Master's degree in Information Technology
Artificial Intelligence - Syllabus Fall 2008

Professors:

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Course schedule:

IA MAS

Theory	A5 202	Tu 15-17	Luigi Ceccaroni
Theory	A5 202	Th 19-20	Luigi Ceccaroni
Recitations	A5 202	Fr 15-17	Núria Castell
Laboratory	B5S101	Th 20-21	Luigi Ceccaroni

This course introduces representations, techniques and architectures used to build applied systems and to account for intelligence from a computational point of view. This course also explores applications of rule chaining, heuristic search, logic, constraint propagation, constrained search and other problem-solving paradigms. In addition, it covers applications of decision trees, knowledge representation, knowledge-based systems and natural-language processing. This course is in the first semester of the Master's degree in Information Technology (MTI). It accounts for 7.2 credits of work load, distributed as 3.6 credits for theory, 2.4 for recitations and 1.2 for laboratory.

Web pages:
http://www.lsi.upc.es/~bejar/ia/ia.html
http://www.lsi.upc.edu/~luigi/MTI/AI-2007-fall/ai.html
http://raco.fib.upc.es/

1 Background

Students need the following knowledge (at the undergraduate level) to appropriately follow the course:

- English language.
- Propositional and predicate logic. Capacity to formulate a problem in logical terms.
- Logical inference. Strategies of resolution. Capacity to solve problems by resolution.
- Graph and tree structures. Algorithms for search in trees and graphs.
- Computational complexity. Calculation of algorithm execution's cost.

There are assignments that expect students to be able to read and write basic Java. This is the only formal pre-requisite.

2 Aims of the course

The general objectives of the course can be summarized in the following points:

- To identify the kind of problems that can be solved using AI techniques; to know the relation between AI and other areas of computer science.
- To have knowledge of generic problem-solving methods in AI.
- To understand the role of knowledge in present IA; to know the basic techniques of knowledge representation and their use.
- To be able to apply basic AI techniques as support for the solution of practical problems.
- To be able to navigate the basic bibliography of AI.

3 Topics

The course covers five major areas:

Introduction to AI

1. Search
   - 1.1 Problem representation
   - 1.2 Search in state space
   - 1.3 Uninformed search
   - 1.4 Informed search (A*,IDA*, local search)
   - 1.5 Games
   - 1.6 Constraint satisfaction
2. Knowledge representation and inference
   - 2.1 Methodologies for knowledge representation
   - 2.2 Rule-based systems
   - 2.3 Structured representations: frames and ontologies
3. Knowledge-based systems
   - 3.1 Definition and architecture
   - 3.2 Expert systems
   - 3.3 Knowledge engineering
   - 3.4 Approximate reasoning
4. Natural language
   - 4.1 Textual, lexical and morphological analyses
   - 4.2 Levels of natural language processing
   - 4.3 Logical formalisms: definite clause grammars
   - 4.4 Applications and current areas of interest
5. Machine learning
   - 5.1 Decision trees

4 Recitation classes

The recitation classes are **essential** to illustrate and deepen the understanding of the concepts introduced in the theoretical classes. They also familiarize the student in the design, combination and use of different knowledge-representation paradigms, and in their application to specific problems. These classes have a fundamental role for the students to obtain the necessary capacity to solve non-trivial AI problems.

The benefit of recitation classes depends to a great extent on a proactive attitude on the part of the student. All students should actively participate in the resolution of the proposed problems. It is also important to note that the exams of the course are essentially composed of problems. An extensive collection of problems is available, some of which are solved in class; the rest is to support students' personal work. This material is from previous terms of undergraduate courses and so is not necessarily exactly what students can expect to see in a quiz this term. But, we believe that doing these problems helps students prepare for the quizzes this term.

5 Laboratory classes

Projects assigned in laboratory classes are applications of the concepts learned in the theoretical and recitation classes. The different algorithms and techniques are implemented by means of different tools and programming languages.

Assignments will be evaluated via a required, written report about the results obtained in each project. The evaluation of these projects is part of the final grade.

6 Evaluation

Grading takes into account quizzes, final, deliverables and projects evaluation. The final grade is calculated via the following formula:

Final grade = max (quizzes grade * 0,15 + final grade * 0,55, final grade * 0,7) + project grade * 0,3

There will be some deliverables during the semester, this deliverables can add up to an extra point to the course grade.

The grade corresponding to an evaluation act not attended is 0.

Date of quizzes: November 13th, 2008. The examination is done during class hours.
Date of the final exam: January 15th, 2009. The examination is without books nor notes.

7 Bibliography

There are no required readings, apart from the course lecture notes. Additional reading can be found in the following text:

- Russell, Stuart J., and Peter Norvig. Artificial intelligence: a modern approach. 2nd edition. Upper Saddle River, NJ: Prentice Hall, 2002. ISBN: 0137903952.

7.1 Complementary bibliography

- Luger, G, Stubblefield, W *Artificial Intelligence: Structures and Strategies for Complex Problem Solving*, Addison-Wesley, 1998
- P. Jackson *Introduction to Expert Systems*, Addison-Wesley, 1990
- Giarratano, Joseph C., Riley, Gary D. *Expert Systems: Principles and Programming*, Brooks/Cole, 2003
- R. Mitkov (editor) *The Oxford handbook of Computational Linguistics*, Oxford University Press, 2003
- Nilsson, N. *Artificial Intelligence: A new Synthesis*, Morgan Kauffman, 1998
- Gonzalez, A.J., Dankel, D.D. *The engineering of Knowledge-Based Systems*, Prentice-Hall, 1993
- Allen, J. *Natural Language Understanding*, Benjamin/CummingsPublishing Company, 1995
- Clocksin, W.F., Mellish, C.S. *Programming in Prolog: Using the ISO Standard*, Springer, 2003
- Dechter, Rina *Constraint processing*, Morgan Kaufmann Publishers, 2003
- J. F. Sowa *Knowledge Representation*, Brooks/Cole, 2000

7.2 Other publications related to the course

- IA - Col.lecció de problemes @ [http://www.lsi.upc.es/~bejar/ia/problemas.html]
- Undergraduate course lecture notes @ [http://www.lsi.upc.es/~bejar/ia/teoria.html]