

## CSC2542

### Topics in Knowledge Representation & Reasoning: **Automated Planning & Reasoning About Action**

Winter 2009

## Course Description

Automated planning is a branch of AI that concerns the generation of a set of actions, with temporal and other constraints on them, for execution by some agent or agents. Planning is an active area of research that is central to the development of intelligent agents and autonomous robots.

The theory and algorithms we will be exploring in this course are applicable to a diversity of problems including software and hardware verification, genome sequencing, and automated monitoring and diagnosis.

The format of the course will be a mix of class lectures, seminars, and student paper presentations. A course project will make up a significant part of a student's course mark. For those students outside of AI who may be considering taking the course, the course project can be used as an opportunity for students to explore the application of planning techniques to an application area of your interest.

*\*\* This should be a fun and interesting course!*

## Important Announcement

- ✓ Please add your name to the list that is circulating
- ✓ This is a very short lecture because of a death in my immediate family.
- ✓ There is no tutorial tomorrow.
- ✓ There may be a short (or no) lecture next week. Please watch the course web page.

## Course Description (cont.)

**Format:** mix of class lectures, seminars and student paper presentations.

**Prerequisites:** CSC2502 or CSC2512 or my permission

**Breadth Area:** IIIa

**Readings:**

- 1) Reference textbook (optional, but helpful):  
**Automated Planning: Theory and Practice**  
By Ghallab, Nau, Traverso
  - On reserve in the library (2 hour loan)
  - Online copy available free through science direct  
<http://www.sciencedirect.com/science/book/9781558608566>
- 2) Each week we will have a lecture and/or selected readings. Watch the course Web page.

## General Information

**URL:** <http://www.cs.toronto.edu/~sheila/2542/w09>

**Lectures:** Thursday 2:00 – 4:00 PM, GB 221

**Tutorials (as needed):** Friday 1:00 – 2:00 PM, BA 2139

**Instructor:** Sheila McIlraith

**TA:** Jorge Baier

**Email:** [sheila@cs.toronto.edu](mailto:sheila@cs.toronto.edu)

**Office:** Pratt 398D

**Office Hours:** By appointment (*We'll see how this works.*)

**Announcements:** On the course Web page. I will also make a class mailing list. If you wish to be added/removed as the term progresses, let me know.

## Course Work

- Each student will **present one or more papers** to the class. The number will depend on the number of students taking/auditing the course.
- Each week, students will be required to write a **short (1-2 page) written critique of the assigned readings** for that week, except in the case where they are presenting one of the papers.
- There will be a **warm-up assignment** to get your hands dirty. Students will work individually to modify existing planning code to experiment with different algorithms.
- Students will complete a **course project** to be due in early May. The course project is to be completed individually. A list of potential topics will be supplied to the students, though the project need not be taken from this list.

## Grading

The grading breakdown is as follows:

- **Written paper critiques & class participation:** 10%
- **Class presentations:** 20%
- **Warm-up assignment:** 15%
- **Course project:** 55%

**There is no exam.**

## Presentations (20%) (cont.)

- Presenting students must **make an appointment to meet with Sheila (several days) prior to their presentation** to go over the material they plan to present. Students should have a substantial draft of the presentation ready to show at that time.
- Students will be required to make a **copy of their presentations available to the class (in ps or pdf) at least 2 hours before class.** These presentations will be posted on the course Web page. Presenting students also have the option of linking any relevant supplementary material.

**Student paper presentations will likely start in late January or early February.**

**Students auditing the course may be required to present one paper.**

## Paper Critiques (10%)

- Each week students will be required to **hand in a 1-2 page written critique** of each of the assigned readings. Reports are not required by students on weeks they are presenting a paper.
- Your goal in the written critique is to explain the nature of the problem, its significance, and your assessment of the contribution. You may write a separate critique of each reading on a given week, or one critique that discusses all of the assigned readings together.
- As an aid to writing this critique, it is recommended that you follow a **review form as a guideline.** Training yourself to critically evaluate your own work and that of others will help you significantly in your research career.

**You will not have to do paper critiques for the instructor and guest lectures, but you will be expected to participate in class.**

## Warm-up Assignment (15%)

- There will be a warm-up exercise to get your hands dirty. It will probably take the form of modifying an existing planning algorithm in various ways and testing the effectiveness of these modifications on some benchmark problem sets.

**The assignment will be handed out in early February and will be due in late February or early March.**

## Presentations (20%)

Students taking the course for credit must give **2 class presentations:**

1. Presentation of an assigned reading. (possibly 2 if the class is small)
  2. Presentation of your course project (marked as part of project).
- Discussion of each assigned reading will take one hour. This discussion will be informal and interactive. The student paper presentation should be approximately 40 minutes in length and should help stimulate discussion. The presenter should provide an overview of the paper, identify the important contributions of the paper and situate the paper within a broader research context. The presenter should be prepared to be interrupted and to answer questions about the paper.

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## Class Project (55%)

The course project must be on the general topic of automated planning and reasoning about action. A set of potential topics will be provided, but I encourage students to choose their own topic and to use this as a vehicle to jumpstart a new research project or to investigate a new aspect of ongoing research.

2-page **project proposal** due **in late February.** Start thinking about your project early. **Come and talk to me now and before submitting your proposal!** The proposal must comprise:

- a careful description of the problem your project will address;
- a set of approx 2-4 research papers from which the projects will be drawn;
- a description of the approach you will take to addressing the project;
- a description of how you will evaluate the success of the project;
- a rough schedule for when you'll accomplish the work

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## Class Project (55%) (cont.)

Evaluation of the project (55 marks) will be as follows:

- (5 marks) Your project proposal.
- (10 marks) Your project presentation. Your presentation will be given in a class towards the end of term. As such, your presentation may have to be given before your project is completed.
- (40 marks) For the overall quality of your project, based in part on its level of difficulty, on the insights you exposed, and any novel ideas of your own that you are able to explore, and your final analysis of your project. A major proportion of this mark will depend on the students' presentation of their final results. This should usually be in the form of a formal written paper, perhaps with a well-structured web site to show results, if relevant.

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## Class Poll

1. What's your primary area of research right now
  - (undecided, AI, Database, Software Engineering, Formal Methods)
2. Do you (or do you know of others) who have a conflict w/ the scheduled time for this class?
3. What interests you about the course? E.g.,
  - gaining more general knowledge of automated planning and reasoning about action
  - exploring the application of planning techniques to a domain of interest (e.g., diagnosis, planning, verification, etc.)
  - You need an area 3 course for breadth
  - other?
4. If you're interested in a particular aspect of planning, what is it?
  - (e.g., planning with uncertainty, conditional planning, heuristic search, etc.)
5. If you're interested in the applying planning techniques to a particular application, what is it?
  - (e.g., robots, software agents, verification, diagnosis, etc.)
6. Have you taken CSC2502 or CSC2514?
7. What is your level of knowledge in knowledge representation & automated reasoning.
  - (Low, Medium, High)

## Class Project (55%) (cont 2)

- (40% cont.) A major component of the report will be a review and analysis of the related literature, along with your assessment of the effectiveness and relative merits of each approach. This will focus mainly on the 2-4 papers you chose, but will also likely require several further sources in order to provide sufficient groundwork. The written report and/or website should will also include a detailed description of any algorithms you implemented. This should include problems you faced, the mathematical details of what was implemented, and an assessment of any empirical results.

**Due Date:** last day of examinations, but I'm happy if you hand it in earlier!

**Extra Incentive:** ICAPS Conference Deadline – April 17/22, 2009

## For Next Week (Jan 15)

**Read Chapters 1 and 2 in the reference textbook.**

**(I'll post the URL on our web page)**

## To audit or to register?

Auditors are welcome, I only ask that you actively participate in the class including presenting one paper presentation.

Advantages of registering:

- Breadth and credit (if you need them)
- A good mark on your transcript (if you work for it)
- Forces you to do the work

## That's it for this week!