Course Outline

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Course Details

Course Code	COMP4418
Course Title	Knowledge Representation and Reasoning
Convenor	Maurice Pagnucco (/users/z9600614)
Admin	Maurice Pagnucco (/users/z9600614)
Classes	**3-6pm Monday Colombo Theatre B**
Consultations	Please request a time by email.
Units of Credit	6
Course Website	http://cse.unsw.edu.au/~cs4418/18s2/ (http://cse.unsw.edu.au/~cs4418/17s2/)
Handbook Entry	http://www.handbook.unsw.edu.au/undergraduate/courses/current/COMP4418.html (http://www.handbook.unsw.edu.au/undergraduate/courses/current/COMP4418.html)

Course Summary

Knowledge Representation and Reasoning (KRR) is at the core of Artificial Intelligence. It is concerned with the representation of knowledge in symbolic form and the use of this knowledge for reasoning. This course presents current trends and research issues in Knowledge Representation and Reasoning (KRR). It enables students interested in Artificial Intelligence to deepen their knowledge in this important area and gives them a solid background for doing their own work/research in this area. The topics covered include: Commonsense reasoning, Description logics and ontologies, Answer set programming, Planning, Reasoning about action, Constraint programming.

This course can be a starting point for further exploration of artificial intelligence. Further courses include COMP3431/COMP9431 Robotic Software Architecture, COMP9417 Machine Learning and Data Mining, COMP9444 Neural Networks and COMP9844 Extended Neural Networks.

Required Knowledge

Students are expected to have some background in symbolic logic and general AI, which might come from COMP3411 or COMP9414 Artificial Intelligence or COMP9814 Extended Artificial Intelligence. The handbook entry (http://www.handbook.unsw.edu.au/undergraduate/courses/2016/COMP4418.html) requires COMP3411 or COMP4415 as pre-requisite for this course. Students with a background in symbolic logic and/or artificial intelligence obtained by other means should contact the lecturer-in-charge to get a waiver for the pre-requisite.

Student Learning Outcomes

COMP4418 is focussed on current trends and issues in Knowledge Representation and Reasoning. The intent of this course is to connect students to the topics through lecturers who know their subjects intimately, through continuing active use and research. To this end, there are a large number of lecturers, each with great expertise in the topics they present. The course is structured to keep related topics close together, and to develop some themes. Assessment is based around assignments, which supports "learning by doing".

As a result of this course, students will:

- develop an understanding of theoretical and practical issues in symbolic knowledge representation and reasoning, in general
- develop an understanding of the capabilities of specific knowledge representation formalisms for specific tasks
- learn techniques specific to specific knowledge representation problems and formalisms
- have practical experience in using special-purpose languages for (some of) commonsense reasoning, ontologies, planning, reasoning about actions, and constraint programming.

Student Conduct

The **Student Code of Conduct** (Information (https://student.unsw.edu.au/conduct) , Policy (https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf)) sets out what the University expects from students as members of the UNSW community. As well as the learning, teaching and research environment, the University aims to provide an environment that enables students to achieve their full potential and to provide an experience consistent with the University's values and guiding principles. A condition of enrolment is that students *inform themselves* of the University's rules and policies affecting them, and conduct themselves accordingly.

In particular, students have the responsibility to observe standards of equity and respect in dealing with every member of the University community. This applies to all activities on UNSW premises and all external activities related to study and research. This includes behaviour in person as well as behaviour on social media, for example Facebook groups set up for the purpose of discussing UNSW courses or course work. Behaviour that is considered in breach of the Student Code Policy as discriminatory, sexually inappropriate, bullying, harassing, invading another's privacy or causing any person to fear for their personal safety is serious misconduct and can lead to severe penalties, including suspension or exclusion from UNSW.

If you have any concerns, you may raise them with your lecturer, or approach the School Ethics Officer (mailto:ethics-officer@cse.unsw.edu.au) , Grievance Officer (mailto:grievance-officer@cse.unsw.edu.au) , or one of the student representatives.

Plagiarism is defined as (https://student.unsw.edu.au/plagiarism) using the words or ideas of others and presenting them as your own. UNSW and CSE treat plagiarism as academic misconduct, which means that it carries penalties as severe as being excluded from further study at UNSW. There are several on-line sources to help you understand what plagiarism is and how it is dealt with at UNSW:

- Plagiarism and Academic Integrity (https://student.unsw.edu.au/plagiarism)
- UNSW Plagiarism Procedure (https://www.gs.unsw.edu.au/policy/documents/plagiarismprocedure.pdf)

Make sure that you read and understand these. Ignorance is not accepted as an excuse for plagiarism. In particular, you are also responsible that your assignment files are not accessible by anyone but you by setting the correct permissions in your CSE directory and code repository, if using. Note also that plagiarism includes paying or asking another person to do a piece of work for you and then submitting it as your own work.

UNSW has an ongoing commitment to fostering a culture of learning informed by academic integrity. All UNSW staff and students have a responsibility to adhere to this principle of academic integrity. Plagiarism undermines academic integrity and is not tolerated at UNSW. Plagiarism at UNSW is defined as using the words or ideas of others and passing them off as your own.

If you haven't done so yet, please take the time to read the full text of

- UNSW's policy regarding academic honesty and plagiarism (https://student.unsw.edu.au/plagiarism)

The pages below describe the policies and procedures in more detail:

- Student Code Policy (https://www.gs.unsw.edu.au/policy/documents/studentcodepolicy.pdf)
- Student Misconduct Procedure (https://www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf)
- Plagiarism Policy Statement (https://www.gs.unsw.edu.au/policy/documents/plagiarismpolicy.pdf)
- Plagiarism Procedure (https://www.gs.unsw.edu.au/policy/documents/plagiarismprocedure.pdf)

You should also read the following page which describes your rights and responsibilities in the CSE context:

- Essential Advice for CSE Students (https://www.engineering.unsw.edu.au/computer-science-engineering/about-us/organisational-structure/student-services/policies/essential-advice-for-cse-students)

Assessment

Item	Topics	Due	Marks
Assignment 1	Introduction to KRR, formal logic and reasoning, commonsense reasoning	Week 5	15%
Assignment 2	Non-monotonic reasoning, reasoning about knowledge, reasoning about actions	Week 10	15%
Assignment 3	Decision making	Week 13	15%
Final Exam	All topics	Exam period	55%

Course Schedule

Week	Lectures	Assignments	Lecturer	Notes
1	Introduction to KRR, Modelling	-	Maurice Pagnucco	23 July
2	Formal Logic and Reasoning	-	Maurice Pagnucco	30 July
3	Formal Logic and Reasoning	-	Maurice Pagnucco	6 August

4	Commonsense Reasoning	-	Maurice Pagnucco	13 August
5	Answer Set Programming	Assignment 1 Due	Christoph Schwering	20 August
6	Satisfiability Checking	-	Christoph Schwering	27 August
7	Reasoning about Knowledge	-	Christoph Schwering	3 September
8	Reasoning about Actions	-	Christoph Schwering	10 September
9	Social Choice		Haris Aziz	17 September
-	Study Break (no class)			24 September
10	Public Holiday (no class)	Assignment 2 Due		1 October
11	Multi-agent Resource Allocation	-	Haris Aziz	8 October
12	Cooperative Game Theory	-	Haris Aziz	15 October
13	Noncooperative Game Theory	Assignment 3 Due	Haris Aziz	22 October

Resources for Students

This course does not have a prescribed textbook. Notes and/or slides on each topic will be made available on the class web page.

1. General Knowledge Representation and Reasoning
   - Ronald J. Brachman and Hector J. Levesque. Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
2. Planning
   - Malik Ghallab, Dana Nau, Paolo Traverso, Automated Planning — theory and practice, Morgan Kaufmann, 2004. Chapters 1 to 6, especially.
3. Answer Set Programming
   - Bruce Porter, Vladimir Lifschitz, Frank Van Harmelen, Handbook of Knowledge Representation, Elsevier, 2007.
   - Potassco User Guide (http://sourceforge.net/projects/potassco/files/potassco_guide/2010-10-04/guide.pdf/download)
4. Agent Programming
   - Raymond Reiter, Knowledge in Action, MIT Press, 2001.
   - Michael Thielscher, Action Programming Languages, Morgan & Claypool, 2008.
5. Constraints
   - Constraint Logic Programming using ECLiPSe. Krzysztof Apt and Mark Wallace. Cambridge University Press, 2007.
   - Programming with Constraints: An Introduction. Kim Marriott and Peter J. Stuckey. MIT Press, 1998.
   - Francesca Rossi, Peter van Beek, and Toby Walsh (Eds), Handbook of Constraint Programming. Elsevier, 2006. ISBN 0-444-52726-5, 978 pages.
   - Rina Dechter. Constraint Processing. Morgan Kaufmann, 2003.
6. Nonmonotonic Reasoning
   - Michael R. Genesereth and Nils J. Nilsson. Logical Foundations of Artificial Intelligence, Morgan Kaufmann, 1987.T
7. Reasoning about Knowledge
   - Hector J. Levesque, Gerhard Lakemeyer. The Logic of Knowledge Bases, 2002.
8. Belief Change
   - Sven Ove Hansson, Textbook of Belief Dynamics: Theory Change and Database Updating, Kluwer Academic, 1999.
   - Salem Benferhat, Souhila Kaci, Daniel Le Berre, Mary-Anne Williams. Weakening conflicting information for iterated revision and knowledge integration. Artificial Intelligence 153(1-2): 339-371, 2004.
   - Adnan Darwiche, Judea Pearl. On the Logic of Iterated Belief Revision. Artificial Intelligence 89(1-2): 1-29, 1997.
   - Hirofumi Katsuno, Alberto O. Mendelzon. Propositional Knowledge Base Revision and Minimal Change. Artificial Intelligence 52(3): 263-294, 1992.
9. Description Logics
   - Franz Baader, Diego Calvanese, Deborah McGuinness, Daniele Nardi, Peter Patel-Schneider, The Description Logic Handbook: Theory, Implementation and Applications, Cambridge University Press, 2003.
10. Game Theory/Social Choice
    - Y. Shoham and K. Leyton-Brown, Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations. Cambridge, U.K.: Cambridge Univ. Press, 2008.
    - J. Rothe. Economics and Computation. Springer, 2016.

Course Evaluation and Development

This course is evaluated each session using the myExperience system.

Student feedback will be obtained by electronic survey at the end of the course through myExperience (https://myexperience.unsw.edu.au) . Students are also encouraged to provide informal feedback during the session, and to let the lecturer-in-charge know of any problems as soon as they arise.

Student feedback from the last offering indicated that students were satisfied with the course, but suggested to include more guidance to the programming languages in the lectures. We will endeavour to achieve that in this offering.

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