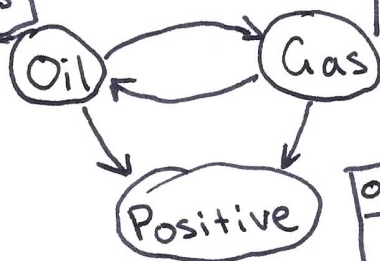


Question 1

a) $P(\text{Oil}) = 0.5$
 $P(\text{Gas}) = 0.2$
 $P(\text{Neither}) = 0.3$

Gas	$P(\text{Oil})$
0	0.625
1	0

Oil	$P(\text{Gas})$
0	0.4
1	0



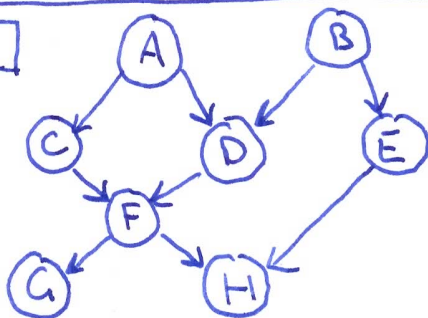
Oil	Gas	$P(\text{Positive})$
0	0	0.1
0	1	0.3
1	1	0.9

b) $P(\text{Oil} | \text{Positive}) = \frac{P(\text{Positive} | \text{Oil})P(\text{Oil})}{P(\text{Positive} | \text{Oil})P(\text{Oil}) + P(\text{Positive} | \text{Gas})P(\text{Gas}) + P(\text{Positive} | \text{Neither})P(\text{Neither})}$

$$= \frac{0.9(0.5)}{0.9(0.5) + 0.3(0.2) + 0.1(0.3)}$$

$$= \boxed{0.8333}$$

Question 2



A	$P(A)$
1	0.2
0	0.8

B	$P(B)$
1	0.7
0	0.3

B	E	$P(E B)$
1	1	0.1
1	0	0.9
0	1	0.9
0	0	0.1

A	B	D	$P(D AB)$
1	1	1	0.5
1	1	0	0.5
1	0	1	0.6
1	0	0	0.4
0	1	1	0.1
0	1	0	0.9
0	0	1	0.8
0	0	0	0.2

a) $P(A, B, C, D, E, F, G, H)$

$$= P(G|F)P(H|F, E)P(F|C, D)P(C|A)P(D|A, B)P(E|B)P(A)P(B)$$

b) $f(G, F)f(H, F, E)f(F, C, D)f(C, A)f(D, A, B)f(E, B)f(A)f(B)$

c) $f(G, F)f(H, F, E)\sum_a f(F, C, D)\sum_b f(E, B)\sum_a f(C, A)f(D, A, B)f(a)f(b)$

d) $P(\neg a, \neg b, c, d, \neg e, f, \neg g, h)$

$$= P(\neg g|f)P(h|f, \neg e)P(f|c, d)P(c|a)P(d|a, \neg b)P(\neg e|b)P(a)P(\neg b)$$

$$= P(\neg g|f)P(h|f, \neg e)P(f|c, d)P(c|a)(0.6)(0.1)(0.2)(0.3)$$

$$= 0.0036 [P(\neg g|f)P(h|f, \neg e)P(f|c, d)P(c|a)]$$

e) $P(\neg a, b) = P(\neg a)P(b)$ (They are independent)

$$= 0.8(0.7)$$

$$= \boxed{0.56}$$

$$P(\neg e|a) = \frac{P(\neg e \wedge a)}{P(a)} = \frac{P(\neg e)P(a)}{P(a)}$$

$$= P(\neg e) = P(\neg e|b)P(b) + P(\neg e|\neg b)P(\neg b)$$

$$= 0.9(0.7) + 0.1(0.3)$$

$$= \boxed{0.66}$$

Question 2 cont.

 $I(\text{Var}, \{\text{Parents}\}, \{\text{Non Descendants}\})$

$$\begin{aligned}
 f) & I(A, \{\emptyset\}, \{B, E\}) \quad I(E, \{B\}, \{A, C, D, F, G\}) \\
 & I(B, \{\emptyset\}, \{A, C\}) \quad I(F, \{C, D\}, \{A, B, E\}) \\
 & I(C, \{A\}, \{B, D, E\}) \quad I(G, \{F\}, \{A, B, C, D, E, H\}) \\
 & I(D, \{A, B\}, \{C, E\}) \quad I(H, \{F, E\}, \{A, B, C, D, G\})
 \end{aligned}$$

$$g) \{A, B, F, C\}$$

$$\begin{aligned}
 h) & f(e, b) = 0.1(0.7) = 0.07 \\
 & f(\neg e, b) = 0.9(0.7) = 0.63 \\
 & f(e, \neg b) = 0.9(0.3) = 0.27 \\
 & f(\neg e, \neg b) = 0.1(0.3) = 0.03
 \end{aligned}$$

$$\begin{aligned}
 & f(d, a, b) = 0.5(0.2)(0.7) = 0.07 \\
 & f(\neg d, a, b) = 0.5(0.2)(0.7) = 0.07 \\
 & f(d, a, \neg b) = 0.6(0.2)(0.3) = 0.036 \\
 & f(\neg d, a, \neg b) = 0.4(0.2)(0.3) = 0.024 \\
 & f(d, \neg a, b) = 0.1(0.8)(0.7) = 0.056 \\
 & f(\neg d, \neg a, b) = 0.9(0.8)(0.7) = 0.504 \\
 & f(d, \neg a, \neg b) = 0.8(0.8)(0.3) = 0.194 \\
 & f(\neg d, \neg a, \neg b) = 0.2(0.8)(0.3) = 0.048
 \end{aligned}$$

$$\begin{aligned}
 i) & P(d) = \sum_a \sum_b f(d, a, b) = 0.354 \\
 & P(\neg d) = \sum_a \sum_b f(\neg d, a, b) = 0.646
 \end{aligned}$$