Collaborator(s): Joe Yunis

Note: The table in Q1 and the Bayes Net in Q2 are based on the original rounded values, not the corrected ones.

1. Alarmist JPT (32 points)

Time of Day	Alarm	Burglar	P(T, A, B)
night	true	true	0.060
night	true	false	0.060
night	false	true	0.196
night	false	false	0.084
evening	true	true	0.009
evening	true	false	0.081
evening	false	true	0.063
evening	false	false	0.147
afternoon	true	true	0.007
afternoon	true	false	0.068
afternoon	false	true	0.035
afternoon	false	false	0.14
morning	true	true	0.009
morning	true	false	0.006
morning	false	true	0.028
morning	false	false	0.007

Rough Notes for Q1:

$P(A|T) = P(A)$
$P(T|A) = P(T)$

$P(T|B) \neq P(T)$
$P(A|B) \neq P(A)$

$P(B = true,\ A = true,\ T = night) = 0.060$
$P(B = true,\ A = false,\ T = night) = 0.196$
$P(B = false,\ A = true,\ T = afternoon) = 0.068$
$P(B = false,\ A = false,\ T = morning) = 0.007$

$P(T = night) = 0.4$
$P(A = true) = 0.3$
$P(A = false) = 0.7$

$P(A = true,\ T = evening) = 0.09$
$P(T = evening) = 0.3$

$P(B = false \mid A = true,\ T = evening) = 0.9$
$P(B = false,\ A = true,\ T = evening) = 0.081$
$P(B = true \mid A = true,\ T = evening) = 0.1$
$P(B = true,\ A = true,\ T = evening) = 0.009$

$P(B = true,\ T = evening) = 0.072$

$P(A = true) + P(T = afternoon)$
$\quad - P(A = true,\ T = afternoon)) = 0.475$
$P(A = true) + P(T = afternoon)P(A = false) = 0.475$
$P(T = afternoon) = 0.25$
$P(T = morning) = 0.05$

$P(B = true \mid A = false,\ T = afternoon) = 0.2$
$P(A = false,\ T = afternoon) = 0.175$
$P(B = true,\ A = false,\ T = afternoon) = 0.035$

$P(B = false \mid A = false,\ T = afternoon) = 0.8$
$P(B = false,\ A = false,\ T = afternoon) = 0.14$

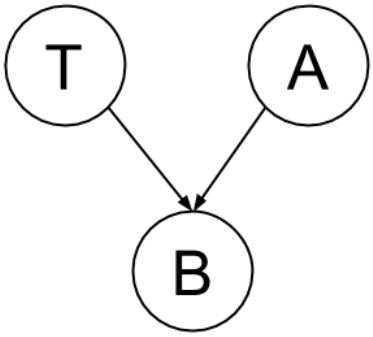
$P(B = false) = 0.593$
$P(B = true) = 0.407$

$P(A = true,\ T = morning \mid B = true) = 0.03$
$P(B = true,\ A = true,\ T = morning) = 0.01221$

$P(T = morning \mid B = false,\ A = true) = 0.027972$

2. All Your Bayes (20 points)

T	P(T)
night	0.4
evening	0.3
afternoon	0.25
morning	0.05



A	P(A)
true	0.3
false	0.7

T	A	P(B|A, T)
night	true	0.5
night	false	0.7
evening	true	0.1
evening	false	0.3
afternoon	true	$0.09\overline{3}$
afternoon	false	0.2
morning	true	0.6
morning	false	0.8

3. Separation Anxiety (24 points)

a. $\neg(A \perp C),\ A \perp C \mid B$

Without conditioning, A is d-connected to C through A-B-C. Conditioning on B makes B a blocker, so A is no longer d-connected to C.

b. $A \perp C,\ \neg(A \perp C \mid B)$

Without conditioning, A is not d-connected to C, since B is a collider. Conditioning on B unblocks B, so A is d-connected to C through A-B-C.

c. $\neg(A \perp C),\ A \perp C \mid B$

Without conditioning, A is d-connected to C through A-B-C. Conditioning on B makes B a blocker, so A is no longer d-connected to C.

d. $A \perp C,\ \neg(A \perp C \mid B)$

Without conditioning, A is not d-connected to C, since B and the bottom blank node are both colliders. Conditioning on B unblocks B, so A is d-connected to C through A-B-_-C.

e. $\neg(A \perp C),\ A \perp C \mid B$

Without conditioning, A is d-connected to C through A-B-_-C. Conditioning on B makes B a blocker, and the right blank node is a collider on A-_-_-C, so A is no longer d-connected to C.

f. $A \perp C,\ A \perp C \mid B$

Without conditioning, A is not d-connected to C, since the bottom and right blank nodes are both colliders. Conditioning on B blocks B, which only further blocks A-B-_-C, so A is still not d-connected to C.

4. Graph CSP (24 points)

a. VT: {blue, green, pink}
   NH: {blue, green}
   ME: {blue, green}
   MA: {blue, green}
   CT: {blue}
   RI: {blue, green, pink}

b. VT, NH: (blue, green), (green, blue), (pink, blue), (pink, green)
   NH, ME: (blue, green), (green, blue)
   VT, MA: (blue, green), (green, blue), (pink, blue), (pink, green)
   NH, MA: (blue, green), (green, blue)
   MA, CT: (green, blue)
   MA, RI: (blue, green), (green, blue), (blue, pink), (green, pink)
   CT, RI: (blue, green), (blue, pink)

c. VT: {blue, pink}
   NH: green
   ME: {blue}
   MA: {blue}
   CT: {blue}
   RI: {blue, green, pink}

d. VT: {}
   NH: green
   ME: {blue}
   MA: {}
   CT: {}
   RI: {}