Homework 3: James Carroll and Joel Carrillo
Bayesian Inference, Temporal State Estimation and Decision Making under Uncertainty

1. Question 1

    (a) a)

        i. $P(A, B, C, D, E) =$
        ii. $P(A)P(B)P(C)P(D|A, B)P(E|B, C) =$
        iii. $(0.2)(0.5)(0.8)(0.1)(0.3) = 0.0024$

    (b) b)

        i. $P(\neg A)P(\neg B)P(\neg C)P(\neg D)P(\neg E) =$
        ii. $P(\neg A)P(\neg B)P(\neg C)P(\neg D|\neg A, \neg B)P(\neg E|\neg B, \neg C) =$
        iii. $(1 - 0.2)(1 - 0.5)(1 - 0.8)(1 - 0.9)(1 - 0.2) =$
        iv. $(0.8)(0.5)(0.2)(0.1)(0.8) = 0.0064$

    (c) c)

        i. $P(\neg A|B, C, D, E) = \frac{P(\neg A, B, C, D, E)}{P(\neg A, B, C, D, E) + P(A, B, C, D, E)}$
        ii. $P(\neg A, B, C, D, E) = P(\neg A)P(B)P(C)P(D|\neg A, B)P(E|B, C) =$
        iii. $(0.8)(0.5)(0.8)(0.6)(0.3) = 0.0576$
        iv. $\frac{0.0576}{0.0576 + 0.0024} = 0.96$

2. Question 2

    (a) $P(Burglary|JohnCalls = true, MaryCalls = true)$
    Factors:$P(Burglary), P(EQ),$ $P(Alarm|EQ, Burglary), P(JohnCalls|Alarm),$ $P(MaryCalls|Alarm)$
    Elimination Order: EQ, Alarm

    $f_1(Alarm, Burglary) = \sum_{EQ} P(EQ)P(Alarm, EQ, Burglary)$
    $f_2(John, Mary, Alarm, EQ) = \sum_{Alarm} f_1(Alarm, Burglary)P(John|Alarm)P(Mary|Alarm)$
    $P(Burglary|JohnCalls, MaryCalls) = P(Burglary)f_2(John, Mary, Alarm, Burglary)$

    Normalize the above to find $P(Burglary|JohnCalls = true, MaryCalls = true)$

    (b)

    (c)

3. Question 3

(a) a)

    i. By definition: $P(X|MB(X)) = P(X|Parents, Children, PofC)$

    ii. FJPD for parents: $P(Y_i, ..., Y_n) = \prod i = 1^n P(Y_i|Z_i 1)$

    iii. All together:

(b) b)

(c) c)

4. Question 4

    (a)

    (b)

    (c)

    (d)

5. Question 5a

6. Question 5b

7. Question 5c

8. Question 5d

9. Question 5e

10. Question 5f

11. Question 5h