# 570 HW2

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## 1 Q1

Yes. First command generates the string in fsa7 that has the highest probability calculated by wfst1 while second takes in wfst1_test, which has the same content as fsa7 and using the carmel commands takes that in as standard input(-s means standard input, -l means left hand side transduction, -i means standard input as string)

## 2 Q2

I made 4 NFAs in q2

## 3 Q3

Acceptor build with a python back end so I could use pythons string cleaning and printing abilities.

## 4 Q4

See code but since all of my fsa's were NFAs all of the results result in error and don't produce output. To test everything works as expected I created a new ex file and new fsa's.

I wrote the accept to first load the fsa, next check if its a NFA, if it isn't open the input file and run the fsa through it.

## 5 Q5

$$P(H >= 4) = P(H = 4) + P(H = 5) \tag{1}$$

$$P(H = 4) = \binom{5}{4}(0.8^4)(0.2) = 5 * 0.08192 = 0.4096 \tag{2}$$

$$P(H = 5) = \binom{5}{5}(0.8^5) = 0.32768 \tag{3}$$

$$P(H >= 4) = P(H = 4) + P(H = 5) = 0.4096 + 0.32768 = 0.73728 \tag{4}$$

# 6 Q6

## 6.1 Probability Distribution P(X)

P(X=0)=P(X=0,Y=1)+P(X=0,Y=0)=0.1+0.5=0.6
P(X=1)=P(X=1,Y=1)+P(X=1,Y=0)=0.15+0.25=0.4

| | 0 | 1 |
|---|---|---|
| P(X) | 0.6 | 0.4 |

## 6.2 Probability Distribution P(Y)

P(Y=0)=P(X=0,Y=0)+P(X=1,Y=0)=0.5+0.25=0.75
P(Y=1)=P(X=1,Y=1)+P(X=1,Y=0)=0.15+0.10=0.25

| | 0 | 1 |
|---|---|---|
| P(Y) | 0.75 | 0.25 |

## 6.3 Probability Distribution P(Y$\|\|X$)

P(Y=0$\|\|X = 0) = P(X = 0, Y = 0)/P(X = 0) = 0.5/0.6 = 0.83333$
$P(Y = 0\|\|X = 1) = P(X = 1, Y = 0)/P(X = 1) = 0.25/0.4 = 0.625$
$P(Y = 1\|\|X = 0) = P(X = 0, Y = 1)/P(X = 0) = 0.1/0.6 = 0.16667$
$P(Y = 1\|\|X = 1) = P(X = 1, Y = 1)/P(X = 0) = 0.15/0.6 = 0.25$

| | P(Y=y $\|\|X = 0$ | P(Y=y $\|\|X = 1$ |
|---|---|---|
| P(Y=0) | 0.833 | 0.625 |
| P(Y=1) | 0.16667 | 0.25 |

## 6.4 Are X and Y Independent?

No. If they were independent P(X=0,Y=0) would be P(X=0)*P(Y=0) which P(X=0)=0.6 and P(Y=0)=0.75 so P(X=0)*P(Y=0)=0.45 != what our look up table gives us at 0.5

# 7 Q7

## 7.1 Toss Once

$$P(H) = P(H\|\|C1)P(C1) + P(H\|\|C2)P(C2) + P(H\texttt{C3)P(C3)} \quad (5)$$

$$P(H) = 0.1 * 0.2 + 0.4 * 0.5 + 0.7 * 0.3 = .02 + 0.2 + 0.21 = 0.43 \quad (6)$$

## 7.2 Probability c1 given head

$$P(c1\|\|H) = (P(H\|\|c1)P(c1))/P(H) = (0.1*0.2)/0.43 = 0.02/0.43 = 0.0465116279 \quad (7)$$