ProGammon

COLLABORATORS

	TITLE : ProGammon		
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WRITTEN BY		June 25, 2022	

REVISION HISTORY

NUMBER	DATE	DESCRIPTION	NAME

Contents

Chapter 1

ProGammon

1.1   ProGammon Documentation

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                    ProGammon

                 Version 2.83

                 29 March 1999

                    FREEWARE

        The Ultimate Amiga Backgammon Game

--------------------------------------------------------------------
```

1.2 introduction

```
Introduction:
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```

Have you tried playing computer backgammon before? Were you a little disappointed?

In the long run, most users will find that this program plays a pretty good game of backgammon. Anyone from beginner to expert will improve their game by playing and using ProGammon.

It's also possible to set the board up however you like which will allow you to practise up at certain situations like the "Back Game".

This program keeps track of your wins and losses as well as gammons and backgammons. The Statistics Page also tabulates each dice roll so you can examine the dice for randomness and fairness.

It's operating system friendly and is very cpu & memory efficient so even your 3-D rendering work will barely slow down while you play a game or 3.

1.3 requirements

```
           Requirements:
-------------
```

This program works on any Amiga with kickstart 2.04 or greater and even works on non-Amigas using UAE.

With an AGA Amiga, this game will use a 640 x 480 multiscan productivity screen, if available. It also works good in 640 x 256 PAL and 640 x 200 NTSC mode. Just use the appropriate
```
           Tool Type
           if necessary.
```

One user also informed me that it works great on his Picasso II+ graphics board in his A1200T. Thanks Dirk!

1.4 What's New

```
                What's New:
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Version 2.83:

     -the random opening moves feature has been fixed so it finally works
      the way I intended.  It also works in  TRAINER  mode now.

     -an optimized version for  68020+  users is included.

Version 2.82:

     -fixed a small bug that sometimes caused stones to be created just
      outside the main board when using  Undo Move.

     -fixed the stats screen text color so it should now be the same
      color as used elsewhere.

     -changed the menu background color so it's easier to see.

     -added a
              NOBORDER
              tool type.

     -a couple of very minor changes in game play.

     -changed the default palette.  Thanks go to Tomas Amsrud for this
      combination of colors.  Now it looks as good as it plays!

Version 2.8:

     -the way the dice are rolled has been changed.  If you think this
      program cheats then read
              The Dice
              section.

     -lots and lots of new
              Tool Types
              .  Also check the
              Advanced
                   section for their use.

        USERDICE makes it simple to use your own dice by entering in each
        roll from the keyboard.

        SHOWMOVE displays the previous Amiga move.

        JENA allows you to play the game the way Volkmar does in Jena,
        Germany.  Players are limited to a maximum of 5 stones per point
        in Jena.

        RANDOM enables random opening moves.  Another Volkmar suggestion
        which results in a variety of opening moves, including some
        non-traditional ones.

        CPU
```

        MAN
        These two allow you to set the board up however you like.

        CPUFIRST
        MANFIRST
        These last two allow either player to have the first move
        regardless of the opening role.

    -a new @{ " Auto Play " LINK Auto} feature. One mouse click in the lower ←
        right
     corner of the board and the Amiga will move your stones for
     you. An Amiga vs Amiga match can be kind of interesting.

    -also added a second set of dice to the board. Should be a
     little easier to understand and review previous moves.

    -another 101 changes in the AI, some good some not so good!
     This version plays a little different style of backgammon compared
     to previous versions so try playing a few hundred games before
     passing judgement. It's a work in progress!

    -a new [Clear Stats] button in the Color Window so you can
     reset your statistics without changing the board colors that you
     have saved in your gammon.prefs file.

    -and finally, a slightly redesigned, recolored icon.

Version 2.7:

    -added a tool type called TRAINER. This allows the user to
     ask ProGammon to suggest a move anytime during gameplay. A
     second opinion is useful, even if you don't agree with it!

    -finally, a PAL tool type so the program will now work in
     640 x 256 hi-res PAL mode if needed.

    -the last release introduced a major change in game play. This
     version merely contains some minor adjustments.

    -added a new section on interpreting the winning percentage.
     If you like
             mathematics
             then check it out.

Version 2.6:

    -complete rewrite of the AI to encourage more blocking and
     maintaining of key positions.

    -added a NAME tool type and a CHEAT tool type so you can use
     your own dice if you don't like the computer generated ones.

    -also added a DONE tool type. See the Tool Type section.

    -click on the dice after you complete a game and the Amiga
     winning percentage will now be displayed.

Version 2.5:

    -improved the AI used during the late stages of the game. It
     should be much harder to gammon the Amiga.

    -added some code to encourage the Amiga to maintain a wall of
     6 stones once it has established one.

    -cleaned up various routines for speed and size.

Version 2.4:

    -added an Undo function so you can start your move over again if
     you need to.

    -fixed a bug in v2.3 where occasionally the program would prevent
     you from making a valid move.

    -removed the debug_hunks which significantly reduced the size of
     the program.

 Thanks to Nils Goers for all of the above suggestions and improvements.

    -finally got around to putting the documentation in AmigaGuide
     format.

1.5 The Basics

The Basics:

The game begins with the following board setup:

```
    ********************************************         Direction of
    *  24 23 22 21 20 19    18 17 16 15 14 13  *         Movement:
    *   v  v  v  v  v  v     v  v  v  v  v  v   *
    *   X           O           O           X  *         --->
    *   X           O           O           X  *
    *               O           O           X  *            |
    *               O                       X  *            |
    *               O                       X  *            |
    *                                          *            V
    *                      3 5                  *
    *                                          *            |
    *               X                       O  *            |
    *               X                       O  *            |
    *               X           X           O  *            V
    *   O           X           X           O  *
    *   O           X           X           O  *         <---
    *   ^  ^  ^  ^  ^  ^     ^  ^  ^  ^  ^  ^   *
    *   1  2  3  4  5  6     7  8  9 10 11 12   *
    ********************************************
```

```
                 ^   ^   ^   ^   ^   ^
                 Your  HOME  area is positions 1 to 6.
```

There are 24 positions on the board and each player begins with 15 stones.
'X' represents your stones and the 'O' represents the Amiga's stones. In
the diagram above you have 2 stones on position 24, 3 stones on position
8 and 5 stones each on positions 6 and 13. The 3 and the 5 in the center
of the board represent the dice.

Each player takes turns rolling the dice and moving their stones an amount
equal to whatever was rolled.

The object of the game is to move your stones in a clockwise direction
into your home area. When all 15 stones are home you can remove them from
the board depending on what you roll. The first player who removes all of
their stones from the board wins the game.

The game starts with each player rolling one die to determine which player
gets to go first. For example, if the Amiga rolled a 3 and you rolled a
5 then you would start by using this combination for your first move.
Here is one possibility:

```
                 *********************************************
                 *  24 23 22 21 20 19    18 17 16 15 14 13  *
                 *   v  v  v  v  v  v     v  v  v  v  v  v   *
          MOVE 1--> X        X     O        O           X   *
                 *                 O        O           X   *
     Using the 3 *                 O        O           X   *
                 *                 O                    X   *
                 *                 O                 <---MOVE 2
                 *                                       *
                 *                    _ _                *  Using the 5
                 *                                       *
                 *                 X                  O  *
                 *                 X        X         O  *
                 *                 X        X         O  *
                 *   O             X        X         O  *
                 *   O             X        X         O  *
                 *   ^  ^  ^  ^  ^  ^     ^  ^  ^  ^  ^  ^  *
                 *   1  2  3  4  5  6     7  8  9 10 11 12  *
                 *********************************************
                                    ^
```

With the 3 I moved one stone from position 24 to position 21. For the
second move I moved a stone from position 13 to position 8. After the
opening move each player alternates rolling the dice.

Either player can move to any position as long as it is not blocked by 2
or more of the opposing players stones. In the above example I would not
have been allowed to use the 5 to move a stone from position 24 to
position 19 because the Amiga has position 19 blocked.

It is possible to move to a position that has only 1 Amiga stone on it. When this happens, your stone will take possesion of that point and the Amiga stone will be knocked off onto the center bar. Any stone on the bar has to enter the board in the opposing players home area. You must get back on the board, on a point that is not blocked, before any further moves are allowed. If you cannot make a move just click once on the dice to give up your turn and resume play.

When all of your stones are home, you can start removing them from the board. This is called bearing off. If, for example, you rolled a 6 and a 2, you could remove one stone from position 6 and another one from position 2. If you rolled a 6 but didn't have any stones on position 6 to remove then you are allowed to take one stone off the next highest position. It is also legal to move stones within your home area rather than bearing them off. It might be an advantage to do this if the Amiga still has some stones in your home area and is trying to knock you off onto the bar.

The only other rule is that both players must use as much of what they rolled as possible. If you rolled a 5 and a 3 and it is possible to use both the 5 and the 3 then you must make both moves. If you can only use the 5 or the 3 but not both then you are required to use the higher amount(5). The Amiga plays by these rules and now, since version 2.3, you are forced to play by these rules also.

1.6 Game Play

Game Play:

To move a stone just click once on the stone and then once on the spot where you want it to go. If you did it right then the stone should move to the new location or else a message will appear to help you out.

If you roll doubles (i.e. two 3's) then instead of getting two moves of 3 you get four moves of 3.

Anytime during a move you can get an update to how many moves you have left by clicking anywhere outside the main board area. In the message area will be displayed the dice values that have not yet been used.

You can also make multiple moves. If, for example, you roll a 3 and a 4 then you are allowed to make one move of 7 as long as both points between your present location and your destination are not blocked.

If you are unable to make a move then just click once on the dice to continue with the game. If you select a stone by mistake then just click on that same stone to start your move over again.

Once all your stones are in your home area, you can remove them from the board by double clicking on them.

A gammon will be declared if one player is able to get all his stones off before the other player has removed one. This is equivalent to winning 2 games.

A backgammon occurs when one player gammons the other player plus he traps
at least one of the opposing players stones in his home area. This is
worth 3 wins.

1.7 menus

Menus:

Undo Move

 You can restart your move from the beginning by selecting this from the
 menus. You could also accomplish the same thing by clicking on the
 stone and putting it back wherever it came from.

Stats

 This menu item will display a table of what you have rolled so far as
 well as what your average roll has been. A long term average roll of
 about 8.144 is ideal. If you are interested in how I determined this
 number then send me some mail.

 Statistics on wins/gammons/backgammons are now also displayed within
 this window.

 Clicking on the left side of the stats window will show the statistics
 for the present series of games and clicking on the right side will show
 the overall statistics for all games that have been played, including
 previous games stored in the gammon.prefs file.

Colors

 Selecting this will allow you to adjust both the board colors as well
 as the speed of the game.

 If you select SAVE in the color adjustment window then your game
 preferences will be saved to a 266 byte file called gammon.prefs in
 the current directory. The program keeps track of the AMIGA's winning
 percentage in this file as well as statistics on the dice. If you want
 this feature then remember to click on SAVE before the end of the
 first game.

1.8 Tool Types

            Tool Types:

   MAINFONT=topaz
   FONTSIZE=8

These 2 tool types allow you to use any reasonably sized font for your
menus, message display and window title in VGA mode. If the program is
unable to find this font or if your size choice is too large then it will
use topaz 8 as the default.

   REVERSE

I prefer setting up the board so that you move your stones from the
upper left part of the screen to the lower left in a clockwise direction.
If you would prefer that the board was set up so that your stones move
from the upper right part of the board to the lower right in a counter-
clockwise direction then use this tool type.

   NTSC

This tool will force the program to use a 640x200 NTSC screen or dblNTSC
screen if available.

   PAL

As above except this one causes ProGammon to use a 640x256 PAL screen.

   NAME=Kevin

Replace Kevin with your name and then you won't have to be called Human
anymore. Name lengths can now be as long as 19 characters including
spaces. Wide fonts combined with a long name may cause part of your
name to be printed off the screen so use some common sense. It's fine
with topaz 11 but a 19 character name won't work if you use ruby 15!

   USERDICE

This tooltype simply lets you use your own dice and enter values in from
the keyboard.

   DONE

With this tool type you will have to click on the dice after each move to
signal to the Amiga that you are done. Some users like to be able to see
how a move looks before having to commit themselves to it. Should be
fewer accidental moves.

   TRAINER

Use this tool type to improve your game. Click anywhere on the lower part
of the board and the Amiga will suggest a move for you. For example, if
the opening roll was (2 - 3) then the Amiga might display this:

   13/11 13/10

This means move one stone from your 13 point to your 11 point and move
another stone from your 13 point to your 10 point. The points are
numbered from 1 to 24 with 24 being the farthest point away from your home
area. See
                    The Basics
                    for further board numbering information.

A display of Bar/23 means move a stone from the Bar to point 23 and
 5/0 suggests that you should bear a stone off from the 5 point.

If you are having trouble winning, then learning to play like ProGammon
does is a good first step. As you improve, you should start to see moves
that are even better than the ones that PG suggests.

Winning should now be easy, or at least, easier!

    JENA

In Jena, Germany players are limited to a maximum of 5 stones on each
point at any one time. 6 or more stones on a point is not allowed.
This will force you to play the game more intelligently so that you
don't stack all your stones on the same point.

    SHOWMOVE

This displays what the previous move for the Amiga was in the upper left
portion of the screen.

    NOBORDER

This will cause the border around the board to be the same color as the
outside board color which will eliminate the border.

    RANDOM

Starting with v2.8, the first/opening move is somwhat random. Of the 15
opening moves, 9 of them have 2 or 3 unique possibilities. For example,
if the Amiga rolled a 6 and you rolled a 4 it might make one of the
following moves:

        a) 1 / 7   7 / 11
        b) 1 / 7   12 / 16
        c) 1 / 5   1 / 7

You might not agree with the last one but in testing it has proven to
be just as good as the other two more common moves. If you don't like
random moves then get rid of the above tool-type.

    CPU=
    MAN=

These two tool types will allow you to set the board up anyway you wish.

Here's how it works:

```
CPU=2000000000050000305000000
MAN=0000050300005000000000020
```

Those 2 lines entered as tool types would allow you to set the board
up in the traditional manner. The 24 positions on the board correspond
to the first 24 digits after the equals sign. The 25th digit represents
the number of stones on the bar for each player.

The board is numbered from 1 to 24. See
                 The Basics
                 . The first line
translates as follows. The CPU has 2 stones on the 1 point, 5 stones on
the 12 point, 3 on the 17 point and 5 more on the 19 point. The final
digit is a zero which means that no stones are on the bar.

There has to be exactly 25 digits/characters after the equals sign. Any
more or less and the program will default to the traditional setup. Both
tool types are not required. You can use either, neither or both.

The letters A through F are also available to place between 10 and 15
stones on any point.

Another example: if you wanted to set the board up so that the game starts
with all 15 stones on the bar for both players then use the following:

```
CPU=000000000000000000000000F
MAN=000000000000000000000000F
```

The 24 zeros means there are no stones on the board and the last F means
that both players will start with 15 stones on the bar.

```
CPUFIRST
MANFIRST
```

Either of these tool types can be used to force the program to let the
Amiga or you start first regardless of who wins the opening role.

1.9 Advanced Section

Backgammon Simulations:

During a game of backgammon you often times get to a stage when you have
to make a decision about whether to run home, make a hit, hold on to a
key point or whatever.

One way to compare 2 moves is to write down what the board would look
like after each move. Now, let the computer play against itself a few

thousand times for each version. Compare the resulting 2 different
winning percentage numbers and you will find out what ProGammon
considers the best move to be.

You can also do this sort of testing on moves recommended by the experts.
You will find that PG still has plenty of room for improvement!

Does that make sense? If so, then read on. In order to be able to do
this kind of testing then you are going to need the following tools:

     CPU=
     MAN=

These two tool types will allow you to set the board up anyway you wish.

     CPUFIRST
     MANFIRST

In the above situation you would be using CPUFIRST because you just
finished your turn and the Amiga will be rolling the dice next.

     (RANDOM)

To make sure that your tests are consistent, you should eliminate the
random opening moves by getting rid of the above tool-type.

     TEST

This tool type turns off the majority of the graphics, sets the speed at
15 and automatically starts playing against itself. This greatly
increases the number of games/hour that the Amiga can complete. The
more games played, the more meaningful your results will be.

Remember to make sure that the boards being compared are set up properly
before doing any long term testing.

An NTSC screen seems quicker than multiscan productivity mode.

The stats can be examined at any time during testing and then you can
continue on by resuming Auto Mode.

After 1000 games, the winning percentage will vary by +/- 0.050 It may
take as many as 5000 games to get meaningful results. Give me access to
a supercomputer and I'll give you a better backgammon algorithm!

1.10 Testing the Dice

                    The Dice:

The dice are generated using the SAS/C random number generating function

called drand48(). I have done a 1001 tests and rolled these dice a
million and one times and I am thoroughly convinced that the numbers
returned by this function are 100% random.

Most computer backgammon players are very suspicious of the dice, never
when they win but always when they lose! The dice are now pre-rolled
before the first game. There are enough pre-determined dice rolls for
approximately 20 complete games. No program can predict what moves you
are going to make so it is absolutely impossible to arrange the dice file
to the advantage/disadvantage of either player.

If if happens to roll double 6's for it's last roll and wins it is because
it got damn lucky!

You can now see exactly what dice rolls are coming up. At the start of a
game when it says, Click Mouse To Roll , just click the mouse in the
lower left corner of the board. This will create a file called dice.PG
in your RAM: directory. This file contains what the dice are going to
roll for the next, approximately, 20 games. Any statistical analysis on
this file will prove to you the 100% randomness of the dice.

No more suspicious, surprise, miracle rolls for the Amiga!

Every roll of the dice is also kept track of in the gammon.prefs file
after you select Quit in the menus or close the game screen.

During the game, you can select Stats in the menus to see the averages
for the games that you are presently playing. By clicking on the right
portion of the statistics screen you can also examine the stats saved in
the gammon.prefs file.

Is there anyway now that the Amiga can cheat? Sure. The program could
cheat by looking ahead in the dice file. It's obvious that the Amiga
could make a risky move if it knew for sure that your next roll would
not give you the opportunity to make contact. It could also avoid risky
moves if it determined that your next roll would make contact.

Does it cheat like this? Certainly not, and I can prove it!

After the first roll, every move is predictable and repeatable. What
this means is that if the board is set up in a certain way and a certain
number shows up on the dice then it is always going to make the exact
same move regardless of what's in the dice file.

If you witness a very suspicious looking move during game play then stop
and do the following.

There are now
                Tool Types
                available for you to recreate the exact
same situation. Once you have recreated the position of the stones on
the board, you can then use the USERDICE tool type to enter in what the
dice roll was. Turn off the (RANDOM) opening moves and the Amiga will
now proceed to make the identical move to what it made during game play.

This proves that the dice file is not being used to gain an advantage over
you. It would have made that exact same move anyhow.

I have done everything I can think of to prove that this program does not
cheat. I really have nothing to gain by writing such a program.

If you have any other "it cheats" theories then let me know and I will
be happy to prove to you otherwise.

Remember, winning against this game is easy. Don't use "bad dice" as an
excuse for playing a "bad game"!

1.11 Auto Mode

Auto Mode:

Clicking the mouse in the lower right portion of the board will start
automatic game play. The center portion of the bar will change colors
while you're in Auto Mode. The Amiga now takes over rolling the dice
and making moves for both players.

Basically, this turns the program into Amiga vs Amiga game play.

Let the computer play overnight and then you can check the Stats screen
to see if the dice really are random. Also check for wins/gammons etc.

Novice players may learn a thing or two by watching the game play against
itself.

Expert players can watch and tell me where my algorithms need improvement.
They may notice areas where my program is weak and find ways to take
advantage of it.

You could also set the board up in a back game situation and then run
some tests. I've found that the 2,3 backgame returns the highest
percentage of winning. What are your findings.

A single click of the mouse anywhere should return control to the user.

This feature is also handy when you are way ahead or behind in a game
and the outcome is obvious. Put the program into Auto Mode and then sit
back while the Amiga completes the game for you.

1.12 Interesting Stuff

            Math Facts:

This section is optional but if your background in mathematics is fairly strong then you may find what follows very interesting.

Let's say there are 2 computer backgammon players that are completely equal. They use the exact same algorithm. In the long run, they will both win 50% of the games that they play against each other.

Now, you know from playing ProGammon that in a short set of games you can be either a hero or a bum! Recently, I went 1 Win and 9 Losses during a set of 10 games. At other times, I have gone 9 Wins and 1 Loss.

The point I'm trying to make is that you can't judge a player or a game over a small set of games. A 10 game set neither proves that a player or program is stupid or brilliant. There is a lot of luck involved in a game of backgammon. This is why you have to play a large number of games before the winning percentage starts to have some real meaning.

So, the question is, how many games is enough? Is 100 games enough, or 300, or 500, or perhaps even 900? I have played a couple of 300 game sets and by then the average dice rolls for both players were nearly even. I used to think that at this point the winning percentage would start to have some real meaning.

Guess what? Mathematically, or scientifically speaking, this number really doesn't mean as much as you might think.

Even after playing 500 games, 2 completely equal players can have their winning percentage vary between 0.400 and 0.600. Most of the time they are going to win about 250 games each because they are equally skilled. However, one player may get extremely lucky over a 500 game set and end up winning 300 games and the other player only 200. Believe it or not, this can happen even though they are completely equal.

I've included a computer generated chart to help explain this further.

The implications are kind of interesting.

The amount of variation quoted above is between 2 players that play consistent backgammon. They never get tired and they never learn from their mistakes. The moves they make never change or evolve.

People, on the other hand, as they learn are constantly changing how they play backgammon. They find a particular style of play that seems to work over 100 games and they stick to it. What doesn't work is abandoned.

There is so much variation in a game of backgammon, that coming to any conclusions concerning what works and what doesn't is often times wrong! The amount of variation increases when you add in the fact that people get tired and the decisions they make concerning when to run, when to hit, etc., etc. are constantly changing.

Have a look at the following chart:

```
   W I N  %      N U M B E R  O F  G A M E S  P E R  S E T

                    100        300        500        900

    0.300  ->         1          0          0          0
    0.310  ->         0          0          0          0
    0.320  ->         1          0          0          0
    0.330  ->         6          0          0          0
    0.340  ->         5          0          0          0
    0.350  ->        10          0          0          0
    0.360  ->        12          0          0          0
    0.370  ->        26          0          0          0
    0.380  ->        40          1          0          0
    0.390  ->        68          0          0          0
    0.400  ->       107          2          0          0
    0.410  ->       138         18          1          0
    0.420  ->       243         25          3          0
    0.430  ->       293         83         11          0
    0.440  ->       399        162         51          8
    0.450  ->       463        302        141         35
    0.460  ->       555        515        355        149
    0.470  ->       704        811        751        482
    0.480  ->       738       1085       1184       1135
    0.490  ->       781       1331       1593       1999
    0.500  ->       824       1363       1809       2384
    0.510  ->       785       1261       1649       1926
    0.520  ->       735       1080       1132       1158
    0.530  ->       676        805        756        542
    0.540  ->       589        577        335        149
    0.550  ->       472        305        150         28
    0.560  ->       390        162         63          5
    0.570  ->       297         72          8          0
    0.580  ->       214         25          6          0
    0.590  ->       163          8          1          0
    0.600  ->       102          3          1          0
    0.610  ->        62          4          0          0
    0.620  ->        41          0          0          0
    0.630  ->        26          0          0          0
    0.640  ->        14          0          0          0
    0.650  ->        10          0          0          0
    0.660  ->         6          0          0          0
    0.670  ->         2          0          0          0
    0.680  ->         1          0          0          0
    0.690  ->         1          0          0          0
    0.700  ->         0          0          0          0
```

Ok now, what do all these numbers really mean??

I wrote a program to simulate 2 Amigas playing backgammon against each
other. I've also subsequently used Amiga vs Amiga mode to confirm these
numbers. They are both using the same algorithm and are both as equal as
can be.

The first column is the winning percentage just like what is displayed
in ProGammon.

The second through fifth columns represent sets of games that they played
against each other. The two Amigas were always fighting about who was the
better backgammon player so they started by playing sets of 100 games.
At the end of each set of 100 games, Player A would see what his winning
percentage was and then he would add 1 to the appropriate row.

The first time they got together to determine a champion they played
10,000 sets of 100 games each. (i.e. 10,000 x 100 = 1,000,000 games)
If you look at the table you will see that they played dead even at
(0.500) 824 out of the 10,000 sets they played (8.24% of the time).

If you look up at the 0.350 level you will see that on 10 occasions
Amiga A had a winning percentage of only 0.350 after a 100 game set.
These two players are totally equal but because of the luck of the dice,
look how poorly Amiga A did on 10 different occasions.

There was also 13 other times when his winning percentage was worse. On
those occasions Amiga A only won between 0.300 and 0.340 of the time.

What this proves is that if you play 100 games and you think the winning
percentage is telling you whether you're a good player or ProGammon is a
good program is nonsense. You can't come to any conclusions whatsoever.

On one occasion Player A won only 30 of 100 games and at the other extreme
one time Player A won 69 out of 100 games. This large variation isn't
because Player A or B were playing tremendously or lousy. They were
always playing equally intelligently. The variation is due solely to
the randomness of the dice.

If you look at the other columns you will see that there is still a lot
of variation even when they sat down and played 300 game sets, 500 game
sets and finally they played a 900 game set 10,000 times.

Even after playing a 900 game set of backgammon, the winning percentage
varied between 0.440 and 0.560. If your winning percentage is 0.560
after playing 900 games, you have not proven that you are clearly
superior.

Though unlikely, it is still possible that you were just lucky. It is
possible that you could play another 900 game set and the Amiga could
come out on top.

Give the above some thought after you win or lose 10 games in a row!

For some real world testing, check out
                 CPU vs ME
                    .

1.13   CPU vs ME

```
The Results:
------------


How well do I do playing against this program?


I usually play sets of games and then record the results whenever the sum
of both players in the Total column is 100.

   Kevin           45 Wins  +  12 Gammons  +  0 Backgammons  =   69 Total
   Amiga           25 Wins  +   3 Gammons  +  0 Backgammons  =   31 Total
                                                                  ---
Dice :   ( K= 8.459  A=7.976 )                                    100

I absolutely killed the Amiga during the first set!  To be honest, this
is one of the best sets that I have ever completed.  Most users will
find it very difficult, in the long run, to maintain that average.

The average of the dice rolls confirm that I had been getting some very
lucky dice.


I played on and at the 200 game mark the results were the following:

   Kevin           79 Wins  +  21 Gammons  +  1 Backgammons  =  124 Total
   Amiga           56 Wins  +  10 Gammons  +  0 Backgammons  =   76 Total
                                                                  ---
Dice :   ( K= 8.347  A=8.062 )                                    200

During that set the Amiga played at 0.450 to bring it's overal average
up to 0.380.  The overall dice were still in my favor.  In the long run
the dice averages are going to be nearly equal which means that the
Amiga's winning percentage will likely improve.


The 300 game mark:

   Kevin          124 Wins  +  25 Gammons  +  1 Backgammons  =  177 Total
   Amiga           93 Wins  +  12 Gammons  +  2 Backgammons  =  124 Total
                                                                  ---
Dice :   ( K= 8.264  A=8.115 )                                    300

That time the Amiga played at 0.470 for an overall average of 0.413.


The 400 game mark:

   Kevin          161 Wins  +  32 Gammons  +  1 Backgammons  =  228 Total
   Amiga          129 Wins  +  17 Gammons  +  3 Backgammons  =  172 Total
                                                                  ---
Dice :   ( K= 8.268  A=8.076 )                                    400

That was a close set!  The Amiga played at 0.490 which means that I
could have easily lost it.  The overall Amiga average has continued to
climb and is now at 0.430.  The dice continue to be in my favor.
```

Ignoring the first 100 games, the Amiga has been playing at 0.470 during
the most recent 300 games. That's a pretty competitive game of back-
gammon!

And finally the 500 game mark:

```
  Kevin         206 Wins  +  40 Gammons  +  2 Backgammons  =  292 Total
  Amiga         153 Wins  +  23 Gammons  +  3 Backgammons  =  208 Total
                                                               ---
                                                               500
```

Final Dice :   (K= 8.236 A=8.080)

The Amiga's winning percentage for the last 100 games was only 0.360
for an overall total of 0.416. I guess that means that I'm a better
backgammon player than programmer!

During that 500 game set I was constantly rolling at least as much
and usually more than what the Amiga was rolling. The Amiga rolled
36 more double 1's and 2's but I rolled 145 more double 3's, 4's, 5's
and double 6's. That's equivalent to almost 4 more doubles for me
per game. If ProGammon cheats, then it isn't doing a very good job!

Many games are decided on the last roll of the dice. I'm pretty sure
that if the Amiga rolled what I rolled, it would have ended up with a
much higher winning percentage.

Lousy, crooked dice? No, just lucky dice for me. I probably won't be
nearly as lucky during my next set of 500 games.

If you're a serious backgammon player then play some games and let me
know how you do. I hope ProGammon plays as competitively against you
as it does against me.

1.14 Acknowledgments

helped with the
                    TRAINER
                    and
                    USERDICE
                    features.

Tomas Amsrud created the default palette and some good looking icons.

This program is dedicated to my dad who died 10 years ago this month.

Without the encouragement from all of the above, this program would not
have reached it's current level.

1.15 author

Freeware:

You will be hard pressed to find a significantly better playing, more
configurable game of backgammon.

Your questions and comments are always welcome.

Long live the classic AMIGA!

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