Unit Outline: KXA463 Intelligent Software Agents

Semester 1, 2007

Sandy Bay Campus, Hobart
Newnham Campus, Launceston

Prerequisites
None

Corequisites
None

Unit Weight
12.5% of one academic year

Unit Coordinator
Dr. Ray Williams

Lecturing Staff
Sandy Bay Campus, Hobart: Dr. Ray Williams
Newnham Campus, Launceston: Dr. Ray Williams

Scheduled Teaching Sessions
Lectures: 3 hours per week
The Unit Timetable can be accessed from the Study Resources section of the School website. ([http://www.comp.utas.edu.au/app/studyresources.jsp](http://www.comp.utas.edu.au/app/studyresources.jsp)).

All sessions are delivered via video conference. For information about videoconferencing at UTAS and how to participate effectively, see the Students’ guide to Videoconferencing available at: [http://www.utas.edu.au/itr/videoconf/StudentGuide2006.pdf](http://www.utas.edu.au/itr/videoconf/StudentGuide2006.pdf) or follow the Service desk link from the Current Students homepage>Videoconferencing.

Unit Website
The unit website is accessed from [http://www.utas.edu.au/coursesonline/](http://www.utas.edu.au/coursesonline/). You will need to use your university email pop account username and password to log on to the WebCT system. Once authenticated by the system your personalised MyWebCT area will be displayed. It contains links to the websites that you have permission to access - including the website for this unit.

If you are not able to access the unit website, please contact the University IT help desk:
- Entrance Level, Morris Miller Library, Sandy Bay Campus;
- Entrance Level, Launceston Campus Library, Newnham Campus.
- Telephone: 6226 1818 and 1300 304 903.
- Email: servicedesk@utas.edu.au

University Website
Information and Resources for 'Current Students' are available on the university website at: [http://www.utas.edu.au/students/](http://www.utas.edu.au/students/)

Provider
School of Computing - Faculty of Science, Engineering, and Technology.

OVERVIEW

Introduction
This unit covers the principles involved in the design and implementation of intelligent software agents. It discusses current research being undertaken to develop agent systems for use in the internet environment. It builds on basic artificial intelligence concepts to explain the fundamentals of agent design and introduces various commonly used agent architectures. Agent communication, cooperation and learning are discussed and the unit concludes by showing how these concepts can be incorporated into the process of building a multi-agent system. Students learn the principles of agent-based programming by undertaking the design and implementation of a multi-agent system, using a suitable programming environment.

Prior Learning
Students entering this unit will be assumed to have a knowledge of basic Artificial Intelligence concepts.

Learning Outcomes
On successful completion of this unit, you will be able to:

1. understand the concept of an intelligent agent as a core unifying concept in the Artificial Intelligence field.
2. recognise the common properties generally regarded as being characteristic of agent software, including autonomy, adaptability, knowledgability, collaboration and mobility.
3. describe the range of agent types and relate these to recognised applications of agent technology within scientific, commercial, industrial and educational environments.
4. describe the main deliberative, reactive and hybrid agent architectures and outline the
benefits and limitations of each.  
5. design and implement a multi-agent system, using a recognised agent programming environment.  
6. identify links between research into agent systems and related research in the biological, social and mathematical sciences.

**Unit Content**

"Agents" as a Theoretical Concept:  
- Definition of a Rational Agent  
- Reflex and Goal-based Agents  
- Agent Environments  
- The Unifying Role of the Agent Concept in AI

"Agents" as an Applications Technology:  
- Agent Characteristics  
- Collaborative Agents  
- Personal Agents  
- Mobile Agents

Early Deliberative Architectures:  
- The Deliberative Paradigm  
- The World Model  
- The STRIPS Method  
- Modular Horizontal Architectures  
- Limitations

Reactive Architectures:  
- The "New AI" Approach  
- Characteristics of "New AI" Agents  
- The Subsumption Architecture  
- Competitive Task Architectures  
- Potential Field Architectures  
- Emergent Behaviour  
- Advantages and Limitations

Hybrid Architectures:  
- Real-time Deliberative Architectures  
- Deliberative Architectures for Open Worlds  
- The Hybrid Paradigm  
- Examples of Hybrid Systems  
- BDI Architectures  
- Fuzzy Logic Control  
- Evaluation

Agents in Software Environments:  
- The "Software Robot"  
- Advantages of Software Environments  
- Software Agents on the Internet

Agent Communication:  
- Types of Communication  
- Speech Acts  
- Conversations  
- Agent Communication Languages

Agent Negotiation:  
- Agent Cooperation  
- Utilities and Preferences  
- The Payoff Matrix  
- The Prisoner's Dilemma  
- The Nash Equilibrium  
- Task Negotiation Protocols

Deliberative Multi-Agent Systems:  
- Cooperative Distributed Problem Solving  
- Multi-Agent Organisations  
- Task Allocation  
- The Contract Net

A-Life Co-ordination Techniques:  
- Swarm Algorithms  
- Ant Colony Optimisation  
- Ant-based Clustering Algorithms

Reactive Multi-Agent Systems:  
- Self-Organisation by Agent Competition  
- Neural Network and Reinforcement Learning  
- Evolution and Co-Evolution
Challenges and Impact:
- Software Quality
- Semantic Infrastructure
- Improved Agent Capabilities
- User Confidence and Trust
- Electronic Business
- Ambient Intelligence
- Scientific Grid Computing
- Education and Entertainment

For more information see the section titled ‘Content’ on the unit website.

**Generic Skills**

The university has defined a set of generic graduate attributes expected in its graduates. [http://www.utas.edu.au/policy/subject.html#graduates](http://www.utas.edu.au/policy/subject.html#graduates) Your course is designed to enable you to develop generic skills that are valued in, and expected of, graduates. These are skills that you will need to develop over time. Hence you are encouraged to look for opportunities, as you study each unit, to reflect on and improve these skills.

**LEARNING AND TEACHING**

**Approach to Learning**

You are expected to spend about 130 hrs studying in this unit - this includes attendance at scheduled teaching sessions. (For a 13 week semester this is, on average, 10 hr/wk.) This is the amount of study time that the 'typical' student will need to reach the level of competence and understanding required to fulfil the unit objectives.

You are expected to:
- attend all scheduled lectures, unless otherwise notified by the unit coordinator
- prepare for, and actively participate in lectures
- complete the assigned learning tasks
- review what has been learnt
- complete assessment items and submit them on time
- access and be familiar with the information and resources available on the unit website
- seek help from teaching staff if you have any questions or difficulties in studying this unit

You are encouraged to read the university's Code of Conduct for Teaching and Learning. Part A describes the 'Responsibility of the University to Students' and part B describes the 'Responsibilities of Students to the University'. [http://www.utas.edu.au/tl/policies/codes.html](http://www.utas.edu.au/tl/policies/codes.html)

**Schedule**

See the ‘Schedule’ section on the unit website.

**Teaching and Support Staff**

**Unit Coordinator:**

Dr. Ray Williams  
E-Mail: R.Williams@utas.edu.au  
Phone: (03) 6226 2951  
Room: 452, Sandy Bay Campus, Hobart

**Lecturing Staff**

Sandy Bay Campus, Hobart: Dr. Ray Williams  
Newnham Campus, Launceston: Dr. Ray Williams

**School Help Desk**

Contact the School Help Desk if you have any queries or problems with accessing, using, or printing from the computers in the School of Computing labs.

- **Hobart:** the Help Desk is located near the School's reception desk and is open from 10am - 4pm Monday-Friday. The phone number is 6226 2960.
- **Launceston:** the Help Desk is located near the entrance to the computing labs and is open in the morning from 10am - 12pm, and in the afternoon from 2pm - 4:30pm, Monday-Thursday. On Fridays it is open from 10am - 12pm in the morning and 2pm - 4pm in the afternoon. The phone number is 6324 3447.
- **Burnie:** the computer labs at the NWC are maintained by ITS. Please contact the University Help Desk for assistance. The 6 Macs are maintained by the School of Computing. If you have a query or problem that is specific to the School of Computing please phone the School of Computing Help Desk in Launceston.

**University Services and Support**

The University has staff available to assist you, such as the:

- Learning Development Advisor
Resources

Unit Website

The unit website contains unit information and resources. Students will be able to print lecture notes from the website at least one week prior to the delivery of the corresponding lecture. Electronic versions of selected articles, research papers and chapters from some books on the reading list will also be available on the website. Links to other websites, from which you can obtain relevant information and software, are also provided.

Prescribed Text

None

Readings

A classic AI text which uses the agent concept as a common principle underlying the study of Artificial Intelligence is:


Other relevant reference books for this unit are:


Russell and Norvig is available on reserve in both the Science and Launceston libraries. The other books are on reserve in either one library or the other. Specified chapters from these other books are also available on the unit website. A selection of other readings is also available on the unit website.

Software

The software that you will need to access the unit website and to study this unit, including general purpose software such as word processors, is provided on the computers in the School's computing labs. If you intend to use software on other computers please check that the versions are compatible.

The agent programming environment to be used in this unit is the Breve 3d Simulation Environment. This is available for the MacOS X operating system and has been installed on all computers in both Macintosh laboratories on each of the Launceston and Hobart campuses. This version, and an alternative Windows-based version, is available for download from the Breve website (www.spiderland.org/breve). A link to this site is available on the KXA463 unit website.

Computing Facilities

The School has PC labs (Windows XP), Mac labs (Mac OS-X 10.4), and Networking labs at the Newnham and Sandy Bay campuses. It also maintains 6 Macs (Mac OS-X 10.4) at the NW Centre. Unix accounts can be accessed from all Macs and PCs.

If you have not used these facilities before please contact the School Help Desk to organise your account details. If you would like to access the facilities at the Newnham and Sandy Bay campuses after hours please contact the School Help Desk.

Please contact the School Help Desk if you have difficulty accessing or using these facilities.

Use of Facilities

Use of computing facilities provided by the School is subject to the School's Ethics Guidelines - [http://www.comp.utas.edu.au/app/ethics.jsp](http://www.comp.utas.edu.au/app/ethics.jsp). Copies of the guidelines are also available in all School labs. The School's facilities may only be used for study-related purposes, and may not be used for personal gain. The playing of games is strictly prohibited in all labs at all times. Before being granted access to the School's facilities, you will be required to sign a declaration that you have read and understand these guidelines, and that you will abide by them. Disciplinary action may be taken against students who violate the guidelines.

Occupational Health and Safety

The university is committed to providing a safe and secure teaching and learning environment. For more information see [http://www.admin.utas.edu.au/hr/ohs/pol_proc/](http://www.admin.utas.edu.au/hr/ohs/pol_proc/)
### Assessment Items

<table>
<thead>
<tr>
<th>Item</th>
<th>Title</th>
<th>Type</th>
<th>Weighting</th>
<th>Due</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 1</td>
<td>Written Assignment</td>
<td>In-Semester - individual assignment</td>
<td>10%</td>
<td>Wednesday 4th April at 10.30 am</td>
<td>This assignment will require you to prepare and submit a short paper discussing a specified topic related to the application of software agent technology within the Internet environment. The topic to be discussed will be specified at the beginning of the semester.</td>
</tr>
<tr>
<td>Item 2</td>
<td>Practical Assignment</td>
<td>In-Semester - individual assignment</td>
<td>30%</td>
<td>Wednesday 9th May at 10.30 am</td>
<td>This assignment will require you to design and implement a multi-agent system, using the Breve 3d Simulation Environment. The system to be developed will be specified early in the semester. A skeleton system will be provided to you as a starting point.</td>
</tr>
<tr>
<td>Item 3</td>
<td>3 hr Examination</td>
<td>Formal Examination</td>
<td>60%</td>
<td>University Examination Period</td>
<td>See the 'Assessment' section in unit website for more detailed information about assessment items.</td>
</tr>
</tbody>
</table>

### In-Semester Assessment

Unless specifically stated in the specification of the assessment item provided on the unit website, it is required that:

- work submitted by a student is the work of that student alone OR
- where the assessment item is to be completed by a group of students, the work submitted by the group of students is the work of that group of students alone.

### Plagiarism

Plagiarism is a form of cheating. It is taking and using someone else's thoughts, writings or inventions and representing them as your own, for example:

- using an author’s words without putting them in quotation marks and citing the source;
- using an author's ideas without proper acknowledgment and citation; or
- copying another student's work.

If you have any doubts about how to refer to the work of others in your assignments, please consult your lecturer or tutor for relevant referencing guidelines, and the academic integrity resources on the web at [http://www.utas.edu.au/tl/supporting/academicintegrity/index.html](http://www.utas.edu.au/tl/supporting/academicintegrity/index.html).

The intentional copying of someone else’s work as one’s own is a serious offence punishable by penalties that may range from a fine or deduction/cancellation of marks and, in the most serious of cases, to exclusion from a unit, a course or the University. Details of penalties that can be imposed are available in the Ordinance of Student Discipline – Part 3 Academic Misconduct, see [http://www.utas.edu.au/policy/subject.html#students](http://www.utas.edu.au/policy/subject.html#students).

The University reserves the right to submit assignments to plagiarism detection software, and might then retain a copy of the assignment on its database for the purpose of future plagiarism checking.

### Referencing

The university document on plagiarism contains information about referencing the work or ideas of others. (See [http://www.utas.edu.au/plagiarism/](http://www.utas.edu.au/plagiarism/).) The preferred text referencing systems for the School is the Harvard system (also referred to as the author-date system).

### Submissions

The details of the submission method (paper, electronic or other) for each assignment will be supplied in a separate assignment specification sheet. All in-semester assignment submissions (including electronic submissions) are to include an Assignment Cover Sheet which includes a statement confirming that the submission is your own work. If this undertaking is not signed, the assignment will not be marked. The Assignment Cover Sheet is available from the School Help Desk in Launceston and Hobart, and on the School’s web site [http://www.comp.utas.edu.au/app/studyresources.jsp](http://www.comp.utas.edu.au/app/studyresources.jsp).
Extensions

Assessment items will not be accepted after the due date except under the conditions stated in the school policy on late assessment. [http://www.comp.utas.edu.au/app/late_assess.jsp](http://www.comp.utas.edu.au/app/late_assess.jsp)

Formal Examination

The formal examination is conducted by the University Registrar. The 'Current Students' section on the university website contains information about the conduct of, and timetable for, formal examinations.

Final Grade

Overall assessment will be based on the student's performance throughout the semester as well as in a formal examination. In order to achieve a pass (or better) result, a student must obtain:

1. at least 45% of the total mark for in-semester assessment items
2. at least 45% of the mark for the formal examination
3. at least 50% of the overall mark

In order to comply with the benchmarks set by the Faculty of Science, Engineering & Technology for distribution of grades in units, both the in-semester and examination marks that students obtain may be adjusted either upwards or downwards. See [http://fcms.its.utas.edu.au/scieng/scieng/policies.asp](http://fcms.its.utas.edu.au/scieng/scieng/policies.asp) for details of the Faculty Assessment Guidelines.

Passing grades will be awarded based on the AVCC guidelines:

- PP at least 50% of the overall mark but less than 60%
- CR at least 60% of the overall mark but less than 70%
- DN at least 70% of the overall mark but less than 80%
- HD at least 80% of the overall mark

The maximum mark awarded to a student who fails the unit will be 44.

For more information, including other grades such as Supplementary and Terminating grades, see the School of Computing's guidelines for assessment - available at: [http://www.comp.utas.edu.au/app/assess.jsp](http://www.comp.utas.edu.au/app/assess.jsp)