# Introduction to Artificial Intelligence

September 20th, 2019

# Overview

- Definitions
  - Intelligence
  - AI
  - Machine Learning

# What is Intelligence?

# What is Intelligence?

- Ability to acquire and apply knowledge and skills
- General Intelligence: Human level intelligence and reasoning

# What is Intelligence?

Broader views of AI fall into four categories:

- Thinking humanly
- Thinking rationally
- Acting Humanly
- Acting rationally

# Thinking humanly: cognitive modeling

- 1960s "cognitive revolution": information-processing psychology
- Requires scientific theories of internal activities of the brain
- How to validate? Requires
  - Predicting and testing behavior of human subjects (top-down)
  - Direct identification from neurological data (bottom-up)
- Both approaches (roughly, Cognitive Science and Cognitive Neuroscience) are now distinct from AI

# Thinking rationally: "laws of thought"

- Aristotle: what are correct arguments/thought processes?
  - Syllogisms: patterns for argument structures
  - Socrates is a man; all men are mortal; Socrates is mortal.
- Logicians in the 19$^{th}$ century developed a precise notation for statements about all kinds of objects in the world
- Problems:
  - It’s not easy to take informal knowledge and state it in the formal terms required by logical notation
  - There is a big difference between solving a problem “in principle” and solving it “in practice”

# Acting rationally: rational agent

- Rational behavior: doing the right thing
- The right thing: which is expected to maximize goal achievement, given the available information
- The rational-agent approach has two advantages
  - It's more general than the "laws of thought" because correct inference is just one of several possible mechanisms for achieving rationality
  - Second , it's more amendable to scientific development than approaches based on human behavior or human thought.
- One point to keep in mind: we will see before too long that achieving perfect rationality is not feasible in complicated environments

# What is Artificial Intelligence?

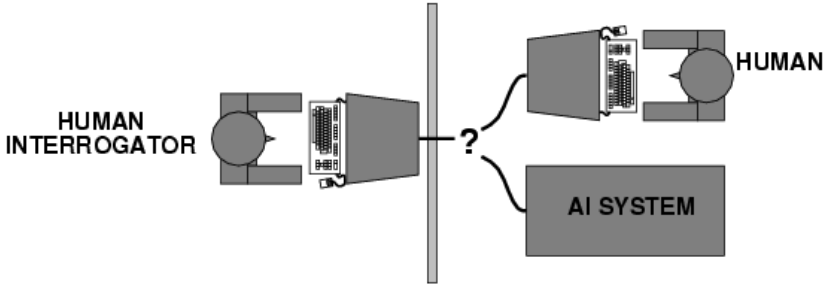
**I propose to consider the question, "Can machines think?"** - Alan Turing

# Alan Turing

- In 1950, the famous Turing test was born, according to the definition of "the father of artificial intelligence" Alan Turing: if a machine can talk to humans (via telex equipment) without being identified as a machine, then the machine is said to be intelligent.
- That same year, Turing also predicted the possibility of creating machines with real intelligence.

Alan Turing

# Turing Test



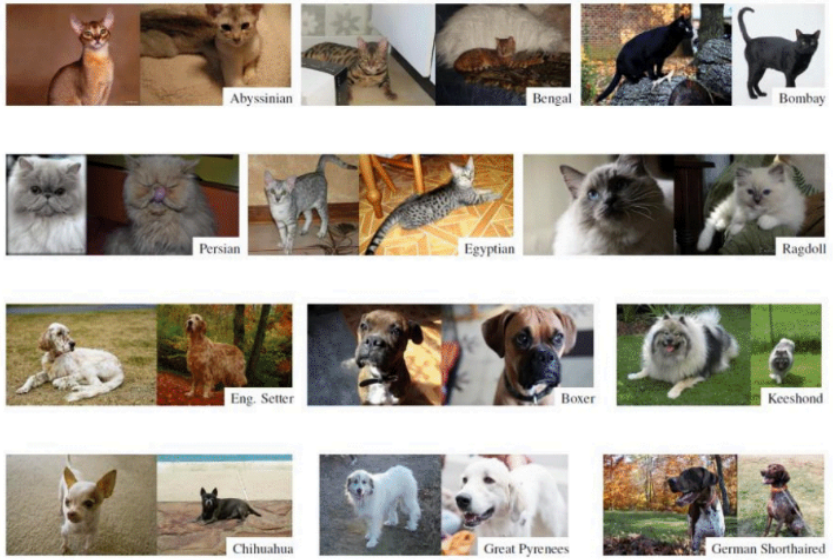

- Three rooms contain a person, a computer, and an interrogator.
- The interrogator can communicate with the other two by teleprinter.
- The interrogator tries to determine which is the person and which is the machine.
- The machine tries to fool the interrogator into believing that it is the person.
- If the machine succeeds, then we conclude that the machine can think.

# AI Achieved Tremendous Success in Last Decade

# Tremendous Amount of Data Available

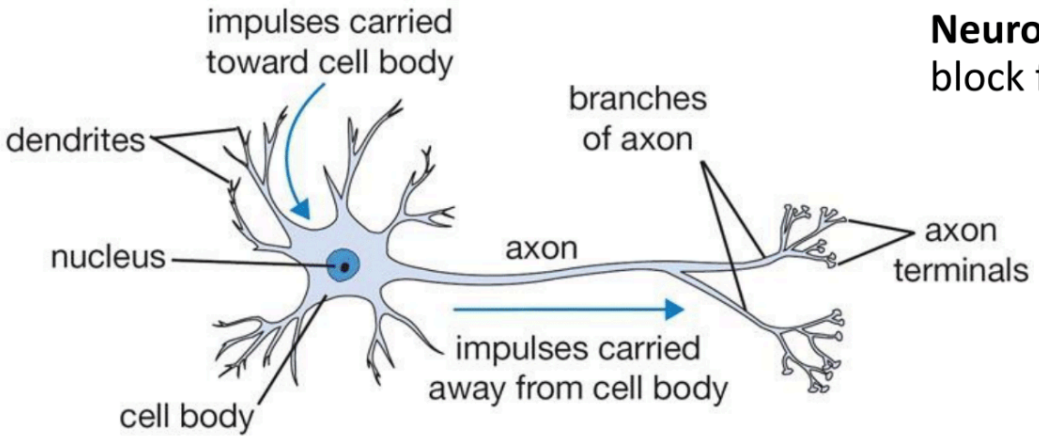
- We are generating more and more data
- There are great of labeled data available


14 Million Images and 1000 Categories

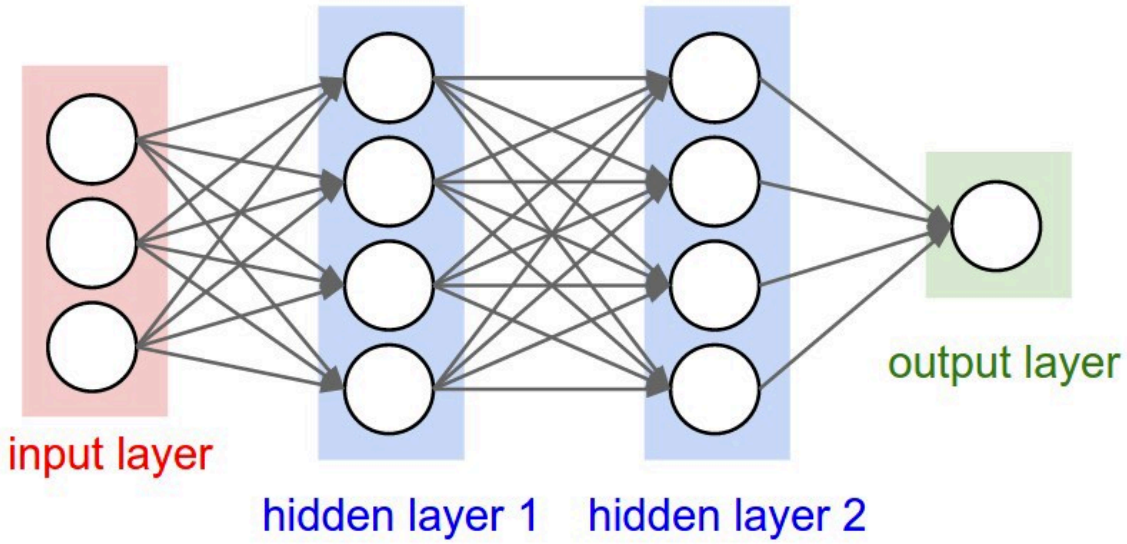



Many labeled data for each category

# Deep Learning Algorithms was Very Successful in Solving Problems

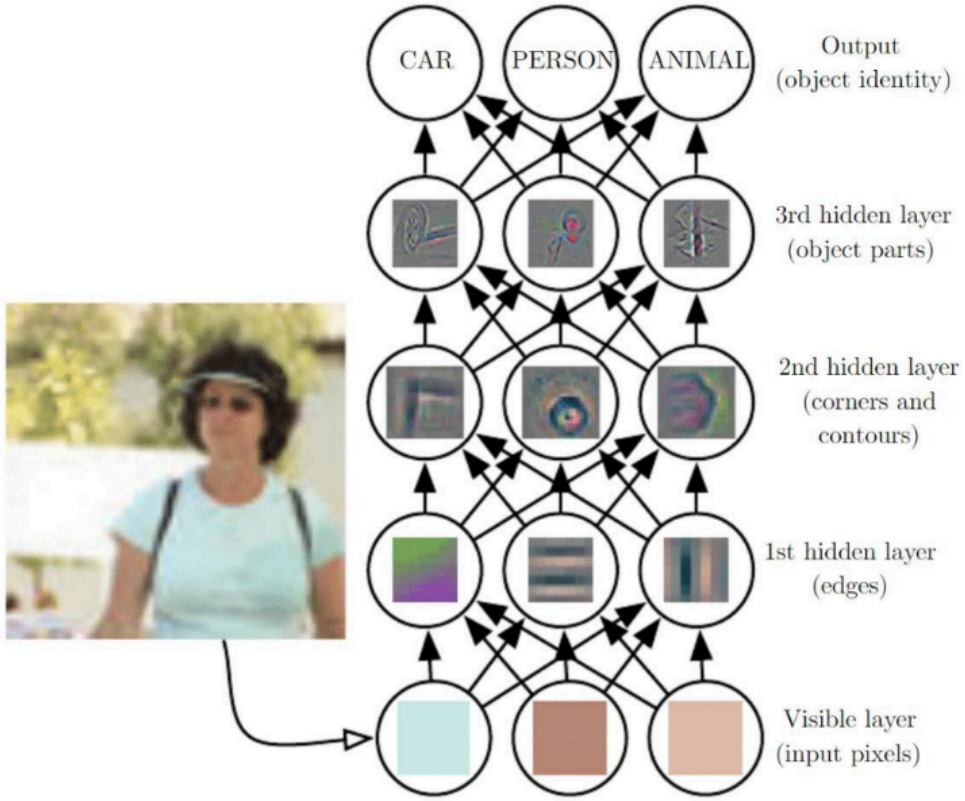


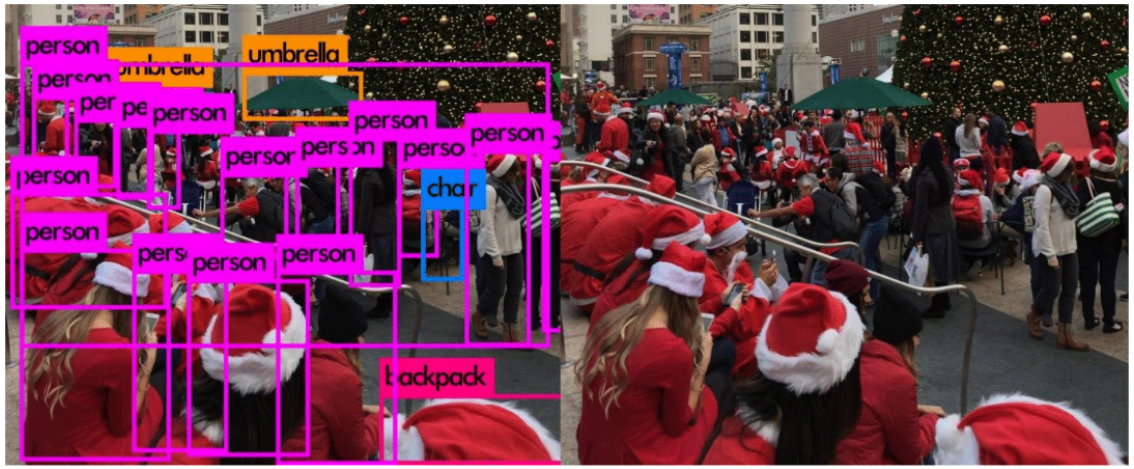

**Neuron:** computational building block for the brain




Artificial Neural Network

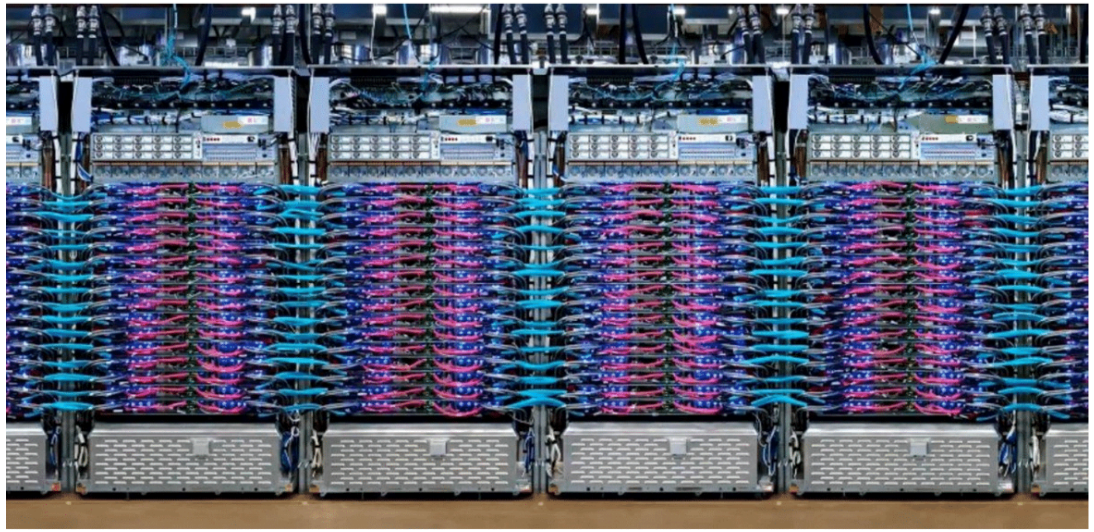
# Deep Learning Algorithms was Very Successful



# Computing Power Increase was Critical to Success of Deep Learning Algorithms

- CPU - General Purpose, serial, everyone has one
- GPU(Graphics Processing Unit) - Parallelizable, still general purpose
- TPU and Friends – Highly Parallelizable, specialized for AI
- Cloud Computing, Distributed Computing Tools (Hadoop, Spark)

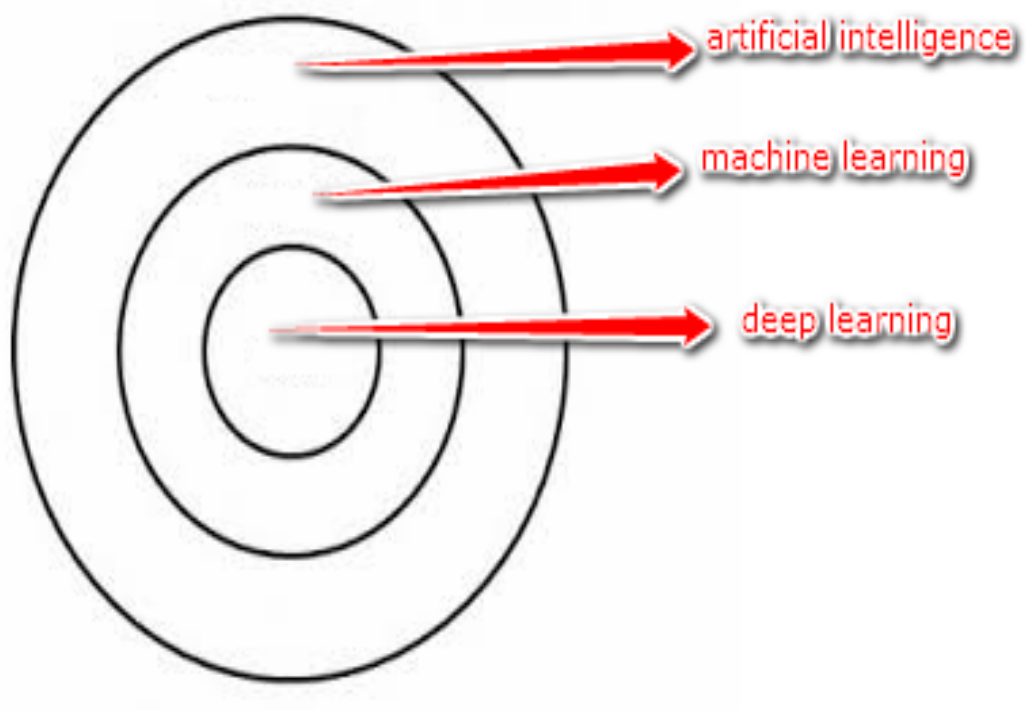
# Artificial Intelligence: Some Definitions

- Artificial Intelligence: The capacity of a computer to perform operations analogous to learning and decision making in humans.

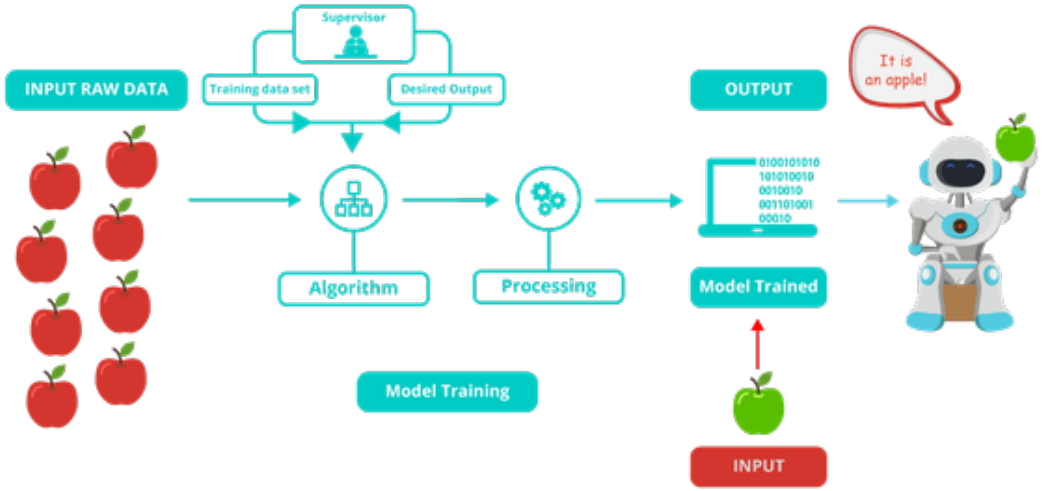
- Three Levels AI:
  - Artificial Narrow Intelligence – Specialized in **one** area
  - Artificial General Intelligence – Specialized in **all** areas
  - Artificial Super Intelligence – Smarter than humans in **every way**

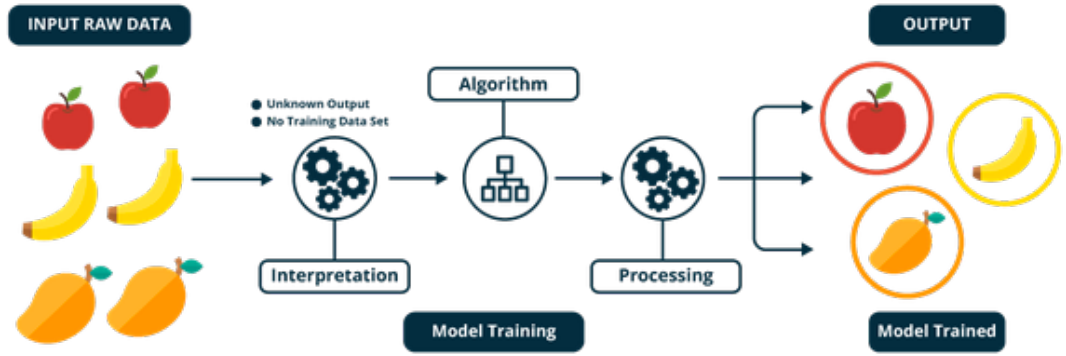
# Artificial intelligence: Some Definitions

- Artificial Intelligence (AI)
  - Aims to bring about intelligent behavior in machines
- Machine Learning (ML)
  - Enables machines to learn by themselves using the provided data and make accurate predictions
- Deep Learning (DL)
  - The next evolution of machine learning, inspired by the information processing patterns found in the human brain



# Some More Definitions: Supervised Learning and Unsupervised Learning



# Machine learning

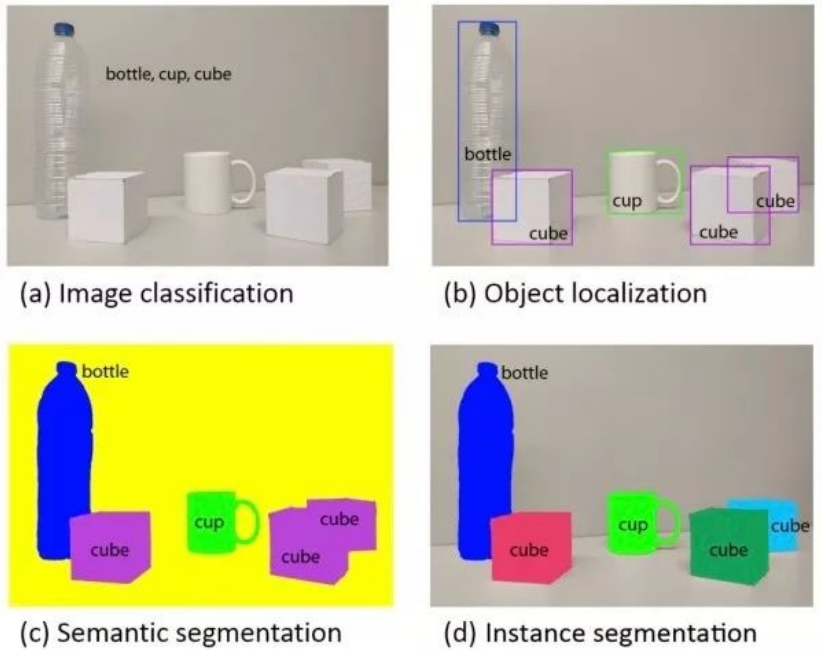
- How the computer simulates or implements human learning behavior in order to acquire new knowledge or skills, reorganize the existing knowledge structure and continuously improve its performance.

- Deep Learning
- Transfer Learning
- Reinforcement Learning

# Computer vision

- Computer vision is the science of how to make artificial systems "aware" from images or multidimensional data.

- Image Classification
- Object Localization
- Semantic Segmentation
- Instance Segmentation



# Natural language processing

- It studies various theories and methods which can realize effective communication between human and computer by natural language.

- Semantic analysis
- Speech recognition
- Language Translation
- Text-to-speech

# Robotics

- A robot is a machine that automatically executes the work. It can not only accept human command, but also run pre programmed programs, or act according to the principles and principles formulated by AI technology.

- Automation
- Reinforcement learning