Application Abstracts

November 1st 1997

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Section 1 - Introduction

This manual is the *CLIPS Application Abstracts* manual. This booklet contains brief descriptions, supplied by CLIPS users, of applications where CLIPS is being used. Previous versions of this manual were put together by Linda Martin, Wendy Taylor, Scott Meadows, and Ken Freeman.

If you'd like to share information with other CLIPS users about your CLIPS applications, please provide the following information:

- The name of your expert system.
- Its purpose (brief—one or two sentences).
- Development stage (conceptual, developing, alpha testing, beta testing, finished).
- Other Languages/Shells used.
- Papers or other references that describe your application.
- Contact person (name, organization, address, phone, fax, email address, etc).
- Description of your application (no more than a page or so).

Send the information by electronic mail to clips@ghg.net.

Since the primary purpose of this booklet is to provide CLIPS users the opportunity to contact other individuals developing applications of interest, we're limiting the applications listed in this booklet to those that provide at least some source of further information (such as a mail address, email address, phone number, or reference other than the CLIPS conference proceedings). In either case, we're still interested in hearing about any applications you've developed.

Section 2 - Abstracts

Expert System Name:	Prototype Electronic Purchase Request (PEPR)
Purpose:	To improve the efficiency of "paper" workflow systems by automating commonly used forms in a commercial forms package and having CLIPS validate the form and generate an electronic "routing slip" based on its content.
Development Stage:	Beta Testing
Other Languages/Shells Used:	AppleScript, Informed Manager (commercial forms package), FileMaker Pro (commercial DBMS), PowerTalk/PowerShare (part of Apple's Open Collaboration Environment, aka "System 7 Pro")
Last Update:	April 28, 1994
Contact:	Michael Compton, AI Research Branch M/S 269-2 NASA Ames Research Center Moffett Field, CA 94035-1000 Phone: (415) 604-6776 Fax: (415) 604-3594 Email: compton@ptolemy.arc.nasa.gov

We have developed a knowledge-based system for improving the efficiency of automated workflow systems by 1) ensuring the correctness and completeness of data contained on forms that are originated and transmitted electronically, and 2) generating an electronic 'routing slip' that reflects who must approve the form. The system uses a form-independent validation engine and form-specific constraints to check that electronic forms are filled out correctly. If no errors are detected during validation, the system uses information on the form to generate a list of individuals and/or organizations that must approve it. This 'approval path' information is added to the form so that it can be automatically routed from one approver to the next. The system is implemented in CLIPS and currently runs on Macintosh computers. It communicates with an off-the-shelf electronic forms package via AppleScript(tm) and can operate within the Apple Open Collaboration Environment (AOCE™), which supports a variety of other workflow capabilities including digital signatures, system-level electronic mail, and data encryption. The system has successfully validated and generated approval paths for approximately ten different types of forms, and is easily extended to new forms via a "BUILDCLASS" facility that automatically generates the CLIPS code necessary to represent and reason about the new form.

Expert System Name:	TENNIS
Purpose:	To build an expert system to estimate and evaluate the ease of service for a computer network.
Development Stage:	Developing
Other Languages/Shells Used:	C, XVT, DEC's Polycenter NetView
Last Update:	April 28, 1994
Contact:	Dr. David C. Brown Computer Science Department Worcester Polytechnic Institute Worcester, MA 01609 Phone: (508) 831-5618 Email: dcb@cs.wpi.edu

The system uses multiple phases, each consisting of a collection of small expert agents written in CLIPS, to produce a set of service tasks and estimate their cost. The system connects to different user interfaces for different types of users, and with different databases that hold descriptions of hardware and software, costs, and a description of the network being evaluated.

Expert System Name:	The Computer Aided Aircraft design Package (CAAP)
Purpose:	engineeringTo aid in the preliminary design of modern, fixed wing aircraft.
Development Stage:	Developing
Other Languages/Shells Used:	C and the Macintosh Toolbox
Last Update:	April 28, 1994
Contact:	Guy Yalif, Princeton University Department of Mechanical and Aerospace Engineering 114 Walker Princeton, NJ 08544 Phone: (609) 258-7613 Email: guyyalif@phoenix.princeton.edu

CAAP is an expert system design to aid both the student and engineer design airplanes. Using a custom standard "Macintosh" user interface "look and feel," CAAP allows the user, based on simple specifications, to perform preliminary airplane design. When presented with results, the user can then change the configuration and see the effect their change has on the airplane. For example, if CAAP designs a plane with a 40 foot wingspan and you realize that your hangar is only 30 feet wide, you can shorten the wing and see the effects this change has on the rest of the plane.

Expert System Name:	Intelligent Remote Automation Project
Purpose:	Embedded automation in PLC / C Modules for field automation.
Development Stage:	Conceptual / Developing
Other Languages/Shells Used:	C++, C, G2, WindExS, Level5
Last Update:	April 28, 1994
Contact:	Edward B. Toupin, Texaco Trading & Transportation, Inc. Email: etoupin@aol.com

The application will reside in remote racks made part of a wide area SCADA system. The expert system will provide intelligence at a low level in the system's hierarchy for immediate decision making as well as automated control in case of loss of communications with central control.

Expert System Name:	PROMEAT
Purpose:	Quality inspection in food processing industries.
Development Stage:	Developing
Other Languages/Shells Used:	ET++
Last Update:	April 28, 1994
Contact:	Thomas Cord Forschungszentrum Informatik (FZI) Technical Expert Systems and Robotics Haid-und-Neu-Strasse 10-14 76131 Karlsruhe, Germany Phone: ++49/721/9654-322 Fax: ++49/721/9654-309 Email: cord@fzi.de

Cured ham of Parma is well known to be a delicacy. The unique taste of this ham is guaranteed by the high quality of raw material, the scrupulousness and experience during production as well as the exceptional climatic conditions in the region of Parma.

The “Consorzio Carni Suine Garantite” from Reggio Emilia in Italy and the spanish company “Oscar Mayer Alimentacion” in Valencia will apply a quality control system, that is developed in the european BRITE/EURAM project PROMEAT, in their ham production in order to increase the quality of the final products and the efficiency and economy of the meat manufacturing process. Objectives of the system are the supervision of the different production phases and the optimization of product quality.

Common to all processes in the meat transformation industry are the biochemical complexity and the high cost of the raw material. It is very difficult to make objective measurements of quality

parameters through non-destructive techniques. This all supports the view that human experts are central to supervision of production and therefore cannot be replaced by machines.

A knowledge-based system to support process supervision and quality control operations is developed. The data acquired by different sensors, the parameters and features extracted in-process, and additional observations supplied by the operator are collected and combined. The interpretation of these data allows the determination of the process state and the recognition and diagnosis of product defects. The process supervision system is based on a blackboard architecture, whose knowledge base represents the properties of the manufactured products, the production phases and the devices involved in production.

Expert System Name:	TOPKAT (The Open Practical Knowledge Acquisition Toolkit)
Purpose:	To build a tool which supports structured knowledge acquisition techniques (transcript analysis, repertory grid, card sort, laddered grid) and knowledge modelling using the CommonKADS method.
Development Stage:	Prototype finished. Final system under development.
Other Languages/Shells Used:	HARDY (Hypertext and Diagramming System)
Last Update:	April 28, 1994
Contact:	John Kingston, AIAI Edinburgh Email: jkk@aiai.ed.ac.uk

TOPKAT (The Open Practical Knowledge Acquisition Toolkit) is a hypertext and diagram-based toolkit which integrates knowledge elicitation techniques with the CommonKADS approach to knowledge modelling.

The KADS methodology for developing knowledge-based systems attempted to resolve this problem by suggesting that knowledge should be analysed on several different levels simultaneously: the domain level, the inference level and the task level. The development of a set of generic models which serve as a template for the inference level of knowledge has proved extremely useful, with the result that KADS is now the most widely used methodology for KBS development in Europe. CommonKADS, the recent successor to KADS, has extended and refined the recommended representations for each level, so that CommonKADS now provides a comprehensive suite of representations for the analysis of knowledge. In particular, CommonKADS has defined a set of ontological primitives with which domain level knowledge can be analysed.

CommonKADS aims to provide a detailed and re-usable approach to the analysis of acquired knowledge. It is therefore important to understand how the results of various knowledge elicitation techniques should be mapped onto CommonKADS models; however, there is

currently little understanding of how the results of structured approaches to knowledge elicitation, such as card sorting or the repertory grid, could be mapped to other formalisms. Integration between structured knowledge elicitation techniques and the CommonKADS modelling methods is being developed using a hypertext and diagram-based toolkit, known as TOPKAT (The Open Practical Knowledge Acquisition Toolkit). TOPKAT includes support for knowledge elicitation techniques (transcript analysis, laddered grids, card sorting and repertory grids), support for developing the CommonKADS model of expertise, and hyperlinks between different representations. A particularly useful feature is the ability to translate from CommonKADS to the knowledge elicitation tools; this allows one knowledge elicitation technique to generate input for another.

TOPKAT is implemented in HARDY and in CLIPS; a number of functions have been written which allow CLIPS to create, modify, access or delete HARDY diagrams and hyperlinks. This allows CLIPS to be used for much of the analysis of the acquired knowledge, such as the statistical comparison of elements in the repertory grid. HARDY (and therefore TOPKAT) runs on machines supporting either X Windows or Microsoft Windows.

Expert System Name:	COURSE SELECTOR
Purpose:	To allow students to choose courses which comply with university regulations.
Development Stage:	Finished
Other Languages/Shells Used:	None
Last Update:	April 28, 1994
Contact:	John Kingston, AIAI Edinburgh Email: jkk@aiai.ed.ac.uk

The COURSE SELECTOR system was implemented for the Department of Business Studies in the University of Edinburgh. The Department's problem was that, in the first two weeks of the Autumn term, every student is required to choose courses for the coming year. Each student has a Director of Studies who is responsible for ensuring that a legitimate combination of courses has been chosen, and every Director of Studies finds that the whole of the first week of term, plus a significant proportion of time thereafter, is taken up with advising students on this complex problem. The task of choosing an acceptable combination of courses is complex.

The current procedure (in theory) is for the students to examine the University Calendar, an 800-page volume describing the regulations and timetables of every available course, and to make their course choices which are then verified by their Director of Studies. In practice, many students rely on their Director of Studies to be a source of wisdom, making little or no effort to look at the University Calendar themselves. The result is that the Director has to conduct one or more lengthy interviews with each student. Since each Director is currently responsible for 60 students, the workload is large. There is also considerable scope for error; the number of possible

interactions between courses is so great that, during the development of the course selector system, the University Calendar itself was found to have omitted to mention a timetable clash between two courses which were recommended for a particular degree. The COURSE SELECTOR system was designed to encode the knowledge stored in the University Calendar, with some additional input from two experienced Directors of Studies.

A version of the KADS methodology was used to build the system; the final stages of this method recommended that the system use data driven reasoning, object oriented representation, truth maintenance, and external file storage. A brief description of the actual design of the system is given below:

- Data driven reasoning was implemented using forward chaining rules.

- The recommended object-oriented representation was actually implemented using facts, where each object was represented by several facts. The first element in each fact was the name of an "object."

- Truth maintenance was implemented using facts, since the built-in truth maintenance facility was not sufficiently expressive. Truth maintenance was implemented by the simple but powerful technique of creating a fact to represent a course which was known NOT to be eligible for selection. This contrasts with the normal truth maintenance technique of keeping track of valid assumptions; the reason for this choice was that there are likely to be fewer ineligible courses than eligible ones, and so fewer "truth maintenance" facts will be required, leading to increased efficiency. The "truth maintenance" facts note the reason for the creation of the fact, which will be the addition of a certain course to the course schedule; if that course is ever removed from the schedule, then any "truth maintenance" facts associated with it are also removed. This technique is powerful because it is able to handle a situation where a course is ineligible for more than one reason; a course is only considered eligible if all the "truth maintenance" facts affecting it are removed.

- The external file of course information was developed by using a spreadsheet, and writing out a text file containing the fields of the spreadsheet. This file was then parsed using an ASCII parser.

In addition, it was decided that the KBS should be broken down into separate files of rules, and that the content of these files should mirror the functional decomposition (and hence the models of expertise and interaction) as far as possible. This decision helped in the debugging of the KBS, and clarified later decisions about where to store certain rules.

Expert System Name:	GermWatcher
Purpose:	medicalTo assist the Infection Control Department of Barnes Hospital (a large teaching hospital affiliated with the university) with its infection control activities. These activities include surveillance of microbiology culture data.
Development Stage:	Used in production since February 1993
Other Languages/Shells Used:	Sybase ISQL scripts, Bourne shell scripts
Last Update:	April 28, 1994
Contact:	Sherry Steib, Washington University School of Medicine Division of Medical Informatics 660 South Euclid Campus Box 8005 St. Louis, Missouri 63110 Phone: (314) 362-4322 Email: sherry@osler.wustl.edu

Hospital-acquired (nosocomial) infections represent a significant cause of prolonged inpatient days and additional hospital charges. We have developed an expert system called GermWatcher, which applies the Centers for Disease Control's (CDC) National Nosocomial Infection Surveillance (NNIS) culture-based criteria for detecting nosocomial infections. GermWatcher has been deployed at Barnes Hospital, a large tertiary-care teaching hospital, since February 1993.

Microbiology culture data from the hospital's laboratory system are monitored by GermWatcher. Using a rulebase consisting of a combination of the NNIS criteria and local hospital infection control policy, GermWatcher scans the culture data, identifying which cultures represent nosocomial infections. These infections are then reported to the CDC.

Expert System Name:	GermAlert
Purpose:	medicalTo assist the Infection Control Department of Barnes Hospital (a large teaching hospital affiliated with the university) with its infection control activities. These activities include surveillance of microbiology culture data.
Development Stage:	Used in production since February 1993
Other Languages/Shells Used:	Sybase ISQL scripts, Bourne shell scripts
Last Update:	April 28, 1994
Contact:	Sherry Steib, Washington University School of Medicine Division of Medical Informatics 660 South Euclid Campus Box 8005 St. Louis, Missouri 63110 Phone: (314) 362-4322 Email: sherry@osler.wustl.edu

Most hospitals have infection control programs which are aimed at the early detection and aggressive treatment of infections. The earlier an infection is discovered and treated, the less likely it is to spread to other patients and hospital staff--and the less likely it is to prolong the infected patient's stay in the hospital. We have developed an expert system called GermAlert, which applies local hospital culture-based criteria for detecting “significant” infections, which require immediate treatment. GermAlert has been deployed at Barnes Hospital, a large tertiary-care teaching hospital, since February 1993.

Microbiology culture data from the hospital’s laboratory system are monitored by GermAlert. Using a rulebase consisting of criteria developed by local infectious diseases experts, GermAlert scans the culture data and generates an “alert” to the Infection Control staff when a culture representing a “significant” infection is detected.

Expert System Name:	Drive Analysis Expert System
Purpose:	Scan log files from diagnostics and OS after running tests on hard drives and determine their pass/fail status.
Development Stage:	Finished
Other Languages/Shells Used:	C, C-shell
Last Update:	April 28, 1994
Contact:	Greg Moore Mack Technologies, Inc. 27 Carlisle Rd. Westford, MA. 01886 Phone: (508)-392-5539 (days) Email: gmoore@macktech.com

In a high volume drive test (Winchester hard drives) process, we can test anywhere from 1 to 20 drives. When testing is completed, the expert system reads the log files generated by the diagnostics, the operating system and a serial number collection routine.

The system generates 3 reports:

1) PASS/FAIL status: Each drive is identified (serial number) and tagged with a pass or fail status. If the drive failed, a general failure description is given. This is a single page report with the target audience being a technician who may or may not have any experience with the particular test environment and/or Winchester technology.

2) Summary of generated errors: This is a summary of all error activity for each drive tested. The report gives more detail than the pass/fail report above, and is targeted to an engineering level audience. In our application, this page is usually given to the drive manufacturer along with the drive for failure analysis.

3) Unknown situation report: This is a report used by the developer of the expert system (me) to alert when a situation has occurred that the expert system could not handle. Corrective action can then be taken to handle the problem the next time it occurs.

In addition to the above three reports, we save the log files for future reference in resolving issues from report #3 above and as a basis to test future changes to the rule base.

The system has helped by:

- Reducing the level of knowledge required by the person operating the test. Allows higher level personell to be utilized elsewhere, while allowing a greater pool of personell to attend the test process

- Eliminating the risk of shipping a bad product. A bad drive can generate megabytes of data. If a failure on another drive is embedded within this massive data, chances are a person would miss the entry.

- Reduced the time required to disposition drives after test.

- Alerted engineering to trends sooner than with the manual process.

- Saves paper - most final report runs are 3 pages verses the hundreds of pages that the log files may take up.

The system was developed in Unix, on a Sun platform running SunOS 4.1.3. We have since turned the process over to Solaris 2.3.

Expert System Name:	FIRE-XPS
Purpose:	Analysis and Diagnosis of the setup of complex fluid flow calculations using the commercial CFD code FIRE (TM of AVL)
Development Stage:	Developing
Other Languages/Shells Used:	FORTRAN, C
Last Update:	April 28, 1994
Contact:	Peter Blahowsky, AVL List GmbH Fluid Dynamics Research Kleiststrasse 48 A-8020 Graz Austria Phone: xx43 316 987-618 Fax: xx43 316 987-777 Email: hpb@avl.co.at

The setup of a modern CFD calculation is a quite formidable task and a successful flow calculation depends heavily on the users experience. Especially for new users or new applications it is necessary to support the user of FIRE with in depth knowledge about fluid flow problems in general, numerical, calculation mesh quality and stability criterias. The choice of the right parameters like time step or under-relaxation factors determines the speed of a flow calculation. FIRE-XPS will support the user of taking the right choices of parameters and boundary conditions, check the calculation mesh quality and analyse flow calculations which did not succeed at all. The knowledge and experience of the development and application group will thus be easier accessible to the user. As a side effect we expect to reduce training time for new users. FIRE-XPS will be a stand alone process exchanging information with FIRE via sockets or RPC.

Expert System Name:	ITS-Engineering
Purpose:	The development of an Intelligent Tutoring System Shell for Engineering. The system contains pedagogical teaching styles for engineering, student models of engineering learning, and a knowledge representation for technical subjects.
Development Stage:	Conceptual / Developing
Other Languages/Shells Used:	C, TAE+, multimedia interfaces
Last Update:	April 28, 1994
Contact:	Nelson Baker, Assistant Professor Georgia Institute of Technology School of Civil and Environmental Engineering 790 Atlantic Drive Atlanta, Georgia 30332-0355 USA Phone: (404) 894-2223 Fax: (404) 894-2278 Email: nelson.baker@ce.gatech.edu Mosaic: http://howe.ce.gatech.edu/Faculty/Structures/N.Baker/baker.html

Researching, developing, and deploying new and creative methods for disseminating and educating diverse populations of engineers and scientists (practitioners as well as students) comprises the motivation for creating ITS-Engineering. Continued life long education is a reality of today's engineering work place and methods are needed to provide this education; thus, the motivation for doing the research necessary to create this system.

Efforts are directed to determine how techniques of artificial intelligence, multimedia, computer simulation and visualization, and engineering pedagogy can be combined or enhanced to stimulate students, help them to excel in their studies, while retaining and improving quality education.

Through these activities, research and development are underway to investigate the learning styles of engineers along with pedagogical teaching techniques for engineering material. What kinds of experiences benefit engineering instruction for some people? Can these experiences be provided via software to increase the learning comprehension of others? Assuming that software systems will benefit engineering education, the time to develop the software is very lengthy. Thus, ITS-Engineering is looking into ways to produce a shell which incorporates sound pedagogical strategies and student learning methodologies. The shell can then be used to develop applications which require only the encoding of the subject domain. Research/development is approaching these issues by studying how to combine multimedia with knowledge-based systems; how to automatically generate examples and exercises for the student

to achieve pedagogical objectives; how to incorporate appropriate levels and timing of explanation to users; how to allow the spatial visualizations needed by most engineers during problem solving, namely sketching; how to instruct engineers using this new technology; and how to deploy these systems when completed.

Expert System Name:	Event Pattern Language (EPL)
Purpose:	Extend Sybase trigger mechanism with temporal information
Development Stage:	Beta Testing
Other Languages/Shells Used:	Sybase
Last Update:	April 28, 1994
Contact:	Giovanni Giuffrida UCLA 11050 Strathmore Dr. #403 Los Angeles, CA, 90024 Phone: (310) 285-2476 Email: giovanni@cs.ucla.edu

Description of your Application: EPL allows the user to specify rules modelling temporal sequences of generic events (insert, delete or update) on a database. Actions can take place when a certain pattern of events is completely satisfied. The basic idea is that you can model situations like:

1) “If the temperature goes down for 3 consecutive days then ...”
2) “If there is a withdrawal for more than $100,000 and within the next 20 minutes a deposit into the bank account for the same amount of money then ...”
3) “If IBM share goes down for the entire week then ...”

Each of the previous examples involve sort of temporal relationships (enriched with constrains on some arguments) on database accesses. The current implementation uses SYBASE as database host. EPL itself is built on top of CLIPS which is in turn coupled with SYBASE through Open-Library.

Expert System Name:	Numerical Propulsion System Simulation (NPSS) Monitor
Purpose:	To monitor a variety of engine component simulations and the data exchange across various computing platforms.
Development Stage:	Conceptual
Other Languages/Shells Used:	None
Last Update:	April 28, 1994
Contact:	Henry Lewandowski NASA Lewis Research Center Cleveland State University Industrial Engineering Dept. Cleveland, Oh 44115 NASA Phone: (216) 433-6542 CSU Phone: (216) 687-4668 Email: henryl@hopper1.lerc.nasa.gov

The NPSS project is a joint effort between NASA, university researchers and industry to bring advanced design analysis techniques to the next generation of propulsion systems. As a part of this effort, an expert system is being designed to monitor the various engine component simulations as they run and to examine the data that is exchanged between modules. The various models run on heterogeneous platforms in a parallel environment.

Expert System Name:	PRISM
Purpose:	Price quotation system for telephone switches.
Development Stage:	Alpha Testing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	William Mettrey, Bell Northern Research P.O. Box 13478 Research Triangle Park, NC 27709-3478

We are testing a Price Quotation System that has approximately 500 rules and is expected to grow significantly.

Expert System Name:	None
Purpose:	An expert diagnostic and maintenance system.
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Albert Koval Cray Research P.O. Box 17500 Colorado Springs, CO 80935

CLIPS is the cornerstone for an expert diagnostic and maintenance system being developed for the Cray III.

Expert System Name:	None
Purpose:	Planning and scheduling and intelligent databases.
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Steven Gold General Electric 780 Third Ave. Bldg. 8, Room 8347 King of Prussia, PA 19406

We are using CLIPS in Planning and Scheduling. Also, we are using CLIPS in intelligent data bases. We are running on a Sun III with OS 4.

Expert System Name:	None.
Purpose:	Helps people to use SLATEC routines.
Development Stage:	Beta Testing
Other Languages/Shells Used:	SLATEC
Last Update:	May 29, 1992
Contact:	Barbara Helland, Iowa State University Ames Laboratory 136 E. Wilhelm Ames, IA 50011

We automated a document search using the SLATEC mathematical subroutine package, and added an Expert System that will help people to use SLATEC routines.

Expert System Name:	None
Purpose:	A consultant for chemical engineers who design chemical plants or refineries.
Development Stage:	Developing
Other Languages/Shells Used:	ASPEN
Last Update:	May 29, 1992
Contact:	W.J. Parkinson, W.J. Los Alamos National Lab MS: G787 P.O. Box 1663 Los Alamos, NM 87545

We are developing an Expert System to be used with ASPEN - a chemical process plant flow sheet simulator. It will be a consultant for young chemical engineers who design chemical plants or refineries.

Expert System Name:	Laser Docking Sensor Associate
Purpose:	Assists mission specialists aboard the Space Shuttle in rendezvous/docking and space experiments.
Development Stage:	Finished
Other Languages/Shells Used:	TSR Graphics
Last Update:	May 29, 1992
Contact:	Paul Griffith, Microexpert Systems, Inc. 24007 Ventura Blvd. #210 Calabasas, CA 91302 Phone: (818) 712-9934

We have developed the Laser Docking Sensor Associate. It has a TSR Graphics Interface with CLIPS. There are approximately 80 compiled rules for checking data evaluation, anomaly checking and vision analysis. It runs on a Grid Shuttle Payload general support computer.

Developed for NASA Johnson Space Center, the Laser Docking Sensor Associate assists mission specialists aboard the Space Shuttle in rendezvous / docking and space experiments. It integrates three Expert Systems for multiple, simultaneous, real-time graphical visualizations of data from laser docking sensors to aid in maneuvering the spacecraft.

Expert System Name:	Planners Workbench
Purpose:	Integrates knowledge gained from shop floor experience with computerized CAD/CAM data to support cable assembly planning.
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Paul Griffith, Microexpert Systems, Inc. 24007 Ventura Blvd. #210 Calabasas, CA 91302 Phone: (818) 712-9934

Planner's Workbench integrates knowledge gained from shop floor experience with computerized CAD/CAM data to support cable assembly planning. It incorporates manufacturing expertise into the design, layout, color-coding, hardware placement, and assembly of cables for the Navy's Trident missle systems. It runs on an IBM RT workstation.

The Expert System modules are as follows:

- Data Convertor Module
  - Reads dimensions from CADAM file.
  - Recognizes cable components in CADAM file.
  - Reads cable geometry.
  - Links CADAM data with wires and parts data to create the database.

- Form Board Design Module
  - Arranges harness on board.
  - Eliminates crossovers and bends to fit.
  - Considers human and machine reach and access, bending radii and supports.
  - Allows user to override expert system bends with custom bends.

- Connector/Color Coding Planning Modules
  - Sequences connector assembly.
  - Minimizes wire ambiguity.
  - Optimizes movement of continuity/Hi Pot tester equiptment.
  - Assigns color coding to individual wires.

- Wirematic Planning Module
  - Fits cable in minimum space.
  - Identifies guide and anchor pin locations.
  - Creates full-scale CADAM drawing.

    - Creates wirematic routing program.
    - allows user to override Expert System bends with custom bends.

- Hardware Assembly Planning Module
    - Sequences cable segment assembly.
    - Organizes cable segments into wire bundles.
    - Minimizes loose wire bundles.

- Report Generating Module
    - Generates assembly method instructions for operators.
    - Generates programs for wirematic and cablescan support equiptment.
    - Makes full-scale CADAM drawings for form board and layup board.

Expert System Name:	STRUTEX
Purpose:	Initially configures a structure to support point loads in two dimensions.
Development Stage:	Finished
Other Languages/Shells Used:	FORTRAN, DI-3000, RIM, PROLOG
Last Update:	May 29, 1992
Contact:	James Rogers, NASA Langley Research Center MS: 246 Hampton, VA 23665-5225

We have developed a prototype knowledge base system for initially configuring a structure to support point loads in two dimensions. This system combines numerical and symbolic processing by the computer with interactive problem solving aided by the vision of the user by integrating a knowledge base interface and inference engine, a database interface, and graphics - while keeping the knowledge base and the database files separate. The system writes a file which can be input into a structural synthesis system, that combines structural analysis and optimization.

STRUTEX emulates an engineering student taking a blank sheet of paper to a teacher to discuss an idea for building a structural model to support one or more point loads in two dimensions. As the teacher asks questions about the loading conditions and the support surface, the student responds with answers or by sketching ideas on the piece of paper. Based on what is seen and heard the teacher can help the student determine a reasonable initial structure for supporting the given loads. In STRUTEX, a knowledge base replaces the teacher, a graphics window on the computer replaces the piece of paper, and a dialogue area in the graphics window replaces the verbal question and answer. The user interactively interfaces with the system through two methods, typed dialogue and mouse-oriented graphics. The user graphically inputs loading and support surface data using the mouse in response to questions about the load points, support surface, and support structure. The data is stored in a relational database.

Once all questions are answered, the appropriate data is transferred from the database to the knowledge base and the system determines the type of structure most suitable for satisfying the input conditions. If the structure is determined to be a beam(s) or a string(s), then the structure is drawn on the graphics window and the session is completed. If there is only one load and the structure is determined to be a truss, then other rules are invoked to determine whether or not bracing is needed, and, if so, the type and amount of bracing. This structure is then drawn on the graphics window. If there is more than one load point and the structure is determined to be a truss, then the user is guided by recommendations in a step-by-step approach to building the truss. The truss built by the user is then tested against rules in the knowledge base and recommendations are given for the user to improve the model. This is done iteratively until all rules are satisfied and no recommendations for improvements are made. An input file for a structural analysis program is written for a truss so that the model can be analyzed and optimized by a previously developed system for structural synthesis.

One objective was to investigate methods for passing data between a database and a knowledge base. This was accomplished by separately integrating two types of inference engines, one forward chaining based on production rules, and one backward chaining based on PROLOG, into the system and determining their effects on the flow of data between the knowledge base and the database. No significant problems were encountered in integrating either of the inference engines. Nor did one inference engine run significantly faster than the other for this small knowledge base. It was concluded that these two systems supplement rather than compete with one another.

A second objective was to examine when it is preferable for a computer to supply the data and when it is preferable for the data to be supplied by human vision. It was also concluded during the development of this system, that there are times to rely on the computer and there are times to rely on the vision of the user. For small problems such as the ones used for testing, there are several instances where the user's vision was more preferable than relying on the computer, such as determining the location of the support surface relative to the loads. However, for larger, more complex problems, it might be preferable to add symbolic rules to the knowledge base, numerical algorithms to the main program, and rely on the computer.

The main program driver for STRUTEX is written entirely in Fortran. Other components were added by linking existing software - DI-3000 for the graphics, RIM (relational Information Management) for the relational database management, and CLIPS for the inference engine - to the main driver program. The data for RIM and the knowledge base (rules) for CLIPS are maintained in different files separated from STRUTEX. EAL (Engineering Analysis Language) for the structural analysis, and CONMIN (Constraint Minimization) for the optimization are coupled in PROSSS (Programming System for Structural Synthesis) to perform the analysis and optimization.

Expert System Name:	None
Purpose:	Implements a decomposition scheme suitable for multilevel optimization and to display the data in an N x N matrix format.
Development Stage:	Finished
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	James Rogers, NASA Langley Research Center MS: 246 Hampton, VA 23665-5225

CLIPS was used to develop an engineering knowledge based tool for decomposing complex design problems into a suitable multilevel structure based on the multilevel optimization approach. This tool requires an investment of time to generate and refine the input for each design module. This investment may not be justified for a small, well-understood problem, but should save a significant amount of money and time in organizing a new design problem where the ordering of the modules is still unknown. The decomposition of a complex design system into subsystems requires an interaction with the judgment of the design manager. This tool can aid the design manager in making decomposition decisions early in the design cycle.

This tool provides help to the design manager by reordering and grouping the modules based on the links (interactions) among the modules. The modules are grouped into circuits (the subsystems) and displayed in an N x N matrix format. The feedback links, which indicate an iterative process, are limited and restricted to be within a circuit. Since there are no feedback links among the circuits, the circuits can be displayed in a multilevel format. Thus, a large amount of information is reduced to one or two displays. The displays are stored and can be easily retrieved and modified. The design manager and leaders of the design teams are given a visual display of the design problem and the intricate interactions among the different modules so that they can see how a change in one subsystem will effect other subsystems. It also helps reduce the possibility of overlooking important links.

The tool gives the design manager the capability of examining the potential savings in time by executing some of the modules in a circuit in parallel. A substantial time savings can be obtained if circuits on the same level of the multilevel structure are executed in parallel. The time savings as well as the number of processors that will be required are determined. In addition to decomposing the system into subsystems, the tool examines the dependencies of the problem and creates a dependency matrix. This matrix shows the relationship among the independent design variables and the dependent objective and constraint functions.

Expert System Name:	BRAT
Purpose:	Simulation of the actions of the man-in-the-loop in conducting command and control tasks.
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Brett Gossage MS: 1-1-188 Nichols Research Corporation 4040 S. Memorial Pkwy. Huntsville, AL 35802

We are building BRAT - BMC3 Requirements Analysis Tool - a simulation tool for the U.S. Army Strategic Defense. It will simulate actions of the man-in-the-loop in conducting command and control tasks. Development is on a Compaq 386, with Dos and Microsoft C 5.1, and on a Vax VMS with Dec C.

Expert System Name:	None
Purpose:	An Expert System to manage the operation of the Space Shuttle’s fuel cell cryogenic reactant tanks.
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Amy Murphey Rockwell Space Operations Co. MC: R16G 600 Gemini Ave. Houston, TX 77058

To ensure an adequate and uninterrupted supply of electrical power during all phases of the Space Shuttle's flight, it is necessary to judiciously monitor and control the flow of cryogenic hydrogen and oxygen out of storage tanks and into the fuel cells. To maintain a reliable supply of cryogenic reactants and to provide redundancy and fault-tolerance, the Power Reactant Storage and Distribution (PRSD) tanks must be depleted as evenly as possible, within the constraints of certain guidelines. Therefore, the PRSD system must be configured at certain times during the nominal mission according to, not only the mission profile and initialization specifications, but also an appropriate schedule of tank depletion.

We are developing a rule-based expert system which may be used for flight design to manage the operation of the Space Shuttle's PRSD system. The expert system provides the user with recommendations on how to configure the PRSD system. That is, for a given state of the PRSD system, the expert system indicates which manifold valves to close and which tanks to activate.

The knowledge of this expert system is based upon standardized management criteria established by Johnson Space Center. Thus, this expert system is a tool to aid flight design analysts of the Space Shuttle's Electrical Power System to devise PRSD operational schemes during preflight planning.

Expert System Name:	EMI Detection Expert
Purpose:	An EMI detection Expert System.
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Dave Swanson, SEI 4241 Jutland San Diego, CA 92117

We are developing an EMI Detection Expert System for the U.S. Navy.

Expert System Name:	Woodpecker
Purpose:	Assists in the management of woodpecker habitat.
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Robert Coulson, Department of Entomology Texas A&M University College Station, TX 77843

No abstract.

Expert System Name:	Weed Control Advisor
Purpose:	Selects proper herbicides for weed control in rice production.
Development Stage:	Finished
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Robert Coulson, Department of Entomology Texas A&M University College Station, TX 77843

The Weed Control Advisor provides expert advice on the selection of effective herbicides during all phases of the rice production time-line. It also provides the following:

- Explanations of why a particular herbicide is or is not suggested.
- Effectiveness of appropriate herbicides.
- Application information such as rates of applications and general application methods.
- Information on how a suggested herbicide provides control against weeds.
- Any warnings that might apply to a particular herbicide.

It is also a learning tool and can be used by those who want to learn more about weeds common to rice fields, and their control. Users can learn more about herbicides, when they are most effectively used, rates of use, and other application information by using the Weed Control Advisor.

Expert System Name:	Southern Pine Beetle
Purpose:	Forecasts infestation of southern pine beetles.
Development Stage:	Developing
Other Languages/Shells Used:	GIS, GRASS
Last Update:	May 29, 1992
Contact:	Robert Coulson, Department of Entomology Texas A&M University College Station, TX 77843

Forecasts infestation of southern pine beetles based on information about the area considered, such as the age of the forest, the occurrence of lightning, and the history of bark beetles.

Expert System Name:	INSEX
Purpose:	Recommends insecticides to use in forest management.
Development Stage:	Beta Testing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Robert Coulson, Department of Entomology Texas A&M University College Station, TX 77843

No abstract.

Expert System Name:	ISPPEX
Purpose:	Integrated pest management system for southern pine beetles.
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Robert Coulson, Department of Entomology Texas A&M University College Station, TX 77843

ISPBEX, Integrated Southern Pine Beetle Expert System, is a software program which uses Artificial Intelligence programming techniques to solve problems associated with identifying and suggesting treatment recommendations for the control of southern pine beetle infestations. The system utilizes information about specific pine beetle spots which can be entered directly through the data entry screens in ISPBEX and transferred to or retrieved from the Data General. The Expert System asks you, the user, questions about your particular problem and utilizes field data collected from spots during ground checking. Rules based on knowledge compiled from experts specializing in forest management, wildlife management, and southern pine beetle biology are applied to the field data to determine the appropriate treatment actions. ISPBEX also provides:

- Data entry and update capabilities for SPBIS and RCW data sets.
- Spot growth model for estimating tree mortality up to 31 days.
- Spot geometry routine for estimating the distance the spot will travel up to 1600 meters.
- Treatment priority classification for the spot.
- Explanations of why a particular management tactic was recommended.

ISPBEX is also a learning tool and can be used by those who want to learn more about SPB (Southern Pine Beetle) management. It is a menu driven system which queries the user for input or selection of menu items. There are two ways to respond to these queries. The first way is to select items from a list of choices that ISPBEX presents to you. The second way is to type values into menus that resemble SPBIS and RCW data forms.

Expert System Name:	UNIX Advisor
Purpose:	Assist Unix Microcomputer System Administrators in diagnosing and solving problems.
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Mott Given U.S. Army MS: DSAC-TMP Defense Logistics Agency Bldg. 27, Section 1, P.O. Box 1605 Columbus, OH 43216-5002

I am developing UNIX Advisor: an Expert System to assist UNIX system administrators for Gould 9050 minicomputers running UTX/32 UNIX (which is based upon BSD 4.3). The system covers the following types of problems:

- RJE problems, eg. line down, lines up but data not being transmitted.
- System crashes, hangs, panics, or halts.
- Tuning advisor.
- Analyzing system console messages.
- Why is the file system filling up?
- How do you rebuild a crashed disk?
- Building a facility for people to keep online notes about problems.
- Sources of information on UNIX.
- Automatically run certain monitoring commands.

In its present form, UNIX Advisor covers the initial requirements, as well as having the following:

- A facility to let users exit to the UNIX shell, run UNIX commands, and return to the Expert System.
- A survey form that application users go through as they exit the application.
- A note-taking facility for recording observations about how different types of problems that are not currently in the knowledge base were solved.
- An electronic mail facility to send comments to the author of UNIX Advisor.

Expert System Name:	None
Purpose:	Assists in management decisions for steep pastures in the Appalachian region.
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Douglas Boyer USDA-ARS P.O. Box 867 Beckley, WV 25802-0867

CLIPS is being used to build an Expert System for assisting in management decisions for steep pastures in the Appalachian region. Given certain soils, macro-climate, micro-climate, management goals and farmer experience, CLIPS will assist the farmer in making decisions that will make the best use of his land, with resource conservation being a requirement.

Expert System Name:	Front-end to GIS
Purpose:	Acts as an aid and enhancer of the GIS decision making process.
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Robert MacArthur, Computer Application Group College of Agriculture University of Arizona Tucson, AZ 85721

No abstract.

Expert System Name:	None
Purpose:	Verification and validation of expert systems.
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Peter Green Worchester Polytechnic Institute 100 Institute Road Worchester, MA 01609

No abstract.

Expert System Name:	ASW Info Sys Dynamic Data Store
Purpose:	Test & track file storage
Development Stage:	Conceptual
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Dr. John Esch, Paramax Systems Inc. P.O. Box 64525 MS - U1N28 St. Paul, MN 55164

Prototype / Test both dynamic track file storage in a distributed ASW Inf. Sys and CLIPS.

Expert System Name:	SelectPC
Purpose:	Allows selection of PC equipment on the basis of a client's software specifications.
Development Stage:	Conceptual
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Rob Schaller Lockheed 2400 Nasa Road One MS - B08 Houston, TX 77058

No abstract.

Expert System Name:	Leukemia Diagnostic Assistant
Purpose:	Assist clinicians in analysis of data from cancer patients.
Development Stage:	Conceptual
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Gary Salzman Los Alamos National Lab MS - M888 Los Alamos, NM 87545

Flow cytometry data is obtained from the patient. System then supervises cluster analysis and applies rules to make decisions about the various cell populations.

Expert System Name:	None
Purpose:	Medical expert systems
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	James M. Lamiell Brooke Army Medical Center Box 4, Bldg 1029 Fort Sam Houston, TX 78234

1) Expert system to assist in scheduling nurses for ward shifts.
2) Expert system to assist in Emergency Department disposition of chest pain patients.
3) Expert system to assist in Emergency Department triage of patients.

Expert System Name:	FEVES
Purpose:	Validate aircraft finite element models
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Nasir Munir, Northrop Aircraft Division 1 Northrop Avenue Hawthorne, CA 90250

Finite Element Validation Expert System aids in the automation of the analysis/design tasks in the NASTRAN modeling of aircraft structures by addressing the problems of validation and classification.

FEVES represents knowledge using frames and production rules. A frame based knowledge representation is used for the classification portion and production rules are used to validate the model. FEVES communicates with the user through a graphical interface. A forward chaining mechanism is used to make expert decisions. The separate components of FEVES communicate through a common database.

The chief benefits of using FEVES are: (1) automation of the errorprone task of classifying sub-components in a large NASTRAN model. For large models the time saved is between 40 and 60 percent; (2) automation of the error checking process which leads to consistent modeling practices. As a training vehicle, it aids inexperienced users to learn good modeling practices.

Expert System Name:	None
Purpose:	Resource allocation planning
Development Stage:	Conceptual
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Michael McKenney U.S. Army 75 SW Cutoff Northboro, MA 01532

Given a current plan and a current state of resource allocation:

- Evaluate current state of plan against administrative rules.
- Evaluate current state against policy rules.
- Redistribute
- Evaluate new distribution against various other senarios.

Expert System Name:	B2C2
Purpose:	Distributed and stand-alone terminal application in support of command and control (C2); decision support
Development Stage:	Developing
Other Languages/Shells Used:	KBEST/RBEST(TITAN) and M-1
Last Update:	May 29, 1992
Contact:	George E. Sherman U.S. Army ATTN: AMSEL-RD-C3-CC Ft. Monmouth, NJ 07703

Utilize TAE+ for X Window user interface and C code generation, linked to TACTICIAN and mapped data, distributed data access and position-location capability, supported by VHF and area communications architectures. Map-based decision aid with task matrix format.

Expert System Name:	GESLAN
Purpose:	Allow choice of suitable conditions for laminar analysis programs.
Development Stage:	Developing
Other Languages/Shells Used:	FORTRAN
Last Update:	May 29, 1992
Contact:	Michael K. Neylon NASA Lewis Research Center 2100 Brookpark Rd. MS - 49-8 Cleveland, OH 44135

GESLAN provides both an expert system and a direct input that creates the necessary files to run the laminar programs.

Expert System Name:	Intelligent tutoring system shell
Purpose:	Provide a generic ITS Shell for Army personnel to use to create ITS's for various areas.
Development Stage:	Developing
Other Languages/Shells Used:	C++
Last Update:	May 29, 1992
Contact:	Robert E. Scurlock Naval Postgraduate School 108 Brownnell Circle Monterey, CA 93940

Working on establishing generic modules of ITS design that can be put together with a knowledge base to use as an ITS. Examining using C++ object interfaced with CLIPS 5.0.

Expert System Name:	Intelligent Forecasting System
Purpose:	PC-based forecasting workstation
Development Stage:	Beta testing
Other Languages/Shells Used:	Autobox 3.0, FORTRAN Forecasting Engine
Last Update:	May 29, 1992
Contact:	Nelson Marquina KETRON 350 Technology Drive Malvern, PA 19355-1315

Initial application provides GUI front end to a Box-Jenkins forecasting algorithm/engine. The expert system will automatically interact with the forecasting engine to find better models for the given time series. Application system can be used with time-domain or frequency-domain data.

Expert System Name:	EVAL
Purpose:	Incorporate Program Impact Advisor System into a component module of Program Manager's Support System.
Development Stage:	Conceptual
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Tanya Tran EG&G Wasc Inc. 8809 Sudley Road Manassas, VA 22110

The PIA currently exists as a fully functional prototype on a Xerox 1186 Workstation. The code consists of roughly 4000 lines of INTERLISP-D. We are in the process of translating LISP into CLIPS. Modification of CLIPS will be supplemented to interface with RDBMS (Ingress/ORACLE/INFORMIX). The user interface will be needed later in our development.

Expert System Name:	Value Engineering Change Proposal
Purpose:	Calculating engineering change proposals
Development Stage:	Finished
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Becky Williams, U.S. Army HQ AMCCOM, Attn: AMSMC-SAO Rock Island, IL 61299-6000

When a contractor finds a less expensive way to provide a product the government shares the savings with the contractor. The VECP program is an automated system which asks required questions and then makes the required calculations.

Expert System Name:	DMINS
Purpose:	Diagnose faults in inertial guidance unit
Development Stage:	Finished
Other Languages/Shells Used:	KMS
Last Update:	May 29, 1992
Contact:	Eric Hanson U.S. Air Force WL/AAA-1 WPAFB, OH 45433

The user interface was done using KMS, a hypermedia system. The system runs on Sun 3 and Sun 4 workstations.

Expert System Name:	Post-Market Care
Purpose:	Evaluate protocols for medical device studies.
Development Stage:	Conceptual
Other Languages/Shells Used:	SQL and C
Last Update:	May 29, 1992
Contact:	Robert Fike, USFDA - Office of Science & Technology MS - HFZ-142 12720 Twinbrook Parkway Rockville, MD 20857

The Safe Medical Device Act of 1990 requires that certain types of medical devices be studied after their introduction into the market. We hope to automate as much as possible the scientific and administrative evaluations of the protocols for these post-market studies. This could include accessing pre-market study information about a particular device from a relational database. Also, the possibility of multiple linked expert systems exists.

Expert System Name:	None
Purpose:	militaryBattle manager for SDI simulation
Development Stage:	Developing
Other Languages/Shells Used:	FORTRAN and C
Last Update:	May 29, 1992
Contact:	Charles Bosch General Electric P. O. Box 1000 Blue Bell, PA 19422

Core simulation written in FORTRAN interfacing to CLIPS via C. C will call CLIPS with various positional, situation, sensor data and will get “shot” strategy from a knowledge base.

Expert System Name:	PNS
Purpose:	Diagnosis of fluid dynamics analysis codes
Development Stage:	Finished
Other Languages/Shells Used:	ART, ART-IM, KEE, OPS5, Smalltalk, and Objective C
Last Update:	May 29, 1992
Contact:	James A. Simak General Dynamics 3849 Misty Meadow Drive Fort Worth, TX 76133

The Parabolized Navier-Stokes (PNS) Advisor is an embedded expert system application that diagnoses and corrects problems encountered while running the AFWAL PNS Code. Originally developed and running on a Cray XMP, the Advisor provided pre-execution analysis of a user's problem specification and post-analysis of the solution and any error conditions that had occurred. The Advisor currently runs on a Convex C240 and supports several CFD Analysis including the AFWAL PNS Code.

An interactive knowledge acquisition tool was developed on an IRIS 4D/25 in 1990 to enable the "export" developers to directly manage and modify the knowledge bases. A case library has been added to provide extended diagnostics support for problems not explicitly identified in the knowledge base. A case-base reasoning rulebase and automated case acquisition and indexing methodology is under development.

Expert System Name:	OPPLAN
Purpose:	Operations Planning
Development Stage:	Developing
Other Languages/Shells Used:	LISP and MetaData
Last Update:	May 29, 1992
Contact:	Bruce H. Cottman, Symbiotics, Inc. 60 Canterbury Road Waltham, MA 02139

Integrate CLIPS with a logistics model based on an object-oriented DBMS.

Expert System Name:	Payload Avionics Integration Tool
Purpose:	Analysis of Shuttle payload electrical and avionic requirements
Development Stage:	Developing
Other Languages/Shells Used:	ART, KEE, and Ada
Last Update:	May 29, 1992
Contact:	Robert Duane Lockheed P. O. Box 58561 Houston, TX 77258-8561

The tool is a relatively simple forward-chainer with a lot of comparison of input values to known limits. A fairly sophisticated user interface has been written with Hypercard. The only interface between the Hypercard application and the CLIPS application is through external text files.

Expert System Name:	None
Purpose:	Control and diagnosis of nuclear reactors
Development Stage:	Developing
Other Languages/Shells Used:	C, Objective C
Last Update:	May 29, 1992
Contact:	Luis Rovere Oak Ridge National Laboratory P. O. Box 2008 Oak Ridge, TN 37831-6010

Implementation of diagnostic rules to identify plant operational status and generate appropriate control actions. Fuzzy control was included as a separate set of objects in Objective C. Now they will be moved to COOL. These control systems are running on a Sun network using RPCS.

Expert System Name:	TARGET v3.0
Purpose:	Simulation and analysis of warfare engagements and systems performance
Development Stage:	Developing
Other Languages/Shells Used:	C++
Last Update:	May 29, 1992
Contact:	Laura G. Hinton Trident Systems Inc. 10201 Lee Highway, Suite 300 Fairfax, VA 22030

This project involves the complex development of a Tactical Resource Generation and Evaluation Tool. The TARGET model is an object-oriented, Monti-Carlo simulation of multi-

warfare engagements that includes platforms (air, surface, and subsurface), sensors (platform-based, and independent, such as buoys), weapons, C3I functions and tactics. Additional features of the model include interaction with tactical procedures and operation through an embedded expert system, and a sophisticated graphical user interface.

Expert System Name:	Resource Management
Purpose:	Develop scenarios for resource evaluation
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Dave DeMascio General Electric P. O. Box 8048 Philadelphia, PA 19101

Build knowledge bases to reuse previously developed applications knowledge; update the knowledge; then use the newly modified knowledge to evaluate resources.

Expert System Name:	FMES
Purpose:	Assist field investigator at flight mishap site.
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Paul R. Cyrus, U.S. Air Force 2049 C-CSG/SCDC McClellan AFB, CA 95652

Flight Mishap Expert System allows the field investigator to collect data on a mishap investigation. CLIPS is used to guide the investigator through the investigation. It utilitzes a pen-based computer (GRIDPAD) to perform this function.

Expert System Name:	None
Purpose:	Meteorologic/Oceanographic forecasting
Development Stage:	Conceptual
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Paul Ehrler, Lockheed 6800 Burleson Road O/T2-30 B/310 Austin, TX 78744

Initial plans are to develop a low-cost oceanographical work station using multi-source data an visualization techniques. Plans are to upgrade to 386 or 486-based develpment with Turbo C++. Decision to use CLIPS based on cost, growing user community, efficiency, suitability to low-cost platforms.

Expert System Name:	None
Purpose:	aerospaceSupport human & habitation team for Lunar/Mars program
Development Stage:	Conceptual
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Martha Evert Lockheed 2499 Nasa Road One MC - C44 Houston, TX 77058

Currently reviewing CLIPS as a resource to be used in modeling a habitat on the Moon and Martian surface. CLIPS would be used to make decisions on combining various subsystems during an outpost operation. The decision-making would interface with Excel databases to calculate subsystems' mass, volume and power figures. Interested in obtaining HyperCLIPS as another possibility. No formal presentation has been made to NASA. The team is reviewing possibilities in parametric analysis.

Expert System Name:	None
Purpose:	Project management
Development Stage:	Conceptual
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Gerald M. Powell U.S. Army HQ, U. S. Army, CECOM Ft. Monmouth, NJ 07703

Specific applications would come from the Army's five battlefield functional areas, for example, countability planning is a subfunction of the Maneuver control functional area.

Expert System Name:	PreAmp
Purpose:	PWA Producibility Advisor
Development Stage:	Conceptual
Other Languages/Shells Used:	C, LISP
Last Update:	May 29, 1992
Contact:	James C. Muller Martin Marietta Electronics P.O. Box 628007 12506 Lake Underhill, Dr. Orlando, FL 32825

The PreAmp Program will significantly advance U.S. electronic product development. It will demonstrate integration of engineering and manufacturing enabled by a modular, standards-based data-sharing automation framework. The PreAmp program addresses the technology, automation software, and information-sharing requirements that will enable the U.S. electronics industry to obtain the huge competitive benefits integrated product development studies have identified in limited, proprietary settings. Those benefits include a substantial increase in product flexibility together with dramatic reductions in time-to-market, product development cost and cost of quality. The data sharing and concurrent engineering automation technology concepts developed in PreAmp will focus on the electrical/electronic domain. These concepts will be demonstrated and technology barriers to wide-spread use will be identified. Ultimately, this approach can be extended to other industries to obtain similar global competitive advantages.

Expert System Name:	None
Purpose:	Simulation of distributed autonomous network management algorithms & protocols
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Scott Wills, Harris GASD MS - 102-4844 P. O. Box 94000 Melbourne, FL 32902

Discrete event simulations of various network designs. Uses COOL extensively to describe COMM components, uses rules to describe protocols & algorithms.

Expert System Name:	HLPR
Purpose:	Improve process by which optimal production methods and procedures are forecast and determined
Development Stage:	Conceptual
Other Languages/Shells Used:	C, Vermont Views
Last Update:	May 29, 1992
Contact:	J. V. Dart, LTV Aerospace & Defense 9314 W. Jefferson Blvd. Dallas, TX

The system will automate tasks of pre-planning, bid-planning, tool ordering, electronic buyoff and generation of various reports. The system is interactive and VAX-based using C and SQL.

Expert System Name:	Eagle Analyst Workstation
Purpose:	Detection of anomalies
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Dennis Powell Los Alamos National Laboratory MS - F602 Los Alamos, NM 87545

Apply expert system technology to reviewing the outputs of an Army combat model (Eagle) in order to detect anomalies and subsequently point to potential errors in model input or algorithms.

Expert System Name:	None
Purpose:	Resource Planning
Development Stage:	Finished
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Vincent Papandrea General Dynamics 75 Eastern Point Rd. D/449 C62 Groton, CT 06340-4989

Production flow through major facilities is modeled using input from individual currently performing planning task (ie: the expert). System assigns jobs to appropriate work area in accordance with end use date obtained from the company's planning databases (MRP/ARTEMUS). Outputs include drawings of the facility showing location of units or ships at

any point in the schedule usage charts, and work center loading displays. The system has been used extensively for analyzing facility requirements for a new product line.

Expert System Name:	None
Purpose:	JIT System for delivery of spare parts
Development Stage:	Alpha Testing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Bill Spernow Entelechy Research, Inc. 9448 Miranoy Drive Sacromento, CA 95826-5227

Attempting to develop a CLIPS program that can be used as a structure, around which will be built a JIT system for delivery of spare parts (from a central warehouse) used in maintenance and repair of aircraft at an Air Force repair depot.

Expert System Name:	Situation Assessment Subsystem
Purpose:	Situation Assessment Subsystem for rotorcraft pilots associate
Development Stage:	Developing
Other Languages/Shells Used:	C and C++
Last Update:	May 29, 1992
Contact:	Dan Ballaro Reticular Systems, Inc. 4095 Calgary Ave San Diego, CA 92122

The Situation Assessment Subsystem is being developed as a cognitive decision aid to assist the pilot in high threat environments. The system uses multiple blackboards to recognize, analyze and predict threat behavior and infer high level attributes about detected objects of interest.

Expert System Name:	None
Purpose:	Computer language conversion
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Robert L. Klungle, Hughes Aircraft 506 N. Irena #B Redondo Beach, CA 90277

- System for performing language conversion (FORTRAN, C, Pascal) to ADA. Also improves ADA code currently running.
- Automatic generaion of SIMSCRIPT II.5 simulation code from graphic pictures.

Expert System Name:	SIPS QA/DA
Purpose:	aerospaceResolve errors during dowlink transmission from Spacelab.
Development Stage:	Finished
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	W. David Ripley III Computer Sciences Corporation 4600 Powder Mill Road Beltsville MD 20705

The Spacelab Input System (SIPS) Quality Assurance and Data Accountability (QA/DA) expert system was developed for NASA to aid Spacelab Data Processing Facility (SLDPF) personnel. The system assists SLDPF personnel in detecting and resolving anomalies that occur during a downlink transmission from Spacelab and those that reesult from a variety of data processing system failures associated with the capture and storage of large amounts of data.

Expert System Name:	AIDBI
Purpose:	Assist radar systems intelligence analysts
Development Stage:	Conceptual
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Russell Moody, ORION International Technologies, Inc. 4027 Colonel Glenn Highway: Suite 411 Dayton, OH 45431

The FASTC (Foreign Aerospace Science & Technology Center) computer environment consists of large on-line databases (structured/formatted and free text), models and simulations, and other analytical and data processing software tools. FASTC is transitioning from a PC to a Sun client/server environment. The AIDBI program is investigating opportunities to apply expert systems to improve the analysis process. Prime candidates which have been identified are:

1) Text search, retrieval and processing
2) Intelligence data research and collection
3) On-line radar systems expert advisor
4) Radar systems analyst tutor

The project is currently in the operational requirements definition stage.

Expert System Name:	Rapidism
Purpose:	Improve Rapidism transportation model decisions.
Development Stage:	Conceptual
Other Languages/Shells Used:	Ada
Last Update:	May 29, 1992
Contact:	Donald E. Clemmer Computer Sciences Corporation MS 312 3160 Fairview Park Drive Falls Church, VA 22042

Purpose of concepts being worked out is to show government personnel how expert systems and CLIPS can enhance model processing.

Expert System Name:	Finance Studies
Purpose:	Alternatives for manpower reductions
Development Stage:	Conceptual
Other Languages/Shells Used:	C, C++, XLisp, Clipper 5.0
Last Update:	May 29, 1992
Contact:	David T. Roberts U.S. Army HQ 3rd Corps at Fort Hood Fort Hood, TX 76544-5056

We anticipate a number of retirees who won't be replaced during manpower reductions and hiring freezes. We seek to use expert system to:

1) Capture their knowledge
2) Permit new employees to handle the most common problems without a lengthy training period.
3) Use expert system as a training vehicle.

Areas under exploration: travel pay; estimating, travel pay settlement, allowable expenses; commercial accounts payable; civilian pay queries; military pay queries; contract management; interfund transfers.

Knowledge bases would be updated as regulations change. When old rules (superseded) are overlooked and thus not deleted, conflict resolution becomes paramount.

Expert System Name:	None
Purpose:	Assist in combat simulation
Development Stage:	Conceptual
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	H. M. Ryan III U.S. Army 8120 Woodmont Ave Bethesda, MD 20814

We are beginning a project in which we contemplate the use of CLIPS. The system will be rule based and will compare and check the output of a combat simulation model against a database of "clean" model runs. System purpose is to flag output elements that might appear not to be representative of expected combat.

Expert System Name:	AI/Ada Processor
Purpose:	Improvement of Ada AI systems
Development Stage:	Developing
Other Languages/Shells Used:	Ada
Last Update:	May 29, 1992
Contact:	Bill Wavering Integrated Software, Inc. 1945 Palm Bay Rd NE Palm Bay, FL 32905

Particular application will be an expert system (pilot's aid) for an en route mission planning system. We are currently using an expert system written in Ada at Florida Institute of Technology. We will be exploring the possibility of using our hardware to improve Ada CLIPS performance.

Expert System Name:	TBHELP
Purpose:	Air to air combat simulation
Development Stage:	Developing
Other Languages/Shells Used:	FORTRAN 77
Last Update:	May 29, 1992
Contact:	Barry N. Cox Lockheed 501 Marin St., Suite 214 Thousand Oaks, CA 91360

TAC BRAWLER consists of over 2,600 subroutines and 110,000 lines of code. It is an exceptionally complex model because of the huge number of parameters which may be varied. It

is hoped that CLIPS may be embedded within the TBHelp Tool (an enhanced user interface tool) to assist with failure diagnostics and reporting.

Expert System Name:	Automated Message Update Module
Purpose:	Integration of NASA data sources
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Glenn Oliveira Marin Marietta 700 W. Mineral Ave MS - XL 8058 Littleton, CO 80120

This would provide a front-end for diverse NASA data set header formats. Its functions would include:

1) Integrate interdisciplinary data set information into a common format; and
2) Provide inference metadata to these input data sets based on prior data set knowledge. This includes establishing a "confidence factor" for existing header information, and augmenting existing header information with relevant user, site, interest domain, and storage information.

Expert System Name:	Intelligent Computer Aided Design System
Purpose:	Use of expert systems in CAD
Development Stage:	Finished
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	Jesse Allen Accugraph Corporation 5822 Cromo Drive El Paso, TX 79912-5598

Designing a new home or office building is much more than just transferring a mental image of the structure onto a computer screen via your favorite CAD program. It involves the interaction of an experienced architect and many specialists in areas as diverse as interior lighting and structural engineering. The process of design, consultation with specialists, and revision can be a long, arduous and costly affair.

The ICADS system consists of a number of expert systems developed with CLIPS and is designed to run under Accugraph's MountainTop CAD and Graphic Information Management

Software. Some of the experts that can be consulted include a structural analyst, lighting expert, cost advisor, and an acoustical consultant.

Another expert system that Accugraph is using CLIPS and ICADS for is their "NetWork Analyst" which also runs under MountainTop. It could be used to determine the connectivity of objects in a network for fault analysis or rerouting.

Expert System Name:	Financial Management System
Purpose:	Financial data base system management
Development Stage:	Conceptual
Other Languages/Shells Used:	GURU and First Class
Last Update:	May 29, 1992
Contact:	Kerry Culligan U.S. Navy NCTS Code N813 Bldg 600 Pensacola, FL 32508

We have just become involved with the maintenance and enhancement of the Financial Management System and the Inventory Management System. If applicable, we plan to combine the two databases and use an expert system. One of these applications is written in GURU, however, it appears to be mostly procedural code for the database.

Expert System Name:	Risk Assessment Tool
Purpose:	Provide an on-line risk assessment tool
Development Stage:	Finished
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	David B. Ramsey, PRC 600 Maryland Ave., S.W., Suite 400 Washington, DC 20024

This application provides the user with a sensitivity/criticality assessment.

Expert System Name:	None
Purpose:	Power supply contingency evaluation
Development Stage:	Developing
Other Languages/Shells Used:	None
Last Update:	May 29, 1992
Contact:	John Bremser, Los Alamos National Laboratory MS F661 Los Alamos, NM 87545

Given a particular power utility company and a description of their operating procedures, this expert system can make recommendations as to actions to be taken in the event of a contingency or contingencies.

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