EE 586 Artificial Intelligence
Spring 2005

Instructor:

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Office Hours: To be announced. **Course Web:** online.metu.edu.tr

Assistants:

None

Course Purpose:

The purpose of this course is to teach the fundamentals of intelligent behavior and decision making by machines. By the end of this course, you will have gained an overall view of a wide range of methods and technologies for automated decision making as well as practical applications of these techniques in commercial, scientific and engineering problems. Hopefully, you will be at a point to use this knowledge to advance your research goals or to find more competitive engineering solutions in your work.

Textbook:

There is no single textbook for this course.

Main Reference:

"Artificial Intelligence: A Modern Approach", 2nd Ed.
Stuart Russel and Peter Norvig - 2002

Prerequisites:

None. However, good knowledge of data structures and competence in at least one programming language is recommended.

Course Objectives:

By the end of this course, we will have covered:

- **Rational Agents:** Evolution of AI. Intelligent system as a Rational Agent. Properties of task environments. Agent architectures. (1 week, Ch 1,2)
- **Problem Solving as Search:** Data structures. Uninformed search: Depth first, breath first, progressive deepening. Search with partial information. Informed search, A* search and Heuristic functions. Local search and optimization. (2 weeks, Ch 3,4)
- **Adversarial Search and Games:** Optimal decision in games. Minimax algorithm. Alpha Beta Pruning. Imperfect decisions. Element of chance. (1 week, Ch 6)
- **Logical Agents:** Propositional logic. Reasoning in propositional logic. Resolution. Forward and backward chaining. First order logic. Inference in first order logic. (3 weeks, Ch 7,8,9)

- **Knowledge Representation:** Ontological Engineering. Categories and Objects. Actions, situations and Events. Mental Events and Objects. Internet Shopping World, Reasoning with default information. (1 week, Ch 10)

- **Planning:** The planning problem. Planning with state space search. Partial order planning. Planning graphs. GRAPHPLAN algorithm. Planning with propositional logic. Time, schedule and resources, Constraints, Hierarchical task network planning. (2 weeks, Ch 11, 12)

- **Physically Embodied Agents: Robotics:** Robot hardware. Sensors. Effectors. Localization and Mapping. Planning and acting move. Moving. Robotic software architectures. (1 week, Ch. 25)

- **Uncertainty (Time permitting):** Handling uncertain knowledge, Probability, Inference using joint distributions. Independence, Bayes' Rule and applications. (1 week, Ch 13)

- **Learning Agents (Time permitting):** Inductive learning from observations. Learning decision trees. Performance of learning. Noise and overfitting. Why it works. Examples of statistical learning methods. (1 week, Ch 18,20)

Other References:

- "Introduction to AI Robotics", R.R. Murphy - 2000

- "Artificial Intelligence, 2nd Ed." E. Rich, K. Knight – 1991

- "Mathematical Methods for Artificial Intelligence and Autonomous Systems", E.R. Dougherty, C.R. Giardina - 1988

- "Artificial Intelligence - A Knowledge Based Approach", M.W. Firebaugh – 1989

- "Pattern Classification, 2nd Ed.", R.O.Duda, P.E. Hart, D.G.Stork – 2001

- "Robotics and AI: An Introduction to Applied Machine Intelligence", A.C. Staugaard, Jr. - 1987

COURSE POLICIES AND GUIDELINES

Professional Behavior:

This is a graduate course. I will treat you as professionals and will expect to see ethic and professional behavior in return. Honesty is of paramount importance for me. Remember: Respect comes mutually.

Class Web Site and Resources:

The class has a web site in METU-ONLINE: **online.metu.edu.tr**
Registered students will have access to the course content, notices and additional materials. You will have the chance to use the discussion forums to ask general questions or to exchange ideas. Check the web-site to make sure you have access and check periodically so that you do not miss anything. I will try to check the discussion forums periodically to answer your questions. Same professional behavior is expected in these forums as would be expected in-class.

Grading:

The course will involve reading assignments, in-class discussions and pop-quizzes, programming projects/survey study and a final examination. The contribution of the course work to grading is given below.

- In-class work, quizzes and attendance: % 20
- Paper Homeworks (not collected): % 0
- Term projects and Survey – Intermediate % 15
- Term Projects and Survey – Final % 30
- Final Exam % 35

In-Class Work and Quizzes:

There will be in-class discussions and pop-quizzes to probe your understanding of the topics. You will work as teams of two and submit one output with both names. You will share the same grade for the work you have produced. You are free to form your small team and both of you will be expected to equally contribute. Team members will alternate in presenting their ideas and results.

Paper Homeworks:

I will try to distribute some paper homeworks to stimulate your thinking on the topics discussed. The homeworks will not be collected or graded. However, the homeworks may hint to the questions you may get in the examinations.

Term Projects and Surveys:

A number of programming intensive (sometimes open ended) projects and research and survey areas will be offered. You will select either a term project or a survey area. Alternatively, you will have a chance to make a preliminary search, think about your desired area of research and propose your own term project or survey topic.

The project topics will be reviewed and fixed at a later meeting (**Saturday March 5, 2005. Time: 13:00 – 16:00**) If you find your own project/survey topic of interest, you should bring it to the preliminary review session (time to be announced).

- **Term Projects:** These will require programming effort, reporting and presentation. You are free to choose the implementation language (C/C++, Matlab, Java Etc.) The intermediate reporting is to help you focus your effort and organize your timing. Final report and presentation will present all your work. The following will be expected:
  - ***Intermediate report:*** Definition of the problem/task, Summary of previous efforts (from the web). Chosen implementation language / framework. An outline of how you will implement it. What the outcome will look like? Work allocation for team members.
  - ***Final report/presentation:*** A parallel report/presentation. Definition of the problem, algorithmic details, some level of implementation details. Work breakdown for team members. Demo of the implementation. If the work is open ended and not completed within the course, then a convincing plan of how it will be finalized.

- **Surveys:** The purpose of the survey work is to explore the state-of-the-art for a chosen domain/problem and give us a good understanding of it. By the end of your work, we (and you) should have a good idea

about how to attack the field in case we choose to do so. We should have a collection of a number of key papers and we should know the key players (labs, researchers). The following will be expected:

  - *Intermediate Report*: Definition of the problem/task, draft overview of efforts and key players (from the web), 5 key papers on the problem/task selected and retrieved. You will work at least on these for your final survey.
  - *Final Report/presentation*: A parallel report/presentation. Detailed definition of the problem/task. Overview of key players and solutions. Detailed consolidated information from the key papers that you have identified. You will present your work in a way that we can follow. Suggestions about open points and possible directions for future research.

- **Quality of Reports:** You are considered to be engineering professionals. You will be expected to present a well structured, quality report that has an introduction and conclusion as well as all the relevant information in a well organized manner. If you are not familiar with a well written report format, use the web resources to find examples. The report should contain all the extra details that might be left out of the presentation.

- **Presentations:** You will present the material in a 15 minutes PowerPoint presentation (electronic). There will be an additional 5 minute period for questions. Another 10 minutes will be allocated for term project demonstrations. Both team members will present a section of the presentation and they will answer the questions together. The time and place for the presentations will be announced later in the class web site.

- **Term Project Programs/Demos:** You will be expected to produce a presentable program or model to solve the problem that you have chosen. This will have a concise but functional GUI interface that makes all the relevant points about the task clear. Basic GUI work is possible with reasonable effort in most programming languages and in Matlab. Over-embellished interfaces are not necessary and will not be considered as a contribution. You are all intelligent people. If you feel good about it, they the chance is high that it will have acceptable quality. Source package of your work will also be submitted electronically together with your reports (in zipped format).

- **Submissions:** The date for submitting the intermediate term project and survey reports will be announced later at the course web site. Final reports will submitted some time before the date for the presentations (again to be announced in the course web site). The reports will be submitted electronically (again to be announced how). Late submissions are strongly discouraged. They will be graded at most %80 of full value for up-to 2 days late and %50 full value for up-to a week late. Reports later than that will not receive any credits.

Policy on Collaboration:

You will work in teams of two and will be expected to contribute equally to the team's performance. Collaboration between teams is possible out-of-class at a level where general ideas and algorithms are discussed. In-class discussions will be a necessary part of the class. Cheating, copying work from each other or from the web will not be tolerated. Also remember that all of us have the same tools to search the web.

Note:
This is an exiting field. I hope you will enjoy it as much as I will enjoy teaching it. Good luck and have a nice spring term.