# Artificial Intelligence

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# Thinking Machines

- Are there tasks which cannot easily be automated? If so, what are the limitations?

- How do computers abilities compare to that of humans?

# What is an AI?

# Computers versus humans

- A computer can do some things better than a human can
  - Adding a thousand four-digit numbers
  - Drawing complex, 3D images
  - Store and retrieve massive amounts of data

- However, there are things humans can do much better.

# Thinking Machines

A computer would have difficulty identifying the cat, or matching it to another picture of a cat.

# Computer or human?

- Which of the following occupations could (or should) be performed by computers?
  - Postman
  - Bookstore clerk
  - Librarian
  - Doctor
  - Lawyer
  - Judge
  - Professor

# Thinking Machines

**Artificial intelligence** (AI)

The study of computer systems that attempt to model and apply the intelligence of the human mind

For example, writing a program to pick out objects in a picture

# First things first…

- Of course, first we have to understand why we use the term “intelligence” in regard to humans.
  - What defines “intelligence”?
  - Why is it that we assume humans are intelligent?
  - Are monkeys intelligent? Dogs? Ants? Pine trees?

# Early History

- In 1950 English mathematician Alan Turing wrote a landmark paper titled “Computing Machinery and Intelligence” that asked the question: “Can machines think?”
- Further work came out of a 1956 workshop at Dartmouth sponsored by John McCarthy. In the proposal for that workshop, he coined the phrase a “study of artificial intelligence”

# Can Machines Think?

- So Turing asked: “Can machines think?” He felt that such machines would eventually be constructed.
- But he also realized a bigger problem. How would we know if we’ve succeeded?

# The Turing Test

## Turing test

A test to empirically determine whether a computer has achieved intelligence

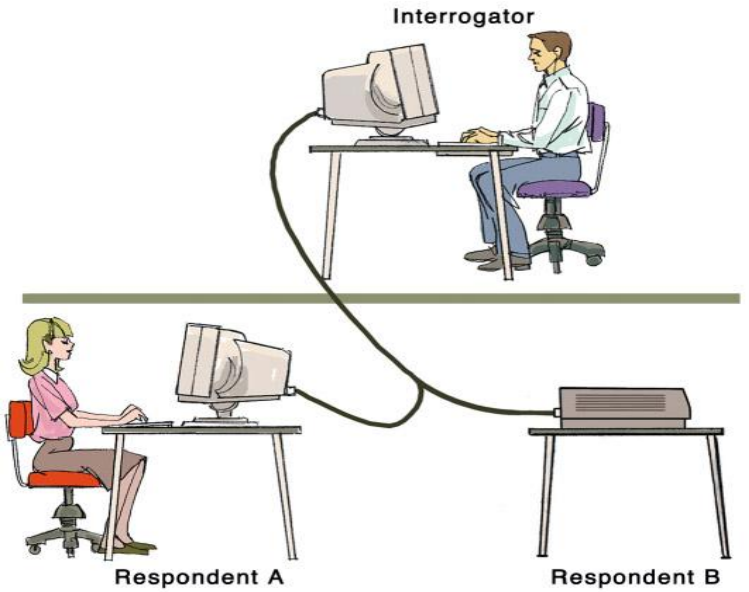



**Figure 13.2**
**In a Turing test, the interrogator must determine which respondent is the computer and which is the human**

# The Turing Test

- Passing the Turing Test does not truly show that the machine was thinking. It simply shows that it generated behavior consistent with thinking.
- **weak equivalence:** the two systems (human and computer) are equivalent in **results** (output), but they do not necessarily arrive at those results in the same way
- **Strong equivalence:** the two systems use the same internal processes to produce results

# The Turing Test

**Loebner prize**

The first formal instantiation of the Turing test, held annually

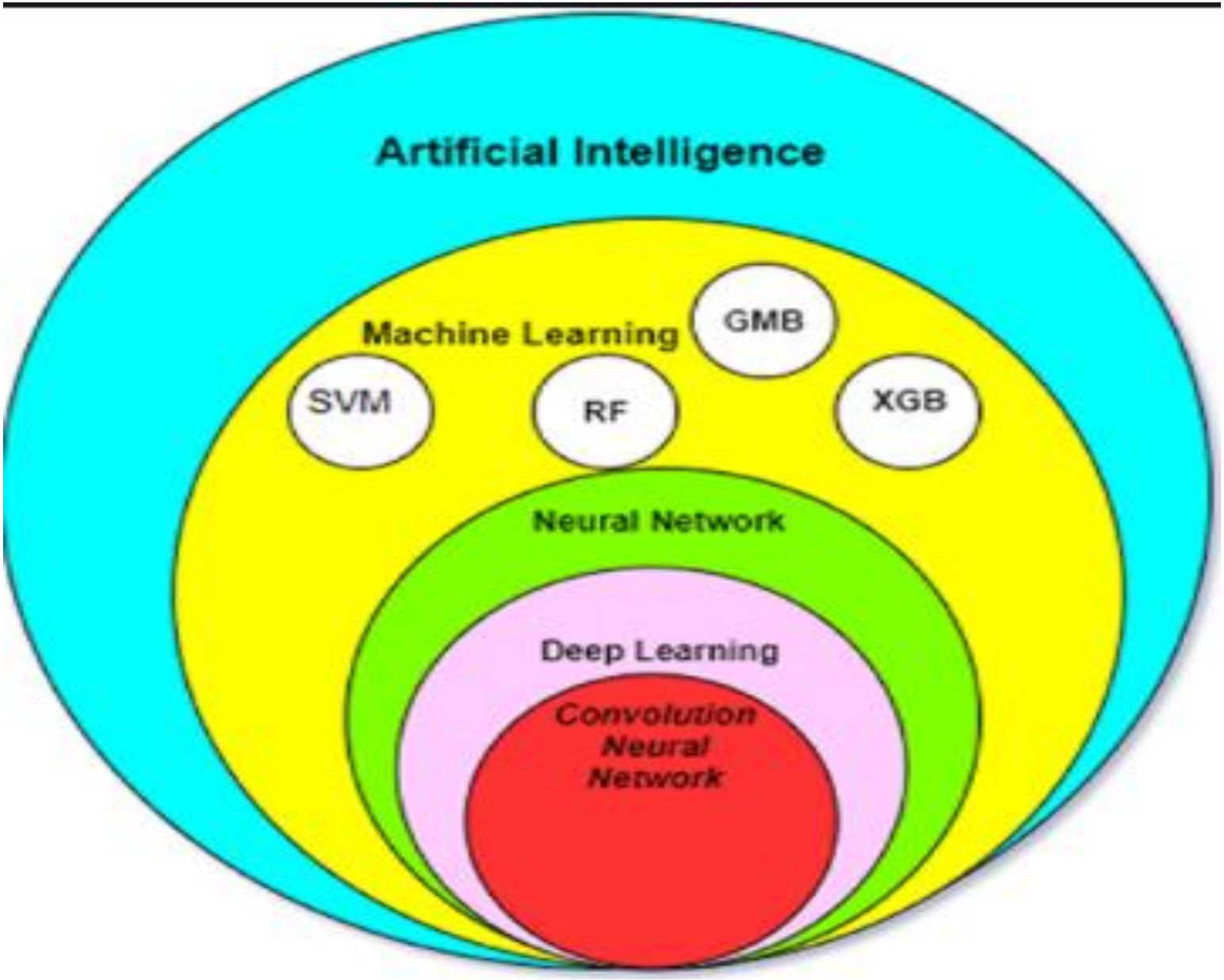

**Chatbots**

A program designed to carry on a conversation with a human user

# Knowledge Representation

- We want to compare the way that computers and humans work to see if we can better understand why each have their (computational) strengths.
  - Processing Models
  - Knowledge Representation
  - Reasoning

# INTRODUCTION TO Machine Learning

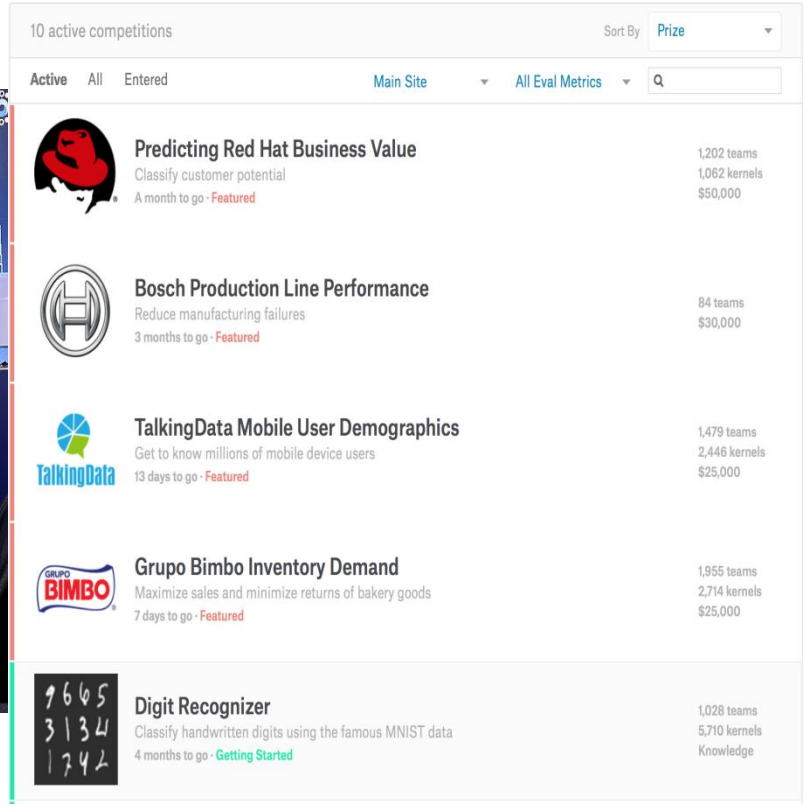

Artificial Intelligence
Machine Learning
GMB
SVM
RF
XGB
Neural Network
Deep Learning
Convolution Neural Network

# Machine Learning (ML)

- ML is a branch of artificial intelligence:
  - Uses computing based systems to make sense out of data
    - Extracting patterns, fitting data to functions, classifying data, etc
  - ML systems can learn and improve
    - With historical data, time and experience
  - Bridges theoretical computer science and real noise data.

# ML in real-life





# Big Data

- Widespread use of personal computers and wireless communication leads to “big data”
- We are both producers and consumers of data
- Data is not random, it has structure, e.g., customer behavior
- We need “big theory” to extract that structure from data for

  (a) Understanding the process

  (b) Making predictions for the future

# Why “Learn” ?

- Machine learning is programming computers to optimize a performance criterion using example data or past experience.
- There is no need to “learn” to calculate payroll
- Learning is used when:
  - Human expertise does not exist (navigating on Mars),
  - Humans are unable to explain their expertise (speech recognition)
  - Solution changes in time (routing on a computer network)
  - Solution needs to be adapted to particular cases (user biometrics)

# What We Talk About When We Talk About "Learning"

- Learning general models from a data of particular examples
- Data is cheap and abundant (data warehouses, data marts); knowledge is expensive and scarce.
- Example in retail: Customer transactions to consumer behavior:

  *People who bought "Blink" also bought "Outliers" (www.amazon.com)*

- Build a model that is *a good and useful approximation* to the data.

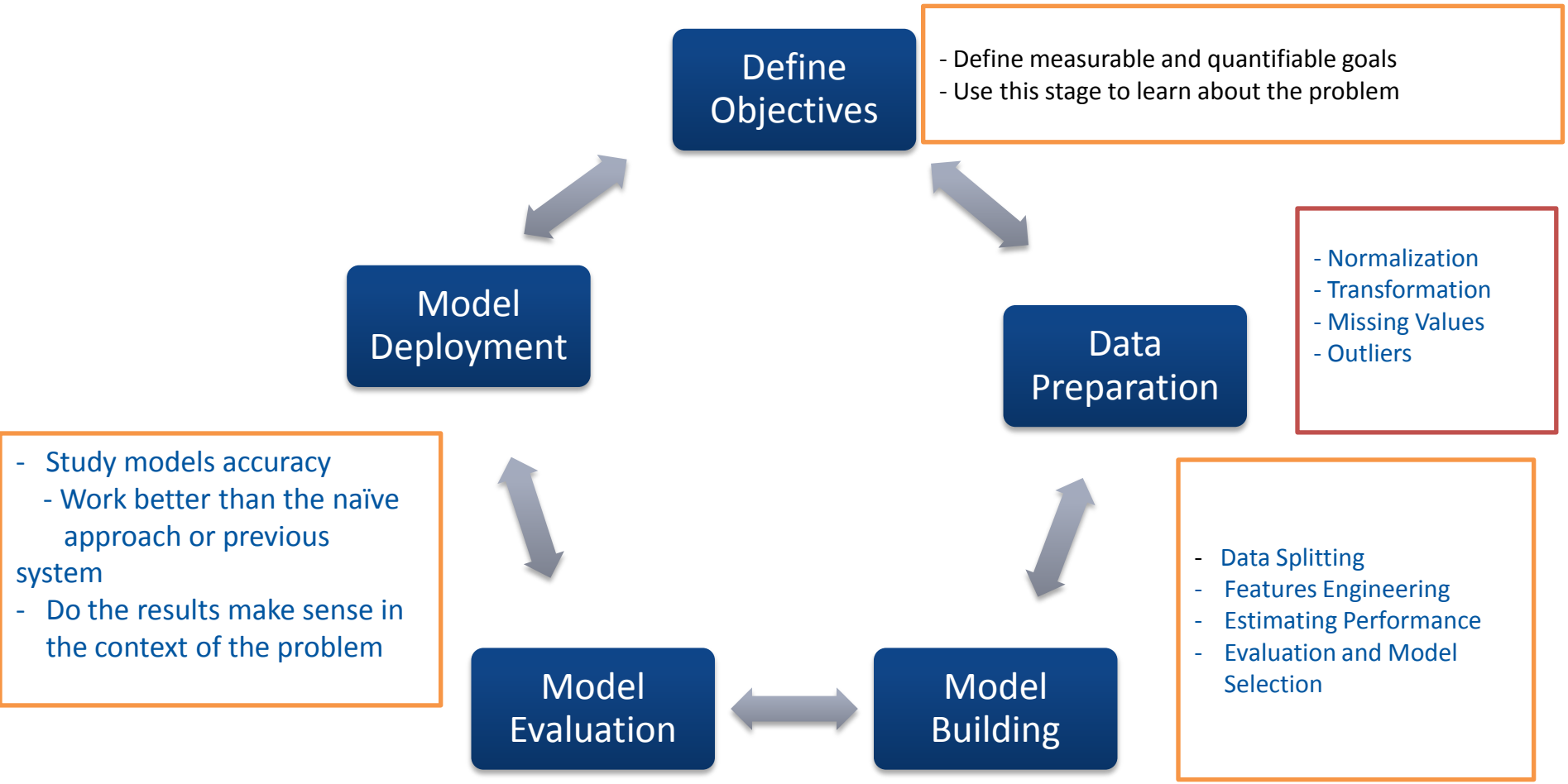
# Data Mining

- Retail: Market basket analysis, Customer relationship management (CRM)
- Finance: Credit scoring, fraud detection
- Manufacturing: Control, robotics, troubleshooting
- Medicine: Medical diagnosis
- Telecommunications: Spam filters, intrusion detection
- Bioinformatics: Motifs, alignment
- Web mining: Search engines
- …

# What is Machine Learning?

- Optimize a performance criterion using example data or past experience.
- Role of Statistics: Inference from a sample
- Role of Computer science: Efficient algorithms to
  - Solve the optimization problem
  - Representing and evaluating the model for inference

# Machine Learning as a Process



# Applications

- Association
- Supervised Learning
  - Classification
  - Regression
- Unsupervised Learning
- Reinforcement Learning

## ISSUES:

- Asking the wrong question
- Trying to solve the wrong problem
- Not having enough data
- Not having the right data
- Having too much data
- Hiring the wrong people
- Using the wrong tools
- Not having the right model
- Not having the right yardstick

# Challenges

- Not enough training data.
- Poor Quality of data.
- Irrelevant features.
- Nonrepresentative training data.
- Overfitting and Underfitting.