## RECENT REPORT ABSTRACTS

**PLINTH: Integrating Hypertext, Semantic Nets and Rule-Based Systems in an Expertext Shell for Authors and Readers of Regulatory Documents**
*Casson, A., September 1994*

**Abstract**
This paper describes current research, in collaboration with the Building Directorate of the Scottish Office, concerned with the design and implementation of an authoring and information retrieval tool for technical documents, with particular application to the Building Standards Regulations for Scotland and the associated Technical Standards. The system we are building, called PLINTH (the Platform for Intelligent Hypertext) is an expertext shell which combines a variety of established representation schemes into a new, integrated architecture, which not only supports the creation and manipulation of standards documents in hypertext form, but also manages the design rationale of underlying documents, and provides facilities for intelligent guided browsing and consultation of the texts. The paper explains the way in which the diverse representations have been combined, and gives an example of the system in use.

**Reference**
Casson, A., 'PLINTH: Integrating Hypertext, Semantic Nets and Rule-Based Systems in an Expertext Shell for Authors and Readers of Regulatory Documents', *Technical Report AIAI-TR-142*, 1994

**EXCALIBUR: A Program for Planning and Reasoning with Processes**
*Drabble, B., Revised February 1992*

**Abstract**
This article describes research aimed at building a hierarchical partial order planner which is capable of interacting with a constantly changing world. The main aim is to verify a planning and execution strategy based on Qualitative Process Theory which allows a greater level of interaction between the planner and the real world than exists within current planners. A variety of techniques are described which allow the planner to create a model of the world in which plan failures can be analysed and faulty plans repaired. These techniques also allow the planner to react to changes in the world outside of the plan which it has been told previously to avoid happening eg. an explosion.

**Reference**
Drabble, B., 'EXCALIBUR: A Program for Planning and Reasoning with Processes', *Technical Report AIAI-TR-143*, 1992

**Re-engineering IMPRESS and X-MATE using CommonKADS**
*Kingston, J., April 1994*

**Abstract**
The CommonKADS methodology, which is currently being developed as a successor to the KADS methodology, has suggested a considerable number of alterations or extensions to the modelling approaches used in KADS. This paper reviews these changes by applying the CommonKADS approach to two KBS systems which were originally engineered using a version of KADS: the IMPRESS system, for diagnosing faults in plastic moulding machinery, and the X-MATE system, for advising on whether a mortgage application should be granted. The focus of the work is on the modelling of expertise (domain, inference and task levels) in CommonKADS. The conclusion of the paper is that the new approaches recommended by CommonKADS are all valuable for KADS-based projects, although some of the ‘libraries’ of techniques are currently very small. However, the new approach to domain modelling would benefit

from some guidance on ontological classification.

**Reference**
Kingston, J., 'Re-engineering IMPRESS and X-Mate using CommonKADS', *Technical Report AIAI-TR-144*, 1994

**The Use of Object Oriented Database in PLINTH**
*Casson, A., March 1994*

**Abstract**
This paper addresses the data storage and access problems in the current implementation of the expertext shell PLINTH. The nature of these problems and of the data that PLINTH manipulates suggest object oriented database (OODB) technology as a possible solution. OODB features are described and their appropriateness for use in PLINTH examined. Finally, we discuss the changes that need to be made to the existing system in order to accommodate an OODB storage medium.

**Reference**
Casson, A., 'The Use of Object Oriented Database in PLINTH', *Technical Report AIAI-TR-145*, 1994

**The Use of Condition Types to Restrict Search in an AI Planner**
*Tate, A. Drabble, B. & Dalton, J., July 1994*

**Abstract**
Condition satisfaction in planning has received a great deal of experimental and formal attention. A “Truth Criterion” lies at the heart of many planners and is critical to their capabilities and performance. However, there has been little study of ways in which the search space of a planner incorporating such a Truth Criterion can be guided. The aim of this document is to give a description of the use of condition “type” information to inform the search of an AI planner and to guide the production of answers by a planner’s truth criterion algorithm. The authors aim to promote discussion on the merits or otherwise of using such domain-dependent condition type restrictions as a means to communicate valuable information from the domain writer to a general purpose domain-independent planner.

**Reference**
Tate, A., Drabble, B. & Dalton, J., 'The Use of Condition Types to Restrict Search in an AI Planner', *Technical Report AIAI-TR-146*, 1994

**Putting Knowledge Rich Process Representations to Use**
*Tate, A., March 1994*

**Abstract**
Research into the generation of plans using knowledge based techniques is now maturing and finding practical application in the commercial, industrial and defence sectors. This has led to a rapid expansion in the last couple of years of investment in this area. Ways to represent plans which have emerged from the research have been found to be of benefit in a number of areas - even when the generation of a plan is not the primary concern. One way in which the research is being exploited is via the use of knowledge rich plan representations to allow systems to improve their monitoring, analysis and advisory capabilities. These knowledge rich plan representations are now finding uses in the area of Process Modelling - in particular for business process modelling. Enriched process models can lead to enhancements of the analysis and critiquing of business processes and can open up a variety of ways to support the synthesis and re-engineering of processes, the creation of plans and intelligent workflow management systems. Knowledge based approaches are acknowledged as a key component in facilitating the integration of “islands of automation” in today’s enterprises.

Means to connect executive strategic decision making, analysis and direction with tactical planning and scheduling capabilities and on to effective operations management within an organisation may be facilitated by using AI based plan representation approaches. The First Conference on Enterprise Integration Modelling [6] identified support for the management of change as an important area for the success of enterprise integration efforts. The working groups of the conference also believed that a combination of Artificial Intelligence (AI) and Operations Research (OR) methods as explored by the knowledge based planning community could be a good basis for this work.

**Reference**

Tate, A., 'Putting Knowledge Rich Process Representations to Use', *Technical Report AIAI-TR-147*, 1994

**Sythesizing Protection Monitors from Causal Structure**

*Reece, G. A. Tate, A., June 1994*

**Abstract**

Protection monitors synthesized from plan causal structure provide execution systems with information necessary to detect potential failures early during execution. By detecting early, the execution system is able to address these problems and keep the execution on track. When the execution system finds that the necessary repairs are beyond its capabilities, early detection gives the planning system additional time to suggest a repair. This paper discusses how protection monitors are synthesized directly from plan causal structure, and the options which are available to an execution system when protection violations occur.

**Reference**

Reece, G. A. & Tate, A., 'Synthesizing Protection Monitors from Causal Structure', *Technical Report AIAI-TR-148*, 1994

**A Review of Commercially Available Constraint Programming Tools**

*Duncan, T., October 1993*

**Abstract**

Here at AIAI we are fortunate enough to have access to three major constraint programming tools: CHIP, CHARME, and ILOG SOLVER. These systems are currently attracting much interest due to their ability to represent and solve Constraint Satisfaction Problems (CSP), and thus their suitability for dealing with scheduling problems.

**Reference**

Duncan, T., 'A Review of Commercially Available Constraint Programming Tools', *Technical Report AIAI-TR-149*, 1993

**Intelligent Vehicle Scheduling Experiences with a Constraint-based Approach**

*Duncan, T., June 1994*

**Abstract**

This paper describes the experiences and insights that AIAI have gained during the development of an intelligent vehicle scheduling system using a commercially available library for constraint-based programming. The application involves the assignment of drivers and vehicles for single-drop deliveries, under a wide range of regulations, physical compatibility restrictions, and operating preferences. The aims of the project were to produce good quality schedules within a limited time while minimizing operating costs. In addition to generating predictive schedules, the system provides some support for user interaction with the schedule generation process, and reactive scheduling.

**Reference**

Duncan, T., 'Intelligent Vehicle Scheduling Experiences with a Constraint-based Approach', *Technical Report AIAI-TR-150,* 1994

**Corporate Knowledge Management State-of-the-Art Survey**
*Macintosh, A., September 1994*

**Abstract**
Corporate knowledge and corporate knowledge management systems are terms that are being used widely by organisations but with apparently little understanding of their meaning and the extent to which the technologies are available today. The ISMICK'93 conference highlighted this lack of understanding but also showed that companies appreciate that better management of their corporate knowledge asset is required. This paper describes the major projects being undertaken in this area throughout the world. To effectively carry out corporate knowledge management consideration has to be given to how knowledge can be represented in a computer; queried and manipulated by different categories of users; shared and re-used between different applications; and updated and maintained while still guaranteeing quality. These considerations are used as the basis for this comparative review. The information in this report has been gained primarily through three mechanisms: personal communication with project teams engaged in the research area; from the World Wide Web; and from recent publications - the emphasis is on an up-to-date critique of corporate knowledge management. AIAI, at the University of Edinburgh, is engaged in a number of projects related to corporate knowledge management.

**Reference**
Macintosh, A., 'Corporate Knowledge Management State-of-the-Art Survey', *Technical Report AIAI-TR-151*, 1994

**A Daily Operation Planning Method for a Large Scale Water Distribution System**
*Miyajima, Y., September 1994*

**Abstract**
The distribution of drinking water to a large metropolitan areas represents a challenging planning problem. The distribution systems consist of a number of plants and basins which are connected together via pipelines, for which an operation plan is defined by a water distribution plan for each of these pipelines. The water distribution plan defines the water quantity in each pipeline and the load on the plant which acts as the source of the water. The reasoning about the water quantity in each pipeline and the routing of water from the intake plants to the consumer forms a number of subproblems. An Artificial Intelligence based planning system has been developed which extends the capabilities of traditional Nonlin-style planners in that it is able to deal with continuous value variables e.g. water quantity, flow and pressure. A Water Distribution Route Planner has been successfully tested on a number of different water distribution process models. The current system produces a daily operation plan for a large scale water distribution process model which does not contain detours and loops on the pipelines.

**Reference**
Miyajima, Y., 'A Daily Operation Planning Method for a Large Scale Water Distribution System', *Technical Report AIAI-TR-152*, 1994

**The Use of Optimistic and Pessimistic Resource Profiles to Inform Search in an Activity Based Planner**
*Drabble, B. and Tate, A., June 1994*

**Abstract**
Resource reasoning has been at the heart of many of the successful AI based scheduling systems - yet no attempt has been made to integrate the best techniques from scheduling with the best techniques from AI activity based planning. This paper presents a set of incremental algorithms which create two

separate profiles to represent the optimistic and pessimistic use of resources within an activity plan. These allow the planner to ensure that there is a feasible assignment of resources available within any plan state being considered. The paper demonstrates how these profiles can be used to track the usage of a variety of different resource types and how they can be used to provide detailed and relevant information when a resource constraint conflict is detected.

**Reference**

Drabble, B. & Tate, A., 'The Use of Optimistic and Pessimistic Resource Profiles to Inform Search in an Activity Based Planner', *Technical Report AIAI-TR-153*, 1994

**Linking Knowledge Acquisition with CommonKADS Knowledge Representation**

*Kingston, J., July 1994*

**Abstract**

This paper describes approaches to the linking of knowledge acquisition techniques (such as transcript analysis, card sorting, the repertory grid, and the laddered grid) to the CommonKADS framework for knowledge representation and analysis. These links allow semi-automatic mapping from acquired knowledge to CommonKADS domain knowledge. The key to the success of the linking is that each knowledge acquisition technique produces knowledge within a structure, whether that structure is a taxonomic hierarchy (as produced by the laddered grid) or simply the grammatical structure of English. The structure produced is exploited to determine appropriate classification of knowledge into the CommonKADS domain ontology.
The techniques described in this paper have been used for commercial training at AIAI, and have also been implemented in a knowledge engineer's support toolkit, known as TOPKAT (The Open Practical Knowledge Acquisition Toolkit). This toolkit has been used to obtain experience of the practicality of the techniques recommended. Examples throughout this paper are drawn from TOPKAT.

**Reference**

Kingston, J., 'Linking Knowledge Acquisition with CommonKADS Knowledge Representation', *Technical Report AIAI-TR-156*, 1994

**Modelling Business Processes using the Soft Systems Approach**

*Kingston, J. K. C., January 1995*

**Abstract**

This paper describes a project which modelled the business processes involved in the commercial sales process in a small company, using Checkland's soft systems approach. The aims of the project were: to elicit a model of the commercial sales process which could be used to identify areas for improvement; to evaluate the soft systems approach as a tool for business process modelling; and to evaluate Hardy, a computerised tool for editing hypertext-based diagrams, as a support tool for the soft systems approach. The results of the project showed that soft systems is a viable approach to business process modelling;
its strengths include the ability to structure a loosely defined problem, the modelling of an agreed 'ideal' system, and the identification of key attributes of each process. However, it also has weaknesses, principally in the limited guidance available on how to construct soft systems models. In the course of this project, it was discovered that guidance on model construction can be obtained from another source; if a business process required knowledge-based reasoning, then the CommonKADS methodology for the analysis and design of knowledge based systems can supply a generic model of that process, which

could then be instantiated to the task in hand.

**Reference**
Kingston, J. K. C., 'Modelling Business Processes using the Soft Systems Approach', *Technical Report AIAI-TR-157*, 1995

**Applying KADS to KADS: knowledge based guidance for knowledge engineering**
*Kingston, J. K. C., February 1995*

**Abstract**
The KADS methodology [Schreiber et al, 1993] [Tansley & Hayball, 1993] and its successor, CommonKADS [Wielinga et al, 1992] have proved to be very useful approaches for modelling the various transformations involved between eliciting knowledge from an expert and encoding this knowledge in a computer program. These transformations are represented in a series of models. While it is widely agreed that these methods are excellent approaches from a theoretical viewpoint, the documentation provided concentrates on defining what models should be produced, with only general guidance on how the models should be produced. This has the advantage of making KADS and CommonKADS widely applicable, but it also means that considerable training and experience is required to become proficient in them.
This paper reviews three projects, which investigated the feasibility of producing specific guidance for certain decisions which are required when using KADS or CommonKADS to develop a knowledge based system. Guidance was produced for the identification of the generic task addressed by a knowledge based system; for the selection of appropriate AI techniques for implementing the analysed knowledge; and for selecting a suitable tool for implementing the system. Each set of guidance was encoded in its own knowledge based system, which was itself developed with the assistance of KADS or CommonKADS. These projects therefore both studied and applied KADS and CommonKADS in order to produce knowledge based guidance for knowledge engineers. The projects showed that it was feasible to produce heuristic guidance which could be understood, applied and occasionally overridden by knowledge engineers. The guidance provides reasonably experienced knowledge engineers with a framework for making the key decisions required by CommonKADS, in the same way that CommonKADS provides knowledge engineers with a framework for representing knowledge. The projects also produced some new insights about CommonKADS domain modelling and about the process of task identification.

**Reference**
Kingston, J. K. C., 'Applying KADS to KADS: knowledge based guidance for knowledge engineering', *Technical Report AIAI-TR-158*, 1995

**Intelligent Systems for Business Planning**
*Drabble, B. and Beck, H., January 1995*

**Abstract**
Businesses face ever greater demands to change and improve. Many of these demands are common across a wide-range of commercial and government organisations. One critical element in the process of improvement is the ability to generate and communicate business goals and plans.
This report produced by AIAI for CCTA (the UK Government's Centre for Information Technology) reviews the requirements of business planning together with the intelligent tools and techniques which have been developed to address this requirement. In particular, the report shows how current intelligent business planning tools could be used to address the challenges faced by H.M. Customs and Excise. The focus on H.M. Customs and Excise case study is used to

exemplify generic business planning issues and to indicate potential solutions with wide applicability.

**Reference**
Drabble, B. & Beck, H., 'Intelligent Systems for Business Planning', *Technical Report AIAI-TR-159*, 1995

**Managing Change through Enterprise Models**
*Fraser, J.*

**Abstract**
In this paper we present a perspective on enterprise modelling which is emerging under the Enterprise project. Enterprise modelling can be used as a catch-all title to describe the activity of modelling any pertinent aspect of an organisation. We present a more restricted use of the term, which implies the need to focus on the organisation as a whole: taking a more "total systems" approach. We describe the main motivations for enterprise modelling. We identify features of enterprise models and suggest how they might be used. A key element which we discuss is the use of an ontology which permits the interchange of information and knowledge between different users, tasks and systems. Finally we give a high level view of a computer tool set to support enterprise modelling.

**Reference**
Fraser, J., 'Managing Change through Enterprise Models', *Technical Report AIAI-TR-161*, 1995

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## DEPARTMENT OF ARTIFICIAL INTELLIGENCE

### DAI Reports

A DYNAMIC MODEL FOR AUTONOMOUS VEHICLE NAVIGATION
*KICK, A.; WALKER, A.; FISHER, R.B.* No. 691

Abstract: In recent years, much progress has been made in robotics research by employing ideas taken from biology. In particular, inspiration has been drawn from ethologists' study of insect navigatory capabilities. The long distance foraging behavior of honey bees (Apil mellifera) has been well studied and models of bee navigation have been suggested and simulated. The most popular of these models (due to Cartwright and Collett), proposes that honey bees navigate via a static image comparison process wherein motion vectors towards a target are calculated based on the differences between an image currently projected on a bee's retina and a remembered snapshot - taken from a similar place in the environment. The current work describes our implementation of such a static localization model on a mobile robot and discusses our conclusion that a dynamic model of bee navigation, based on optical flow, is more plausible. We propose a dynamic model based on comparison of apparent speeds of edges. (Submitted to SAB'94)

ROBOTIC LEARNING BY IMITATION
*HAYES, G.M.; DEMIRIS, J.* No. 692

Abstract: Roboticists have already invested considerable energy in modelling on robots the learning capacities of single animals. However, the field of learning by imitation, in which one agent learns from perceiving the behaviour of another, is largely untouched. The range of behaviour described as "learning by imitation" in the ethological literature is wide. We argue that building and observing robots which instantiate the mechanisms hypothesised to underlie these types of behaviour will cut through the chaos of the terminology and illuminate those mechanisms with explanatory adequacy. We present an architecture within which to study one of these mechanisms and describe two implementations, a simulator and a robot, with which we are studying different aspects of the mechanism. (Submitted to the 3rd International Conference on Simulation of Adaptive Behavior, "From Animals to Animats", UK, 1994)

DIRECT CALIBRATION AND DATA CONSISTENCY IN 3-D LASER SCANNING
*TRUCCO, E.; FISHER, R.B.; FITZGIBBON, A.W.* No. 693

Abstract: This paper addresses two aspects of triangulation-based range sensors using structured laser light: calibration and measurements consistency. We present a direct calibration technique which does not require modelling any specific sensor component or phenomena, and therefore is not limited in accuracy by the inability to model error sources. We also sketch some consistency tests based on two-camera geometry which make it possible to acquire satisfactory range images of highly reflective surfaces with holes. Experimental results indicating the validity of the methods are reported. (Proc. British Machine Vision Conference BMVC94, York, September, 1994)

A DYNAMIC NET FOR ROBOT CONTROL
*HALLAM, B.; HALLAM, J.; HAYES, G.* No. 694

Abstract: This paper describes ongoing work to assess the appropriateness of using Halperin's Neuro-Connector model, originally devised to explain fish behaviour, to control a robot. The model is described in

mathematical detail and suggestions for improving computational efficiency are made. The operation of the model and the information necessary for initialisation are also discussed. Preliminary experiments on a mobile robot platform are described and some simulation results presented. The Neuro-Connector model is computationally expensive and requires careful initialisation, so is not suitable for standard robot tasks. However, it can tolerate a designer's imprecise understanding of sensory states, refining the stimuli used to trigger each behaviour until only specific and reliable ones are considered, and can tolerate changes in the environment and in its own sensor system. It can be trained as much as programmed and can be instructed whilst operational. This is feasible because it learns in only four stimulus presentations. Therefore this model warrants further investigation with particular reference to controlling sensor-rich robots in complex and changing environments, especially where the task requires fine sensory discriminations to be made. ( In book "Progress in Neural Networks: Special edition on Robot Control", ed. Patrick van der Smagt.)

AN ETHOLOGICAL MODEL FOR IMPLEMENTATION IN MOBILE ROBOTS
*HALLAM, B.; HALPERIN, J.; HALLAM, J.*
No. 695

Abstract: This paper describes a neuroethological model of learning and motivation which accounts for many of the behavioral phenomena observed in animals. Unusual predictions from the model have been tested and shown to be demonstrable in laboratory Siamese fighting fish. In addition, the model is sufficiently mathematically well-defined to be implementable in a robot or in computer simulation. A trial implementation in a mobile robot was carried out as part of this work. This paper describes a simplified version of the model which was programmed into the robot, a thought experiment designed to show the main features of the model, and the preliminary robot experiments carried out. Putting ethological models of animal behavior onto robots is interesting for both robotics and ethological research: the study of robot autonomy can be enhanced through an understanding of complex and realistic models of animal autonomy; and ethological research should benefit from a supply of guaranteed 'naive' agents on which rigorous testing of such models is tractable. (Submitted to "Adaptive Behavior", pub. MIT Press)

USE OF CASE-BASED REASONING IN THE DOMAIN OF BUILDING REGULATIONS
*YANG, S-A.; ROBERTSON, D.; LEE, J.*
No. 696

Abstract: In traditional legal decision support systems, it has been regarded as natural to represent statutes in terms of decision rules and to link these to a separate case-based reasoning system for handling precedent. Statutory legal rules used in these systems are formal and prescriptive. Building regulations in Scotland are part of statute law and constitute part of a legal system together with case histories. In recent years, the regulations have been becoming less prescriptive and more emphasis has been put onto the interpretive use of the regulations. In developing a system which can assist domain experts in interpreting the regulations, this trend has presented us with difficulties in employing this traditional approach and has led us to a unified case-based model of the regulations and case histories. In this paper, we first describe the characteristic of the regulations and the activities involved in this domain. Second, we explain the reason why we abandoned the traditional approach. Third, we describe the system which is under development using this case-based model.

(Accepted for the 2nd European Workshop on Case-Based reasoning (EWCBR 94) Chantilly, France, November 1994)

AN EMPIRICAL STUDY ON THE GENERATION OF ZERO ANAPHORS IN CHINESE
*YEH, C-L.; MELLISH, C.* No. 697

Abstract: In this paper, we describe the creation of rules for generating Chinese zero anaphors through a sequence of experiments in a stepwise enhanced manner. In the experiments, we basically examined the occurrence of zero anaphors in a real text and the ones generated by the algorithms employing the rules assuming the same semantic and discourse structures as the text. The factors of locality, syntactic constraints, discourse structure and salience of objects were considered in the rules. The results of the experiment show that 93% of the zero anaphors in the text can be correctly generated by an algorithm using a rule involving all the above factors. (Accepted for publication by 15th International Conference on Computational Linguistics.)

CASE-BASED SELECTION OF REQUIREMENTS SPECIFICATIONS FOR TELECOMMUNICATION SYSTEMS
*FUNK, P.; ROBERTSON, D.* No. 698

Abstract: Using formal specifications based on varieties of mathematical logic is becoming common in the process of designing and implementing software. The advantage of this procedure is that it enables us to verify the specification's properties before the real system is implemented. Up to now, formal methods were usually applied to include all details of the final system in the specification. In large, complex systems this requires sophisticated logic, which makes theorem proving a difficult and complex task. Telecommunication systems are large and complex. However, our case-based approach uses coarse-grained requirements sketches to outline the basic behaviour of the system's functional components, thereby allowing us to identify, re-use and adapt requirements (from cases stored in a library) to construct new cases. By using cases that have already been tested, integrated and implemented, less effort is needed to produce requirements specifications on a large scale. Using a hypothetical telecommunication system as our example, we shall show how comparatively simple logic can be used to capture coarse-grained behaviour and how a case-based approach benefits from this. The input from these examples is used to induce a set of state-transition rules that are applied to match and identify the cases whose behaviour corresponds most closely to the designer's intentions. (In Proceedings of the 2nd European Workshop on Case-Based Reasoning (EWCBR 94))

INSPECTION OF FREE-FORM SURFACES USING DENSE RANGE DATA
*BISPO, E.M.; FISHER, R.B.* No. 700

Abstract: This paper presents some research on the use of dense range data for the automatic inspection of mechanical parts that have free-form surfaces. Given a part to be inspected and a corresponding model of the part, the first step towards inspecting the part is the acquisition of a range image of it. In order to be able to compare the part image and its stored model, it is necessary to align the model with the range image of the part. This process, called registration, finds the rigid transformation that superposes model and data. After the registration, the actual inspection uses the range image to verify if all the features predicted in the model are present and within tolerance. Free-form surfaces are particularly interesting in that few inspection processes can inspect surface shape across the whole surface. We focus in the inspection of free-form surfaces and present some results concerning the extraction of nominal shape

models from dense range data using B-splines and the use of B-spline models of free-form surfaces for the purposes of registration. (Submitted to the European Symposium on Optics for Productivity and Manufacturing Conference: Automated Vision Inspection, Frankfurt, June 1994)

A META-LEVEL APPROACH TO EXPLORATION OF MULTIPLE KNOWLEDGE BASES
*HAGGITH, M.* No. 701

Abstract: This paper presents a meta-level framework for exploration of multiple knowledge bases in which conflicting opinions are expressed. In the first section, the usefulness of a meta-level approach to inconsistency handling is explained and comparisons made with other related work. In the second section a formal meta-level language is defined to allow arguments from knowledge bases to be reasoned about independently to their object-level representation. Four basic meta-level relations are introduced: disagreement, equivalence, justification and elaboration. In the third section, an example is given to illustrate the framework. The fourth section demonstrates how the four basic relations can be used to guide a user in exploring the range of opinion in a collection of knowledge bases. The notion of a conflict set is introduced to provide a focussed 'window' on the particular disagreements a user is interested in. A flavour is also given of how these primitive relations can be used as the basis of definitions of more complex argument constructs, such as those encountered in the literature on argumentation. These argument constructs may provide ways to automate comparison and evaluation of knowledge bases. An initial prototype has been implemented to evaluate the usefulness of this framework and to assess its computational feasibility. The results so far are promising. The paper concludes with a discussion of future directions. (For presentation at CKBS-94)

THE SATISFIABILITY CONSTRAINT GAP
*GENT, I.P.* No. 702

Abstract: We describe an experimental investigation of the satisfiability phase transition for several different classes of randomly generated problems. We show that the "conventional" picture of easy-hard-easy problem difficulty is inadequate. In particular, there is a region of very variable problem difficulty where problems are typically underconstrained and satisfiable. Within this region, problems can be orders of magnitude harder than problems in the middle of the satisfiability phase transition. These extraordinary hard problems appear to be associated with a constraint gap, a minimum in the amount of constraint propagation compared to the amount of search. We show that the position and shape of this constraint gap are very consistent with problem size. Unlike hard problems in the middle of satisfiability phase transition, hard problems in the variable region are not critically constrained between satisfiability and unsatisfiability. Indeed, hard problems in the variable region often contain a small and unique minimal unsatisfiable subset or reduce at an early stage in search to a hard unsatisfiable subset. The difficulty in solving such problems is thus in identifying the minimal unsatisfiable subset from the many irrelevant clauses. The existence of a constraint gap greatly hinders our ability to find such minimal unsatisfiable subsets. We conjecture that these results will generalise both to other SAT problem classes, and to the phase transitions of other NP-hard problems. (Submitted to Artificial Intelligence Journal, special issue on Phase Transitions in Problem Spaces)

STUDENT MODELLING FOR SECOND LANGUAGE ACQUISITION
*BULL, S.* No. 703

Abstract: This paper describes the student model of an intelligent computer assisted language learning (ICALL) system which is based on current theories in the field of second language acquisition (SLA). The following four issues were selected as important questions in SLA, while also being implementable in the ICALL environment: 1. the acquisition order of the target rules, 2. language learning strategies, 3. language transfer, 4. language awareness. The first three points are represented in the student model. A learner's language awareness is enhanced by explicit user/system discussion of these issues and the target constructions, and also by cooperative construction and repair of the student model. The project aims both to test the suitability of these theories in the context of ICALL, and at the same time develop a system which demonstrates guidelines for the creation of more successful and acceptable ICALL systems. The area of language used for illustration is clitic pronoun placement in European Portuguese. (To appear in Computers and Education: special issue on CALL, 1994)

LEARNING LANGUAGES: IMPLICATIONS FOR STUDENT MODELLING IN ICALL
*BULL, S.* No. 704

Abstract: Many factors affect the learning of a foreign language. When designing computer assisted language learning software it is usually not sufficient to think only about creating an exercise in the language, but students should be modelled in order to allow the program to take account of individuals' beliefs and learning. However, student models are criticised for various reasons, the most common of which include: 1. Modelling the learner places a great burden on the system, as it has sole responsibility for the creation of an accurate student model. 2. Student models are inadequate because it is not possible to model all aspects of a student's knowledge and learning. This paper describes the student model of an intelligent computer assisted language learning (ICALL) system which strives to overcome problems of traditional student models by taking into account issues important in the field of second language acquisition, and research in collaborative approaches to learning. (Accepted for publication in ReCALL vol. 6, no. 1, pp 34-39)

A CASE-BASED REASONING APPROACH TO SUPPORTING NOVICE PROGRAMMERS
*BOWLES, A.; ROBERTSON, D.* No. 705

Abstract: The use of examples in teaching programming is subject to certain pitfalls. To address these problems, we suggest a modification to the way examples are presented during teaching. We make use of an intermediate language in between programming problem statements and solution code. The use of this language helps students to describe the programming task more clearly, and also relates program functionality to patterns of code. We describe computer based tools which support our approach in the context of teaching the programming language PROLOG. We place our work in the paradigm of case-based reasoning. (Submitted to the journal "Applied Artificial Intelligence")

INVARIANT FITTING OF ARBITRARY SINGLE-EXTREMUM SURFACES
*FITZGIBBON, A.W.; FISHER, R.B.* No. 706

Abstract: Besl and Jain's variable order surface fitting algorithm [1] is a useful method of constructing a noise-free reconstruction of 2 1/2 D range images with a small number of primitive regions. The use

of bivariate polynomials as the approximation basis function is linear, fast and easy to render robust. Seeding fits from regions classified by differential geometry is an important step towards a viewpoint invariant segmentation. However, in order to better approximate arbitrarily shaped surfaces, polynomials of high degree are needed. For a region-growing paradigm, the poor extrapolation of high order polynomials shows convergence and generates "non-intuitive" segmentations when crossing curvature discontinuities. Such segmentations are difficult to match against traditional CAD-like models. Further, the instability of the segmentation makes invocation of the correct model from a large database extremely difficult. We show that these algorithms must of necessity trade representational richness for repeatability. In this paper we describe a new method of satisfying the requirement for high representational richness while retaining the ease of manipulation and recognition of single-extremum surface patches. By introducing a canonical reparameterised coordinate system, biquadratic patches can be made to approximate arbitrary single-extremum shapes in a viewpoint invariant manner. An iterative fitting algorithm is presented, which quickly converges to the appropriate description. Examples of the abilities of the new approach are supplied, and compared with alternative strategies. (In the Proceedings of the British Machine Vision Conference, Surrey, Sept. 1993)

NATURAL LANGUAGE INTERFACES TO DATABASES - AN INTRODUCTION
*ANDROUTSOPOULOS, I.; RITCHIE, G.D.; THANISCH, P.* No. 709

Abstract: This paper is an introduction to natural language interfaces to databases (NLIDBS). A brief overview of the history of NLIDBS is first given. Some advantages and disadvantages of NLIDBS are then discussed, comparing NLIDBS to formal query languages, form-based interfaces, and graphical interfaces. An introduction to some of the linguistic problems NLIDBS have to confront follows, for the benefit of readers less familiar with computational linguistics. The discussion then moves on to NLIDB architectures, portability issues. restricted natural language input systems (including menu-based NLIDBS), and NLIDBS with reasoning capabilities. Some less explored areas of NLIDB research are then presented, namely database updates, meta-knowledge questions, temporal questions and multi-modal NLIDBS. The paper ends with some reflections on the current state of the art. (Accepted by the Journal of Natural Language Engineering)

IS COMPUTER VISION STILL AI?
*FISHER, R.B.* No. 710
Abstract: Recent general AI conferences show a decline in both the number and quality of vision papers, whereas there is a great growth and specialization of computer vision conferences. Hence, one might conclude that CV is parting, or has parted, company from AI. This essay proposes that the divorce of CV and AI suggested above is actually an "open marriage", and while CV is developing through its own research agenda, there are many shared areas of interest and many of its key goals, assumptions and characteristics are also clearly found in AI. (Published in AI Magazine)

INCORPORATING LEARNING ISSUES INTO COMPUTER ASSISTED EDUCATION
*BULL, S.; MUSSON, T.* No. 711

Abstract: Traditional computer assisted learning (CAL) programs tend to be very limited as they take little account of real learning issues. If CAL software aims to facilitate students' learning of some domain, it should itself 'know' both the domain material and the manner in which students

acquire this knowledge. It cannot necessarily be assumed that simple question/answer sequences, for example, actually lead to understanding and therefore the lasting acquisition of knowledge. The advantages of using an intelligent learning environment instead of a traditional CAL program are that it has a better 'understanding' of pedagogic issues. The main weakness of conventional CAL is its rigidity. For example: 1. How do you take account of the different background knowledge which will necessarily be found among any group of students ? 2. How can you deal with different individual approaches to learning ? 3. How does the program know what aspects of the domain the student has learnt ? 4. What should the program do if students react differently than expected ? 5. How can the system diagnose students problems ? This paper will discuss these questions in the context of an intelligent learning environment for foreign language acquisition. (In the Proceedings of the 29th Annual International Conference of the Association for Educational and Training Technology, April, 1994)

GOAL-ORIENTED SOFTWARE: WHEN THE DEVELOPMENT PROCESS IS DIFFERENT...
*BULL, S.; MUSSON, T.* No. 712

Abstract: Two types of software are contrasted: output-oriented and goal-oriented. The typical development process of output-oriented software is presented and compared with the approach necessary for developing goal-oriented software. This paper describes the development of one specific goal-oriented system (an intelligent computer assisted language learning system) in order to highlight the differences in approach. (In the Proceedings of the 2nd International Conference on Software Quality Management, Edinburgh, July 1994)

STUDENT MODELLING BEYOND DOMAIN KNOWLEDGE
*BULL, S.; PAIN, H.; BRNA, P.* No. 713

Abstract: In this paper we argue that there are benefits to extending the scope of student models to include additional information as part of the explicit student model, for example a system should not only take account of a learner's performance in the domain, but also his beliefs. Issues such as the sequencing of material can be important in some subjects. The possibility of (positive and negative) analogy should also be considered, as should a learner's general approach to learning. As an illustration we describe the student model of an intelligent computer assisted language learning (ICALL) system which focuses on 1. performance in the domain; 2. acquisition order of the target rules; 3. language transfer; 4. learning strategies; 5. language awareness. The system has been based on research findings in the field of second language acquisition (SLA). The student model has been designed to model real errors (identified from a corpus of students' work), and also learning-related issues. The student model is also used to promote learning reflection by encouraging the learner to view, discuss and even suggest changes to the model. (In the Proceedings of the International Conference on User Modeling, Hyannis, MA, August 1994)

HOW NOT TO DO IT
*GENT, I.P.; WALSH, T.* No. 714

Abstract: We give some dos and don'ts for those analysing algorithms experimentally. We illustrate these with many examples from our own research. Where we have not followed these maxims, we have suffered as a result. (Presented at the AAAI Workshop on Experimental Evaluation of Reasoning and Search Methods, July 31, 1994)

EXTRACTING PROLOG PROGRAMMING TECHNIQUES
*VASCONCELOS, W.W.* No. 715

Abstract: We present a method for extracting the programming techniques employed in Prolog programs. Our method records the manner in which each subgoal has been used and employs this, together with its syntax and other auxiliary information, to partition the program into single-argument procedures possibly sharing variables. A technique is formally characterised as a sequence of such single-argument procedures. (In the proceedings of the XI Brazilian Symposium on Artificial Intelligence, Ceara, Brazil, Oct. 17 - 20, 1994)

PRODUCTIVE USE OF FAILURE IN INDUCTIVE PROOF
*IRELAND, A.; BUNDY, A.* No. 716

Abstract: Proof by mathematical induction gives rise to various kinds of eureka steps, e.g. missing lemmata, generalization, etc. Most inductive theorem provers rely upon user intervention in supplying the required eureka steps. In contrast, we present a novel theorem proving architecture for supporting the automatic discovery of eureka steps. We build upon rippling, a search control heuristic designed for inductive reasoning. We show how the failure of rippling can be used in bridging gaps in the search for inductive proofs. (Submitted to the Special Issue of the Journal of Automated Reasoning on Automation of Proof by Mathematical Induction.)

BEST-FIRST AND TEN OTHER VARIATIONS OF THE INTERPRETATION-TREE MODEL MATCHING ALGORITHM
*FISHER, R.B.* No. 717

Abstract: The best known control algorithm for symbolic model matching in computer vision is the Interpretation Tree search algorithm, popularized and extended by Grimson, Lozano-Perez, Huttenlocher and others. This algorithm has a high computational complexity when applied to matching problems with large numbers of features. This paper examines eleven variations of this algorithm in a search for improved performance, and concludes that a best-first algorithm has greatly reduced theoretical complexity and runs much faster than the standard algorithm. (Submitted to the AI Journal)

AN ENVIRONMENT FOR BUILDING PROLOG PROGRAMS BASED ON KNOWLEDGE ABOUT THEIR CONSTRUCTION
*VARGAS-VERA, M.; ROBERTSON, D.* No. 718

Abstract: Program combination can be used to promote the reuse of software by allowing complex programs to be built by repeated combination of other programs. Previous attempts at automatic systems which assist programmers in the task of combining programs have generally required lots of interaction from a user, who also typically needs a good understanding of the particular program transformation process being applied. A system for transforming programs expressed as recursion equations is given in [BD77], but its use requires intervention of a human with a good understanding of program transformation methods. In procedural languages, there are ways [HPR88] to merge programs derived from an initial generic template, however, this approach is restricted to a limited class of programs. In [TS83, TS84], an unfold/fold based transformation system was given, but requires user intervention and is restricted to programs with the same flow of control. In [LS87, SL88] methods were given for combining Prolog programs with the same basic flow of control (meta-interpreters) but these also require user

intervention. The method of [FF91] employs basic schemata (supplied by an expert) to combine list-processing programs. The method is very efficient; however it can present the user with a difficult choice between possible output schemata. The method in [PP92] combines logic programs with the same flow of control using basic fold/unfold transformations, but relies on user-guidance and its efficiency depends on the decisions made by the user. Given these problems of over-reliance on the user, and lack of flexibility, we started out with three basic ideas as to how the situation could be improved. (Accepted for the Tenth Logic Programming Workshop (WLP-94))

CALIBRATION, DATA CONSISTENCY AND MODEL ACQUISITION WITH A 3-D LASER STRIPER
*TRUCCO, E.; FISHER, R.B.; FITZGIBBON, A.W.; NAIDU, D.K.* No. 719

Abstract: We analyse the issues of calibration, stripe location and measurement consistency in low-cost, triangulation-based range sensors using structured laser light. We adopt a direct calibration technique which does not require modelling any specific sensor component or phenomena, and therefore is not limited in accuracy by the inability to model error sources. We compare five algorithms for determining the location of the stripe in the images with subpixel accuracy. We describe data consistency tests based on two-camera geometry, which make it possible to acquire satisfactory range images of highly reflective surfaces with holes. Finally, we sketch the use of our range sensor within an automatic system for 3-D model acquisition from multiple range images. Experimental results illustrating the various topics' accuracy are reported and discussed. (Submitted to IEEE Transactions on Robotics and Automation.)

FREE-FORM SURFACE MATCHING FOR SURFACE INSPECTION
*BISPO, E.M.; FISHER, R.B.* No. 720

Abstract: Despite their great accuracy, coordinate measuring machines (CMM) for the inspection of mechanical parts present some drawbacks related to their low speed, which make it impossible to measure many points on the surface of an object. Another difficulty is programming the coordinate measuring machines. We are investigating the use of dense range data acquired using laser stripers for the inspection of mechanical parts. Laser stripers do not produce as accurate measurements as CMMs but are much faster and consequently are able to measure many more points on the surface of the object. This makes possible a better evaluation of shape. We concentrate on the inspection of free-form surfaces, which are particularly interesting because few inspection processes can inspect the surface shape across the whole surface. The key idea involved in our work is the comparison of previously stored model surfaces with range images of the part being inspected. Clearly, before any comparison between data and model can take place, it is necessary to align the model with the range image of the part. This process, called registration, is relatively simple in the case of objects that have distinctive geometric features (e.g. planes), but is a very complicated problem in the case of free-form surfaces when no a priori information about the rigid transformation that aligns data and model is known. We use a modified version of Besl's ICP (iterative closest point) algorithm [10] that uses a priori knowledge of an approximation to the right registration to make the method more robust to outliers and avoid the problem of convergence to local minima. After the registration, we can explicitly compare the complete measured surface to the model and inspect the part. In this paper, we present some results concerning the registration of free-form surfaces and the final inspection of

mechanical parts after registration. (Submitted to the 6th Conference on Mathematics of Surface, Surrey)

UNSATISFIED VARIABLES IN LOCAL SEARCH
*GENT, I.P.; WALSH, T.* No. 721

Abstract: Several local search algorithms for propositional satisfiability have recently been proposed which are able to solve hard random problems beyond the range of conventional backtracking procedures. In this paper, we explore the impact of focusing search in these procedures on the "unsatisfied variables"; that is, those variables will appear in clauses which are not yet satisfied. For random problems, we show that such a focus reduces the sensitivity of these procedures to their input parameters. We also observe a simple scaling law in performance. For non-random problems, we show that whilst this focus can improve performance, many problems remain difficult. We speculate that such problems will remain hard for local search unless constraint propagation techniques can be combined with hill-climbing. (Slightly expanded version of paper submitted to AISB-95)

INVESTIGATING PARALLEL INTERPRETATION-TREE MODEL MATCHING ALGORITHMS WITH PROSET-LINDA
*HASSELBRING, W.; FISHER, R.B* No. 722

Abstract: This paper discussed the development of algorithms for parallel interpretation-tree model matching for 3-D computer vision applications such as object recognition. The algorithms are developed with a prototyping approach using PROSET-Linda. PROSET is a procedural prototyping language based on the theory of finite sets. The coordination language Linda provides a distributed shared memory model, called tuple space, together with some automatic operations on this shared data space. The combination of both languages, viz. PROSET-Linda, is designed for prototyping parallel algorithms. The classical control algorithm for symbolic data/model matching in computer vision is the Interpretation Tree search algorithm. This algorithm has a high computational complexity when applied to matching problems with large numbers of features. This paper examines parallel variations of this algorithm. Parallel execution can increase the execution performance of model matching, but also make feasible entirely new ways of solving matching problems. In the present paper, we emphasize the development of parallel algorithms with a prototyping approach, not the presentation of performance figures displaying increased performance through parallel execution. The expected improvements attained by the parallel algorithmic variations for interpretation-tree search are analyzed. The implementation of PROSET-Linda is briefly discussed. (Submitted to the 6th International Conference CAIP'95 COMPUTER ANALYSIS OF IMAGES AND PATTERNS, Prague, Czech Republic, Sep. 6-8, 1995)

MOLLUSC: A GENERAL PROOF-DEVELOPMENT SHELL FOR SEQUENT-BASED LOGICS
*RICHARDS, B.L.; KRAAN, I.; SMAILL, A.; WIGGINS, A.* No. 723

Abstract: This article describes an interactive proof development shell, Mollusc [Richards 93] which can be used to construct and edit proofs in sequent-based logics. Conceptually, Mollusc may be thought of as a logic-independent successor to Oyster [Bundy et al 90]. However, where Oyster was tied to a variant of Martin-Loef type theory, Mollusc can be used with any sequent-based logic for which a suitable definition is provided. Although developed in a research environment, Mollusc should also be suitable

for use in classroom exercises. In addition to proof editing facilities, Mollusc supports the definition of new logics, includes a proof-planner interface, and provides for automated proof construction through a tactic language and interpreter. (Appeared in CADE 12, A. Bundy (ed), Springer Lecture Notes in AI vol. 814, 1994, pp 826-30.)

COMPUTATIONAL PHASE TRANSITIONS IN REAL PROBLEMS
*GENT, I.P.; WALSH, T.* No. 724

Abstract: We examine phase transitions in real computational problems using a wide variety of algorithms. These phase transitions resemble those observed with randomly generated problems. Real problems do, however, contain new features (for example, large scale structures are rare in random problems) which can make them significantly harder than random problems. Our results suggest a new methodology for benchmarking algorithms. In addition, they help to identify the location of the really hard real problems. (Submitted to IJCAI-95)

RIPPLING ON RELATIONAL STRUCTURES
*LOMBART, V.; DEVILLE, Y.* No. 725

Abstract: The rippling heuristic has been rather successfully used to guide inductive proofs in a functional framework. We present here how that heuristic can be formalized in a relational framework, more adapted to logic programming. The rippling heuristic is first analysed to identify its key components. A formalization of these to a relational framework is then presented. The applicability and the power of our methods is illustrated on two examples: the simulation of the functional rippling's behaviour, and program transformation.

CONTROL OF WALKING BY CENTRAL PATTERN GENERATORS
*REEVE, R.; HALLAM, J.* No. 726

Abstract: Research into legged robots predates the discovery of the neural basis of rhythmical motion in animals by several decades. As a result almost no research in legged robotics has ever been based on this, and indeed most is still derived from personal insight or previous biological theories which are now known to be flawed. One group which has used these ideas to design a control structure for a robot is Taga and his colleagues, who made a crude simulation of a planar biped controlled by neural oscillators. In this paper we replicate and extend Taga's work, correcting flaws in the original model which made it extremely mechanically implausible. Disappointingly, it was found that the original model was only stable in a very limited range of conditions. However, making the model more realistic has improved this considerably, and the authors are now investigating further similar biologically inspired control structures. (In the proceedings of Intelligent Autonomous Systems, IAS-4, Karlsruhe, 1995)

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| 711 | 1.39 | 1.68 | 1.58 | 2.11 |
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## COURSE SCHEDULE FOR 1995

### Techniques and Methods

| | | |
|---|---|---|
| *Advanced IT for Enterprise Modelling* | *8-10 Nov 95* | Gives students working knowledge of some key advanced IT techniques for enterprise modelling, with particular emphasis on modelling business processes. Techniques are illustrated and reinforced through the use of case studies and practical exercises. We highlight business benefits of using such techniques. |
| *Advanced Scheduling Methods* | *1-3 Nov 95* | Introduces the problem of scheduling, particularly in the context of manufacturing environments. Case studies and practical exercises are used to illustrate how various tools and techniques can be applied to real industrial applications |
| *Knowledge Engineering Using CommonKADS* | *16-19 Oct 95* | Teaches a disciplined approach to developing knowledge based systems based on the CommonKADS methodology. This is achieved by covering the KBS development process from identifying a feasible application, through knowledge elicitation by various techniques, up to the production of a detailed design ready for implementation. Emphasis is placed on the modelling of expertise. |
| *Common Lisp* | *On Demand* | Teaches the core parts of Common Lisp, enabling students to understand and apply a representative subset of the language to a range of programming problems. Aspects of CLOS, the Common Lisp Object System, are also described. |

## COURSE FEES

| Short Course Title | No of Days | Standard Fee | Affiliate/ Associate | Stand-By Academic |
|---|---|---|---|---|
| *Techniques and Methods* | | | | |
| Advanced IT for Enterprise Modelling | 3 | £800 | £720 | £320 |
| Advanced Scheduling Methods | 3 | £700 | £630 | £280 |
| Knowledge Engineering Using CommonKADS | 4 | £1075 | £968 | £430 |
| Common Lisp | 5 | £1075 | £968 | £430 |

Prices for courses at client locations are available on request.

All fees include refreshments, lunches and course documentation. The fees exclude travel and accommodation. The training services of AIAI are not subject to VAT.

A 10% reduction on all courses is available to Affiliates and Associates of AIAI. To qualify for this discount, registrations must be received at least 6 weeks before the start of the course.

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No refunds can be given for cancellations or non-attendance, if notice is received less than 2 weeks before the start of the course. In the case of transfers between courses which take place within 2 weeks notice period, an administration fee of 25% is charged. Substitutes may attend in place of the originally booked student without any further charge.

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**PERSONAL CHAIR of Knowledge Based Systems**

We are pleased to announce that Austin Tate, Technical Director of AIAI and formerly a Professorial Fellow within the University of Edinburgh, has been awarded a Personal Chair of Knowledge Based Systems. This recognises his continuing achievements within AIAI.

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**British Computer Society Specialist Group on Expert Systems (SGES)**

## Annual Conference: Expert Systems'95 (ES95)

**Call for Papers**

The 15th annual conference of the British Comptuer Society Specialist Group on Expert Systems, ES95, is being held at Queens College, Cambridge between 11th and 13th December 1995.

The objectives of the ES series of conferences is to bring together researchers and application developers from business, industrial and academic communities to discuss issues and solutions to problems based on techniques derived from Artificial Intelligence.

The Conference continues to build on the success of previous years, with a two-track event containing fully refereed technical and application papers.

For the Technical Stream, contributions are invited in the form of papers of up to 5,000 words on knowledge-based systems and related areas of artificial intelligence. Papers representing original work on theoretical and applied AI relating to: constraint satisfaction; intelligent agents; knowledge engineering methods; machine learning; model-based reasoning; verification and validation of KBS; natural language understanding; case-based reasoning; knowledge discovery in databases and other related areas are welcome.

For the Application Stream, contributions are invited in the form of papers of up to 5,000 words presenting case studies of knowledge-based systems that address real-world problems such as: diagnosis, monitoring, scheduling and selection. Most importantly, the papers should highlight the critical elements of success and lessons learned.

Papers submitted to both streams will be refereed and those accepted will again be published in book form in the 'Research and Development in Expert Systems' and 'Applications and Innovations in Expert Systems' (for the technical and application streams respectively).

To assist us with the planning of the conference, anyone intending to submit a paper should provide a short abstract, with title, at the earliest opportunity to the Conference Secretariat.

Authors should indicate the stream to which their papers are being submitted. Please include your full name and postal address in any email submissions.

Formatting instructions for papers will be sent as soon as the title and abstract are received.

Four copies of papers should be submitted to arrive no later than Friday 23 June 1995. Submissions should be sent in paper form by post to the Conference Secretariat.

Please note that presenters of submitted papers will be asked to cover their costs of attending the conference by paying at the SGES members' academic rate.

**TUTORIALS**

The conference committee invites proposals for tutorials to be presented on Monday 11 December. Proposals for full and half day tutorials, from an individual or pair of presenters should be directed in the first instance to the Conference Secretariat.

**EXHIBITION**

A table top exhibition will run alongside the conference. There will be a limited number of spaces available and potential exhibitors are encouraged to book early, as these will be on a first-come, first-served basis.

**SPONSORSHIP**

We are also keen to make contact with any organisations who may wish to sponsor the conference, in whole or in part. Sponsorship of an international conference such as ES95 will ensure the highest visibility for the benefactor, both through the appearance of the company logo on all promotional literature and through references to the conference in all media exposure prior to and after the event.

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**IMPORTANT DATES**

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| Title/Abstract notification | NOW |
| Full paper submission | 23 June 1995 |
| Notification of acceptance | 11 August 1995 |
| Camera ready papers due | 22 September 1995 |

**First Call for Papers**

## The 14th Workshop of the UK Planning and Scheduling Special Interest Group

**University of Essex, Colchester**
**Wednesday 22 November - Thursday 23 November 1995**

We are pleased to invite contributions for the 14th UK Workshop on AI Planning Systems and AI Scheduling Systems, to be held at the University of Essex, Colchester, on Wednesday 22 November and Thursday 23 November 1995.

This workshop will be aimed at
- Bringing together researchers attacking different aspects of the planning problem and the scheduling problem
- Introducing beginners (for instance PhD students) in the fields of planning and scheduling to other workers.

To assist this, there will be two sorts of paper.

Full papers: (approx 5000 words) These will report work in progress or completed work. The author(s) will be invited to give a talk on the paper.

Short papers: (2 pages) These will report views or ambitions, or describe problems. The author will be able to discuss the paper informally with others at the workshop.

All papers, full or short, accepted by the workshop will be included in the workshop proceedings.

Though it is called the "United Kingdom" Special Interest Group, we have had people from Europe and America at previous workshops, and hope to at this one too.

As at the thirteenth SIG meeting we intend to run two concurrent sessions on the first day, one devoted to AI planning, the other to AI scheduling, and to have discussion groups on the second day.

Topics of interest include (but are not limited to):

**Applications:** Empirical studies of existing planning/scheduling systems; domain-specific techniques; heuristic techniques; user interfaces for planning and scheduling.

**Architectures:** Real-time support for planning/scheduling/control; mixed-initiative planning and user interfaces.

**Environmental and task models:** Analyses of the dynamics of environments, tasks, and domains with regard to different models of planning and execution.

**Formal Models:** Reasoning about knowledge, action, and time representations and ontologies for planning and scheduling; search methods and analysis of algorithms; formal characterisation of existing planners and schedulers.

**Intelligent Agency:** Resource-bounded reasoning; distributed problem solving; integrating reaction and deliberation.

**Learning:** Learning in the context of planning and execution; learning new plans and operators; learning in the context of scheduling and schedule maintenance

**Memory Based Approaches:** Case-based planning/scheduling; plan and operator learning and reuse; incremental planning.

**Planning and Perception:** Integration of planning and perceptual systems.

**Reactive Systems:** Environmentally driven devices/behaviours; reactive control; behaviours in the context of minimal representations; schedule maintenance.

**Robotics:** Motion and path planning; planning and control; planning and perception.

**Constraint-based Planning/Scheduling and Control Techniques:** Constraint/preference propagation techniques, variable/value ordering heuristics, intelligent backtracking/ TMS-based techniques, iterative repair heuristics, etc.

**Coordination Issues in Decentralised/ Distributed planning/scheduling:** Coordination issues in both homogeneous and heterogeneous systems, system architecture issues, integration of strategic and tactical decision making.

**Iterative Improvement Techniques for Combinatorial Optimisation:** Genetic Algorithms, Simulated Annealing, Tabu Search, Neural Nets, etc applied to scheduling and/or planning.

**Artificial Intelligence and Operations Research:** Comparative studies and innovative applications combining AI and OR techniques, applied to scheduling and/or planning

**Submission Requirements:**

Those interested in participating should submit a paper (which may describe work in progress, completed work, or a statement of interest) to the workshop organiser (Sam Steel) by 16 June 1995. Papers can be submitted via email to sam@essex.ac.uk as compressed and uuencoded postscript files, or in Latex format, or ASCII text, or three copies of a paper can be submitted on paper.

Participants will be selected by the Programme Committee based on their submissions. Invitations to participate will be sent by 14 July 1995. Authors of accepted papers will as usual have an opportunity to revise their papers between acceptance and the printing of the proceedings.

Submissions and inquiries should be sent to:
Sam Steel
Department of Computer Science
University of Essex
Colchester CO4 3SQ, United Kingdom

email: sam@essex.ac.uk
phone: +44 1206 872786
fax: +44 1206 872788

**Workshop Location**

The workshop will be held on the University of Essex campus, in the Wivenhoe House Conference Centre. Accommodation is available in the Conference Centre. The campus is about 70 minutes by rail and taxi from London Liverpool Street railway station, and about 2 1/2 hours by rail from Heathrow and Gatwick airports.

**Important Dates**

| | |
|---|---|
| 16 June 1995 | Submission Deadline |
| 14 July 1995 | Invitations to attend sent out |
| 22-23 November 1995 | Workshop |

**Programme Committee:**

Sam Steel, University of Essex
Brian Drabble, AIAI, University of Edinburgh
Ruth Aylett, University of Salford
Patrick Prosser, University of Strathclyde
Edward Tsang, University of Essex
Howard Beck, AIAI, University of Edinburgh

## Conference Announcement

**Improving Manufacturing Performance in a Distributed Enterprise:**
**Advanced Systems and Tools**
*Edinburgh, Scotland, July 13th and 14th 1995*

**SCOPE**
Emerging technologies are creating unprecedented opportunities for manufacturing enterprises. The focus of the conference is the distributed manufacturing enterprise, which today in global economies is an established necessity. The distributed enterprise has particular problems to solve in terms of communications, interactive control, and decision making. The conference offers an exciting forum for Europe to present and discuss the issues and the solutions.

The conference is brought to Edinburgh by the Esprit Project PASSE which is tasked with determining the strengths and weaknesses in European manufacturing and how the results from ESPRIT and national programmes are helping to improve performance.

**TOPICS**
The topics will include all aspects of a system from the design to implementation and use for planning and manufacturing control. Such topics are

- Strategic, Tactical & Operational Tools
- Global Manufacturing Information System
- Support for Management of the Dynamic Environment
- Performance Tracking against Best Practice
- Extendible Open Systems

**THE CONFERENCE**
The two-day event will have four sessions covering a wide range of advanced systems and applications. The session are:
The Distributed Enterprise: Issues and Requirements
Modelling and IT Architectures
Decision Support Systems and Tools (I)
Decisions Support Systems and Tools (II)
Complementing the program are poster sessions illustrating new R&D and an exhibition space for display of new software.

**KEYNOTE SPEAKERS**
International authorities will give keynote presentations. Patricia McConnaill of the European Commission will open the conference, and each of the other sessions will be introduced by a keynote presentation.

The keynote speakers include: Prof William O'Riordan (ICL), Prof Mark Fox (Enterprise Integration Laboratory, University of Toronto), Mr Graham Eastwood (GEC Plessey), and Dr Peter Whelan (SEMATECH).

**LOCATION**
Edinburgh is one of the world's most beautiful capital cities and is renowned for its unique history, heritage, architectural grandeur and cultural vibrance. The conference hotel will be the Scandic Crown which is located right on the Royal Mile in the city centre.

**Further information can be obtained from**
Ken Baird
AIAI
80 South Bridge
Edinburgh
EH1 1HN
Tel: 0131-650 2732
Fax: 0131-650 6513
*email: K.Baird@ed.ac.uk*

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