CSC2542

Topics in
Knowledge Representation & Reasoning:
Automated Reasoning

Winter 2006

Important Announcement

- ✓ **Please add your name to the list that is circulating**

- ✓ **I will be away from the university (but in email contact)**

  Monday January 16 – Friday January 27

- ✓ **Our next 2 lectures will be guest lectures.**

General Information

URL: http://www.cs.toronto.edu/~sheila/2542/w06

Lectures: Thursday 2:00 – 4:00 PM, WB 144

Instructor: Sheila McIlraith

Email: sheila@cs.toronto.edu

Office: Pratt 398D

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

Newsgroup: We have one, but won't use it (at least for now).

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

This course will explore recent advances in automated reasoning for artificial intelligence (AI). We will discuss formal principles and algorithmic techniques, with a focus on their application to AI query answering, planning, diagnosis and decision making. Topics may include: propositional satisfiability, QBFs, theorem proving, answer set programming, and model checking.

Particular emphasis will be placed on techniques for exploiting *structure* in logical theories. The term 'structure' is somewhat vague, but generally refers to some recognizable patterns which are often exposed or exploited by the use of different representation schemes, graphical techniques, compilation methods and/or heuristics. It has long been argued that we need to exploit problem structure if we want to solve problems efficiently.

This course will provide you with a reasonable overview of the state-the-art in propositional and first-order automated reasoning, while enabling you to tailor the course project to an area of personal interest within AI problem-solving.

Course Description (cont.)

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

Prerequisites: CSC2502 or CSC2512 or my permission

Breadth Area: IIIa

Readings: There is no course textbook. Each week we will have a lecture and/or selected readings. Watch the course Web page.

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.
- Students will work individually or in small groups to implement a **small AI problem solving application on existing software**. This is just a warm-up exercise to get your hands dirty. Students will present "lessons learned" from your experience.
- Students will complete a **course project** to be due on May 12. 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.

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.

Presentations (20%)

Students taking the course for credit must give **3 class presentations:**

1. Presentation of an assigned reading. (possibly 2 if the class is small)
2. Short presentation of the results of your (group) assignment.
3. 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.

...

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 start in early February.

Students auditing the course will be required to present one paper.

Warm-up Assignment (15%)

- Students will work individually or in small groups to implement a **small AI problem solving application on existing software**. This is just a warm-up exercise to get your hands dirty. Students will present "lessons learned" from your experience.

The assignment will be handed out in early February and will be due in early March. The exact date depends on resolution of scheduling of an external guest lecturer.

Class Project (55%)

The course project must be on the general topic of automated reasoning for AI problem solving. 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 ***no later than*** **5pm, Mon Feb 27**. 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

...

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.

...

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, **Friday May 12 at 5:00pm**.

Important Dates

January 27: Last day to add a grad course

Feb TBD: Assignment handed out

March 3: Last day to drop a grad course

March TBD: Assignment due

April 14: Last class (to be confirmed)

May 12: Deadline for submission of project

Overview of Schedule

Week 1: Course introduction

Week 2: Theorem proving (Scott Sanner)

Week 3: SAT & QBF (Fahiem Bacchus)

Week 4: AI Reasoning Problems (Sheila)

Model Checking (Marsha Chechik)

Week 5: Logic Programming and Answer Set Programming (Sheila)

DL Reasoners?

Week 6-12: Paper readings and some guest lectures

Week 13: Student project presentations

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'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 reasoning**
   - **gaining more knowledge about a specific AI reasoning task (e.g., diagnosis, planning, verification, etc.)**
   - **you're interested in techniques for exploiting structure in logical reasoning.**
   - **other?**
4. **If you're interested in a specific reasoning task is it:**
   - **(Query answering, Diagnosis, Planning, Decision-making, Verification, Other?)**
5. **If you're interested in a particular type of reasoning is it:**
   - **(SAT, QBP, Theorem Proving, DL reasoning, Logic programming or ASP, Other?)**
6. **Have you taken CSC2502 or CSC2514?**
7. **What is your level of knowledge in automated reasoning.**
   - **(Low, Medium, High)**

For Next Week (Jan 19)

Topic: Overview Theorem Proving (Scott Sanner)

Assigned Readings: Russell and Norvig, (2nd Edition)

Chapters 8 & 9

Photocopies available from me.

Slides: posted before/after lecture

(watch announcements on Web)

For The Week After (Jan 26)

Topic: SAT and QBF Overview (Fahiem Bacchus)

If there are readings, Scott will announce them in class or I will announce them on our Web page.

That’s it for this week!