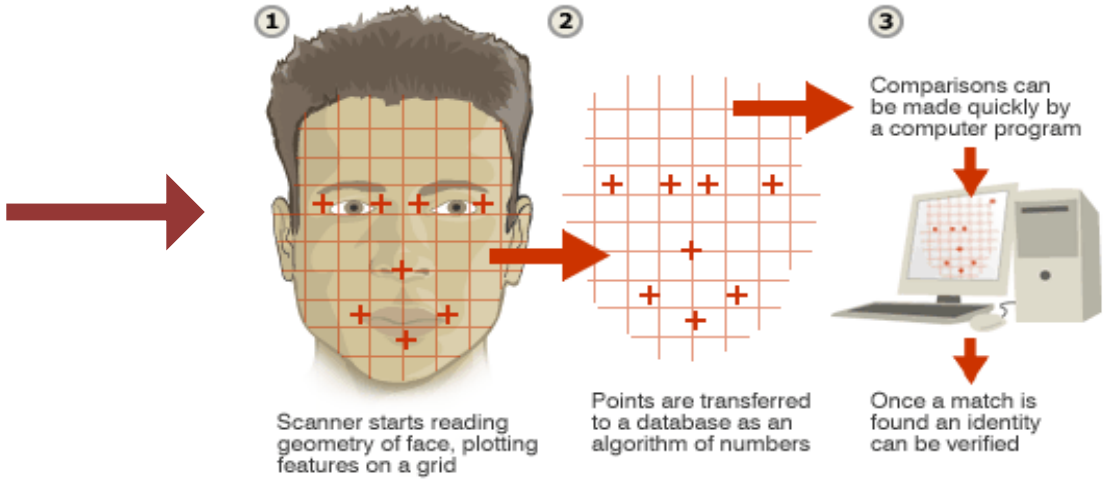
Artificial Intelligence 2

Pattern recognition

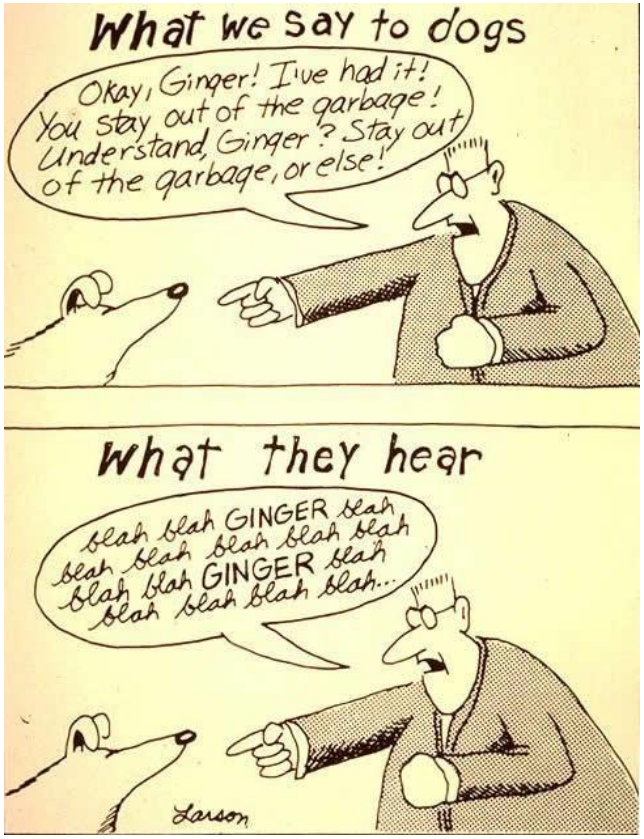
- Techniques that classify data (patterns) in an attempt to understand the data and take actions based on that understanding
  - A priori knowledge: Previous knowledge that does not get modified with new experiences
  - Statistical information extracted from the patterns
  - Example: Face recognition system – understanding pixels

A priori or statistical information based?



Natural language processing

- Branch of AI concerned with interactions and human languages
- **Natural Language**: Set of languages that humans use to communicate
- This problem is of strong equivalence
  - Ability to comprehend languages, extensive knowledge about the outside world and being able to manipulate it
  - **Voice recognition**: recognizing human words
  - **Natural language comprehension**: interpreting human communication
  - **Voice synthesis**: recreating human speech



Natural language comprehension

- Most challenging aspect!
  - Natural language is ambiguous – multiple interpretations
  - Understanding requires real world knowledge and syntactic structure of sentences
- Examples:

Time flies like an arrow

The pen is in the box

The box is in the pen

George: My aunt is in the hospital. I went to see her today and, took her flowers.

Computer: `George, that's terrible!`

Natural language comprehension

- **Lexical ambiguity**: Words have multiple meaning

  Time **flies** *like an arrow*

- **Syntactic ambiguity**: Sentences have more than one meaning

  The pen is in the box ← Makes sense

  The box is in the pen ← Makes no sense!

  George: My aunt is in the hospital. I went to see her today and, **took** her flowers.

  Computer: `George, that's terrible!`

- **Referential ambiguity**: Ambiguity created when pronouns could be applied to multiple object

  Ally hit Georgia and then ***she*** *started yelling*

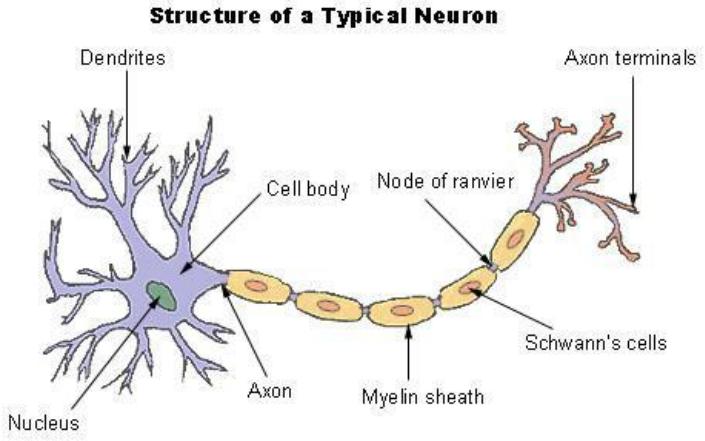
  Who started yelling? Ally, Georgia or someone else?

Natural language comprehension

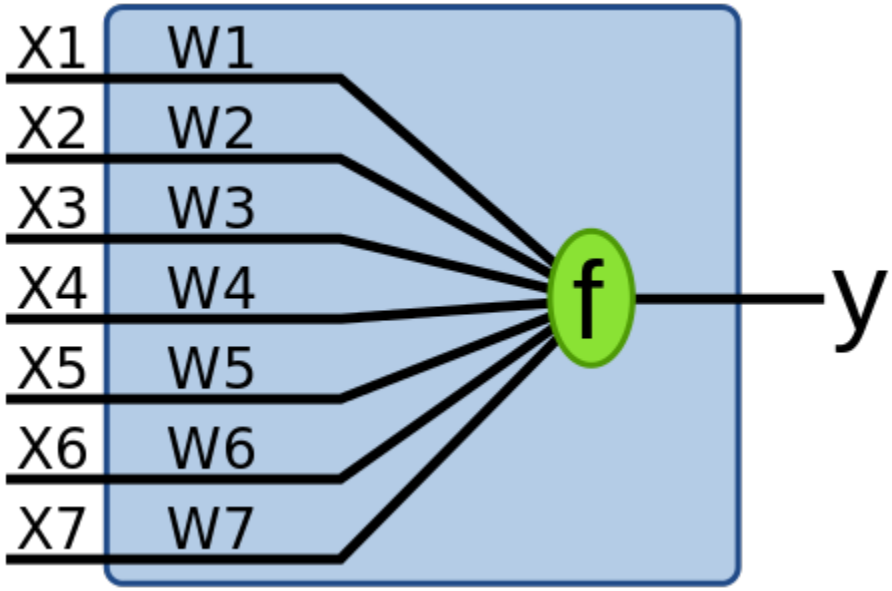
- Systems must have these common components:
  - **Lexicon**: vocabulary, word and expressions
  - **Parser/Syntax**: Text analyzer, inbuilt grammar rules, to form an internal representation of the text
  - **Semantic theory**: study of meaning and relationships between words, phrases
  - **Logical inference**: Process of drawing conclusions based on rules applied depending on observations or statistical models

Neurons

- Brain is made up of neurons
  - An electrically excitable cell that processes and transmits information by electrical and chemical signaling
  - An excited neuron conducts a strong signal and vice versa
  - A series of excited neurons form a strong pathway
  - A neuron receives multiple inputs from other neurons
    - Assigns a weight on each signal based on its strength
    - If enough signals are weak-> inhibited state or vice versa



Perceptrons

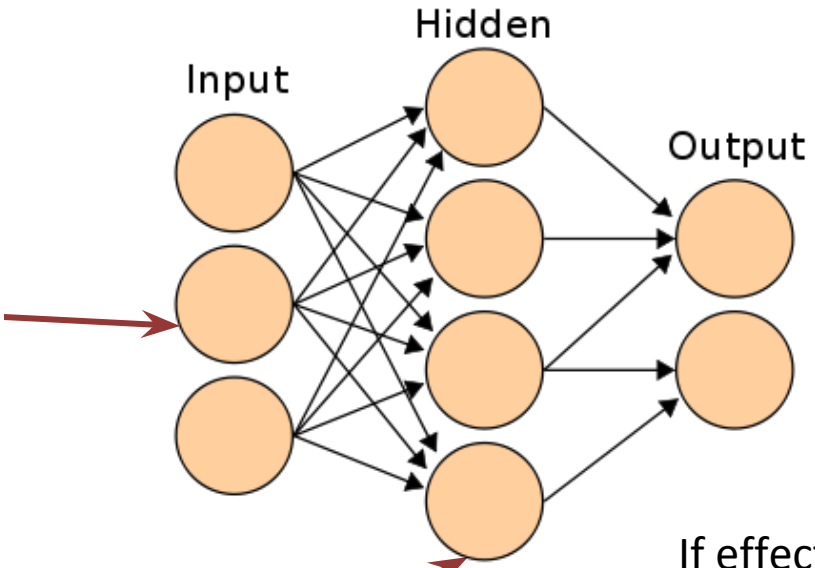


A model of a neuron. Some inputs multiplied by some weights to output a value 1 or 0

x1*w1 + x2*w2 + ... x7*w7 >= 0 then y = 1 else -1

Artificial Neural Networks

- A mathematical model inspired by the structure and/or functional aspects of biological neural networks



Artificial Neuron or Node
Inputs: 1 or 0

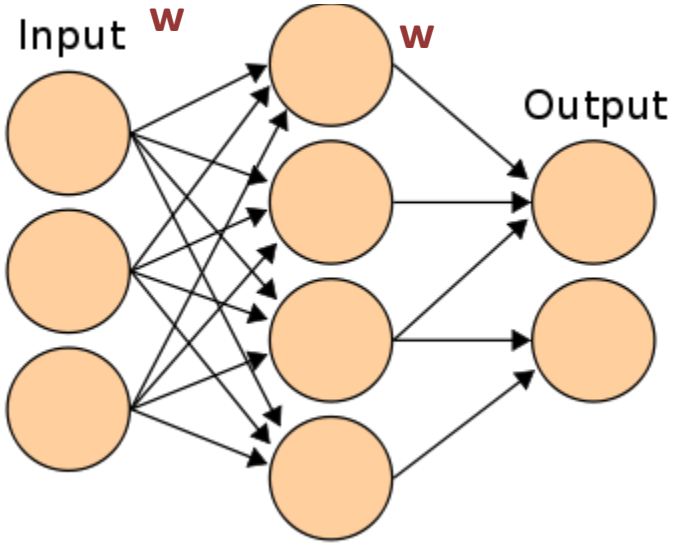
Receives many inputs
Assigned a numeric weight

If effective weight of each neuron is above a certain threshold, output is 1

Artificial neural networks

- **Training**: The process of adjusting the weights and threshold values
  - Series of comparisons to desired results

0	0	0	0	0	0
1	0	0	0	0	0
1	0	0	0	0	0
1	0	1	0	0	0
1	1	1	1	0	0
0	0	1	0	0	0
0	0	0	0	0	0



Artificial neural networks

- You can train a neural network to do anything
  - No inherent meaning to the weights: Making it versatile
- Applications:
  - Pattern recognition
  - Classification
  - Modeling how are brain works