Artificial Intelligence

COURSE INSTRUCTOR: MUHAMMAD SAIF UL ISLAM

Lecture Outline – Week#1

- Introductory words
- Introduction to the Course
- Discussion on the Course outline
- Course plan, Assignments, and Project
- Introduction to AI
- Foundation of AI
- A brief history of AI
- Applications of AI

About Myself

Muhammad Saif ul Islam

Education:

Masters in Data Science - 2019

- FAST-NUCES, PK

Bachelors in Computer Science -2017

- Bahria University, PK

Certifications:

- Data Science Essentials
- Machine Learning
- Python Programming
- R Programming
- SQL Querying
- HTML5/CSS3

Work Experience:

IT Instructor (IBA-BBSYDP)

Python Developer (Innovative Solutions)

Sr. Operations Engineer (Gfk Etilize)

Lecturer (FAST- NUCES)

Lecturer
(Mohammad Ali Jinnah University)

Lecturer (Beaconhouse University)

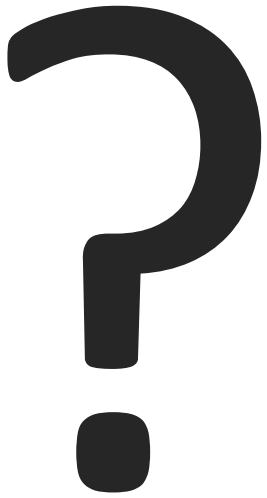
Students' Introduction

Name?

Expectation:

- What do you expect from this course?

Course Outline



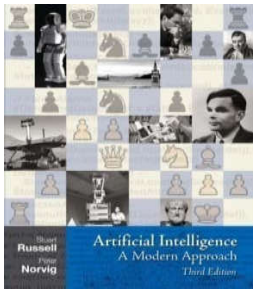
Course plan, Assignments and Quizzes

	Graded Assessment types	Weights (%)
1	Class Participation and Project	10%
2	Quiz	10%
3	Assignments	10%
4	Mid Exam	30%
5	Final Exam	40%
	Total:	100%

Text Book and Reference Books

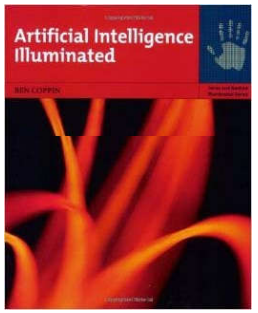
Text Book

- S. Russell, Artificial Intelligence: A Modern Approach, Prentice Hall, (4rd edition)

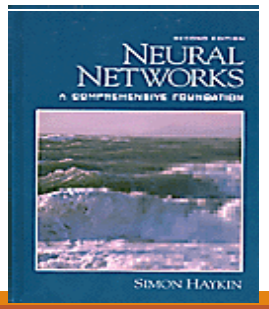


Reference books

- Ben Coppin, "Artificial Intelligence Illuminated", Jones and Bartlett illuminated Series, 2004



- Simon Haykin, "Neural Networks: A Comprehensive Foundation", Prentice Hall, 1999



Consulting Hours

Contact at:

Email: **@nu.edu**

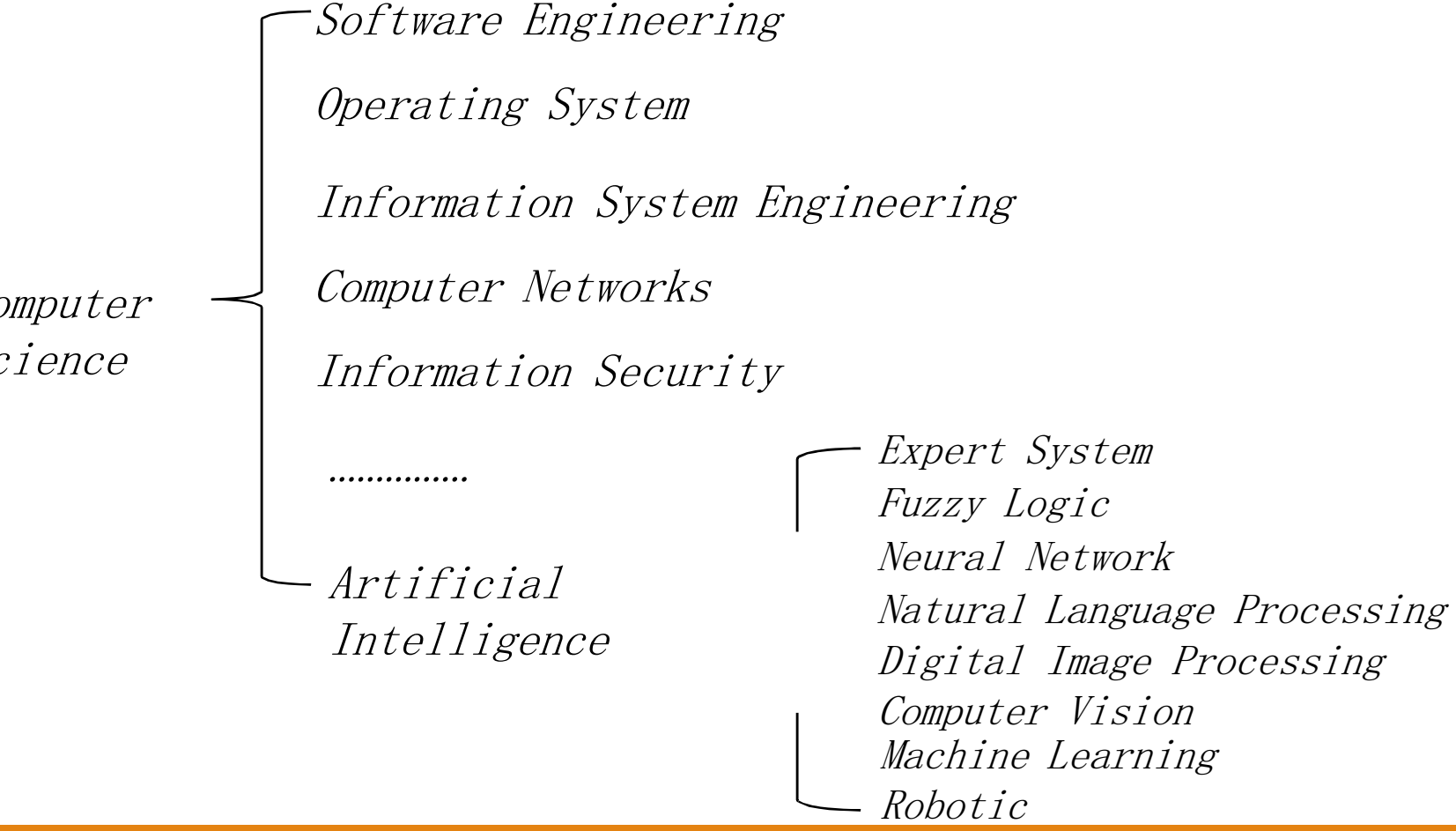
OR

Visit my Office:

Faculty Office 3, Block D

OFF Days: Sat, Sun

Position of Artificial Intelligence in Computer Science



Introduction to Artificial Intelligence

What is Intelligence?

Ability to plan, solve problems, give reasoning.

Ability to make right decision given a set of inputs and variety of possible actions.

Introduction to Artificial Intelligence

- Artificial Intelligence is one of the newest sciences which emerged after the world war II.
- AI represents a big and open field.
- The name Artificial Intelligence was adopted for the first time in 1956. (Computational Intelligence)
- Artificial Intelligence can be viewed as a universal field: How to automate intellectual tasks?

Introduction to Artificial Intelligence

- Goal of Artificial Intelligence: Not only to *understand* how does mind work? but also how to *build* intelligent entities?
  - Engineering point of view:
    - Solve real-world problems using knowledge and reasoning
    - Develop concepts, theory and practice of building intelligent entities
    - Emphasis on system building
  - Scientific point of view:
    - Use computers as a platform for studying intelligence itself
    - Emphasis on understanding intelligent behavior.

Introduction to Artificial Intelligence

- What is artificial Intelligence?
  - Several definitions are available in the literature.

Thinking vs. Behavior

Model humans vs. Ideal standard (Rationality)

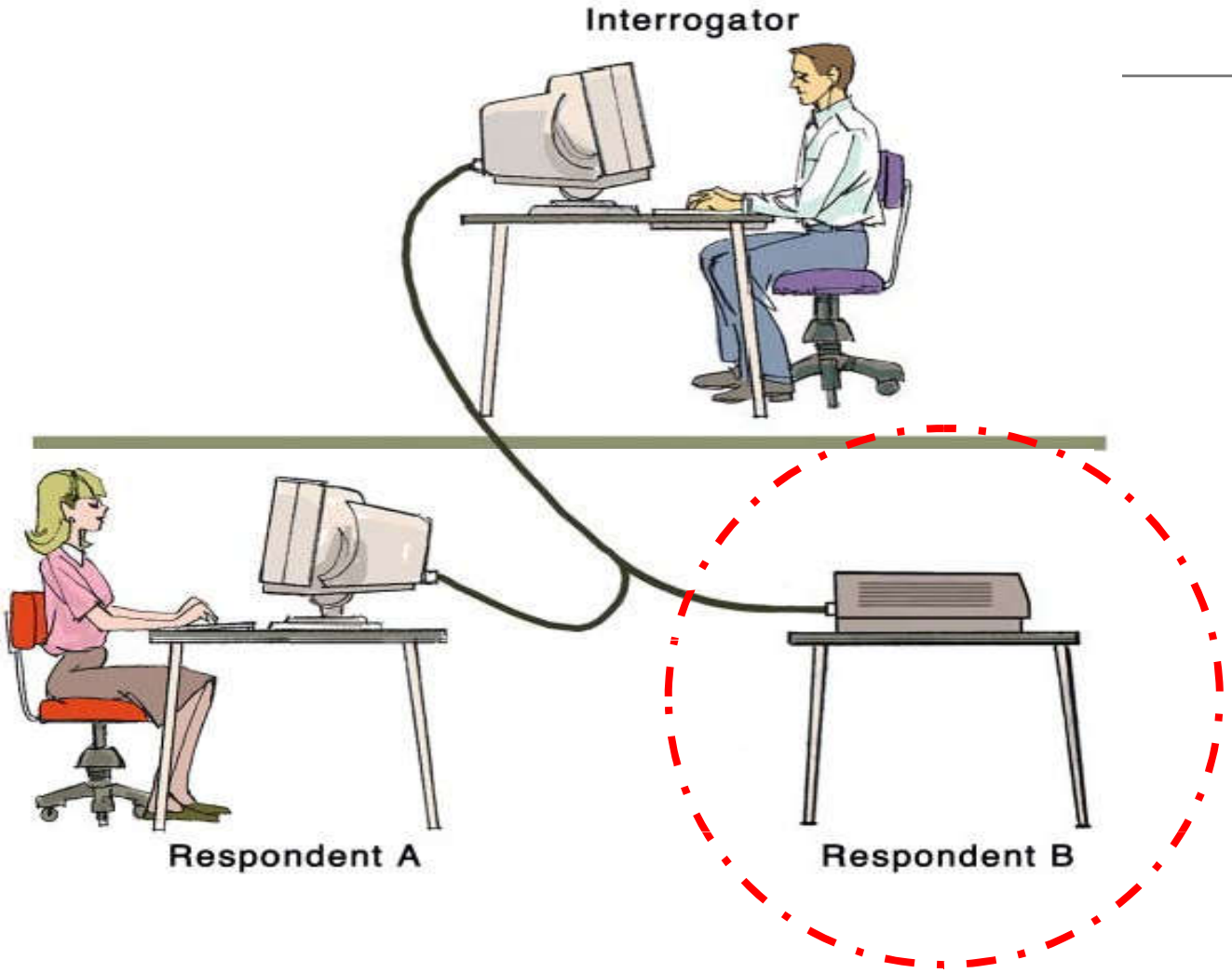
- Rational System = system which does the "right thing" given what it knows.

Introduction to Artificial Intelligence

- Definitions fall into four categories:

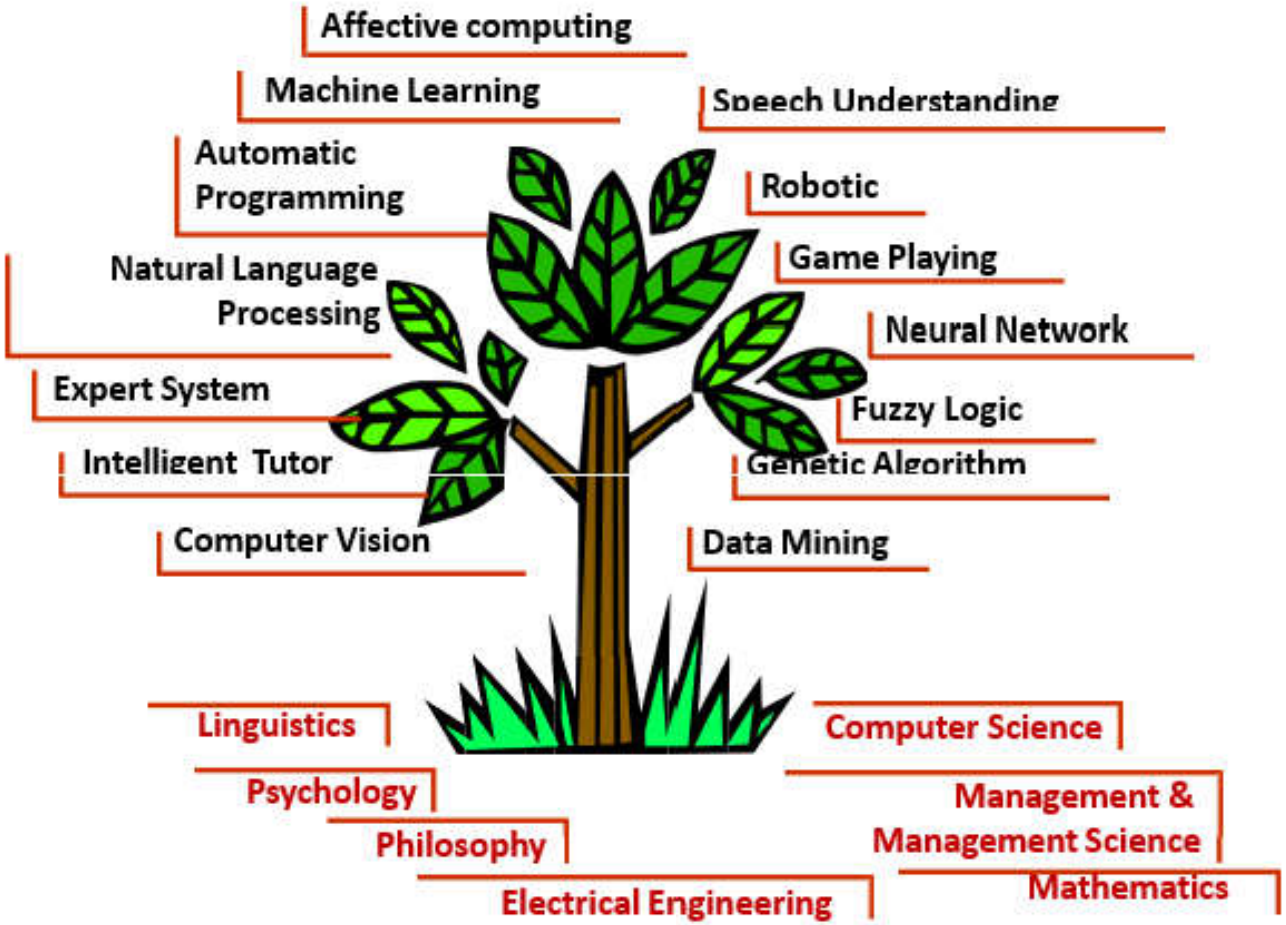
	Human models	Rationality
Thinking	"The exciting new effort to make computers think . . . **machines with minds**, in the full and literal sense." (Haugeland, 1985) "[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning . . ." (Bellman, 1978)	-The study of *mental* faculties through the use of *computational models*. (Charniak and Mcdermott, 1985) -The study of the computations that make it possible to perceive, reason and act. (Winston 1992)
Acting	-The art of creating machines that *perform* functions that require intelligence when performed by people. (Kurzweil, 1990) -The study of how to make computers *do things* at which, at the moment, *people* are better. (Rich and Knight, 1991)	-Computational intelligence is the study of the *design* of intelligent agents. (Poole et al.,1998). - AI...is concerned with intelligent *behavior* in artifacts. (Nilsson, 1998)

Introduction to Artificial Intelligence

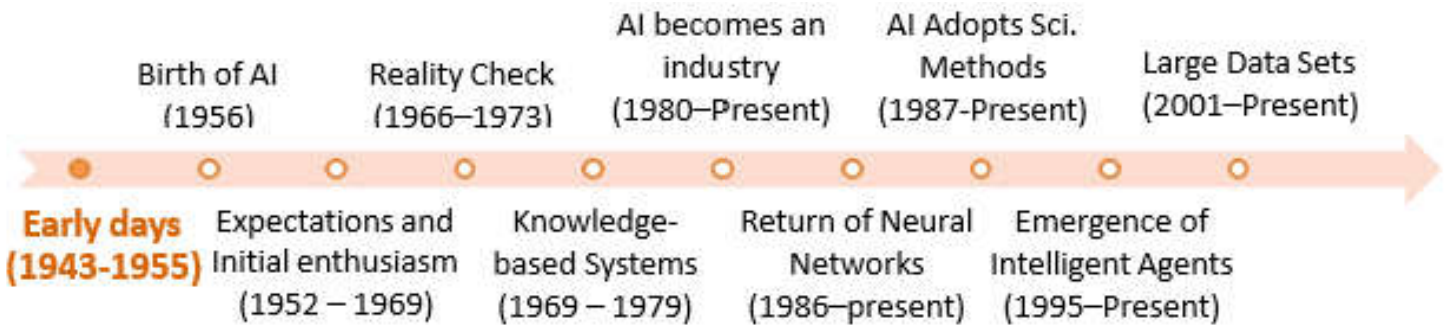


The Turing Test

Foundations of Artificial Intelligence



History of Artificial Intelligence



1943: *first* piece of AI work: Warren McCulloch and Walter Pitts

Model of artificial neurons.
Mathematical learnable functions that generate "on/off" depending on inputs (logic gates)
Any computable function can be computed by a network of connected neurons.
Suitably defined networks can learn.

1949: Hebbian learning

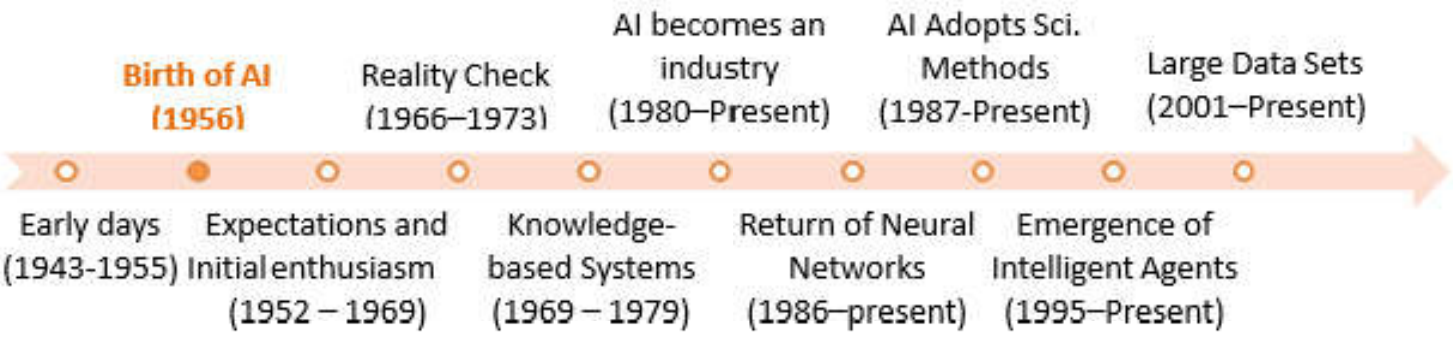
A mechanism for updating the connection strength of a neuron.
Today, neurologists have confirmed that something similar to Hebbian learning indeed is going on in our brain when we are learning.

1950: Turing test complete vision of AI in "computing machinery and Intelligence"

1951: first neural network computer

Implemented by M. Minsky and D. Edmonds

History of Artificial Intelligence



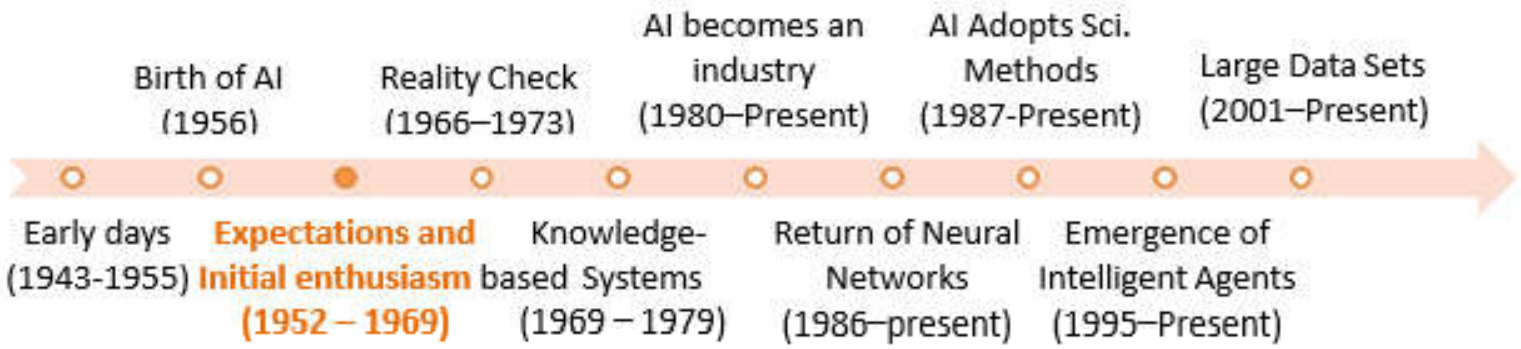
1956: Dartmouth Conference

Organized by John McCarthy and colleagues for starting a new area in studying computation and intelligence.

John McCarthy introduced the term "artificial intelligence" in the conference.

The next 20 years witnessed steady growth of the field led by the pioneers appeared in the Dartmouth conference.

History of Artificial Intelligence



1963: Thomas Evan's program ANALOG

Solved analogy problems in an IQ test.

1965: ELIZA

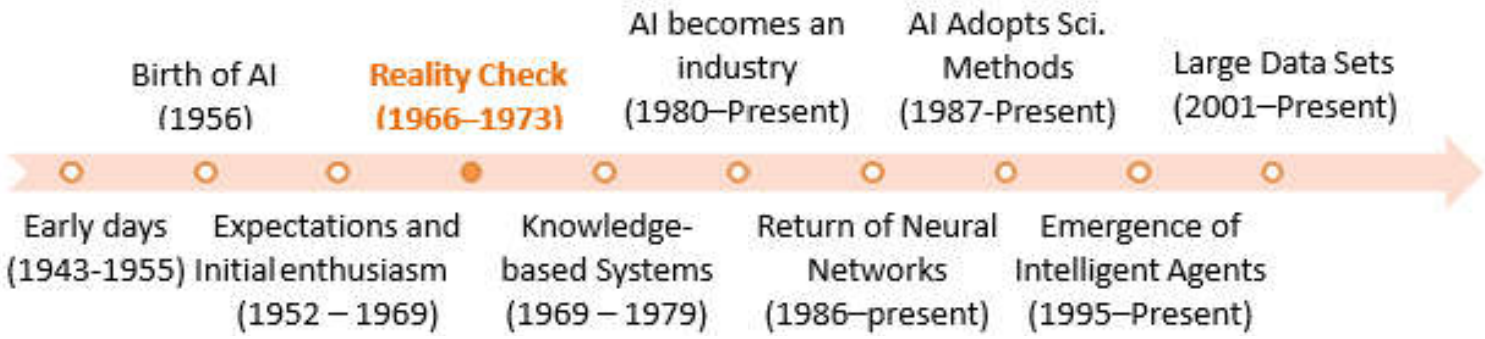
Simulates a dialog with a computer in English on any topic.

Became popular when programmed to simulate a psychotherapist (Fedora's Emacs).

1967: Dendral program (developed at Stanford)

- First successful program for scientific reasoning – one of the earlier rule based expert systems.
- A program that can infer molecular structures given the information provided by a mass spectrometer

History of Artificial Intelligence



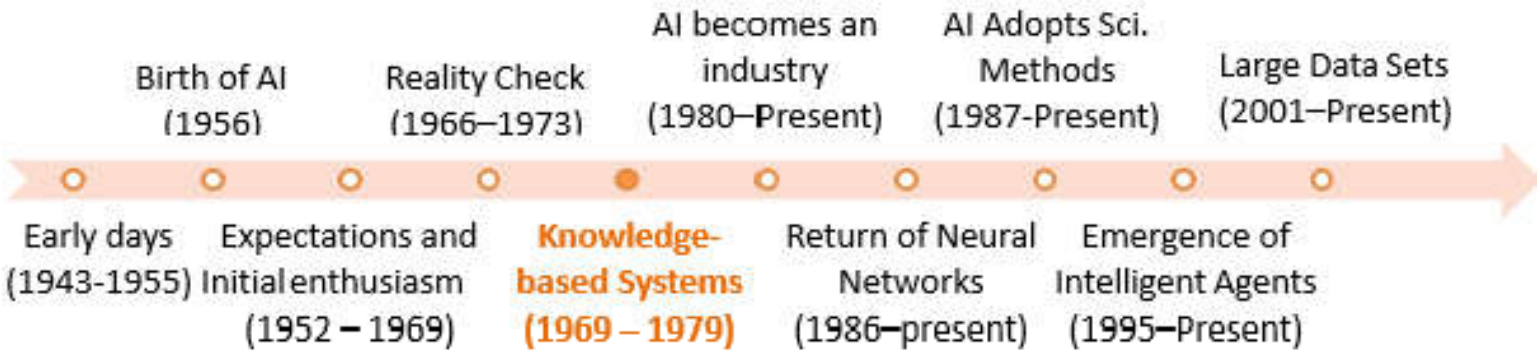
Series of disappointments and frustrations

AI was poured little buckets of "reality cold water"

Problems:

- Most early systems contain little or no knowledge of their subject matter
  - Example: Poor performance of earlier machine translation system (Russian ⇔English): "the spirit is willing but the flesh is weak" was translated to "the vodka is good but the meat is rotten".
- Computational Intractability of AI problems
  - Theory of computational complexity was not developed. Polynomial solvable problems, NP-completeness, etc
  - People thought a faster machine could solve any hard problem.

History of Artificial Intelligence

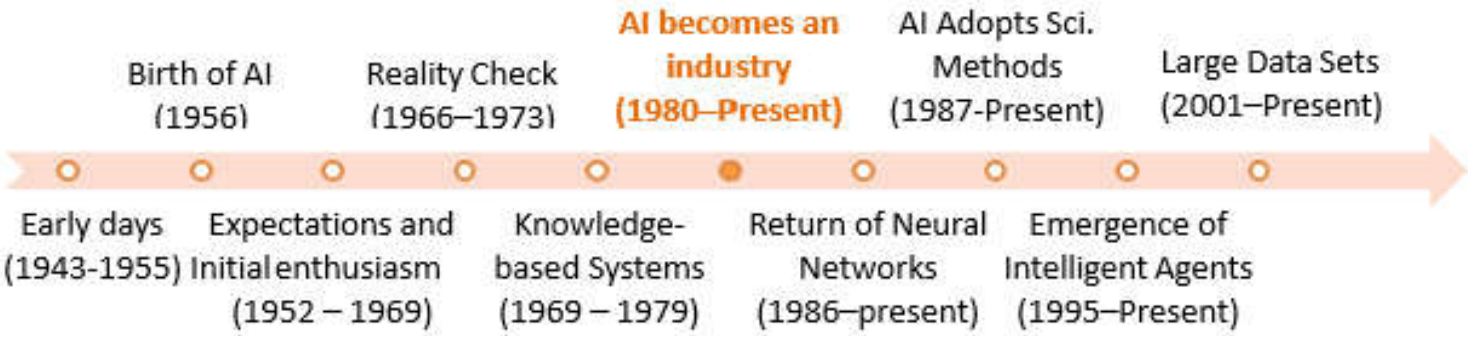


- **1971: T. Winograd's Ph.D. thesis (MIT)**
  demonstrated a system that can understand English in a micro-domain (the block world).

-**1972: PROLOG was developed**

- **1974: MYCIN was developed by Ted Shortliffe**
  Expert system for medical diagnosis. Sometimes called the first expert system.
- And many other works...

History of Artificial Intelligence



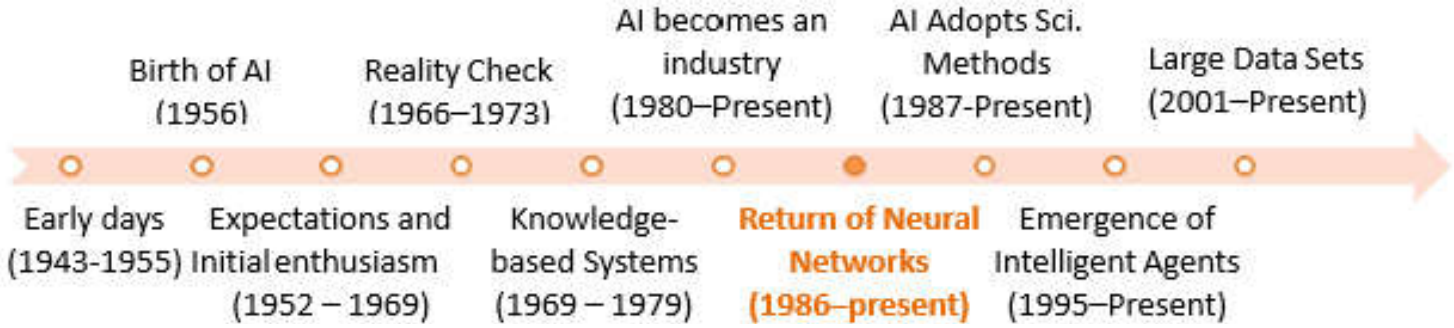
AI started to become industrially and commercially beneficial

- 1982: R1 was deployed at DEC – an expert system that saved the company around $40M / year
- Du Pont had 100 in use and an estimated 500 in development at late 90's to early 21st century

At an international level, AI was considered a part of a country's technological developments

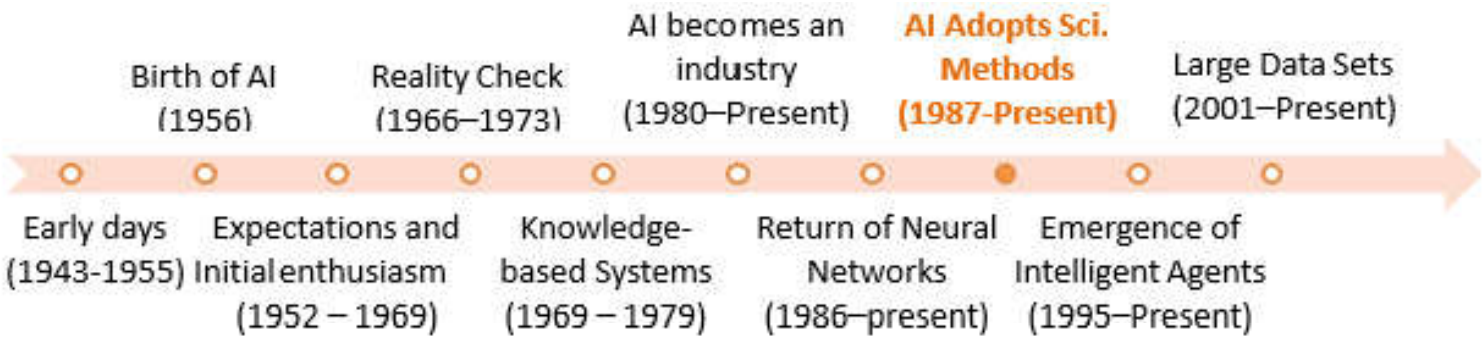
- Japan: "First Generation" project (10 year plan to build intelligence machines running in Prolog)
- USA: Microelectronics and Computer Technology Corporation (MCC) was formed in response
- Britain: Funding for AI was reinstated

History of Artificial Intelligence



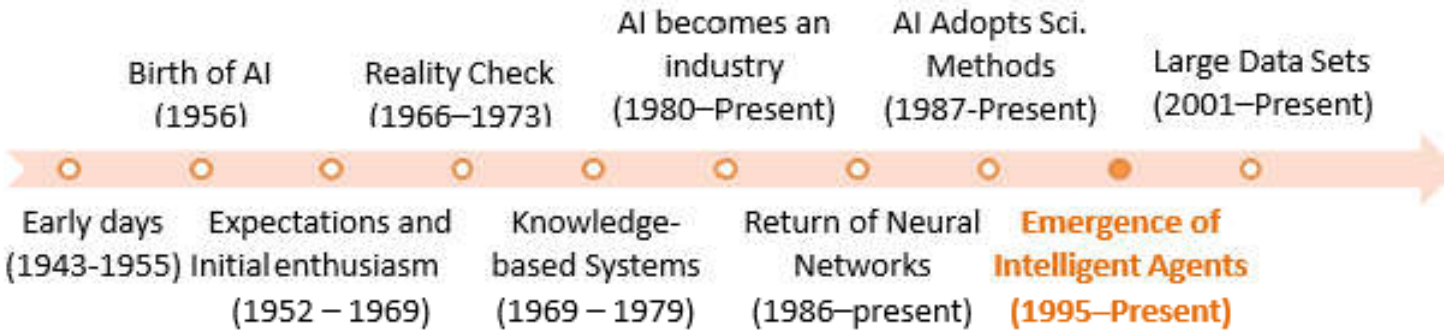
- In the mid-1980s at least four different groups reinvented the back-propagation learning algorithm first found in 1969 by Bryson and Ho.

History of Artificial Intelligence



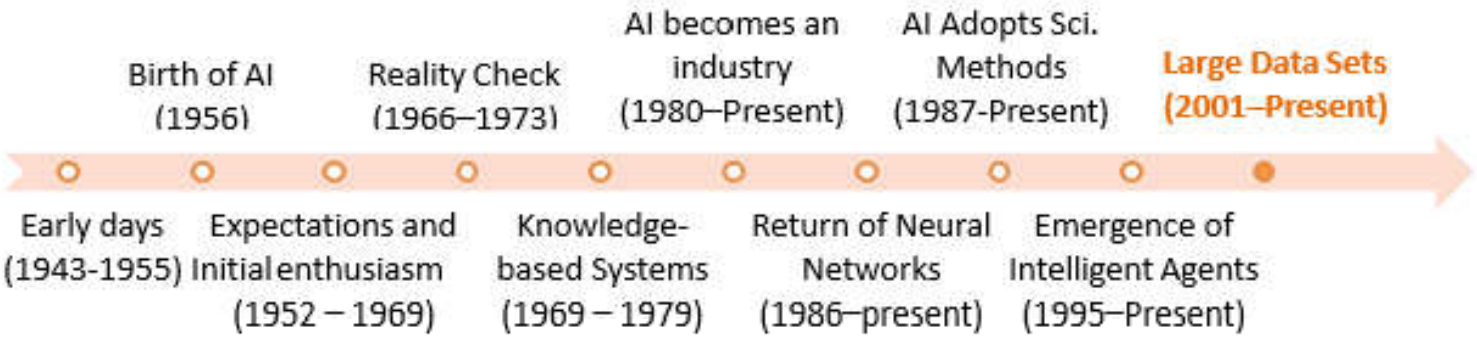
-Work of the physicist John Hopfield (1982) on using techniques from statistical mechanics.
-Connectionist models of intelligent systems competitor to the symbolic models (Newell and Simon) and logicist approach (McCarthy). (complementary approaches in fact).
- Several revolutions in many fields: pattern recognition, computer vision, robotics...
- Emergence of intelligent agents.

History of Artificial Intelligence



- The work of Allen Newell, John Laird, and Paul Rosenbloom on SOAR (Newell. 1990: Laird el al., 1987) is the best-known example of a complete agent architecture.
-AI technologies under lie many Internet tools, such as search engines, recommender systems, and Web site construction systems

History of Artificial Intelligence



-Data rather than which algorithm sometimes more important

-Billions of words, pictures, base pairs of genomic sequences, ...

-Yarowsky (1995) showed that a simple bootstrapping approach over a very large corpus could be effective for WSD (word-sense disambiguation). [e.g. plant]

-Perhaps the knowledge bottleneck will be solved by learning methods over very large datasets rather than by hand-coding knowledge.

Real Life Applications of AI & Data Science

- Marketing
- Finance
- Agriculture
- HealthCare
- Gaming
- Space Exploration
- Autonomous Vehicles
- Artificial Creativity

Real Life Applications of AI & Data Science

Marketing

AI generated content: An AI writing program called 'WordSmith' produced 1.5 billion pieces of content in 2016, and is expected to grow further in popularity in the coming years.

Smart Content Curation: Allows you to better engage visitors on your site by showing them content relevant to them. Cross selling, personalized messaging, recommendation etc.

Smart Search: Search engines read our minds and provide all possible results related to the item, Voice-search technology (Google, Amazon, Apple), Interpret consumer's queries -Chatbots.

Predictive analytics: Predicting the likelihood of a given customer to convert, predicting what price a customer is likely to convert at, or what customers are most likely to make repeat purchases. Propensity modeling.

Dynamic pricing: Dynamic pricing can nudge interested consumers into becoming customers by targeting only special offers only at those likely to need them in order to convert.

Real Life Applications of AI & Data Science
Banking & Finance

Recommendation Engines: In the banking sector, the system learns from the user's behavior. Based on the previous actions, it can recommend appropriate investment strategies, credit card plans, and make other offers that would save the user a lot of time browsing through the website.

Fraud Detection and Prevention: Based on self-learning artificial technology and real-time behavioral profiling, the system can detect suspicious behavior and prevent frauds.

Trading: Investment companies have been relying on computers and data scientists to determine future patterns in the market. As a domain, trading and investments depend on the ability to predict the future accurately.

Predictive analytics: Uses real-time and historical data to deliver precise information that helps traders to quote a better price when selling and buying bonds for their clients.

Real Life Applications of AI & Data Science

Agriculture

Forecasted Weather data: The forecasted/ predicted data help farmers increase yields and profits without risking the crop. By implementing such practice helps to make a smart decision on time.

Monitoring Crop and Soil Health: Utilizing AI is an efficient way to conduct, or monitor identifies possible defects and nutrient deficiencies in the soil. With the image recognition approach, AI identifies possible defects through images captured by the camera.

Decrease pesticide usage: With the help of the AI, data are gathered to keep a check on the weed which helps the farmers to spray chemicals only where the weeds are. This directly reduced the usage of the chemical spraying an entire field.

AI Agriculture Bots: AI bots in the agriculture field can harvest crops at a higher volume and faster pace than human laborers. By leveraging computer vision helps to monitor the weed and spray them.

Real Life Applications of AI & Data Science

Health Care

Medical Imaging: With AI in medical imaging, treatments can be personalized, and results can be transmitted with ease. Doctors can also efficiently identify cardiovascular disorders along with other fractures and injuries. Cancer cells detection, brain tumor detection, pneumonia detection etc. are few example.

Robot Assisted Surgery: In orthopedic surgery, a form of AI-assisted robotics can analyze data from pre-op medical records to physically guide the surgeon's instrument in real-time during a procedure. It can also use data from actual surgical experiences to inform new surgical techniques.

Automated Diagnosis and Error Reduction: In 2017, a group at Stanford University tested an AI algorithm against 21 dermatologists on its ability to identify skin cancers. The clinical findings, as reported by Nature last year, "artificial intelligence capable of classifying skin cancer with a level of competence comparable to dermatologists."

Virtual Nurses: To interact with patients, ask them questions about their health, assess their symptoms, and direct them to the most effective care setting. Molly, etc.

Real Life Applications of AI & Data Science

Gaming

AlphaGo: DeepMind's AlphaGo is the first computer program to defeat a professional human Go player (GrandMaster)

AlphaZero: AI beats champion chess program 'StockFish' after teaching itself in four hours.

Intelligent behaviors in characters: In video **games**, **artificial intelligence** (**AI**) is used to generate responsive, adaptive or **intelligent** behaviors primarily in non-player characters (NPCs) similar to human-like **intelligence**

Adversarial searches: Examples are Chess, Checkers, Go, etc.

Real Life Applications of AI & Data Science
Space Exploration

Spacecraft Monitoring and Control: Machine learning algorithms have been used in monitoring the spacecraft, autonomous navigation of the spacecraft, controlling systems, and intelligently detecting objects in the route

AI Based Assistants: AI-based assistants are being created to aid astronauts in their missions to Mars and beyond. These assistants are designed to understand and predicts the requirements of the crew and comprehend astronauts' emotions and their mental health.

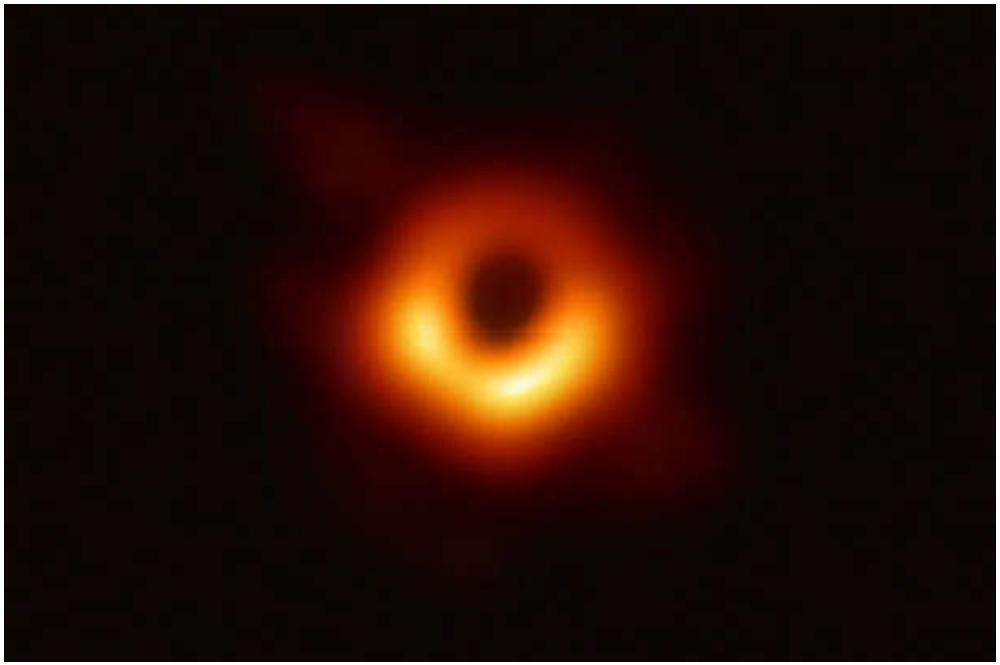
Space Imaging and Exploration: According to the European Space Agency (ESA), satellites can produce over 150 terabytes of data per day. With the use of AI technologies, one can reduce the mission costs, extend battery life, and can analyze a vast amount of imaging data produced by the satellites. Example: Earth Observer 1 (EO-1) satellite, SKICAT, ENVISAT etc.

With the help of Google's trained model, NASA also managed to discover two obscure planets — **Kepler-90i and Kepler-80g**.

The creation of the algorithm that made the **first black hole image** possible was led by MIT grad student **Katie Bouman**

Real Life Applications of AI & Data Science

Space Exploration (Continue..)



Real Life Applications of AI & Data Science

Autonomous Vehicles

Waymo: n April 2017, Waymo started a limited trial of a self-driving taxi service in Phoenix, Arizona. On December 5, 2018, the service launched a commercial self-driving car service called "Waymo One"; users in the Phoenix metropolitan area use an app to request a pick-up

Advanced Driver Assistance Systems (ADAS): Camera-based machine vision systems, radar-based detection units, driver condition evaluation and sensor fusion engine control units (ECUs).

Infotainment human-machine interface: Speech recognition and gesture recognition, eye tracking and driver monitoring, virtual assistance and natural language interfaces.

Real Life Applications of AI & Data Science
Artificial Creativity

ChatGPT: ChatGPT (Chat Generative Pre-trained Transformer) is a chatbot launched by OpenAI in November 2022. It is built on top of OpenAI's GPT-3 family of large language models, and is fine-tuned (an approach to transfer learning) with both supervised and reinforcement learning techniques.

- Question answer
- Solving math equations
- Writing texts (basic academic articles, literary texts, movie script, etc.)
- Interlingual translation
- Summarizing text and detecting keywords in text
- Classification
- Making recommendations
- Explaining what anything does (for example, explaining what a code block does)

Summary

- AI can help us to solve difficult, real-world problems, creating new opportunities in business, engineering, and many other application areas.
- The history of AI has had cycles of success, misplaced optimism, and resulting cutbacks in enthusiasm and funding. There have also been cycles of introducing new creative approaches and systematically refining the best ones.
- AI has advanced more rapidly in the past decade because of the greater use of the scientific method in experimenting with and comparing approaches.