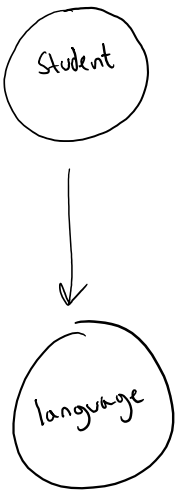
Homework 1

Tuesday, January 24, 2017 3:01 PM

PROBLEM 1

$P(\text{student} = \langle \text{CSE}, \text{ECE} \rangle) = \langle 0.8, 0.2 \rangle$

1.



student	$P(\text{language} = \langle \text{Java}, \text{C++} \rangle)$
CSE	$\langle 0.75, 0.25 \rangle$
ECE	$\langle 0.5, 0.5 \rangle$

2. $P(\text{student} = \text{ECE} \mid \text{language} = \text{C++}) = \dfrac{P(\text{C++} \mid \text{ECE})\, P(\text{ECE})}{P(\text{C++} \mid \text{ECE})\, P(\text{ECE}) + P(\text{C++} \mid \text{CSE})\, P(\text{CSE})}$

$= \dfrac{0.5 \cdot 0.2}{0.5 \cdot 0.2 + 0.25 \cdot 0.80}$

$= 0.3\bar{3}$

$P(\text{CSE} \mid \text{C++}) = \dfrac{P(\text{C++} \mid \text{CSE})\, P(\text{CSE})}{P(\text{C++} \mid \text{ECE})\, P(\text{ECE}) + P(\text{C++} \mid \text{CSE})\, P(\text{CSE})}$

$= \dfrac{0.25 \cdot 0.80}{0.5 \cdot 0.2 + 0.25 \cdot 0.80}$

$= 0.6\bar{6}$

More likely a CSE student turned it in

3.

c.

$$P(CSE \mid C++) = 0.50$$

$$0.50 = \frac{P(C++ \mid CSE)\, P(CSE)}{P(C++ \mid ECE)(1 - P(CSE)) + P(C++ \mid CSE)\, P(CSE)}$$

$$0.50\left[P(C++ \mid ECE)(1 - P(CSE))\right] + 0.50\left[P(C++ \mid CSE)\, P(CSE)\right] = P(C++ \mid CSE)\, P(CSE)$$

$$0.50\left[P(C++ \mid ECE)(1 - P(CSE))\right] = 0.50\left[P(C++ \mid CSE)\, P(CSE)\right]$$

$$0.5 - 0.5\,P(CSE) = 0.25\,P(CSE)$$

$$\frac{0.5}{0.75} = P(CSE)$$

$P(CSE) = 0.6\bar{6}$

$P(ECE) = 1 - P(CSE) = 0.3\bar{3}$

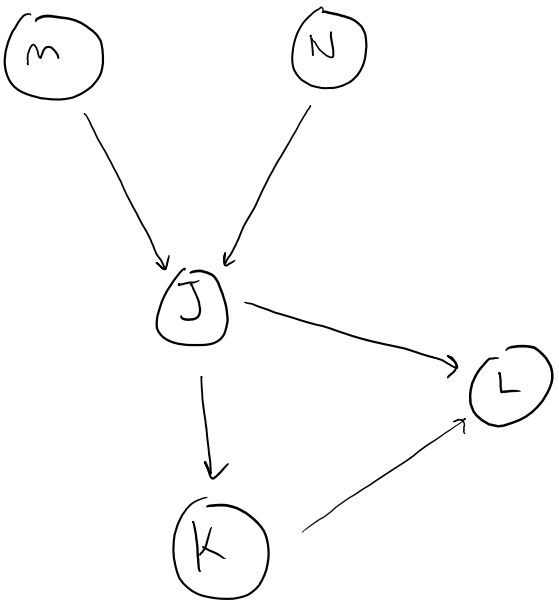
PROBLEM 2

1. $P(m \mid J, K, L, N) = \alpha\, P(J, K, L, N \mid m)\, P(m) = \alpha\, P(J, K, L, N, m)$

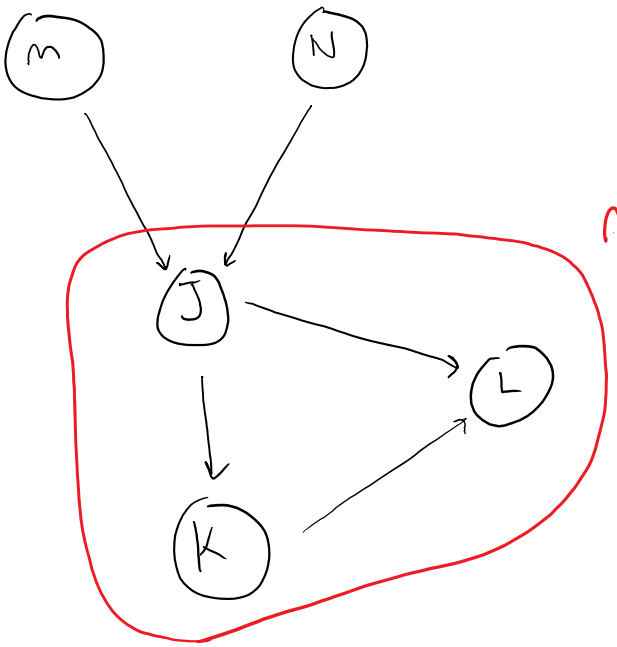
$$= \alpha\, P(J, K, L, N, m)$$

$$= \alpha\, P(J \mid m, N)\, P(K \mid J)\, P(L \mid J, K)\, P(m)\, P(N)$$

2.

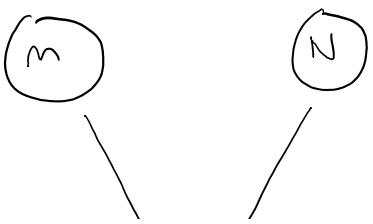


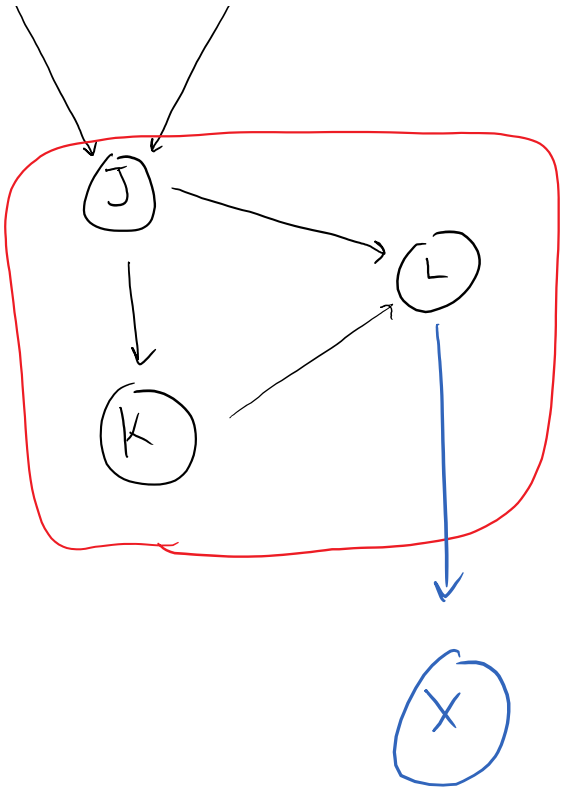
3



Markov Blanket

4.





PROBLEM 3

1. $P(\text{BAR}/\text{BAR}/\text{BAR}) = P(\text{BELL}/\text{BELL}/\text{BELL}) = P(\text{ORANGE}/\text{ORANGE}/\text{ORANGE}) = P(\text{LEMON}/\text{LEMON}/\text{LEMON})$

$= P(\text{CHERRY}/\text{CHERRY}/\text{CHERRY}) = \frac{1}{125}$

$P(\text{CHERRY}/\text{CHERRY}/?) = \frac{4}{125} = \frac{1}{5} \cdot \frac{1}{5} \cdot \frac{4}{5}$

$P(\text{CHERRY}/?/?) = \frac{4}{25} = \frac{1}{5} \cdot \frac{4}{5}$

$$\text{Expected payout} = -1 + \frac{1}{125}(25) + \frac{1}{125}(10) + \frac{1}{125}(5) + \frac{1}{125}(4) + \frac{1}{125}(3) + \frac{4}{125}(2) + \frac{4}{25}(1)$$

$$= -0.4 \text{ coins}$$

Expected loss $= 0 = -1 + \frac{1}{125}X + \frac{1}{125}(10) + \frac{1}{125}(5) + \frac{1}{125}(4) + \frac{1}{125}(3)$

$+ \frac{4}{125}(2) + \frac{4}{25}(1)$

$X = 125\left(1 - \frac{10}{125} - \frac{5}{125} - \frac{4}{125} - \frac{3}{125} - \frac{8}{125} - \frac{20}{125}\right)$

$X = 125\left(1 - \frac{50}{125}\right)$

$X = 125 - 50$

$X = 75$ coins

3. $P(\text{win}) = P(\text{BAR}|\text{BAR}|\text{BAR}) + P(\text{BELL}|\text{BELL}|\text{BELL}) + P(\text{ORANGE}|\text{ORANGE}|\text{ORANGE})$

$+ P(\text{LEMON}|\text{LEMON}|\text{LEMON}) + P(\text{CHERRY}|\text{CHERRY}|\text{CHERRY}) +$

$P(\text{CHERRY}|\text{CHERRY}|?) + P(\text{CHERRY}|?|?)$

$= \frac{1}{125} + \frac{1}{125} + \frac{1}{125} + \frac{1}{125} + \frac{1}{125} + \frac{4}{125} + \frac{4}{25}$

$= \frac{29}{125}$

$P(\text{win}) = \frac{29}{125}$

4. I used the follow python simulation to get the results shown:

```python
import random

trials = 1000000.0

results = []

for i in range(0, int(trials)):

    coins = 10
    spins = 0

    while coins > 0:
        coins -= 1
        spins += 1

        spin = random.randint(1,125)

        if spin == 125:
            coins += 25
        elif spin == 124:
            coins += 10
        elif spin == 123:
            coins += 5
        elif spin == 122:
            coins += 4
        elif spin == 121:
            coins += 3
        elif spin <= 120 and spin >= 117:       # 4 / 125 odds
            coins += 2
        elif spin <= 116 and spin >= 97:        # 20 / 125 odds
            coins += 1

    results.append(spins)

results.sort()
print "Median: " + str((results[int(trials/2)] + results[int(trials/2 - 1)]) / 2.0)
print "Mean: " + str(sum(results) / trials)

```

```
Griffins-MacBook-Pro:Desktop griffinsolimini$ python slot.py
Median: 15.0
Mean: 25.016416
Griffins-MacBook-Pro:Desktop griffinsolimini$ _
```