ... one by another until one expression evaluates to NIL. If all expressions evaluate to non-NIL then the value of the last expression is returned. Otherwise NIL is returned.

This function is non-strict which means that arguments of AND may not be evaluated, e.g. in '(AND NIL (+ 1 2))' the expression '(+ 1 2)' is not evaluated since a NIL value has already been processed, however in '(AND (+ 1 2) NIL)' the expression '(+ 1 2)' gets evaluated.

See also OR, NOT.

15.8.2 OR

OR checks if all of its arguments are NIL.

```
(OR [expr ...])
```

checks *expr* ... one by another until one expression evaluates to non-NIL. Returns the value of the first non-NIL expression or NIL if all expressions evaluate to NIL.

This function is non-strict which means that arguments of OR may not be evaluated, e.g. in '(OR TRUE (+ 1 2))' the expression '(+ 1 2)' is not evaluated since a non-NIL value (here 'TRUE') has already been processed, however in '(OR (+ 1 2) TRUE)' the expression '(+ 1 2)' gets evaluated.

See also AND, NOT.

15.8.3 NOT

NOT is used to invert the value of a boolean expression.

```
(NOT expr)
```

results to TRUE if *expr* is NIL, NIL otherwise.

See also AND, OR.

15.9 Comparison functions

In this section you will find functions for comparing values.

15.9.1 Relational operators

For comparing two values in a MUIbase program, use

```
(op expr1 expr2)
```

where *op* is in {=, <, >, >=, <=, =*, <>*, <*, >*, >=*, <=*}. The star is used for special comparison (strings are compared case insensitive, records are compared by using the order defined by the user).

The following table shows all rules for comparing two values in a MUIbase program.

Type	Order relation
Integer	NIL < MIN_INT < ... < -1 < 0 < 1 < ... < MAX_INT
Real	NIL < -HUGE_VAL < ... < -1.0 < 0.0 < 1.0 < ... < HUGE_VAL
String:	NIL < "" < "Z" < "a" < "aa" < "b" < ... (case sensitive)

```

NIL <* "" <* "a" <* "AA" <* "b" < ...      (case insensitive)

Memo:      same as string

Date       NIL < 1.1.0000 < ... < 31.12.9999

Time       NIL < 00:00:00 < ... < 23:59:59

Bool       NIL < TRUE

Record:    NIL < any_record    (records itself are not comparable with <)
           NIL <* rec1 <* rec2 (order specified by user)

```

See also CMP, CMP*, LIKE.

15.9.2 CMP

CMP returns an integer representing the order of its arguments.

```
(CMP expr1 expr2)
```

returns a value less than 0 if *expr1* is smaller than *expr2*, 0 if *expr1* is equal to *expr2*, and a value greater than 0 if *expr1* is greater than *expr2*. For determining the order the simple (non-star) order relation as for relational operators (see Section 15.9.1 [Relational operators], page 76) is used.

Do not assume that the returned value will always be -1, 0, or 1!

Example: '(CMP "Bike" "bIKE")' results to -32.

See also CMP*, Relational operators.

15.9.3 CMP*

CMP* is the star version of CMP. The difference is that CMP* uses the extended ordering as defined for relational operators (see Section 15.9.1 [Relational operators], page 76) where strings are compared case insensitive and records are compared using the user defined record order.

Example: '(CMP* "Bike" "bIKE")' results to 0.

See also CMP, Relational operators.

15.10 Mathematical functions

Here, some mathematical functions are listed.

15.10.1 Adding values

For adding values, use

```
(+ expr ...)
```

Returns the sum of the arguments *expr* If any argument value is NIL then the result is NIL. If the values are of type real or integer then a real (or integer) value is the result.

You may also add strings or memos. In this case the result is the concatenation of the strings/memos.

If *expr* is of type date and the rest of the arguments are integers/real then the sum of integers/real are interpreted as a number of days and added to *expr*. If the resulting date is out of range (smaller than 1.1.0000 or greater than 31.12.9999) then NIL is the result.

If *expr* is of type time and the rest of the arguments are integers/real then the sum of integers/real are interpreted as a number of seconds and added to *expr*. However the rest of the arguments can also consist of expressions of type time. The resulting time value is computed modulo 24:00:00.

Examples

Expression	Value
(+ 1 2 3)	6
(+ 5 1.0)	6.0
(+ "Hello" " " "world!")	"Hello world!"
(+ 28.11.1968 +365 -28 -9)	22.10.1969
(+ 07:30:00 3600)	08:30:00
(+ 03:00:00 23:59:59)	02:59:59

See also -, 1+, *, CONCAT, CONCAT2.

15.10.2 Subtracting values

For subtracting values, use

```
(- expr1 expr2 ...)
```

Subtracts the sum of *expr2* ... from *expr1*. Here the same rules apply as for adding values (see Section 15.10.1 [add], page 77), except that strings and memos can't be subtracted.

(- *expr*) has a special meaning, it returns the negative value of *expr* (integer or real), e.g. '(- (+ 1 2))' results to -3.

See also +, 1-.

15.10.3 1+

1+ increases an integer or real expression by one.

```
(1+ expr)
```

Returns the value of *expr* (integer or real) plus one. If *expr* is NIL then NIL is returned.

See also +, 1-.

15.10.4 1-

1- decreases an integer or real expression by one.

```
(1- expr)
```

Returns the value of *expr* (integer or real) minus one. If *expr* is NIL then NIL is returned.

See also -, 1+.

15.10.5 Multiplying values

For multiplying integer/real values, use

```
(* expr ...)
```

Returns the multiplication of the integer/real values *expr* If all arguments are integers then an integer is returned, otherwise the result is a value of type real.

See also +, /.

15.10.6 Dividing values

For dividing integer/real values, use

```
(/ expr1 [expr2 ...])
```

Divides *expr1* by the multiplication of the rest of the arguments. Returns a real value. On division by zero, NIL is returned.

See also *, DIV, MOD.

15.10.7 DIV

DIV is used for integer division.

```
(DIV int1 int2)
```

Returns the integer division of *int1* with *int2*. For example, '(DIV 5 3)' results to 1.

See also /, MOD.

15.10.8 MOD

MOD is used for modulo calculation.

```
(MOD int1 int2)
```

Returns *int1* modulo *int2*. For example, '(MOD 5 3)' results to 2.

See also DIV.

15.10.9 MAX

MAX returns the argument that has the largest value.

```
(MAX expr ...)
```

Returns the maximum value of the arguments *expr* . . . (all integers or reals). If one of the expressions is NIL then NIL is returned.

See also MIN.

15.10.10 MIN

MIN returns the argument that has the smallest value.

```
(MIN expr ...)
```

Returns the minimum value of the arguments *expr* . . . (all integers or reals). If one of the expressions is NIL then NIL is returned.

See also MAX.

15.10.11 ABS

ABS computes the absolute value of an expression.

```
(ABS expr)
```

Returns the absolute value of *expr* (integer or real). If *expr* is NIL then NIL is returned.

15.10.12 TRUNC

TRUNC truncates decimals of a real value.

(TRUNC *real*)

Returns the largest integer (as a real number) not greater than the specified real number. If *real* is NIL then NIL is returned.

Examples: '(TRUNC 26.1)' results to 26, '(TRUNC -1.2)' results to -2.

See also ROUND.

15.10.13 ROUND

ROUND rounds a real value.

(ROUND *real digits*)

Returns the specified real number rounded to *digits* decimal digits. If *real* or *digits* are NIL then NIL is returned.

Examples: '(ROUND 70.70859 2)' results to 70.71, '(ROUND 392.36 -1)' results to 392.0.

See also TRUNC.

15.10.14 RANDOM

RANDOM can be used to generate random numbers.

(RANDOM *expr*)

Returns a random number. On the first call the random number generator is initialized with a value generated from the current time. RANDOM generates a random number in the range of 0 ... *expr*, excluding the value of *expr* itself. The type of *expr* (integer or real) is the return type. If *expr* is NIL then NIL is returned.

Examples:

Example	Meaning
(RANDOM 10)	returns a value from 0 to 9,
(RANDOM 10.0)	returns a value from 0.0 to 9.99999...

15.11 String functions

This section deals with functions useful for strings.

15.11.1 LEN

LEN computes the length of a string.

(LEN *str*)

Returns the length of the given string or NIL if *str* is NIL.

See also WORDS, LINES, MAXLEN.

15.11.2 LEFTSTR

LEFTSTR extracts a sub string out of a string.

(LEFTSTR *str len*)

Returns the left part of the given string with at most *len* characters. If *str* or *len* are NIL or if *len* is negative then NIL is returned.

Example: '(LEFTSTR "Hello world!" 5)' results to "Hello".

See also RIGHTSTR, MIDSTR, WORD, LINE.

15.11.3 RIGHTSTR

RIGHTSTR extracts a sub string out of a string.

(RIGHTSTR *str len*)

Returns the right part of the given string with at most *len* characters. If *str* or *len* are NIL or if *len* is negative then NIL is returned.

Example: '(RIGHTSTR "Hello world!" 6)' results to "world!".

See also LEFTSTR, MIDSTR, WORD, LINE.

15.11.4 MIDSTR

MIDSTR extracts a sub string out of a string.

(MIDSTR *str pos len*)

Returns a part of the given string with at most *len* characters. If *len* is NIL then the number of returning characters is not restricted. The sub string starts at the *pos*-th position (starting with zero). If *str* or *len* are NIL or if *len* is negative then NIL is returned. If *pos* is out of range, that is, negative or greater than the string length, NIL is returned.

Example: '(MIDSTR "Hello world!" 3 5)' results to "lo wo".

See also LEFTSTR, RIGHTSTR, WORD, LINE, SETMIDSTR, INSMIDSTR.

15.11.5 SETMIDSTR

SETMIDSTR replaces a sub string in a string.

(SETMIDSTR *str index set*)

Returns a copy of string *str* where the sub string starting at *index* is overwritten with string *set*. The length of the returned string is greater or equal to the length of *str*. If one of the arguments is NIL or if *index* is out of range then NIL is returned.

Example: '(SETMIDSTR "Hello world!" 6 "Melanie!)"' results to "Hello Melanie!".

See also INSMIDSTR, REPLACESTR.

15.11.6 INSMIDSTR

INSMIDSTR is used to insert a sub string into a string.

(INSMIDSTR *str index insert*)

Returns a copy of string *str* where the string *insert* has been inserted at the given index. If one of the arguments is NIL or if *index* is out of range then NIL is returned.

Example: '(INSMIDSTR "Hello world!" 6 "MUIbase-")' results to "Hello MUIbase-world!".

See also SETMIDSTR, REPLACESTR.

15.11.7 INDEXSTR

INDEXSTR searches a string for the first occurrence of a sub string.

(INDEXSTR *str substr*)

Searches for the first occurrence of *substr* in *str*. String comparison is done case-sensitive. Returns the index (starting with 0) of the sub string in *str* or NIL if the sub string is not present. If one of the arguments is NIL then NIL is returned.

Example: '(INDEXSTR "Hello world!" "world")' returns 6.

See also INDEXSTR*, RINDEXSTR, RINDEXSTR*, INDEXBRK, INDEXBRK*.

15.11.8 INDEXSTR*

INDEXSTR* has the same effect as INDEXSTR (see Section 15.11.7 [INDEXSTR], page 82) except that string comparison is done case-insensitive.

See also INDEXSTR, RINDEXSTR, RINDEXSTR*, INDEXBRK, INDEXBRK*.

15.11.9 INDEXBRK

INDEXBRK searches for the first occurrence of a character in a string.

(INDEXBRK *str brkstr*)

Searches for the first occurrence of a character from *brkstr* in *str*. String comparison is done case-sensitive. Returns the index (starting with 0) of the first character found in *str* or NIL if no character is found. If one of the arguments is NIL then NIL is returned.

Example: '(INDEXBRK "Hello world!" "aeiou")' returns 1.

See also INDEXBRK*, RINDEXBRK, RINDEXBRK*, INDEXSTR, INDEXSTR*.

15.11.10 INDEXBRK*

INDEXBRK* has the same effect as INDEXBRK (see Section 15.11.9 [INDEXBRK], page 82) except that string comparison is done case-insensitive.

See also INDEXBRK, RINDEXBRK, RINDEXBRK*, INDEXSTR, INDEXSTR*.

15.11.11 RINDEXSTR

RINDEXSTR searches a string for the last occurrence of a sub string.

(RINDEXSTR *str substr*)

Searches for the last occurrence of *substr* in *str*. String comparison is done case-sensitive. Returns the index (starting with 0) of the sub string in *str* or NIL if the sub string is not present. If one of the arguments is NIL then NIL is returned.

Example: '(RINDEXSTR "Do itashimashite." "shi")' returns 11.

See also RINDEXSTR*, INDEXSTR, INDEXSTR*, RINDEXBRK, RINDEXBRK*.

15.11.12 RINDEXSTR*

RINDEXSTR* has the same effect as RINDEXSTR (see Section 15.11.11 [RINDEXSTR], page 82) except that string comparison is done case-insensitive.

See also RINDEXSTR, INDEXSTR, INDEXSTR*, RINDEXBRK, RINDEXBRK*.

15.11.13 RINDEXBRK

RINDEXBRK searches for the last occurrence of a character in a string.

```
(RINDEXBRK str brkstr)
```

Searches for the last occurrence of a character from *brkstr* in *str*. String comparison is done case-sensitive. Returns the index (starting with 0) of the last character found in *str* or NIL if no character is found. If one of the arguments is NIL then NIL is returned.

Example: '(RINDEXBRK "Konnichiwa" "chk")' returns 6.

See also RINDEXBRK*, INDEXBRK, INDEXBRK*, RINDEXSTR, RINDEXSTR*.

15.11.14 RINDEXBRK*

RINDEXBRK* has the same effect as RINDEXBRK (see Section 15.11.13 [RINDEXBRK], page 83) except that string comparison is done case-insensitive.

See also RINDEXBRK, INDEXBRK, INDEXBRK*, RINDEXSTR, RINDEXSTR*.

15.11.15 REPLACESTR

REPLACESTR replaces sub strings by other strings.

```
(REPLACESTR str substr replacestr)
```

Replaces all occurrences of *substr* in *str* by *replacestr*. If any of the strings are NIL or *substr* is empty then NIL is returned.

Example: '(REPLACESTR "From Freiburg to San Francisco" "Fr" "X")' results to "Xom Xeiburg to San Xancisco".

See also SETMIDSTR, INSMIDSTR, REMCHARS.

15.11.16 REMCHARS

REMCHARS removes characters from a string.

```
(REMCHARS str chars-to-remove)
```

Returns a copy of *str* where all characters of *chars-to-remove* are removed from. If *str* or *chars-to-remove* are NIL then NIL is returned.

Example: '(REMCHARS *your-string* "\t\n")' removes all spaces, tabs and newline characters from *your-string*.

See also REPLACESTR, TRIMSTR.

15.11.17 TRIMSTR

TRIMSTR removes leading and trailing spaces from a string.

```
(TRIMSTR str)
```

Returns a copy of *str* where all leading and trailing spaces have been removed.

Example: (TRIMSTR " I wrecked Selma's bike. ") results to "I wrecked Selma's bike."

See also REMCHARS.

15.11.18 WORD

WORD returns a word of a string.

(WORD *str num*)

Returns the *num*-th word (starting with zero) of the given string. Words in a string are non-empty sub strings separated by space-like characters (e.g. space, tab or newline characters).

If *str* or *num* are NIL, or if *num* is out of range, that is, less than zero or greater or equal to the number of words, then NIL is returned.

Example: '(WORD "Therefore, I lend Selma my bike." 3)' results to "Selma".

See also WORDS, LINE, LEFTSTR, RIGHTSTR, MIDSTR.

15.11.19 WORDS

WORDS counts the number of words in a string.

(WORDS *str*)

Returns the number of words of the given string or NIL if *str* is NIL. Words are sub strings separated by space-like characters (e.g. space, tab, or newline characters).

Example: '(WORDS "Actually, it wasn't really my bike.")' results to 6.

See also WORD, LINES, LEN.

15.11.20 CONCAT

CONCAT concatenates strings.

(CONCAT [*str ...*])

Returns the concatenation of the given list of strings where space characters have been inserted between the strings. If one of the strings is NIL, or the list is empty, then NIL is returned.

Example: '(CONCAT "I" "thought" "it" "was" "an" "abandoned" "bike.")' results to "I thought it was an abandoned bike."

See also CONCAT2, +, COPYSTR, SPRINTF.

15.11.21 CONCAT2

CONCAT2 concatenates strings.

(CONCAT2 *insert* [*str ...*])

Returns the concatenation of the given list of strings. The strings will be separated with the given *insert* string. If *insert* is NIL, one of the strings is NIL, or the list is empty, then NIL is returned.

Example: '(CONCAT2 "! " "But" "it" "wasn't!")' results to "But! it! wasn't!".

See also CONCAT, +, COPYSTR, SPRINTF.

15.11.22 COPYSTR

COPYSTR creates copies of a string.

(COPYSTR *str num*)

Returns a string consisting of *num* times the string *str*. If *str* is NIL, *num* is NIL or less than zero, NIL is returned.

Example: '(COPYSTR "+-" 5)' results to "+-+--+--+-"

See also CONCAT, CONCAT2, +, SPRINTF.

15.11.23 UPPER

UPPER converts a string to upper case.

(UPPER *str*)

Returns a copy of the given string where all characters are converted to upper case. If *str* is NIL then NIL is returned.

Example: '(UPPER "Selma found a letter attached to my bike.")' results to "SELMA FOUND A LETTER ATTACHED TO MY BIKE."

See also LOWER.

15.11.24 LOWER

LOWER converts a string to lower case.

(LOWER *str*)

Returns a copy of the given string where all characters are converted to lower case. If *str* is NIL then NIL is returned.

Example: '(LOWER "The letter was from Silke.")' results to "the letter was from silke."

See also UPPER.

15.11.25 ASC

ASC converts a character to its ASCII code.

(ASC *str*)

Returns the ASCII code of the first character of *str*. If *str* is empty, 0 is returned. If *str* is NIL, NIL is returned.

Example: (ASC "A") results to 65.

See also CHR, INT.

15.11.26 CHR

CHR converts an ASCII code to a character.

(CHR *int*)

Returns a string containing the character with ASCII code *int*. If *int* is 0, an empty string is returned. If *int* is NIL or not in the range of ASCII characters (0..255) then NIL is returned.

Example: '(CHR 67)' results to "C".

See also ASC, STR.

15.11.27 LIKE

LIKE compares strings.

(LIKE *str1 str2*)

Returns TRUE if *str1* matches *str2*, NIL otherwise. The string *str2* may contain the joker characters '?' and '*' where '?' matches exactly one character and '*' matches a string of any length. String comparison is done case insensitive.

Example: '(LIKE "Silke has been in France for one year." "*France*")' results to TRUE.

See also Comparison functions.

15.11.28 SPRINTF

SPRINTF formats a string with various data.

(SPRINTF *fmt* [*expr* ...])

SPRINTF takes a series of arguments, converts them to strings, and returns the formatted information as one string. The string *fmt* determines exactly what gets written to the return string and may contain two types of items: ordinary characters which are always copied verbatim and conversion specifiers which direct SPRINTF to take arguments from its argument list and format them. Conversion specifiers always begin with a ‘%’ character.

Conversion specifiers always take the following form:

%[*flags*] [*width*] [. *precision*] *type*

where

- The optional *flags* field controls output justification, sign character on numerical values, decimal points, and trailing blanks.
- The optional *width* field specifies the minimum number of characters to print (the field width), with padding done with blanks or zeros.
- The optional *precision* field specifies either the minimum number of digits to be printed for types integer, string, bool, date and time, or the number of characters after the decimal point to be printed for values of type real.
- The *type* field specifies the actual type of the argument that SPRINTF will be converting, such as string, integer, real, etc.

Note that all of the above fields are optional except for *type*. The following tables list the valid options for these fields.

Flags field

- : The result is left justified, with padding done on the right using blanks. By default when ‘-’ is not specified, the result is right justified with padding on the left with ‘0’'s or blanks.
- +: The result will always have a ‘-’ or ‘+’ character prepended to it if it is a numeric conversion.
- space*: Positive numbers begin with a space instead of a ‘+’ character, but negative values still have a prepended ‘-’.

Width field

- n*: A minimum of *n* characters are output. If the conversion has less than *n* characters, the field is padded with blanks.
- *: The width specifier is supplied in the argument list as an integer or real value, before the actual conversion argument. This value is limited to the range of 0 to 999.

Precision field

- .*n*: For integer, string, bool, date and time values, *n* is the number of characters written from the converted item. For conversions of real values, *n* specifies the number of digits after the decimal point.
- .*: The precision is supplied in the argument list as an integer or real value, before the actual conversion argument. This value is limited to the range of 0 to 999.

Type field

- b: Converts a bool parameter to "TRUE" or "NIL".
- i: Converts an integer value.
- e: Converts a real number using the format [-]d.ddde+dd. Exactly one digit is before the decimal point, followed by an 'e', followed by an exponent. The number of digits after the decimal point is determined by the precision field, or is 2 if precision is not specified. The decimal point will not appear if precision is 0.
- f: Converts a real value using the format [-]ddd.ddd. The number of digits after the decimal point is determined by the precision field, or is 2 if precision is not specified. The decimal point will not appear if precision is 0.
- s: Writes a string value until either the end of string is reached or the number of characters written equals the precision field.
- d: Converts a date value.
- t: Converts a time value.
- %: The character '%' is written, and no argument is converted.

SPRINTF returns the formatted string or NIL in case *fmt* is NIL.

Examples

Call	Result
(SPRINTF "Hello")	"Hello"
(SPRINTF "%s" "Hello")	"Hello"
(SPRINTF "%10s" "Hello")	" Hello"
(SPRINTF "%-10.10s" "Hello")	"Hello "
(SPRINTF "%010.3s" "Hello")	" Hello"
(SPRINTF "%-5.3b" TRUE)	"TRU "
(SPRINTF "%i" 3)	"3"
(SPRINTF "%03i" 3)	"003"
(SPRINTF "% 0+- 5.3i" 3)	" 003 "
(SPRINTF "%f" 12)	"12.00"
(SPRINTF "%10e 12.0)	" 1.20e+1"
(SPRINTF "%+-10.4f" 12.0)	"+12.0000 "
(SPRINTF "%10.5t" 12:30:00)	" 12:30"
(SPRINTF "%d" 28.11.1968)	"28.11.1968"
(SPRINTF "He%s %5.5s!" "llo" "world champion ship")	"Hello world!"

See also PRINTF, FPRINTF, STR, +, CONCAT, CONCAT2, COPYSTR.

15.12 Memo functions

This section deals with functions useful for memos.

15.12.1 LINE

LINE extracts a line in a memo.

(LINE *memo num*)

Returns the *num*-th line (starting with zero) of the given memo. The line string will not have a terminating newline character. If *memo* or *num* are NIL or if *num* is out of range, that is, less than zero or greater or equal to the number of lines, then NIL is returned.

See also LINES, WORD.

15.12.2 LINES

LINES returns the number of lines in a memo.

(LINES *memo*)

Returns the number of lines of the given memo or NIL if *memo* is NIL.

See also LINE, WORDS, LEN.

15.12.3 MEMOTOLIST

MEMOTOLIST converts a memo to a list of strings.

(MEMOTOLIST *memo*)

Converts the given memo to a list. If *memo* is NIL then NIL is returned, otherwise a list is generated where each element contains one line of the memo.

Example: '(MEMOTOLIST "My insurance\npays for\nthe wrecked bike.")' results to ("My insurance" "pays for" "the wrecked bike.").

See also LISTTOMEMO.

15.12.4 LISTTOMEMO

LISTTOMEMO converts a list to a memo.

(LISTTOMEMO *list*)

Converts the given list to a memo. If *list* is NIL then NIL is returned, otherwise a memo is generated where each line consists of the string representation of the corresponding list element.

Example: '(LISTTOMEMO (LIST "Silke" "lends me" "'my' bike" "till" 01.09.1998))' results to: "Silke\nlends me\n'my' bike\ntill\n01.09.1998".

See also MEMOTOLIST.

15.12.5 FILLMEMO

FILLMEMO fills in a memo with the results of expressions.

(FILLMEMO *memo*)

Creates a copy of the given memo where all substrings of the form '\$(*expr*)' are replaced by their results after evaluation.

Example: '(FILLMEMO "(+ 1 1) is \$(+ 1 1).")' results to "(+ 1 1) is 2."

Please use only small expressions in the memo as debugging and tracking down errors is not easy here.

See also FORMATMEMO, INDENTMEMO.

15.12.6 FORMATMEMO

FORMATMEMO formats a memo.

(FORMATMEMO *memo width fill*)

Formats *memo* to a memo with lines not longer than *width* characters. If *fill* is non-NIL then spaces are used to pad the lines up to exactly *width* characters. The memo is processed section-wise. A section starts at the first non-white-space character. The line holding this character and all following lines up to the first line whose first character is a white-space are counted to this section. The whole section is then formatted word-wise, that is, as many words are put in one line as there is space for.

See also FILLMEMO, INDENTMEMO.

15.12.7 INDENTMEMO

INDENTMEMO indents a memo by putting spaces to the left.

(INDENTMEMO *memo indent*)

Returns a copy of the given memo where each line is indented by *indent* space characters. If *memo* or *indent* is NIL then NIL is returned. If *indent* is negative, a value of 0 is used.

See also FILLMEMO, FORMATMEMO.

15.13 List functions

This section lists functions for processing lists.

15.13.1 CONS

CONS builds a pair of expressions.

(CONS *elem list*)

Constructs a new list. The first element of the new list is *elem*, the rest are the elements of *list* (which should be a list or NIL). The list *list* is not copied, only a pointer is used to reference it!

Example: '(CONS 1 (CONS 2 NIL))' results to (1 2).

The elements of a list can be of any type, e.g. it's also possible to have a list of lists (e.g. see Section 15.18.12 [SELECT], page 107). The CONS constructor can also be used to build pairs of elements, e.g. '(CONS 1 2)' is the pair with the two integers 1 and 2.

See also LIST, FIRST, REST.

15.13.2 LIST

LIST generates a list out of its arguments.

(LIST [*elem ...*])

takes the arguments *elem ...* and generates a list of it. This is equivalent to calling (CONS *elem* (CONS ... NIL)). Note that NIL alone stands for an empty list.

See also CONS, LENGTH.

15.13.3 LENGTH

LENGTH determines the length of a list.

```
(LENGTH list)
```

returns the length of the given list.

Example: ‘(LENGTH (LIST "a" 2 42 3))’ results to 4.

See also LIST.

15.13.4 FIRST

FIRST extracts the first element in a list.

```
(FIRST list)
```

returns the first element of the given list. If *list* is empty (NIL) then NIL is returned.

See also REST, LAST, NTH, CONS.

15.13.5 REST

REST returns the sub-list after the first element of a list.

```
(REST list)
```

returns the rest of the given list (the list without the first element). If *list* is empty (NIL) then NIL is returned.

Example: ‘(REST (LIST 1 2 3))’ results to (2 3).

See also FIRST, CONS.

15.13.6 LAST

LAST extracts the last element in a list.

```
(LAST list)
```

Returns the last element of the given list or NIL if *list* is NIL.

See also FIRST, NTH.

15.13.7 NTH

NTH extracts the n-th element of a list.

```
(NTH n list)
```

Returns the *n*-th element of the given list (starting with 0) or NIL if the element doesn't exist.

See also FIRST, LAST.

15.13.8 APPEND

APPEND concatenates lists.

```
(APPEND [list ...])
```

returns the concatenation of *list*

Example: ‘(APPEND (list 1 2) (list 3 4) (list 5))’ results to (1 2 3 4 5).

See also LIST.

15.13.9 REVERSE

REVERSE reverses a list.

```
(REVERSE list)
```

returns the reverse list.

Example: '(REVERSE (list 1 2 3))' results to (3 2 1).

15.13.10 MAPFIRST

MAPFIRST applies a function to all list elements.

```
(MAPFIRST func list [...])
```

Builds a list whose elements are the result of the specified function called with the arguments of the given list elements one by one. The length of the returned list is as long as the length of the longest specified list. If one of the specified lists is too short then the list is padded with NIL elements.

Examples

Expression	Value
(MAPFIRST 1+ (LIST 1 2 3))	(2 3 4)
(MAPFIRST + (LIST 1 2 3) (LIST 2 3))	(3 5 NIL)

15.13.11 SORTLIST

SORTLIST sorts the elements of a list.

```
(SORTLIST func list)
```

Returns a copy of the specified list that has been sorted using the function *func* for ordering. The order function must take two arguments one for each element and return an integer value less than zero if the first element is smaller than the second one, a value greater than zero if the first element is greater than the second one, and a value of zero if the two elements are equal.

Example for a string comparing function usable for sorting:

```
(DEFUN cmp_str (x y)
  (COND
    ((< x y) -1)
    ((> x y) 1)
    (TRUE 0)
  )
)
```

Now you can sort a list by calling:

```
(SORTLIST cmp_str (LIST "hi" "fine" "great" "ok"))
```

which results to ("fine" "great" "hi" "ok").

See also SORTLISTGT, MAPFIRST.

15.13.12 SORTLISTGT

SORTLIST sorts the elements of a list.

(SORTLISTGT *gtfunc list*)

Like SORTLIST but here you specify an order function that returns a value not equal to NIL if the first element is greater then the second one, and NIL otherwise.

Example: '(SORTLISTGT > (LIST "hi" "fine" "great" "ok"))' result to ("fine" "great" "hi" "ok").

See also SORTLIST, MAPFIRST.

15.14 Input requesting functions

For requesting information from the user, the following functions can be used.

15.14.1 ASKFILE

ASKFILE prompts the user for entering a filename.

(ASKFILE *title oktext default savemode*)

Pops up a file-requester for entering a filename. The window title can be set in *title*, the text of the 'Ok' button in *oktext*, and the initial filename in *default*. You may specify NIL for one of them to use default values. The last argument *savemode* (bool) allows setting the file-requester to a save mode. This mode should be used when asking for a filename to write something to.

ASKFILE returns the entered filename as string or NIL in case the user canceled the requester.

See also ASKDIR, ASKSTR.

15.14.2 ASKDIR

ASKDIR prompts the user for entering a directory name.

(ASKDIR *title oktext default savemode*)

Pops up a file-requester for entering a directory name. The arguments are used in the same way as in ASKFILE (see Section 15.14.1 [ASKFILE], page 92).

ASKDIR returns the entered directory name as string or NIL in case the user canceled the requester.

See also ASKFILE, ASKSTR.

15.14.3 ASKSTR

ASKSTR prompts the user for entering a string.

(ASKSTR *title oktext default maxlen*)

Pops up a requester asking for a string to enter. The window title, the text of the 'Ok' button, and the initial value can be set in *title*, *oktext*, and *default* respectively (strings or NIL for default values), *maxlen* determines the maximum characters the user can enter.

ASKSTR returns the entered string or NIL in case the user canceled.

See also ASKFILE, ASKDIR, ASKCHOICESTR, ASKINT.

15.14.4 ASKINT

ASKINT prompts the user for entering an integer value.

(ASKINT *title oktext default min max*)

Pops up a requester asking for an integer to enter. The window title and the text of the ‘Ok’ button can be specified in *title* and *oktext* (strings or NIL for default values). In *default* you pass the initial integer value or NIL to start with an empty editing field. In *min* and *max* you can set the integer range. Entered values outside this range are not accepted by the requester. Use NIL for default min and max values.

ASKINT returns the entered integer or NIL if the user canceled the requester.

See also ASKSTR.

15.14.5 ASKCHOICE

ASKCHOICE prompts the user to select one item out of many items.

(ASKCHOICE *title oktext choices default*)

Pops up a requester allowing the user to choose one item out of many items. You can set the window title and the text of the ‘Ok’ button in *title* and *oktext* (strings or NIL for default values). In *choices* you specify a list of choices from which the user can choose one. The list items can be any expressions that can be converted to strings. The initial choice value can be set in *default* which must be an integer index into the choice list (starting with index 0 for the first item). Use NIL for no initial choice.

ASKCHOICE returns the index of the chosen item or NIL if the user canceled the requester.

Example

```
(LET ((items (LIST "First Entry" 2 3.14 "Last entry"))) index)
  (SETQ index (ASKCHOICE "Choose one item" "Ok" items NIL))
  (IF index
    (PRINTF "User chose item num %i with contents <%s>\n"
      index (STR (NTH index items)))
    )
  )
)
```

See also ASKCHOICESTR, ASKOPTIONS.

15.14.6 ASKCHOICESTR

ASKCHOICESTR prompts the user for entering a string value offering several pre-defined ones.

(ASKCHOICESTR *title oktext strings default*)

Pops up a requester allowing the user to choose one string out of many strings or to enter any other string in a separate string field. You can set the window title and the text of the ‘Ok’ button in *title* and *oktext* (strings or NIL for default values). In *strings* you specify a list of strings from which the user can choose one. The initial value of the string field can be set in *default* (string or NIL for an empty string field).

ASKCHOICESTR returns the chosen string or NIL if the user canceled the requester.

Example

```
(LET ((strings (LIST "Claudia" "Mats" "Ralphie"))) likebest)
  (SETQ likebest
    (ASKCHOICESTR "Who do you like the best?" "Ok" strings "My collies!")
  )
  (IF likebest (PRINTF "User chose <%s>\n" likebest))
)
```

See also ASKCHOICE, ASKOPTIONS.

15.14.7 ASKOPTIONS

ASKOPTIONS prompts the user for selecting several items out of a list of items.

```
(ASKOPTIONS title oktext options selected)
```

Pops up a requester allowing the user to select several options out of many options. You can set the window title and the text of the ‘Ok’ button in *title* and *oktext* (strings or NIL for default values). In *options* you specify a list of options from which the user can select some. The list items can be any expressions that can be converted to strings. The initial selection state can be set in *selected* which must be a list of integers each specifying an index whose corresponding item in the *options* list should initially be selected. Use NIL for all items being unselected.

ASKOPTIONS returns a list of integers each specifying the index of a selected item, or NIL in case the user canceled or did not choose any item.

Example

```
(LET ((options (LIST "Salva Mea" "Insomnia" "Don't leave" "7 days & 1 week")))
  (selected (LIST 0 1 3))
)
(SETQ selected (ASKOPTIONS "Select music titles" "Ok" options selected))
(IF selected
  (
    (PRINTF "User has selected the following items:\n")
    (DOLIST (i selected)
      (PRINTF "\tnum: %i contents: <%s>\n" i (STR (NTH i options)))
    )
  )
)
```

15.14.8 ASKBUTTON

ASKBUTTON prompts the user for pressing a button.

```
(ASKBUTTON title text buttons canceltext)
```

Pops up a requester with the specified window title (string or NIL for a default title) and specified description text (string or NIL for no text). The function waits until the user presses one of the buttons specified in *buttons* (list of strings) or the ‘Cancel’ button. The text of the cancel button can be set in *canceltext*. If you specify NIL here then a default text based on the number of buttons you specified is used.

ASKBUTTON returns the number of the pressed button (starting with 0 for the first (leftmost) button) or NIL if the user pressed the ‘Cancel’ button.

Examples

```
(LET ((buttons (LIST "At home" "In bed" "In front of my Amiga"))) index)
  (SETQ index (ASKBUTTON "Please answer:"
    "Where do you want to be tomorrow?" buttons "Don't know")
  )
  (IF index
    (PRINTF "User chose: <%s>\n" (NTH index buttons))
  )
)

(ASKBUTTON "Info"
  "You have been playing with your\nAmiga for five hours now.\nGo to bed!"
  NIL NIL
)
```

See also ASKCHOICE.

15.14.9 ASKMULTI

ASKMULTI prompts the user to enter various kinds of information.

```
(ASKMULTI title oktext itemlist)
```

ASKMULTI is a multi-purpose requester. It opens a window with the specified title, a set of gui objects for editing data, and two buttons ('Ok' and 'Cancel') for terminating the requester. The text of the 'Ok' button can be set in *oktext* (string or NIL for default text). The set of gui objects are specified in *itemlist* which is a list of items where each item has one of the following forms:

```
(LIST title "String" initial [help])    for editing one line of text,
(LIST title "Memo" initial [help])      for editing multi-line text,
(LIST title "Integer" initial [help])    for editing an integer,
(LIST title "Real" initial [help])       for editing a real,
(LIST title "Date" initial [help])      for editing a date,
(LIST title "Time" initial [help])      for editing a time,
(LIST title "Bool" initial [help])      for a boolean field,
(LIST title "Choice" initial
  (LIST choice ...) [help])
)                                           for a choice field.
(LIST title "ChoiceList" initial
  (LIST choice ...) [help])
)                                           for selecting one item of a list.
(LIST title "Options" initial
  (LIST option ...) [help])
)                                           for selecting several items of a list.
non-list-expr                             for static text
```

The title (string or NIL for no title) will be displayed to the left of the gui object. If the initial value is NIL then a default value is used (e.g. an empty text field). For choice fields the initial value must be the index (starting with 0) for the initial active entry, for choice list fields the initial value may be NIL (no item is activated), and for options fields the initial value must be a list of integers representing the indices (starting with 0) of the items that are initially selected. The optional help field (string) can be used for giving more information to the user about the usage of the field.

ASKMULTI returns a list of result values which the user has edited and acknowledged by pressing the 'Ok' button. Each result value of a field has the same format as the one for the initial value, e.g. for a choice list field the result value is the index of the selected item (or NIL if no item has been selected), or for an options field the result value is a list of integers representing the indices of the selected items. For static text a value of NIL is returned.

E.g. if you have specified a date field, a static text field, a choice field, an options field, and a string field with initial value "world", and the user has entered 11.11.1999, selected the choice entry with index number 2, selected the 3rd and 4th item in the options field, and left the string field untouched then the function returns the list (11.11.1999 NIL 2 (3 4) "world").

If the user cancels the requester, NIL is returned.

Example

```
(ASKMULTI "Please edit:" NIL (LIST
  (LIST "N_ame" "String" "")
  (LIST "_Birthday" "Date" NIL)
  (LIST "_Sex" "Choice" 0 (LIST "male" "female")))
  (LIST "_Has car?" "Bool" NIL)
  (LIST "_Likes", "Options" (LIST 0 2)
    (LIST "Beer" "Wine" "Whisky" "Wodka" "Schnaps"))
  ))
)
```

Please see also the project 'AskDemo.mb' for further examples.

15.15 I/O functions

This sections lists functions and variables for input and output (e.g. printing) of data.

15.15.1 FOPEN

FOPEN opens a file for reading/writing.

```
(FOPEN filename mode)
```

Opens the file specified by *filename* (string). The *mode* parameter (string) controls the access mode. Use "w" to open a file for writing, "a" to append to a file, and "r" for reading from a file. You may also use other flags (or combination of flags) like "r+" for reading and writing. There is no check done that tests if you have specified a valid flag string. However if the file can't be opened, NIL is returned.

FOPEN returns a file handle on success. On failure NIL is returned. If *filename* or *mode* are NIL then NIL is returned.

Example: '(FOPEN "PRT:" "w")' opens and returns a file handle to the printer.

See also FCLOSE, stdout, FFLUSH.

15.15.2 FCLOSE

FCLOSE closes a file.

```
(FCLOSE file)
```

Closes the given file. Returns 0 on success, NIL if an error has occurred. If *file* is NIL then 0 is returned (no error). After closing a file accessing the file handle is an illegal operation and results in aborting program execution with an error message.

See also FOPEN, FFLUSH.

15.15.3 stdout

The global variable `stdout` holds the file handle to MUIbase's standard output file. The output filename can be set in menu item 'Program - Output file'. You may use 'PRT:' here for sending the output to your printer, or 'CON:///Output/CLOSE/WAIT' for printing into a console window.

On the first access of this variable (either directly, e.g. by calling '(FPRINTF stdout ...)', or indirectly, e.g. by calling '(PRINTF ...)', this file is opened. The file is not pre-opened on program execution. This avoids opening the file when no output is generated, e.g. when you simply want to do some calculations and change some record contents.

If MUIbase can't open the program output file then execution is aborted and an error message is generated.

See also FOPEN, PRINTF.

15.15.4 PRINT

PRINT converts an expression to a string and prints it.

(PRINT *elem*)

Converts the value of *elem* to a readable string and prints it to `stdout`. This function mainly exists for debug purposes.

See also PRINTF, stdout.

15.15.5 PRINTF

PRINTF prints a formatted string.

(PRINTF *format* [*expr* ...])

Formats a string using the given format string and arguments and prints it to `stdout`. Formatting is done like in `SPRINTF` (see Section 15.11.28 [`SPRINTF`], page 86).

PRINTF returns the number of output characters or NIL on failure. If *format* is NIL then NIL is returned.

Example: '(PRINTF "%i days and %i week" 7 1)' prints the string "7 days and 1 week" to `stdout` and returns 17.

See also PRINT, FPRINTF, stdout.

15.15.6 FPRINTF

FPRINTF prints a formatted string to a file.

(FPRINTF *file* *format* [*expr* ...])

Formats a string using the given format string and arguments and prints it to the specified file. Formatting is done like in `SPRINTF` (see Section 15.11.28 [`SPRINTF`], page 86).

FPRINTF returns the number of output characters or NIL on failure. If *file* is NIL then FPRINTF still returns the number of potentially written characters but no output is actually written. If *format* is NIL then NIL is returned.

See also PRINTF, FOPEN.

15.15.7 FERROR

FERROR checks if an file I/O error has occurred.

(FERROR *file*)

returns TRUE if an error for the given file has occurred, NIL otherwise. If 'file' is NIL, NIL is returned.

See also FEOF, FOPEN, FCLOSE.

15.15.8 FEOF

FEOF checks for an end of file status.

(FEOF *file*)

Tests the end-of-file indicator for the given file and returns TRUE if it is set. Otherwise NIL is returned. If 'file' is NIL, NIL is returned.

See also FERROR, FTELL, FOPEN, FCLOSE.

15.15.9 FSEEK

FSEEK sets the read/write position in a file.

(FSEEK *file offset whence*)

Sets the read/write position for the given file. The new position, measured in bytes, is obtained by adding *offset* bytes to the position specified by *whence*. If *whence* is set to SEEK_SET, SEEK_CUR, or SEEK_END, the *offset* is relative to the start of the file, the current position, or end-of-file, respectively.

On success, FSEEK returns 0. Otherwise NIL is returned and the file position stays unchanged. If *file*, *offset*, or *whence* is NIL, or if *whence* is not one of the constant values SEEK_SET, SEEK_CUR, or SEEK_END then NIL is returned.

See also FTELL, Pre-defined constants.

15.15.10 FTELL

FTELL returns the read/write position of a file.

(FTELL *file*)

Determines the current read/write position of the given file relative to the beginning of the file and returns it as an integer. If an error occurs or if 'file' is NIL, then NIL is returned.

See also FSEEK, FEOF.

15.15.11 FGETCHAR

FGETCHAR reads a character from a file.

(FGETCHAR *file*)

Returns the next character from the given file as a string or NIL if *file* is NIL, end of file has been reached, or an error has happened. If the next character is a null character, an empty string is returned.

See also FGETCHARS, FGETSTR, FPUTCHAR.

15.15.12 FGETCHARS

FGETCHARS reads characters from a file.

(FGETCHARS *num file*)

returns a string containing the next *num* characters from the given file. If end of file has been reached before reading *num* characters or if a null character has been read then only these characters are returned. If *num* or *file* are NIL, *num* is negative, end of file has been reached before reading the first character, or a read error has happened then NIL is returned.

See also FGETCHAR, FGETSTR.

15.15.13 FGETSTR

FGETSTR reads a string from a file.

(FGETSTR *file*)

returns the next line of the given file as a string or NIL if *file* is NIL, end of file has been reached, or an error happened. The end of a line is detected if either a newline character or a null character is read, or if end of file is detected. In either case the string does not contain any newline characters.

See also FGETCHAR, FGETCHARS, FGETMEMO, FPUTSTR.

15.15.14 FGETMEMO

FGETMEMO reads a memo from a file.

(FGETMEMO *file*)

returns a memo that contains the contents of the given file up to the next null character or up to the end of file. If *file* is NIL, end of file has been reached before reading any characters, or an error occurred then NIL is returned.

See also FGETSTR, FPUTMEMO.

15.15.15 FPUTCHAR

FPUTCHAR writes a character to a file.

(FPUTCHAR *str file*)

Writes the first character of *str* to the given file. If *str* is empty, a null character is written, if *str* or *file* are NIL, nothing happens. Returns *str* or NIL in case an output error occurred.

See also FPUTSTR, FGETCHAR.

15.15.16 FPUTSTR

FPUTSTR writes a string to a file.

(FPUTSTR *str file*)

Prints *str* together with a newline character to the given file. If *str* or *file* are NIL, nothing happens. Returns *str* or NIL in case an output error occurred.

See also FPUTCHAR, FPUTMEMO, FGETSTR.

15.15.17 FPUTMEMO

FPUTMEMO writes a memo to a file.

(FPUTMEMO *memo file*)

Prints *memo* to the given file. If *memo* or *file* are NIL, nothing happens. Returns *memo* or NIL in case an output error occurred.

See also FPUTSTR, FGETMEMO.

15.15.18 FFLUSH

FFLUSH flushes pending data to a file.

(FFLUSH *file*)

Flushes all pending output for the given file. Returns 0 on success, NIL if an error occurred. If *file* is NIL then 0 is returned (no error).

See also FOPEN, FCLOSE.

15.16 Record functions

This section lists functions that deal with records.

15.16.1 NEW

NEW allocates a new record for a table.

(NEW *table init*)

Allocates a new record in the given table. The parameter *init* specifies the record which should be used for initializing the new record. A value of NIL stands for the initial record.

NEW returns a record pointer to the new record.

The NEW function has the side effect of setting the program record pointer of the given table (see Section 5.2 [Tables], page 16) to the new record.

Example: '(NEW table NIL)' allocates a new record in the given table and initializes it with the initial record.

See also NEW*, DELETE, Tables.

15.16.2 NEW*

NEW* is the star version of NEW (see Section 15.16.1 [NEW], page 100).

(NEW* *table init*)

NEW* checks if you have specified a 'New' trigger function for the given table (see Section 15.27.4 [New trigger], page 115). If so then this trigger function is called for allocating the record and its result is returned. The *init* parameter can be used to specify a record with which the new record should be initialized (use NIL for the initial record).

If no trigger function has been specified, the function behaves like the NEW function.

Warning: With this function it is possible to write endless loops, e.g. if you have defined a 'New' trigger function for a table and this function calls NEW* to allocate the record.

See also NEW, DELETE*.

15.16.3 DELETE

DELETE deletes a record in a table.

(DELETE *table requester*)

Deletes the current program record of the given table after an optional delete requester. The first argument specifies the table for which the current program record should be deleted, the second argument is a boolean expression. If it is NIL then the record is deleted silently, if it is not NIL then the state of preferences menu item 'Record delete requester' is checked. If it is not set, the record is deleted silently, otherwise the standard delete requester appears asking for confirmation. If the users cancels the delete operation then the record will not be deleted.

The return code of the DELETE function reflects the selected action. If it returns TRUE then the record has been deleted, otherwise (the user has canceled the operation) NIL is returned.

On deletion, DELETE sets the program record pointer (see Section 5.2 [Tables], page 16) of the specified table to NIL.

Example: '(DELETE table NIL)' deletes the current record in the given table silently.

See also DELETE*, DELETEALL, NEW, Tables.

15.16.4 DELETE*

DELETE* is the star version of DELETE (see Section 15.16.3 [DELETE], page 100).

(DELETE* *table requester*)

DELETE* checks if you have specified a ‘Delete’ trigger function for the given table (see Section 15.27.5 [Delete trigger], page 116). If so then this trigger function is called for deleting the record and its result is returned. The *requester* parameter can be used to specify if the trigger function should pop up a confirmation requester before deleting the record.

If no trigger function has been specified, the function behaves like the DELETE function.

Warning: With this function it is possible to write endless loops, e.g. if you have defined a ‘Delete’ trigger function for a table and this function calls DELETE* to delete the record.

See also DELETE, DELETEALL, NEW*.

15.16.5 DELETEALL

DELETEALL deletes all records of a table.

(DELETEALL *table[*]*)

Deletes all records of the specified table. If you add a star behind the table name then only those records that match the current filter of the table are deleted. There is no saftey requester before deleting the records.

DELETEALL returns TRUE on successful deletion of all records, otherwise NIL is returned. If *table* is NIL then NIL is returned.

Example: ‘(DELETEALL *table**)’ deletes all records in the given table that match the filter of the table.

See also DELETE, Tables.

15.16.6 GETMATCHFILTER

GETMATCHFILTER returns the match-filter state of a record.

(GETMATCHFILTER *rec*)

Returns TRUE if the specified record matches the filter of its table, NIL otherwise. If the filter of the table is currently not active then TRUE is returned. If *rec* is NIL (the initial record) then NIL is returned.

See also SETMATCHFILTER, GETISSORTED, GETFILTERSTR, SETFILTERSTR.

15.16.7 SETMATCHFILTER

SETMATCHFILTER sets the match-filter state of a record.

(SETMATCHFILTER *rec on*)

Changes the match-filter state of the specified record to the value of *on*. SETMATCHFILTER returns the new match-filter state of the given record. The new state may be different from the expected one because setting the match-filter state to NIL does only work when the filter of the corresponding table is currently active, otherwise TRUE is returned. Calling SETMATCHFILTER with a value of NIL for *rec* (the initial record) will always return NIL.

See also GETMATCHFILTER, SETISSORTED, GETFILTERSTR, SETFILTERSTR.

15.16.8 GETISSORTED

GETISSORTED returns the sorted state of a record.

(GETISSORTED *rec*)

Returns TRUE if the specified record is sorted in the order that has been defined for its table, NIL otherwise. If *rec* is NIL then NIL is returned.

See also SETISSORTED, GETMATCHFILTER, REORDER, GETORDERSTR, SETORDERSTR, Comparison function.

15.16.9 SETISSORTED

SETISSORTED sets the sorted state of a record.

(SETISSORTED *rec on*)

Changes the sorted state of the specified record to the value of *on*. Use this function if you think that a certain record is in the right order (*on* = TRUE), or it it should be reordered (*on* = NIL). Reordering all unsorted records can be done by calling the REORDER function (see Section 15.18.4 [REORDER], page 105).

SETISSORTED returns the new sorted state of the given record. Calling SETISSORTED with a value of NIL for *rec* (the initial record) will return NIL.

For an example on how to use this function, see Section 15.27.6 [Comparison function], page 116.

See also GETISSORTED, SETMATCHFILTER, REORDER, GETORDERSTR, SETORDERSTR, Comparison function.

15.16.10 RECNUM

RECNUM returns the record number of a record.

(RECNUM *record*)

Returns the record number of the given record. Please note that the numbering for records is different than e.g. for lists. For lists, strings and others the counting begins with zero, however for records it begins with 1 for the first record. The number 0 is reserved for the initial record. This seems to be inconsistent with the rest of the MUIbase programming functions, but it does really makes sense here as the record numbers are also used in the window display.

See also RECORDS, INT.

15.16.11 COPYREC

COPYREC copies records.

(COPYREC *rec source*)

Copies the contents of record *source* to record *rec*. If *source* is NIL then *rec* is set to the values of the initial record. If *rec* is NIL then an error message is generated.

COPYREC returns *rec*.

See also NEW.

15.17 Attribute functions

This section lists functions that work on attributes of a table.

15.17.1 ATTRNAME

ATTRNAME returns the name of an attribute.

(ATTRNAME *attr*)

Returns a string containing the name of the specified attribute.

See also TABLENAME

15.17.2 MAXLEN

MAXLEN returns the maximum size of a string attribute.

(MAXLEN *string-attr*)

Returns the maximum number of characters that the given string attribute can hold.

See also LEN.

15.17.3 GETLABELS

GETLABELS returns all labels of a choice or string attribute.

(GETLABELS *attr*)

Returns the labels of the given choice or string attribute. In case of a choice attribute, the labels you entered in the attribute requester (see Section 14.2.2 [Type specific settings], page 50) are returned, in case of a string attribute, the labels you entered for the list-view pop-up (see Section 14.3.3 [Attribute object editor], page 53) are returned.

The labels are returned in one single string and are separated by newline characters.

For example, consider you have a choice attribute with the labels 'Car', 'House', and 'Oil'. Then calling GETLABELS on that attribute will result to the string "Car\nHouse\nOil".

Note: you can easily convert the result string to a list by calling MEMOTOLIST (see Section 15.12.3 [MEMOTOLIST], page 88) on the result string.

See also SETLABELS.

15.17.4 SETLABELS

SETLABELS is used to set the labels of a string attribute.

(SETLABELS *attr str*)

Sets the labels of the string attribute *attr* to the labels listed in the *str* argument. The *str* argument consists of lines each of which holds one label. The labels replace the ones you have entered for the pop-up list-view in the attribute object editor (see Section 14.3.3 [Attribute object editor], page 53).

SETLABELS returns the value of its *str* argument.

Example: '(SETLABELS Table.String "My house\nis\nyour house")' sets the list-view labels of the specifies string attribute to 'My house', 'is', and 'your house'.

Note: you can easily convert a list of labels to the required string format by calling LIST-TOMEMO on the list.

See also GETLABELS.

15.18 Table functions

15.18.1 TABLENAME

TABLENAME returns the name of a table.

(TABLENAME *table*)

Returns a string containing the name of the specified table.

See also ATTRNAME

15.18.2 GETORDERSTR

GETORDERSTR returns the record order of a table.

(GETORDERSTR *table*)

Returns the current order expression of the given table. If the table uses an attribute list for ordering then the returned string contains the attribute names separated by spaces. Each attribute name is prepended by a '+' or a '-' sign indicating ascending or descending order.

If the table is ordered by a comparison function then the name of this function is returned.

An empty string means no ordering.

Example

Consider a table 'Person' which is ordered by the Attributes 'Name' (ascending), 'Town' (ascending), and 'Birthday' (descending). Then '(ORDERSTR Person)' will result to the string "+Name +Town -Birthday".

See also SETORDERSTR, REORDER, REORDERALL, GETISSORTED, SETISSORTED, Order, Comparison function.

15.18.3 SETORDERSTR

SETORDERSTR sets the record order of a table.

(SETORDERSTR *table order*)

Sets the order of the given table according to the *order* string. The *order* string can either hold a list of attribute names or the name of a comparison function.

For sorting using an attribute list, the *order* string must contain the attribute names separated by any number of spaces, tabs or newlines. Each attribute name may be prepended by a '+' or a '-' sign indicating ascending or descending order. If you omit this sign then ascending ordering is assumed.

For sorting using a comparison function, the *order* string must hold the name of the function.

SETORDERSTR returns TRUE if it has been able to set the new order, NIL otherwise, e.g. if an unknown attribute has been specified or the type of the attribute is not allowed for ordering. If you specify NIL for the *order* argument then nothing happens and NIL is returned.

Note: For building the order string you should not directly write the attribute names into the string because when you change an attribute name then the order string will not be updated. Better use the ATTRNAME function (see Section 15.17.1 [ATTRNAME], page 103) to copy the attribute's name into the order string.

Example

Consider a table ‘Person’ with the attributes ‘Name’, ‘Town’, and ‘Birthday’. Then ‘(SETORDERSTR Person (SPRINTF "+%s" (ATTRNAME Person.Name)))’ will set the order of table ‘Person’ using ‘Name’ as (ascending) order attribute.

See also GETORDERSTR, REORDER, REORDERALL, GETISSORTED, SETISSORTED, Order, Comparison function.

15.18.4 REORDER

REORDER brings all unsorted records back into the right order.

(REORDER *table*)

Examines all records of the given table for unsorted ones and reinserts them to their right positions. After reinserting an unsorted record, the sorted state of the record is set to TRUE, thus on the return of REORDER the sorted state of all records is TRUE.

REORDER returns NIL.

Usually you only need to call this function, when you are using a comparison function for defining the order of a table. Orders defined by an attribute list are automatic, that is, a record is reordered automatically when needed.

For an example on how to use this function, see Section 15.27.6 [Comparison function], page 116.

See also REORDERALL, GETORDERSTR, SETORDERSTR, GETISSORTED, SETISSORTED, Order, Comparison function.

15.18.5 REORDERALL

REORDERALL reorders all records of a table.

(REORDERALL *table*)

Reorders all records of the given table by setting the sorted state of all records to NIL and then calling REORDER for reordering everything.

REORDERALL returns NIL.

See also REORDER, GETORDERSTR, SETORDERSTR, GETISSORTED, SETISSORTED, Order, Comparison function.

15.18.6 GETFILTERACTIVE

GETFILTERACTIVE returns the filter state of a table.

(GETFILTERACTIVE *table*)

Returns TRUE if the filter of the specified table is currently activated and NIL otherwise.

See also SETFILTERACTIVE, GETFILTERSTR, GETMATCHFILTER.

15.18.7 SETFILTERACTIVE

SETFILTERACTIVE sets the filter state of a table.

(SETFILTERACTIVE *table bool*)

Sets the filter state of the specified table. If *bool* is non-NIL then the filter is activated, otherwise it is deactivated.

SETFILTERACTIVE returns the new state of the filter. The new state may not be the expected one in case you activate the filter but an error condition occurs and the filter can’t be activated. However deactivating the filter always succeeds.

See also GETFILTERACTIVE, SETFILTERSTR, SETMATCHFILTER.

15.18.8 GETFILTERSTR

GETFILTERSTR returns the record filter expression of a table.

```
(GETFILTERSTR table)
```

Returns the record filter expression of the specified table as a string. An empty string means that no filter expression has been set for this table.

See also SETFILTERSTR, GETFILTERACTIVE, GETMATCHFILTER.

15.18.9 SETFILTERSTR

SETFILTERSTR sets the record filter expression of a table.

```
(SETFILTERSTR table filter-str)
```

Sets the record filter expression of the specified table to the expression in the *filter-str* argument. If the filter of the given table is currently active then the new filter expression is directly applied to all records and the match-filter state of all records are recomputed.

SETFILTERSTR returns TRUE if it has been able to compile the given filter string expression, otherwise NIL is returned. Note that you only get the result of the compilation. If the filter of the given table is currently active and recomputing all match-filter states of the corresponding records fails then you will not notice that from the result of this function. The recommended way to set a new filter expression is like follows:

```
(SETFILTERACTIVE Table NIL) ; always succeeds.
(IF (NOT (SETFILTERSTR Table filter-string))
  (ERROR "Can't set filter string for %s!" (TABLENAME Table))
)
(IF (NOT (SETFILTERACTIVE Table TRUE))
  (ERROR "Can't activate filter for %s!" (TABLENAME Table))
)
```

If SETFILTERSTR is called with a value of NIL for the *filter-str* argument then nothing happens and NIL is returned.

Example: '(SETFILTERSTR Table "> Value 0.0")'.

See also GETFILTERSTR, SETFILTERACTIVE, SETMATCHFILTER.

15.18.10 RECORDS

RECORDS returns the number of records in a table.

```
(RECORDS table)
```

Returns the number of records in the given table. You may append a star to the table name for counting the number of records that match the filter of the table.

See also RECORD, RECNUM.

15.18.11 RECORD

RECORD returns a record pointer for a given record number.

```
(RECORD table num)
```

Returns the record pointer to the *num*-th record in the given table or NIL if a record with this number doesn't exist. You may add a star to the table name to get the *num*-th record that matches the record filter of the table.

Please note that record numbers start with 1 and record number 0 is used for the initial record.

See also RECORDS, RECNUM.

15.18.12 SELECT

SELECT extracts and returns various data from records.

```
(SELECT [DISTINCT] exprlist FROM tablelist
      [WHERE where-expr] [ORDER BY orderlist])
```

where *exprlist* is either a simple star '*' or a list of expressions with optional titles separated by commas:

```
exprlist:      * | expr "title", ...
```

and *tablelist* is a list of table names:

```
tablelist:    table[*] [ident], ...
```

For each table in the table list you can specify an identifier. This can be very useful if a table occurs more than once in the table list (see example of comparing ages below). If you add a star to a table then only the records matching the currently defined filter of that table will be examined.

The orderlist has the following syntax:

```
orderlist:    expr [ASC | DESC], ...
```

where *expr*, ... can be arbitrary expressions or field numbers. For example '(SELECT Name FROM ... ORDER BY 1)' will sort the result by the 'Name' attribute. You may specify ASC or DESC for an ascending or descending order. If none of them are present then an ascending order is assumed.

How it works

The select-from-where query builds the (mathematical) cross product of all tables in the table list (it examines all sets of records in *table*, ...) and checks the where-expression (if any). If the where-expression results to TRUE (or there is no where-expression) then a list is build whose elements are calculated by the expression list in the select-part. If you have specified a single star for the expression list then the list contains the values of all attributes belonging to tables in the table list (except virtual attributes and buttons).

The result of the query is a list of lists. The first list entry contains the title strings, the remaining ones contain the values of the from-list in the matching records.

Examples

See Section 13.4 [Query examples], page 46 for some examples using the SELECT function.

See also FOR ALL.

15.19 Gui functions

This section describes functions for manipulating gui elements.

15.19.1 SETCURSOR

SETCURSOR sets the cursor on a gui element.

```
(SETCURSOR attr-or-table)
```

Sets the cursor on the given attribute or table gui object. The function also opens the window where the attribute/table resides in if the window was not open.

SETCURSOR returns TRUE if everything went ok (window could be opened) or NIL on failure.

15.19.2 GETDISABLED

GETDISABLED returns the disabled state of an attribute.

(GETDISABLED *attr*)

Returns the disabled state of the specified attribute in the current record.

See also SETDISABLED, GETWINDOWDISABLED.

15.19.3 SETDISABLED

SETDISABLED sets the disabled state of an attribute.

(SETDISABLED *attr bool*)

Sets the disabled state of the specified attribute in the current record to the value of *bool*. Returns the new value of the disabled state.

See also GETDISABLED, SETWINDOWDISABLED.

15.19.4 GETWINDOWDISABLED

GETWINDOWDISABLED returns the disabled state of a window.

(GETWINDOWDISABLED *attr-or-table*)

Returns the state of the disabled flag of the window in which the specified attribute or table resides. If the attribute or table resides in the root window then NIL is returned.

See also SETWINDOWDISABLED, GETWINDOWOPEN, GETDISABLED.

15.19.5 SETWINDOWDISABLED

SETWINDOWDISABLED sets the disabled state of a window.

(SETWINDOWDISABLED *attr-or-table disabled*)

Sets the state of the disabled flag of the window button in which the specified attribute or table resides to the value of *disabled*. If you disable a window, the window is closed and the corresponding window button is disabled. You can't disable the root window of a project.

SETWINDOWDISABLED returns the new state of the window's disabled flag.

See also GETWINDOWDISABLED, SETWINDOWOPEN, SETDISABLED.

15.19.6 GETWINDOWOPEN

GETWINDOWOPEN returns the open state of a window.

(GETWINDOWOPEN *attr-or-table*)

Returns the open state of the window where the given attribute/table resides.

See also SETWINDOWOPEN, GETWINDOWDISABLED.

15.19.7 SETWINDOWOPEN

SETWINDOWOPEN opens and closes a window.

(SETWINDOWOPEN *attr-or-table open*)

Opens or closes the window in which the given attribute/table resides. If *open* is non-NIL then the window is opened, otherwise it is closed. You cannot close the root window of a project.

SETWINDOWOPEN returns the new open state of the window.

See also GETWINDOWOPEN, SETWINDOWDISABLED.

15.20 Project functions

This section lists functions dealing with projects.

15.20.1 PROJECTNAME

PROJECTNAME returns the project name.

(PROJECTNAME)

PROJECTNAME returns the name of the current project as a string or NIL if no name has been defined yet.

See also CHANGES.

15.20.2 CHANGES

CHANGES returns the number of changes in the current project.

(CHANGES)

Returns an integer containing the number of changes since the last save operation of the current project.

See also PROJECTNAME.

15.21 System functions

This section lists functions accessing the operating system.

15.21.1 EDIT

EDIT launches the external editor.

(EDIT *filename*)

Starts the external editor for editing the specified file. The external editor can be set in menu item 'Preferences - External editor' (see Section 7.7 [External editor], page 29). EDIT starts the external editor asynchronously, that is, the function returns to the caller immediately.

EDIT returns TRUE if it was successful in starting the editor, else it returns NIL.

See also EDIT*, VIEW, SYSTEM.

15.21.2 EDIT*

EDIT* is the star version of EDIT and has the same effect as EDIT (see Section 15.21.1 [EDIT], page 109). The only difference is that EDIT* starts the external editor synchronously and waits until the user exits the editor.

See also EDIT, VIEW*, SYSTEM.

15.21.3 VIEW

VIEW launches the external viewer.

(VIEW *filename*)

Starts the external viewer for displaying the specified file. The external viewer can be set in menu item 'Preferences - External viewer' (see Section 7.8 [External viewer], page 29). VIEW starts the external viewer asynchronously, that is, the function returns to the caller immediately.

VIEW returns TRUE if it was successful in starting the viewer, else it returns NIL.

See also VIEW*, EDIT, SYSTEM.

15.21.4 VIEW*

VIEW* is the star version of **VIEW** and has the same effect as **VIEW** (see Section 15.21.3 [**VIEW**], page 109). The only difference is that **VIEW*** starts the external viewer synchronously and waits until the user exits the viewer.

See also **VIEW**, **EDIT***, **SYSTEM**.

15.21.5 SYSTEM

SYSTEM calls an external program.

(**SYSTEM** *fmt* [*arg* ...])

Calls an external program. The command line to call the program is generated from *fmt* and the optional arguments like in the **SPRINTF** function (see Section 15.11.28 [**SPRINTF**], page 86). **SYSTEM** waits until the called program exits. If you don't want **SYSTEM** to wait then use a command line that starts the program in the background.

SYSTEM returns **TRUE** on success and **NIL** on failure, e.g. when the command line could not be executed or the called command returned an error code.

Example: '(**SYSTEM** "run %s %s" "clock" "digital")' launches the system's clock in digital mode.

See also **EDIT**, **EDIT***, **VIEW**, **VIEW***.

15.21.6 STAT

STAT examines a filename.

(**STAT** *filename*)

Examines if the specified filename exists in the file system. **STAT** returns **NIL** if the filename could not be found, 0 if the filename exists and is a directory, and an integer value greater than 0 if the filename exists and is a regular file.

15.21.7 TACKON

TACKON creates a pathname.

(**TACKON** *dirname filename*)

Joins *dirname* and *filename* to a pathname. **TACKON** knows how to deal with colons and slashes in *dirname*. It returns the pathname as a string or **NIL** if *dirname* or *filename* is **NIL**.

Example: '(**TACKON** "Sys:System" "CLI")' results to "Sys:System/CLI".

See also **FILENAME**, **DIRNAME**.

15.21.8 FILENAME

FILENAME extracts the filename part of a path name.

(**FILENAME** *path*)

Extracts the last component of the given path name. There is no check whether *path* actually refers to a file, thus it is also possible to use **FILENAME** to get the name of a sub-directory. **FILENAME** returns its result as a string or **NIL** if *path* is **NIL**.

Example: '(**FILENAME** "Sys:System/CLI")' results to "CLI".

See also **DIRNAME**, **TACKON**.

15.21.9 DIRNAME

DIRNAME extracts the directory part of a path name.

(DIRNAME *path*)

Extracts the directory part of the given path name. There is no check whether *path* actually refers to a file, thus it is also possible to use DIRNAME to get the name of a parent directory. DIRNAME returns its result as a string or NIL if *path* is NIL.

Example: '(DIRNAME "Sys:System/CLI")' results to "Sys:System".

See also FILENAME, TACKON.

15.21.10 TODAY

TODAY returns the current date.

(TODAY)

Returns the current date as a date value.

See also NOW.

15.21.11 NOW

NOW returns the current time.

(NOW)

Returns the current time as a time value.

See also TODAY.

15.21.12 MESSAGE

MESSAGE displays a message to the user.

(MESSAGE *fmt* [*arg* ...])

Sets the window title of the pause/abort window (if it is open). The title string is generated from *fmt* and the optional arguments like in the SPRINTF function (see Section 15.11.28 [SPRINTF], page 86).

MESSAGE returns the formatted title string.

Example: '(MESSAGE "6 * 7 = %i" (* 6 7))'.

See also PRINT, PRINTF.

15.21.13 GC

GC forces garbage collection.

(GC)

Forces garbage collection and returns NIL. Normally garbage collection is done automatically from time to time.

15.22 Pre-defined variables

MUIbase knows some pre-defined global variables.

In the current version there exists only one global variable: `stdout` (see Section 15.15.3 [stdout], page 97).

15.23 Pre-defined constants

The following pre-defined constants can be used in any expression for programming.

Name	Type	Value	Comment
NIL	any	NIL	
TRUE	bool	TRUE	
RESET	string	"\33c"	
NORMAL	string	"\33[0m"	
ITON	string	"\33[3m"	
ITOFF	string	"\33[23m"	
ULON	string	"\33[4m"	
ULOFF	string	"\33[24m"	
BFON	string	"\33[1m"	
BFOFF	string	"\33[22m"	
ELITEON	string	"\33[2w"	
ELITEOFF	string	"\33[1w"	
CONDON	string	"\33[4w"	
CONDOFF	string	"\33[3w"	
WIDEON	string	"\33[6w"	
WIDEOFF	string	"\33[5w"	
NLQON	string	"\33[2\"z"	
NLQOFF	string	"\33[1\"z"	
INT_MAX	integer	2147483647	Maximum integer value
INT_MIN	integer	-2147483648	Minimum integer value
HUGE_VAL	real	1.797693e+308	Largest absolute real value
PI	real	3.14159265359	
OSVER	integer	<OS version>	
OSREV	integer	<OS revision>	
MBVER	integer	<MUIbase version>	
MBREV	integer	<MUIbase revision>	
LANGUAGE	string	depends	Default language.
SEEK_SET	integer	see <code>stdio.h</code>	Seek from beg. of file.
SEEK_CUR	integer	see <code>stdio.h</code>	Seek from current pos.
SEEK_END	integer	see <code>stdio.h</code>	Seek from end of file.

See Section 15.3.7 [Constants], page 64, for more information about constants. For defining your own constants, use the `#define` preprocessing directive (see Section 15.2.1 [`#define`], page 59).

15.24 Functional parameters

You can pass a function as an argument to another function. This is useful for defining functions of higher order, e.g. for sorting or mapping a list.

To call a function that has been passed in an argument you have to use the `FUNCALL` function (see Section 15.5.6 [`FUNCALL`], page 68).

Example:

```
(DEFUN map (1 fun)                # arguments: list and function
```

```

    (LET (res)
      (DOLIST (i l)
        (SETQ res
          (CONS (FUNCALL fun i) res)
        )
      )
    (REVERSE res)
  )
)

```

You can now use the map function for example to increment all items of a list of integers:

‘(map (LIST 1 2 3 4) 1+)’ results to (2 3 4 5).

See also FUNCALL, MAPFIRST.

15.25 Type specifiers

It is possible to specify the type of a local variable by adding a type specifier behind the name. The following type specifiers exist:

Specifier	Description
:INT	for integers
:REAL	for reals
:STR	for strings
:MEMO	for memos
:DATE	for dates
:TIME	for times
:LIST	for lists
:FILE	for file handles
:FUNC	for functions of any type
:table	for record pointers to table

The type specifier appends the variable name as in the following example:

```
(LET (x:INT (y:REAL 0.0) z) ...)
```

The example defines three new variables ‘x’, ‘y’ and ‘z’, where ‘x’ is of type integer and initialized with NIL, ‘y’ is of type real and initialized with 0.0, and ‘z’ is an untyped variable initialized with NIL.

The advantage of the type specifiers is that the compiler can detect more type errors, e.g. if you have a function:

```
(DEFUN foo (x:INT) ...)
```

and call it with ‘(foo "bar")’ then the compiler generates an error message. However, if you call ‘foo’ with an untyped value, e.g. ‘(foo (FIRST list))’ then no error checking can be done at compile time because the type of ‘(FIRST list)’ is unknown.

For reasons of speed no type checking is currently done at run time. It could be implemented but then would add a little overhead which is not really necessary as the wrong type will result in a type error sooner or later anyway.

Type specifiers for record pointers have another useful feature. If you tag a variable as a record pointer to a table then you can access all attributes of this table by using the variable name instead of the table name in the attribute path. E.g. if you have a table ‘Foo’ with an attribute ‘Bar’, and you define a variable ‘foo’ as:

```
(LET (foo:Foo)
```

then you can print the ‘Bar’ attribute of the third record by using:

```
(SETQ foo (RECORD Foo 3)) (PRINT foo.Bar)
```

Note that in a select-from-where expression, variables defined in the from list automatically have a type of record pointer to the corresponding table.

15.26 Semantics of expressions

The semantics of expressions are very important for understanding what a program does. This section lists the semantics depending on syntactical expressions.

(*func* [*expr* . . .])

Evaluates *expr* . . . and then calls the function *func* (call by value). Returns the return value of the called function. In MUIbase there exists some non-strict functions, e.g. AND, OR and IF. These functions may not evaluate all expressions. For more information about non-strict functions, see Section 15.3.2 [Lisp syntax], page 62, Section 15.8.1 [AND], page 76, Section 15.8.2 [OR], page 76, and Section 15.5.7 [IF], page 68.

(*expr* . . .)

Evaluates *expr* . . . and returns the value of the last expression (see Section 15.5.1 [PROGN], page 66). An empty expression () evaluates to NIL.

Table

Returns the program record pointer of the given table.

*Table**

Returns the gui record pointer of the given table.

AttrPath

Returns the contents of the specified attribute. The attribute path specifies which record is used to extract the attribute value. For example ‘Table.Attribute’ uses the program record of ‘Table’ to extract the value of the attribute, ‘Table.ReferenceAttribute.Attribute’ uses the program record of ‘Table’ to extract the value of the reference attribute (which is a record pointer) and then uses this record to extract the value of ‘Attribute’.

localvar

Returns the contents of the local variable. Local variables can be defined e.g. with LET (see Section 15.5.3 [LET], page 67).

localvar.AttrPath

Uses the record pointer of *localvar* to determine the value of the specified attribute.

15.27 Function triggering

For automatic execution of MUIbase programs you can specify trigger functions for projects, tables and attributes which are called in specific cases. This section lists all available trigger possibilities.

15.27.1 onOpen

After opening a project, MUIbase searches the project’s program for a function called `onOpen`. If such a function exists then this function is called without any arguments.

Example

```
(DEFUN onOpen ()
  (ASKBUTTON NIL "Thank you for opening me!" NIL NIL)
)
```

See also `onClose`, `onChange`, demo `'Trigger.mb'`.

15.27.2 onClose

Before closing a project, MUIbase searches the project's program for a function called `onClose`. If such a function exists then this function is called without any arguments. In the current version the result of the trigger function is ignored and the project is closed regardless of its return value.

If you do changes to the project in the `onClose` function then MUIbase will ask you for saving the project first before it is actually closed. If you use menu item `'Project - Save & Close'` for closing the project, the trigger function is called before saving the project, thus the changes are saved automatically.

Example

```
(DEFUN onClose ()
  (ASKBUTTON NIL "Good bye!" NIL NIL)
)
```

See also `onOpen`, `onChange`, demo `'Trigger.mb'`.

15.27.3 onChange

Whenever the user makes changes to a project or after saving a project, MUIbase searches the project's program for a function called `onChange`. If such a function exists then this function is called without any arguments. This can be used to count the changes a user does to a project.

Example

```
(DEFUN onChange ()
  (SETQ Control.NumChanges (CHANGES))
)
```

In the above example `'Control.NumChanges'` could be a virtual attribute somewhere in an `'exactly-one-record'` table for displaying the project's number of changes.

See also `onOpen`, `onClose`, demo `'Trigger.mb'`.

15.27.4 New trigger

When the user wants to allocate a new record by selecting one of the menu items `'New record'` or `'Duplicate record'` and the `'New'` trigger of that table has been set to a MUIbase program function then this trigger function is executed. The `'New'` trigger function can be set in the table requester (see Section 14.1.1 [Creating tables], page 48).

The trigger function receives NIL or a record pointer as the first and only argument. NIL means that the user wants to allocate a new record, a record pointer means that the user wants to duplicate this record. If the trigger function has more than one argument then these are initialized with NIL. The trigger function should allocate the new record by calling the `NEW` function (see Section 15.16.1 [NEW], page 100). The result returned by the trigger function will be examined. If it returns a record pointer then this record will be displayed.

The ‘New’ trigger is also called when a MUIbase program calls the NEW* function (see Section 15.16.2 [NEW*], page 100).

Sample New trigger function

```
(DEFUN newRecord (init)
  (PROG1
    (NEW Table init)
    ...
  )
)
```

See also NEW*, Delete trigger.

15.27.5 Delete trigger

When the user wants to delete a record by selecting menu item ‘Delete record’ and the ‘Delete’ trigger of that table has been set to a MUIbase program function then this trigger function is executed. The ‘Delete’ trigger function can be set in the table requester (see Section 14.1.1 [Creating tables], page 48).

The trigger function receives a boolean argument as its only argument. If the argument is non-NIL then the function should ask the user if he really wants to delete the record. If so, the function should call DELETE (see Section 15.16.3 [DELETE], page 100) for deleting the record.

The ‘Delete’ trigger is also called when a MUIbase program calls the DELETE* function (see Section 15.16.4 [DELETE*], page 101).

Sample Delete trigger function

```
(DEFUN deleteRecord (requester)
  (DELETE Table requester)
)
```

See also DELETE*, New trigger.

15.27.6 Comparison function

For defining an order on the records of a table you can use a comparison function that takes two record pointers as arguments and returns an integer value reflecting the order relation of the two records. The comparison function should return a value smaller than 0 if its first argument is smaller than the second, 0 if they are equal and a value larger than 0 if the first argument is greater than the second one.

For example, if you have a table ‘Persons’ with a string attribute ‘Name’ then you could use the following function for comparing two records:

```
(DEFUN cmpPersons (rec1:Persons rec2:Persons)
  (CMP rec1.Name rec2.Name)
)
```

This will order all records according to the ‘Name’ field using case sensitive string comparison. Note that by using an attribute list you could not achieve the same ordering as string comparison is done case insensitive for attribute lists.

Using a comparison function you can define very complex order relations. Be careful not to create recursive functions that will call itself. MUIbase will stop program execution and prompt you with an error message if you try to do so. Also you should not use commands that cause side effects, e.g. setting a value to an attribute.

When using a comparison function, MUIbase does not always know when it has to reorder its records. E.g. consider in the above example another table ‘Toys’ with a string attribute ‘Name’ and a reference attribute ‘Owner’ referring to ‘Persons’, and the following function for comparing records:

```
(DEFUN cmpToys (rec1:Toys rec2:Toys)
  (CMP* rec1.Owner rec2.Owner)
)
```

This function is using the order of ‘Persons’ for determining the order of the records, thus the records of ‘Toys’ are sorted according to the order of ‘Persons’.

Now if the user changes one record in the ‘Persons’ table and this record gets a new position then also records in ‘Toys’ that refer to this record have to be reordered. MUIbase, however, does not know of this dependency.

Besides using menu item ‘Table - Reorder all records’ on the ‘Toys’ table for rearranging the order, you can implement an automatic reordering yourself by specifying the following trigger function for the ‘Name’ attribute of ‘Persons’:

```
(DEFUN setName (newValue)
  (SETQ Persons.Name newValue)
  (FOR ALL Toys WHERE (= Toys.Owner Persons) DO
    (SETISSORTED Toys NIL)
  )
  (REORDER Toys)
)
```

The function clears the sorted flag for all records that refer to the current record of table ‘Persons’ and then reorders all unsorted records of table ‘Toys’.

See also Order, GETISSORTED, SETISSORTED, REORDER, REORDERALL, GETORDERSTR, SETORDERSTR, demo ‘Order.mb’.

15.27.7 Attribute trigger

In the attribute requester (see Section 14.2.1 [Creating attributes], page 49) you can define a trigger function that is called whenever the user wants to change the attribute contents.

If you have defined such a trigger function for an attribute and the user changes the value of that attribute then the record contents are not automatically updated with the new value. Instead the value is passed to the trigger function as first argument. The trigger function can now check the value and may refuse it. To store the value in the record you have to use the SETQ function.

The trigger function should return the result of the SETQ call or the old value of the attribute if it decides to refuse the new one.

The trigger function is also called when a MUIbase program calls the SETQ* function (see Section 15.5.5 [SETQ*], page 67) for setting a value to the attribute.

Sample attribute trigger function

```
(DEFUN setAmount (amount)
  (IF some-expression
    (SETQ Table.Amount amount)
    (ASKBUTTON NIL "Invalid value!" NIL NIL)
  )
  Table.Amount ; return current value
)
```

See also SETQ*

15.27.8 Programming virtual attributes

In MUIbase virtual attributes are special attributes that calculate their value on the fly whenever it is needed. E.g. if you go to another record by clicking on one of the arrow buttons in a table's panel bar and a virtual attribute in that table has its 'Immediate' flag (see Section 14.3.3 [Attribute object editor], page 53) set then the value of that attribute is computed and displayed. For computing the value the attribute's 'Compute' trigger function is called. This trigger function can be specified in the attribute requester (see Section 14.2.2 [Type specific settings], page 50). The return value of this function defines the value of the virtual attribute. If you don't specify a 'Compute' trigger function for a virtual attribute then the attribute's value is NIL.

You can also trigger the calculation of a virtual attribute by simply accessing it in an MUIbase program, so e.g. if you have a button that should compute the value of the virtual attribute, you only need to specify a function for the button like the following one:

```
(DEFUN buttonHook ()  
  virtual-attr  
)
```

You can also set a virtual attribute to any value by using the SETQ function:

```
(SETQ virtual-attr expr)
```

However if you access the virtual attribute after the SETQ call then the value of the virtual attribute is recomputed.

There is no caching of the value of a virtual attribute because it's not easy to know when the value has to be recomputed and when not. So you should access virtual attributes rarely and cache the value in local variables for further use yourself.

For an example on how to use virtual attributes please check the 'Movie.mb' demo.

See also Virtual, demo 'Movie.db'.

ABConvert

To convert an AmigaBase project to a MUIbase project a small utility called *ABConvert* exists. It loads an AmigaBase project created with AmigaBase version 2.0 or higher and saves it as an MUIbase project. For projects created by older AmigaBase versions, please load and save them with AmigaBase version 2.4 and then do the conversion.

A Solaris binary of ABConvert can be found in the solaris directory. If you have ever problems with low memory when using the Amiga version, run ABConvert on a Solaris box and your memory problems should be gone.

To run the conversion utility type *ABConvert ab-file mb-file* where *ab-file* is an existing AmigaBase project and *mb-file* is a new MUIbase project to be created.

Since MUIbase is a completely new database application, only the structures and datasets of AmigaBase are converted. Programs, filters, orders, etc. must be redone using MUIbase. For converting AmigaBase programs to MUIbase ones it is best to print all programs of the AmigaBase project and then use the guidelines described in the text file 'PortingABPrograms' for converting the programs.

Please note, that the terms used in AmigaBase have been renamed in MUIbase, e.g. an AmigaBase 'record' is now called 'table', a 'variable' is now called 'attribute' and a 'dataset' is now called 'record'.

MUIbase is relational. Therefore the hierarchy of an AmigaBase project has to be converted into tables. This is done by adding reference attributes to each table (except for the "root" table) which point to the "parent" record.

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