

Introduction to Artificial Intelligence

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Intelligence vs Artificial Intelligence

- ❑ Intelligence is a property/ability attributed to people, such as to know, to think, to talk, to learn, to understand.

Intelligence = Knowledge + ability to perceive, feel, comprehend, process, communicate, judge, learn.

- ❑ Artificial Intelligence is an interdisciplinary field aiming at developing techniques and tools for solving problems that people are good at.



What's involved in Intelligence?

- Ability to interact with the world
 - Speech
 - Vision
 - Thinking
 - Decision making
 - Motion, etc.
- Ability to learn and to adapt
- Traditionally, AI is an effort to solve problems by applying knowledge and so we must answer these questions:
 - how do we *represent* knowledge
 - how do we *apply* that knowledge
 - often, the problems that we try to solve in AI require a lot of human knowledge – we may need access to human experts to acquire that knowledge and codify it.

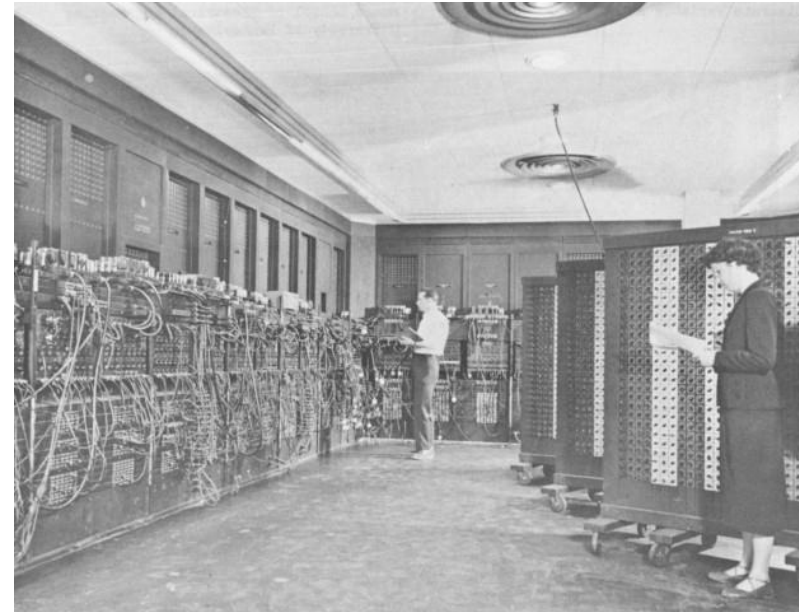
Goals of Artificial Intelligence

- **Scientific goal:** understand the mechanism behind human intelligence.
- **Engineering goal:** develop concepts and tools for building intelligent agents capable of solving real world problems. Examples:
 - **Knowledge-based systems:** capture expert knowledge and apply them to solve problems
 - **Common sense reasoning systems:** capture and process knowledge that people commonly hold which is not explicitly communicated.
 - **Learning systems:** have the ability to expend their knowledge based on the accumulated experience.
 - **Natural language understanding systems.**
 - **Intelligent robots.**
 - **Speech and vision recognition systems.**
 - **Game playing (IBM's Deep Blue)**

History of AI

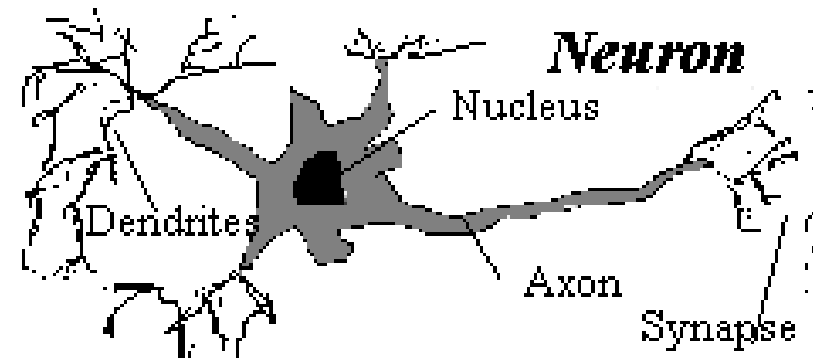
1941-First Electronic Computer

- ENIAC - Electronic Numerical Integrator and Computer
- Medium that made AI possible



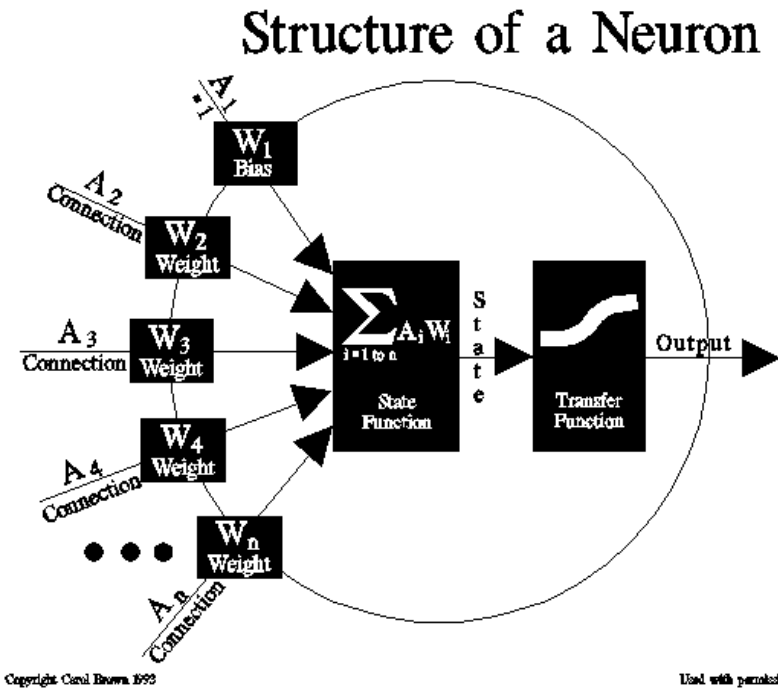
1943 – Neural Networks

- McCulloch & Pitts proposed a model of artificial neurons in 1943
- foundation: basic physiology of the brain
- each neuron either 'on' or 'off'



Neural Networks

- Switch to 'on' (response) if sufficient number of neighbors are 'on' (stimulus)
- Training - reading sample data and iteratively adjusting the network's weights to produce optimum predictions



Neural Networks

Results:

- Any computable function was shown to be computable by some network of connected neurons
- Suggested that suitably defined networks could learn

1950 – The Turing Test

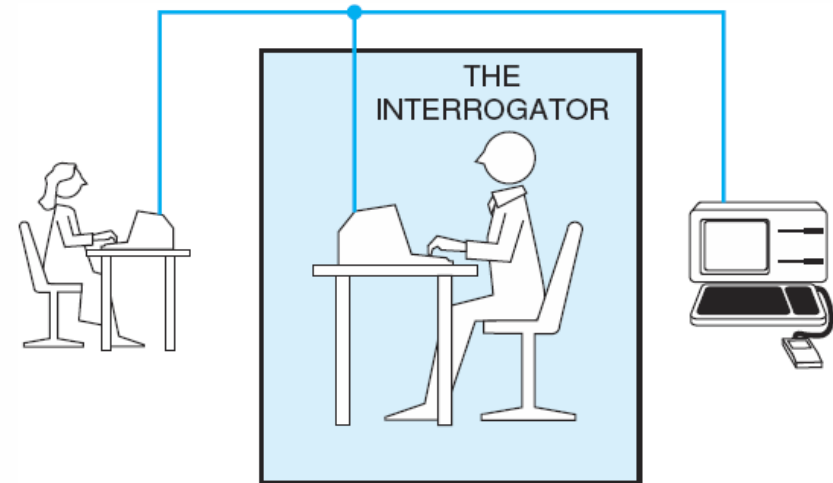
- Turing claimed that computers would in time acquire abilities equal to human intelligence.
- As part of his argument Turing put forward the idea of an ‘imitation game’ (Turing Test)
- An annual competition started by Dr. Hugh Gene Loebner in 1991- a \$100,000 prize is offered to the author of the first computer program to pass an unrestricted Turing test.



2009	David Levy	Do-Much-More
2010	Bruce Wilcox	Suzette
2011	Bruce Wilcox	Rosette ^[33]
2012	Mohan Embar	Chip Vivant ^[34]
2013	Steve Worswick	Mitsuku ^[35]
2014	Bruce Wilcox	Rose
2015	Bruce Wilcox	Rose
2016	Steve Worswick	Mitsuku ^[35]
2017	Steve Worswick	Mitsuku ^[35]
2018	Steve Worswick	Mitsuku ^[35]

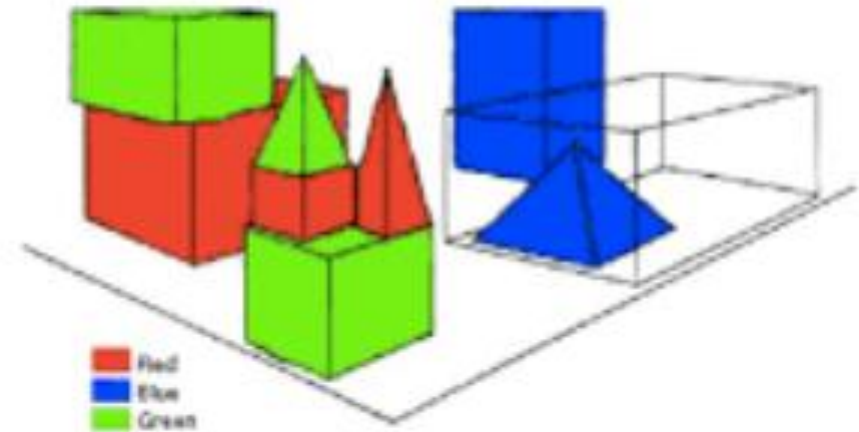
Turing Test

- An interrogator poses questions to two entities, a human and a computer
- If the interrogator cannot tell which is the human and which is the computer, then the computer passes the Turing Test and should be considered intelligent



1960's – AI Programs

- Weizenbaum's [ELIZA](#). –NLP Tool
- Colby's PARRY. –Chatbot
- Winograd's SHRDLU –NLP Tool by MIT



Person: Pick up a big red block.

Computer: OK.

Person: Grasp the pyramid.

Computer: I don't understand which pyramid you mean.

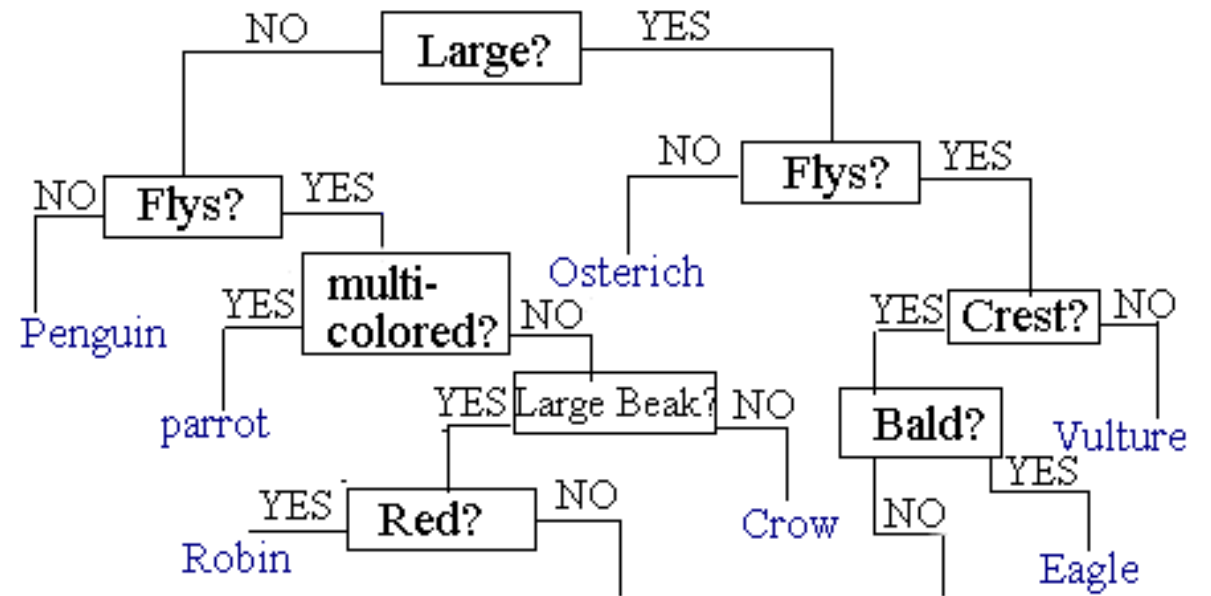
1963 – DARPA Grant



- In 1963 MIT received a 2.2 million dollar grant from the United States government to be used in researching Machine-Aided Cognition (artificial intelligence).
- Served to increase the pace of development in AI research

1970's - Expert Systems

- Example: A program to distinguish birds
- Predicts the probability of a solution using a database of knowledge
- Newer expert systems use fuzzy logic



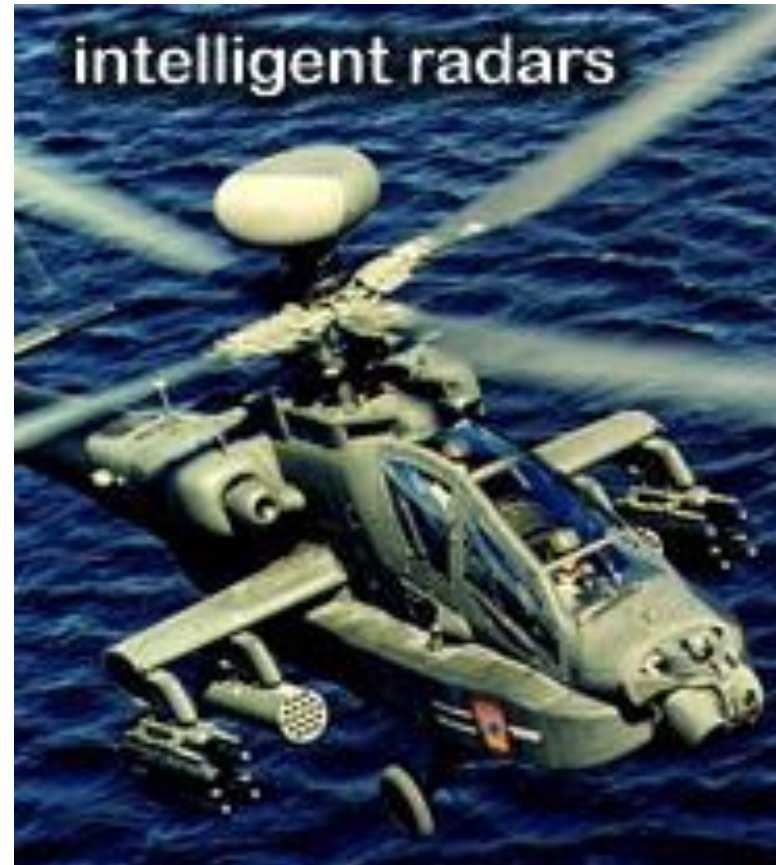
AI Being Incorporated in War (early 1990's)

- The Persian Gulf War proved the importance of AI research for military use.
- Cruise missiles were equipped with AI-related technologies such as Robotics and Machine Vision.



AI In The Military – 1990's

- **Determine whether the threat detected is in fact a threat**
- **Advanced autopilot**
- **Greatly decrease peacetime and wartime accidents**



1997 – Deep Blue Defeats Kasparov

- The IBM computer named Deep Blue was capable of processing 200 million chess positions per second
- Garry Kasparov - world chess champion, was defeated in the series 3.5 games to 2.5 games





Chess

In 1997, Deep Blue beat Gary Kasparov.



AI Programming Methods

Statistical Methods

- **Inferential Statistics:** Probability Distribution Functions, Random Variables, Sampling Methods
- **Hypothesis Testing:** Formulate and test hypotheses to solve business problems
- **Exploratory Data Analysis:** Summarize data sets and derive initial insights

Machine Learning

- **Linear Regression:** Implement linear regression and predict continuous data values
- **Supervised Learning:** Implement algorithms like Naive Bayes, KNN, SVM, Logistic Regression, etc.
- **Unsupervised Learning:** Create segments based on similarities using K-Means and Hierarchical clustering

Deep Learning

- **Information flow in a neural network:** Understand the components and structure of artificial neural networks
- **Training a neural network:** Learn the cutting-edge techniques used to train highly complex neural networks
- **Convolutional Neural Networks:** Use CNN's to solve complex image classification problems
- **Recurrent Neural Networks:** RNN's applications in text analytic
- **Creating and deploying networks using Tensorflow and keras:** Build and deploy your own deep neural, learn to use the Tensorflow API and Keras

Natural Language processing

- **Basics of text processing:** Get started with the Natural language toolkit, learn the basics of text processing in python
- **Lexical processing:** Learn how to extract features from unstructured text and build machine learning models on text data
- **Syntax and Semantics:** Conduct sentiment analysis, learn to parse English sentences and extract meaning from them
- **Other problems in text analytics:** Explore the applications of text analytics in new areas and various business domains

Reinforcement Learning

- **Reinforcement learning** (RL) is an area of **machine learning** concerned with how software agents ought to take actions in an environment so as to maximize some notion of cumulative reward.

AI Applications

AI Applications

Image Processing

- Image tagging / Image Recognition
- OCR or Optical Character Recognition
- Self-driving cars

Text Analysis

- Spam Filtering
- Sentiment Analysis
- Information Extraction

Data Mining

- Anomaly Detection
- Association Rules
- Grouping
- Predictions

Healthcare

- Medical Diagnosis
- Imaging Diagnosis
- Oncology
- Drug Trials

Video Games

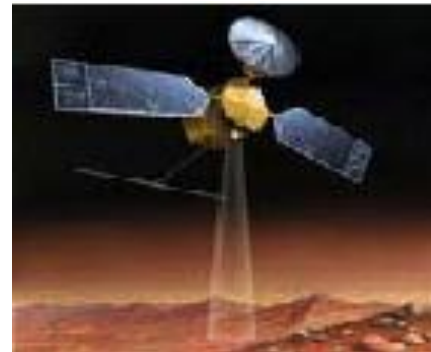
- Reinforcement Learning

Robotics

- Industrial tasks
- Human simulations

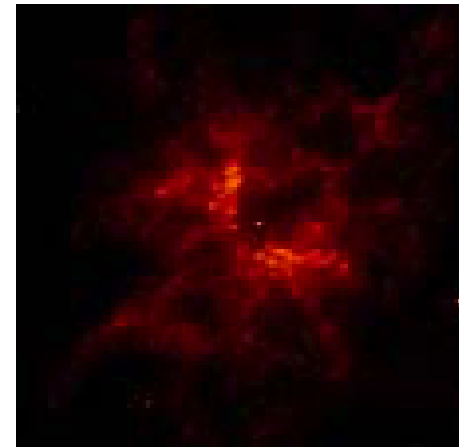
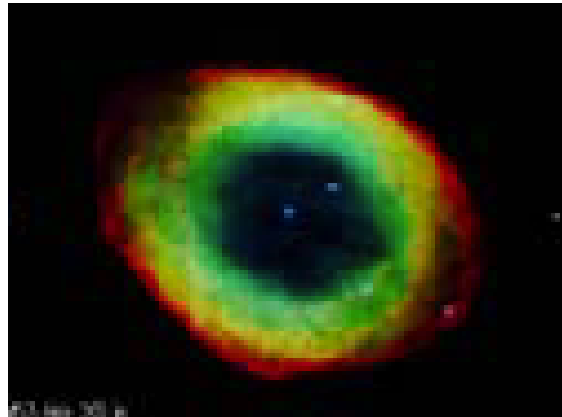
AI Applications

- Autonomous Planning & Scheduling:
 - Autonomous rovers.



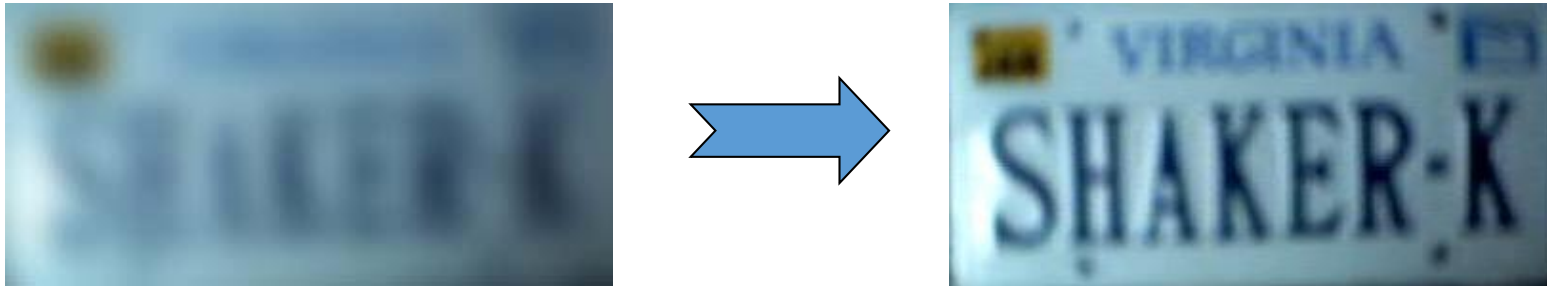
AI Applications

- Autonomous Planning & Scheduling:
 - Analysis of data:



AI Applications

- **Medicine:**
 - Image analysis and enhancement



AI Applications

- **Transportation:**
 - **Autonomous vehicle control:**



AI Applications

- **Transportation:**
 - **Pedestrian detection:**



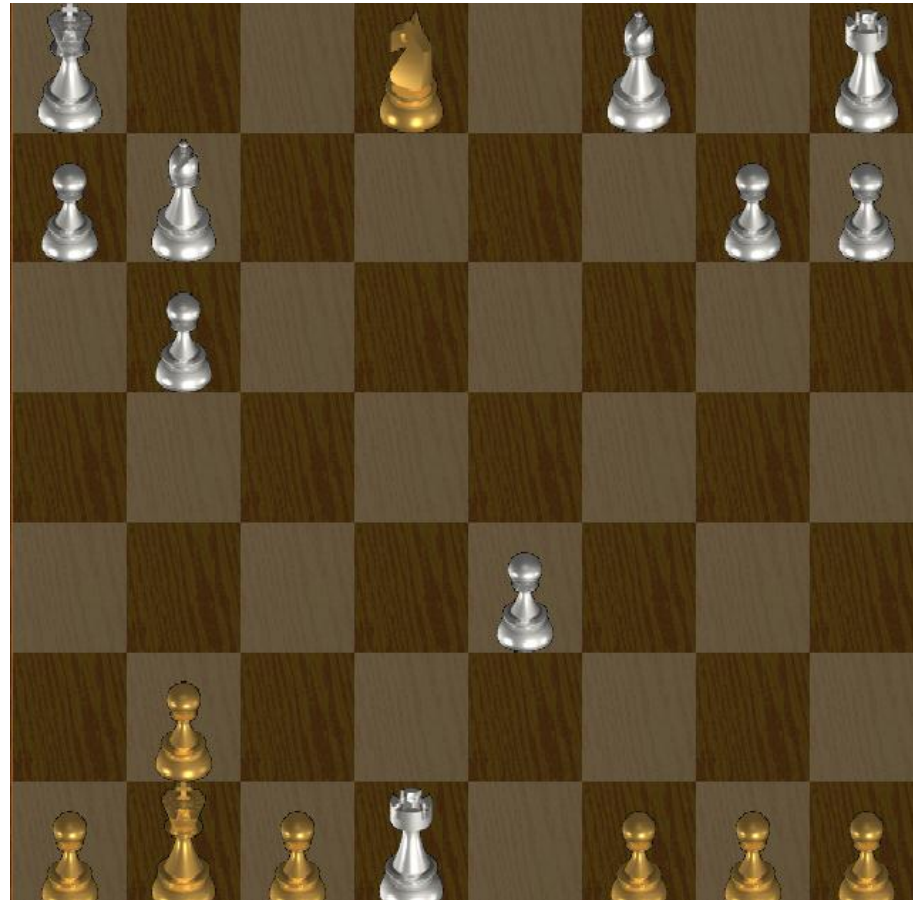
AI Applications

Games:



AI Applications

- **Games:**



AI Applications

- **Robotic toys:**



AI Winters

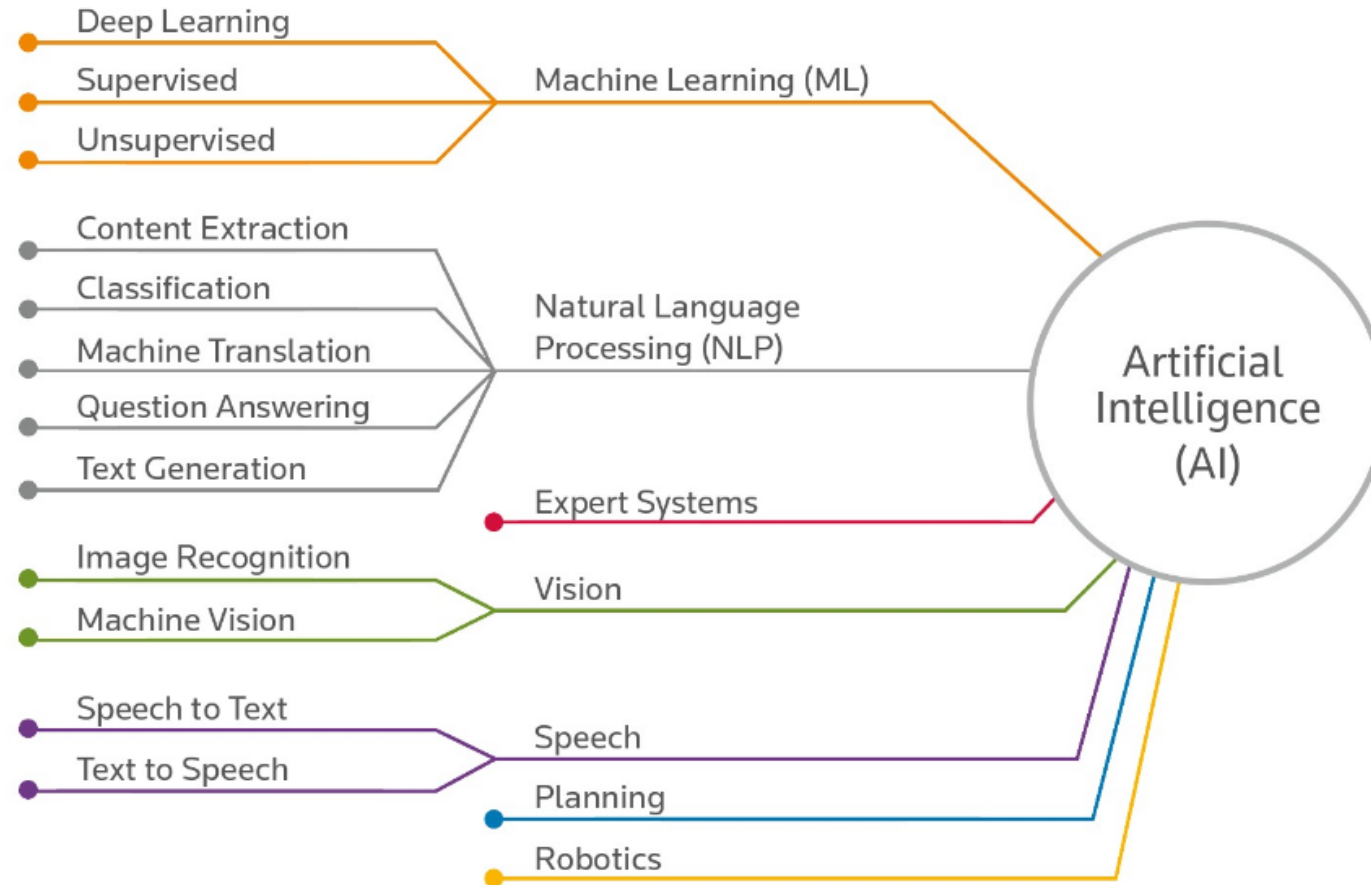
AI HAS A LONG HISTORY OF BEING "THE NEXT BIG THING" ...



Timeline of AI Development

- **1950s-1960s:** First AI boom - the age of reasoning, prototype AI developed
- **1970s:** AI winter I
- **1980s-1990s:** Second AI boom: the age of Knowledge representation (appearance of expert systems capable of reproducing human decision-making)
- **1990s:** AI winter II
- **1997:** Deep Blue beats Gary Kasparov
- **2006:** University of Toronto develops Deep Learning
- **2011:** IBM's Watson won Jeopardy
- **2016:** Go software based on Deep Learning beats world's champions

Artificial Intelligence Streams



Top 10 Hot Artificial Intelligence (AI) Technologies Today

- **Natural Language Generation:** Producing text from computer data. Currently used in customer service, report generation, and summarizing business intelligence insights. Sample vendors: Attivio, Automated Insights, Cambridge Semantics, Digital Reasoning, Lucidworks, Narrative Science, SAS, Yseop.
- **Speech Recognition:** Transcribe and transform human speech into format useful for computer applications. Currently used in interactive voice response systems and mobile applications. Sample vendors: NICE, Nuance Communications, OpenText, Verint Systems.

- **Virtual Agents** chatbots like Alexa to advanced systems that can network with humans. Currently used in customer service and support and as a smart home manager. Sample vendors: Amazon, Apple, Artificial Solutions, Assist AI, Creative Virtual, Google, IBM, IPsoft, Microsoft, Satisfi.
- **Machine Learning Platforms:** Providing algorithms, APIs, development and training toolkits, data, as well as computing power to design, train, and deploy models into applications, processes, and other machines. Currently used in a wide range of enterprise applications, mostly `involving prediction or classification. Sample vendors: Amazon, Fractal Analytics, Google, H2O.ai, Microsoft, SAS, Skytree

- **AI-optimized Hardware:** Graphics processing units (GPU) and appliances specifically designed and architected to efficiently run AI-oriented computational jobs. Currently primarily making a difference in deep learning applications. Sample vendors: Alluviate, Cray, Google, IBM, Intel, Nvidia.
- **Decision Management:** Engines that insert rules and logic into AI systems and used for initial setup/training and ongoing maintenance and tuning. A mature technology, it is used in a wide variety of enterprise applications, assisting in or performing automated decision-making. Sample vendors: Advanced Systems Concepts, Informatica, Maana, Pegasystems, UiPath.

- **Deep Learning Platforms:** A special type of machine learning consisting of artificial neural networks with multiple abstraction layers. Currently primarily used in pattern recognition and classification applications supported by very large data sets. Sample vendors: Deep Instinct, Ersatz Labs, Fluid AI, MathWorks, Peltarion, Saffron Technology, Sentient Technologies.
- **Biometrics:** Enable more natural interactions between humans and machines, including but not limited to image and touch recognition, speech, and body language. Currently used primarily in market research. Sample vendors: 3VR, Affectiva, Agnitio, FaceFirst, Sensory, Synqera, Tahzoo.

- **Robotic Process Automation:** Using scripts and other methods to automate human action to support efficient business processes. Currently used where it's too expensive or inefficient for humans to execute a task or a process. Sample vendors: Advanced Systems Concepts, Automation Anywhere, Blue Prism, UiPath, WorkFusion.
- **Text Analytics and NLP:** Natural language processing (NLP) uses and supports text analytics by facilitating the understanding of sentence structure and meaning, sentiment, and intent through statistical and machine learning methods. Currently used in fraud detection and security, a wide range of automated assistants, and applications for mining unstructured data. Sample vendors: Basis Technology, Coveo, Expert System, Indico, Knime, Lexalytics, Linguamatics, Mindbreeze, Sinequa, Stratifyd, Synapsify.

Thank You