Homework 8

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CS 161

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1. Disease and Diagnosis

   - See **test.net**.
   - Using the sensitivity analysis I constrained $Pr(\text{Disease} = \text{Positive}|\text{Test} = \text{Positive}) \geq 0.3$. SamIam gave the following suggested values $Pr(\text{Test} = \text{Positive}|\text{Disease} = \text{Negative}) \leq 0.002386$ and $Pr(\text{Disease} = \text{Positive}) \geq 0.008322$.

2. Sambot

   (a) Variables and 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

   (b) Causal structure:

   - ExpectingGuests ⇒ FamilyHome
   - ExpectingGuests ⇒ OutdoorLight
   - FamilyHome ⇒ OutdoorLight
   - FamilyHome ⇒ DogOutside
   - SoundSensorHealth ⇒ SoundSensor

- LightSensorHealth ⇒ LightSensor
- Battery ⇒ SoundSensor
- Battery ⇒ LightSensor
- HearableBarking ⇒ SoundSensor
- DogOutside ⇒ DogBarking
- DogBarking ⇒ HearableBarking
- OutdoorLight ⇒ LightSensor
- DogBowelTrouble ⇒ DogOutside

(c) EM Learning results (achieved by creating all the necessary nodes and states and implmenting the causal structure, followed by using the EM algorithm with the given data found in **sambot.dat**):

- I found the most likely instantiation of values y setting the LightSensor value to "On" and the SoundSensor value to "Off" and then running an MPE Computation on the resulting network. The result was as follows:
  - Battery: OK
  - DogBarking: No
  - DogBowelTrouble: Yes
  - DogOutside: Yes
  - ExpectingGuests: No
  - FamilyHome: No
  - HearableBarking: No
  - LightSensorHealth: OK
  - OutdoorLight: On
  - SoundSensorHealth: OK

  With the following probability values:
  - $P(MPE, e) = 0.1526$
  - $P(MPE|e) = 0.3571$
- I found the most likely instantiation of values y setting the FamilyHome value to "Yes" and the ExpectingGuests value to "No" and then running an MAP Computation on the resulting network. The result was as follows:
  - LightSensor: Off
  - SoundSensor: Off

  With the following probability values:
  - $P(MAP, e) = 0.0673$
  - $P(MAP|e) = 0.3552$
- We can set **Z** to the set of variables {Battery, FamilyHome}. This will be sufficient to indiciate that LightSensor and SoundSesnor are independent by the divergence of both variables into the sensors by d-separation.
- The network constructed is a multiply-connected network.