

# Lab Report #3

## COM S 572

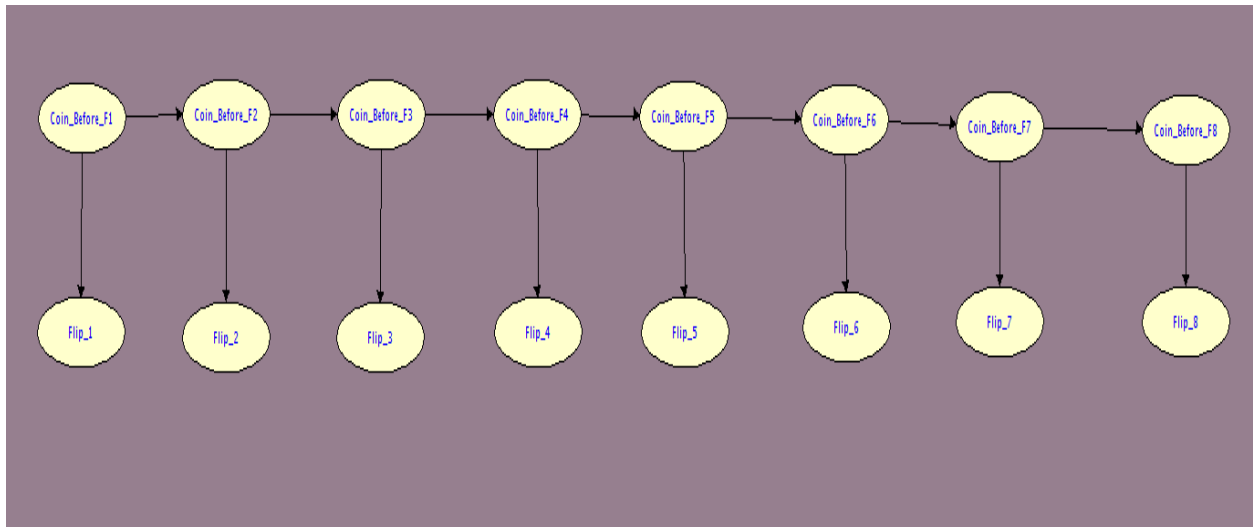
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**Task 1:** I have created a bayesian network for the given scenario on Samiam as Lab3.net, and submitted that file. Now, I would like to briefly explain the variables of the nodes and the conditional probability tables(CPT).



**Figure 1:** The Bayesian network

Coin\_Before\_F1 node represents the coin before flipping the fair coin for the first time and the variables are Fair and Bias. As, it is mentioned in the question that the first flip was done with the fair coin, so the CPT of is node is given here:

**Table 1:** CPT for Coin\_Before\_F1

Coin_Before_F1	Probability
Fair	1.0
Bias	0.0

After the first flip, Lisa could swap the fair coin to bias coin at any time. Coin\_Before\_F2 to Coin\_Before\_F8 nodes represent the probability of Lisa to switch the coin before every flip from flip 2 to flip 8. Once Lisa switches the biased coin with the 40% probability, she won't change the coin for the rest of her flips, so after switching to Bias coin, she will never select Fair coin again, hence the probability of switching to Fair coin from Bias coin is 0. For example, the CPT for Coin\_Before\_F5 is given here:

**Table 2:** CPT for Coin\_Before\_F5

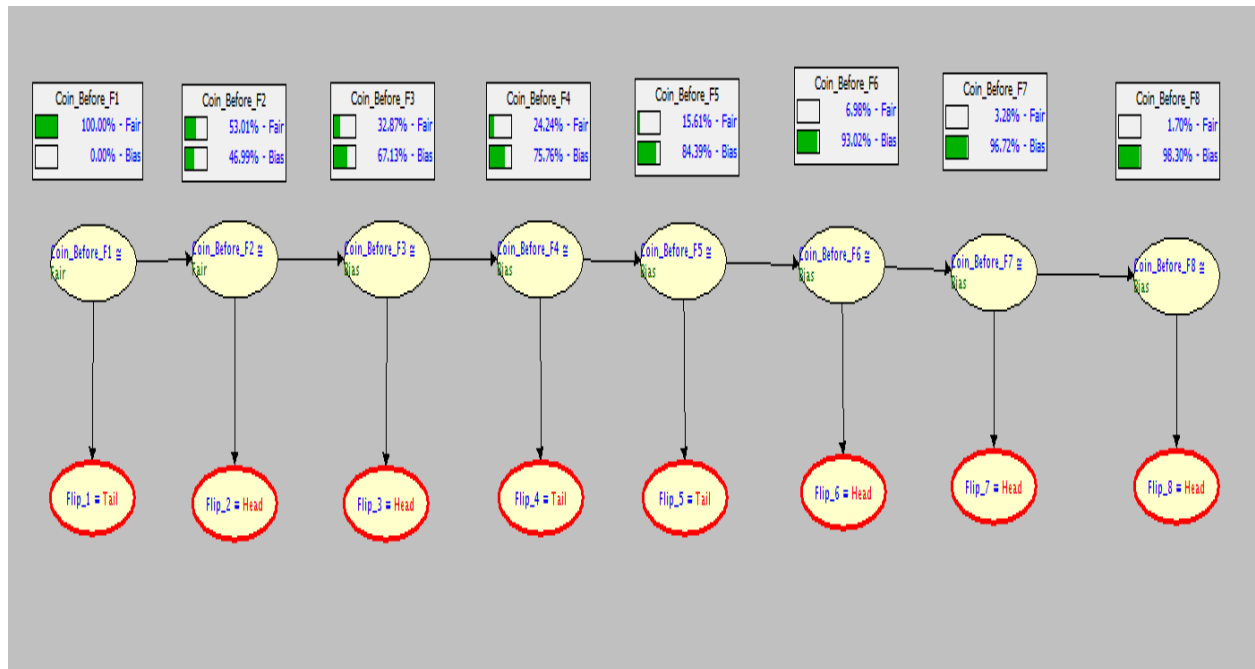
		Coin_Before_F4	
	Variables	Fair	Bias
Coin_Before_F5	Fair	0.6	0.0
	Bias	0.4	1.0

Now, moving to the Flip nodes, all the flip nodes will have the same joint probability. I have denoted the eight flips as Flip\_1 to Flip\_8. These flip variables can take variables Head and Tail. For Fair coin, both Head and Tail outcomes are equally possible. But in the case of a Bias coin, the probability of Head is 70%. For example, the CPT for Flip\_5 is given below:

**Table 3:** CPT for Flip\_5

		Coin_Before_F5	
	Variables	Fair	Bias
Flip_5	Head	0.5	0.7
	Tail	0.5	0.3

**Task 2:** Let us consider the given results of 8 flips, tail, head, head, tail, tail, head, head, head as evidence, our task is to find out whether Lisa was able to switch the coin or not, if yes then when. So, in the provided Lab3.net bayesian network, I gave flip\_1=tail, flip\_2=head, flip\_3=head, flip\_4=tail, flip\_5=tail, flip\_6=head, flip\_7=head, flip\_8=head. From this given evidence E, we have to find out which is the most probable node when Lisa made her switch from fair coin to biased coin. These evidences are selected in the query mode of Samiam. For the algorithm, I have chosen the Junction Tree algorithm (shenoy-shafer).



**Figure 2:** Samiam result on given evidence

From the given figure 2, we can see that, by using the Junction Tree algorithm, it is mostly probable that Lisa switched to a biased coin before the third flip(head).

Now, for Most Probable Explanation(mpe), clicking the mpe option on the query. Here I have provided the result. Here, the result is generated on the previously stated evidence E.

MPE Computation	
File Edit Tools Sensitivity	
P(mpe,e)=0.0030252599999999999 P(mpe e)=0.46988271803402437	
Variable	Value
Coin_Before_F1	Fair
Coin_Before_F2	Bias
Coin_Before_F3	Bias
Coin_Before_F4	Bias
Coin_Before_F5	Bias
Coin_Before_F6	Bias
Coin_Before_F7	Bias
Coin_Before_F8	Bias

**Figure 3:** MPE

Maximum a posteriori(MAP) is shown by clicking the MAP icon on the tools option. The result is being shown here. Here, the result is generated on the previously stated evidence E.

$P(\text{MAP}, e) = 0.003025259999999999$ $P(\text{MAP}   e) = 0.4698827180340243$	
Variable	Value
Coin_Before_F1	Fair
Coin_Before_F2	Bias
Coin_Before_F3	Bias
Coin_Before_F4	Bias
Coin_Before_F5	Bias
Coin_Before_F6	Bias
Coin_Before_F7	Bias
Coin_Before_F8	Bias

**Figure 4:** MAP

So, from the given results and analysis, we can infer that it is highly likely that Lisa was able to switch the fair coin to the biased coin and from Figure 2, we can say this switching took place likely after the second flip. From Figure 3 and Figure 4, Lisa managed to switch the coin after the first flip. So, we can conclude that Lisa most likely was able to switch the coin and flipped remaining times with a biased coin.