Foundations of Artificial Intelligence
Exercise Sheet 8

Robin Vogt, Riccardo Salvalaggio, Simon Lempp, Josephine Bergmeier

September 23, 2021

Exercise 8.1

a)

E,T and O,T are independent. Therefore they're for sure conditionally independent.

$$P(e \wedge t|u) = P(e|t,u)P(t|u) \overset{e,t\ independent}{=} P(e|u)P(t|u)$$

and therefore E,T are conditionally independent. Same follows for O,T.

$$P(e \wedge o|u) = P(e|o,u)P(o|u) = 0 \cdot P(o|u) = 0 \neq \frac{6}{25} = \frac{3}{5} \cdot \frac{2}{5} = P(e|u) \cdot P(o|u)$$

b)

$P(a, \neg b, \neg d, e) = P(a|\neg b, \neg d, e)P(\neg b|\neg d, e)P(\neg d|e)P(e) = P(a)P(\neg b)P(\neg d)P(e)$

$P(A, notB, notD, E) = P(A)P(notB)P(notD|notB)P(E|A, notB, notD) = 0.6 \cot 0.8 \cdot 0.5 \cdot P(\neg d) = 1 - (0.5 \cdot 0.2 +$

- 8.1 a)

$P(A, \neg B, \neg D, E)$
$= P(A|\neg B, \neg D, E) * P(\neg B|\neg D, E) * P(\neg D|E) * P(E)$
$= P(A) * P(\neg B) * (\neg D) * P(E)$
$= 0.6 * 0.2 * 0.82 * 0.266 = 0.026$

$P(D) = P(D, B) + P(D, \neg B) = P(D|B)P(B) + P(D|\neg B)P(\neg B)$
$= 0.1 * 0.8 + 0.5 * 0.2 = 0.18$

$P(\neg D) = 1 - P(D) = 0.82$

$P(C) = P(C, A, B) + P(C, \neg A, B) + P(C, A, \neg B)$
$P(C) = P(C|A, B)P(A|B)P(B) + P(C|\neg A, B)P(\neg A|B)P(B) + P(C|A, \neg B)P(A|\neg B)P(\neg B) +$
$P(C|\neg A, \neg B)P(\neg A|\neg B)P(\neg B)$

$P(C) = 0.1 * 0.6 * 0.8 + 0.2 * 0.4 * 0.8 + 0.1 * 0.6 * 0.2 + 0.8 * 0.2 * 0.4 = 0.188$

$P(E) = P(E, C, D) + P(E, \neg C, D) + P(E, C, \neg D) =$
$= P(E|C, D)P(C|D)P(D) + P(E|\neg C, D)P(\neg C|D)P(D) + P(E|C, \neg D)P(C|\neg D)P(\neg D) +$
$P(E|\neg C, \neg D)P(\neg C|\neg D)P(\neg D)$
$P(E) = 0.5 * 0.188 * 0.18 + 0.3 * 0.812 + 0.18 + 0.9 * 0.188 * 0.82 + 0.1 * 0.812 * 0.82 =$
0.266

Exercise 8.2