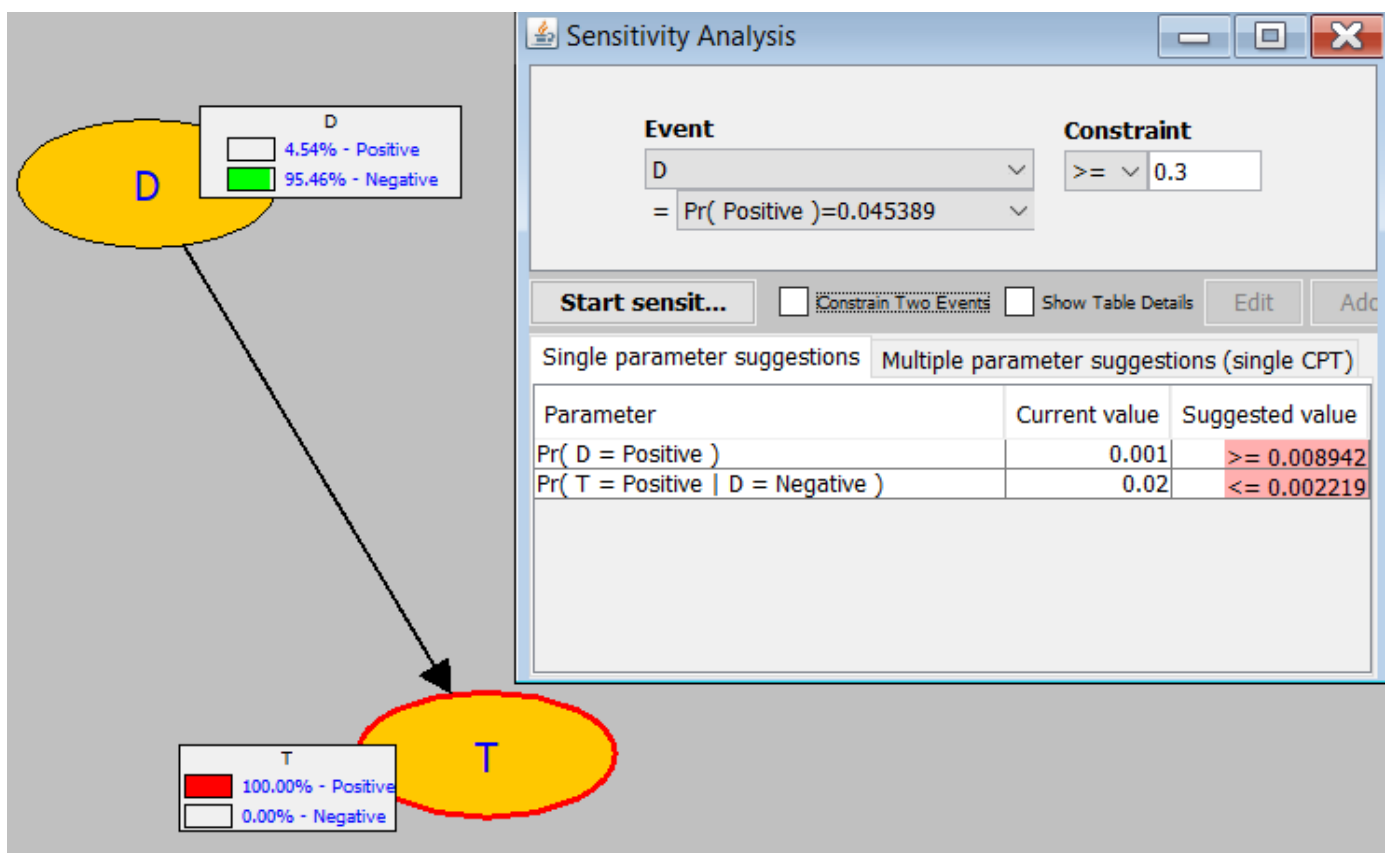


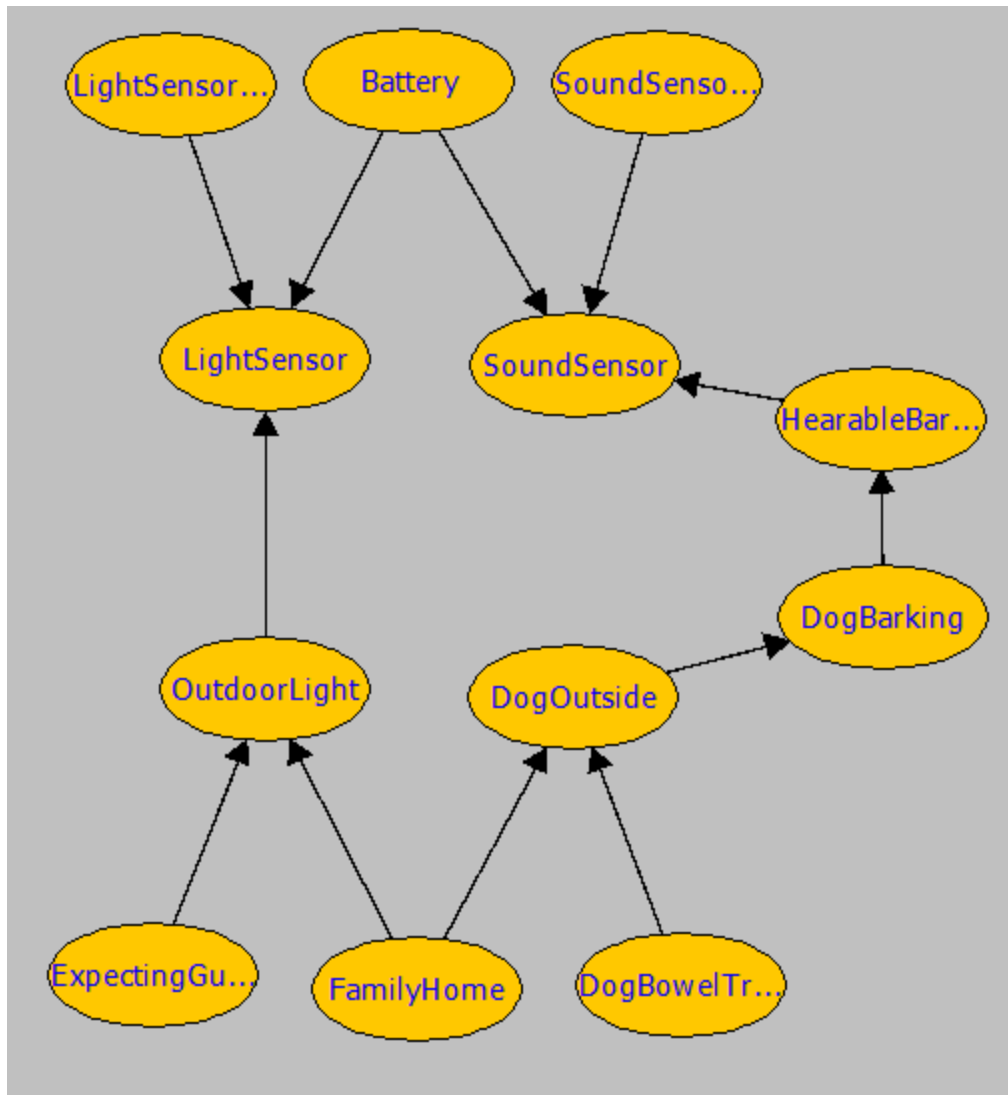
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HW8 Report

1. I created a Bayesian Network to encompass the relationship between Disease and Test results. We can confirm here that the probability of $\Pr(D|T) \approx 0.045$ with no constraints. After running the sensitivity analysis to find the conditions under which the probability of $\Pr(D|T)$ is no less than .30, Samlam gives us the following result.



Here, I set Test Result = Positive in order to find the conditional probability and ran the sensitivity analysis. The suggested values for $\Pr(T|D)$, $\Pr(D)$ are shown in the picture above.

2. For the second question I created a Bayesian Network shown below. I implemented my network as a **polytree**. You can tell that the network is a polytree because the “Battery” node creates two possible paths through the network. It *might* seem that my network is a multiply connected network and that the “FamilyHome” node converges the two paths again, but this is false. The directed edges of the network ensures it is a polytree. The casual structure is shown below:

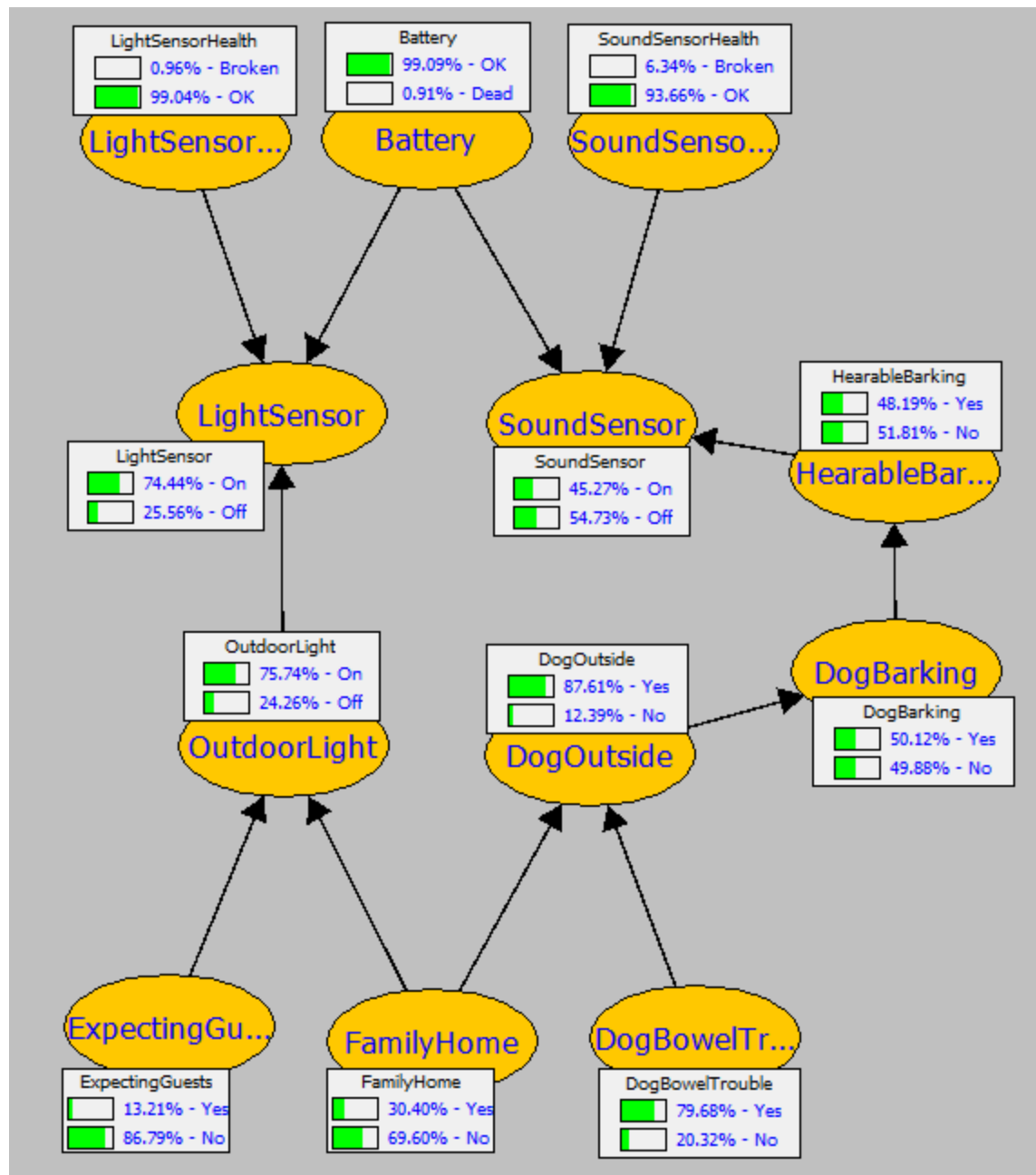


I interpreted the variables in the following ways:

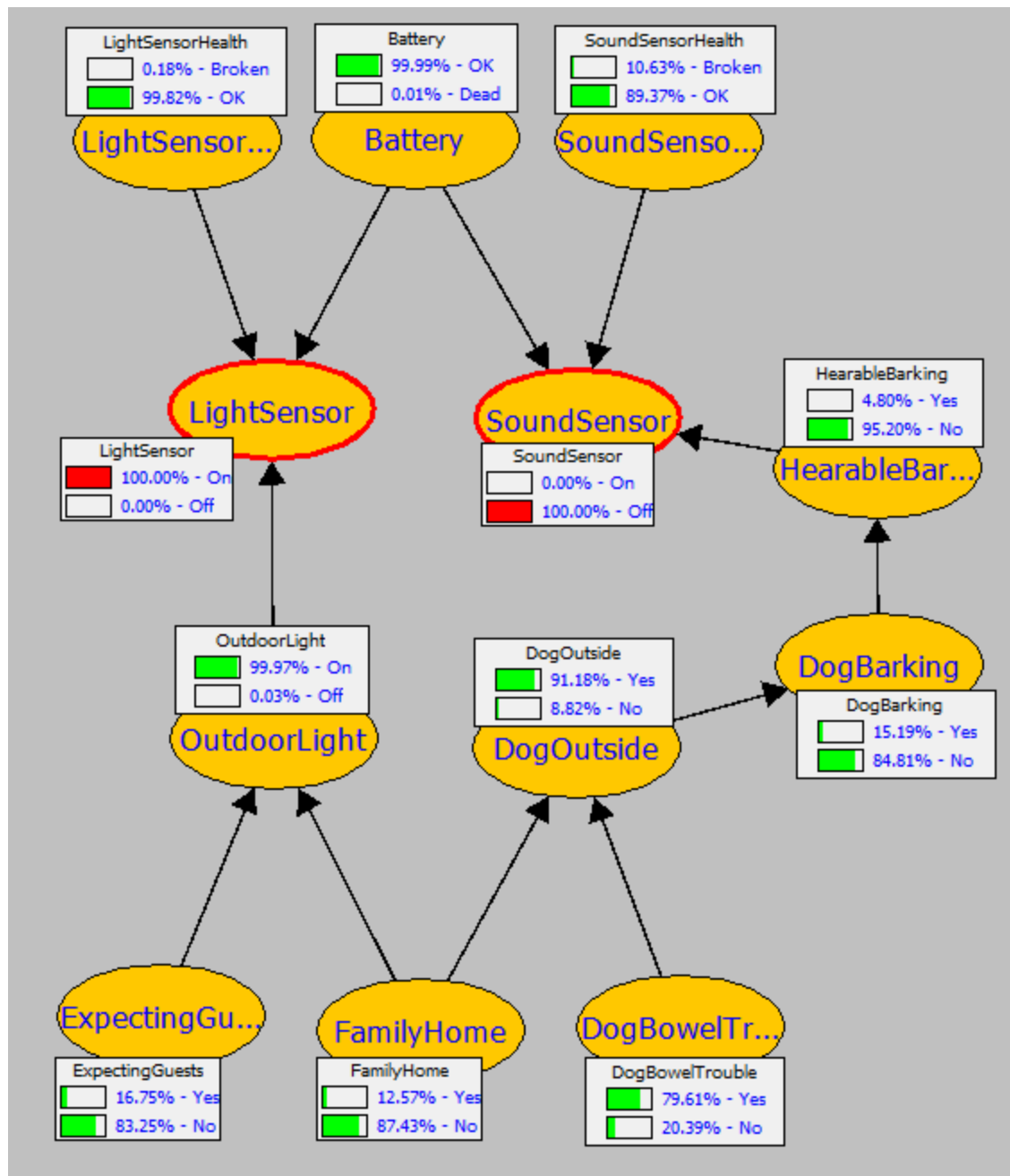
Variable	Interpretation
OutdoorLight	If the outdoor light is on.
LightSensorHealth	If the Light Sensor is broken.
Battery	If Sambot's battery has charge.
SoundSensorHealth	If the Sound Sensor is broken.
HearableBarking	If there is hearable barking.
DogBarking	If Sambot's dog is barking.
DogOutside	If Sambot's dog is outside.
SoundSensor	If Sambot's Sound Sensor detects barking.
LightSensor	If Sambot's Light Sensor detects light.
ExpectingGuests	If Sambot's wife is expecting guests.
DogBowelTrouble	If Sambot's dog is having bowel trouble.
FamilyHome	If Sambot's family is home.

The results of my structure are shown below.

After running EM on the sombat.dat file, the following conditional probability tables were created using the given data. These probabilities are shown below:



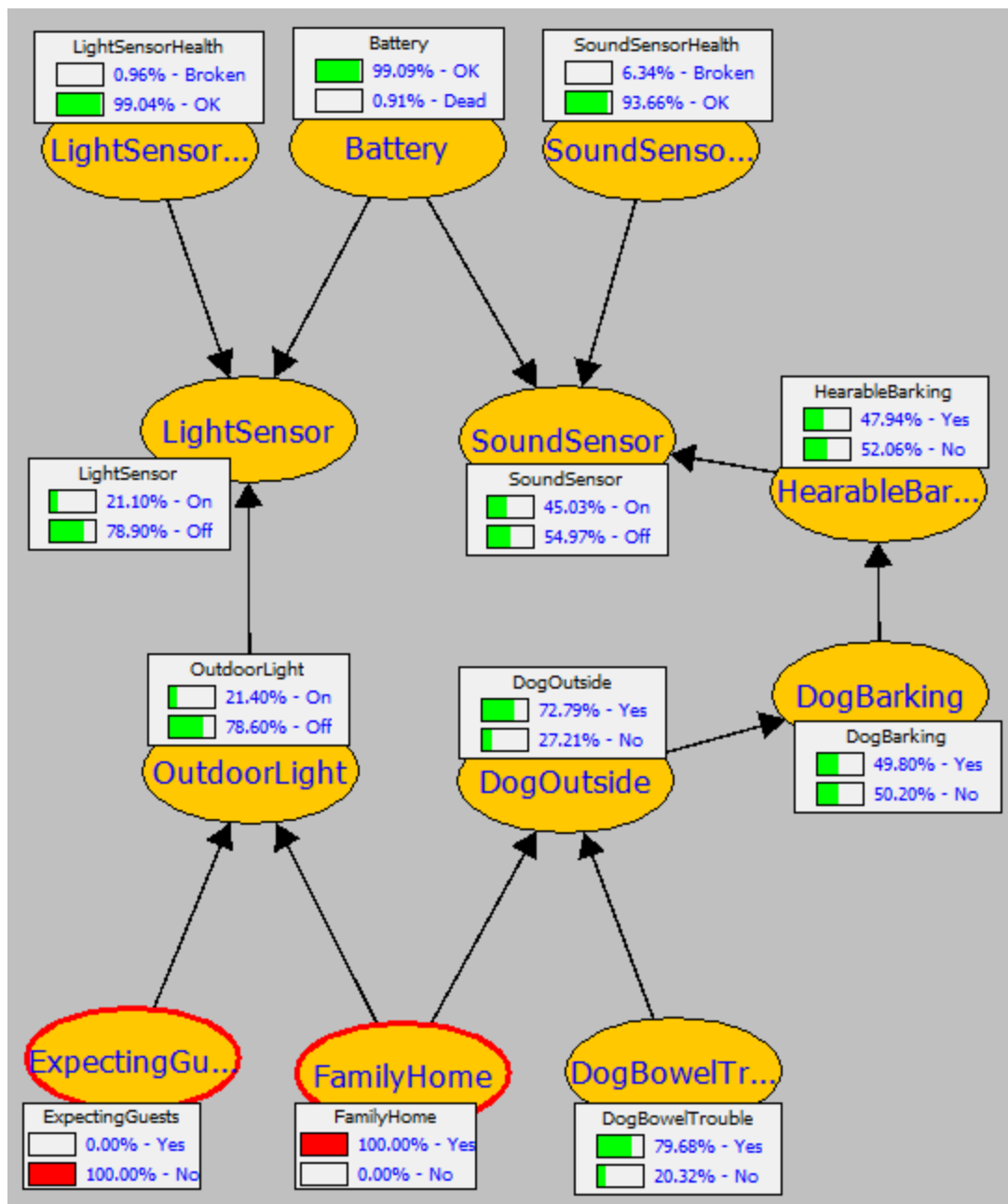
When setting *LightSensor* = Yes and *SoundSensor* = No, Samlam returns the following probabilities of instantiation:



The following probabilities make logical sense. If the light sensor reads 'On', the probability of the battery being dead is almost 0. Similarly, the probability of the sensor being broken is almost 0, but a little higher. Therefore, the probability of the outdoor light being on is almost 1, driving the probability that the family is home low. On the other side, the sound sensor must have a charged battery too. Since it doesn't hear

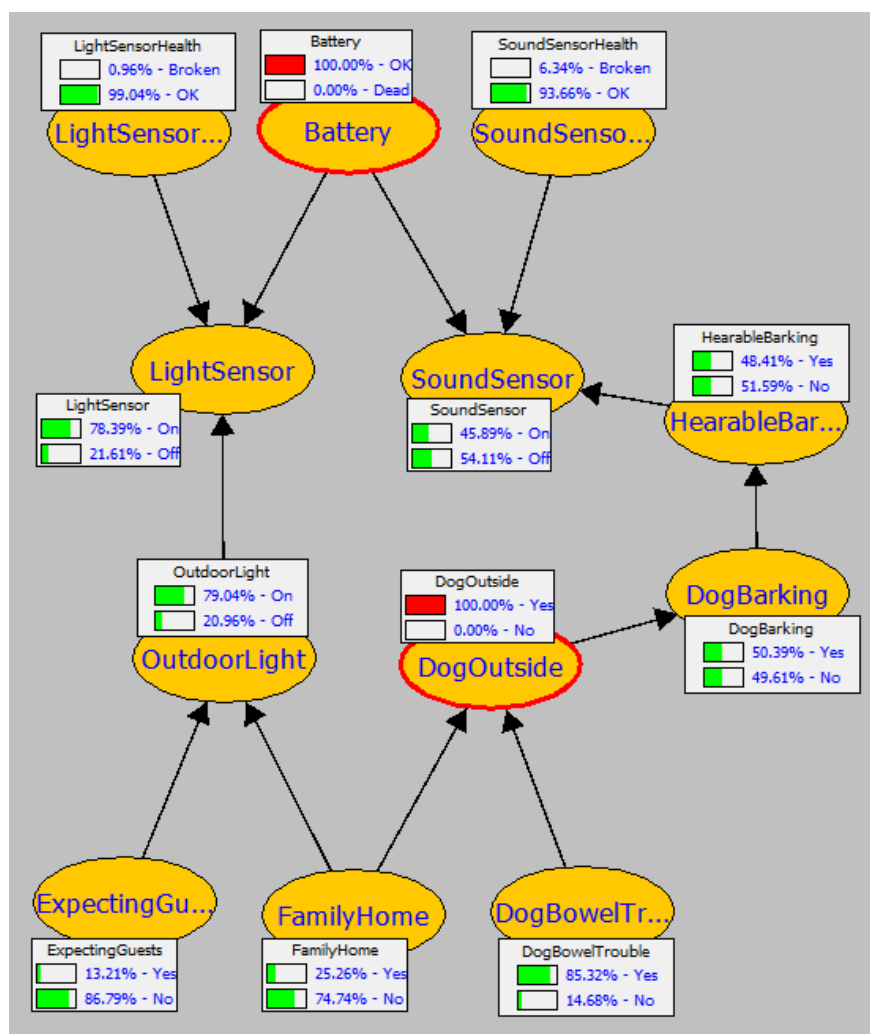
barking, the probability that it is higher - but still improbable. Therefore the probability that there is hearable barking is very low, meaning the probability Sambot's dog is barking is also very low.

When setting *FamilyHome* = Yes and *ExpectingGuests* = No, Samlam returns the following probabilities of instantiation:



These probabilities also make logical sense. While I will not explain every probability, the important one here is OutdoorLight. Since the family is home and not expecting any guests, the lights are most likely off, aligning with the homework spec. While some might think this must mean DogOutside should be mostly 'No', this is incorrect. The high probability of Bowel Trouble given in the '.dat' file makes it highly probable that the dog is indeed outside. From this, it's a toss up (50-50) whether the dog is barking or not.

Finally, in order to separate the two sensors, our set must only include **2** nodes. An example of this separating set is shown below.



In this way, $Z = \{\text{Battery}, \text{DogOutside}\}$ gives no undirected paths between the two sensors.