CIS*4780 Computational Intelligence

Fall 2020

School of Computer Science
Credit Weight 0.50

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1 Course Details

1.1 Calendar Description

This course introduces concepts of soft computing: modelling uncertainty, granular computing, neurocomputing, evolutionary computing, probabilistic computing and soft computing for software engineering. (Offered in odd-numbered years.)

Pre-Requisites: CIS*3490, (CIS*3750 or CIS*3760), (CIS*2460 or STAT*2040)

1.2 Course Description

This is an advanced course on intelligent computational systems. The focuses are on three classes of artificial intelligence methodologies: constraint-based reasoning, probabilistic reasoning, and reinforcement learning.

Under constraint-based reasoning, topics covered include constraint satisfaction problems, backtracking, iterative improvement, and constraint propagation. For probabilistic reasoning, we study limitation of logic, Bayesian probability, inference with JPD, Bayesian networks (BNs), inference in BNs by variable elimination, and learning BNs from data. Under reinforcement learning, we study Markov decision processes, value iteration, and passive and active reinforcement learning techniques.

Student background of an introductory course on Artificial Intelligence, such as CIS*3700, and fluency in Java programming are assumed.

All components of this course are delivered online. Some components involve real-time communication. Hence, a reliable computer and an internet connection are necessary to participate in online learning. Assignment and exam submissions involve scanning or photocopying hand-written answers into PDF files, and a scanner or photo-taking cell phone is needed.

1.3 Timetable

Three time slots are scheduled for this course in WebAdvisor:

LEC Tues, Thur
02:30PM - 03:50PM
AD-S, Room Virtual
LAB Mon
09:30AM - 10:20AM
AD-S, Room Virtual

Due to online delivery of this course, WebAdvisor time slots will be used as follows:

1. Virtual lectures (video-recorded) will be delivered to CourseLink according to the lecture starting time on WebAdvisor. That is, video lectures will be available for students to view on Tues and Thur by 2:30PM.
2. The lab time on Mon was intended for virtual office hour. As the 9:30AM time slot is expected to be unfavorable by most students, this time slot will NOT be used on a weekly basis. Instead, the weekly virtual office hour will be on Thur, 2:30 - 3:30 PM (see below).
3. Based on the above, Mon, 9:30 – 10:20 AM and Tues, 2:30 - 3:50 PM are NOT used weekly. Instead, they will be used occasionally as needed, e.g., a virtual class meeting or an extra virtual office hour. In such cases, advance notice will be sent to the class.

F20 classes start on 2020/09/10 (Thur) and end on 2020/12/4 (Fri). Hence, the 1st CIS*4780 lecture is on Sept 10. That week is referred to as Week 1 with one lecture only. Subsequent weeks are referred to as Week 2, Week 3, and so on. Oct 3 in Week 6 is Fall Study Break Day without lecture. The lecture is rescheduled to Dec 3 of Week 13, which is the last lecture.

Assignment A1 will be distributed on Week 4 and due on Week 6. Assignment A2 will be distributed on Week 8 and due on Week 10. Assignment A3 will be distributed on Week 11 and due on Week 13.

1.4 Final Exam

The Final Exam is open-book and online. It includes both multiple-choice and short answer questions. The expected time to answer all questions by an average student is 2-hour. Counting the additional time for online file processing, the Final Exam will have 3-hour duration. The exact date and time are pending on University scheduling.

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2 Instructional Support

2.1 Instructor

Yang Xiang, Professor, yxiang@uoguelph.ca

2.2 Consultation of Instructor

This course has limited TA resource, and it is focused on assignment marking. Please direct all your questions to the Instructor. Consultation with the Instructor is available in the following ways:

1. Virtual office hours (Thur, 2:30 - 3:30 PM): Each week from Week 2 to 13, except Week 6 (Fall Study Break), there is a virtual office hour. It is organized as a Microsoft Teams meeting. All students will be invited, but participation is voluntary. The meeting will be driven by questions from individual students, typically questions from one student at a time, while other participating students are present in the meeting.

   The virtual office hour is on Thur, 2:30 - 3:30 PM. The choice is made among the 3 alternative time slots scheduled for this course, Mon from 9:30, Tue from 2:30, and Thur from 2:30, as the Mon slot is expected to be unfavorable by most students. The 3:30 PM end time will be extended if at least one student remains with unanswered questions.

   In addition to the above weekly virtual office hours, additional virtual office hours may be arranged if needs arise. They will be scheduled to Mon, 9:30 – 10:20 AM or Tues, 2:30 - 3:50 PM, with advance notice.
2. By Discussions forum at CourseLink: A Discussions forum, "Ask the Instructor", can be used by students to raise questions on the course materials, and they will be answered by the Instructor. Both the question and the answer are visible by all students.
3. By email to Instructor: If a student prefers to keep their question private, email it to **yxiang@uoguelph.ca**. They will normally be answered within 24 hours. Please do not email your questions to other addresses, such as by replying to assignment marking reports emailed to you. If your question is not answered within 24 hours, most likely it was sent to a wrong address, and never reached the Instructor. Please re-send to the above email address.
4. By individual Teams meeting: Since email is not interactive, if a student prefers interactive discussion with the Instructor, they can request one-on-one Teams meeting. In the email request, suggest 2 alternative time slots.

3 Learning Resources

3.1 Textbook

S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, (3rd Ed.), Prentice Hall, 2010.

3.2 Additional Resources

Course Websites (Website)

There are 2 course websites that distribute different subsets of resource info for the course. Website 1 is located at URL http://www.socs.uoguelph.ca/~yxiang/4780/4780f20.html and contains the following resources:

1. Course outline
2. News for the course
3. Assignment Submission Instruction
4. Resources for assignments

Website 2 is located at **CourseLink**. It contains the following resources:

1. Virtual lectures
2. Lecture notes
3. Discussions forum "Ask the Instructor"
4. Discussions forum "Discuss with Peers" for students to share thoughts on course materials
5. Assignment descriptions
6. Droboxes for submission of assignments
7. Assignment solutions distributed after marking

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4 Learning Outcomes

After completing this course, students will be able to

1. Identify intelligent system application tasks solvable as constraint satisfaction problems (CSPs)
2. solve CSPs by backtracking, iterative improvement, and constraint propagation
3. identify intelligent system application tasks that are suitable for probabilistic inference with Bayesian networks
4. understand fundamentals of Bayesian probability
5. implement probabilistic reasoning with Bayesian networks by variable elimination
6. identify intelligent system application tasks that are suitable for

reinforcement learning
7. implement reinforcement learning by value iteration

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5 Teaching and Learning Activities

The course includes the following teaching and learning activities:

1. Fundamental concepts, theories, methodologies, and algorithms are described and analyzed through virtual lectures.
2. The theories, methodologies, and algorithms are practiced through lecture examples lead by the Instructor.
3. The theories, methodologies, and algorithms are practiced independently by students through short-answer questions in assignments.
4. Hands-on experience on solving AI problems by constraint reasoning, probabilistic reasoning, and reinforcement learning is gained through algorithm implementation problems in assignments.
5. Learning from peers is facilitated by Discussions Forum "Discuss with Peers".

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6 Assessments

6.1 Marking Schemes & Distributions

Student performance will be evaluated by three assignments (A1, 17%; A2, 17%; A3, 17%), and the Final Exam (49%).

6.2 Assignment Submission

Assignment Submission Instruction in the course Website 1 should be followed.
Assignments should be submitted to CourseLink Dropbox by 11:30PM on specified due dates. Late submissions are subject to 20% of the total mark per day, up to 2 ***calendar*** days (graceful period). For instance, the latest time to submit an assignment due on Thursday is 11:30PM on Saturday, with the highest possible mark of 60%.

6.3 Re-Grading Policy

For each assignment, a mark report will be emailed to each student. Problems in marking should be reported to the Instructor at yxiang@uoguelph.ca within 48 hours after receiving the mark report. After 48 hours, the reported mark will be finalized. Please do not make re-grading request by replying to the mark report email, as it will NOT reach the Instructor.

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7 University Statements

7.1 Email Communication

As per university regulations, all students are required to check their e-mail account regularly: e-mail is the official route of communication between the University and its students.

7.2 When You Cannot Meet a Course Requirement

When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. The grounds for Academic Consideration are detailed in the Undergraduate and Graduate Calendars. Undergraduate Calendar - Academic Consideration and Appeals https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml Graduate Calendar - Grounds for Academic Consideration https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml Associate Diploma Calendar - Academic Consideration, Appeals and Petitions https://www.uoguelph.ca/registrar/calendars/diploma/current/index.shtml

7.3 Drop Date

Students will have until the last day of classes to drop courses without academic penalty. The deadline to drop two-semester courses will be the last day of classes in the second semester. This applies to all students (undergraduate, graduate and diploma) except for Doctor of Veterinary Medicine and Associate Diploma in Veterinary Technology (conventional and alternative delivery) students. The regulations and procedures for course registration are available in their respective Academic Calendars.
Undergraduate Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-drop.shtml Graduate Calendar - Registration Changes
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/genreg-reg-regchg.shtml Associate Diploma Calendar - Dropping Courses
https://www.uoguelph.ca/registrar/calendars/diploma/current/c08/c08-drop.shtml

7.4 Copies of Out-of-class Assignments

Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

7.5 Accessibility

The University promotes the full participation of students who experience disabilities in their academic programs. To that end, the provision of academic accommodation is a shared responsibility between the University and the student. When accommodations are needed, the student is required to first register with Student Accessibility Services (SAS). Documentation to substantiate the existence of a disability is required; however, interim accommodations may be possible while that process is underway. Accommodations are available for both permanent and temporary disabilities. It should be noted that common illnesses such as a cold or the flu do not

constitute a disability. Use of the SAS Exam Centre requires students to book their exams at least 7 days in advance and not later than the 40th Class Day. For Guelph students, information can be found on the SAS website https://www.uoguelph.ca/sas For Ridgetown students, information can be found on the Ridgetown SAS website
https://www.ridgetownc.com/services/accessibilityservices.cfm

7.6 Academic Integrity

The University of Guelph is committed to upholding the highest standards of academic integrity, and it is the responsibility of all members of the University community-faculty, staff, and students-to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff, and students have the responsibility of supporting an environment that encourages academic integrity. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.
Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor. Undergraduate Calendar - Academic Misconduct https://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml Graduate Calendar - Academic Misconduct
https://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/index.shtml

7.7 Recording of Materials

Presentations that are made in relation to course work - including lectures - cannot be recorded or copied without the permission of the presenter, whether the instructor, a student, or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

7.8 Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies, and regulations that apply to undergraduate, graduate, and diploma programs.

Academic Calendars https://www.uoguelph.ca/academics/calendars

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8 Policy Regarding Online Course Delivery

Do not redistribute recorded interactive discussions that involve your classmates. This includes virtual office hours with the instructor.

Online activities such as virtual office hours may be recorded by the instructor and posted to Courselink. By taking this course you are agreeing that your participation in these activities can be used in this manner. If you do not wish to have your image or voice recorded as part of these activities, then either do not take this course or do not ask verbal questions during these activities.

A reliable internet connection that is sufficient for online learning is necessary for this course. If you do not have a sufficiently fast and reliable internet connection, then you may not be able to view or download lectures or other course material. It may also not be possible to attend virtual office hours or have individual Teams meetings with the instructor.

This course is offered in the eastern standard time zone (EST). While taking this course, you may be required to attend online activities such as virtual office hours or individual Teams meetings with the instructor between 9:00 and 4:30 EST.