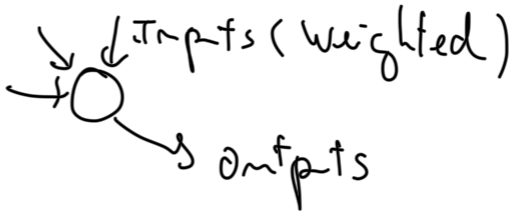
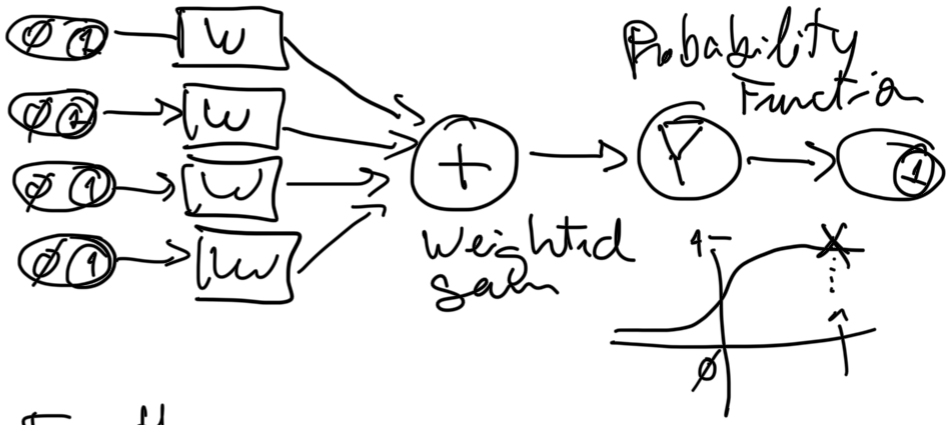
CS109 - lecture 1

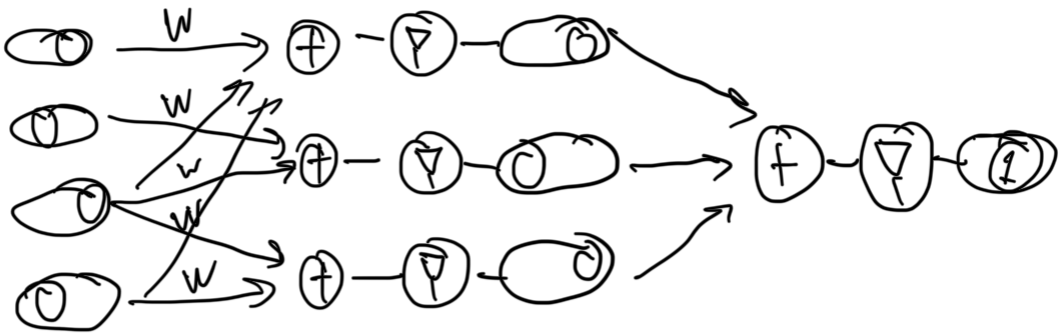
Classification Ideas:

1. Artificial Neurons





Put Many Together



Input Neurons

Hidden Nemons

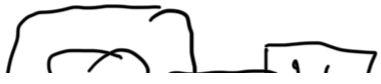
Output Nemons

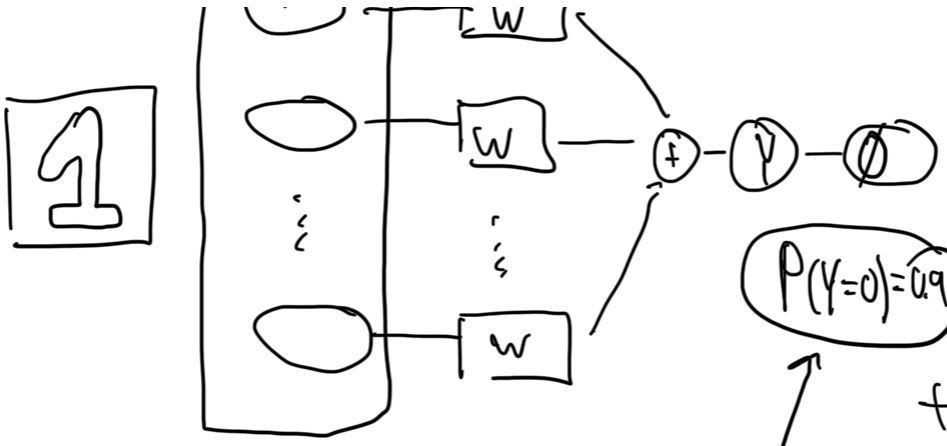
↓

Make a Prediction

The Intelligence of the Model is in the weights

2. Learn by Example





When it receives a result it will adjust the weights to do a better job in the future

This works because we can express the conditions inputs and outputs Mathematically.

How could I change so i can improve? Via Probability

Open Problem: One Shot Learning

- Algorithms use probability

Philosophy and Ethics

Art and Probability

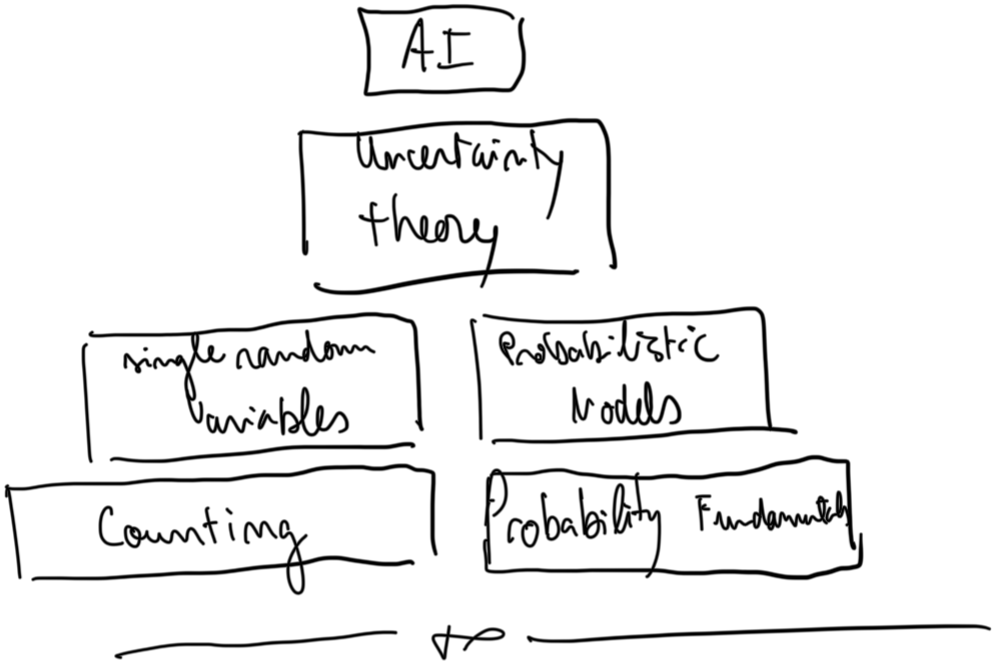
- Most Desired Skill in Academia (Probability)

However Probability is very non intuitive → Important
→ Needs Study

- A patient has a positive Zika test
- 0.8% of people have Zika

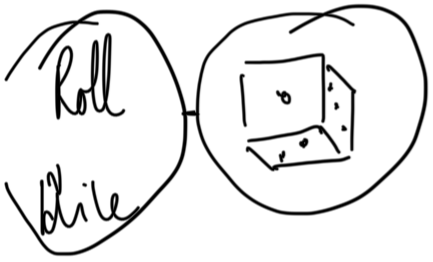
- Test has 90% positive rate for ppl w/ zika
- " " 7% " " " " without zika
- Right answer is 9%! How! ⇒ Probability theory

CS109



Foundation of Probability theory is in counting

Counting: how many possible outcomes satisfy some event



⇒ 6 possible outcomes

⇒ 3 possible outcomes

⇒ 36 possible Outcomes

How to count easily:

- If a expriment has a steps
  - : Outcomes of Step A $|A| = m$ outcomes
  - : Outcomes of Step B are unaffected (IF)

Then total outcomes is

$$|A| \times |B| = m \times n$$

Example: How many unique images? rgb = $(256)^3$ ← each 8 bits = 2^8

(a) 12 M pixels / (b) 300 pixels / (c) 12 pixels → each pixel 17M colors

(c) Pixels: □ □ .... □ (1, 2, ..., 12)

$17M \times 17M \times \cdots \times 17M = 17M^{12}$

(b) Unique Images: $17M^{300}$

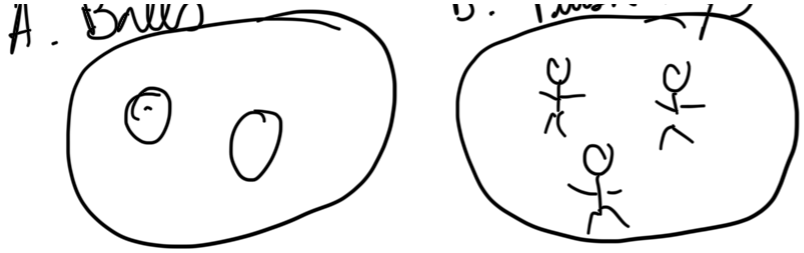
(a): $17M^{12M}$

Sum Rule of Counting

If outcomes either A OR B then $|A| + |B|$

Set A and Set B are Mutually exclusive

[illegible] R Plush toys



$|A| + |B| = m + n$

$= 9 + 2$

Problem:

00 11 00

- Strings that start with 01 $= 2^4 = 16$ Set A
- or " " end " 10 : $2^4 = 16$ Set B

So we can Add them (?) = 32 No because there are elements that exist in both

Example: 01 0010 / 01 00 10) 4 elements overlap

More generic formula for outcomes from Sum Rule OR

$$\# = |A| + |B| - |A \text{ and } B|$$

Counting Options:

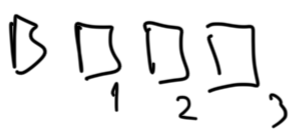
- Counting with Steps = $m \cdot n$ if independent outcomes
- counting with "or" = $|A| + |B| - |A \text{ and } B|$

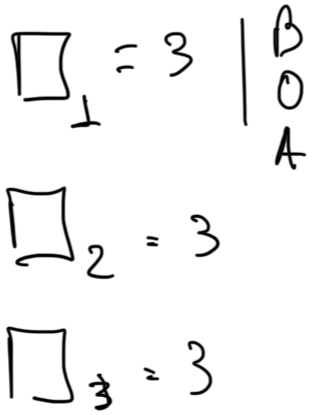
Challenge

Subtract the overlap

How many unique orderings of BOBA

BOBA
BBOA
BABO
BOAB





→ Restricts the next

not independent!

Easier Problem:

ABCD = 4 × 3 × 2 × 1 = 24

So
 = has 4 choices
 = has 3 choices
 = has 2 choices
 = has 1 choice

Formula = $n!$

Back to BOBA

↑ ↑

B is repeated

$$\text{Formula} = \frac{n!}{\underbrace{k_1! \cdot k_2! \cdots k_m!}_{\text{repeats}}}$$