

## Sample Answers to Chapter 6

6.1

$$\begin{aligned} \text{Given } P(\text{cancer}) &= .008, & P(\neg\text{cancer}) &= .992, \\ P(+|\text{cancer}) &= .98, & P(-|\text{cancer}) &= .02, \\ P(+|\neg\text{cancer}) &= .03, & P(-|\neg\text{cancer}) &= .97 \end{aligned}$$

$$\begin{aligned} P(\text{cancer}|++) &\propto P(++|\text{cancer}) * P(\text{cancer}) \\ &= P(+|\text{cancer}) * P(+|\text{cancer}) * P(\text{cancer}) \quad (\because \text{the two tests are independent}) \\ &= (.98) * (.98) * (.008) \\ &= .0076832 \end{aligned}$$

$$\begin{aligned} P(\neg\text{cancer}|++) &\propto P(++|\neg\text{cancer}) * P(\neg\text{cancer}) \\ &= P(+|\neg\text{cancer}) * P(+|\neg\text{cancer}) * P(\neg\text{cancer}) \\ &= (.03) * (.03) * (.992) \\ &= .0008928 \end{aligned}$$

Therefore,

$$P(\text{cancer}|++) = .0076832 / (.0076832 + .0008928) = .8959$$

$$P(\neg\text{cancer}|++) = .0008928 / (.0076832 + .0008928) = .1041$$

6.2

$$\begin{aligned} \because P(\text{cancer}|+) + P(\neg\text{cancer}|+) &= 1, \\ P(\text{cancer}|+) &= P(+|\text{cancer}) * P(\text{cancer}) / P(+), \\ P(\neg\text{cancer}|+) &= P(+|\neg\text{cancer}) * P(\neg\text{cancer}) / P(+). \end{aligned}$$

Therefore,

$$P(+|\text{cancer}) * P(\text{cancer}) / P(+) + P(+|\neg\text{cancer}) * P(\neg\text{cancer}) / P(+) = 1,$$

Implies,

$$P(+) = P(+|\text{cancer}) * P(\text{cancer}) + P(+|\neg\text{cancer}) * P(\neg\text{cancer}).$$

$\therefore$

$$\begin{aligned} P(\text{cancer}|+) &= P(+|\text{cancer}) * P(\text{cancer}) / P(+) \\ &= (P(+|\text{cancer}) * P(\text{cancer})) / (P(+|\text{cancer}) * P(\text{cancer}) + P(+|\neg\text{cancer}) * P(\neg\text{cancer})), \end{aligned}$$

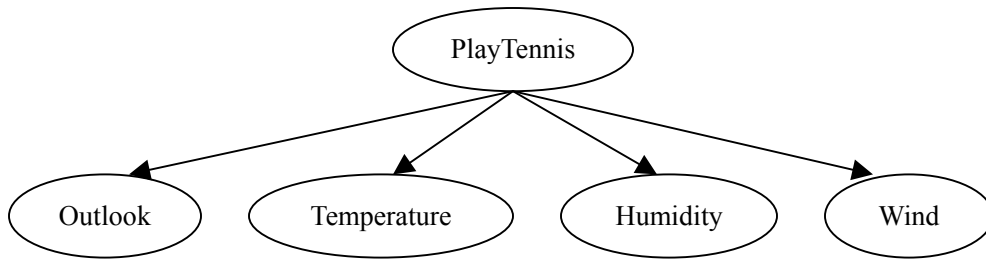
and

$$\begin{aligned} P(\neg\text{cancer}|+) &= P(+|\neg\text{cancer}) * P(\neg\text{cancer}) / P(+) \\ &= P(+|\neg\text{cancer}) * P(\neg\text{cancer}) / (P(+|\text{cancer}) * P(\text{cancer}) + P(+|\neg\text{cancer}) * P(\neg\text{cancer})). \end{aligned}$$

The method to compute the posterior probability of cancer by normalizing the quantities  $P(+|\text{cancer}) * P(\text{cancer})$  and  $P(+|\neg\text{cancer}) * P(\neg\text{cancer})$  is valid.

6.6

Bayesian Belief Network:



Conditional Probability Table associated with Wind:

	PlayTennis	$\neg$ PlayTennis
Strong	1/3	0.6
Weak	2/3	0.4