K-NN

4.9 $ID_x = \{1, 0, 1\}$

$dist(ID_x, ID_1) = 2$ classe X
$dist(ID_x, ID_2) = 2$ classe Z
$dist(ID_x, ID_3) = 1$ classe X
$dist(ID_x, ID_4) = 1$ classe X
$dist(ID_x, ID_5) = 3$ classe X
$dist(ID_x, ID_6) = 0$ classe Z

1-NN :
classe X = 0
classe Z = 1

5-NN :
classe X = 3
classe Z = 2

Naive Bayes

4.10

$P(c = X \mid a_1 = 0\ a_2 = 1, a_3 = 1)$

$P(c = Z \mid a_1 = 0, a_2 = 1, a_3 = 1)$

$$P(c \mid T) = \frac{P(c) \cdot P(T \mid c)}{P(T)}$$

$$P(T \mid c) = P(x_1 \mid c) \cdot P(x_2 \mid c) \cdot \ldots \cdot P(x_m \mid c)$$

Probabilidades a priori :

$P(C = X) = 4/6 = 2/3$

$P(C = Z) = 2/6 = 1/3$

Vraisemblance :

$P(a_1 = 0 \mid c = X) = 2/4 = 0.5$

$P(a_1 = 0 \mid c = Z) = 1/2 = 0.5$

$P(a_2 = 1 \mid c = X) = 3/4 = 0.75$

$P(a_2 = 1 \mid c = Z) = 1/2 = 0.5$

$P(a_3 = 1 \mid c = X) = 2/4 = 0.5$

$P(a_3 = 1 \mid c = Z) = 2/2 = 1$

$P(a_1 = 0, a_2 = 1, a_3 = 1 \mid c = X) = 0.5 \times 0.75 \times 0.5 = 0.1875$

$P(a_1 = 0, a_2 = 1, a_3 = 1 \mid c = Z) = 0.5 \times 0.5 \times 1 = 0.25$

$P(c = X \mid a_1 = 0, a_2 = 1, a_3 = 1) = 2/3 \times 0.1875 = 0.125$

$P(c = Z \mid a_1 = 0, a_2 = 1, a_3 = 1) = 1/3 \times 0.25 = 0.083$

$$\frac{P(c = x \mid a_1 = 0, a_2 = 1, a_3 = 1)}{P(c = Z \mid a_1 = 0, a_2 = 1, a_3 = 1)} = 1.5$$

4.11 $P(C=\text{"no"} \mid \text{outlook}=\text{"sunny"}, \text{Temperature}=66, \text{Humidity}=90, \text{Wind}=\text{TRUE})$

$P(C=\text{"yes"} \mid \text{outlook}=\text{"sunny"}, \text{Temperature}=66, \text{Humidity}=90, \text{Wind}=\text{TRUE})$

Probabilidades a priori

$P(C=\text{"no"}) = 5/14$

$P(C=\text{"yes"}) = 9/14$

Verosimilhança

$P(\text{outlook}=\text{"sunny"} \mid C=\text{"no"}) = 3/5$

$P(\text{outlook}=\text{"sunny"} \mid C=\text{"yes"}) = 2/9$

$\mu_{\text{Temperature, no}} = 74.6$

$\sigma_{\text{Temperature, no}} = 7.89$

$P(\text{Temperature}=66 \mid C=\text{"no"}) = \text{Normal}(x=66 \mid 74.6, 7.89) = 0.0279$

$\mu_{\text{Temperature, yes}} = 73$

$\sigma_{\text{Temperature, no}} = 6.16$

$P(\text{Temperature}=66 \mid C=\text{"yes"}) = \text{Normal}(x=66 \mid 73, 6.16) = 0.0340$

$\mu_{\text{Humidity, no}} = 80$

$\sigma_{\text{Humidity, no}} = 9.62$

$P(\text{Humidity}=90 \mid C=\text{"no"}) = \text{Normal}(x=90 \mid 80, 9.62) = 0.0242$

$\mu_{\text{Humidity, yes}} = 78.22$

$\sigma_{\text{Humidity, yes}} = 9.88$

$P(\text{Humidity}=90 \mid C=\text{"yes"}) = \text{Normal}(x=90 \mid 78.22, 9.88) = 0.0198$

$P(\text{Wind}=\text{TRUE} \mid C=\text{"no"}) = 3/5$

$P(\text{Wind}=\text{TRUE} \mid C=\text{"yes"}) = 3/9$

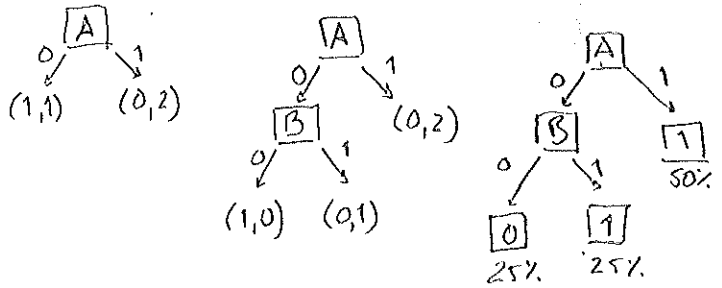
$P(C=\text{"no"} \mid \text{outlook}=\text{"sunny"}, \text{Temperature}=66, \text{Humidity}=90, \text{Wind}=\text{TRUE}) = 5/14 \times 3/5 \times 0.0279 \times 0.0242 \times 3/5 = 1.45 \times 10^{-4}$

$P(C=\text{"yes"} \mid \text{outlook}=\text{"sunny"}, \text{Temperature}=66, \text{Humidity}=90, \text{Wind}=\text{TRUE}) = 9/14 \times 2/9 \times 0.0340 \times 0.0198 \times 3/9 = 0.96 \times 10^{-4}$

$$\frac{P(C=\text{"no"})}{P(C=\text{"yes"})} = \frac{1.45 \times 10^{-4}}{0.96 \times 10^{-4}} = 1.51$$

Árvores de Decisão e Regras de Decisão

4.12



4.13

DMC = alta → {mau} ou {sim}

$Erro_{DMC=alta} = 1/2$

DMC = baixa → {mau}

$Erro_{DMC=baixa} = 1/3$

$Erro_{DMC} = (1+1)/(2+3) = 2/5$

FUM = alta → {mau}

$Erro_{FUM=alta} = 1/3$

FUM = baixa → {mau} ou {sim}

$Erro_{FUM=baixa} = 1/2$

$Erro_{FUM} = (1+1)/(2+3) = 2/5$

CT = mau → {mau}

$Erro_{CT=mau} = 0/2 = 0$

CT = sim → {sim}

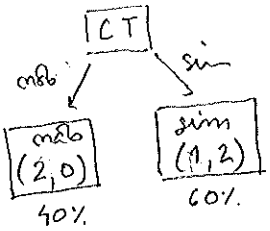
$Erro_{CT=sim} = 1/3$

$Erro_{CT} = (0+1)/(2+3) = 1/5$

$A = v_i \longrightarrow C$

$Erro_{regra} = \frac{erro}{total}$

$Erro_{atributo} = \frac{\sum_i erro_i}{\sum_i total_i}$



Redes Neuronais

4.14.1

$w_i(t+1) = w_i(t) + \eta \cdot (Esp. - Obs) \cdot x_i$

{A=0, B=0, ∧=0}

$y = -1.5 + 0 + 0 = -1.5 \quad o(y) = 0$

$w_1 = -1.5 + 0.25 \times 0 \times 1 = -1.5$

$w_A = 0.5 + 0.25 \times 0 \times 1 = 0.5$

$w_B = 0.5 + 0.25 \times 0 \times 1 = 0.5$

{A=0, B=1, ∧=0}

$y = -1.5 + 0 + 0.5 = -1 \quad o(y) = 0$

⋮

{A=1, B=0, Λ=0}

y=-1.5+0.5+0=-1 o(y)=0

⋮

{A=1, B=1, Λ=1}

y=-1.5+0.5+0.5=-0.5 o(y)=0

w_1=-1.5+0.25x(1-0)x1=-1.25

w_A=0.5+0.25x(1-0)x1=0.75

w_B=0.5+0.25x(1-0)x1=0.75

4.14.2

{A=0, B=0, Λ=0}

y=-1.25+0+0=-1.25 o(y)=0

{A=0, B=1, Λ=0}

y=-1.25+0+0.75=-0.5 o(y)=0

{A=1, B=0, Λ=0}

y=-1.25+0.75+0=-0.5 o(y)=0

{A=1, B=1, Λ=1}

y=-1.25+0.75+0.75=0.25 o(y)=1

5.1