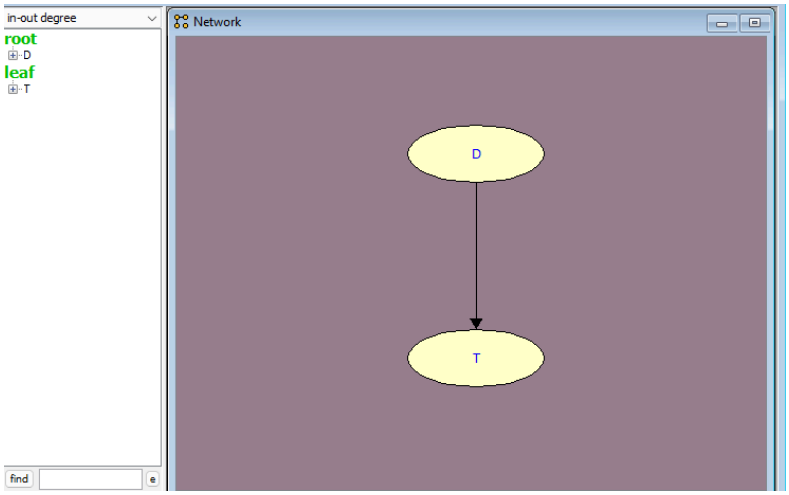
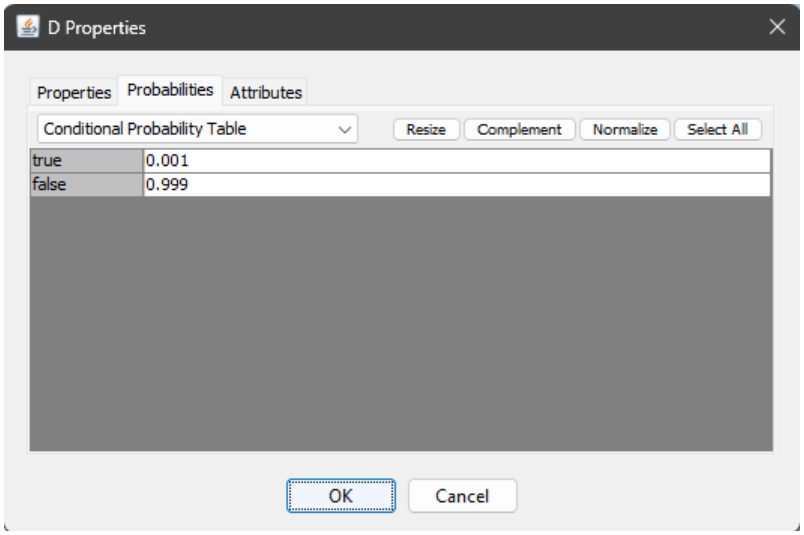
**Question 1:**

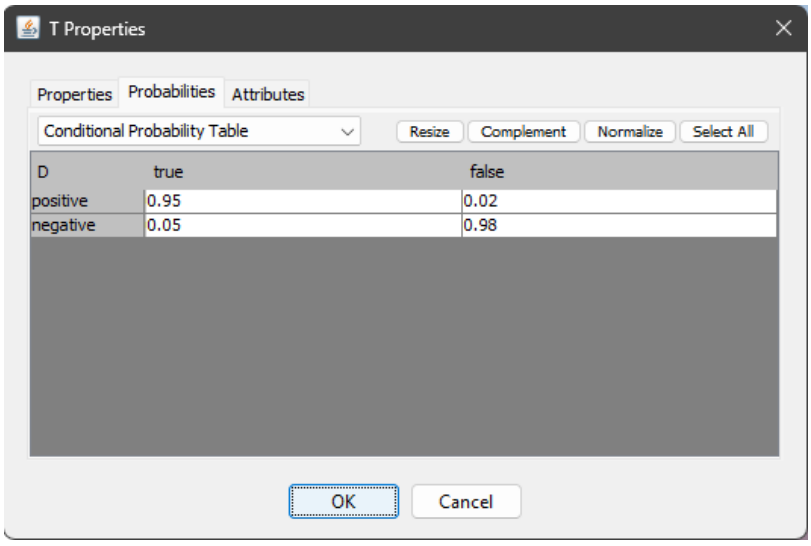
Bayesian Network:

Structure:

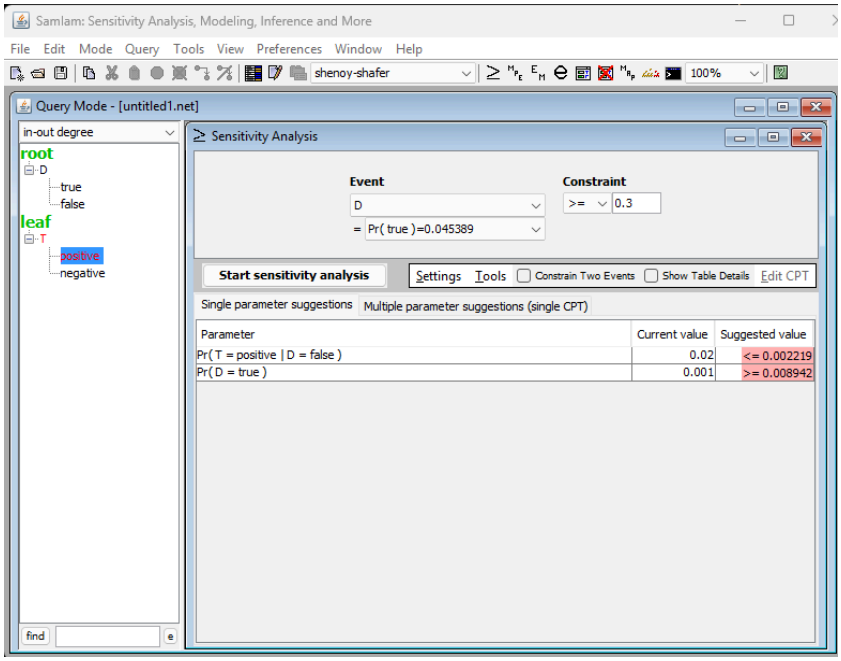



CPTs:



Result:

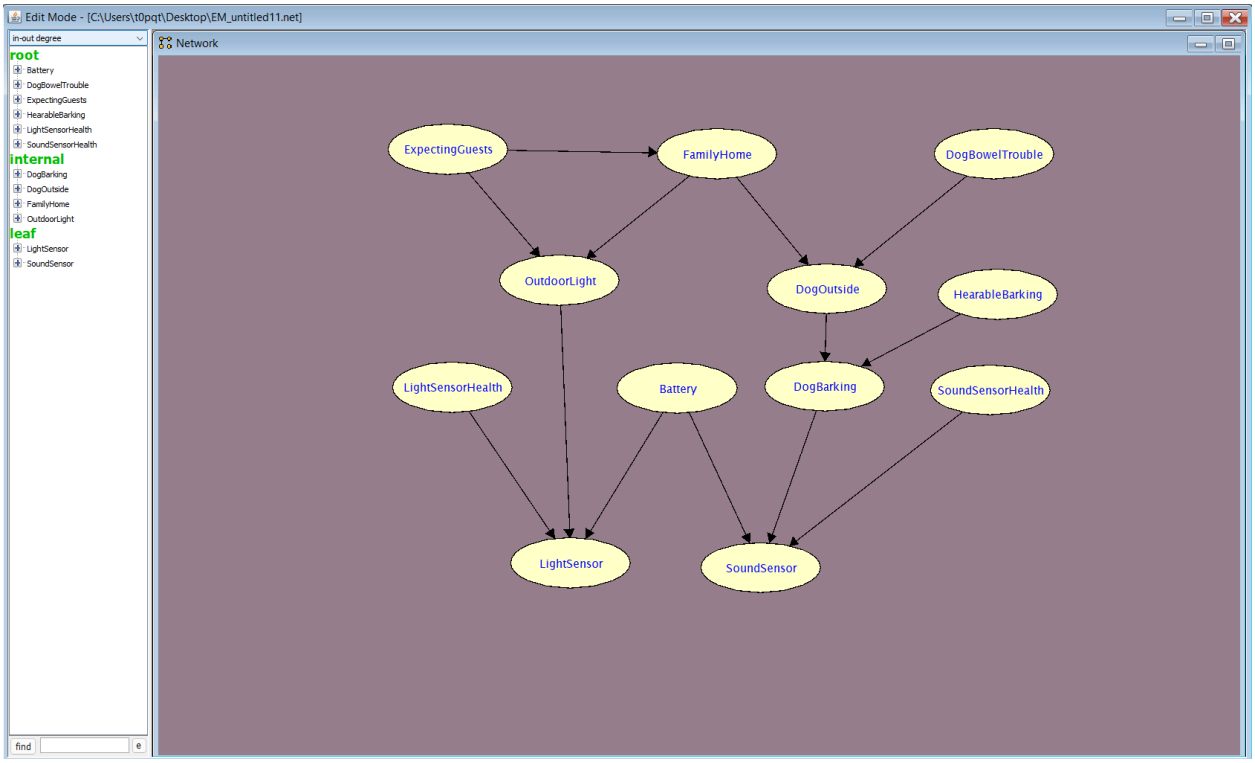



I used the sensitivity analysis tool in Samlam to find out what changes would make Pr(D|T) >= 0.3:

1. The prior probability of having the disease needs to increase from 0.001 to at least 0.008942.
2. The false positive rate needs to decrease from 0.02 to 0.002219 or lower.

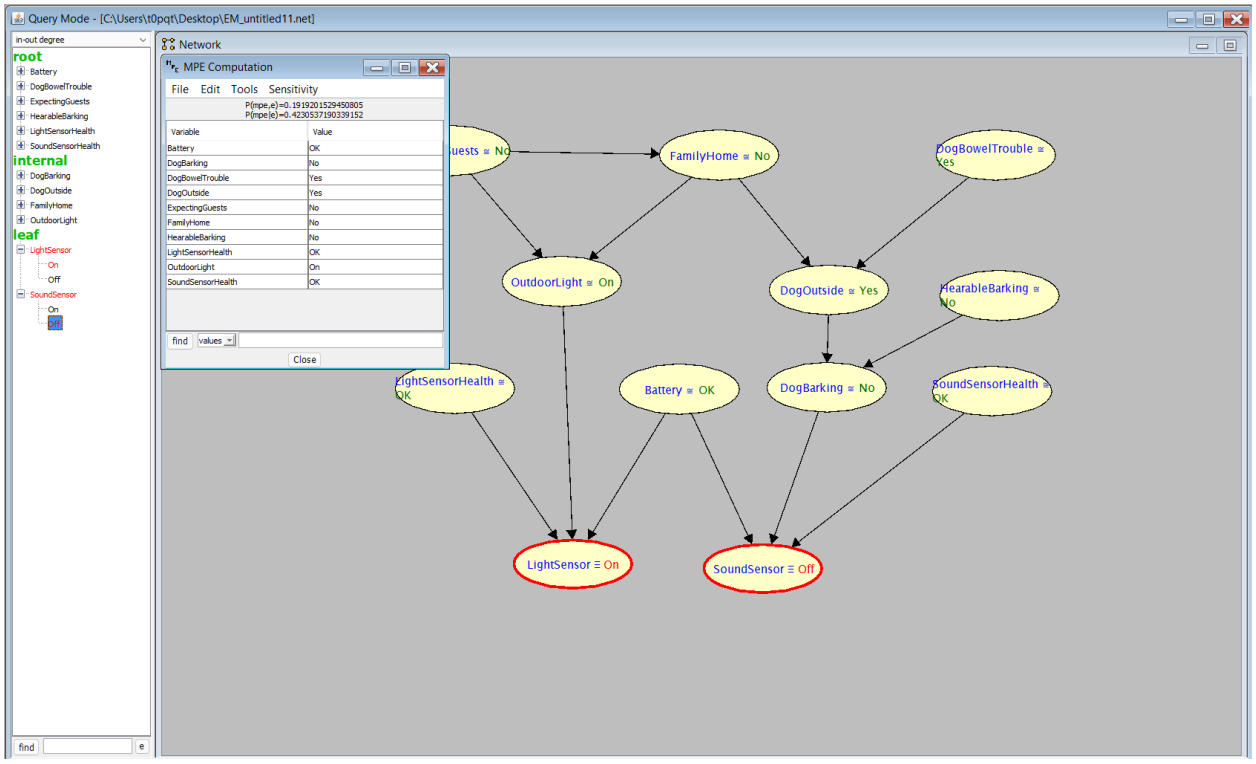
**Question 2:**

Bayesian Network:



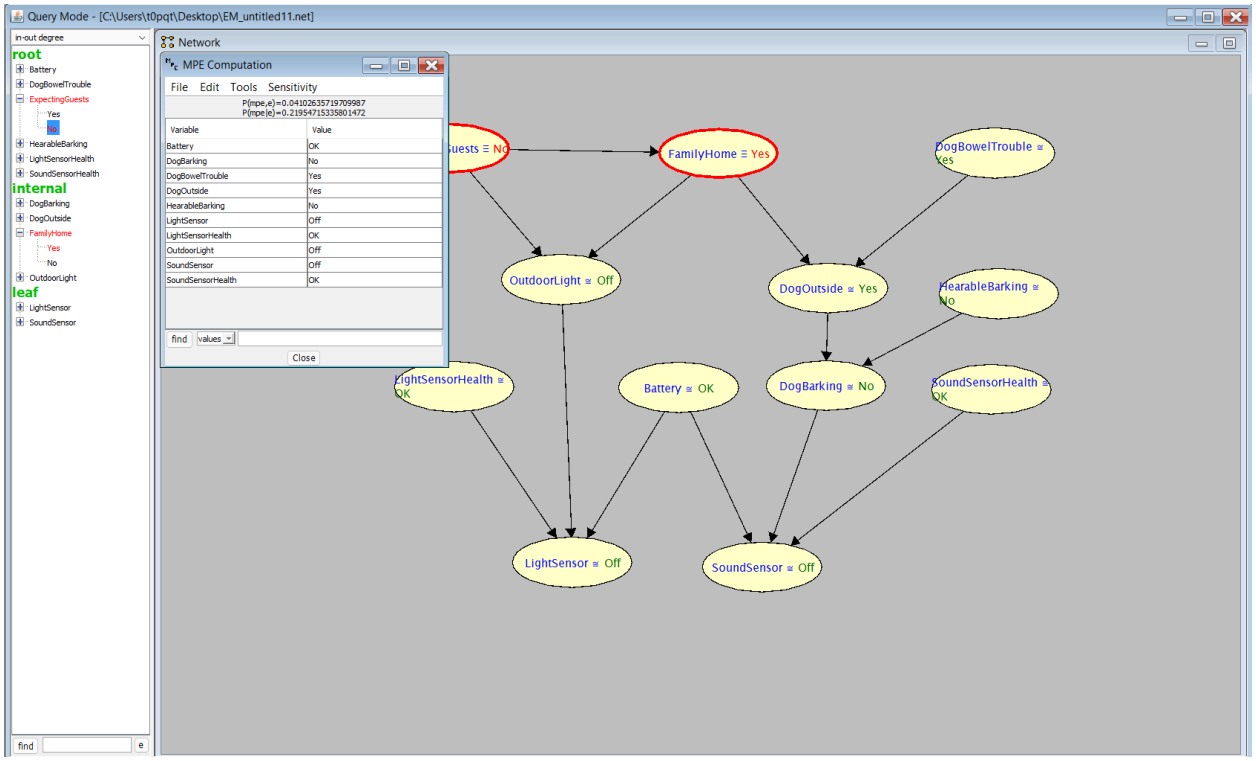

First I used the sambot.dat file to extract all of the variables and their values. Then I built the network by creating the nodes and the edges based on the relationship descriptive in the scenario. After setting up the structure, I ran the EM learning in Samiam to train the network using the sambot.dat data.

- LightSensor on and SoundSensor off




I first set LightSensor to on and SoundSensor to off, then I used the Most Probable Explanation (MPE) feature to get the results above.

- ExpectingGuests No and FamilyHome Yes




I first set FamilyHome as Yes and ExpectingGuests to No, then I used the Most Probable Explanation (MPE) feature to get the results above.

- Smallest set of variable Z

  There are two main paths:
  - LightSensor ← Battery → SoundSensor
  - LightSensor ← OutdoorLight ← ExpectingGuests → FamilyHome → DogOutside → DogBarking → SoundSensor

  Conditions:
  - Battery blocks the first path
  - OutdoorLight blocks the second path

  Smallest Set Z:
  - Z = {Battery, OutdoorLight}

  Justification Based on D-separation:
  - By conditioning Battery and OutdoorLight, we block out all the paths between SoundSensor and LightSensor. According to d-separation, this makes the two sensors conditionally independent.

- Type of Network:

  This network is a polytree because there are no cycles and it is singly connected.