CSC 384
Introduction to Artificial Intelligence

Alice Gao and Randy Hickey

Winter 2023

Instructors

Alice Gao

Randy Hickey

Alice Gao

- Grew up in Beijing, China.
- Moved to Vancouver in high school.
- Undergrad in Math and CS w/ Co-op @UBC.
- PhD in CS @Harvard.
  - Algorithmic Game Theory, Information Elicitation and Aggregation
- Microsoft Research Internships @UK and @NYC.
- Postdoc @UBC.
- Lecturer @UWaterloo.
- Assistant Professor, Teaching Stream @UofT.
- Current Research in CS Education
  - Procrastination.

Randy Hickey

- grew up in Toronto, Canada
- B.Sc. at York University in Computer Science
- M.Sc. at U of T in Computer Science
- still completing PhD at U of T
- my research is specialized in Artificial Intelligence!
- specifically, my research is about improving Propositional Satisfiability (SAT) solvers, which are a subset of Constraint Satisfaction Problems (CSP), which we study in Unit 3. SAT Solvers have many applications in Knowledge Representation (KR), which we study in Unit 5.

Q: Questions or comments for Alice and Randy?

Meet Your Peers!

- In the next 2 minutes, introduce yourself
- to someone you don’t know.
- Talk about courses, internship, dorms, extracurricular activities, graduation, jobs, etc.

Q: Share something interesting about your new/old friend!

OUR FAVOURITE AI MOMENTS

Q: Why did you decide to learn about AI?

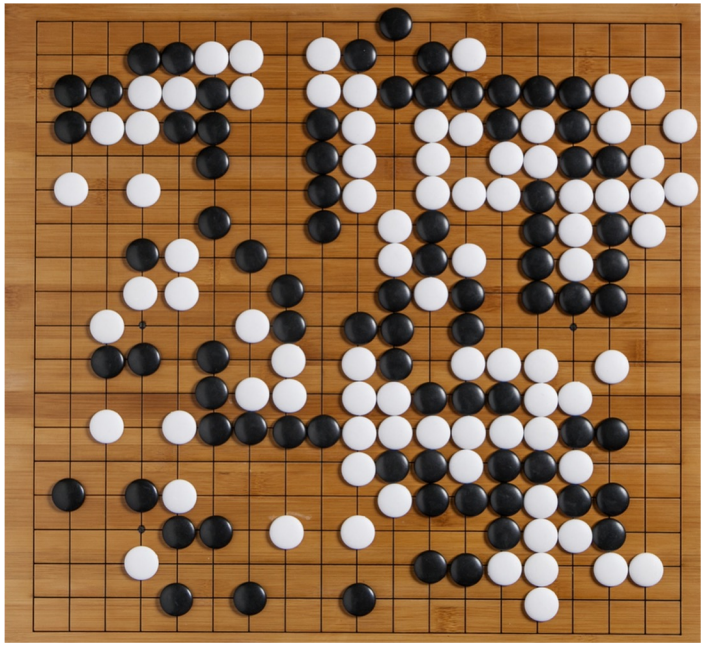
Share your thoughts!

DeepBlue vs. Kasparov (1997)

IBM’s Deep Blue beats chess grandmaster Garry Kasparov

AlphaGo vs. Lee Sedol (2016)

- AlphaGo defeated Lee Sedol (4-1).
- Tree search, deep convolutional neural networks, supervised learning, reinforcement learning.



AlphaGo and DeepMind

2016: AlphaGo beats 9-Dan pro Go player Lee Sedol

- Monte Carlo tree search + neural net trained on human games
- Silver, D., Huang, A., Maddison, C. *et al.* Mastering the game of Go with deep neural networks and tree search. *Nature* **529**, 484–489 (2016).

2017: AlphaGo Zero

- Neural net completely *self taught* (no human games data)
- Silver, D., Schrittwieser, J., Simonyan, K. *et al.* Mastering the game of Go without human knowledge. *Nature* **550**, 354–359 (2017). https://doi.org/10.1038/nature24270

2017: AlphaZero

- Plays more games – chess, shogi
- Silver, David, et al. "A general reinforcement learning algorithm that masters chess, shogi, and Go through self-play." *Science* 362.6419 (2018): 1140-1144.

2019: MuZero

- Learns without knowing rules
- Schrittwieser, J., Antonoglou, I., Hubert, T. *et al.* Mastering Atari, Go, chess and shogi by planning with a learned model. *Nature* **588**, 604–609 (2020).

StarCraft II (2019)

Vinyals et al. (2019). Grandmaster level in StarCraft II using multi-agent reinforcement learning. Nature, 575(7782), 350-354.

2-minute paper:
https://www.youtube.com/watch?v=jtlrWblOyP4&t

Watson v.s. Rutter & Jennings (2011)

- IBM's Watson trains a question-answering system on unstructured data (Wikipedia, IMDB, etc)
- Defeats Jeopardy champions Brad Rutter and Ken Jennings by a significant margin.

Autonomous Driving

- 2005: DARPA Grand Challenge – Stanford won!
- 2007: DARPA Urban Challenge – CMU won!
- The perception and decision-making systems.
- A survey paper on self-driving cars

Stanford's Stanley

CMU's Boss

…AND LOTS OF IT IS HAPPENING IN TORONTO!

theReview

How Canada became a hotspot for artificial intelligence research

Nvidia launches new metaverse efforts at SIGGRAPH

TRANSPORTATION | UBER | SELF-DRIVING CARS

Uber hired noted AI researcher Raquel Urtasun to lead its self-driving expansion into Canada

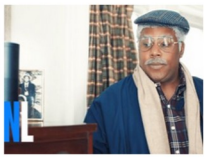
Urtasun will continue to teach at the University of Toronto part-time and will be joined by eight of her students.

BY JOHANA BHUIYAN | @JMBOOYAH | MAY 8, 2017, 10:32AM EDT

TWEET | SHARE | LINKEDIN

Raquel Urtason | uber

TRENDING



Watch this 'SNL' skit about an Amazon Echo Silver for senior citizens

Vector Institute is just the latest in Canada's AI expansion

By Jessica Murphy
BBC News, Toronto

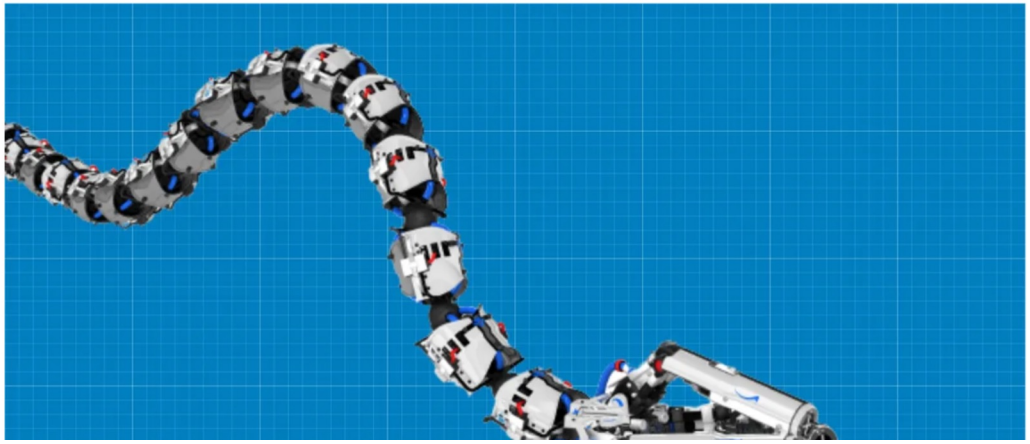
29 March 2017 Share

These snake-like robots could be used in surgery to save lives

The machines are not limited to one industry and have many useful applications.

Loukia Papadopoulos
Created: Aug 13, 2022 11:32 AM

HEALTH



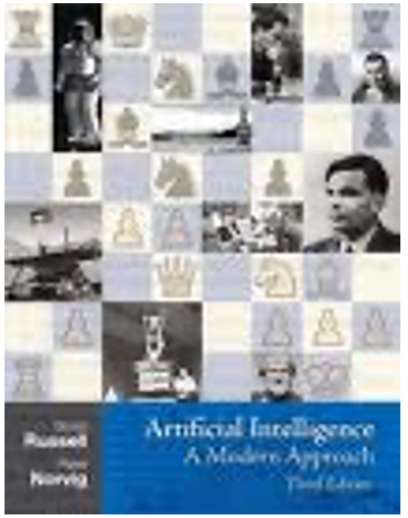
CSC384 TOPICS

Textbook

Artificial Intelligence: A Modern Approach

Stuart Russell and Peter Norvig.

3rd edition, 2010.

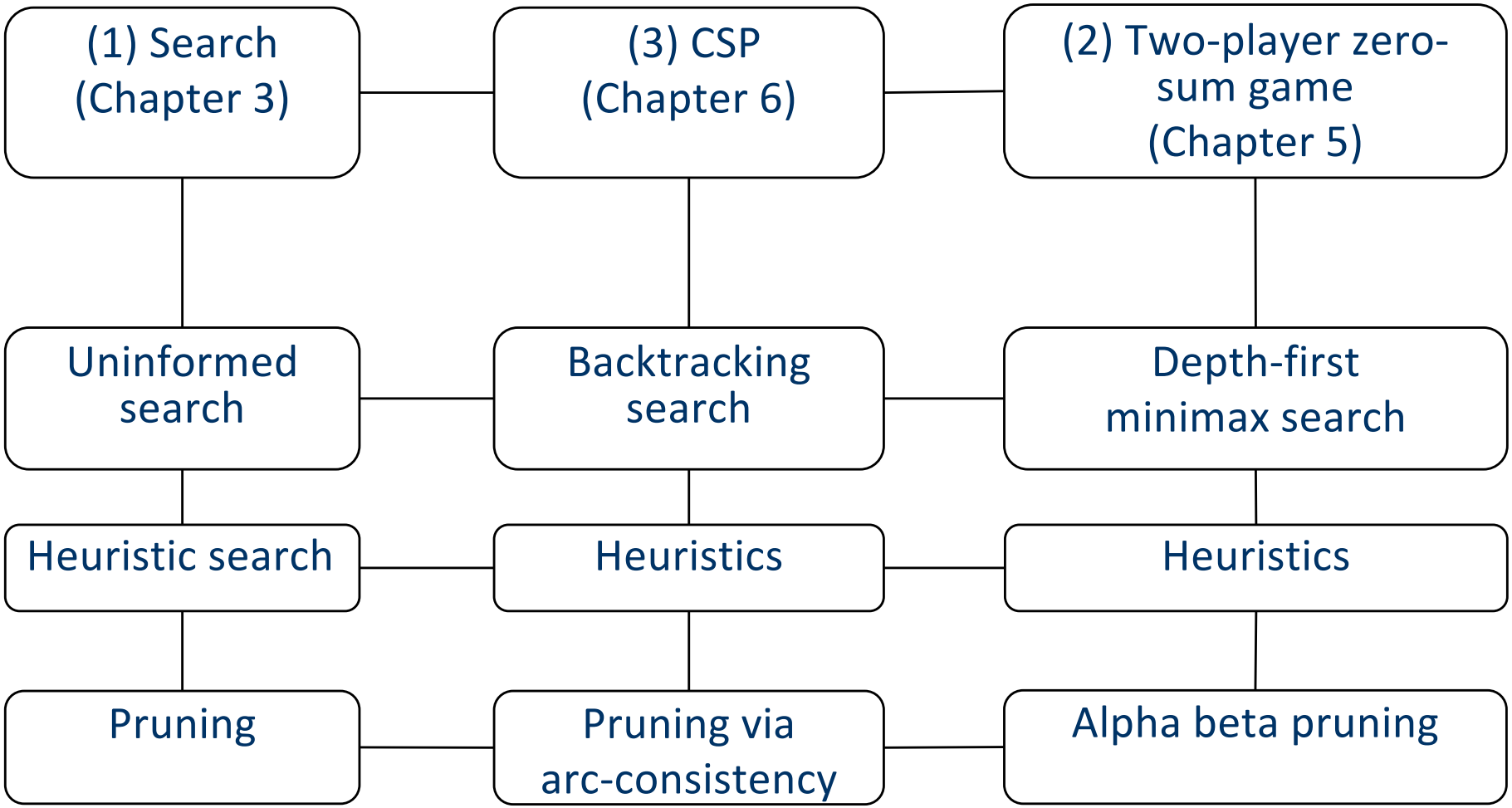


- Recommended but not required.
- Lecture notes will be available online before class.

CSC384 Topics (1/2)

- Search (R&N Ch3)
  - Formulating a search problem
  - Uninformed search
  - Heuristic search
  - Pruning
- Game Tree Search (R&N Ch5)
  - Properties of a game
  - Minimax search
  - Alpha-beta pruning
- Constraint Satisfaction Problems (R&N Ch6)
  - Formulating a CSP
  - Backtracking search
  - Pruning via Arc consistency

CSC 384 Topics (1/2)

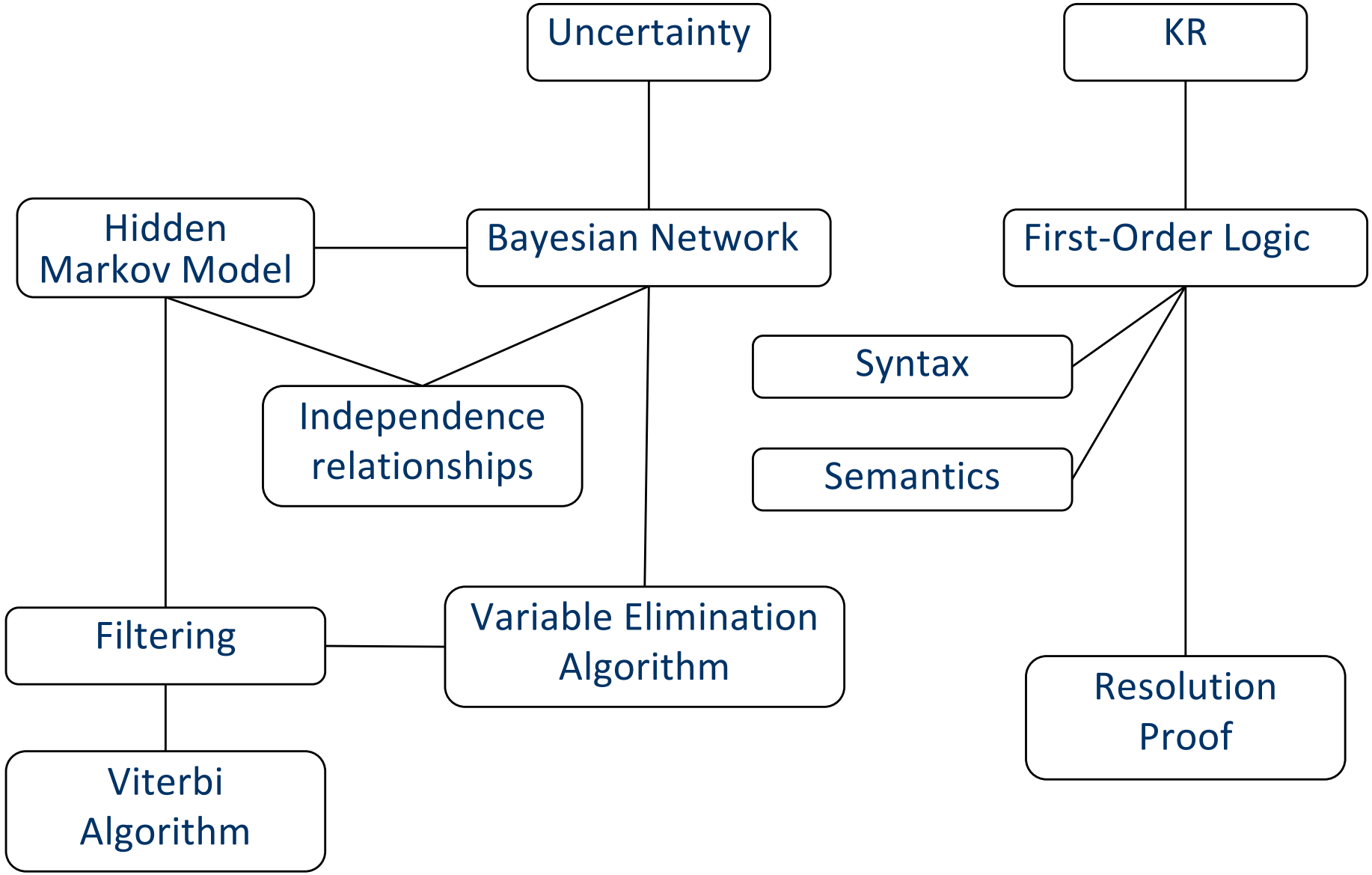


CSC384 Topics (2/2)

- Uncertainty (R&N Ch13-15)
  - Interpreting a Bayesian network.
  - Performing inference in a Bayesian network.

- Knowledge Representation (R&N Ch7-9)
  - Representing knowledge using first-order logic.
  - Constructing a resolution proof.

CSC384 Topics (2/2)



Prerequisites

- Basic data structures, graph, Big O notation and runtime complexity (to analyze and implement algorithms)
- Probability (to understand Bayesian networks)
- Python (for the programming assignments)

You will be responsible for relearning any needed background material.

Q: How are AI and ML related?

Further Courses in AI

- CSC311 Introduction to Machine Learning
- CSC320 Introduction to Visual Computing
- CSC401 Natural Language Computing
- CSC412 Probabilistic Learning and Reasoning
- CSC413 Neural Networks and Deep Learning
- CSC420 Introduction to Image Understanding
- CSC485 Computational Linguistics
- CSC486 Knowledge Representation and Reasoning

Getting Involved in AI @ UofT

- Undergraduate AI Group (UAIG)
  - https://www.uoft.ai/
  - Project X research competition - https://www.uoft.ai/projectx
- Undergraduate Research
  - Undergraduate Summer Research Program (UGSRP) – Dep't CS
  - Undergraduate Research Fund (Faculty of Arts & Sciences)
  - CSC494/495 Project Courses
- UofT Self-driving Car Team
- "SCI-FI+" AI SciFi Reading Group
  - Run by Sonya Allin at UTM

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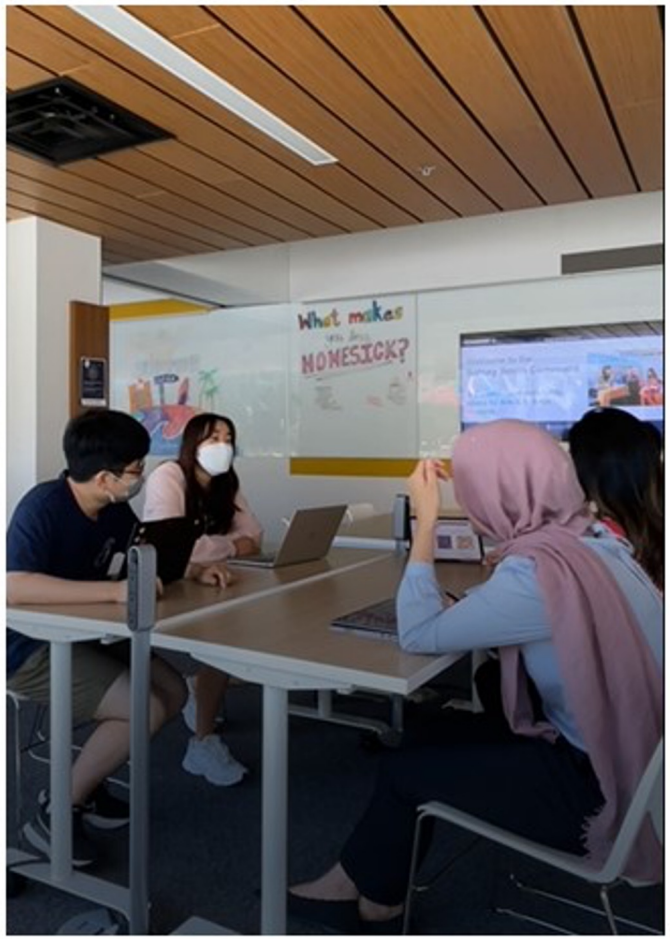
Student Support Resources

- CSC Wellness Resources:
  - https://q.utoronto.ca/courses/221753/pages/wellness-resources
- Student Mental Health Resources
  - https://mentalhealth.utoronto.ca/my-student-support-program/
- Accessibility Resources
  - https://studentlife.utoronto.ca/service/accessibility-services-registration-and-documentation-requirements/
- Student Life
  - https://studentlife.utoronto.ca/
- Recognized Study Groups
  - https://sidneysmithcommons.artsci.utoronto.ca/recognized-study-groups/

UNIVERSITY OF TORONTO
FACULTY OF ARTS & SCIENCE



Join or Lead an RSG

- Meet weekly with up to 8 classmates
- Review and discuss course material
- Prepare for tests and exams
- Get student advice from upper year mentors

Last year, over 3,000 students joined an RSG where they met friends and reached their study goals.

Join an RSG at
UOFT.ME/RECOGNIZEDSTUDYGROUPS

SIDNEY SMITH COMMONS

@sidneysmithcommons

CCR CO-CURRICULAR RECORD

Alice Gao and Randy Hickey, CSC 384 Intro to AI, University of Toronto.

COURSE ADMINISTRATION

Marking Scheme

Course Component	Percentage of Final Grade
4 Assignments (10% each)	35%
4 Tests (5% each)	20%
Final Exam	45%

You must get $\geq 40\%$ on the final exam to pass the course.

Course Schedule

	Monday	Wednesday	Friday	Thursday
Jan 09 - Jan 13	Intro	Search 1 - 2		
Jan 16 - Jan 20	Search 3 - 5			<= A1 posted
Jan 23 - Jan 27	Search Review	Games 1 - 2		
Jan 30 - Feb 03	Test 1 Search	Games 3 - 4		<= A2 posted
Feb 06 - Feb 10	Games Review	CSP 1 - 2		<= A1 due
Feb 13 - Feb 17	Test 2 Games	CSP 3 - 4		<= A3 posted
Feb 20 - Feb 24	Reading Week			
Feb 27 - Mar 03	CSP 5 - 6, Review			<= A2 due
Mar 06 - Mar 10	Test 3 CSP	Uncertainty 1 - 2		<= A4 posted
Mar 13 - Mar 17	Uncertainty 3 - 5			<= A3 due
Mar 20 - Mar 24	Uncertainty 6 - 7, Review			
Mar 27 - Mar 31	Test 4 Uncertainty	KR 1 - 2		
Apr 03 - Apr 07	KR 3, Review			<= A4 due

Lecture Topics

1. Search	6 lectures
2. Game Tree Search	5 lectures
3. Constraint Satisfaction Problems	7 lectures
4. Uncertainty	8 lectures
5. Knowledge Representation	4 lectures

Tests

- Four tests for the first four topics.
- In-class on Mondays.
- Focuses on concepts and theory.

- Why do we have four tests instead of one midterm?
  - Encourage/force you to study regularly.
  - Retain knowledge better.
  - Feel less stressed by the end of the term.

Assignments

- Implement a substantial program in Python.
- Due at 11:59 pm on Thursdays

- Submitted and auto-tested on Markus.
- One-page write-up marked by TA manually.

Final Exam

- 3-hour final exam.
- Covers all the course materials.
- Must get $\geq 40\%$ on the final exam to pass the course.

Academic Integrity

Cheating only cheats yourself!

- Consult U of T Code of Behaviour on Academic Matters

What you should do for assignments:

- Ask questions during office hours.
- Discuss ideas and code examples with others.
- Write code on your own.
- Say no to sending code to others.

What you should do for tests and exams:

- Create practice questions.
- Test yourself/each other under time pressure.

COURSE RESOURCES

A few important resources

- Quercus:
  - https://q.utoronto.ca
- Course email:
  - csc384-2023-01@cs.toronto.edu
- Piazza:
  - link on Quercus.
- MarkUs:
  - https://markus.teach.cs.toronto.edu/2023-01/
- Crowdmark:

Course Resources (1/2)

Admin Matters

- Regular announcements → Piazza
- Admin questions → Course email
- Marks → Quercus

Lectures

- Syllabus, Lecture Slides → Quercus
- Questions about lectures → Piazza

Course Resources (2/2)

Assignments

- Instructions → Quercus
- Questions about assignments → Piazza
- Submission and Remark Requests → MarkUs

Tests

- Questions about tests → Piazza
- Marks → Crowdmark
- Solutions → Quercus
- Remark requests → Course email

Remark Requests

- Assignments: submit remark requests on MarkUs.
- Tests: send a form to the course email.

- When there's a marking error on test/assignment

- Submit within **one week** after marks are released

Special Consideration Requests

- Missing an assessment due to extraordinary circumstances?
  - Send a form and supporting documentation to the course email.

- Acceptable reasons:
  - Late course enrollment
  - Medical conditions (physical/mental health, hospitalizations, injury, accidents)
  - Non-medical conditions (i.e., family/personal emergency)
- Unacceptable reasons:
  - Heavy course loads, multiple assignments/tests during the same period, time management issues

- Accessibility students:
  - Accommodations are listed in Accessibility documentation

Instructor Office Hours

Alice Gao:

- In-person OH:
  - Wednesday, 10-11 am and 4-5 pm in BA 4240.
- Online OH:
  - Friday, 9-11 am, Zoom
  - https://utoronto.zoom.us/j/6768588609
  - Passcode: 829272

Randy Hickey:

- In-person OH: Tuesday, 4:45-5:45 pm, BA 3289.

Or email us to make appointments.

WELCOME TO CSC384!