Tasks for part II

5)

a) The risk for the melt down in power plant when there is an icy weather the risk of melt down is 0.03472.

When meltdown is true , before observation 0.02465

b) The risk of the melt down in the power plant when both sensors indicate failure is 0.001. When there is an actual meltdown because of pump failure and water leak is 0.2 and we can see that probability is P (Meltdown | waterleak, Pump failure) – P (Meltdown | waterleak, Pump failure) = 0.2 – 0.001 = 0.199.

c) The results of observations and experiments vary each time when we do process and hence it’s very difficult to get the accurate numbers each and every time. The conditional probabilities like pump failure and icy weather are difficult and impossible to estimate since it’s not dependent on anything because they don’t have any parents.

d) If we change the icy weather to temperature in our model, as temperature can be more accurately determine than icy weather and hence P(waterleak | Temperature) will be more accurate than P(Waterleak | Icy weather).

6)

a) Probability table in the Bayesian network depicts the probability of the current distribution considering the prior probabilities.

b) Joint probability distribution has their own independent random variables, it has its own probability distribution, variance and standard deviation.

P (Meltdown=F, PumpFailureWarning=F, PumpFailure=F, WaterLeakWarning=F, WaterLeak=F, IcyWeather=F)

=

P (PumpFailureWarning | PumpFailure) \* P (PumpFailure) \* P (Meltdown | PumpFailure, WaterLeak) \* P (WaterLeak | IcyWeather) \* P (WaterLeakWarning | WaterLeak) \* P (IcyWeather)

= 0.95 \* 0.9 \* 0.999 \* 0.9 \* 0.95 \* 0.95 = 0.6937792763

We can conclude that this is not a common state because all the node gets false but still these conditions may occur.

c) If we know that both pump failure and water leak get true then the probability of the meltdown state is 0.2. We only have two states on which meltdown is dependent and we already know that so knowing the state of any other variable doesn’t matter.

d)

We are calculating Meltdown considering the facts that PumpFailureWarning=F, WaterLeak=F, WaterLeakWarning=F and IcyWeather=F. Using the Exact inference formula, we are calculating P(meltdown=T) and p(Meltdown=F)

P(X ∣ e) = α \* P(X, e) = α \*∑ y P(X, e, y)

P (Meltdown=T| PumpFailureWarning, WaterLeak, WaterLeakWarning, IcyWeather) =

α P(Meltdown, PumpFailureWarning, WaterLeak, WaterLeakWarning, IcyWeather,y)=

α P(MeltdownT, PumpFailureWarning, WaterLeak, WaterLeakWarning, IcyWeather, pumpfailure) +

P(MeltdownT, PumpFailureWarning, WaterLeak, WaterLeakWarning, IcyWeather, pumpfailure) =

(0.15\*0.1\*0.9\*0.95\*0.95\*0.1) + (0.001\*0.95\*0.9\*0.95\*0.95\*0.9)

0.0012183+0.00069447375 = 0.0019127737

Case 2: when meltdown is False

α P(MeltdownF, PumpFailureWarning, WaterLeak, WaterLeakWarning, IcyWeather, pumpfailure) +

P(MeltdownF, PumpFailureWarning, WaterLeak, WaterLeakWarning, IcyWeather, pumpfailure) =

(0.85\*0.1\*0.9\*0.95\*0.9\*0.1)+ (0.999\* 0.95\*0.9\*0.95\*0.95\*0.9) =

0.00654075+ 0.6937792 = 0.7003200263

Therefore,

α \*∑ y P(X, e, y)=

α(0.0019127737 , 0.7003200263)

**Part III: Extending a network**

Task for Part #

1. We have created the model.
3. After the demonstration by the owner to the employees his stereo doesn’t work so we are calculating the owner’s chance of survival before and after as shown below.

The probability of survival before testing the stereo was:

P (survive = T) = 0.99561

P (survive = F) = 0.00439

Now after the demonstration the probability values changes are follows:

P (survive = T) = 0.99227

P (survive = F) = 0.00773

After buying the bicycle the owner’s chance of survival are the following

P (survive = T) = 0.99561

P (survive = F) = 0.00439

1. Bayesian Networks makes it possible to model any function in propositional logic. But the problem we face with the complexity of exact inference in Bayesian Networks is that when we have more number of unknown variables in our system, it will create more number of steps for each single unknown probability variable. Thus as the number of unknown probability variables increases the complexity of exact inference also increases, that is it is dependent on the structure.

But we have certain alternatives to the exact inference. Polytrees or singly connected networks are those kind of networks where there is at most one undirected path between any two nodes in the network. The time and space complexity of exact inference is linear to the size of the network. In a multiple connected networks we are combining the common variables in between the states and thus combining it together and hence the complexity will be reduced to a great extent and this concept is called as clustering algorithm.

**Part IV: More extensions**

**2.**

**a).** Even though the Owner decides to replace the pump with a better one rather than employing the safety person, there would still be the problem of water leakage which will still create the problem of meltdown. Hence in our model, we are unable to compensate for Mr. H.S expertise even if we replace the pump with a better one.

**b).** When its waterleakwarning and pumpfailurewarning then it alarm one more warning afterwards MR H.S only has higher chances to escape more than 85% in the car that shows like this:

P (HS Escape | Onemorewarning).

**c).** Some of the assumptions we don’t consider while creating a Bayesian network model of a human is that, we are not taking into consideration the knowledge and ability of a person gained through experience like Mr. H.S can learn how to do perform things at the right time from his experience. And we don’t treat the other factors like sickness or failure that a human can make while considering the factors.

**d).** Letsuppose we will add two more node “Yesterdayicyweather” and “DaybeforeYesterdayicyweather” and will connect that with icyweather if both “Yesterdayicyweather” and “DaybeforeYesterdayicyweather” is true, then probability of “Icyweather” for true will increase.