Academic Projects Listing

The purpose of this section is to facilitate communication among NeXT users in higher education. Many of the projects are under development. If a project's status is not listed, please contact the project manager for more information.
This is a partial list of projects. Projects listed in previous issues of NeXT on Campus may not appear here due to space constraints.

ARTIFICIAL INTELLIGENCE
PROTEGEÐAn automated system for the generation of interfaces to perform knowledge acquisition for expert systems. The interfaces help experts enter their expertise directly into an expert system's database. *Status: project is ongoing.*
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BUSINESS
Decision Sciences 101ÐA class to teach business students how to use computers in a business environment. Students learn to use WriteNow, NeXTmail, and other productivity tools.
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DESIGN
DBAÐA project to research issues of user interface to a relational database management system. All aspects of database use will be examined, including query, design, and administration. The goal is to produce a graphical user interface that addresses all aspects of user interaction in a system and network

independent fashion.

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ENGINEERING

Fast Algorithms for Signal Processing and Numerical AnalysisÐWork in progress includes low bitrate sound and picture compression by adapted transform coding. Experiments have yielded compression rates of up to twice the current standard. Algorithms have been designed to exploit the compressed data's reduced complexity, in particular Karhunen-Loeve factor analysis for pattern recognition.

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GEOGRAPHY

Teaching Historical GeographyÐA series of modules to teach students a combination of history and geography. An introductory module teaches latitude and longitude and the difference between globes and projections. Planned modules will focus periods ranging from Ancient Greece to geographic conflicts during the Cold War and the end of the bipolar world.

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GEOLOGY

Earthquake Hazard EstimationÐ*Mathematica* is used to model the dynamic response of the ground to large earthquakes. Seismic wave propagation through realistic models of the earth are shown to develop chaotic behavior. Research may help explain why earthquake damage patterns seem, in general, randomly distributed.

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LANGUAGE

Flexible Environment for the Recognition of Impaired Speech (FERIS)ÐAn impaired-speech recognizer design tool that provides a dynamic environment for speech researchers to study relationships among the recognition rate, the speech parameters, and the degree of dysarthria. FERIS will also help researchers better understand the unintelligible nature of dysarthric speech. *Status: under development.*

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GrammaticaÐA prototype application for interactively exploring the relationships of spatial grammars to their languages. Grammatica will work like a conventional drawing application with the added ability to graphically define rules of composition. *Status: being specified.*

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The Reading AssistantÐA computer-assisted system for foreign language learning. Users can browse through foreign language texts. By pointing to words on the screen, students can access a context-sensitive

on-line dictionary, translation aids, and hear the proper pronunciation of words and sentences. *Status: in testing.*

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MATHEMATICS

Learning about Differential EquationsÐA three-component course in differential equations. The first component consists of ªinteractive lecturesº using *Mathematica* notebooks to explore topics in differential equations. The second component is homework projects. Students use *Mathematica* to derive, solve, and graph differential equations. The third component is a term paper/research project. Teams of students are assigned a differential equation to investigate and must discuss the physical derivation of the equation, the linearization of the equation and special small amplitude solutions, and the solution of the equation. The term papers require the use of WriteNow, CharFind, Draw, *Mathematica* and FORTRAN.

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MEDICAL

The Genome MachineÐA genetic information access and analysis tool. Location of genes on chromosomes, DNA and protein sequences, physical and genetic chromosome maps, and data on genetic diseases will be accessible through a graphical user interface. The Genome Machine will be used to organize and analyze data from the Human Genome Project, a 15-year effort to map the entire human genome.

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Health Care Professionals WorkstationÐSoftware to enable rapid, high-quality health care decisions. The software will provide smooth integration among existing hospital and clinical systems, access to the current literature of medicine, and the ability to network with health care professionals locally and statewide. *Status: being coded; early prototype exists.*
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MidasPlus: Molecular Interactive Design and Simulation SystemÐA molecular modeling and drug design support system that allows real-time display of color, line, and surface displays of several interacting molecules, while qualitatively monitoring the stereo chemistry. The mouse controls three-dimensional rotations and translations to provide concise control of viewing angles and positions. MidasPlus can display full wireframe structures with depth cuing, dot cloud solvent accessible and van der Waals surfaces, and full shaded color surfaces with multiple light sources and shading. MidasPlus allows users to view the complete model or any subsegment in isolation. *Status: completed.*
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MULTIMEDIA
Auditory Navigation of Hypertext DocumentsÐResearchers are using quadraphonic sound cues to construct sonic maps of hypertext documents. Sound cues allow viewers to concentrate on information retrieval rather than navigation.
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Human Computer Interaction Research Students
Computing & Information Science Department
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Gita and SiddharthaÐGita is a guided tour designed to assist in the understanding the *Bhagavad Gita.* Students click on buttons in the margin of the text for information on the content of specific verses. Siddhartha is a tour of the life and times of Siddhartha Gautama. The application presents a map of Northeast India. To follow the path of Siddhartha's life, students click on points on the map to bring up images and text describing these locations.

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MediaViewÐAn application that combines text, images, live video, sound, links to other applications, and various forms of paste-on notes to create an interactive learning tool. *Status: in testing.*

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MUSIC
Acoustic Tutorials: Waveform Analysis and Simple Harmonic MotionÐA project to develop a comprehensive series of interactive modules to help students understand the basic concepts and phenomena of acoustics. Tutorials focus on time-varying waveforms and their analysis, simple harmonic oscillators, and acoustic wave phenomena.

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Bessie±An interactive tutorial for teaching frequency modulation (FM) synthesis for music. The tutorial includes an explanation of FM, a historical overview of FM, and a glossary of terms. Users can experiment with the various parameters involved in FM synthesis and hear results in real-time.
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Music Composition LabÐUsers compose musical pieces using Music Kit, Cmix, and CSound. Projects include interactive sound editing tools, computer-music instrument design, and acoustic simulations. Other projects include computer improvisation and digital signal processing research.
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Neural Network Music CompositionÐAlgorithmic music composition using a recurrent neural network called CONCERT. CONCERT is trained on a set of melodies written in a certain style composes new melodies in the same style, as well as in real time. Currently, CONCERT is being trained using J.S. Bach minuets and marches. Output can be converted to Score file format.
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PatchmixÐA graphical user interface to the Cmix music programming language.
Stochastic Granular SynthesisÐAn application that allows users to generate Cmix files and access the DSP chip for real-time granular synthesis.
Mara Helmuth

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Understanding the Historical TemperamentsÐAn application for the performance of musical scores in various timbres and temperaments. *Status: being coded.*
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COGNITIVE SCIENCE
Associative ProcessingÐEfficient neuro-computation algorithm simulations for pattern recognition and adaptive control applications.
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Connectionist Model of Short-Term Sequential MemoryÐA project to develop a memory model that shows some of the same kinds of memory errors humans exhibit. The network does not use weight changes to learn the order of the input sequence. Consequently, the network learns given a single presentation of a sequence, rather than through multiple presentations.
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Neural Network ModelingÐResearchers are using neural network simulations to explore how neuron-like elements (units) work together to transform time-varying input signals into output activities. A NeXTstep

application aids the research by allowing users to check how well a network has learned a task, view past activities of simulated neurons, and impose specific input activities on any unit.

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OPERATIONS RESEARCH

Intelligent Guidance for Headway and Lane ControlÐAn expert system for vehicle guidance and a highway traffic simulator. *Status: being extended to handle uncertainty.*

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UTILITIES

The Audio Disk ControllerÐA special SCSI disk controller that records and plays either AES/EBU, S/PDIF or analog directly to a SCSI disk. The system supports from 4 to 196 audio channels and uses the standard NeXT file system. *Status: completed.*

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B-CUBEÐAn ongoing software engineering student project to create a personal database. The database will

be used as an on-line address and telephone book. The database will also store short notes and dates. Individuals' records will be groupable into organization records.

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MailManager and EasyMailÐMailManager is an advanced electronic mail system that handles local (file) and remote (IMAP2) mailboxes, multiple simultaneous mailboxes, complex message searching, advanced message status management, and file attachments using RFC-1154 encoding. EasyMail is a less-powerful version of MailManager for novice users. *Status: completed.*

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PopMailÐA port of the University of California at Berkeley Post Office Protocol version 3 server.

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Research Paper Management SystemÐAn article/research paper management system that stores information on various articles along with keywords. The article base is searched and abstracts from the requested articles are displayed.

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Sampling Analog to Digital Converter InterfaceÐAn analog to digital Interface Board with 12 Bit A/D

conversion resolution, 0-50kHz (through ~10us) sample rate range, bipolar input voltages over range of +/- 3V peak, bipolar offset and full scale adjustment on board, LED display of converted signal, 2us track and hold amplifier, and an internal clock. Output code is 2's complement binary with LSB = FS/4096 or 6V/4096 =1.46 mv.

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VISUALIZATION, GRAPHICS & ANIMATION

Atmospheric ModelingÐGlobal atmospheric modeling on remote supercomputers using NeXT computers for code development, image manipulation, and running small models.

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3D_Interactive_GraphicsÐA 3D graphics tutorial that displays a simple wireframe, solid, or Bezier surface object according to the object transformation, viewing parameters and projection types. *Status: completed.*

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Objective_PHIGSÐAn application that can execute a C program with PHIGS function calls and display the graphical output in a view window. All PHIGS functions are implemented using Objective-C. *Status: being coded.*

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The ShaderÐA dynamic shadow projection tutorial for design disciplines. Users can manipulate a single light source in 3D space and view the resulting shadow.

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TopDrawerÐA general mathematical drawing tool used to investigate knotted surfaces in four-dimensional space. It can be used to draw and study other areas of geometric topology such as knots, links and knotted graphs. *Status: being coded.*

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Visual ProgrammingÐThe use of meaningful graphic representation to aid parallel programming.

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If you would like your project(s) included in future sections of Academic Projects, please submit the following information:
Project title and discipline
Project manager's full name and title
Institution/Organization
Department
Address, phone, and e-mail address

Number of systems in department
Brief description of project
Project status
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