# CS 161 HW 8

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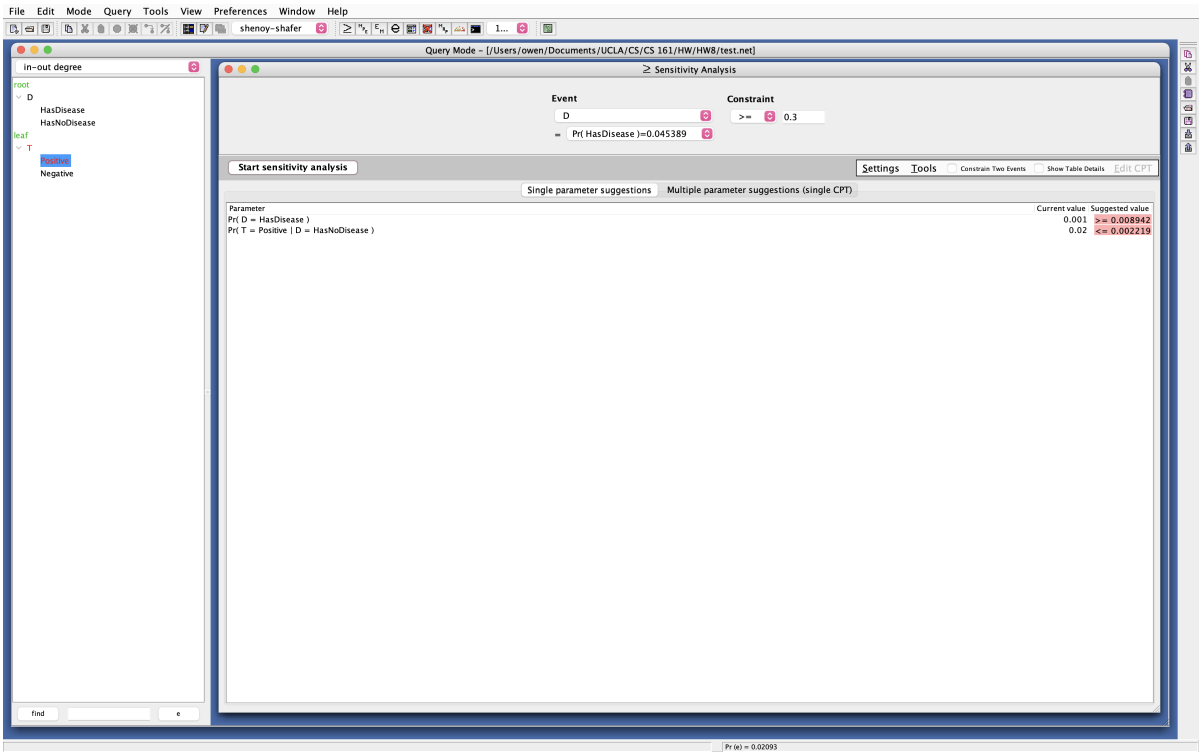
## 1 Question 1:




By the attached image above, we see that in order to ensure that $Pr(D|T) \geq 0.3$:

i. The prior probability of having the disease need to be greater than 0.008942;

ii. The probability of false positive for the test need to be less than 0.002219;

iii. The probability of false negative for the test has no constraint.

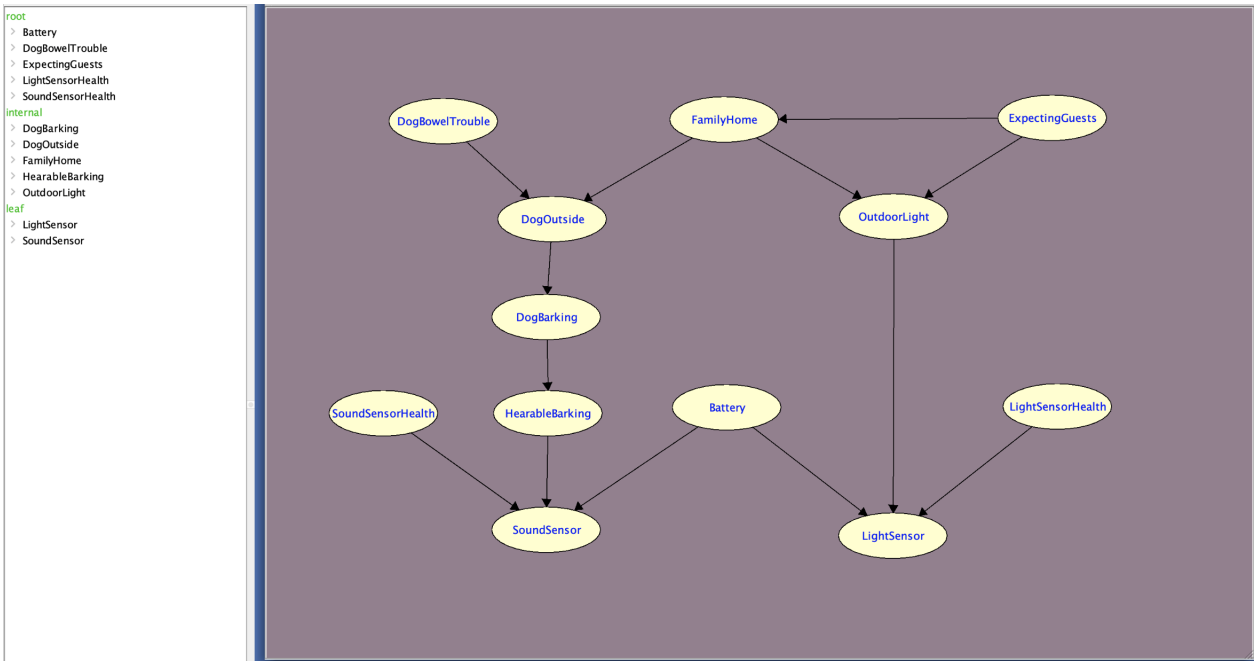
## 2 Question 2:

### a.

The set of variables and their values:

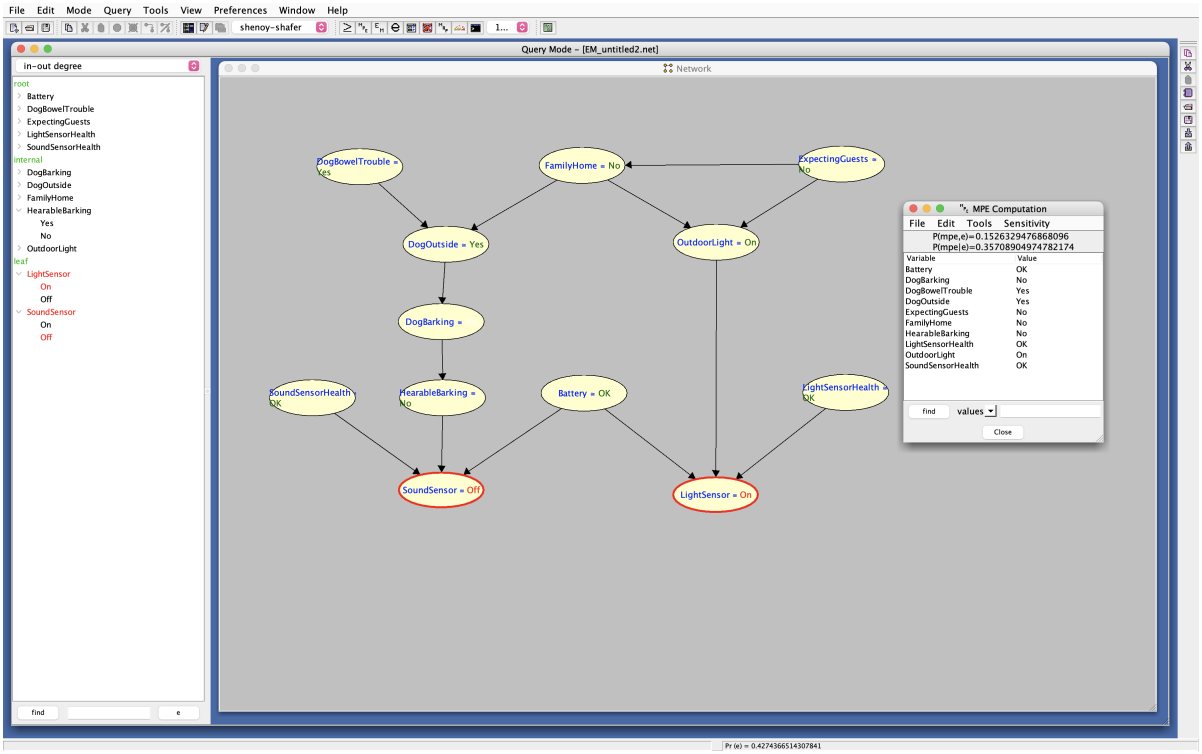
ExpectingGuests: Yes/No
FamilyHome: Yes/No
SoundSensor: On/Off
LightSensor: On/Off
HearableBarking: Yes/No
Battery: OK/Dead
SoundSensorHealth: OK/Broken
LightSensorHealth: OK/Broken
DogBarking: Yes/No
DogOutside: Yes/No
OutdoorLight: On/Off
DogBowelTrouble: Yes/No

### b.



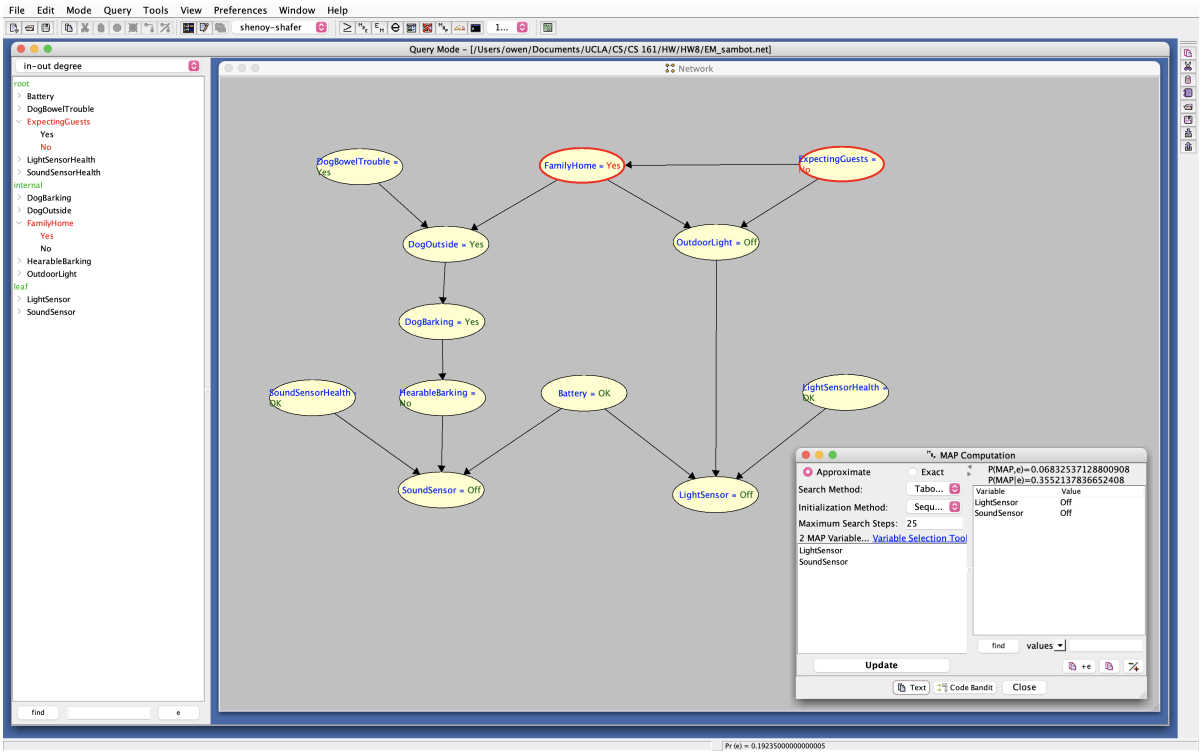
**c.**

i.



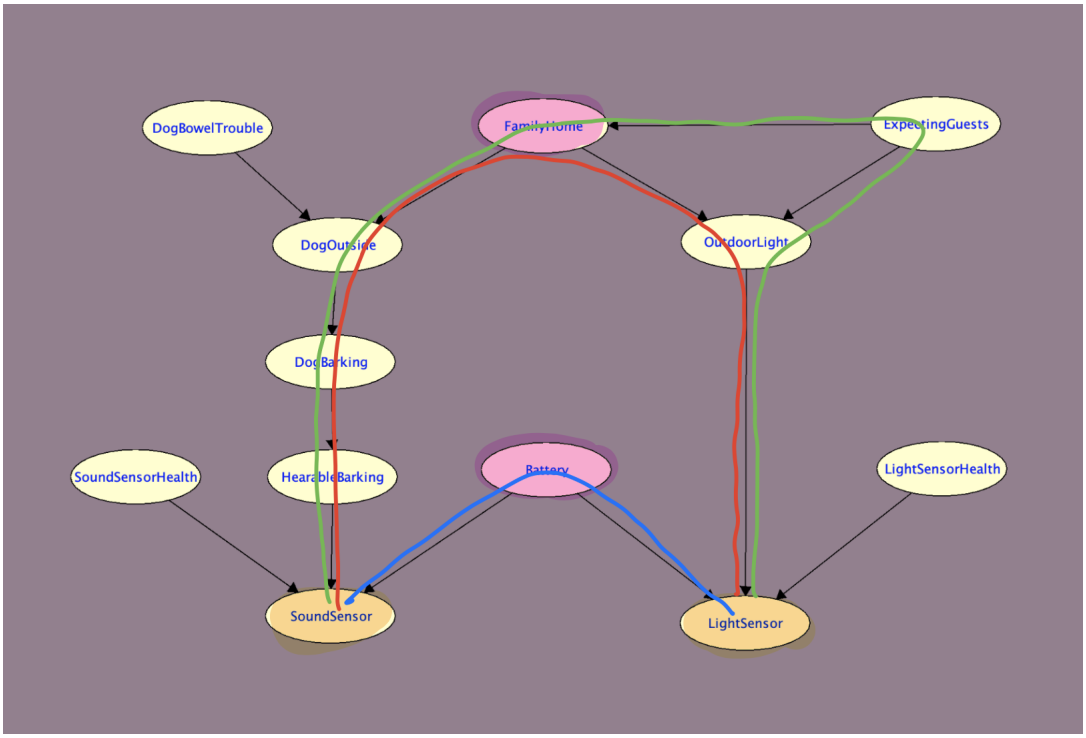

After running the EM algorithm, I switched into Query Mode and set the variable "SoundSensor = Off" and "LightSensor = On". Then in the Query Menu Tab I used MFE Computation to get the result shown in the diagram above, which indicates that the most likely instantiation of all other variables are "Battery = OK", "DogBarking = No", "DogBowelTrouble = Yes", "DogOutside = Yes", "EspectingGuests = No", "FamilyHome = No", "HearableBarking = No", "LightSensorHealth = Ok", "OutdoorLight = On", and "SoundSensorHealth = OK".

ii.




After running the EM algorithm, I switched into Query Mode and set the variable "FamilyHome = Yes" and "ExpectingGuest = No". Then I used MAP Computation and used Variable Selection Tool to select the variables "LightSensor" and "SoundSensor". Finally, I derived the results as shown in the image above, which indicates that the most likely instantiation for sensors are "LightSensor = Off" and "SoundSensor = Off".

iii.




The smallest set is $Z = \{FamilyHome, Battery\}$.

Consider the three possible paths:

> For the blue path, we see that SoundSensor $\leftarrow$ Battery $\rightarrow$ LightSensor is a divergent valve, and since Battery $\in Z$, we see this valve is closed, and hence this path is blocked.
>
> For the green path, we see that ExpectingGuests $\rightarrow$ FamilyHome $\rightarrow$ DogOutside is a sequential valve, and since FamilyHome $\in Z$, we see this valve is closed, and hence this path is blocked.
>
> For the red path, we see that DogOutside $\leftarrow$ FamilyHome $\rightarrow$ OutdoorLight is a divergent valve, and since Familyhome $\in Z$, we see this valve is closed, and hence this path is blocked.

Since all three possible paths are blocked, we see that the two sensors are independent given $Z = \{FamilyHome, Battery\}$.

iv.

The type of network you constructed is a multiply-connected network, as there are multiple paths between two nodes.

For instance, between the nodes “ExpectingGuests” and “OutdoorLight”, there are two paths:

ExpectingGuests → FamilyHome → OutdoorLight
ExpectingGuests → OutdoorLight