機器學習
Naive Bayes

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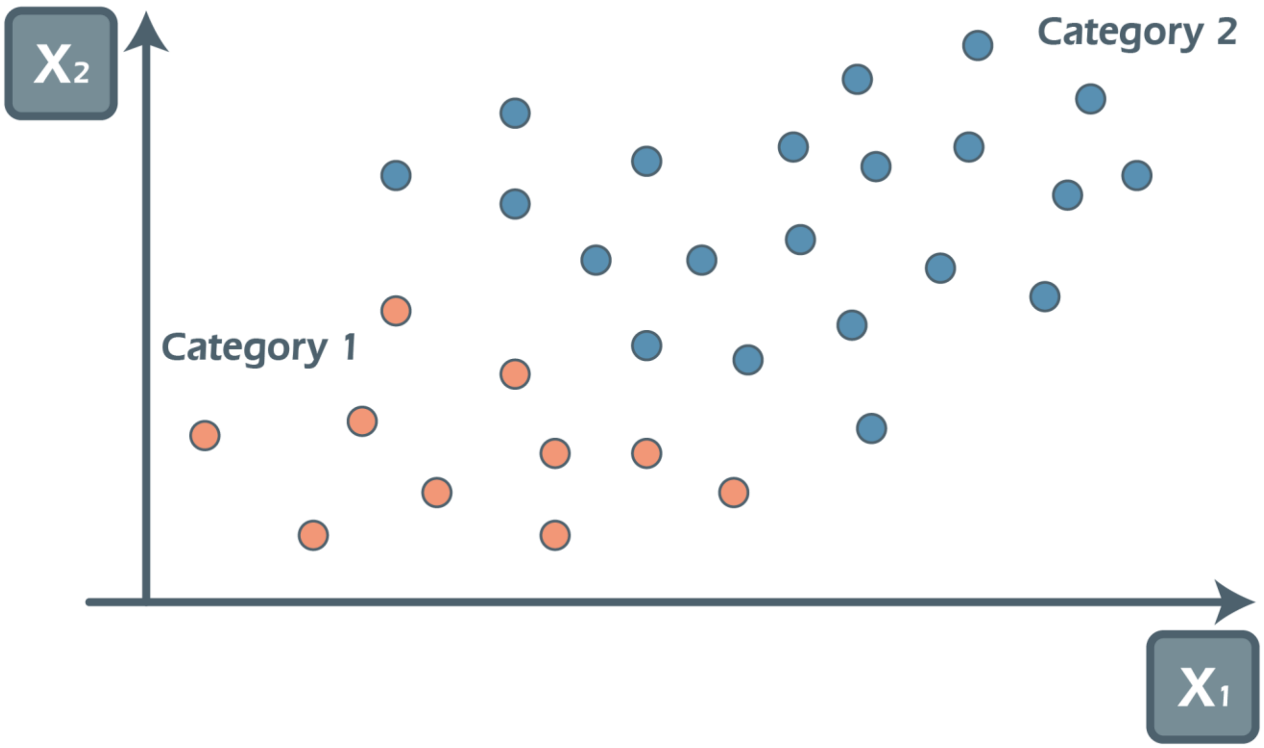
Naive Bayes Classifier Intuition

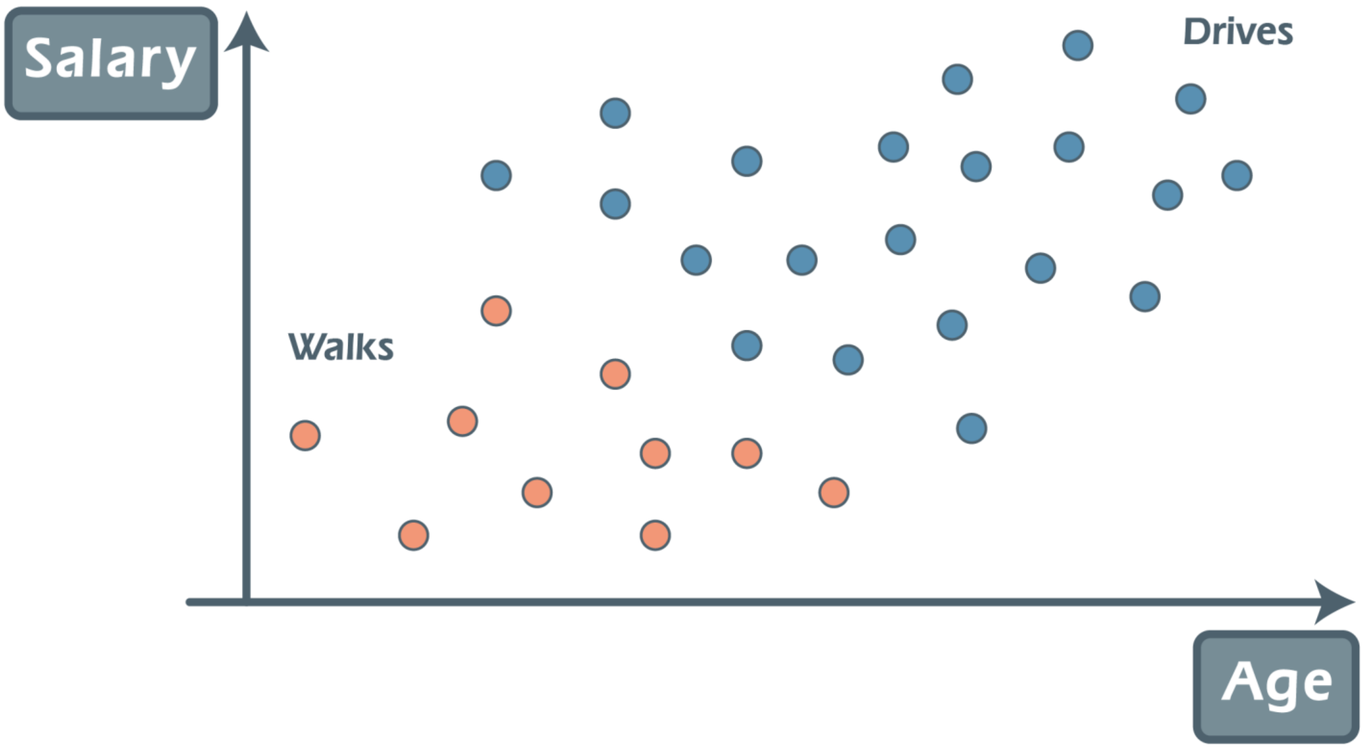
Naive Bayes

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

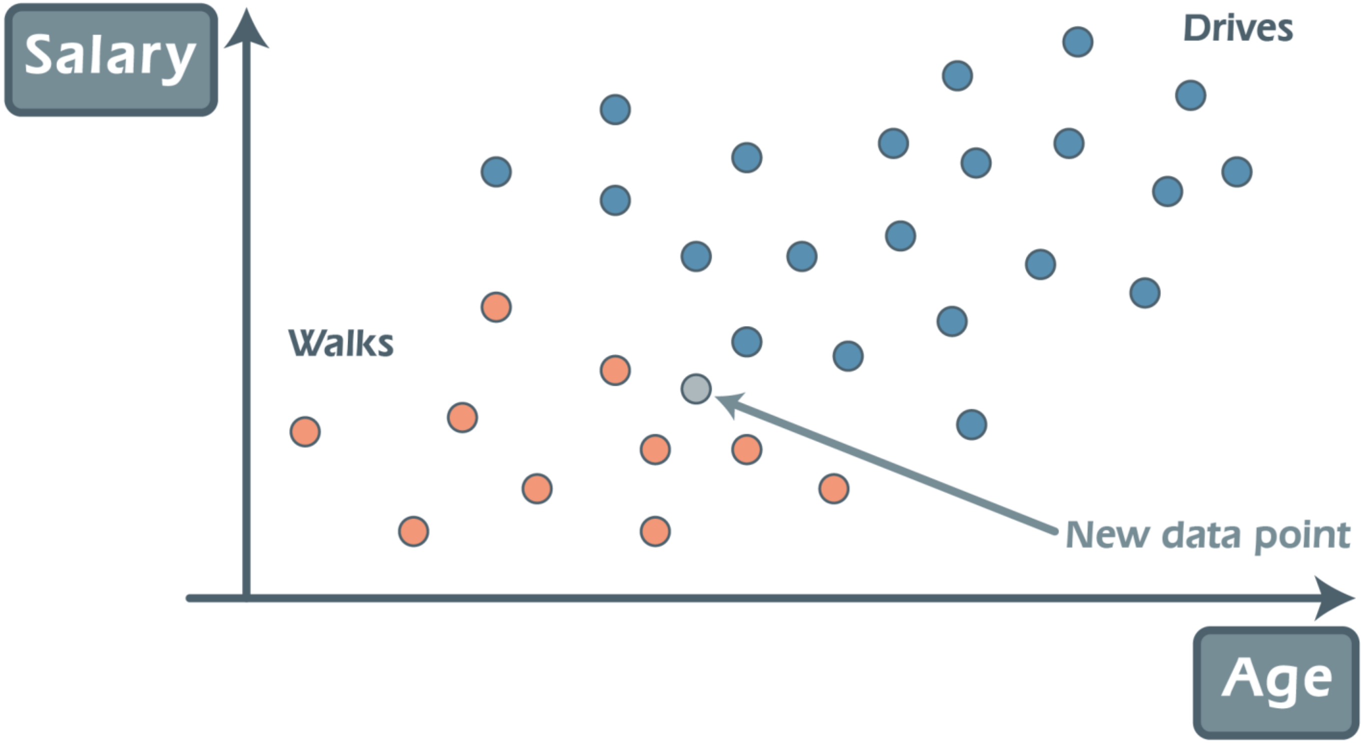
Naive Bayes



Naive Bayes



Naive Bayes



Naive Bayes

Plan of Attack

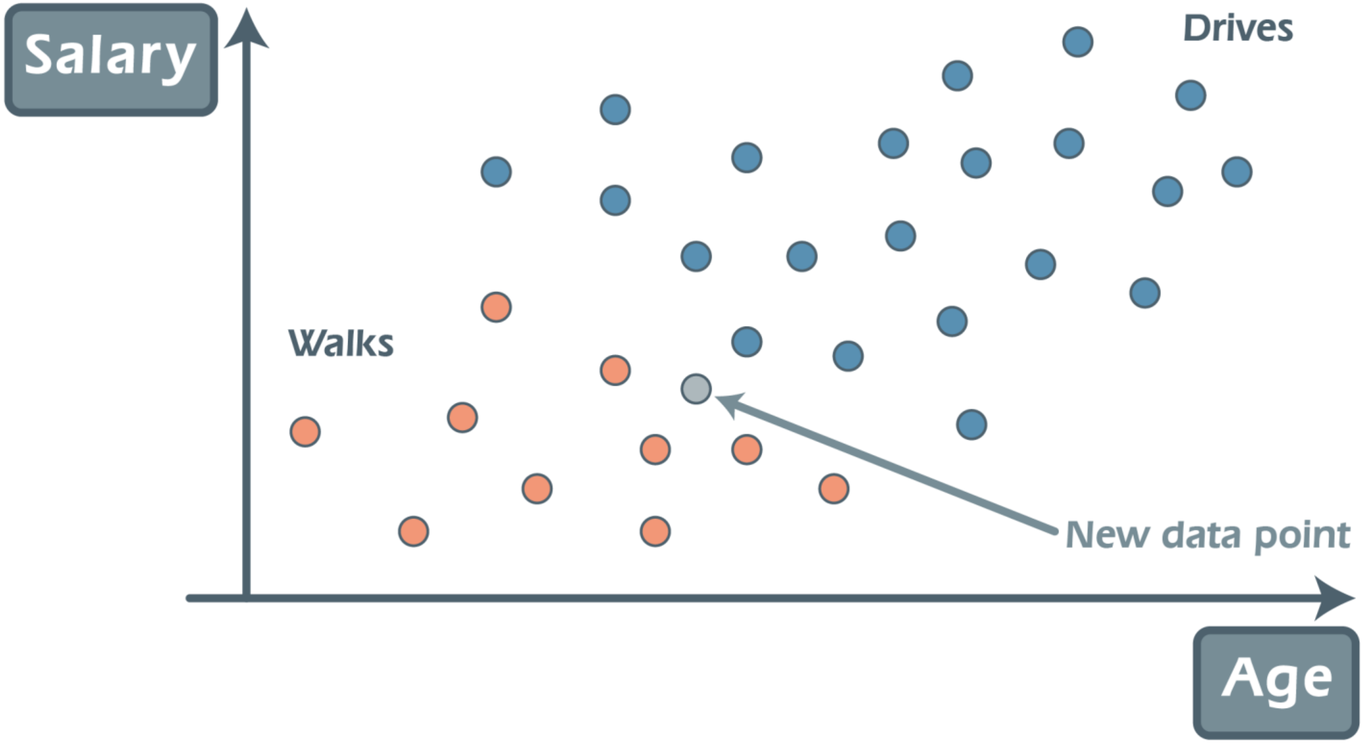
Naive Bayes

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

Naive Bayes

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

Naive Bayes



Naive Bayes

#4 Posterior Probability

#3 Marginal Likelihood

#1 Prior Probability

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

#2 Likelihood

Naive Bayes

#4 Posterior Probability

#3 Marginal Likelihood

#1 Prior Probability

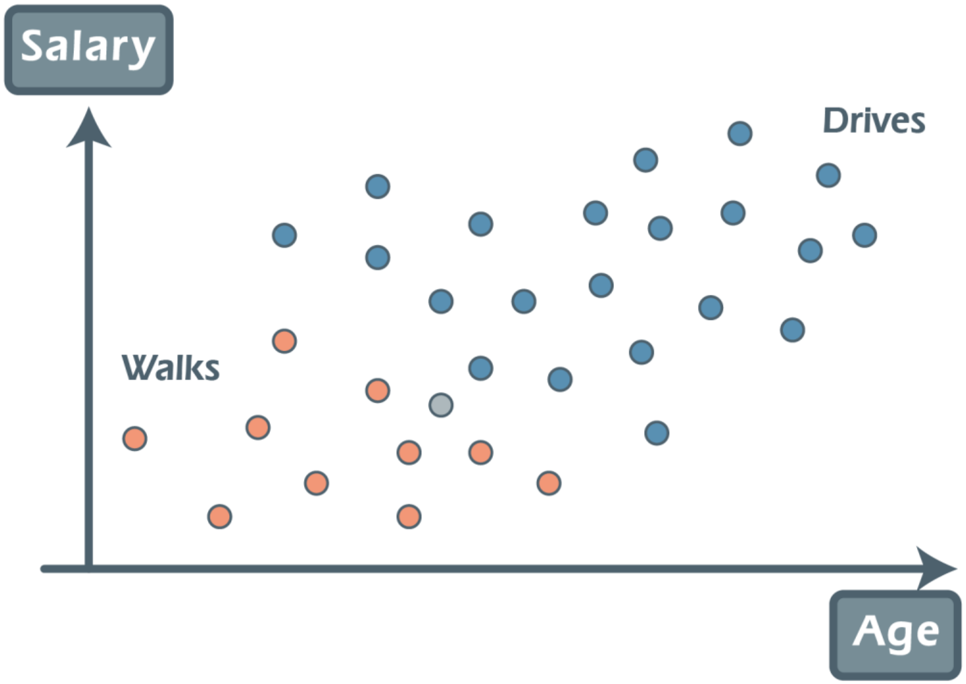
$$P(Drives|X) = \frac{P(X|Drives) * P(Drives)}{P(X)}$$

#2 Likelihood

Naive Bayes

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

Naive Bayes



#1. P(walks)

$$P(Walks) = \frac{Number\ of\ Walkers}{Total\ Observations}$$

$$P(Walks) = \frac{10}{30}$$

Naive Bayes

#4 Posterior Probability

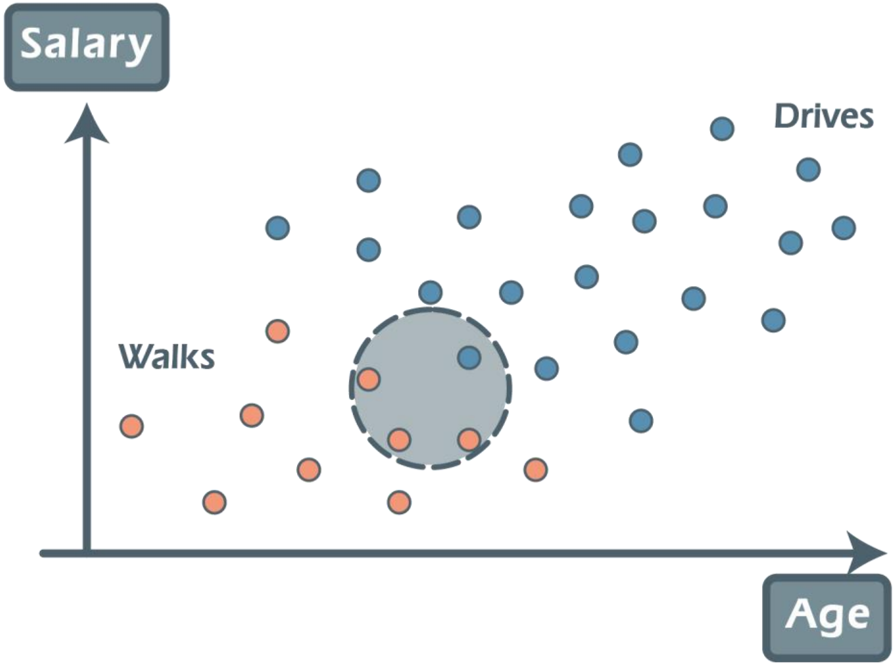
#3 Marginal Likelihood

#1 Prior Probability

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

#2 Likelihood

Naive Bayes



#2. P(X)

$$P(X) = \frac{Number\ of\ Similar\ Observations}{Total\ Observations}$$

$$P(X) = \frac{4}{30}$$

Naive Bayes

#4 Posterior Probability

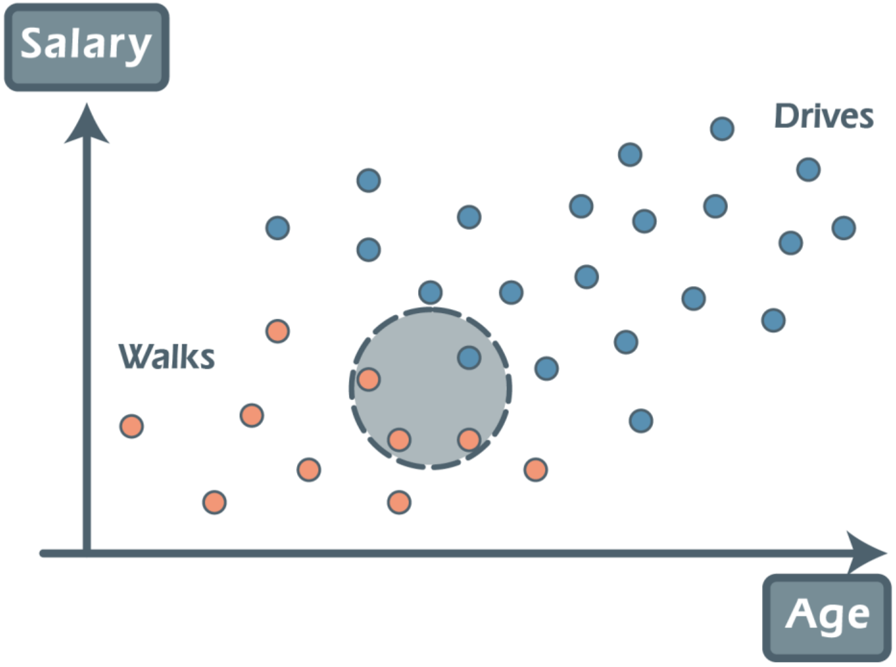
#3 Marginal Likelihood

#1 Prior Probability

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

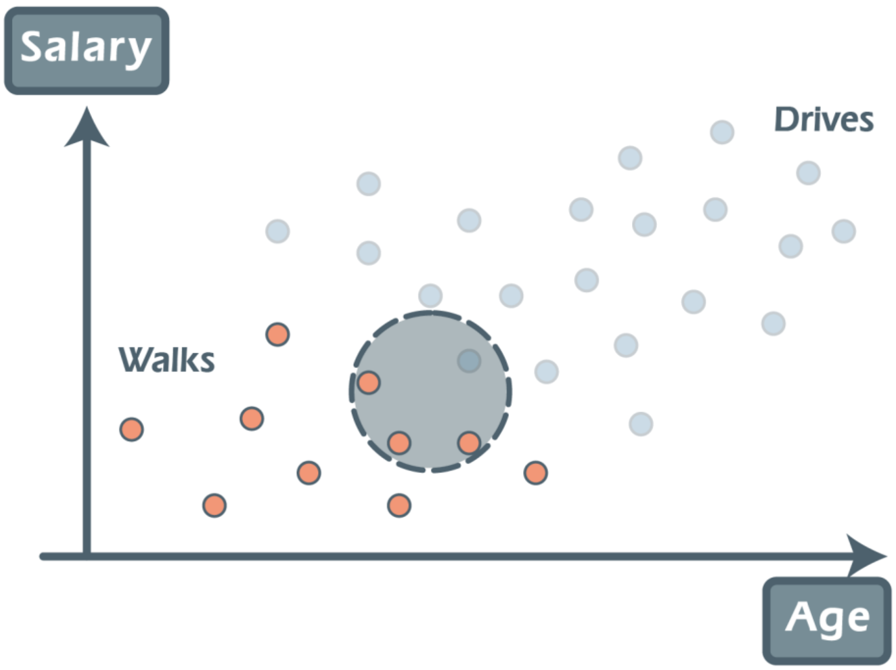
#2 Likelihood

Naive Bayes



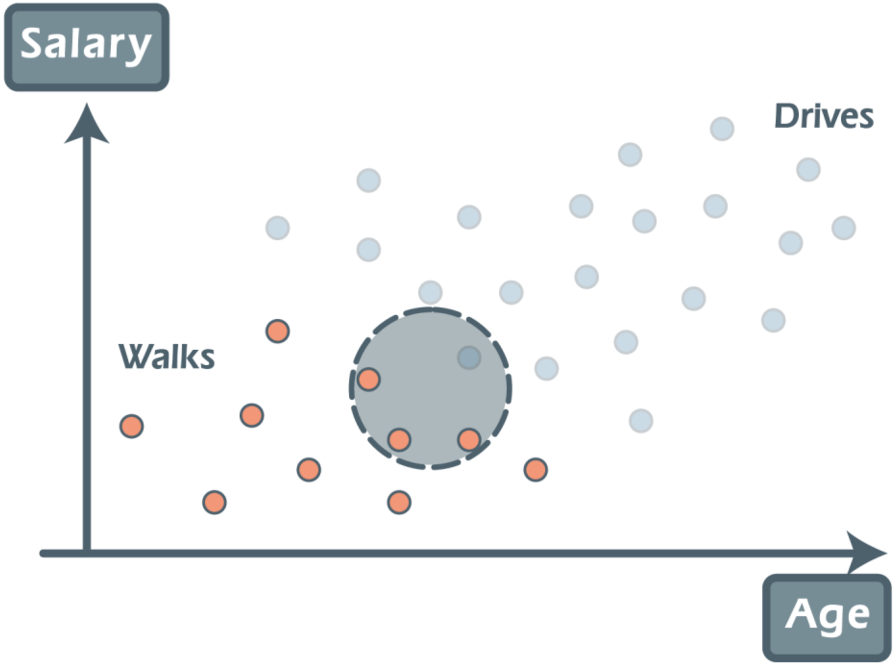
#3. P(X|Walks)

Naive Bayes



#3. P(X|Walks)

Naive Bayes



#3. P(X|Walks)

$$P(X|Walks) = \frac{\textit{Number of Similar Observations Among those who Walk}}{\textit{Total number of Walkers}}$$

$$P(X|Walks) = \frac{3}{10}$$

Naive Bayes

#4 Posterior Probability

#3 Marginal Likelihood

#1 Prior Probability

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

#2 Likelihood

Naive Bayes

#4 Posterior Probability

#3 Marginal Likelihood

#1 Prior Probability

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

#2 Likelihood

Naive Bayes

#4 Posterior Probability

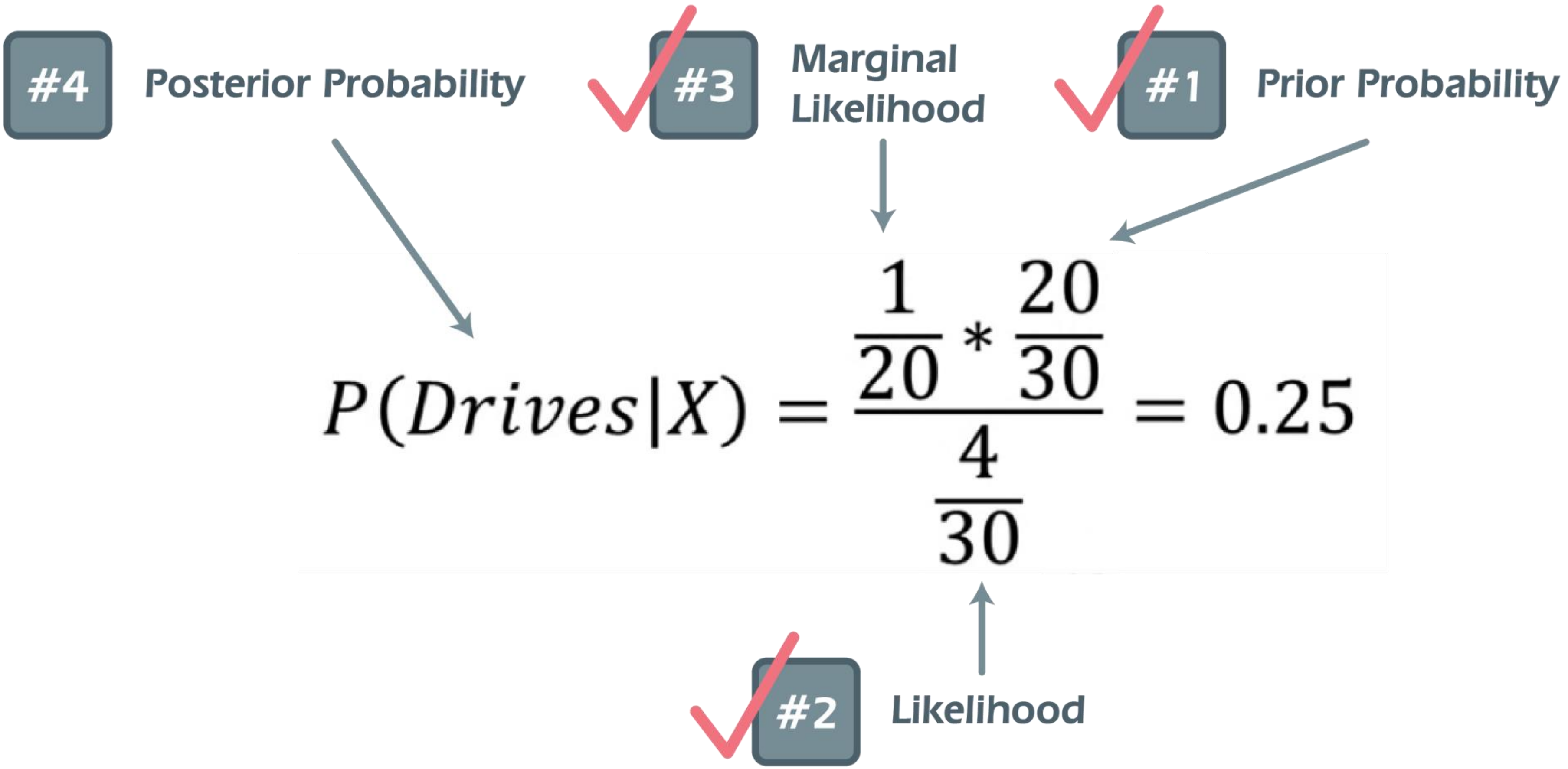
#3 Marginal Likelihood

#1 Prior Probability

$$\overbrace{P(Drives|X)}^{\#4} = \frac{\overbrace{P(X|Drives)}^{\#3} * \overbrace{P(Drives)}^{\#1}}{\underbrace{P(X)}_{\#2}}$$

#2 Likelihood

Naive Bayes



#4 Posterior Probability
#3 Marginal Likelihood
#1 Prior Probability
#2 Likelihood
$$P(Drives|X) = \frac{\frac{1}{20} * \frac{20}{30}}{\frac{4}{30}} = 0.25$$

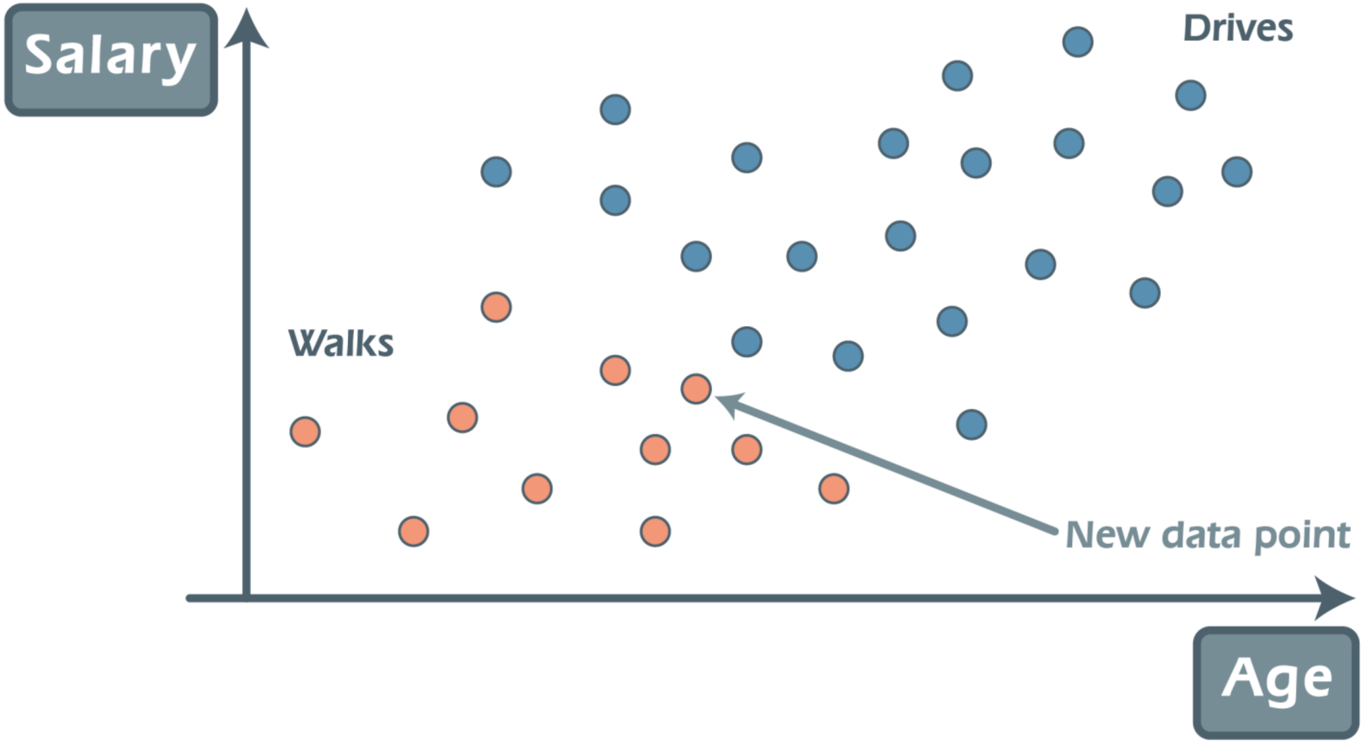
Naive Bayes

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

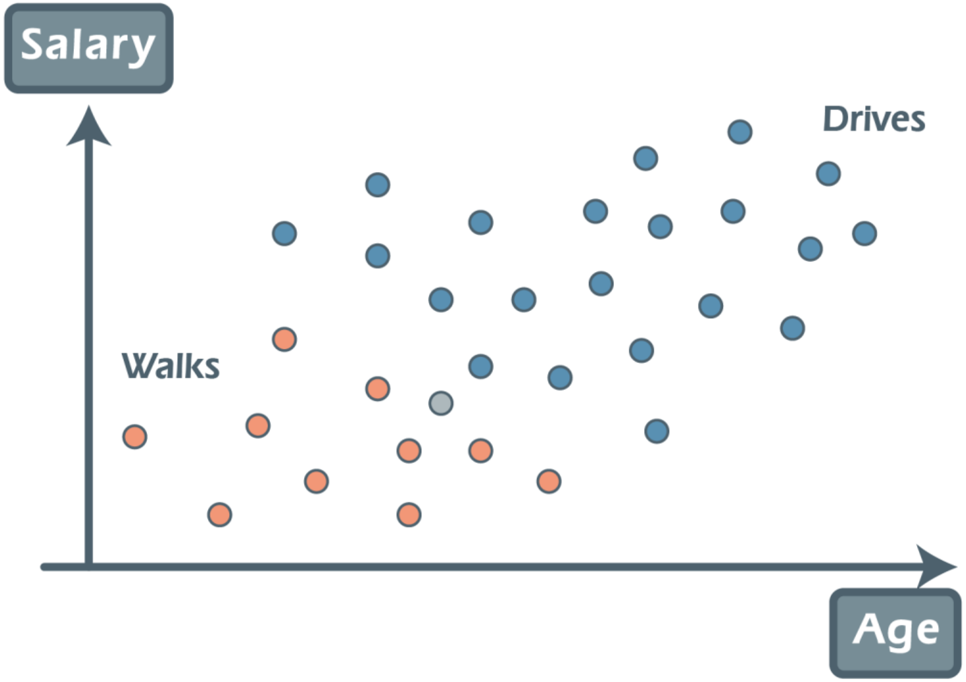
Naive Bayes

$$0.75 > 0.25$$

Naive Bayes



Naive Bayes

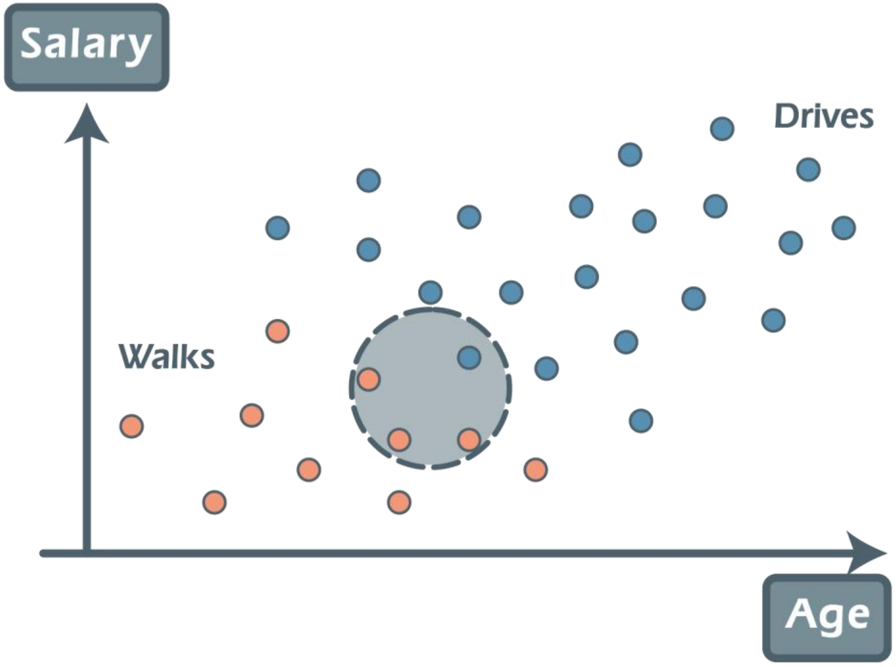


#1. P(Drives)

$$P(Drives) = \frac{Number\ of\ Drivers}{Total\ Observations}$$

$$P(Drives) = \frac{20}{30}$$

Naive Bayes

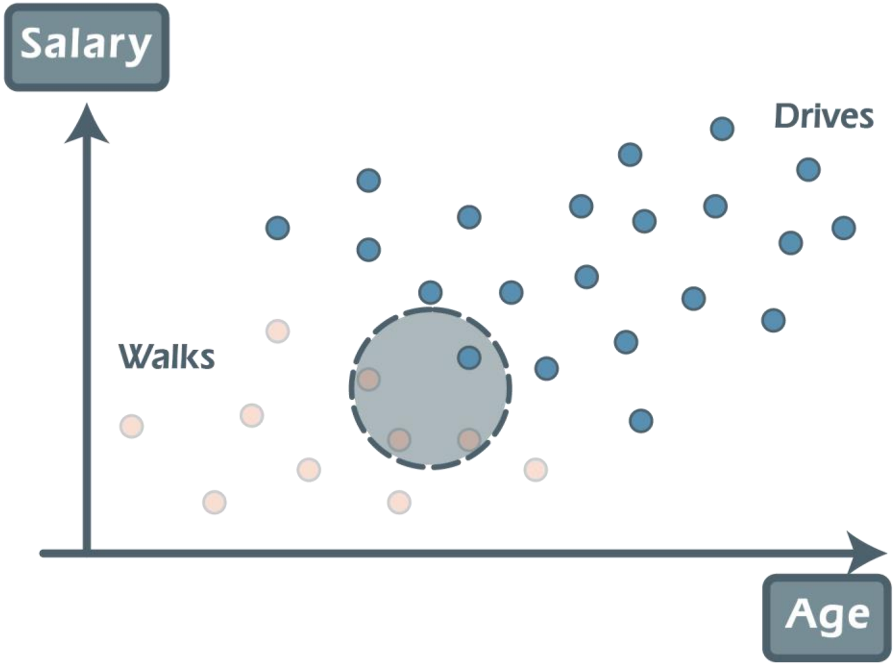


#2. P(X)

$$P(X) = \frac{Number\ of\ Similar\ Observations}{Total\ Observations}$$

$$P(X) = \frac{4}{30}$$

Naive Bayes



#3. P(X|Drives)

$$P(X|Drives) = \frac{\text{Number of Similar Observations Among those who Walk}}{\text{Total number of Walkers}}$$

$$P(X|Drives) = \frac{1}{20}$$

Naive Bayes

#4 Posterior Probability

#3 Marginal Likelihood

#1 Prior Probability

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

#2 Likelihood

Naive Bayes

1. **Q: Why ”Naive”?**
2. **P(X)**
3. **More than 2 classes**

Naive Bayes

Q: Why ”Naive”?

A: Independence assumption

Naive Bayes

$$\mathbf{P(X)}$$

Naive Bayes

$$\frac{P(X|Walks) * P(Walks)}{P(X)} \quad v.s. \quad \frac{P(X|Drives) * P(Drives)}{P(X)}$$

Naive Bayes

$$\frac{P(X|Walks) * P(Walks)}{\cancel{P(X)}} \quad v.s. \quad \frac{P(X|Drives) * P(Drives)}{\cancel{P(X)}}$$

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More than 2 classes

Naive Bayes

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

THE END

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