C161: Homework #8

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Problem 1

Solution:

The constraints to ensure $Pr(D|T) \geq 0.3$ are:

1. Prior on disease i.e. $Pr(D) \geq 0.008942$
2. False positive rate i.e. $Pr(T|\neg D) \leq 0.002219$
3. Changing the false negative rate cannot be used to achieve the desired $Pr(D|T) \geq 0.3$

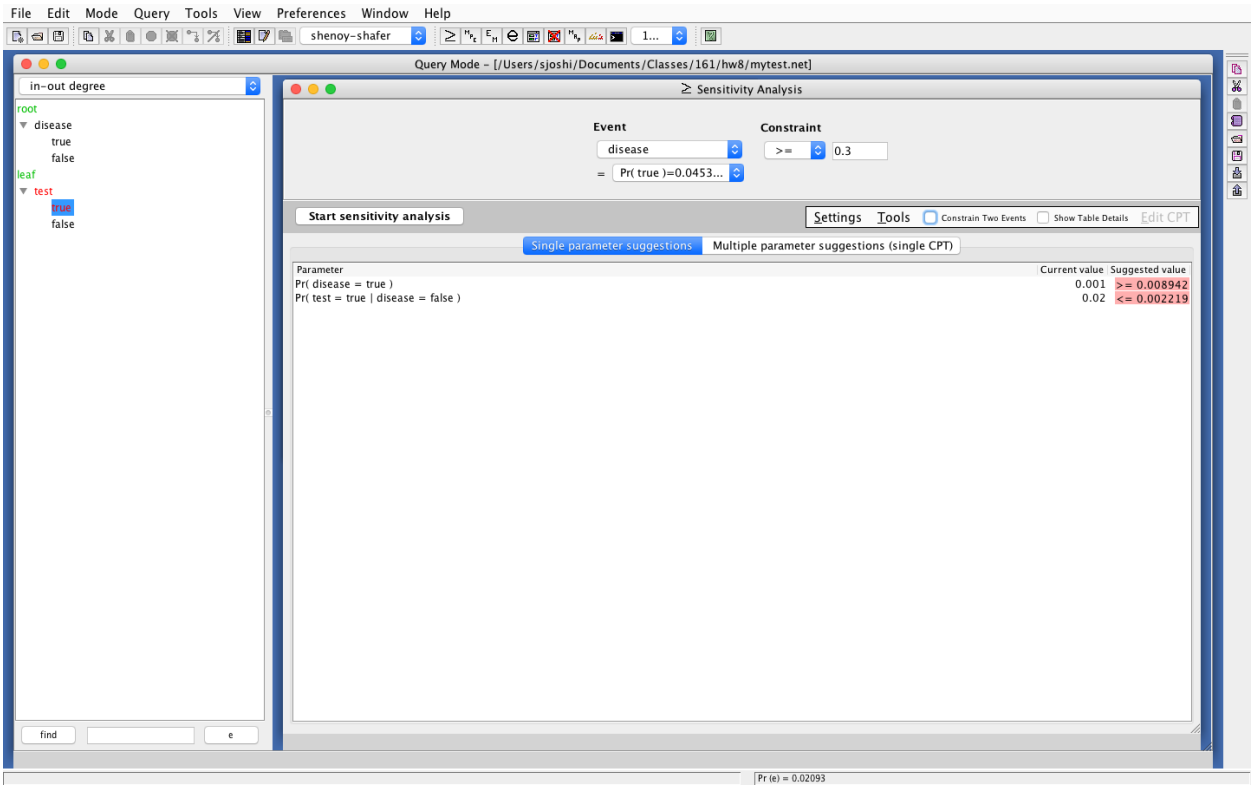

Figure 1: Screenshot for Problem 1

Problem 2

1.

Solution:

The most likely instantiation of all variables given that Sambot has sensed the lights to be on, but has sensed no bark

- Battery OK
- DogBarking No
- DogBowelTrouble Yes
- DogOutside Yes
- ExpectingGuests No
- FamilyHome No
- HearableBarking No
- LightSensorHealth OK
- OutdoorLight On
- SoundSensorHealth OK

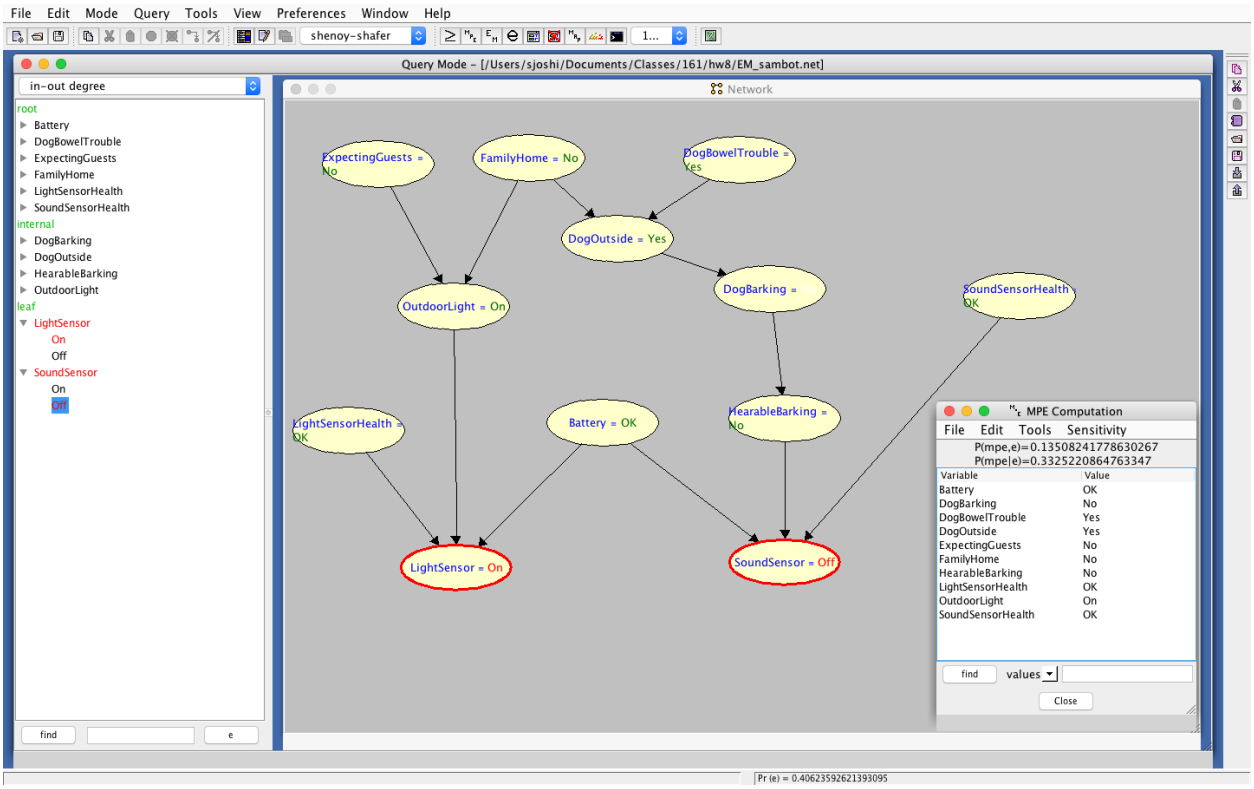

Figure 2: Screenshot for Problem 2 part 1

2.

Solution:

The most likely instantiation of the sensors given that the family is home and no guests are expected.

- Battery OK
- DogBarking No
- DogBowelTrouble Yes
- DogOutside Yes
- HearableBarking No
- LightSensor Off
- LightSensorHealth OK
- OutdoorLight Off
- SoundSensor Off
- SoundSensorHealth OK

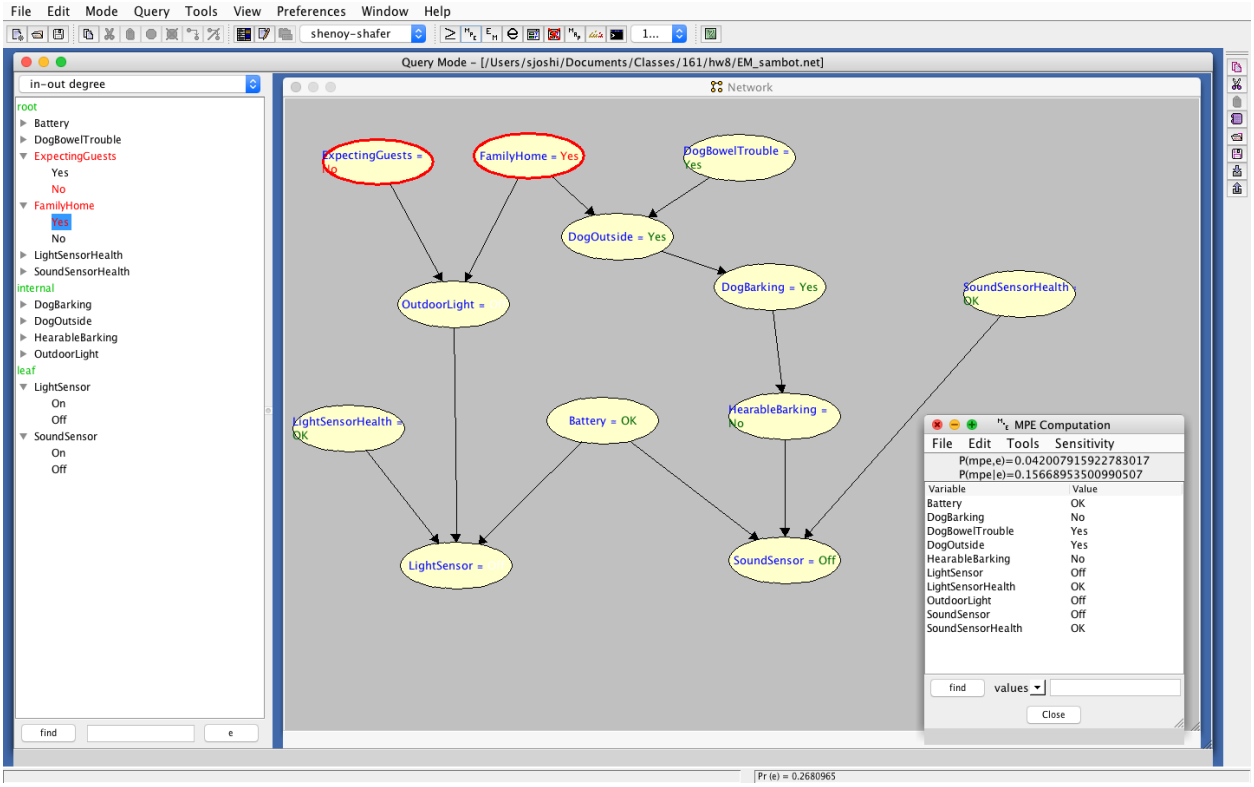

Figure 3: Screenshot for Problem 2 part 2

3. **Solution:** Z = {FamilyHome, Battery} is the smallest set such that the two sensors are independent given Z. This is because there are two paths between the two sensor nodes (one through Battery and the other through FamilyHome) and thus conditioning on any single node will still leave one path that is unblocked between the two sensor nodes. For the first path, the only node that appears on the path is Battery and hence Battery must belong to any such set Z. For the other path, there are many choices along the path and FamilyHome is one such valid choice. Including these two nodes in Z guarantees that any path between the nodes must traverse nodes from Z and hence is blocked by Z, therefore the two sensor nodes are d-separated by Z.

4. **Solution:** The network is multiply connected.