

NUS Course Materials: Ethical Behaviour and Respecting Copyright

All course participants (including permitted guest students) who have access to the course materials on Canvas or any approved platforms by NUS for delivery of NUS modules are not allowed to re-distribute the contents in any forms to third parties without the explicit consent from the module instructors or authorized NUS officials

Examples of Disallowed Actions

- No Posting on any websites (except for the materials explicitly allowed by your lecturer in the respective module)
- No selling of material
- No sharing of questions/answers which could lead to cheating/plagiarism



Course Overview

CS4246/CS5446

AI Planning and Decision Making

This lecture will be
recorded!

Hello!

- **Akshay Narayan**

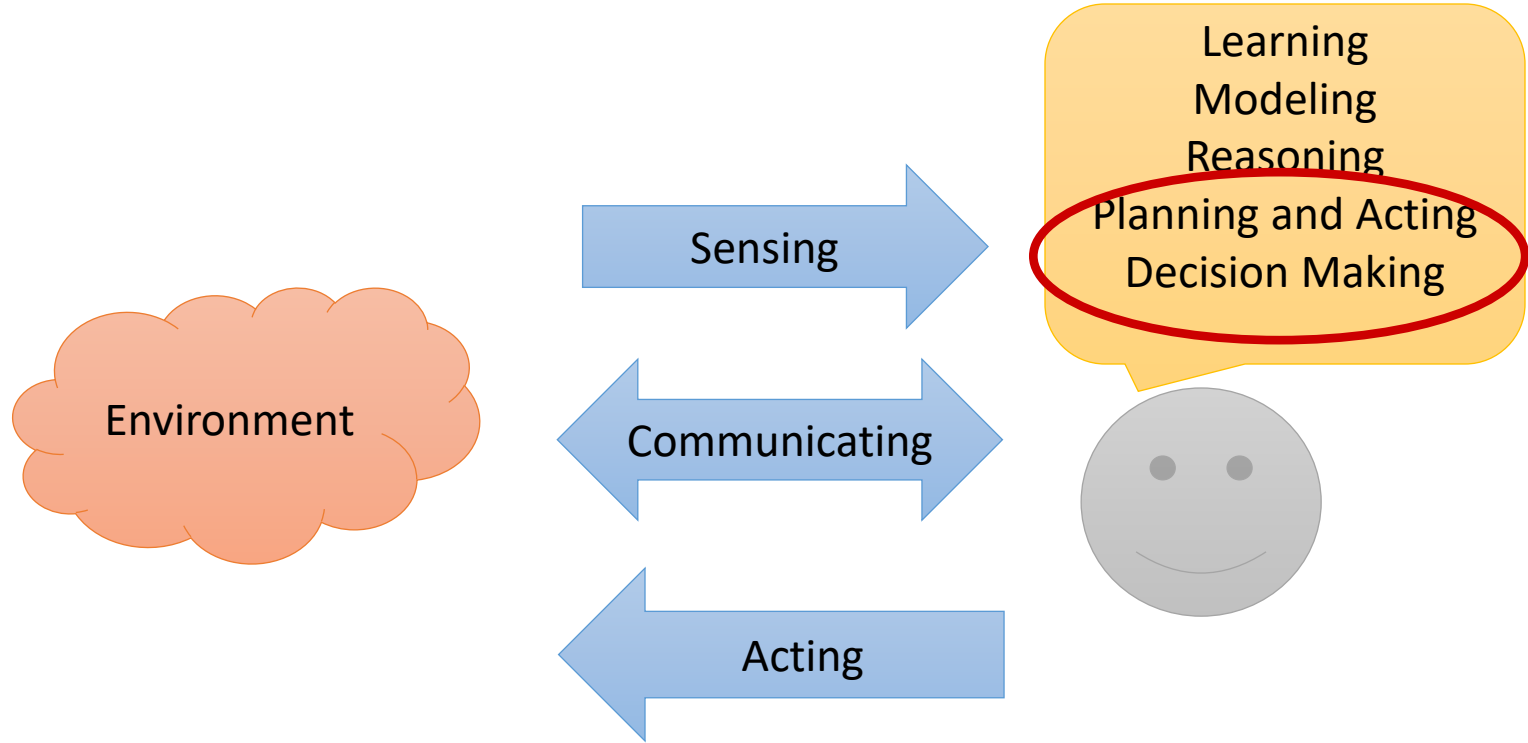
- Lecturer, SOC
- Teaching: AI (CS4246/CS5446, CS3243) and SE (CS2113, CS3219, TIC3001, CS3203, CS2103)
- Research: AI and Reinforcement learning
- Before: TA 4 times; 3 yrs. Industry



- **Contact**

- MSTeams: dcsaksh
- anarayan@comp.nus.edu.sg | dcsaksh@nus.edu.sg

AI: Building A Rational Agent



AI Planning and Decision Making

- An intelligent agent needs to:
- make rational decisions
 - What does rational mean?
 - What are the decision objectives and guiding values?
 - plan a sequence of actions to achieve some objective
 - How to learn to take actions optimally when there is uncertainty? Change?
 - How to scale it up to large problems?
 - act appropriately when there are other agents around
 - How to act when the other agents are also “thinking” and optimizing for themselves?
 - How to function and behave in a **responsible** manner in a human society?
- The **Actor's View of Planning**:
- How to **plan to act** effectively in the real world?
 - How to **act to plan** effectively in the real world?



Course Objectives

- What is this course about?
 - To introduce **foundational concepts and practical implications** of AI planning and decision making
 - To survey some state-of-the-art advancements in theory and application of AI planning and decision-making technologies
- What will you learn from this course?
 - Understand the main **concepts, capabilities, and limitations** of AI planning and decision technologies
 - Apply the technologies in different applications
 - *Develop new technologies and applications

Syllabus

Week	Topics	Week	Topics
1	Introduction & Classical Planning	7	Reinforcement Learning
2	Real-world Planning and Acting	8	Real World Reinforcement Learning
3	Rational Decision Making	9	Partially Observable Markov Decision Process (guest lecture)
4	Decision Analysis/Decision Theory	10	Game Theory and Multi-agent Decision Making
5	Markov Decision Process	11	Human Factors and Judgmental Decision Making & Responsible AI Decision Making
6	Reinforcement Learning	12	Test Buffer
R		13	<i>State-of-the-art Applications and Future Trends</i> AKA Project Presentations



Required Background for Enrollment

- Discrete Structures
 - Logic, Proofs, Functions, Relations, Recursion, Induction, Combinatorics, Graph Theory
- Probability and Statistics
 - Basic probability theory, random variables, Bayes' Theorem, probability models, information theory, experiment design, hypothesis testing, statistical inference
- Artificial Intelligence
 - Knowledge Representation, Reasoning, Learning, Search
- Linear Algebra and Calculus
 - Matrices, basic matrix operations, eigenvalues and eigenvectors, derivatives, maximization and minimization

Teaching Team

Name	Role	Contact
Akshay Narayan	Course Coordinator	dcsaksh@nus.edu.sg
Hannah Brown	Tutor	e0792519@u.nus.edu
Tasbolat Taunyazov	Tutor	e0348851@u.nus.edu
Jiang Hang	Tutor	e0673181@u.nus.edu
Wu Zhanxin	Tutor	e0945787@u.nus.edu
Bharath Shankar	Tutor	e0550582@u.nus.edu
Yue Junfeng	Tutor	e0555802@u.nus.edu
Samson Yu Bai Jian	Tutor	e0954716@u.nus.edu
Drishti Sanjay Jain	Tutor	e0962980@u.nus.edu

Note: Please ask technical and course organization questions through the **FORUM** on **Canvas**!

Course Logistics

- Classes (weekly)

- Wednesday 1830 – 2030

In-person

Lecture (LT19)

- Various

In-person

Tutorials

- Grading policy

- Homework, participation, and quizzes

(30 + 5 + 10) %

- Project (report due 22 Nov; presentation in week 13)

(20 + 5) %

- Test(s) (*in-person, closed-book*)

30 %

Submission via Turnitin

Course Logistics

- Core Contents


- Main components are the same for CS4246 and CS5446
- Common lectures
- Tests and assignments may be differentiated between CS4246 and CS5446
- Discussions on Canvas forum

- Tutorials and Assignments

- Attempt tutorial questions before class; present and discuss in class
- Homework (Pair): Written questions + Programming – Prerequisite: Python

- Project

- Self-defined topic in teams of 4
- 1-page proposal due after Recess Week (you can submit earlier too!)



Should be from
the same cohort



Course Logistics

- SOC Unix Account

- If you don't already have a SOC Unix account, please create one
- Refer to the announcement made earlier



Course Resources

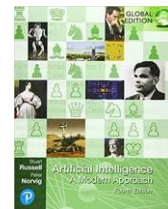
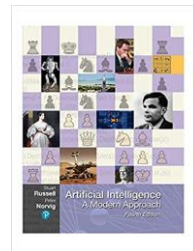
- Canvas
 - Course syllabus
 - Announcements
 - Lecture notes
 - Handouts
 - Assignments
 - Discussion Forum
 - Multimedia

Information on and web-links to other relevant materials will be made available throughout the course

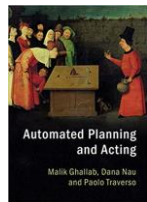
Reference Books

- Main reference book:

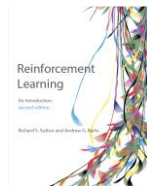
- (RN) Russell, S. and P. Norvig, Artificial intelligence: A modern approach. 4th ed. (Global ed.) 2021: Pearson. (Alternate: 3rd ed.)
[Table of contents for 4th ed.: <http://aima.cs.berkeley.edu/contents.html>]



- Reference books:



- (GNT) Ghallab, M., Nau, D. and Traverso, P. Automated Planning and Acting. Cambridge University Press, Cambridge, 2016.
[Book website: <http://projects.laas.fr/planning/>]
[e-Book for personal use: <http://projects.laas.fr/planning/book.pdf>]



- (SB) Sutton, R. S. and A. G. Barto. Reinforcement Learning: An introduction. 2nd ed. MIT Press, 2018, 2020
[Book website: <http://incompleteideas.net/book/the-book.html>]
[e-Book for personal use: <http://incompleteideas.net/book/RLbook2020.pdf>]

Additional Resources

- You will also find good tutorials, tools, publications at:
 - Conference in Uncertainty in Artificial Intelligence (UAI)
 - <https://www.auai.org>
 - American Association for Artificial Intelligence Conference (AAAI)
 - <https://www.aaai.org>
 - International Joint Conference on Artificial Intelligence (IJCAI)
 - <https://www.ijcai.org>
 - Neural Information Processing Systems Conference (NeurIPS)
 - <https://nips.cc>
 - International Conference on Automated Planning and Scheduling (ICAPS)
 - <https://www.icaps-conference.org>
 - International Conference on Autonomous Agents and Multiagent Systems (AAMAS)
 - <https://www.ifaamas.org>
 - International Conference on Artificial Intelligence and Statistics (AISTATS)
 - <https://aistats.org>
 - ...



Honour Code

- NUS Code of Student Conduct:
 - (A) Academic, Professional and Personal Integrity
 - (B) Respect for People
 - (C) Respect for and Compliance with the Law and with Campus Policies and Regulations
 - (D) Responsibility towards Maintaining the Campus as a Place Conducive for Learning and Living
- This module will teach you how to apply and develop powerful **Responsible AI** technologies for the betterment of humankind
- If you are unable or unwilling to respect and abide by the Honour code, please **DO NOT** take this module!