

## Assignment 6 Soln

$$1. P(HBP) = \sum_s \sum_{me} P(hbp | s, me) P(s) P(me) \\ = .468$$

$$2. P(HD) = \sum_{hbp} \sum_{ath} \sum_{fh} P(hd | hbp, ath, fh) P(hbp) \frac{P(ath)}{P(fh)} \\ = .66$$

$$3. P(HD | Rapid) = \frac{P(Rapid | HD) P(HD)}{P(Rapid)}$$

We need to calc.  $P(Rapid)$

$$P(Rapid) = \sum_{hd} P(Rapid | HD) P(HD)$$

$$= (.99 \times .66) + (.30 \times .34) = .7554$$

Plug in values:

$$P(Rapid | HD) = .99 \quad \text{Given in Bayes Net}$$

$$P(HD) = .66 \quad \text{Calculated in Q2}$$

$$\frac{P(Rapid | HD) P(HD)}{P(Rapid)} = \frac{.99 \times .66}{.7554} = .86$$

$$4. \quad P(HBP | HD, FH) = \frac{P(HBP, HD, FH)}{P(HD, FH)}$$

$$= \frac{P(HD | HBP, FH) P(HBP) P(FH)}{P(HD | FH) P(FH)}$$

Cancel FH

$$= \frac{P(HD | HBP, FH) P(HBP)}{P(HD | FH)}$$

$$= \frac{\sum_{aH} P(HD | HBP, FH_N^{aH}) P(HBP) P(AH)}{\sum_{aH} \sum_{hbp} P(HD | HBP, FH, AH) P(HBP) P(AH)}$$

$$= \frac{(.92 \times .468 \times .53) + (.75 \times .468 \times .47)}{(.92 \times .468 \times .53) + (.75 \times .468 \times .47) + (.81 \times .532 \times .53) + (.38 \times .532 \times .47)}$$

$$= .55 \quad \text{or} \quad .548$$

Extra Credit

5.

$$P(S|HD) = \frac{P(HD|S)P(S)}{P(HD)} \quad \text{or} \quad \frac{P(HD, S)}{P(HD)}$$

$$= \frac{\sum_{ATR} \sum_{FH} \sum_{HBP} P(HD|ATR, FH, HBP) P(HBP|S) P(ATR) P(FH)}{P(HD)}$$

$$P(HBP|S) = \frac{\sum_{ME} P(HBP|S, ME) P(S) P(ME)}{P(S)}$$
$$= \frac{(.60 \times .20 \times .50 + .72 \times .20 \times .50)}{.20}$$

$$= .66$$

$$P(HD|S) = (.92 \times .66 \times .53 \times .15) + (.91 \times .66 \times .53 \times .85) +$$
$$(.75 \times .47 \times .66 \times .15) + (.81 \times .53 \times .34 \times .15) +$$
$$(.77 \times .53 \times .34 \times .85) + (.69 \times .47 \times .66 \times .85) +$$
$$(.38 \times .47 \times .34 \times .15) + (.23 \times .47 \times .34 \times .85)$$
$$= .71586$$

$$P(S|HD) = \frac{.71586 \times .20}{.66} = .217 \approx .22$$

↑  
calculated  
in question 2

$$6. P(S | HD, HBP) = P(S | HBP)$$

Due to independence

$$P(S | HBP) = \frac{P(HBP | S) P(S)}{P(HBP)}$$

assumption

$$= \frac{.66 \times .20}{.486} = .27$$

$$7. P(ME | Ang) = \frac{P(Ang | ME) P(ME)}{P(Ang)} = \frac{P(ME, Ang)}{P(Ang)}$$

$$P(Ang, ME) = \sum_{HD} \sum_{FH} \sum_{AIR} \sum_{HBP} \sum_{SM} P(Ang | HD) P(HD | HBP, AIR, FH) P(AIR) P(FH) P(HBP | S, ME) P(S) P(ME)$$

see code = .309  
on next page

$$P(Ang) = \sum_{HD} P(Ang | HD) P(HD)$$

$$= .85 \times .66 + .40 \times .34 = .697$$

$$P(ME | Ang) = \frac{.309}{.697} = .44$$

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2
3 FH = [0.15, 0.85]
4 Athero = [0.53, 0.47]
5 HBP = [0.60, 0.33]
6 HD = [0.92, 0.91, 0.81, 0.77, 0.75, 0.69, 0.38, 0.23, 0.08, 0.09,
7     0.19, 0.23, 0.25, 0.31, 0.62, 0.77]
8 Ang = [0.85, 0.40]
9 Sm = [0.20, 0.80]
10 prob = 0
11 i = -1
12
13 for a in Ang:
14     for fh in FH:
15         for ath in Athero:
16             for hbp in HBP:
17                 i = i + 1
18
19                 for s in Sm:
20                     prob = prob +(HD[i] * a * fh * ath * hbp * s * .50)
21                     print prob
22
23 print prob
24
25
26

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