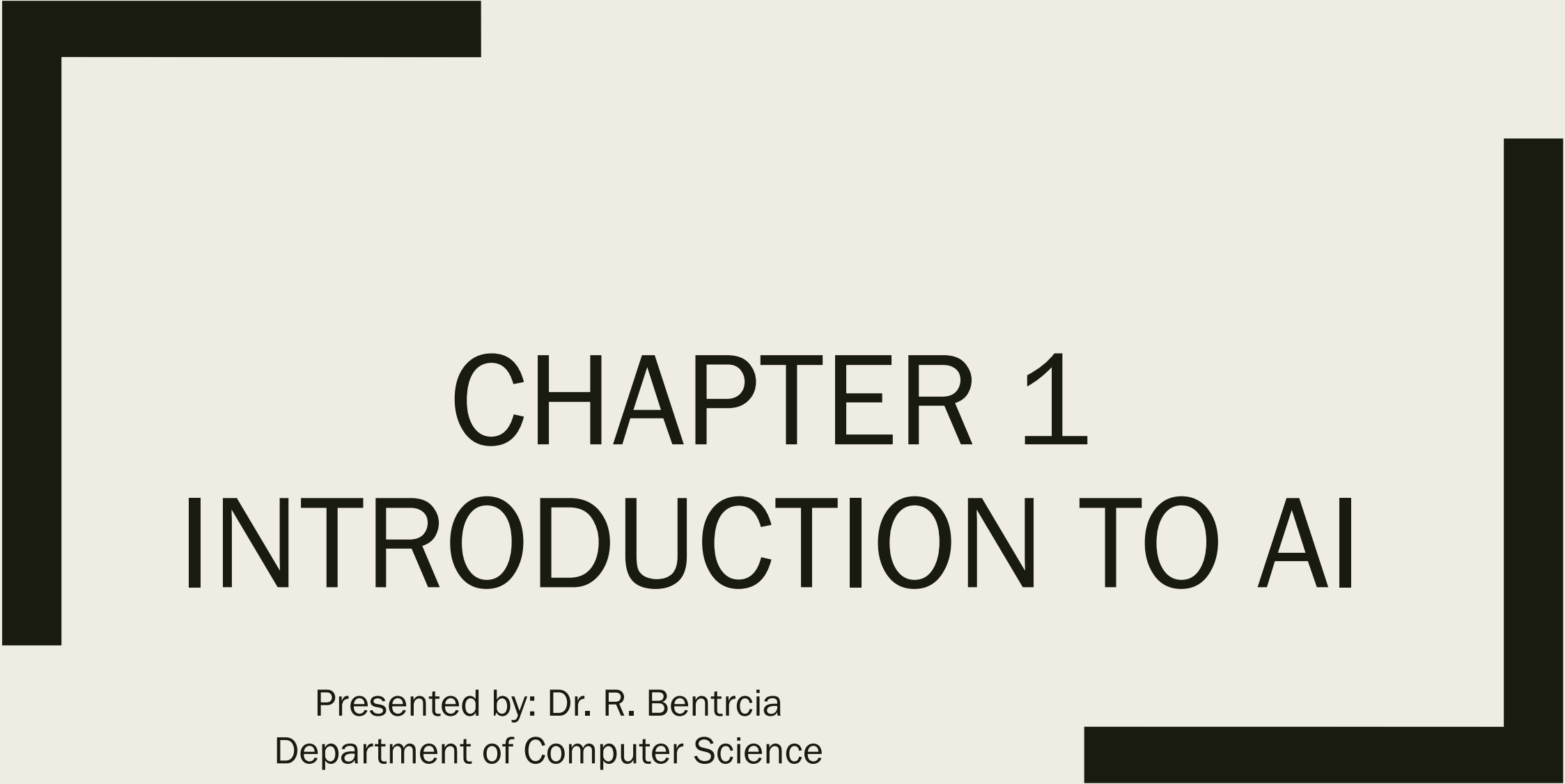


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CHAPTER 1

INTRODUCTION TO AI

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Outline

- AI Basic Concepts
- AI and Programming
- AI History
- AI Applications
- AI Examples
- AI and Problem Solving

AI Basic Concepts

- AI is one of the most powerful fields of Computer science which has a great revolution in future.
- AI goal is to make a machine working as a human.
- It is a branch of computer science by which we can create intelligent machines which can behave like a human, think like humans, and able to make decisions starting from learning and reasoning, ending with solving problems,
- According to the father of Artificial Intelligence in 1956, John McCarthy, it is “The science and engineering of making intelligent machines, especially intelligent computer programs”.

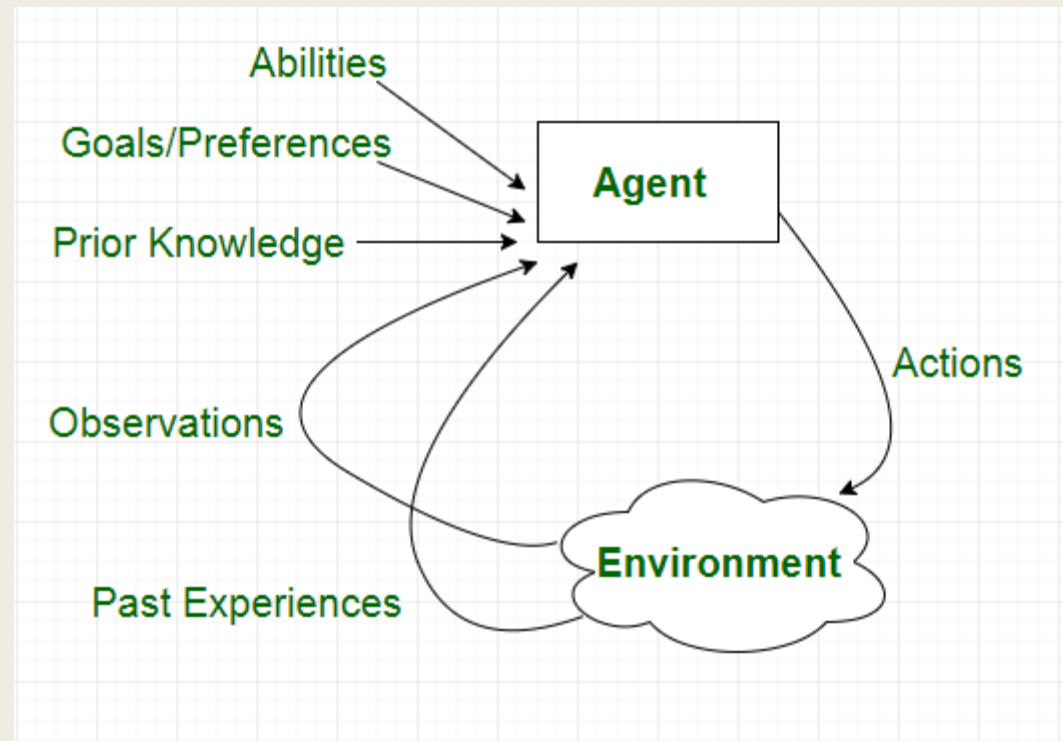
AI Basic Concepts

- Learning: Having the ability to obtain and process new information
- Reasoning: Being able to manipulate information in various ways
- Problem solving is a process of generating solutions from observed data.
- Expert system is a computer program that is designed to solve complex problems and to provide decision-making ability like a human expert. It performs this by extracting knowledge from its knowledge base using the reasoning and inference rules according to the user queries.
- Knowledge is awareness or familiarity gained by experiences of facts, data, and situations.

AI Basic Concepts

- Knowledge representation is a way which describes how we can represent knowledge in artificial intelligence so that a computer can understand and can utilize this information to solve the complex real world problems,
- Inference is the process that a trained machine uses to draw conclusions from new data,
- Agent is a computer program or system that is designed to perceive its environment, make decisions and take actions to achieve a specific goal,
- Environment in Artificial Intelligence is the surrounding of the agent. The agent takes input from the environment through sensors and delivers the output to the environment through actuators,

AI Basic Concepts



Characteristics of an Agent

from <https://www.geeksforgeeks.org/agents-artificial-intelligence/>

AI and Programming

- Programming Without AI
 - *can perform specific functions*
 - *Change the structure to do more tasks*
- Programming With AI
 - *can perform general functions*
 - *Can add independent information without affecting the structure.*

AI History

■ Groundwork for AI: 1900-1950

- **1921:** Czech playwright Karel Čapek released a science fiction play “[Rossum’s Universal Robots](#)” which introduced the idea of “artificial people” which he named robots. This was the first known use of the word.
- **1929:** Japanese professor Makoto Nishimura built the first Japanese robot, named [Gakutensoku](#).
- **1949:** Computer scientist Edmund Callis Berkley published the book “[Giant Brains, or Machines that Think](#)” which compared the newer models of computers to human brains.

AI History

■ Birth of AI: 1950-1956

- **1950:** Alan Turing published “[Computer Machinery and Intelligence](#)” which proposed a test of machine intelligence called The Imitation Game.
- **1952:** A computer scientist named [Arthur Samuel](#) developed a program to play checkers, which is the first to ever learn the game independently.
- **1955:** [John McCarthy](#) held a workshop at Dartmouth on “artificial intelligence” which is the first use of the word, and how it came into popular usage.

AI History

■ AI maturation: 1957-1979

- **1958:** John McCarthy created [LISP](#) (acronym for List Processing), the first programming language for AI research, which is still in popular use to this day.
- **1959:** [Arthur Samuel created the term “machine learning”](#) when doing a speech about teaching machines to play chess better than the humans who programmed them.
- **1961:** The first industrial robot [Unimate](#) started working on an assembly line at General Motors in New Jersey, tasked with transporting die casings and welding parts on cars (which was deemed too dangerous for humans).
- **1965:** Edward Feigenbaum and Joshua Lederberg created [the first “expert system”](#) which was a form of AI programmed to replicate the thinking and decision-making abilities of human experts.

AI History

- **1966:** Joseph Weizenbaum created the first “chatterbot” (later shortened to chatbot), [ELIZA, a mock psychotherapist](#), that used natural language processing (NLP) to converse with humans.
- **1968:** Soviet mathematician Alexey Ivakhnenko published “Group Method of Data Handling” in the journal “Avtomatika,” which proposed a new approach to AI that would later become what we now know as “Deep Learning.”
- **1973:** An applied mathematician named [James Lighthill](#) gave a report to the British Science Council, underlining that strides were not as impressive as those that had been promised by scientists,
- **1979:** The American Association of Artificial Intelligence which is now known as the [Association for the Advancement of Artificial Intelligence](#) (AAAI) was founded.

AI History

■ AI boom: 1980-1987

- **1980:** First conference of the AAAI was held at Stanford
- **1980:** The [first expert system came into the commercial market](#), known as XCON (expert configurer). It was designed to assist in the ordering of computer systems by automatically picking components based on the customer's needs.
- **1981:** *The Japanese government allocated \$850 million (over \$2 billion dollars in today's money) to the [Fifth Generation Computer project](#). Their aim was to create computers that could translate, converse in human language, and express reasoning on a human level.*
- **1984:** *The AAAI warns of an incoming "[AI Winter](#)" where funding and interest would decrease, and make research significantly more difficult.*

AI History

- **1985:** An autonomous drawing program known as [AARON](#) is demonstrated at the AAAI conference.
- **1986:** Ernst Dickmann and his team at Bundeswehr University of Munich created and demonstrated the [first driverless car](#) (or robot car). It could drive up to 55 mph on roads that didn't have other obstacles or human drivers.
- **1987:** Commercial launch of Alacrity by Alactrious Inc. Alacrity was the first strategy managerial advisory system, and used a complex expert system with 3,000+ rules.

AI History

■ AI winter: 1987-1993

- **1987:** The [*market for specialized LISP-based hardware collapsed*](#) due to cheaper and more accessible competitors that could run LISP software, including those offered by IBM and Apple. This caused many specialized LISP companies to fail as the technology was now easily accessible.
- **1988:** A computer programmer named [*Rollo Carpenter invented the chatbot Jabberwacky*](#), which he programmed to provide interesting and entertaining conversation to humans.

AI History

■ AI agents: 1993-2011

- **1997:** [*Deep Blue*](#) (developed by IBM) beat the world chess champion, Gary Kasparov, in a highly-publicized match, becoming the first program to beat a human chess champion.
- **1997:** Windows released a speech recognition software (developed by Dragon Systems).
- **2000:** Professor Cynthia Breazeal developed the first robot that could simulate human emotions with its face, which included eyes, eyebrows, ears, and a mouth. It was called Kismet.
- **2002:** The first Roomba was released.

AI History

- **2003:** [*Nasa landed two rovers onto Mars*](#) (Spirit and Opportunity) and they navigated the surface of the planet without human intervention.
- **2006:** Companies such as Twitter, Facebook, and Netflix started utilizing AI as a part of their advertising and user experience (UX) algorithms.
- **2010:** Microsoft launched the Xbox 360 Kinect, the first gaming hardware designed to track body movement and translate it into gaming directions.
- **2011:** An NLP computer programmed to answer questions named [*Watson*](#) (created by IBM) won Jeopardy against two former champions in a televised game.
- **2011:** Apple released Siri, the first popular virtual assistant.

AI History

■ Artificial General Intelligence: 2012-present

- **2012:** Two researchers from Google (Jeff Dean and Andrew Ng) trained a neural network to recognize cats by showing it unlabeled images and no background information.
- **2015:** Elon Musk, Stephen Hawking, and Steve Wozniak (and over 3,000 others) signed an open letter to the worlds' government systems banning the development of (and later, use of) autonomous weapons for purposes of war.
- **2016:** Hanson Robotics created a humanoid robot named Sophia, who became known as the first “robot citizen” and was the first robot created with a realistic human appearance and the ability to see and replicate emotions, as well as to communicate.

AI History

- **2017:** Facebook programmed two AI chatbots to converse and learn how to negotiate, but as they went back and forth they ended up forgoing English and developing their own language, completely autonomously.
- **2018:** A Chinese tech group called Alibaba's language-processing AI beat human intellect on a Stanford reading and comprehension test.
- **2019:** Google's AlphaStar reached Grandmaster on the video game StarCraft 2, outperforming all but .2% of human players.
- **2020:** OpenAI started beta testing GPT-3, a model that uses Deep Learning to create code, poetry, and other such language and writing tasks. While not the first of its kind, it is the first that creates content almost indistinguishable from those created by humans.

AI History

- **2021:** OpenAI developed DALL-E, which can process and understand images enough to produce accurate captions, moving AI one step closer to understanding the visual world.
- **2022:** OpenAI released the AI chatbot [ChatGPT](#), which interacted with users in a far more realistic way than previous chatbots
- **2023, 2024:** a milestone year in terms of generative AI where Microsoft integrated ChatGPT into its search engine Bing and Google released its GPT chatbot Bard.

AI Applications

- AI has been dominant in various fields such as:
 - *Gaming*
 - *Natural Language Processing*
 - *Expert Systems*
 - *Vision Systems*
 - *Speech Recognition*
 - *Handwriting Recognition*
 - *Intelligent Robots*

AI Examples

- ChatGPT: an advanced language model developed by OpenAI. It can generate human-like responses and engage in natural language conversations using deep learning,
- Google Maps utilizes AI algorithms to provide real-time navigation, traffic updates, and personalized recommendations.
- Smart Assistants like Amazon's Alexa, Apple's Siri, and Google Assistant employ AI technologies to interpret voice commands, answer questions, and perform tasks.
- Snapchat's augmented reality filters, or "Lenses," incorporate AI to recognize facial features, track movements, and overlay interactive effects on users' faces in real-time,
- Self-driving cars rely heavily on AI for perception, decision-making, and control using a combination of sensors, cameras, and machine learning algorithms,

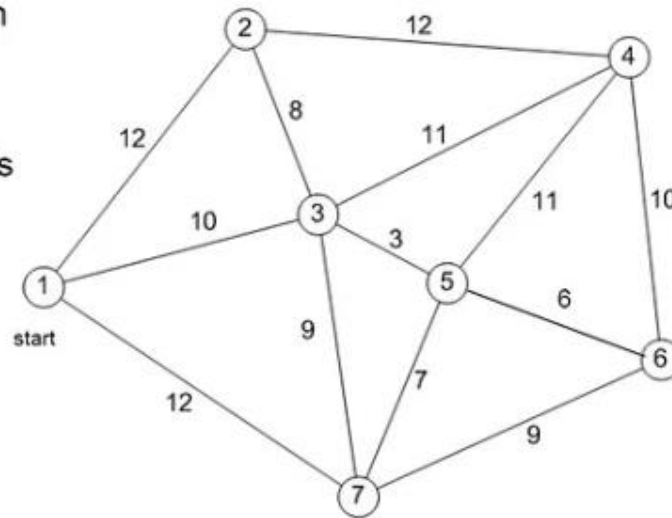
AI and Problem Solving

- Problem solving is a process of generating solutions from observed data.
 - ***Traveling salesman problem:*** find the shortest possible route that visits every city exactly once and returns to the starting point.
 - ***Hanoi tower problem:*** three rings of different sizes that can be placed on three different pegs where only the top ring on a peg can be moved at a time, and it can not be placed on a smaller ring,.

AI and Problem Solving

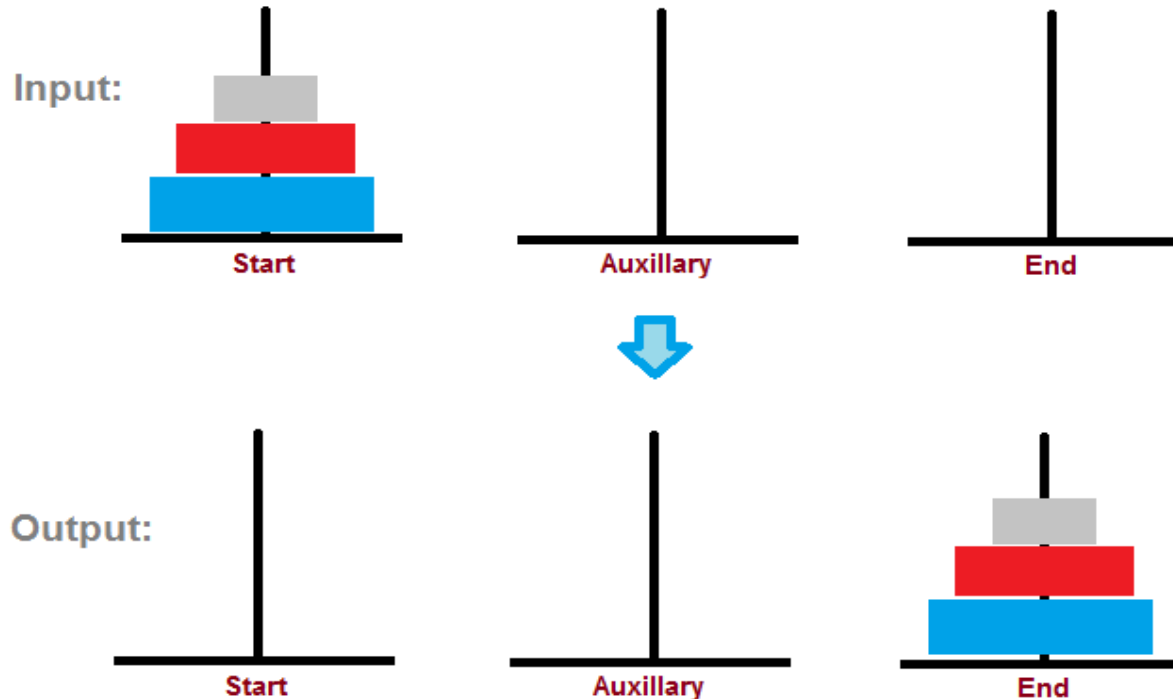
The Traveling Salesman Problem

- Starting from city 1, the salesman must travel to all cities once before returning home
- The distance between each city is given, and is assumed to be the same in both directions
- Only the links shown are to be used
- Objective - Minimize the total distance to be travelled



Source: <https://d2vlcm61l7u1fs.cloudfront.net/media%2F54a%2F54a17834-883d-406e-bbca-7ea37d86b915%2FphpuDTAqw.png>

AI and Problem Solving



Rules:

The objective of the puzzle is to move the entire stack of disks from Start rod to End rod, obeying the following simple rules:

1. Only one disk can be moved at a time.
2. Each move consists of taking the upper disk from one of the stacks and placing it on top of another stack i.e. a disk can only be moved if it is the uppermost disk on a stack.
3. No disk may be placed on top of a smaller disk.

With 3 disks, the puzzle can be solved in seven moves.

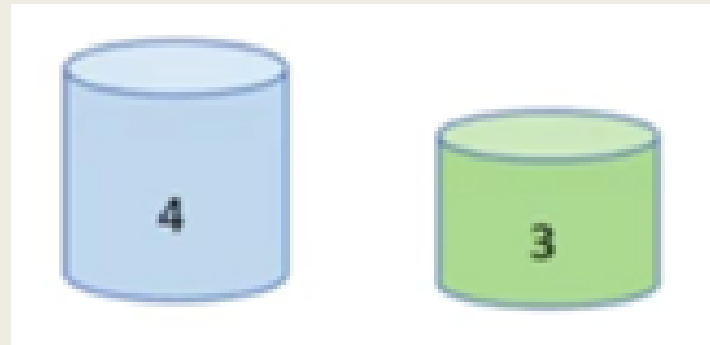
The minimum number of moves required to solve a Tower of Hanoi puzzle is
 $= 2^n - 1$, where n is the number of disks.

Source: <https://javabypatel.blogspot.com/2017/05/tower-of-hanoi-program-in-java.html>

AI and Problem Solving

- ***The Water Jug Problem:*** 4-gallon and 3-gallon Jugs, No measuring mark on the jug. There is a pump to fill the jugs with water. How can you get exactly 2 gallon of water into the 4-gallon jug?
- ***The Missionaries and Cannibals problem:*** Three missionaries and three cannibals wish to cross a river using a two person boat. If at any time the cannibals outnumber the missionaries on either side of the river, they will eat the missionaries. How can a sequence of boat trips be performed that will get everyone to the other side of the river without any missionaries being eaten?

AI and Problem Solving



Source: <https://cs.stackexchange.com/questions/116955/water-jug-problem-in-ai>

AI and Problem Solving



Source: <https://medium.com/@shikhar900/the-missionaries-and-cannibals-problem-377f8b18262>

AI and Problem Solving

- AI operates based on programmed algorithms, without a sense of right or wrong. In situations requiring ethical judgement or moral decisions, AI falls short.
 - *Baby care applications*
 - *Creativity: novel and innovative ideas*
 - *Psychologists, lawyers*

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