Midterm Decision Tree

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Q1 Tree

$H(0.5) = \frac{1}{2}\log_2 2 + \frac{1}{2}\log_2 2 = 1$

Class 1

$H(0) = 0$ $H(\frac{1}{6}) = -\frac{1}{6}\log_2(\frac{1}{6}) - \frac{5}{6}\log_2(\frac{5}{6})$ $H(\frac{1}{3}) = \frac{1}{3}\log_2 3 + \frac{2}{3}\log_2(\frac{3}{2})$

$H(\frac{1}{2}) = \frac{1}{2}\log_2 2 + \frac{1}{2}\log_2 2 = 1$ $H(\frac{2}{3}) = \frac{2}{3}\log_2(\frac{3}{2}) + \frac{1}{3}\log_2 3$ $H(1) = 0$

Class 2

$H(0) = 0$ $H(\frac{1}{6}) = -\frac{1}{6}\log_2(\frac{1}{6}) - \frac{5}{6}\log_2(\frac{5}{6})$ $H(\frac{1}{3}) = \frac{1}{3}\log_2 3 + \frac{2}{3}\log_2(\frac{3}{2})$

$H(\frac{1}{2}) = \frac{1}{2}\log_2 2 + \frac{1}{2}\log_2 2 = 1$ $H(\frac{2}{3}) = \frac{2}{3}\log_2(\frac{3}{2}) + \frac{1}{3}\log_2 3$ $H(1) = 0$

Class 3

$H(0) = 0$ $H(\frac{1}{6}) = -\frac{1}{6}\log_2(\frac{1}{6}) - \frac{5}{6}\log_2(\frac{5}{6})$ $H(\frac{1}{3}) = \frac{1}{3}\log_2 3 + \frac{2}{3}\log_2(\frac{3}{2})$

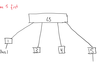
$H(\frac{1}{2}) = \frac{1}{2}\log_2 2 + \frac{1}{2}\log_2 2 = 1$ $H(\frac{2}{3}) = \frac{2}{3}\log_2(\frac{3}{2}) + \frac{1}{3}\log_2 3$ $H(1) = 0$

Class 4

$H(0) = 0$ $H(\frac{1}{6}) = -\frac{1}{6}\log_2(\frac{1}{6}) - \frac{5}{6}\log_2(\frac{5}{6})$ $H(\frac{1}{3}) = \frac{1}{3}\log_2 3 + \frac{2}{3}\log_2(\frac{3}{2})$

$H(\frac{1}{2}) = \frac{1}{2}\log_2 2 + \frac{1}{2}\log_2 2 = 1$ $H(\frac{2}{3}) = \frac{2}{3}\log_2(\frac{3}{2}) + \frac{1}{3}\log_2 3$ $H(1) = 0$

$\therefore$ break on subset with class 4 first



$E(x_1|x=1) = 0$ $E(x_1|x=2) = 0$ $E(x_1|x=3) = 0$

$H(x=1) = 0$ $H(x=2) = 0$ $H(x=3) = 0$

$E(x_1|x=4) = 0$

$H(x=4) = 0$

$I(x_1|x=4) = 0$

*Split 1.3

$E(x_1|x=1) = 0$ $E(x_1|x=2) = 0.5$

$H(x=1) = 0$ $H(x=2) = 1$

$I(x_1|x=1) = 0$

$E(x_1|x=3) = 0$

$H(x=3) = 0$

$I(x_1|x=3) = 0$

$E(x_1|x=4) = 0.5$

$H(x=4) = 1$

$I(x_1|x=4) = 0.5$

*Split 1.4

$E(x_1|x=1) = 0$ $E(x_1|x=2) = 0.5$

$H(x=1) = 0$ $H(x=2) = 1$

$I(x_1|x=1) = 0$

$E(x_1|x=3) = 0$

$H(x=3) = 0$

$I(x_1|x=3) = 0$

$E(x_1|x=4) = 0$

$H(x=4) = 0$

$I(x_1|x=4) = 0$

$I_{tree} = 0.50$

Q2 – Bayes

Class 0

$P(x=1|y=0) = 3/5 = 0.6$ $P(x=2|y=0) = 1/5 = 0.2$ $P(x=3|y=0) = 1/5 = 0.2$

$P(x=1|y=1) = 1/5 = 0.2$

Class 1

$P(x=1|y=1) = 1/5 = 0.2$ $P(x=2|y=1) = 0.2$ $P(x=3|y=1) = 0.2$

$P(x=4|y=1) = 0.4$

$P(x=5|y=1) = 0.2$

Class 5

Class 0

$P(x=4) = 0.4$ $P(x=5) = 0.4$ $P(x=6) = 0.2$

Class 1

$P(x=1) = 0.4$ $P(x=4) = 0.2$ $P(x=5) = 0.4$

Class 6

Class 0

$P(x=5) = 0.2$ $P(x=6) = 0.6$ $P(x=7) = 0.2$

Class 1

$P(x=6) = 0.8$ $P(x=8) = 0.2$

Class 7

Class 0

$P(x=6) = 0.4$ $P(x=7) = 0.6$

Class 1

$P(x=6) = 0.4$ $P(x=8) = 0.6$

Class 8

Class 0

$P(x=8) = 0.4$ $P(x=9) = 0.6$

Class 1

$P(x=8) = 0.2$ $P(x=9) = 0.8$

Class 9

Class 0

$P(x=9) = 0.9$ $P(x=0) = 0.1$

Class 1

$P(x=9) = 0.2$ $P(x=0) = 0.8$

Class 1

$A_1 = 0.166\,333$ $C_1 = 0.034\,482$

$A_2 = 0.25556$ $B_1 = 0.034\,482$

Class 2

$A_2 = 0.05\,0556$ $C_2 = 0.155\,931$

$A_3 = 0.0\,0556$ $C_3 = 0.155\,931$

Class 3

$A_4 = 0.58\,333$ $A_5 = 0.174\,101$

$C_4 = 0.174\,101$ $C_5 = 0.034\,483$

Conditional Probability Numerator

Class 0

1) $Class_0 = 0.00\,153\,42$ $Class_1 = 0.000\,237\,91$

2) $Class_0 = 0.00\,0833$ $Class_1 = 0.000\,833$

3) $Class_0 = 0.000\,0833$ $Class_1 = 0.00\,389$

4) $Class_0 = 0.00\,583$ $Class_1 = 0.000\,0146$

5) $Class_0 = 0.000\,153\,833$ $Class_1 = 0.000\,1\,43$

Class 1

6) $Class_0 = 0.00\,167\,5$ $Class_1 = 0.000\,583\,3$

7) $Class_0 = 0.00\,146$ $Class_1 = 0.000\,833$

8) $Class_0 = 0.00\,833$ $Class_1 = 0.000\,833\,3$

9) $Class_0 = 0.000\,833$ $Class_1 = 0.000\,1\,1111$

Class 2

1) $P(x=0) = 0.000\,5\,1\,1\,1