بسم الله الرحمن الرحيم

BISMILLAH ARRAHMAN ARRAHEEM

Artificial Intelligence (CS-461)

Lecture 1: Introduction to Artificial Intelligence

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Course Objectives

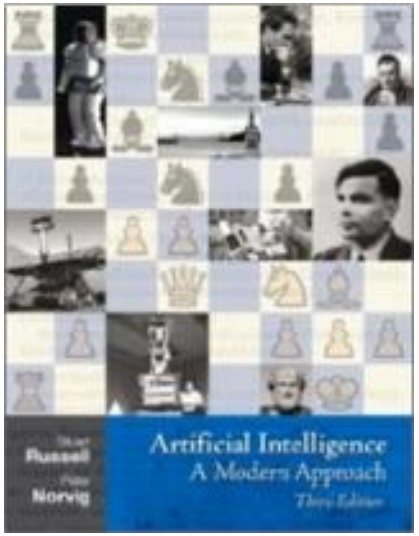
- Become familiar with criteria that distinguish human intelligence from artificial intelligence
- Recall important aspects of artificial intelligence
  - different approaches to analyze intelligence
  - influences from other fields
  - historical development
- Identify advantages and problematic aspects of different approaches to analyze intelligence
- Categorize existing systems using AI with respect to the influences from other fields, and their historical perspective
- Identify, analyze and explain the respective successes and failures of some approaches in the field of AI

Course Contents

- Introduction
- Intelligent Agents
- Search
  - Problem solving through search
  - Uninformed search
  - Informed search
  - Local search and constraint Satisfaction
- Games
  - games as search problems
- Knowledge and Reasoning
  - reasoning agents
  - propositional logic
  - predicate logic
  - planning
  - knowledge-based systems
  - uncertain knowledge and reasoning
- Machine Learning
  - learning from observation
  - reinforcement learning
  - neural networks
  - deep learning
- (Natural Language Processing)
- (Robotics)
- (Philosophical, Ethical, Social Issues with AI)
- Conclusions

Teaching Material:

Textbook:
S. Russell and P. Norvig: ***Artificial Intelligence: A Modern Approach***. Pearson, 2010, *3rd Edition*



Additional Resources

http://aima.cs.berkeley.edu/

Definition of AI

"Intelligence: The ability to learn and solve problems"

Webster's Dictionary

"Artificial intelligence (AI) is the intelligence exhibited by machines or software"

Wikipedia

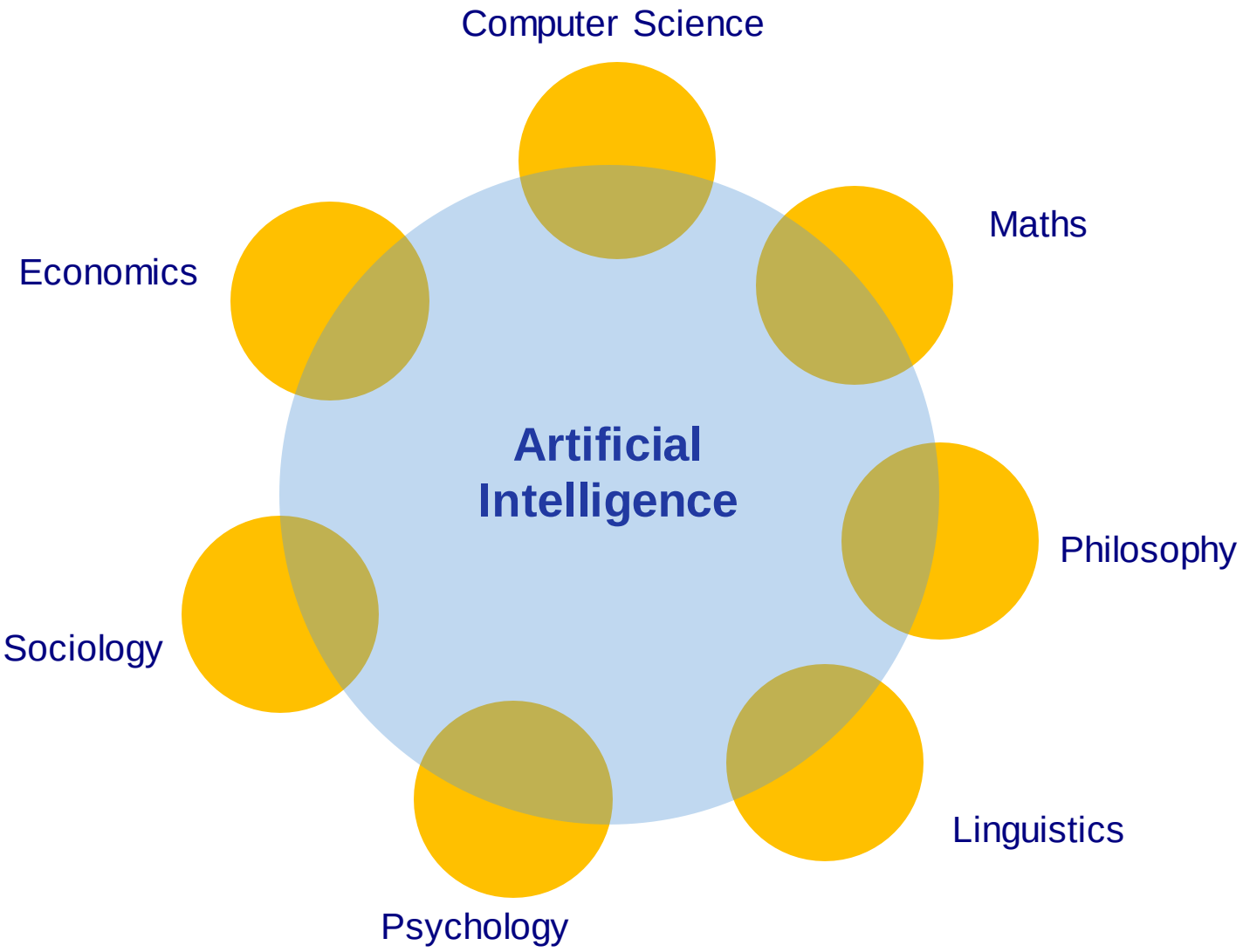
"The science and engineering of making intelligent machines"

McCarthy

"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."

Russel and Norvig, AIMA book

Foundation of AI



Applications of AI

Smart Search Algorithms

- Games
- Route finding
- Transportation/scheduling
- Traveling salesperson
- VLSI layout
- Automatic assembly

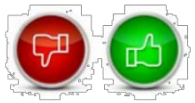
…. **Many more!**

Applications of AI

NLP Applications

- Search engines
- OCR
- Speech recognition
- Machine translation
- Spam fighting
- Information extraction
- Summarization
- Spelling checkers
- Grammar Cheekers
- Sentiment analysis

…. **Many more!**

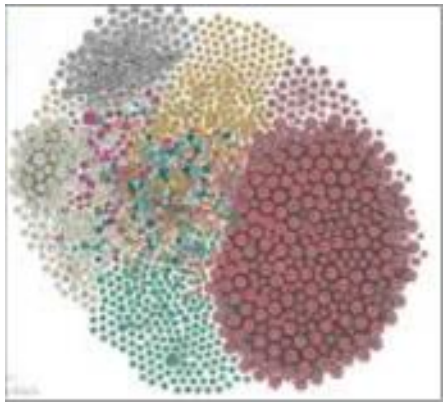


Applications of AI

Knowledge base Applications

- Semantic Web
- Expert Systems
- Reasoning
- Logic based games
- System interoperability
- Semantic search
- Medical diagnosis

…. **Many more!**



Applications of AI

Machine learning

- Face Recognition
- Autonomous cars
- Social network analysis
- Recommendation systems
- Fraud detection
- Financial forecasting

…. **Many more!**

Why we study Artificial Intelligence?

- New emerging field
- Involvement in our daily life
    - AI is playing role in defense, robots, expert systems, games etc.

Multi Disciplinary Aspects

- Philosophers
- Mathematician
- Linguistics
- Biologists
- Computer Scientists

Understanding AI

- How knowledge is acquired, represented, and stored;
- How intelligent behavior is generated and learned;
- How motives, emotions, and priorities are developed and used;
- How sensory signals are transformed into symbols;
- How symbols are manipulated to perform logic, to reason about past and plan for future;
- How mechanisms of intelligence produce the phenomena of illusion, belief, hope, fear, dreams, kindness and love

Hard or Strong AI

- Generally, artificial intelligence research aims to create AI that can replicate human intelligence completely.
- Strong AI refers to a machine that approaches or supersedes human intelligence,
  - If, it can do typical human tasks,
  - If, it can apply a wide range of background knowledge and
  - If, it has some degree of self-consciousness.
- Strong AI aims to build machines whose overall intellectual ability is indistinguishable from that of a human being.

Soft or Weak AI

- Weak AI refers to the use of software to study or accomplish specific problem solving or reasoning tasks that do not encompass (cover) the full range of human cognitive abilities.
- Weak AI does not achieve self-awareness; it demonstrates a few of human-level cognitive abilities; it is merely an intelligent, a specific problem-solver.

General AI Goals

- Replicate human intelligence : still a distant goal.
- Solve knowledge intensive tasks.
- Make an intelligent connection between perception and action.
- Enhance human-human, human-computer and computer to computer interaction / communication.
- **Engineering based AI Goal**
- Develop concepts, theory and practice of building intelligent machines
- Emphasis is on system building.
- **Science based AI Goal**
- Develop concepts, mechanisms and vocabulary to understand biological intelligent behavior.
- Emphasis is on understanding intelligent behavior.

What is AI?

Four schools of thoughts (Russel & Norvig)

Thinking humanly	**Thinking rationally**
"The exciting new effort to make computers think... machines with minds, in the full and literal sense." *(Haugeland, 1985)*	"The study of mental faculties through the use of computational models." (Charniak & McDermott,1985)
Acting humanly	**Acting rationally**
"The study of how to make computers do things which, at the moment, people are better." *(Rich & Knight, 1991)*	"Computational Intelligence is the study of the design of intelligent agents." (Poole et al., 1998)

Cognitive science : Think human-like

- An exciting new effort to make computers think; that it is, the machines with minds, in the full and literal sense.
- Focus is not just on behavior and I/O, but looks at reasoning process.
- Computational model as to how results were obtained.
- Goal is not just to produce human-like behavior but to produce a sequence of steps of the reasoning process, similar to the steps followed by a human in solving the same task.

Laws of Thought : Think Rationally

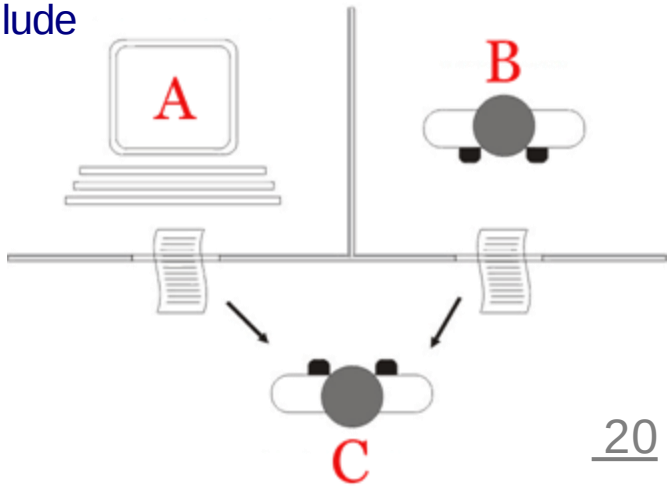
- The study of mental faculties through the use of computational models; that it is, the study of the computations that make it possible to perceive, reason, and act.
- Focus is on inference mechanisms that are provably correct and guarantee an optimal solution.
- Develop systems of representation to allow inference (conclusion) to be like “Ali is a man. All men are mortal (human, earthly). Therefore Ali is mortal.”
- Goal is to formalize the reasoning process as a system of logical rules and procedures for inference.

Act Like Human: Turing Test

- Proposed by Alan Turing in 1950 to provide an operational definition of intelligent behavior
- The art of creating machines that perform functions requiring intelligence when performed by people; that it is the study of, how to make computers to do things which at the moment people do better.
- Focus is on action, and not intelligent behavior centered around representation of the world.
- A Behaviorist approach, is not concerned with how to get results but to the similarity to what human results are…

Example : Turing Test

- 3 rooms contain: a person, a computer, and an interrogator.
- The interrogator can communicate with the other 2 by teletype (to avoid the machine imitate the appearance or voice of the person).
- The interrogator tries to determine which is the person and which is the machine.
- The machine tries to fool the interrogator to believe that it is the human, and the person also tries to convince the interrogator that it is the human.
- If the machine succeeds in fooling the interrogator, then conclude that the machine is intelligent.
- Goal is to develop systems that are human-like.

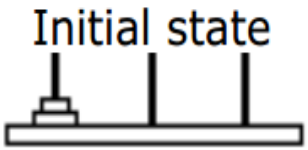


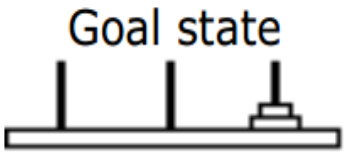
Rational Agent : Act Rationally

- Tries to explain and emulate intelligent behavior in terms of computational processes; that it is concerned with the automation of intelligence.
- Focus is on systems that act sufficiently if not optimally in all situations;
- Goal is to develop systems that are rational and sufficient.

Puzzle : Towers of Hanoi with only 2 disks

Solve the puzzle :





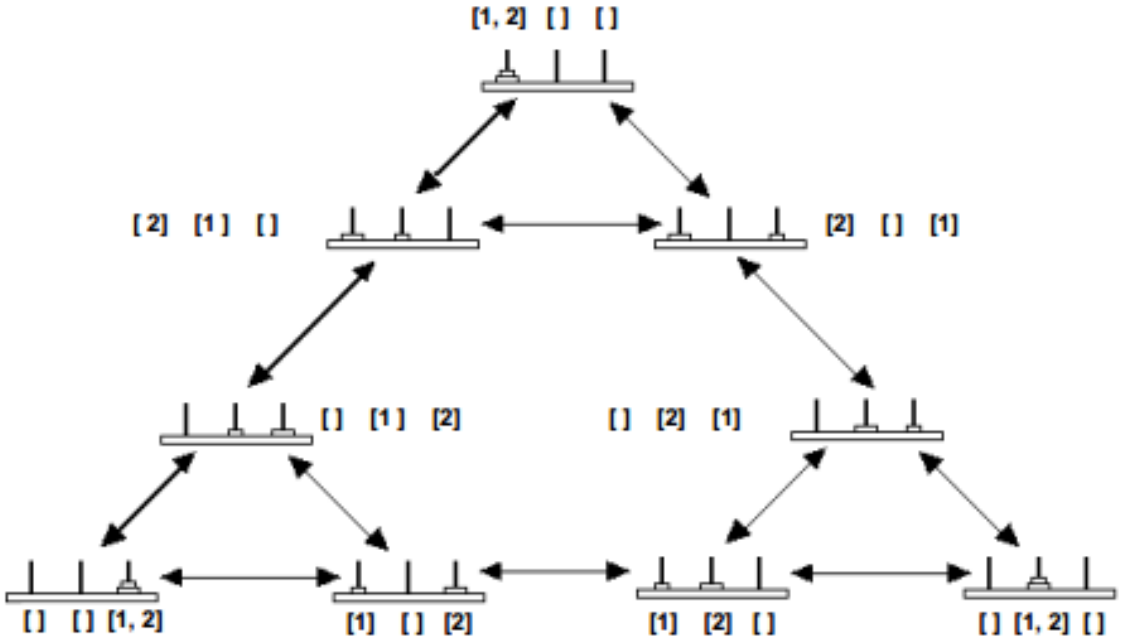
Move the disks from the leftmost post to the rightmost post while

- never putting a larger disk on top of a smaller one;
- move one disk at a time, from one peg to another;
- middle post can be used for intermediate storage.

Play the game in the smallest number of moves possible.

Example

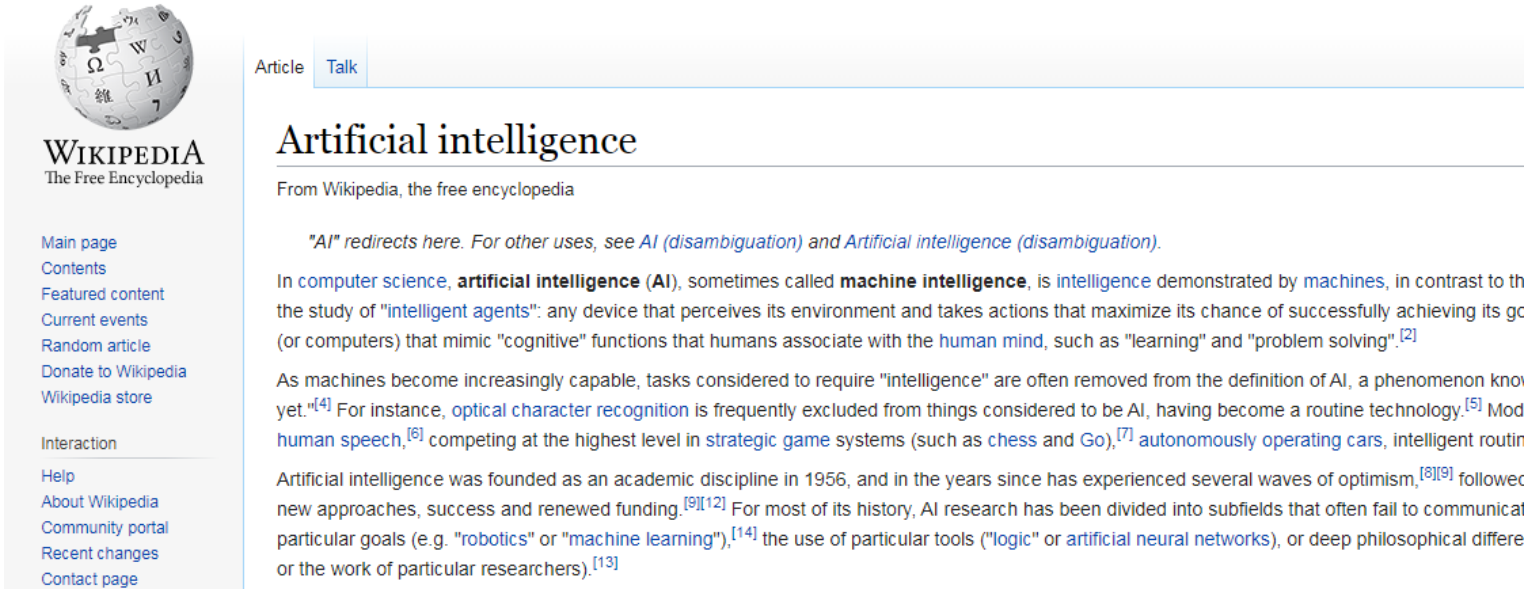
- **Possible state transitions in the Towers of Hanoi puzzle with 2 disks.**



Towers of Hanoi puzzle

- **Shortest solution** is the sequence of transitions from the top state downward to the lower left.

Read Article About Artificial Intelligence @ Wikipedia



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Artificial intelligence

From Wikipedia, the free encyclopedia

"AI" redirects here. For other uses, see AI (disambiguation) and Artificial intelligence (disambiguation).

In computer science, **artificial intelligence** (**AI**), sometimes called **machine intelligence**, is intelligence demonstrated by machines, in contrast to th the study of "intelligent agents": any device that perceives its environment and takes actions that maximize its chance of successfully achieving its gc (or computers) that mimic "cognitive" functions that humans associate with the human mind, such as "learning" and "problem solving".[2]

As machines become increasingly capable, tasks considered to require "intelligence" are often removed from the definition of AI, a phenomenon kno yet."[4] For instance, optical character recognition is frequently excluded from things considered to be AI, having become a routine technology.[5] Mod human speech,[6] competing at the highest level in strategic game systems (such as chess and Go),[7] autonomously operating cars, intelligent routin

Artificial intelligence was founded as an academic discipline in 1956, and in the years since has experienced several waves of optimism,[8][9] followec new approaches, success and renewed funding.[9][12] For most of its history, AI research has been divided into subfields that often fail to communicat particular goals (e.g. "robotics" or "machine learning"),[14] the use of particular tools ("logic" or artificial neural networks), or deep philosophical differe or the work of particular researchers).[13]

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

Important Concepts and Terms

- Agents
- Automated reasoning
- Cognitive science
- Computer science
- Intelligence
- Intelligent agent
- Knowledge representation
- Linguistics
- Lisp
- Logic
- Machine learning
- Natural language processing
- Neural network
- Predicate logic
- Propositional logic
- Rational agent
- Rationality
- Turing test

Assignment 1

- What is the common definition of “AI”? Do you agree?
- Do you know any AI application?
- Should artificial intelligence simulate natural intelligence?
- What are the criticisms on the AI research? Do you agree?
- What is the relation between AI and logic? AI and philosophy? Logic and philosophy?
- Explain the meaning of logic? reasoning? ontology?
- What is Natural Language Processing? And how it is related to AI?
- Why and how Probabilistic and statistical methods are used in AI ?
- What are the major research approaches/schools in AI? Which one you think is more productive?