COSC2129/2723/3118

Semester 2, 2025

Artificial Intelligence

Introduction

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Road Map for Today: First Session

Part 1 : Course Introduction and Administrivia

- Course overview
- Course delivery
- Course assessment
- Communication and feedback

Road Map for Today: Second Session

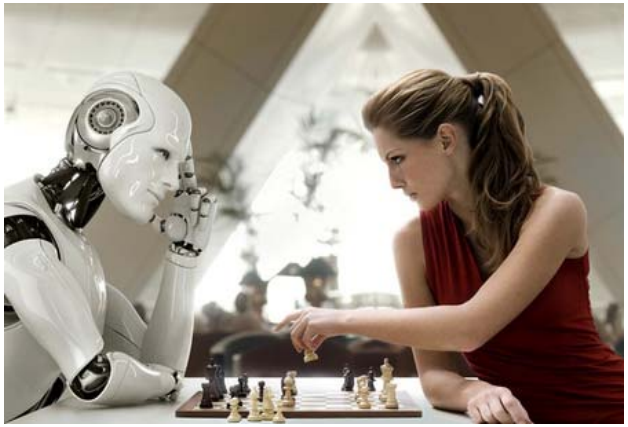
Part 2 : Introduction to Artificial Intelligence (AI)

- Definition and approaches
- Foundations and history
- State-of-the-art and future
- A glance of a key AI problem: Search
- Things to be done by you within the 1st week

Part 1 : Course Introduction and Administravia

- **Course overview**
  - Where is AI? What is AI? Why to study AI?
  - Course objectives
  - Main topics
  - Pre-requisite knowledge and skills
- **Course delivery**
  - Learning activities and resources
- **Course assessment**
  - Assessment breakdown and policies
- **Communication and feedback**

Where is AI?



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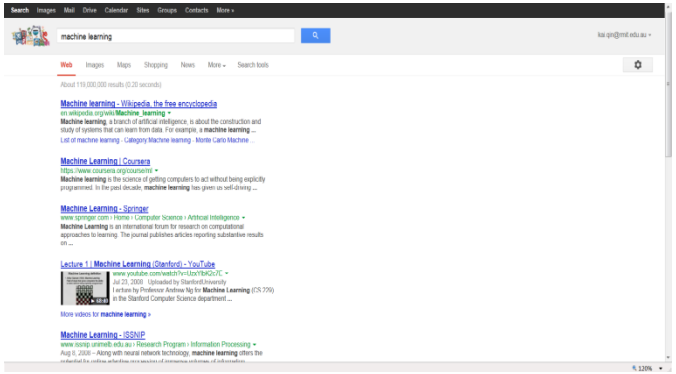
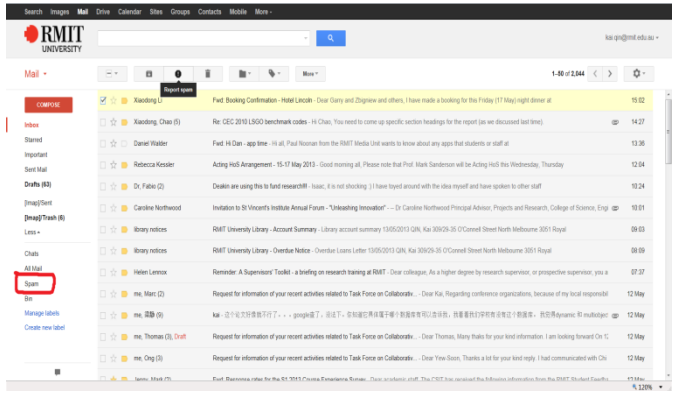
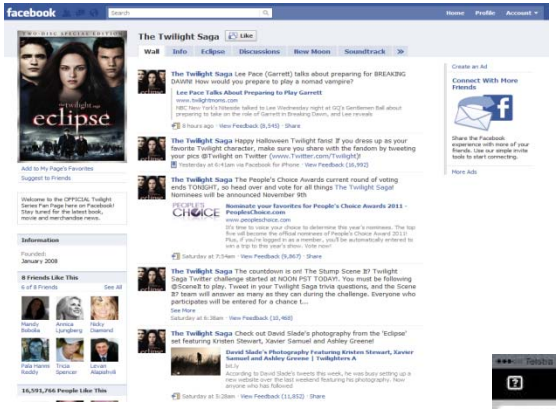
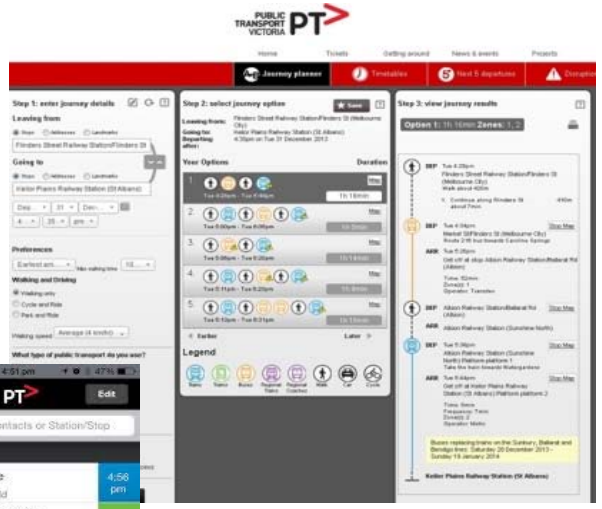
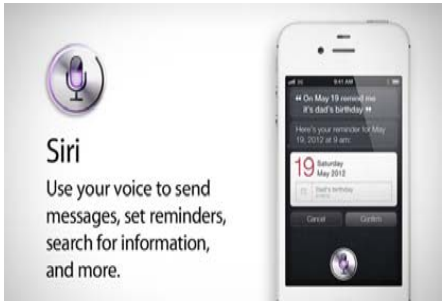
Where is AI?

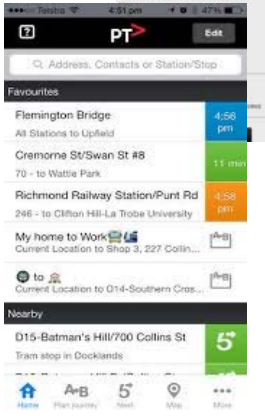












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What is AI?

- **AI is the intelligence exhibited by machines or software.**
- **AI, as an academic field, studies the goal of creating intelligence.**
- **AI has various definitions:**
  - Major AI researchers and textbooks define it as "**the study and design of intelligent agents**", where an intelligent agent is a system that perceives its environment and takes actions that maximize its chances of success.
  - John McCarthy, who coined the term of "AI" in 1955, defines it as " **the science and engineering of making intelligent machines**".
  - Definition is related to approaches to designing and developing AI.

http://en.wikipedia.org/wiki/Artificial_intelligence

Why to Study AI?

- **AI is not just a good science fiction topic, but has produced a variety of amazing success in our daily life.**
- **It provides the core knowledge of computer science, and also the key tools for resolving problems in many other fields.**
- **All serious programmers and software engineers should know about the major artificial intelligence techniques.**
- **It can be profitable.**
  - Expert systems find mineral worth $300,000,000.
  - Digital Equipment, job dispatching saves $26,000,000 per year.
  - ANZ Bank's Product Advisor generates $5,000,000 per year.
- **It is also fun, thinking about 3D films, Xbox, Google glass, ChatGPT, Claude, etc.**
- **It is different to most other subjects.**

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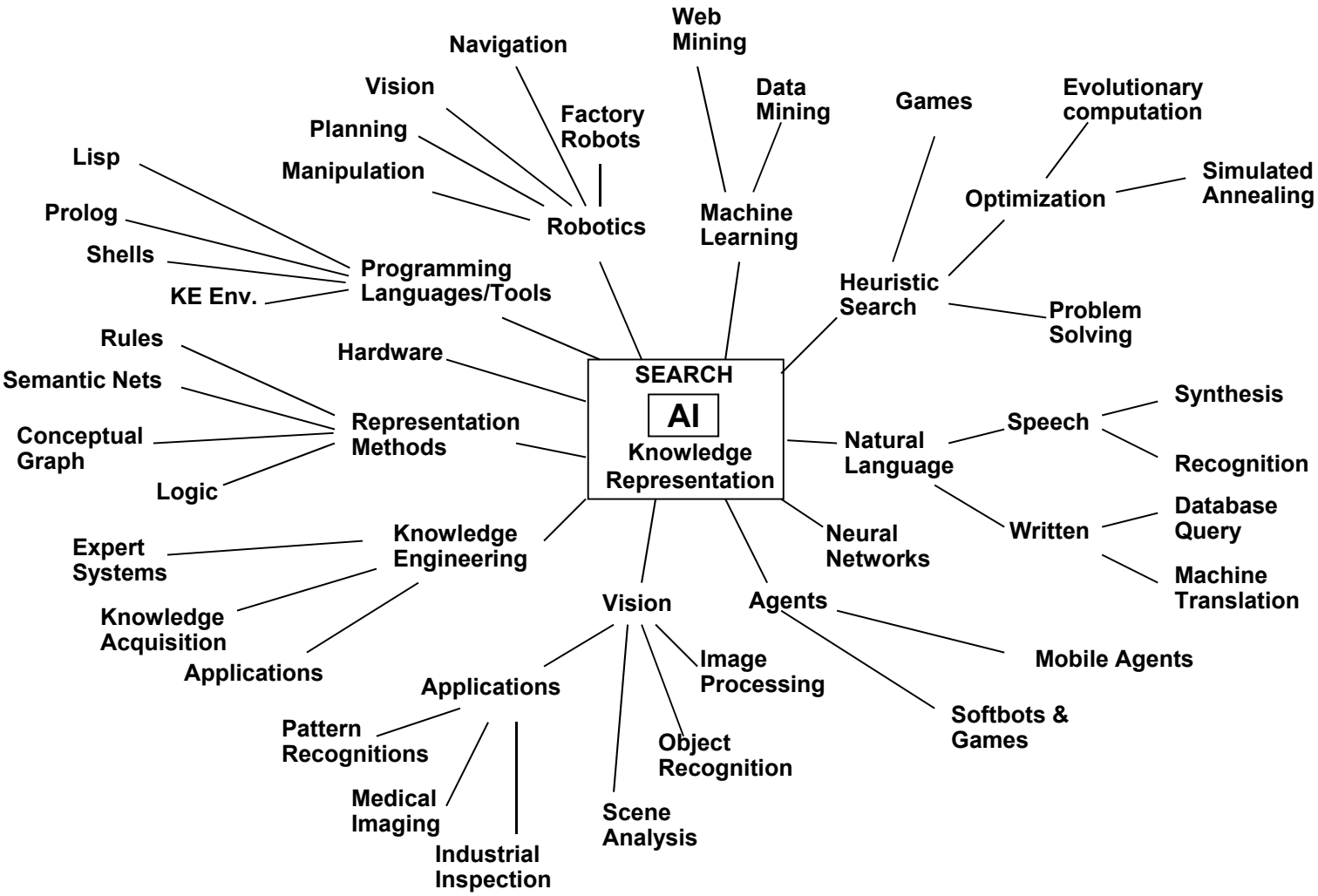
An Overview of AI



AI consists of a huge variety of sub-areas!

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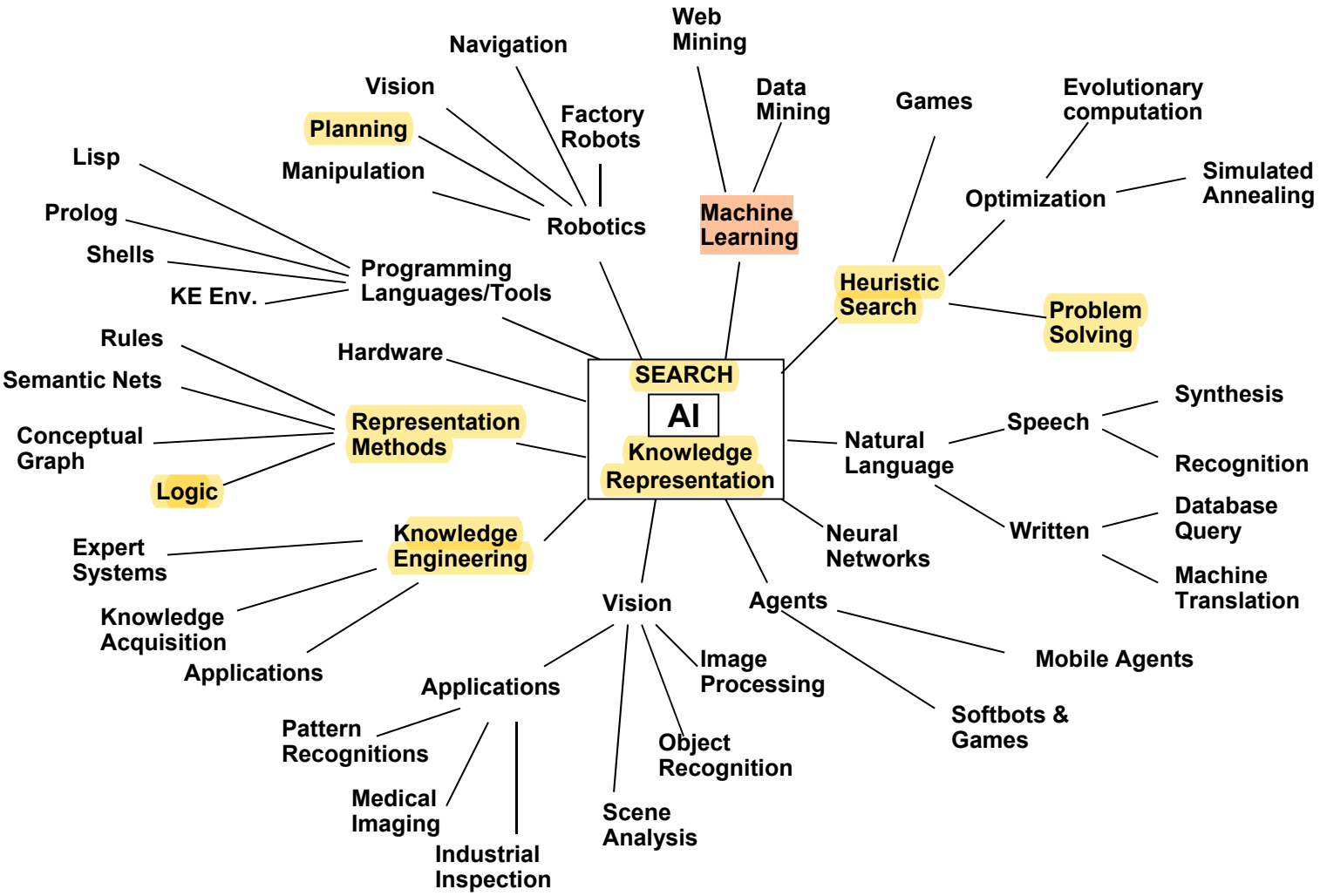
An Overview of AI



AI consists of a huge variety of sub-areas!

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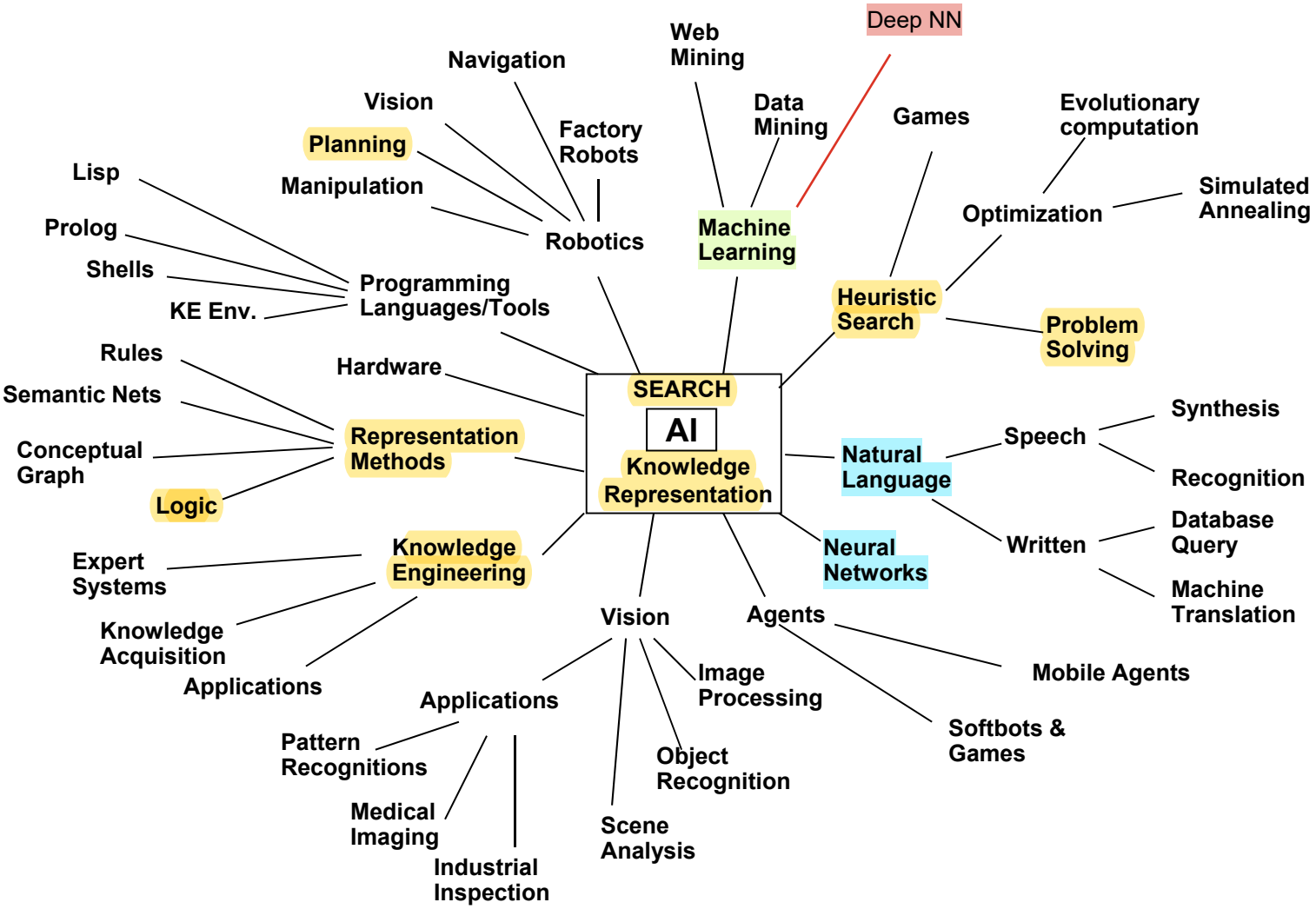
An Overview of AI



AI consists of a huge variety of sub-areas!

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Course Objectives

- **AI is cross-disciplinary, covering a huge variety of subfields ranging from scientific research to real-world applications.**
- **This course only introduces to the basic concepts and techniques of AI, leaving advanced topics for self-exploration or the undertaking of advanced courses.**
- **This course will help you gain AI-based problem solving skills that have applicability to a wide range of real-world problems.**
- **Basic concepts (and techniques) lays foundations for the success of in-depth studies and even job interviews.**

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Main Topics

- W01: Introduction to AI
- W02: Solving Problems by Searching
- W03: Adversarial Search and Game Playing
- W04: Knowledge Representation and Reasoning: Propositional Logic
- W05: Knowledge Representation and Reasoning: Predicate Calculus
- W06: Automated Planning
- W07: ILW (No class)
- W08: Reasoning under Uncertainty I: Probability
- W09: Decision Making Under Uncertainty
- W10: Reasoning under Uncertainty II: Bayesian Networks
- W11: Reinforcement Learning
- W12: Course review.

Pre-requisite Knowledge and Skills

- **You will be expected to have a significant level of programming ability including C/Python programming, and the knowledge of maths, data structures and algorithms.**

- **Completion of "COSC1285/2123: Algorithms and Analysis" or an equivalent course will satisfy the above requirements.**

- **It is an enrolment condition that you accept responsibility for ensuring that you have completed the prerequisite(s) and agree to concurrently enrol in co-requisite courses before enrolling in a course.**

Course Delivery: Learning Activities

- **11 weekly lectures**
  - Every Wednesday 08:30 - 10:00, location: Online, MS. Teams
- **Practical sessions:** 11 Lab/tutorials, starting from Week 1
  - Every Friday 8:30 - 10:00 (group 1), location: B2.4.002
  - Every Friday 10:30 - 12:00 (group 2), location: B2.4.002
  - Every Saturday 12:30 - 14:00 (MAI), location: B2.4.002
- **Self-learning after class**
  - Reading references
  - Online articles, videos or courses
- **Discussion board**
  - Q&A (you and teaching staffs; you and your classmates)
  - Share your thoughts on AI

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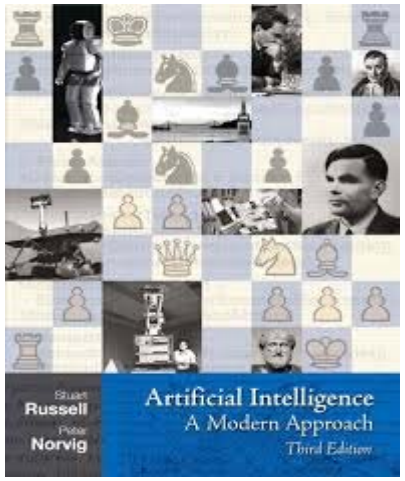
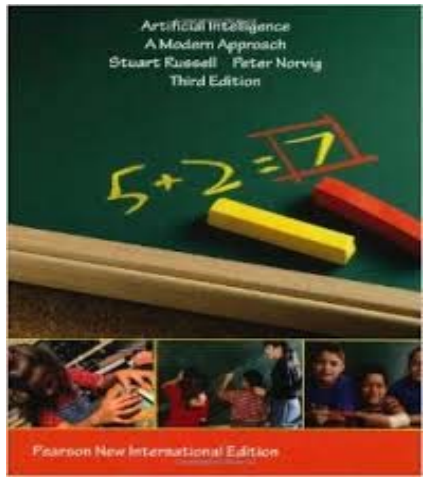
Course Delivery: Learning Resources

- **Textbook**

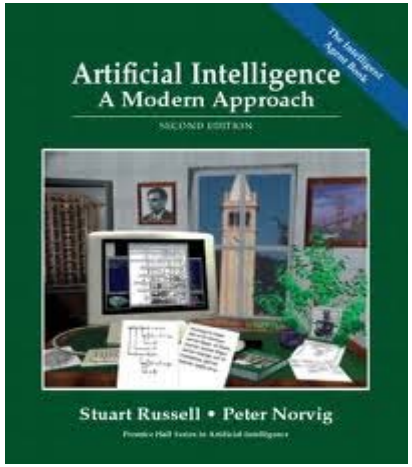
Stuart Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach*



3rd edition
Prentice Hall, 2009
RMIT Library



3rd edition
Pearson , 2014
RMIT bookstore



2nd edition
Prentice Hall, 2002
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- **Other resources**
  - Supplementary reading materials (listed in the course canvas)
  - Online articles, videos, and other resourses.

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Assessment Breakdown

- **Breakdown**
  - Practical Component: 50%
  - Examination Component: 50%

- **Practical component:**
  - Assignment 1 (25%): Part 1 due in week 4

    Part 2 due in week 6
  - Assignment 2 (50%): in-class test, quiz and short questions, week 10
  - Assignment 3 (25%): Individual, take-home, week 12
  - Specification for assignments will be explained in tutorial sessions.

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Assessment Policies

- **Assignments** (please keep a copy of your submitted assignments)
  - All practical assignments must be submitted **electronically**.
  - **Late submissions** will be accepted for up to 5 calendar days after the original due date, with a 10% per day penalty applied to the total score of the assignment.
  - Excuses for late submission will NOT be accepted unless official evidences are provided.
  - Assignment feedback will be given within 2 weeks of the submission deadline.

Communication

- **Discussion board**
  - Efficient and effective Q&A forums
- **Email (mainly for persional or administrative issues)**
  - Thuy Nguyen (Lecturer): thuy.nguyen43@rmit.edu.vn (SGS),
    Anh Hoang (anh.hoang62@rmit.edu.vn, Hanoi campus)
- **Tutorial and lab sessions**
  - Q&A
  - Checking timetable for the time and location of your selection sessions
  - Time: Friday 8:30– 10:00 AM or 10:30 AM-12:00 PM, B2.04.02
    Saturday 12:30-14:00 for Master of AI students, B2.04.02
  - Location: B2, 4th floor.
- **Consult:** Friday, 14:00-16:00 or Saturday, 14:30-15:30 for MAI (please book in advance, online or F2F)

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Feedback

- **Mutual benefits**
  - Interactive learning and teaching
- **Course experience survey (CES)**
  - Managed by the Survey Services Centre to help teaching staffs to obtain the course feedback so as to improve student learning
  - Teaching performance indicator for the lecturer! Please take it seriously!
  - No actions can be taken since a lecturer can only obtain the CES result after the class is finished. **(NO INTERACTION)**

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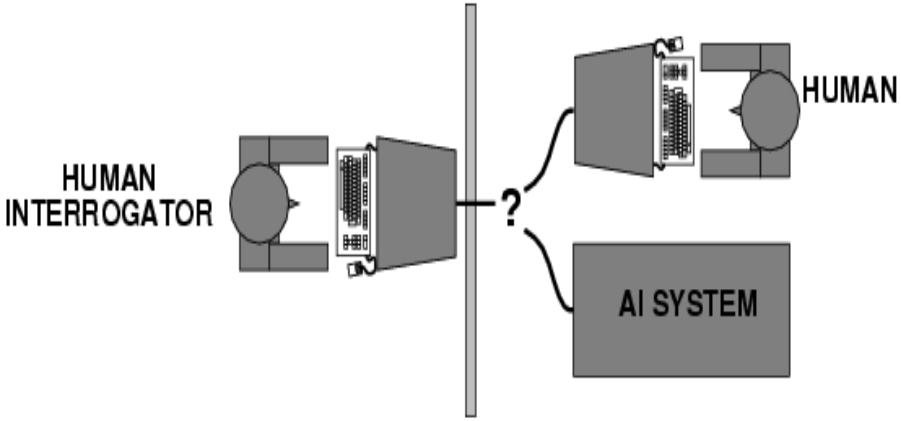
Part 2 : Introduction to Artificial Intelligence

- Definition and approaches
- Foundations and history
- State-of-the-art and future
- A glance at a key AI problem: Search
- Things to be done by you within this week

Turing Test

Allan Turing



- **Introduced by Alan Turing in his 1950 paper "*Computing machinery and intelligence*"**
- **Testing a machine's ability to exhibit intelligent behaviour equivalent to, or indistinguishable from, that of a human**

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Rationality

Turing test:

-- Behaves like a human, but also *thinks* like a human?

-- Doesn't help much on how to *build* an intelligent system

Rationality (as an alternative):

-- Precise mathematical notion of what it means to *do the right thing* in any particular circumstance

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Again, What is AI?

AI studies how to achieve intelligent behaviour through computational means.

- We try to construct systems whose computation achieves or approximates the desired notion of **rationality**.
- AI is part of Computer Science.
- Other areas interested in the study of intelligence lie in other areas or study, e.g., cognitive science, psychology, philosophy, neuroscience, with different *central focus*.

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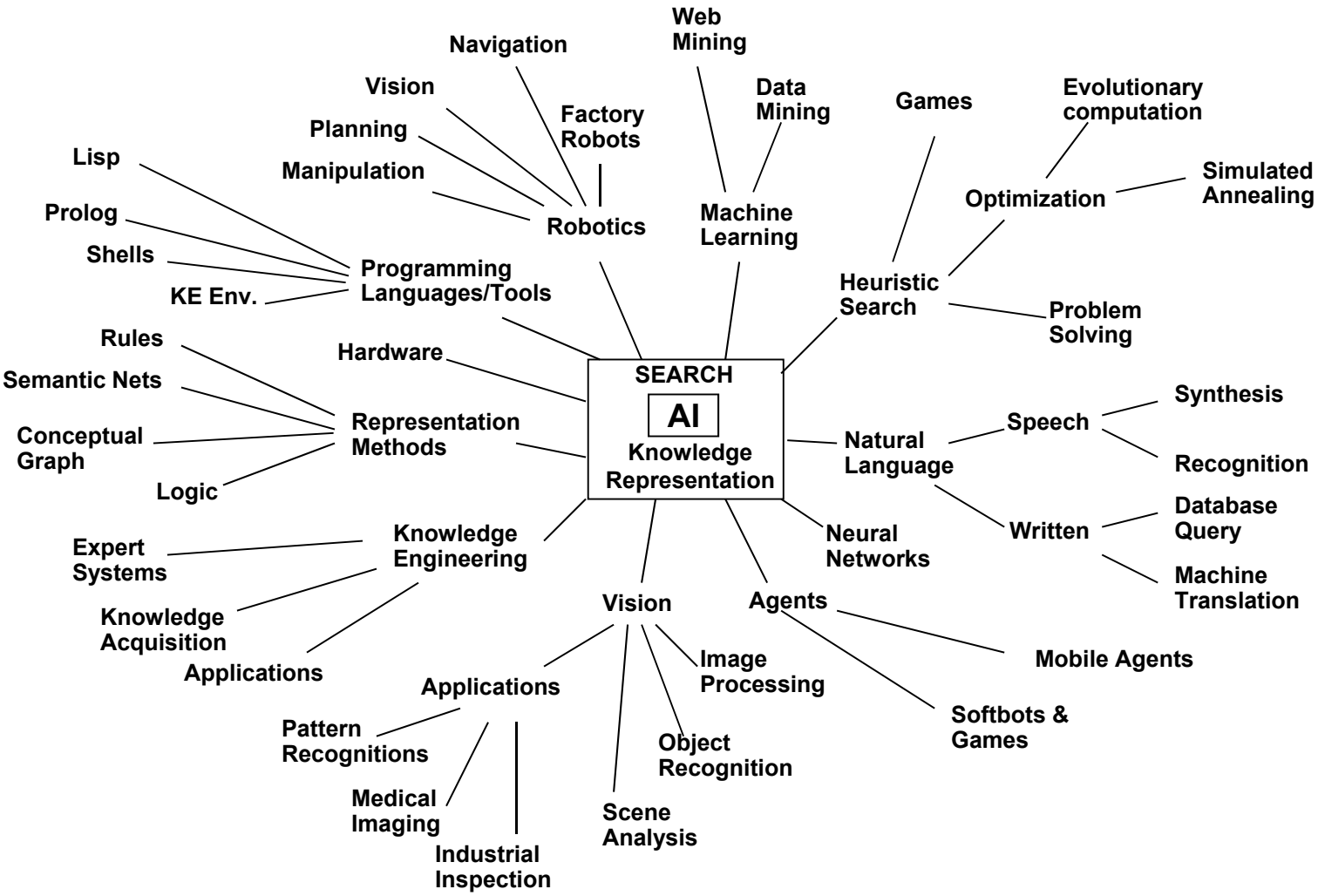
Four Approaches to AI

- **Acting humanly** (human-centred approach)
  - The "Turing Test" approach: to test whether a system can behave intelligently enough to fool a human interrogator.
- **Thinking humanly** (human-centred approach)
  - It is the cognitive modelling approach, which is now distinct from AI.
- **Thinking rationally** (rationalist approach)
  - It is the "laws of thought" approach.
  - Direct line through mathematics and philosophy to modern AI.
- **Acting rationally** (rationalist approach)
  - It is the rational agent approach, which is to do the right thing.
  - The right thing: that which is expected to maximize goal achievement, given the available information.

An Overview of AI



AI consists of a huge variety of sub-areas!

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Foundations of AI

Philosophy	Logic, methods of reasoning, mind as physical system, foundations of learning, language, rationality
Mathematics	Formal representation and proof, algorithms, computation, (un)decidability, (in)tractability, probability
Economics	utility, decision theory
Neuroscience	plastic physical substrate for mental activity
Psychology	adaptation, perception, motor control, experimental techniques
Computer Engineering	building fast computers
Control theory and Cybernetics	design systems that maximize an objective function over time
Linguistics	knowledge representation, grammar

History of AI

1943	McCulloch & Pitts: Boolean circuit model of brain
1950	Turing's "Computing Machinery and Intelligence"
1956	Dartmouth meeting: "Artificial Intelligence" adopted
1952-69	Look, Ma, no hands!
1950s	Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, and Gelernter's Geometry Engine
1965	Robinson's complete algorithm for logical reasoning
1966-73	AI discovers computational complexity Neural network research almost disappears
1969-79	Early development of knowledge-based systems
1980-	AI becomes an industry
1986-	Neural networks return to popularity
1987-	AI becomes a science
1995-	The emergence of intelligent agents
2001-	The availability of very large data sets

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State-of-the-Art of AI

- Deep Blue beat Kasparov.
- DART: automated logistics planning and scheduling for transportation.
- NASA Remote Agent: automated planning and scheduling for the operations of a spacecraft.
- DARPA grand challenge: Autonomous vehicle navigates across desert and then urban environment.
- iRobot's Roomba automated vacuum cleaner, and PackBot was used in Afghanistan and Iraq wars.
- Automated speech recognition systems was used for airline travel booking.
- Spam filters based on machine learning.
- Usable machine translation through Google.

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SOTA & Future of AI

- **LLMs, Movie Gen, AlphaFold,...**
- **Research trends in giant IT companies**
  - **GAFA**
    NVIDIA

- **The threat of AI**

✓ **AI Index Report:**
https://aiindex.stanford.edu/report/

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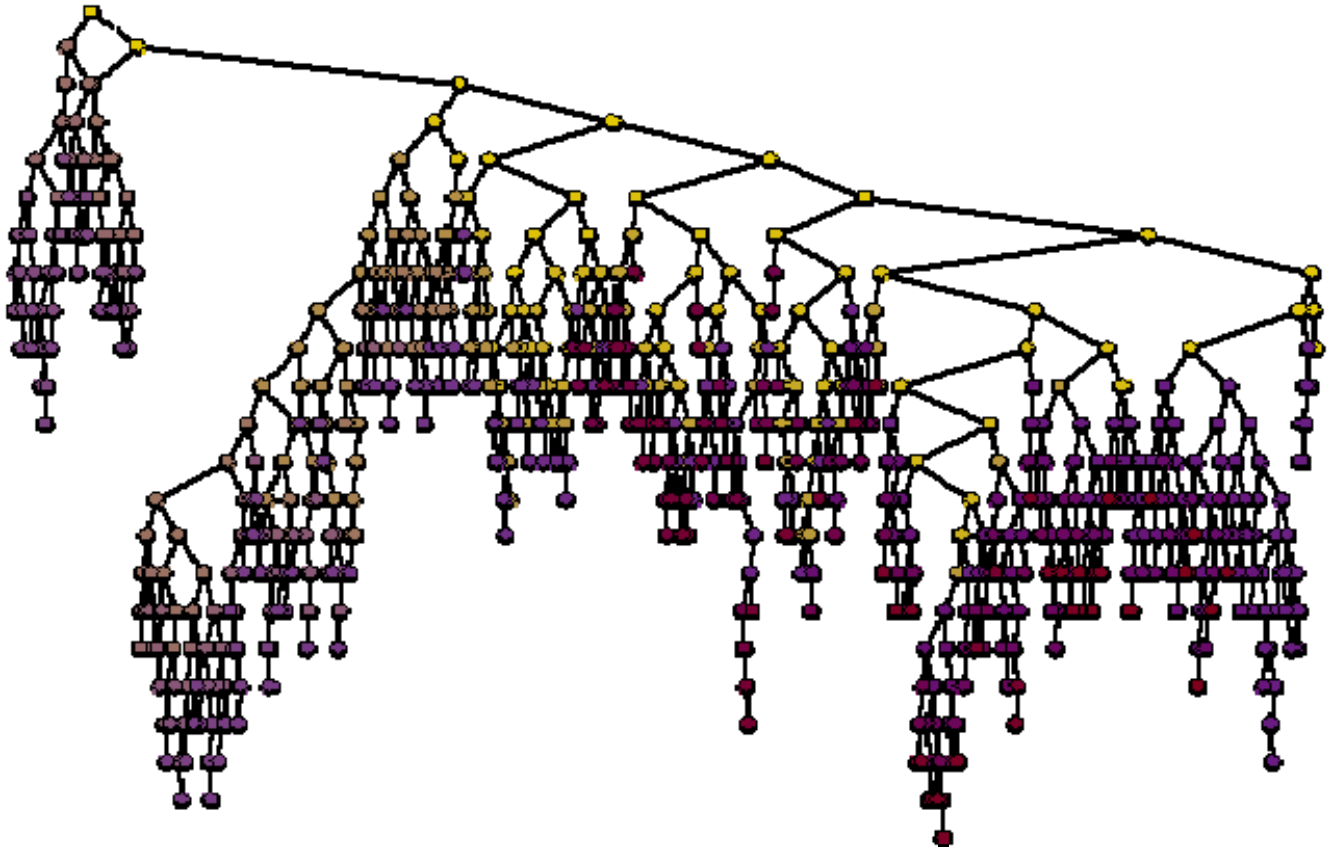
Search



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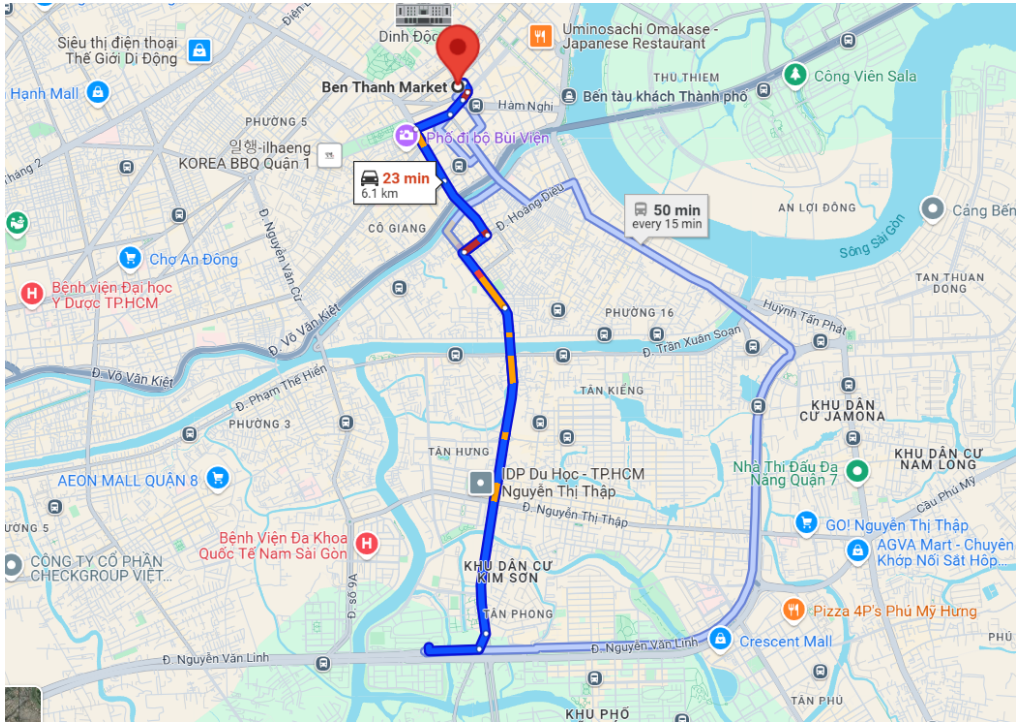
Search

- Path finding

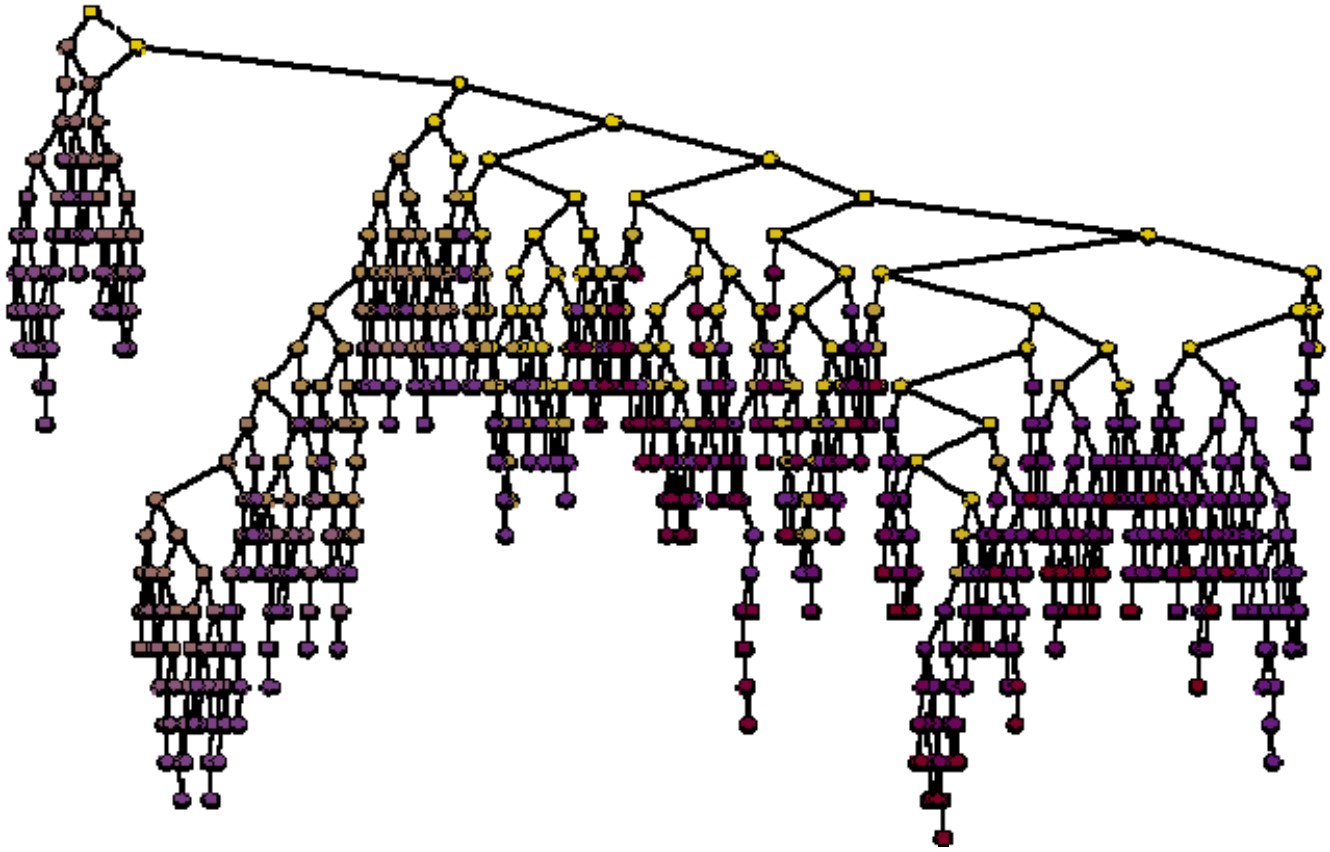


- Game

8		6
5	4	7
2	3	1

	1	2
3	4	5
6	7	8

Search



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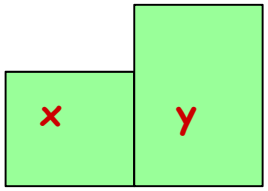
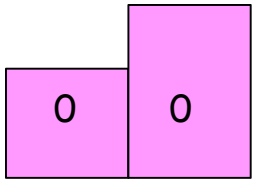
Water Jugs

Given two water jugs (of different sizes), get exactly x litres of water in one of the jugs

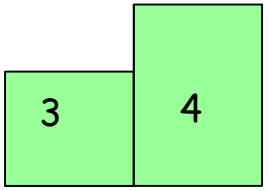
Generic "state":



Initial "state":



Final "state":



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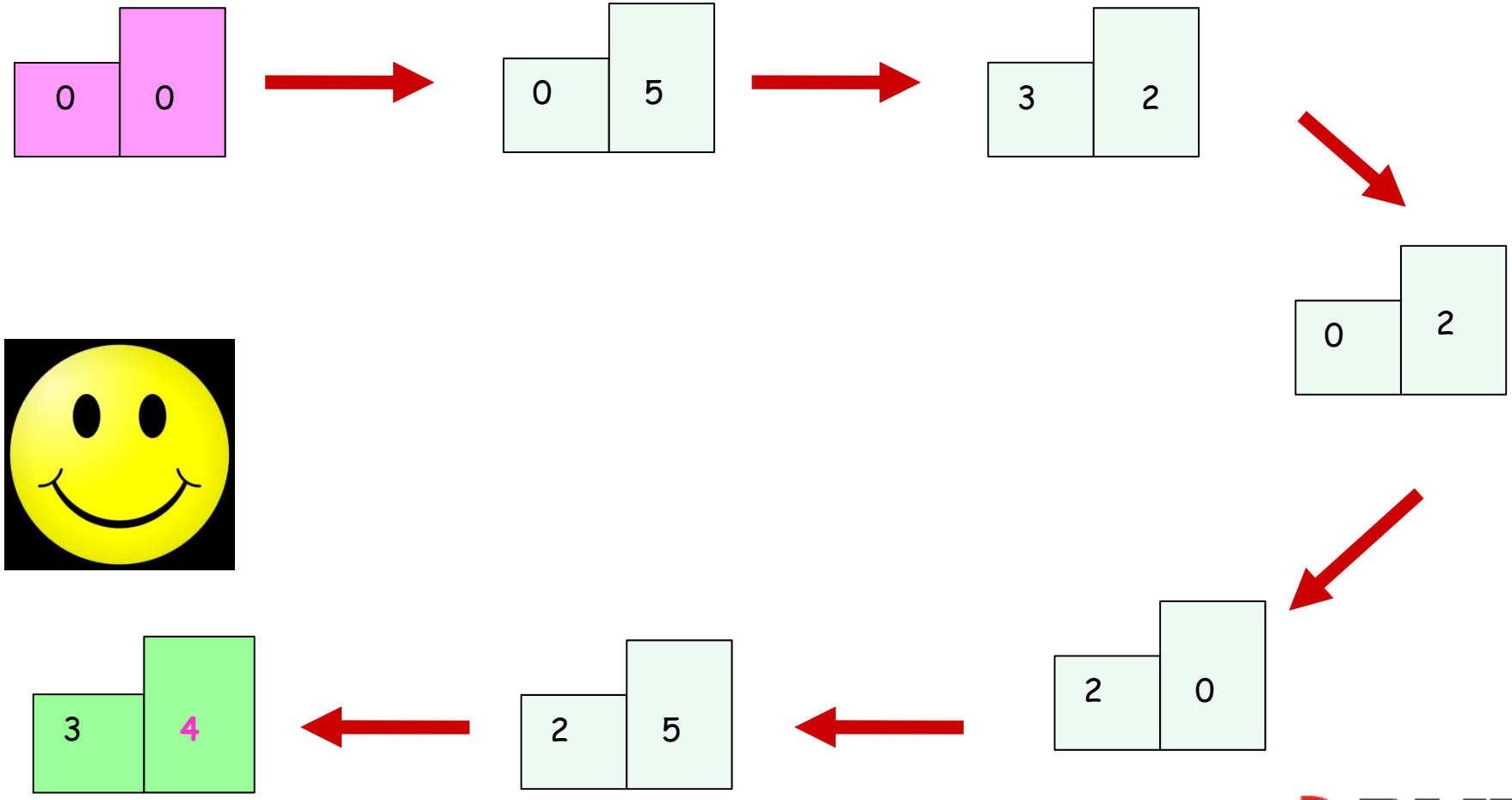
Searching Process



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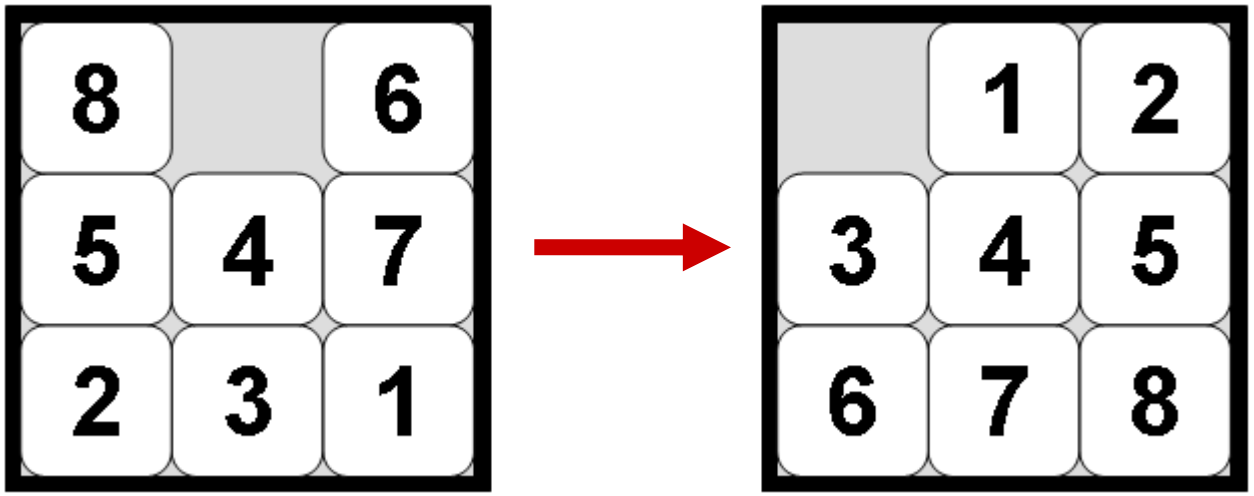
8-Puzzle



One of sliding-block puzzles, often used as test problems for new search algorithms in AI

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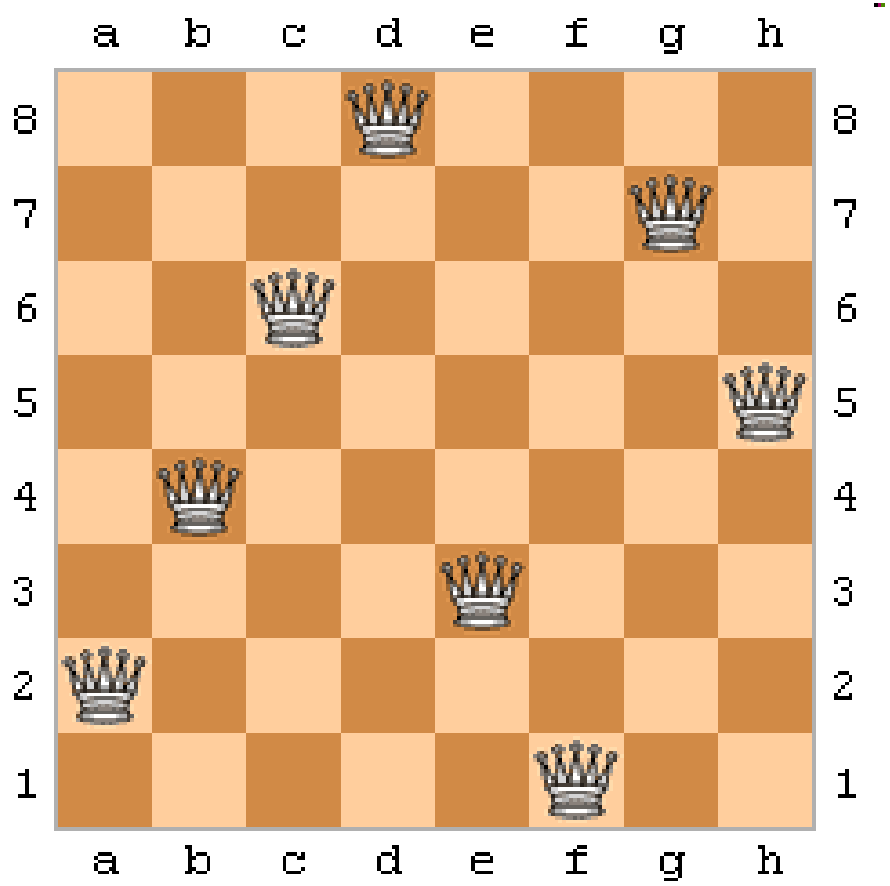
N-Queens



Place N (usually 8) queens on a chessboard so that no queen attracts any other.

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Vacuum World

- Two rooms
  - One vacuum
  - Rooms can be dirty or clean
  - Vacuum has three moves
    - Left
    - Right
    - Suck
- Only 8 possible states (!!)

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Search Problems

A **search problem** is defined by:

- Possible states
- Initial state
- Actions
- Transition model
- Goal test
- Path cost

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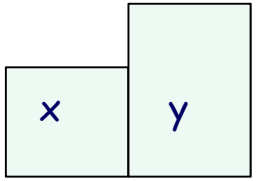
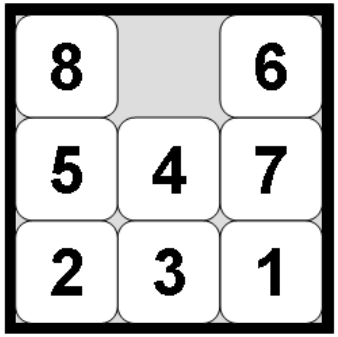
State

Water Jugs:

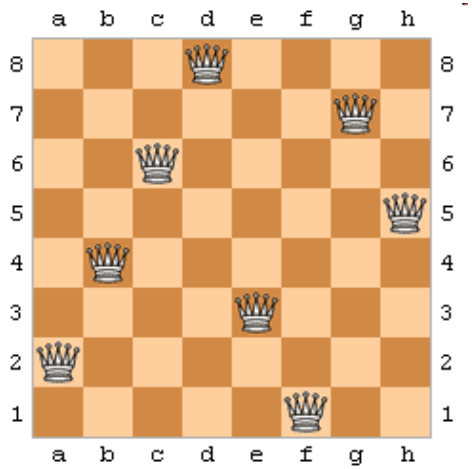


x in {0,1,2,3}
y in {0,1,2,3,4,5}

Eight Puzzle:



N-Queens:



Vacuum World:

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Initial State

- Water Jugs: both jugs are empty
- Eight Puzzle: any state
- N-Queens: empty chessboard
- Vacuum World: any state

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Actions

Water Jugs:

- empty or fill either jug (from tap)
- pour jug 1 into jug 2
- pour jug 2 into jug 1

Eight Puzzle: move a tile towards left, right, up, down (not always possible)

N-Queens:

- add queen to any empty square
- add queen to leftmost empty column
- add queen to leftmost empty column in a 'safe' row

Vacuum World: left, right, suck

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Transition Model

- Water Jugs: new state of jugs
- Eight Puzzle: new puzzle state (if action applicable)
- N-Queens: new chessboard
- Vacuum World: new room state

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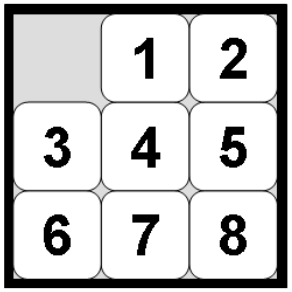
Goal Test

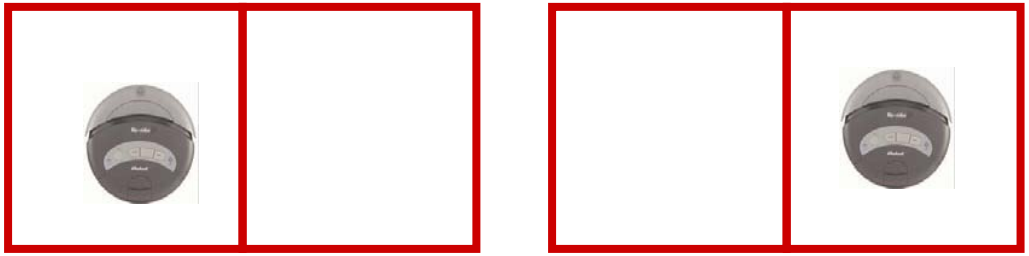
Water Jugs: 4 litres in larger jug

Eight Puzzle:



N-Queens: All N queens on board in safe positions

Vacuum World:



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Path Cost

Water Jugs: number of exchanges

Eight Puzzle: number of tiles moves

N-Queens: number of piece moves

Vacuum World: number of moves

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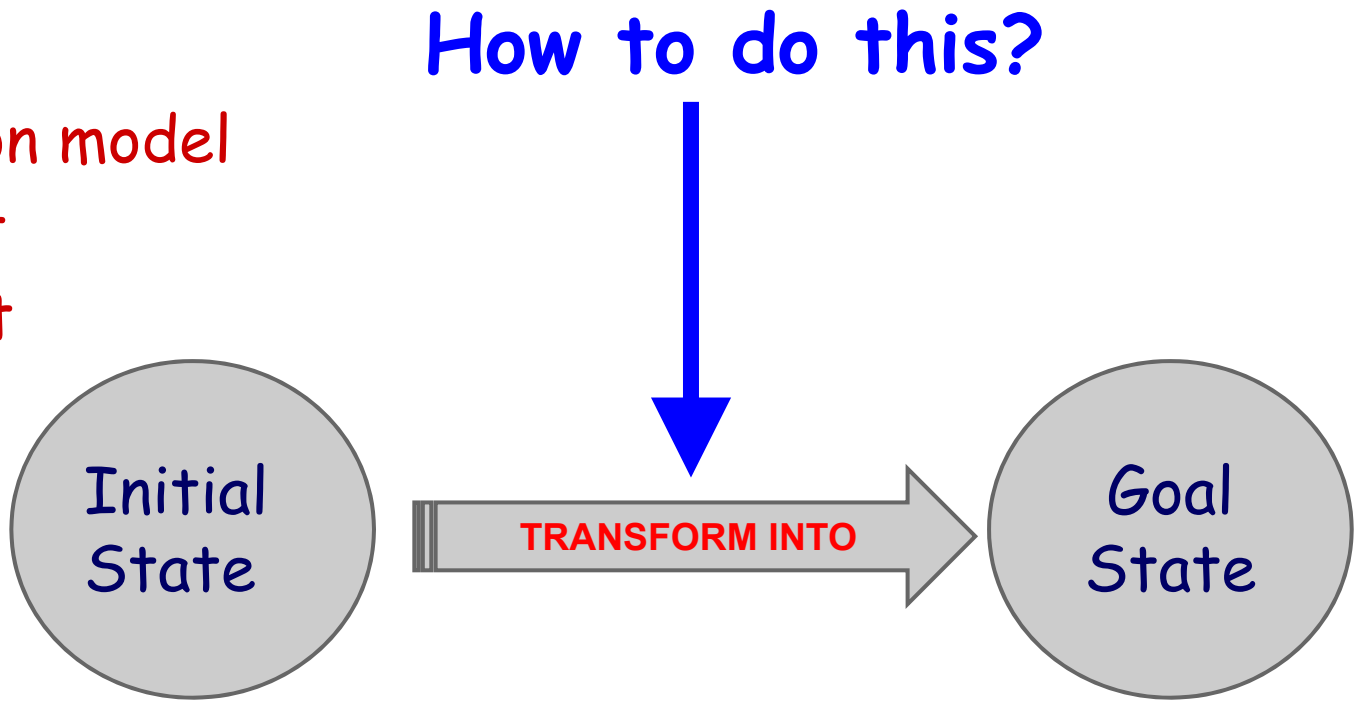
Search Problems

A **search problem** is defined by:

- Possible states
- Initial state
- Actions
- Transition model
- Goal test
- Path cost



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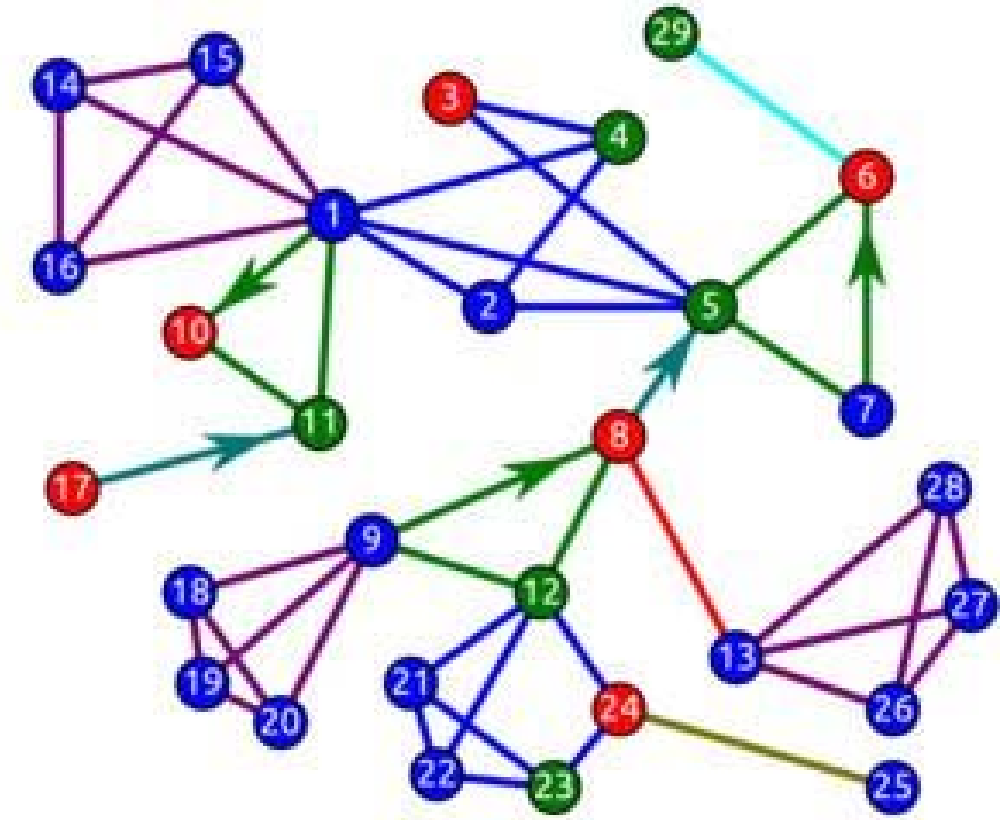
Search as Graph Reachability



Can we reach state/node 25 from state/node 17?

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Search as Graph Reachability (cont.)

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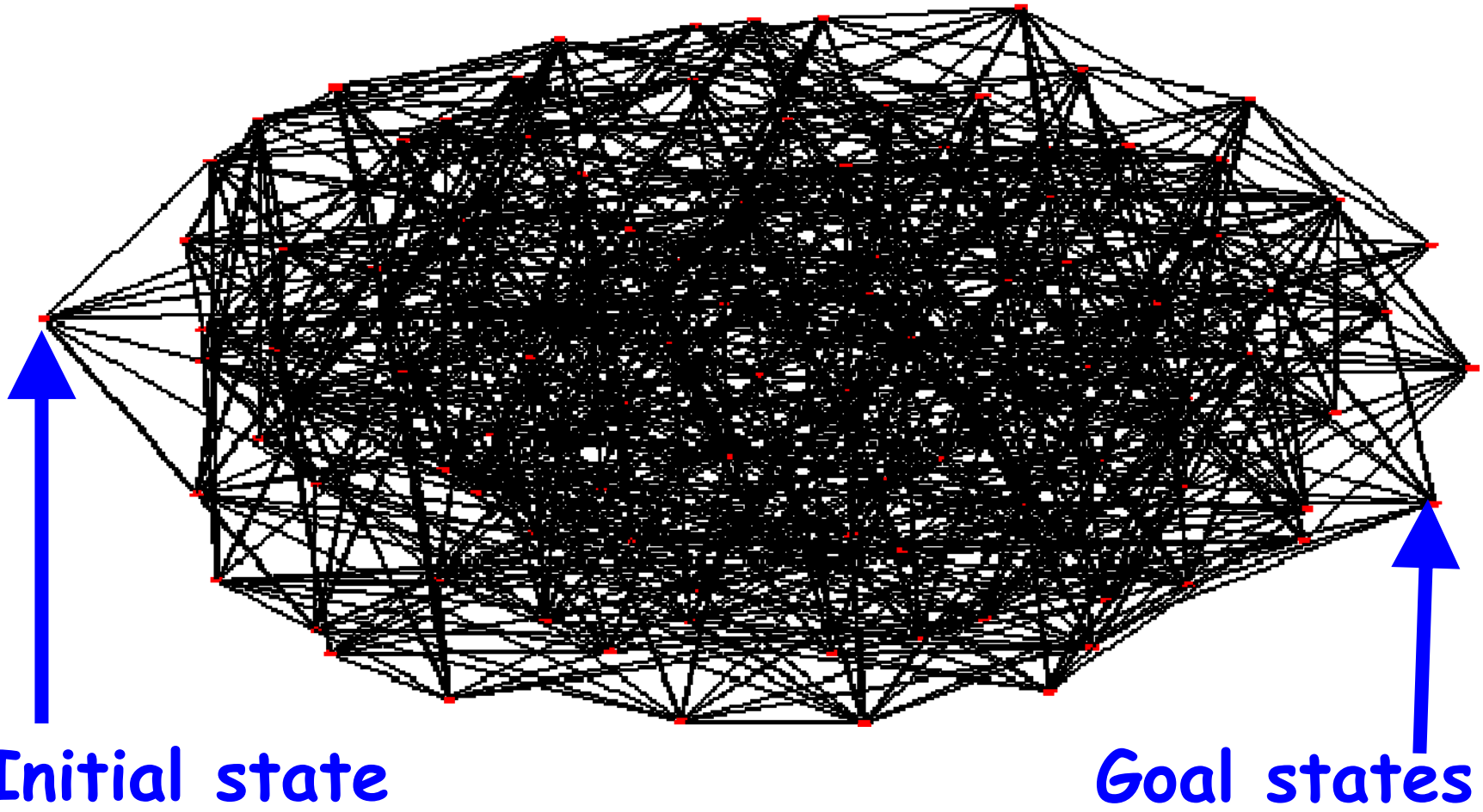
Search as Graph Reachability (cont.)



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To-be-done Things within This Week

- Get the textbook
- Read the recommended chapters in the textbook
- Revise the pre-requisite knowledge
- Check the latest timetable to know the time and location of your selected tutorial and lab sessions
- Attend the 1st tutorial session (important!).

Questions?