CSC2542

Topics in Knowledge Representation & Reasoning:

Automated Planning & Reasoning About Action

Summer 2014

General Information

URL: http://www.cs.toronto.edu/~sheila/2542/s14

Lectures: generally Tues/Thurs 2:00 – 4:00 PM, WB144
Formal classroom activities will end on June 20, but we'll continue to meet as necessary.

I'd like to gather again at the end of August for project presentations. (If you can't make it we'll arrange for an alternative.)

Instructor: Sheila McIlraith

Email: sheila@cs.toronto.edu

Office: Pratt 398D

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

TA: Being finalized

TA Email: Being finalized

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 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.

Reasoning about action and change (RAC) is an area of research within the field of knowledge representation that looks at the formal foundations of reasoning about dynamical systems using logic and probabilities. We will investigate that aspect of RAC that overlaps with cognitive robotics.

The theory and algorithms we will be exploring in this course are applicable to a diversity of problems beyond the development of intelligent agents or cognitive robots, including software and hardware verification, genome sequencing, program synthesis, activity recognition, plan understanding, and automated monitoring and diagnosis.

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.

Course Description (cont.)

Format: class lectures, research paper readings and presentations.

Prerequisites:

Introductory AI course (CSC384 or comparable);

knowledge of logic.

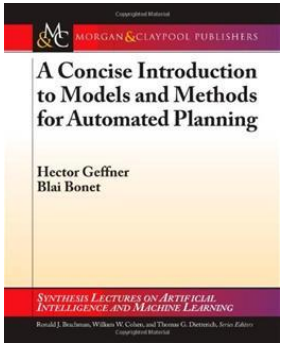
Breadth Area: Area 1

Each week we will have a lecture and/or selected readings.

Watch the course Web page. The first month will be lectures.

Reference Material

1. Reference textbook (optional, but helpful):

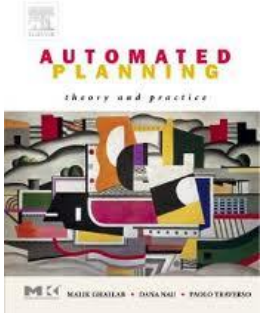


A Concise Introduction to Models and Methods for Automated Planning.
Authors: Hector Geffner & Blai Bonet
Morgan & Claypool 2013

- Online copy available free through science direct

http://www.morganclaypool.com/doi/abs/10.2200/S00513ED1V01Y201306AIM022

2. 2nd Reference Textbook (optional but helpful):



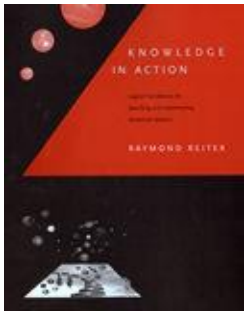
Automated Planning: Theory and Practice
Authors: Ghallab, Nau, Traverso
Morgan Kaufmann, 2004

– On reverse in the library (24 hour loan)
– Online copy available free through science direct

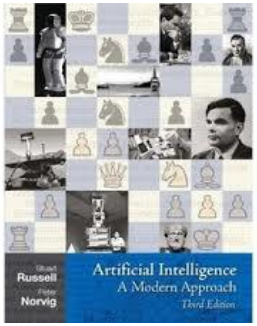
http://www.sciencedirect.com/science/book/9781558608566

Reference Material

3. Reference for one aspect of the course:
   Knowledge In Action
   Author: Raymond Reiter
   MIT Press, 2001
   – On reverse in the library (24 hour loan)



4. General AI Reference
   Artificial Intelligence: A Modern Approach (3rd ed.)
   Authors: Stuart Russell & Peter Norvig
   Pearson, 2010
   - On reverse in the library (24 hour loan)



Course Work

- Each student will **present one paper** to the class..
- 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 at the end of the exam period. The course project is to be completed individually. I have a set of possible projects and will discuss potential topics with students individually. If you have an idea for something you'd like to work on, let's discuss it.

Grading

The grading breakdown is as follows:

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

There is no formal exam but I am considering a **pass/fail "take-home" exam due at the end of August**, to ensure that you know the basics when you leave this course. **It will not be hard or too long, so don't let this scare you off the course.**

Paper Critiques (10%)

- Once we start reading research papers, each week students will be required to **hand in a 1-2 page written critique** of the assigned readings. Reports are not required by students on days 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.

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

Presentations (15%)

- Students taking the course for credit must give one **class presentation and lead a discussion** of an assigned reading.
- Presentation and discussion of each assigned reading will take 40 minutes. This discussion will be informal and interactive. The student paper presentation should be approximately 30 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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Presentations (15%) (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 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 week 3.

Warm-up Assignment (20%)

- There will be a warm-up assignment 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 at the beginning of week 3.

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 ***at the end of June***. 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 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: To be announced (around Aug 25)

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

Class Poll

1. What is your **home department**?
   - (CS, MIE, I-school, UTIAS, EE, …)
2. What's your **primary area of research** right now
   - (undecided, AI, DB, Software Engineering, Formal Methods)
3. What **preparation** do you have for the course?
   - previous AI/Logic/KR courses?
4. 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.)
   - other?
5. If you're interested in a particular **aspect of planning**, what is it?
   (e.g., planning with uncertainty, conditional planning, heuristic search)
6. If you're interested in **applying planning techniques** to a particular application, what is it?
   (e.g., robots, software agents, verification, diagnosis, etc.)