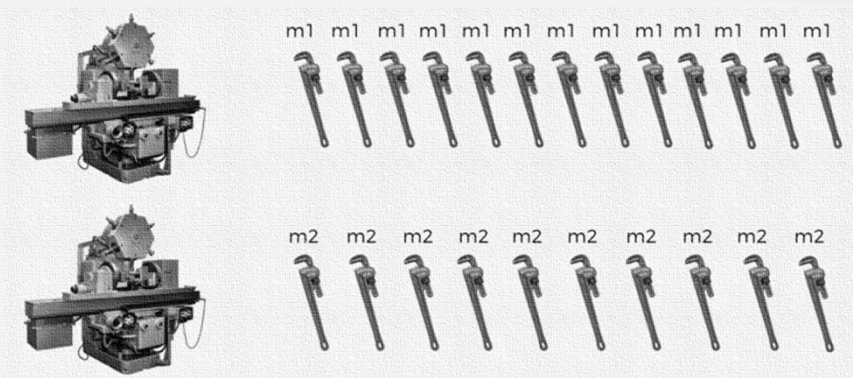


# Naïve Bayes Classifier

Mohan M J

## Bayes' Theorem



What is the probability that Machine 2 produces a defective item?

## Bayes' Theorem

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

## Bayes' Theorem

**Mach1: 30 wrenches / hr**  
**Mach2: 20 wrenches / hr**

->  $P(\text{Mach1}) = 30/50 = 0.6$

->  $P(\text{Mach2}) = 20/50 = 0.4$

**Out of all produced parts:**  
**We can SEE that 1% are defective**

->  $P(\text{Defect}) = 1\%$

**Out of all defective parts:**  
**We can SEE that 50% came from mach1**  
**And 50% came from mach2**

->  $P(\text{Mach1} | \text{Defect}) = 50\%$

->  $P(\text{Mach2} | \text{Defect}) = 50\%$

**Question:**  
**What is the probability that a part**  
**produced by mach2 is defective = ?**

->  $P(\text{Defect} | \text{Mach2}) = ?$

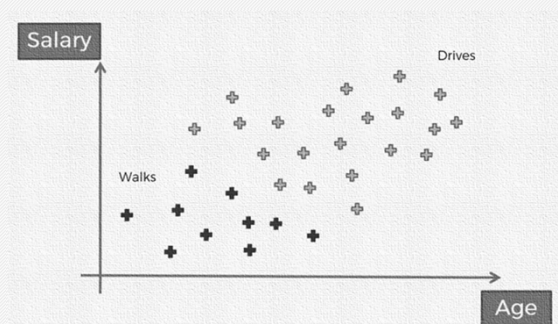
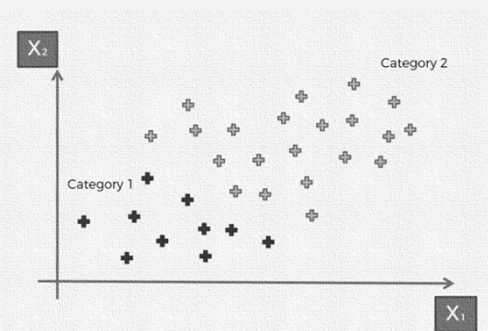
## Bayes' Theorem

**Mach1: 30 wrenches / hr**  
**Mach2: 20 wrenches / hr**  
**Out of all produced parts:**  
**We can SEE that 1% are defective**  
**Out of all defective parts:**  
**We can SEE that 50% came from mach1**  
**And 50% came from mach2**  
**Question:**  
**What is the probability that a part**  
**produced by mach2 is defective = ?**

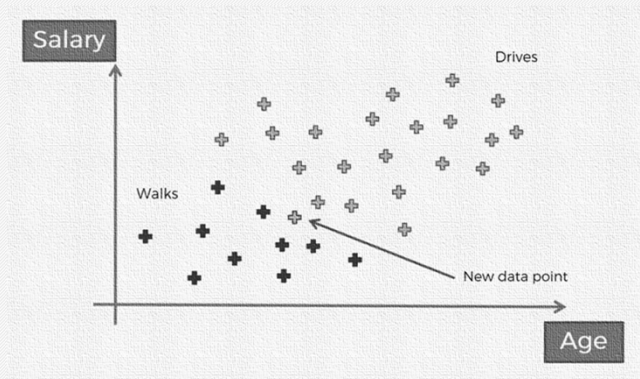
->  $P(\text{Mach2}) = 20/50 = 0.4$   
 ->  $P(\text{Defect}) = 1\%$   
 ->  $P(\text{Mach2} \mid \text{Defect}) = 50\%$   
 ->  $P(\text{Defect} \mid \text{Mach2}) = ?$

$$P(\text{Defect} \mid \text{Mach2}) = \frac{P(\text{Mach2} \mid \text{Defect}) * P(\text{Defect})}{P(\text{Mach2})} = 1.25\%$$

## Naïve Bayes Classifier



## Naïve Bayes Classifier



## Naïve Bayes Classifier

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

$$P(Walks|X) = \frac{P(X|Walks) * P(Walks)}{P(X)}$$

## Naïve Bayes Classifier

The diagram shows the Naïve Bayes Classifier formula with four labeled components pointing to parts of the equation:

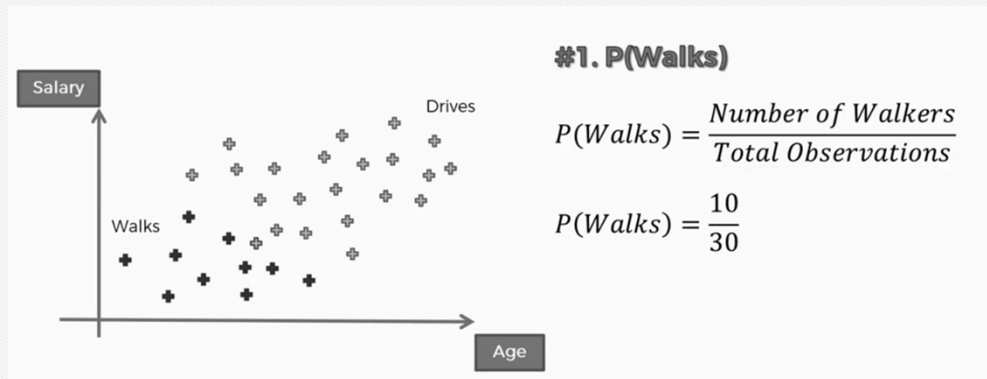
- #4 Posterior Probability** points to  $P(Walks|X)$ .
- #3 Likelihood** points to  $P(X|Walks)$ .
- #1 Prior Probability** points to  $P(Walks)$ .
- #2 Marginal Likelihood** points to  $P(X)$ .

$$P(Walks|X) = \frac{P(X|Walks) * P(Walks)}{P(X)}$$

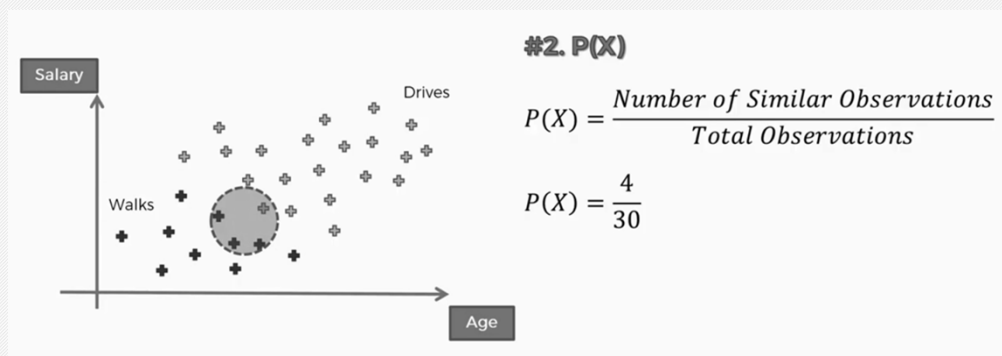
$$P(Drives|X) = \frac{P(X|Drives) * P(Drives)}{P(X)}$$

$P(Walks|X) v.s. P(Drives|X)$

## STEP 1:

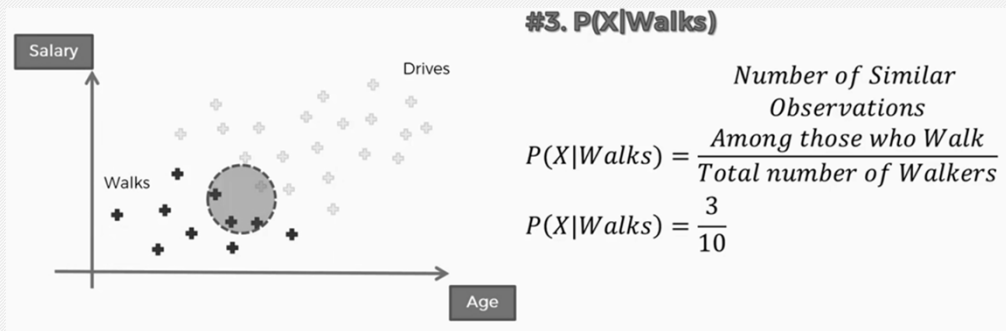


## STEP 2:





## STEP 3:



## Posterior Probability

**#4** Posterior Probability

**#3** Likelihood

**#1** Prior Probability

**#2** Marginal Likelihood

$$P(Walks|X) = \frac{\frac{3}{10} * \frac{10}{30}}{\frac{4}{30}} = 0.75$$

## $P(\text{Drives} | X)$

Diagram illustrating the components of Bayes' theorem for  $P(\text{Drives} | X)$ :

- #4 Posterior Probability: Points to the left side of the equation,  $P(\text{Drives} | X)$ .
- #3 Likelihood: Points to the numerator term  $P(X | \text{Drives})$ .
- #1 Prior Probability: Points to the numerator term  $P(\text{Drives})$ .
- #2 Marginal Likelihood: Points to the denominator term  $P(X)$ .

$$P(\text{Drives} | X) = \frac{P(X | \text{Drives}) * P(\text{Drives})}{P(X)}$$

## $P(\text{Drives} | X)$

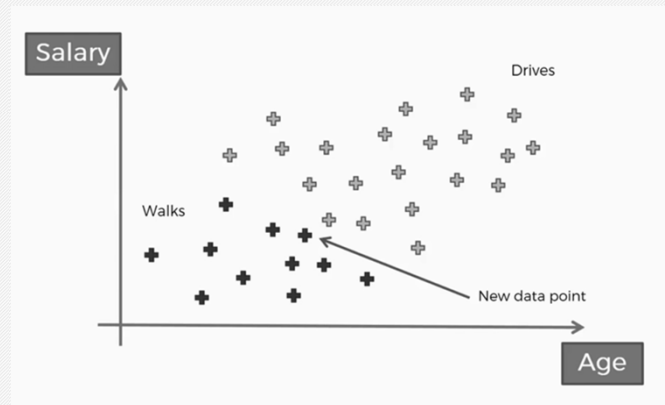
Diagram illustrating the numerical calculation of  $P(\text{Drives} | X)$  using the components from the previous slide:

- #4 Posterior Probability: Points to the left side of the equation,  $P(\text{Drives} | X)$ .
- #3 Likelihood: Points to the numerator term  $\frac{1}{20}$ . A checkmark is next to the label.
- #1 Prior Probability: Points to the numerator term  $\frac{20}{30}$ . A checkmark is next to the label.
- #2 Marginal Likelihood: Points to the denominator term  $\frac{4}{30}$ . A checkmark is next to the label.

$$P(\text{Drives} | X) = \frac{\frac{1}{20} * \frac{20}{30}}{\frac{4}{30}} = 0.25$$



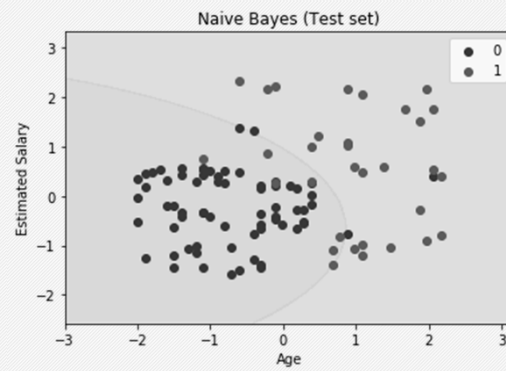
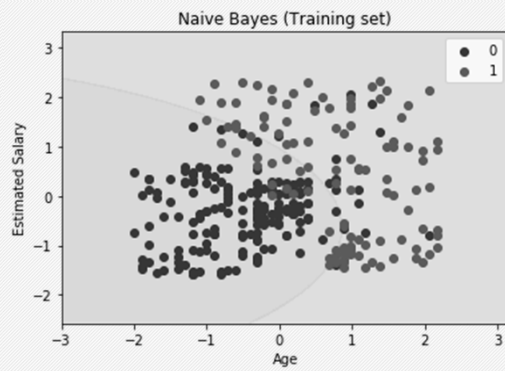
## New Data Point - Walks to work!



## PYTHON CODE

```
# Fitting Naive Bayes to the Training set
from sklearn.naive_bayes import GaussianNB
classifier = GaussianNB()
classifier.fit(X_train, y_train)
```

## Visualization



THANK YOU