Naïve Bayes Classifier

- **Also known as Posterior Probabilities**
  - ✓ Certain probabilities were altered after getting additional information
  - ✓ These new probabilities are known as *posterior probabilities*

- E.g.
  - ✓ Estimating probabilities of a team winning a tournament before start
  - ✓ During the tournament, injuries to key players / underperformance
  - ✓ Probabilities altered to cater to new situation

- NB algorithm assumes all features are independent and important, which is not always correct. Hence the term “Naïve”
- E.g: Age – Salary may be correlated (more age, more salary)

Conditional probabilities for Dependent Events

Probability of an event is dependent by the occurrence of some other event

$$P(B \mid A) = \frac{P(A \mid B) * P(B)}{P(A)}$$

where

P(A | B) = Probability of event A occurring, given B has occurred

P(A) = Prior probability of event A

P(B) = Marginal likelihood of event B

$$P(B \mid A) = \frac{P(AB)}{P(A)}$$

where

P(AB) = Joint probability of A and B

P(A) = Marginal probability of event B

Type 1

P(6) = 0.4

Type 2

P(6) = 0.7

One dice is drawn at random, rolled and it gets a **6**. What is the probability that it comes from a **Type 1** dice ?

P(6 from T1) = [P(T1 giving 6) * P(T1)] / P(6)

$$\textbf{P(Type 1 | 6)} = \frac{\textbf{P(6 | Type 1) * P(Type 1)}}{\textbf{P(6)}}$$

P(6 | Type1)	= 0.4
P(6 | Type2)	= 0.7

P(Type 1)	= 0.5
P(Type 2)	= 0.5

P(6)	= (0.4*0.5) + (0.7*0.5)
	= 0.2 + 0.35
	= 0.55

P(Type 1 | 6)	**= (0.4 * 0.5) / 0.55**
	= 0.2 / 0.55
	= 0.364

Machine 1 produces 30 bolts/hour
Machine 2 produces 20 bolts/hour.

Each bolt is marked with the machine from which it is produced.

At the end of the day, pick up all defective bolts from the total produce.

Given

- 1% of all bolts produced are defective
- Of all defective parts, 50% are from each of the 2 machines

Question

What is the probability of Machine 2 producing a defective bolt ?

Machine 1

Machine 2

P(defective | M2) =

[P(M2 | defective) * P(defective)] / P(M2)
= [0.5 * 0.01] / [0.4]
= 0.0125
= 1.25%

Total bolts=1000
M2=400

1%defect = 10

50% defects from M2 = 5

Question
What is the probability of Machine 2 producing a defective bolt ?

P(defective | M2) = 5/400
= 0.0125
= .125%

Example

10% have a disease, a test to detect the disease is 92% accurate and a false alarm rate of 5%

Q1) If you test positive, what is the probability you have the disease?

Q2) Your friend tests negative, what is the probability the friend has the disease?

10% have a disease, a test to detect the disease is 92% accurate and a false alarm rate of 5%

Q1) If you test positive, what is the probability you have the disease?

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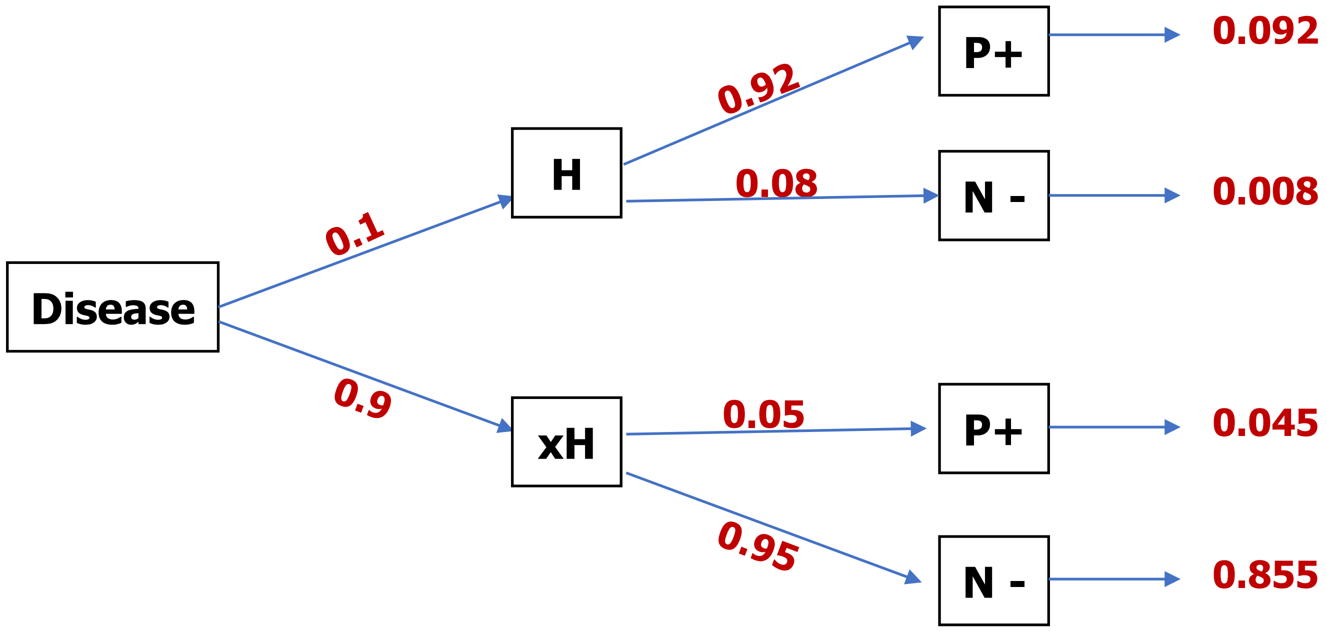


If you test positive, what is the probability you have the disease?

Test Positive = 0.045 + 0.092 ➔ 0.137
Positive and Have disease ➔ 0.092

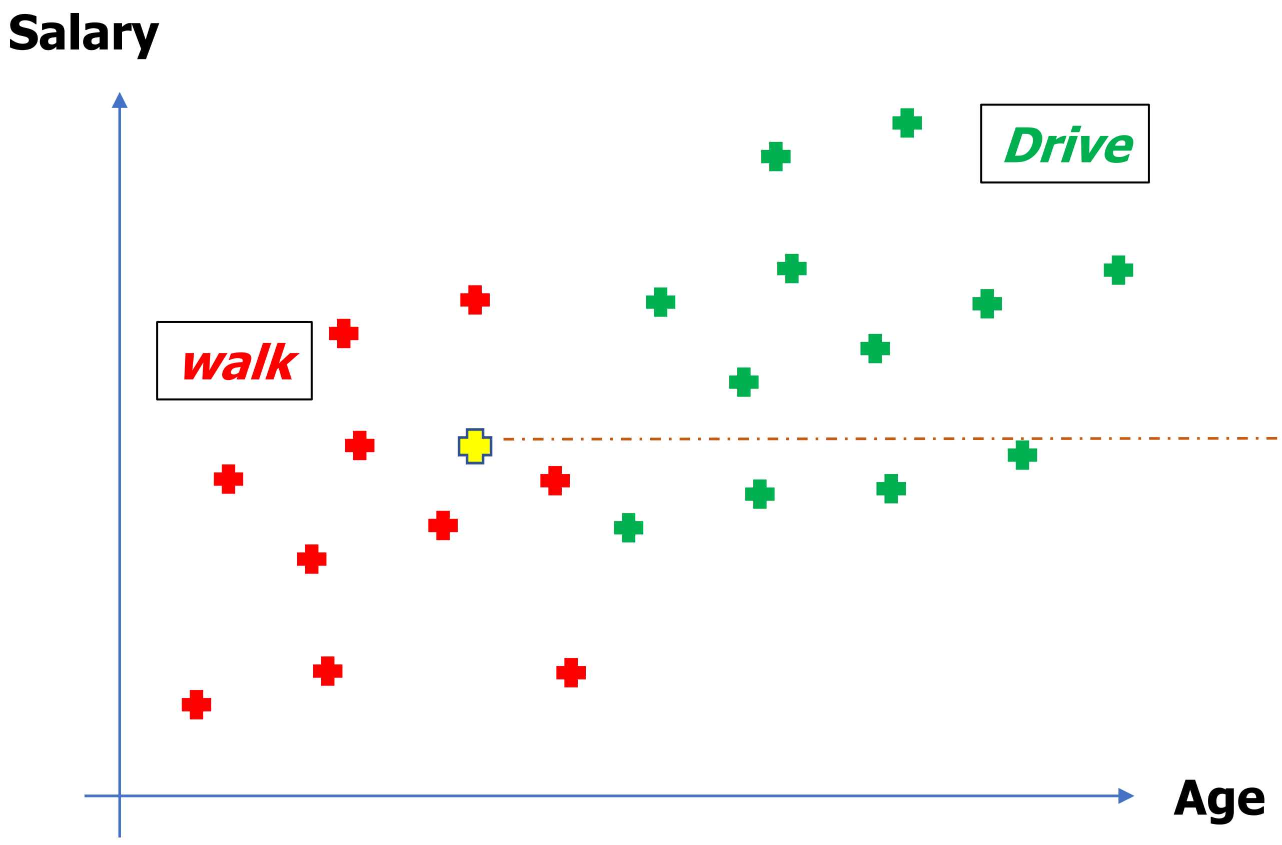
P(You have the disease | You test positive) = 0.092/0.137 ➔ 0.671 ➔ 67.1%

If your friend tests negative, what is the probability the friend has the disease?

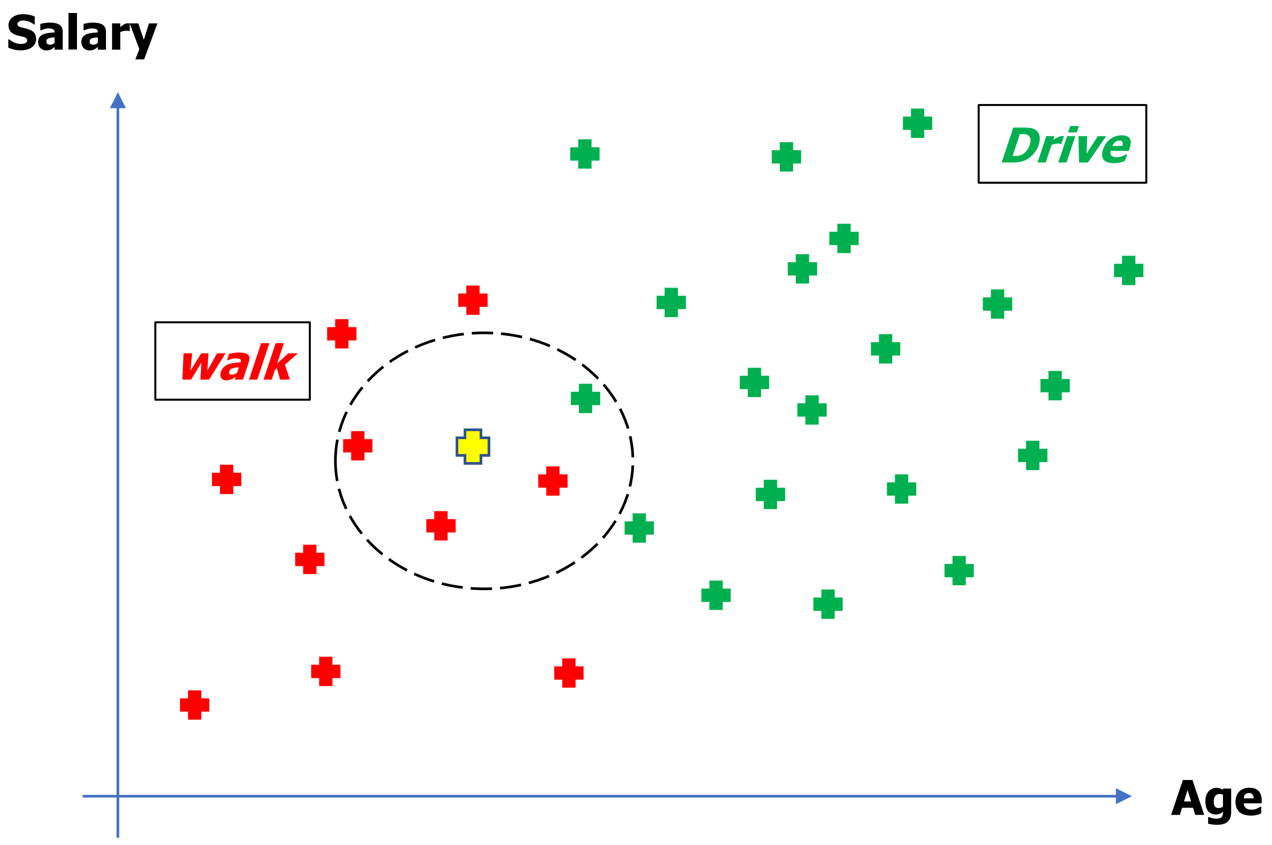
Test Negative = 0.008 + 0.855 ➔ 0.863
Negative and Have disease ➔ 0.008

P(Friend has the disease| Friend tests negative) = 0.008/0.863 ➔ 0.0092 ➔ 0.9%

1. P(Walk | Age) = [P(Age | Walk) * P(Walk)] / P(Age)
2. P(Drive | Age) = [P(Age | Drive) * P(Drive)] / P(Age)
3. Compare P(1) vs P(2) to classify



Predict whether this person will **Walk** or **Drive** ?



1. **P(Walks) = 10/30**

2. **P(Age) = 4/30**
   Probability of a random variable added falls in the circle

3. **P(Age | Walk) = 3/10**
   Probability of someone who walks exhibits the feature 'Age' (from the circle)

P(Walk | Age) = [(3/10)*(10/30)] / (4/30)
= 0.75
= 75%

P(Drive | Age) = 1 – 0.75
= 0.25
= 25%

Since P(Walk|Age) > P(Drive|Age),
will be classified as Walk