CS5201: Advanced Artificial Intelligence

Introduction

Arijit Mondal
Dept of Computer Science and Engineering
Indian Institute of Technology Patna
www.iitp.ac.in/~arijit/

General information

- **Class timings**
  - **Monday - 1400-1500**
  - **Tuesday - 1400-1500**
  - **Thursday - 1400-1500**
- **Venue: LT001**
- **url:** `http://www.iitp.ac.in/~arijit/` **-> Then visit 'Teaching'**
- **Instructor**
  - **Arijit Mondal**
- **TAs**
  - **Jyoti Kumari**
  - **Sofia Jamil**
  - **Mdshahbaz Nazami**

Books

- ***Artificial Intelligence: A Modern Approach*** **by Peter Norvig, Stuart Russell**
- ***Artificial Intelligence - A New Synthesis*** **by Nils J Nilsson**

Evaluation

- Midsem – 30%, Endsem – 50%
- Internal evaluation – 20%
  - At most two quizzes
  - Two projects (in groups, size of group will depend on class strength)
    - Survey on a topic
    - Code implementation
- Institute follows absolute grading policy
- 75% attendance is mandatory

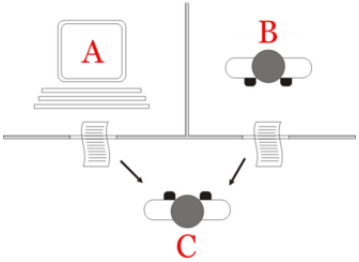
Introduction

What is AI?

- "... the science and engineering of making intelligent machines" (John McCarthy)
- AI is intelligence demonstrated by machines, in contrast to the natural intelligence displayed by humans. (Wikipedia)
- AI attempts not just to understand but also to build intelligent entities. (Russell & Norvig)
- Artificial intelligence is that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment. (Nilsson)

What is AI?

- **Act like human – The 'Turing test'**
  - **A human interrogator fails to distinguish responses generated from a computer or a human**



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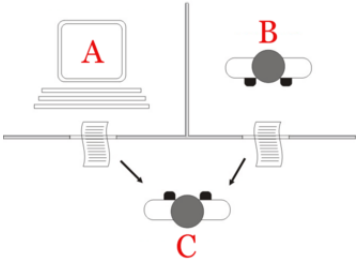

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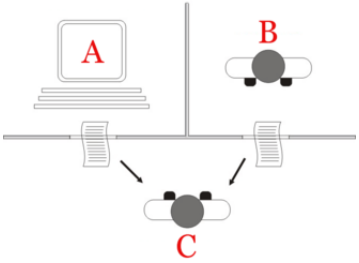
  - Right thinking, irrefutable reasoning processes



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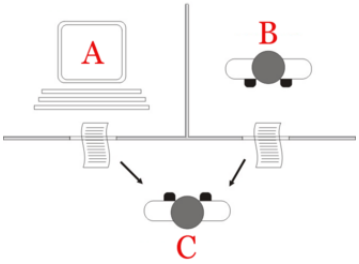
- **Act rationally** – Rational agent
  - Acts to achieve the best outcome in presence of uncertainty, the best expected outcome



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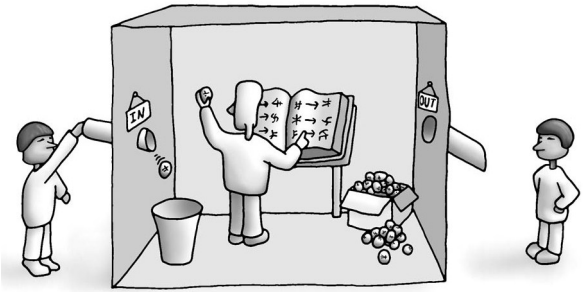
Chinese room argument

- **Suppose, artificial intelligence has succeeded in constructing a computer that behaves as if it understands Chinese. It takes Chinese characters as input and, by following the instructions of a computer program, produces other Chinese characters, which it presents as output.**
  - **Suppose, computer performs its task and comfortably passes the Turing test**



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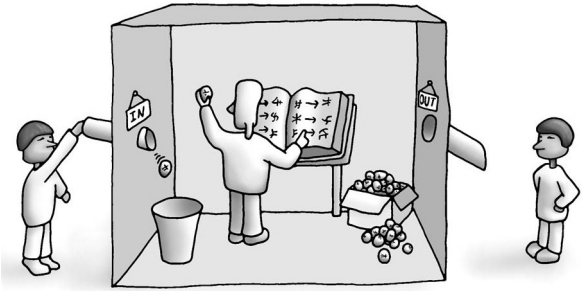

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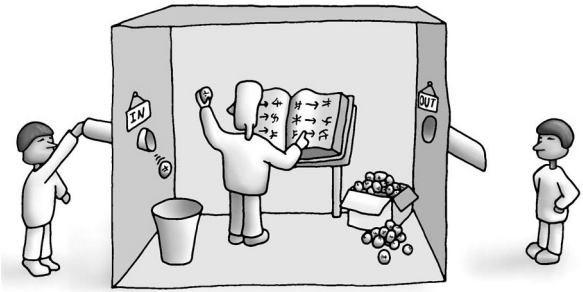

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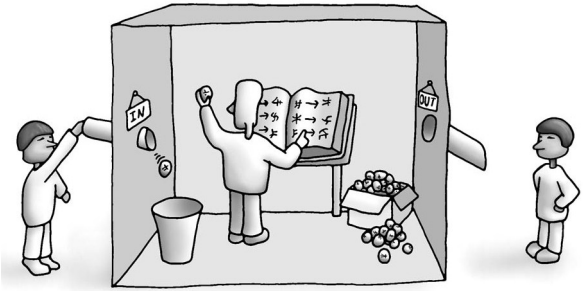
  - **Is it merely simulating the ability to understand Chinese?**



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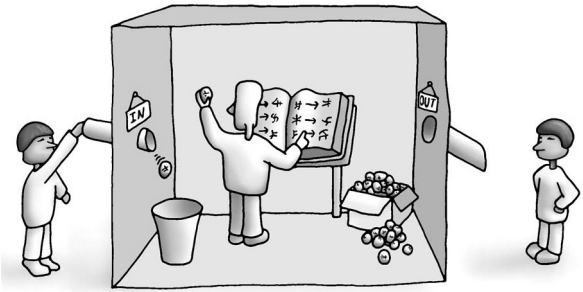

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- Problems that *cannot* be solved by computers
  - Example - detection of infinite loop in a program

Application domains

- Computer vision
- VLSI
- NLP
- Transportation
- Vehicle routing
- Airline/train scheduling
- Supply chain management
- Smart grid
- Operations research
- Healthcare
- Economics
- Games
- Robotics
- Weather forecast
- Agriculture
- Matching
- Linguistic
- Proving theorem
- etc.

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Many problem domains but solved using a few set of techniques.

Broad techniques

- Classical AI
  - Search
  - Logic
  - Constraint satisfaction
  - Planning
  - Probabilistic reasoning

- Statistical / Data driven AI
  - Machine learning - symbolic / logical, statistical
  - Deep learning

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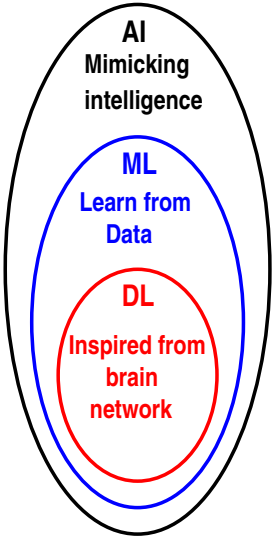

A search problem

- Let a factory produces N different products using M different components. Product n requires S_{nm} number of mth components. Each component has a cost C_m. There are limited number of components available (say L_m number of components for the mth item). Each product earns a revenue of C_n.
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  - Product - sulfuric acid, aqua regia, Components - sulfur, chlorine, nitric acid – Chemical industry

Logic

There are five houses.
The Englishman lives in the red house.
The Spaniard owns the dog.
Coffee is drunk in the green house.
The Ukrainian drinks tea.
The green house is immediately to the right of the ivory house.
The Old Gold smoker owns snails.
Kools are smoked in the yellow house.
Milk is drunk in the middle house.
The Norwegian lives in the first house.
The man who smokes Chesterfields lives in the house next to the man with the fox.
Kools are smoked in the house next to the house where the horse is kept.
The Lucky Strike smoker drinks orange juice.
The Japanese smokes Parliaments.
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Zebra puzzle

Constraint satisfaction

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- **Job-shop scheduling** – Consider car assembly consisting of the tasks: install axles (front and back), affix all four wheels (right and left, front and back), tighten nuts for each wheel, affix hubcaps, and inspect the final assembly. Each task requires some time, some tasks are dependent. Is it possible to finish the job within a given time T say?

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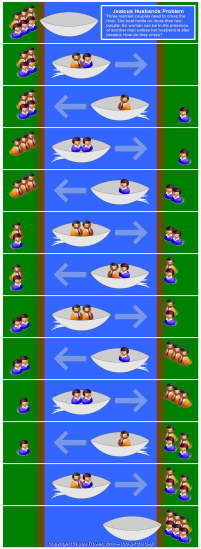
- **Real life problems will have more number of constraints**

Planning

- **Three missionaries and three cannibals are on one side of a river that they wish to cross. A boat is available that can hold at most two people and at least one. You must never leave a group of missionaries outnumbered by cannibals on the same bank.**



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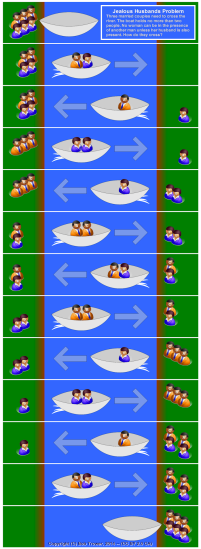

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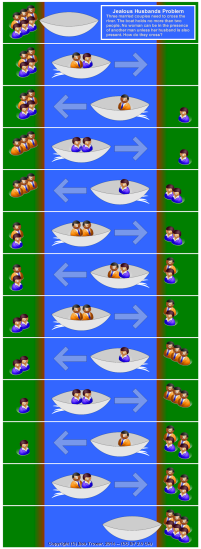
- Applications - dialog management, risk management, robotics, etc.



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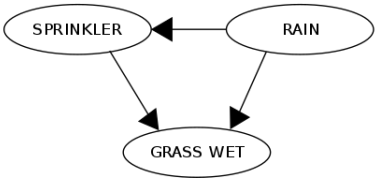
Probabilistic reasoning

- Two events can cause grass to be wet: an active sprinkler or rain. Rain has a direct effect on the use of the sprinkler
  - What is the probability that it would rain, given that we wet the grass?

	SPRINKLER	
RAIN	T	F
F	0.4	0.6
T	0.01	0.99



	RAIN	
T	F	
0.2	0.8	

		GRASS WET	
SPRINKLER	RAIN	T	F
F	F	0.0	1.0
F	T	0.8	0.2
T	F	0.9	0.1
T	T	0.99	0.01

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- **OR – Job shop scheduling, vehicle routing**

Agent and Environment

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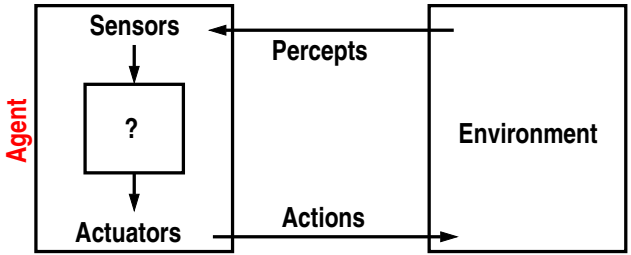
- Environment — Fully / partial observable, deterministic / stochastic, episodic / sequential, static / dynamic, discrete / continuous, known / unknown



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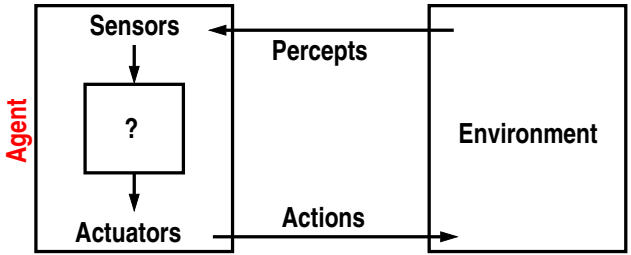
  - Known & partially observable - card games
  - Unknown & fully observable - video games



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