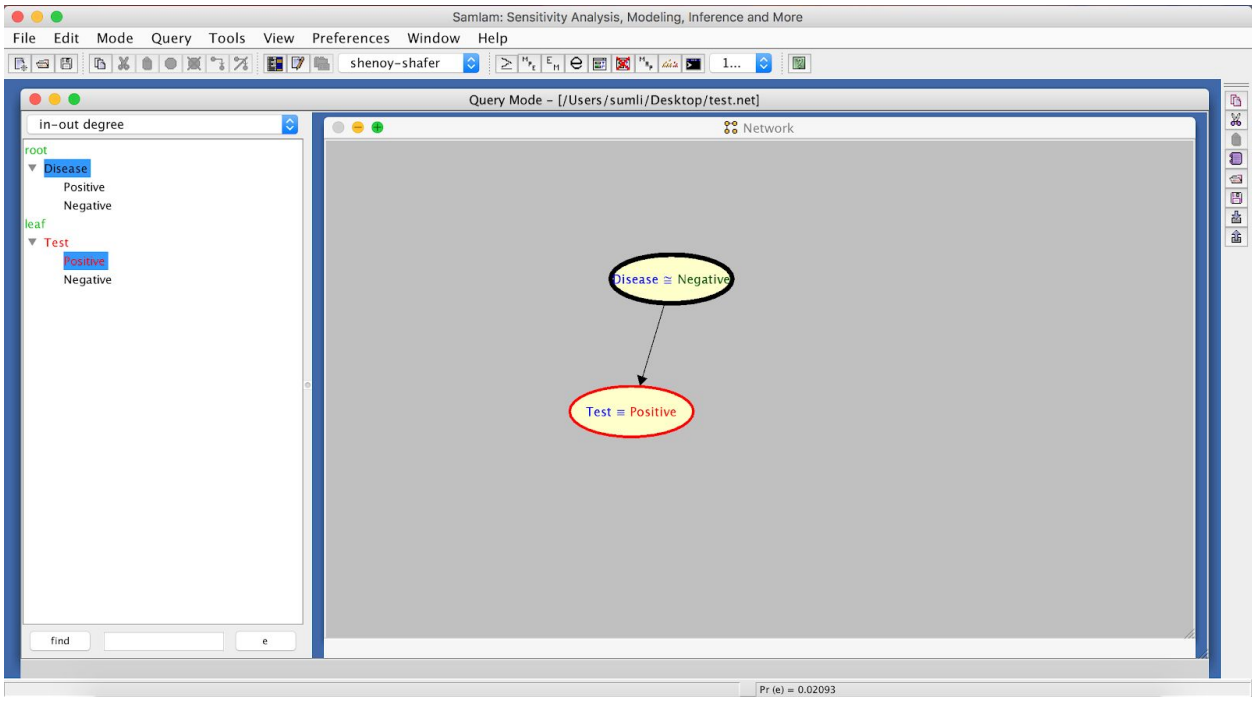
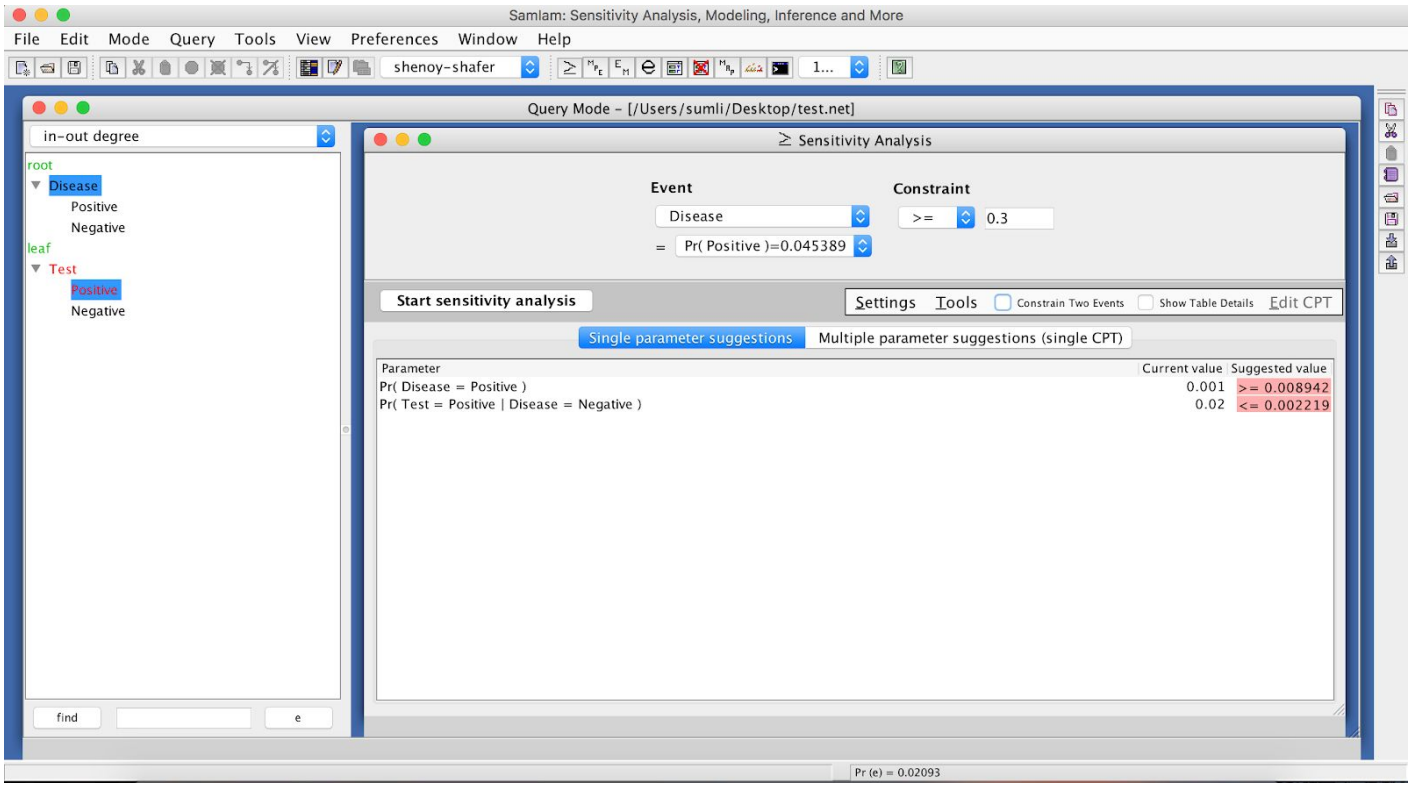
Problem 1

Screenshot of results form SamIam





Explanation of the result

	Constraint to satisfy Pr(D | T) >= 0.3
Prior probability of having the disease (current value = 0.001)	Pr(Disease = yes) >= 0.008942
False positive (current value = 0.02)	Pr(Test = positive | Disease = no) <= 0.002219

The sensitivity analysis does not give any information about the false negative of the result, therefore it does not really affect the Pr (D | T).

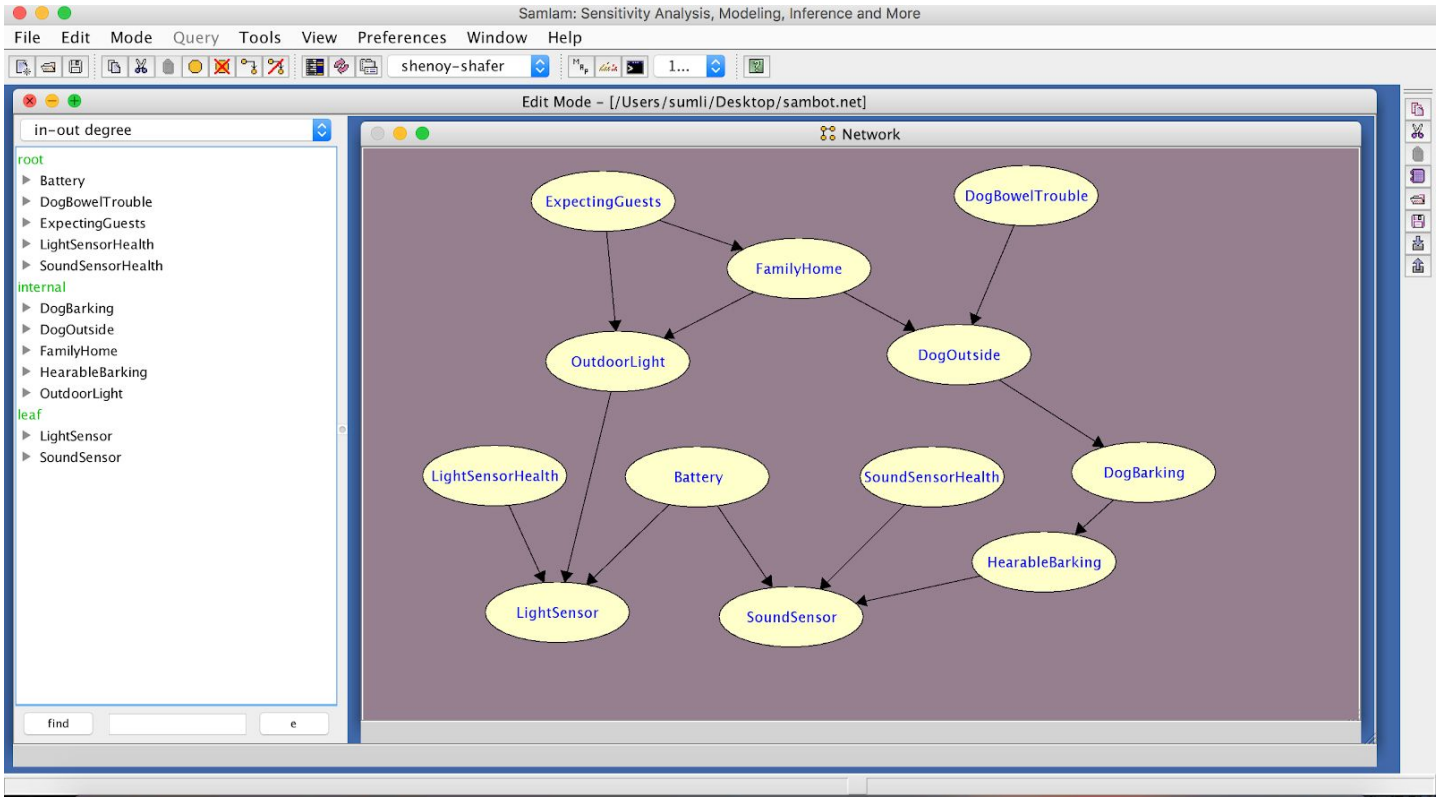
Problem 2

Part (a) Here are the set of variables and the their values

Variables	Values
ExpectingGuests	Yes, No, N/A
FamilyHome	Yes, No, N/A
SoundSensor	On, Off, N/A
LightSensor	On, Off, N/A
HearableBarking	Yes, No, N/A
Battery	Ok, Dead, N/A
SoundSensorHealth	Ok, Broken, N/A
LightSensorHealth	Ok, Broken, N/A
DogBarking	Yes, No, N/A
DogOutside	Yes, No, N/A
OutdoorLight	On, Off, N/A
DogBowelTrouble	Yes, No, N/A

Problem 2

Part (b) The causal structure

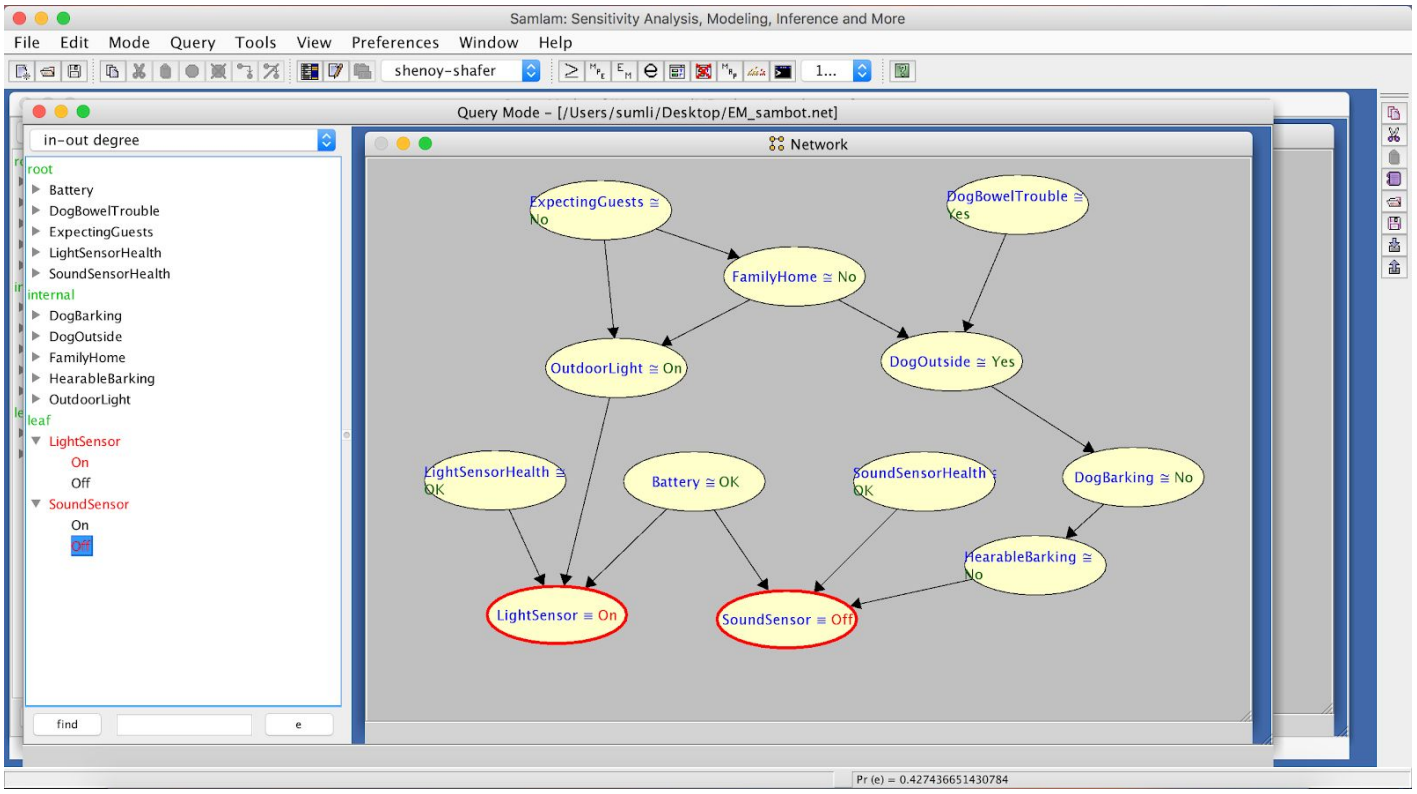


Problem 2

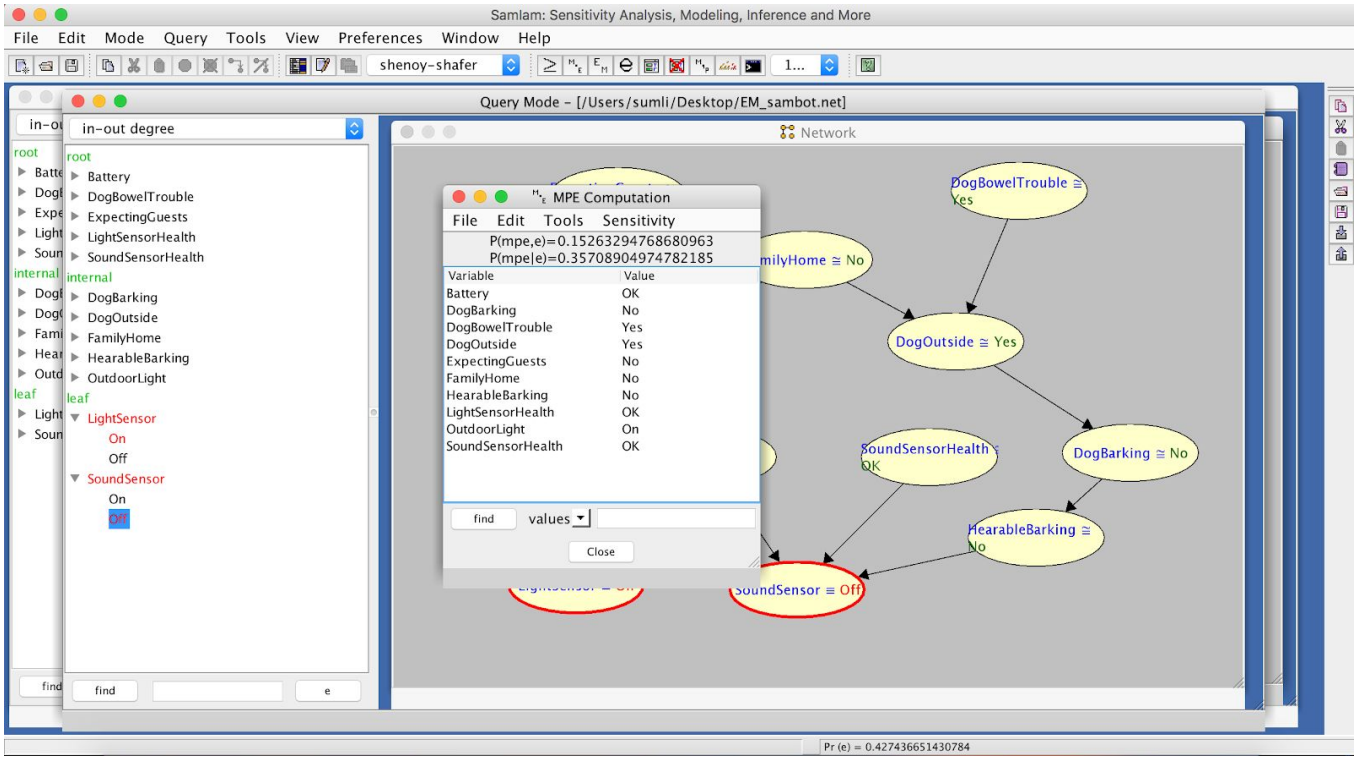
Part (c) Learn the network CPTs using the EM algorithm and the data file (sambot.net)

Question: First instantiation of all variables given that Sambot has sensed the lights to be on, but has sensed no bark. (Given: LightSensor = On ; SoundSensor = Off)

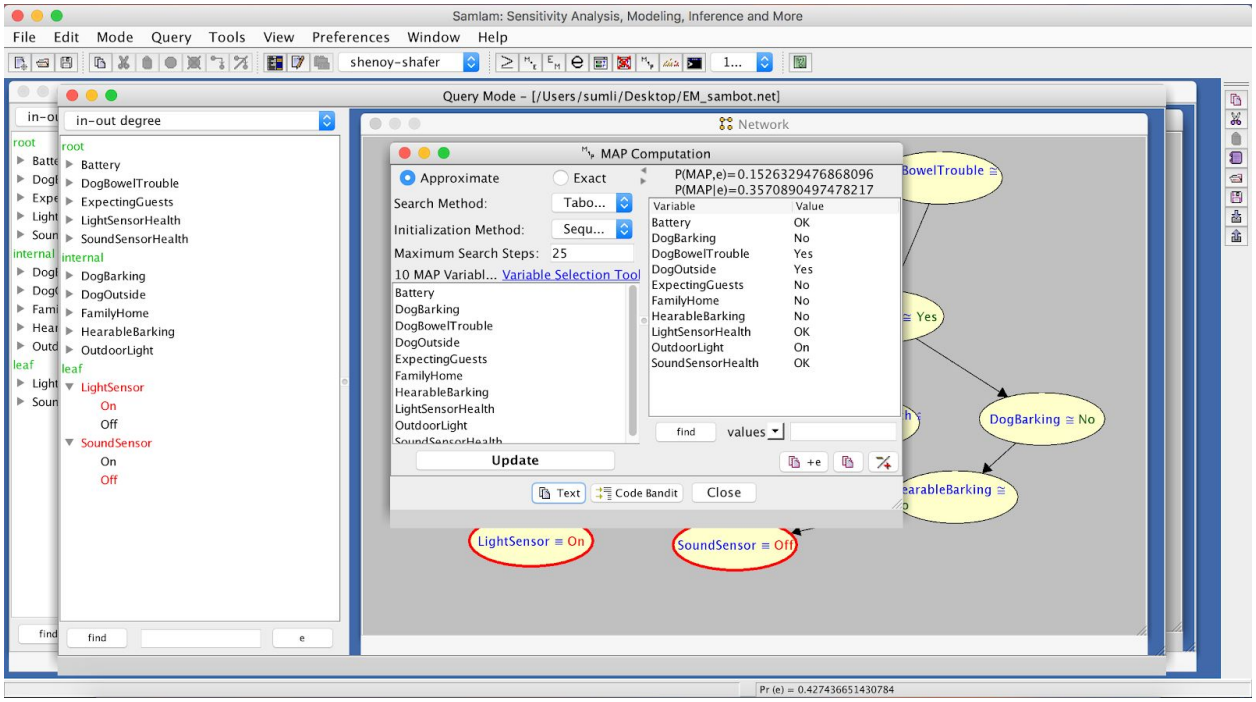
Screenshot (Overall Graph)



Screenshot (MPE Computation)



Screenshot (MAP Computation)



Variable	Value
Battery	OK
DogBarking	No
DogBowelTrouble	Yes
DogOutside	Yes
ExpectingGuests	No
FamilyHome	No
HearableBarking	No
LightSensorHealth	OK
OutdoorLight	On
SoundSensorHealth	OK
LightSensor	On
SoundSensor	Off

Explanation of the procedure of how to get the answers

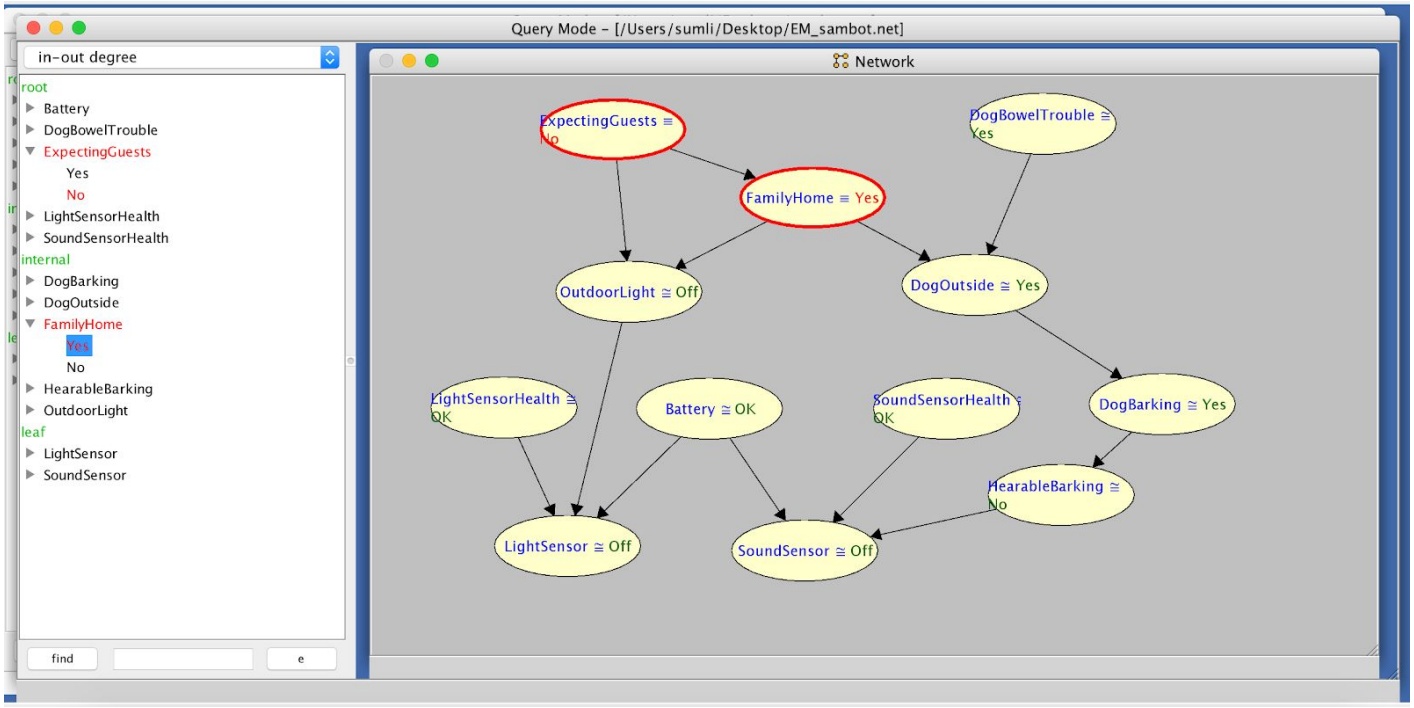
After constructing the Baynesian network diagram, I click the EM button on the top to input the sambot.dat file to learn. Then, it pops up a separate window that says EM_sambot.net. I first set the LightSensor = On and SoundSensor = Off. I click the button to turn on the Query Mode and then I click the MPE computation to get the result window above. After screenshot the MPE data, I click the MAP button and select the 10 MAP variables and get the result as above.
MPE result is the same as MAP result.

Problem 2

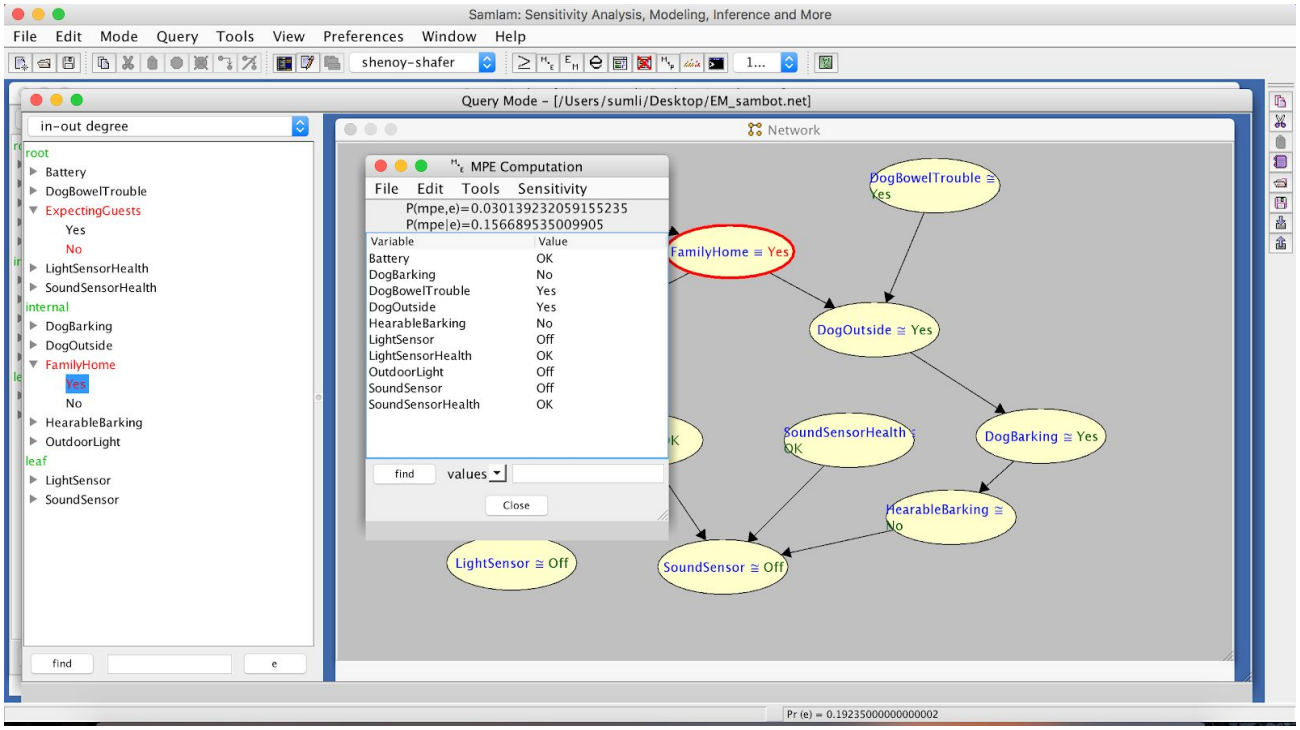
Part (c) Learn the network CPTs using the EM algorithm and the data file (sambot.net)

Question : Second instantiation of the sensors given that family is home and no guests are expected. (Given: ExpectingGuests = No ; FamilyHome = Yes)

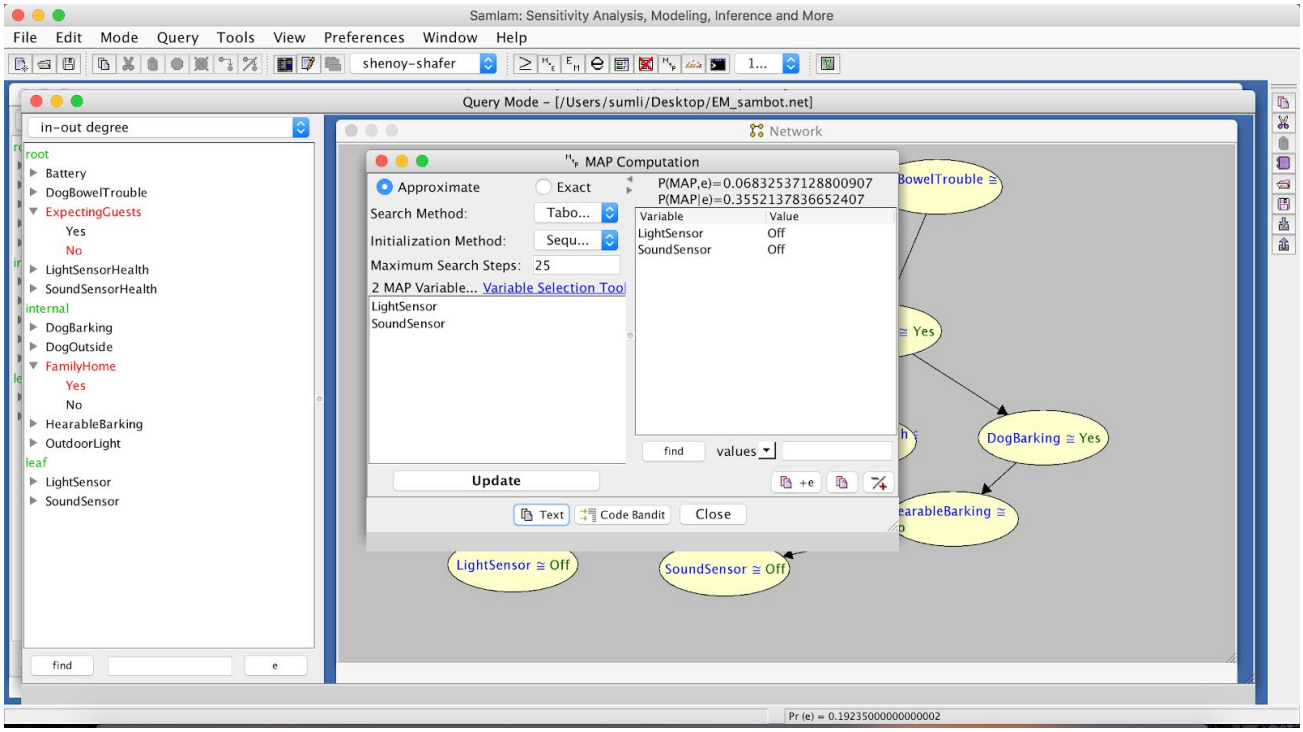
Screenshot (Overall Graph)



Screenshot (MPE Computation)



Screenshot (MAP Computation)



Variable	Value
LightSensor	Off
SoundSensor	Off

Explanation of the procedure of how to get the answers

After constructing the Baynesian network diagram, I click the EM button on the top to input the sambot.dat file to learn. Then, it pops up a separate window that says EM_sambot.net. I first set the ExpectingGuests = No and FamilyHome = Yes. I click the button to turn on the Query Mode and then I click the MPE computation to get the result window above. After screenshot the MPE data, I click the MAP button and select the 2 MAP variables and get the result as above.
MPE result is the same as MAP result.

Problem 2

Question: The smallest set of variables Z in your network such that the two sensors are independent given Z. Justify your answers based on d-separation.

The smallest set of variables Z in the network could be {Battery, DogBarking}.

Path 1 : SoundSensor -> Battery -> LightSensor (blocked because of included Battery in Z)

Path 2 : LightSensor -> Battery -> SoundSensor (blocked because of included Battery in Z)

Path 3 : SoundSensor -> HearableBarking -> DogBarking -> DogOutside -> FamilyHome -> OutdoorLight -> LightSensor (blocked because of included DogBarking in Z)

Path 4 : LightSensor -> OutdoorLight -> FamilyHome -> DogOutside -> DogBarking -> HearableBarking -> SoundSensor (blocked because of included DogBarking in Z)

Path 5 : SoundSensor -> HearableBarking -> DogBarking -> DogOutside -> FamilyHome -> ExpectingGuests -> OutdoorLight -> LightSensor
(blocked because of included DogBarking in Z)

Path 6 : LightSensor -> OutdoorLight -> ExpectingGuests -> FamilyHome -> DogOutside -> DogBarking -> HearableBarking -> SoundSensor (blocked because of included DogBarking in Z)

All the paths between LightSensor and SoundSenor are blocked, so the two sensors are d_separated and thus independent.

Problem 2

Question: The type of network you constructed: tree, polytree, multiply-connected network

The type of network I have constructed is a multiply-connected network.
It is impossible to be a tree since there are nodes that have more than one parent node.
It is also impossible to be a polytree (singly-connected network) because the network will not be acyclic if all the directed edges are changed to be undirected edges.