

CS 561 Artificial Intelligence

Lecture # 1 Introduction

Rashmi Dutta Baruah

Dept. of Computer Science & Engineering



भारतीय प्रौद्योगिकी संस्थान गुवाहाटी
Indian Institute of Technology Guwahati

Guwahati - 781039, INDIA

Outline

- Artificial Intelligence- Past, Present, and Future
 - How AI impacts life today and how it could change things in future?
- What is Artificial Intelligence (AI)?
- Specification and representation of AI Tasks
- Course contents and Grading components

Applications of AI: Present



Transportation

Smart Cars, self-driving cars, on demand transportation



Marketing:
targeted
advertising,
behavioural
targeting



Climate change:
Early warning systems



Applications of AI: Present



Healthcare: scheduling, diagnosis, mobile healthcare , in-home care for elderly

Planning and Scheduling for Assembly



Image processing (Satellite Image source: IEEE Spectrum) Satellites and AI Monitor Chinese Economy's Reaction to Coronavirus



Let's look back...History of AI

During early
1950's

Cybernetics

Norbert Wiener

Games

Christopher Strachey, Dietrich Prinz , Arthur Samuel

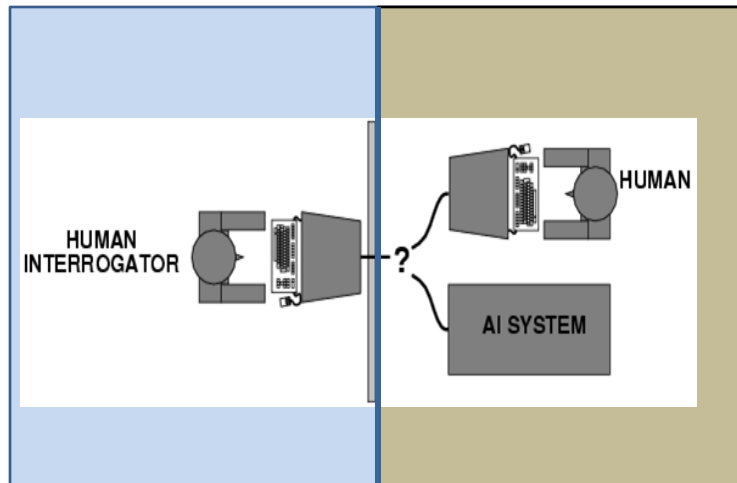
Early neural networks

Warren McCulloch , Walter Pitts, Marvin Minsky

Symbolic reasoning

Allen Newell , Herbert A. Simon

Can Machines think?



Alan Turing (1912-1954) proposed
Turing Test (1950) in his paper
Computing Machinery and Intelligence.



History of Artificial Intelligence

- **Dartmouth Conference 1956:** the term Artificial Intelligence coined

An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves.



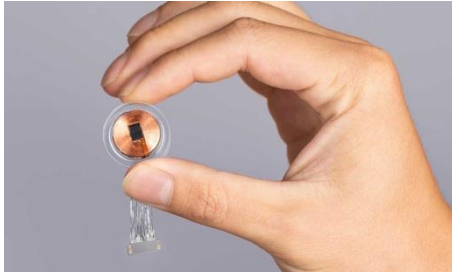
John McCarthy (1927-2011) one of the founders of the AI discipline, **coined the term Artificial Intelligence** in 1956. Also developed LISP programming language.

Marvin Minsky (1927-2016) one of the pioneers of AI discipline (contributions in neural network), jointly hosted the Dartmouth Conference in 1956.



No new breakthroughs

symbolic AI , logic for knowledge representation and reasoning



(Source: IEEE Spectrum, 28 Aug 2020)
Toward Syncing Our Brains With AI
Neuralink's self-contained neural
implant functions without the aid of
external hardware.



Robot Stand-up Comedian



Video available at:
<https://spectrum.ieee.org/automaton/robotics/artificial-intelligence/whats-the-deal-with-robot-comedy>

Self-Driving Cars that
read the body language

Thank god ! Finally
I got to talk to a real
person.



Challenges



sources: <https://www.pinterest.com/jaymzcardi/camouflaged-animal-kingdom/>
<http://www.awayweglobe.com/the-latest/2014/11/19/funny-observations-india>

Commonsense, Vision, Interaction , . . . , which we perform without any conscious thought are most difficult to emulate.

What is Artificial Intelligence?

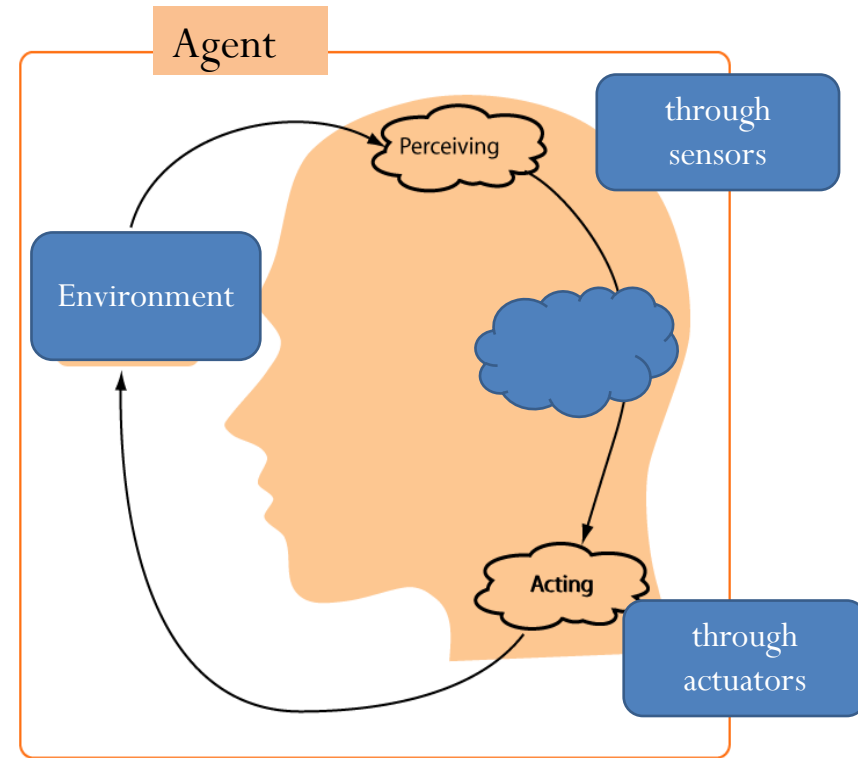
- **Human-centered Approach**

- inspired by capabilities possessed by human beings
- agents that are capable of performing tasks at which at the moment human beings are good at
- Example: Game playing

- **Rational Approach**

- not necessarily imitating human capabilities
- Agents that are capable of performing tasks rationally (does the right thing), expected to maximize the goal, given the available information.
- Example: recommender systems, targeted advertising

- An **agent** is an entity that perceives and acts.



Artificial Intelligence

- Artificial Intelligence covers a HUGE variety of SUB-FIELDS.

Logic
Knowledge
representation and
reasoning

Planning

Machine
Learning

Game Playing
board games:
chess and
checkers

Natural Language
Processing
Machine
Translation

Computer Vision

Robotics

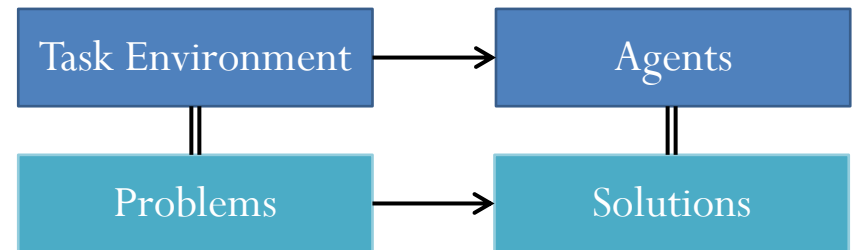
AI Tasks and Solutions

- Mathematically, agent's behaviour can be described by **agent function**:

$$f: p^* \rightarrow a$$

p^* : *percept sequence*

a : *action*



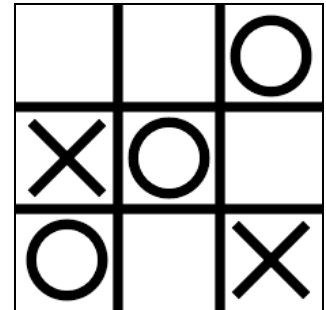
- Agent function implemented by **agent program**.
- The aim here is **to design agent program using AI**.

$$\text{agent} = \text{architecture} + \text{program}$$

- Depending on the agent program, the agent can vary from **simple reflex agent** to **learning agent**.

AI Tasks and Solutions

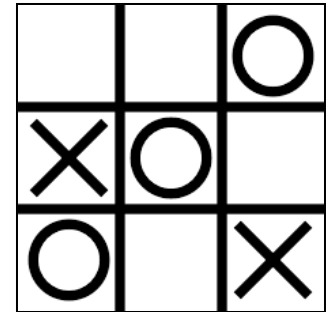
- Types of Environment
 - **Fully observable** (vs. **partially observable**): An agent's sensors give it access to the complete (relevant) state of the environment at each point in time.
 - **Deterministic** (vs. **stochastic**): The next state of the environment is completely determined by the current state and the action executed by the agent.
 - **Episodic** (vs. **sequential**): An agent's experience is divided into atomic episodes (percept and a single action). Decisions do not depend on previous decisions/actions.



AI Tasks and Solutions

- Types of Environment

- **Static** (vs. **dynamic**): The environment is unchanged while an agent is deliberating.
- **Discrete** (vs. **continuous**): A limited number of distinct, clearly defined state, percepts, and actions.
- **Single agent** (vs. **multi-agent**): An agent operating by itself in an environment. Does the other agent interfere with my performance measure?



AI Tasks and Solutions

- AI tasks specification and representation
 - **Specification** in terms of
 - **Performance measure** : defines criterion of success
 - Example: **Touring Agent**: Shortest path, **Medical Health Condition Monitoring Agent**: Early detection of abnormality with accuracy 99%)
 - **Environment** (Example: cities and roads, Monitoring equipment and staff)
 - **Actuators (Actions**: Move from city A to B, Raise alarm)
 - **Sensors (Percepts**: city map, signals from wearable devices)



AI Tasks and Solutions

- AI Tasks uses **representations** to capture the real world environment and AI techniques provide **inference** to reach to the solution.

Search problems ✓
Game playing ✓
Hidden Markov Models ✓
Markov decision processes

Planning
Propositional logic
Bayesian networks ✓
Machine learning ✓
Constraint satisfaction problems

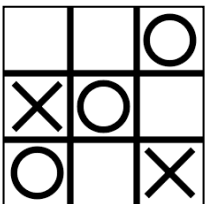
First-order logic
First order probability models ✓
Knowledge-based learning
Natural language -Understanding

Atomic

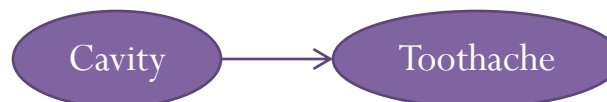
Factored (Variables)

Structured (Objects and Relations)

Low-level intelligence



Increase in Complexity and Expressive Power



High-level intelligence

Father(John) = Henry
King(John)

Course Focus

- We will look at various AI techniques (some what in line with developing rational agents)
 - Solving problems by searching
 - Uniformed and informed search
 - Local search
 - Reasoning (under uncertainty)
 - Probabilistic reasoning: Bayesian Networks
 - Probabilistic reasoning over time
 - Learning

Course Information

- All slides will be shared in the CS 561 Group.
- **Book: Artificial Intelligence : A Modern Approach**
S. Russell and P. Norvig, 3rd Edition, Pearson
- **Grading Components**
 - Viva-Voce and Class Discussion (**40 %**)
 - Quiz (**30 %**)
 - Assignments (Programming & Reading) (**30 %**)

What did we discuss today?

- Brief history of AI and its present and future
- What is Artificial Intelligence (AI)?
- How to specify and represent AI Problems?