

Assignment 4

Thursday, February 11, 2021

5:24 PM

*The other calculations were done on paper which I have chosen to omit here.

Maintenance ①

$$H(\text{High}) = 0 \quad H(\text{Med}) = 0 \quad H(\text{Low}) = -\frac{1}{2} \log_2 \left(\frac{1}{2}\right) - \frac{1}{2} \log_2 \left(\frac{1}{2}\right) = 1$$

$$H(\text{Maintenance}) = 1 \left(\frac{2}{4}\right) = 0.5$$

Doors

$$H(2) = -\frac{1}{3} \log_2 \left(\frac{1}{3}\right) - \frac{2}{3} \log_2 \left(\frac{2}{3}\right) \quad H(4) = 0$$

$$= 0.91829$$

$$H(\text{Doors}) = 0.91829 \left(\frac{3}{4}\right) = 0.688$$

Trunk Size

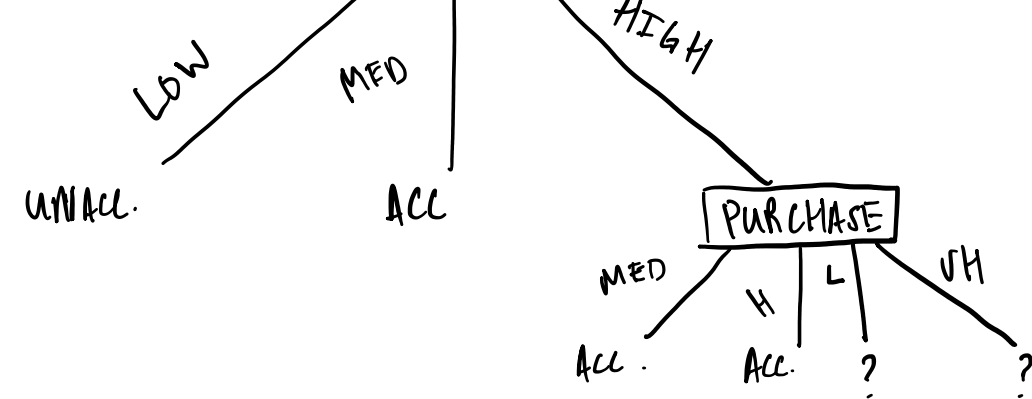
$$H(M) = -\frac{1}{3} \log_2 \left(\frac{1}{3}\right) - \frac{2}{3} \log_2 \left(\frac{2}{3}\right) \quad H(S) = 0$$

$$= 0.91829$$

$$H(\text{Trunk}) = 0.91829 (0.75) = 0.688$$

Purchase = 0.5

∴ b/c entropy is =, example chooses Purchase as lowest



Census Data

Max Education

$$H(\text{Grad}) = 1 \quad H(\text{U.G.}) = -\frac{1}{4} \log_2 \left(\frac{1}{4}\right) - \frac{3}{4} \log_2 \left(\frac{3}{4}\right) = 0.81$$

$$H(\text{H.S.}) = 0.81$$

$$H(\text{Max. Education}) = 1 \left(\frac{2}{10}\right) + (0.81) \left(\frac{4}{10}\right) = 0.85$$

Marital Status

$$H(M) = 1 \quad H(D) = 0 \quad H(NM) = 0$$

$$H(\text{M.S.}) = 0.8$$

Race

$$H(B) = -\frac{3}{4} \log_2 \left(\frac{3}{4}\right) - \frac{1}{4} \log_2 \left(\frac{1}{4}\right) \quad H(W) = -\frac{2}{5} \log_2 \left(\frac{2}{5}\right) - \frac{3}{5} \log_2 \left(\frac{3}{5}\right)$$

$$= 0.8112$$

$$= 0.917095$$

$$H(D) = 0$$

$$H(\text{Race}) = \frac{4}{10} (0.8112) + \frac{5}{10} (0.917095) = 0.80995$$

Solution for H(B) is $-\frac{4}{5} \log_2 \left(\frac{4}{5}\right) - \frac{1}{5} \log_2 \left(\frac{1}{5}\right)$. But there are only 4 data points that are Black.

Gender

$$H(M) = -\frac{2}{6} \log_2 \left(\frac{2}{6}\right) - \frac{4}{6} \log_2 \left(\frac{4}{6}\right) = 0.918$$

$$H(F) = -\frac{3}{4} \log_2 \left(\frac{3}{4}\right) - \frac{1}{4} \log_2 \left(\frac{1}{4}\right) = 0.811$$

$$H(\text{Gender}) = \frac{6}{10} (0.918) + \frac{4}{10} (0.811) = 0.8753$$

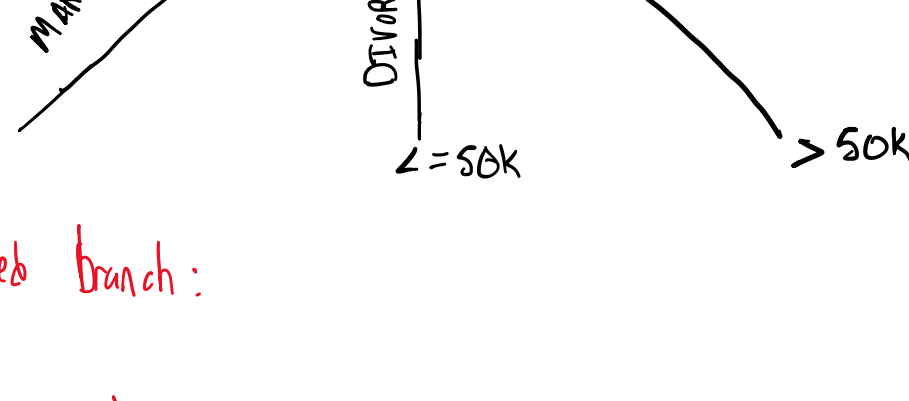
C.O.B

$$G(\text{U.S.}) = -\frac{3}{7} \log_2 \left(\frac{3}{7}\right) - \frac{4}{7} \log_2 \left(\frac{4}{7}\right) = 0.9852$$

$$G(D) = -\frac{1}{3} \log_2 \left(\frac{1}{3}\right) - \frac{2}{3} \log_2 \left(\frac{2}{3}\right) = 0.91829$$

$$G(\text{C.O.B.}) = 0.7 (0.9852) + 0.3 (0.91829) = 0.9852$$

∴ Select Marital Status



For Married branch:

Max Education (8)

$$H(U.G.) = 0 \quad H(\text{U.G.}) = -\frac{1}{4} \log_2 \left(\frac{1}{4}\right) - \frac{3}{4} \log_2 \left(\frac{3}{4}\right) = 0.811278$$

$$H(\text{H.S.}) = -\frac{1}{3} \log_2 \left(\frac{1}{3}\right) - \frac{2}{3} \log_2 \left(\frac{2}{3}\right) = 0.91829$$

$$H(\text{M.E.}) = 0.4 (0.811278) + 0.3 (0.91829) = 0.6$$

Race

$$H(D) = 0 \quad H(B) = -\frac{3}{4} \log_2 \left(\frac{3}{4}\right) - \frac{1}{4} \log_2 \left(\frac{1}{4}\right) = 0.811278$$

$$H(W) = -\frac{1}{3} \log_2 \left(\frac{1}{3}\right) - \frac{2}{3} \log_2 \left(\frac{2}{3}\right) = 0.91829$$

$$H(\text{Race}) = 0.4 (0.811278) + \dots = 0.6$$

Gender

$$H(M) = -\frac{1}{5} \log_2 \left(\frac{1}{5}\right) - \frac{4}{5} \log_2 \left(\frac{4}{5}\right) = 0.72192$$

$$H(F) = 0$$

$$H(\text{Gender}) = 0.5 (0.72192) = 0.36$$

C.O.B

$$H(\text{U.S.}) = -\frac{2}{5} \log_2 \left(\frac{2}{5}\right) - \frac{3}{5} \log_2 \left(\frac{3}{5}\right) = 0.9709505$$

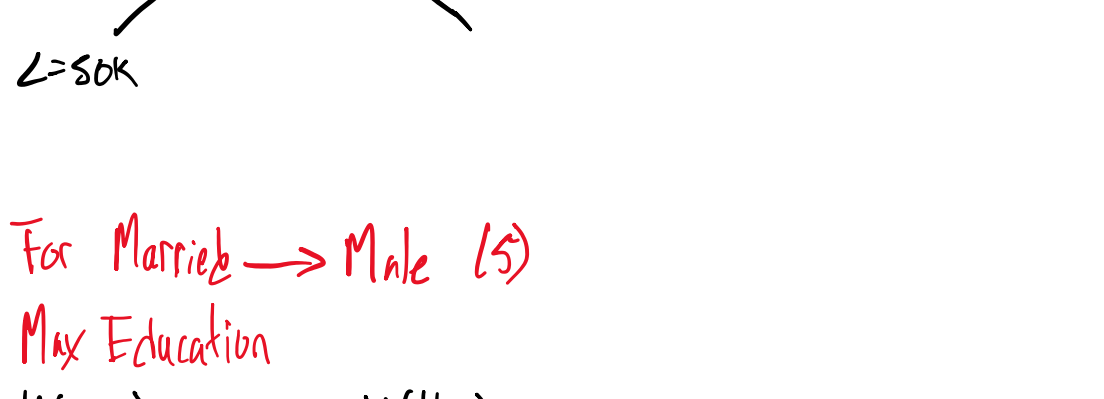
$$H(D) = -\frac{1}{3} \log_2 \left(\frac{1}{3}\right) - \frac{2}{3} \log_2 \left(\frac{2}{3}\right) = 0.91829$$

$$H(\text{L.O.B.}) = 0.3 (0.91829) + 0.5 (0.9709505) = 0.76$$

∴ Select Gender

For Married → Female:

All data points result in L = \$OK



For Married → Male (5)

Max Education

$$H(\text{U.G.}) = 0 \quad H(\text{H.S.}) = 1$$

$$H(\text{Max Education}) = \frac{2}{5} (1) = 0.4$$

Race

$$H(D) = 0 \quad H(B) = 1 \quad H(W) = 0$$

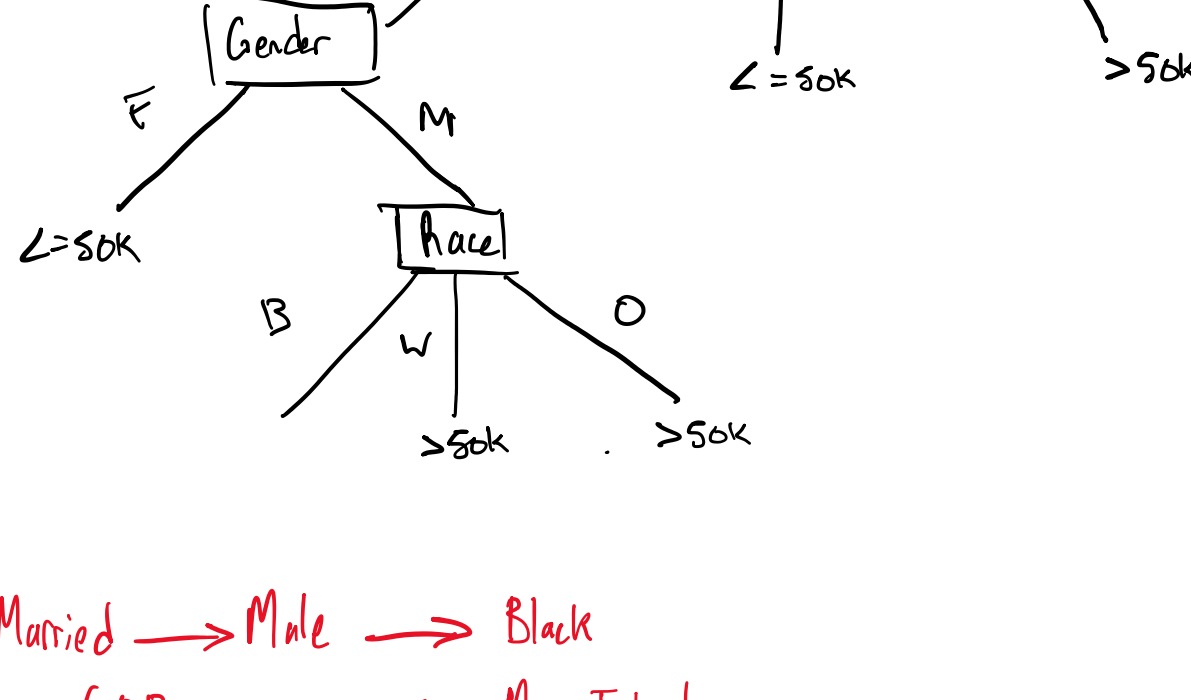
$$H(\text{Race}) = \frac{2}{5} (1) = 0.4$$

C.O.B

$$H(D) = 0 \quad H(\text{U.S.}) = -\frac{1}{4} \log_2 \left(\frac{1}{4}\right) - \frac{3}{4} \log_2 \left(\frac{3}{4}\right) = 0.811278$$

$$H(\text{L.O.B.}) = \frac{4}{5} (0.811278) = 0.64$$

∴ b/c Education and Race are equal. Arbitrarily select Race.



For Married → Male → Black

Can't use C.O.B so ∴ use Max Education

Max Education

$$H(\text{H.S.}) = 0 \quad H(\text{U.G.}) = 0$$

