Course Overview
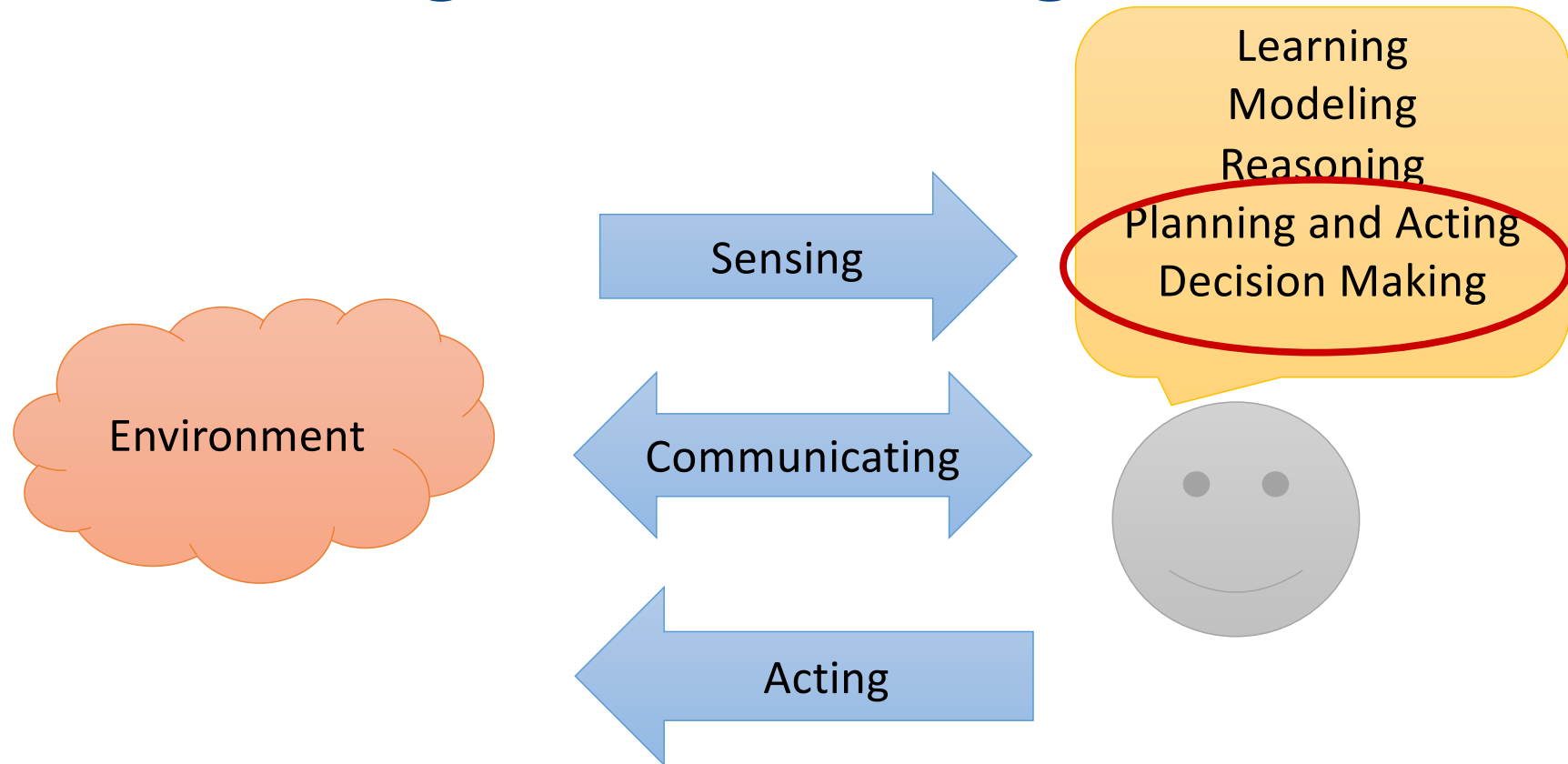
CS4246/CS5446

AI Planning and Decision Making

Sem 1, AY2021-22

AI: Building A Rational Agent

Learning
Modeling
Reasoning
Planning and Acting
Decision Making

Sensing

Communicating

Acting

Environment

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 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

Responsible AI

Week	Topics	Week	Topics	Notes
1	Introduction & Classical Planning	7	Reinforcement Learning	
2	Real world planning and acting	8	Mid-Term Test	
3	Rational Decision Making	9	Real World Reinforcement Learning	
4	Judgmental Decision Making Responsible Techniques and Guidelines	10	Partially Observable Markov Decision Process	
5	Decision Networks	11	Game Theory	
6	Markov Decision Process	12	Multi-agent Decision Making	
R		13	State-of-the-art Applications and Future Trends 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
Abhinit Kumar Ambastha	Teaching Assistant	abhinit@u.nus.edu
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Note: Please ask technical and course organization questions through the **FORUM** on **LumiNUS**!

Course Logistics

- Classes (weekly)

Fri 1830 – 2030	Online	Lecture
TBA	Online	Tutorial

- Grading policy
  - Homework, participation, and quizzes   50%
  - Test   (Friday, 8 October during Lecture hours)   25%
  - Project (presentation in week 13; report due 22 November) 25%
  - No final exam for this module!

Course Logistics

- Core Contents
  - Main components are the same for CS4246 and CS5446
  - Common online lectures
  - May include additional topics for CS5446 in Homework and Test
  - Discussions on LumiNUS Forum.

- Tutorials and Assignments
  - Attempt tutorial questions before class; presentations and discussions in class
  - Team Assignments: Written questions + Programming – Prerequisite: Python

- Project
  - Self-defined topic in teams of 2-3
  - 1 page proposal due after Recess Week

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!
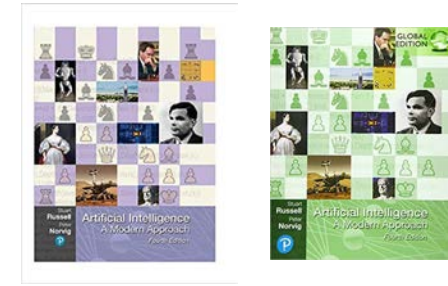
Course Resources

- LumiNUS
  - Course syllabus
  - Announcements
  - Lecture notes
  - Handouts
  - Assignments
  - Discussion Forum
  - Zoom sessions
  - Multimedia

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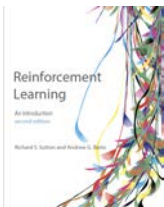
Reference Books

- Main reference book:
  - (RN) Russell, S. and P. Norvig, Artificial intelligence: A modern approach. 4th ed. 2021: Pearson. [Kindle Edition] (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)
    - www.auai.org
  - American Association for Artificial Intelligence Conference (AAAI)
    - www.aaai.org
  - International Joint Conference on Artificial Intelligence (IJCAI)
    - www.ijcai.org
  - Neural Information Processing Systems Conference (NeurIPS)
    - www.nips.cc
  - International Conference on Automated Planning and Scheduling (ICAPS)
    - www.icaps-conference.org
  - International Conference on Autonomous Agents and Multiagent Systems (AAMAS)
    - www.aamas-conference.org