Exercise_1

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1 EECS 491: Probabilistic Graphical Models Assignment 2

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2 Exercise 1

2.1 Problem Setup

Let us say that we are interested in being able to determine whether or not I will be late for class (L) and whether a classmate will be late for class (C). Whether or not I will be late for class is effected by two things: * If I oversleep (O) * If the bus is late (B)

The bus being late also impacts whether or not a classmate will be late for class. Whether or not I oversleep is effected by whether or not my alarm goes off (A).

From experience I have a prior belief that my alarm will go off with probability .96. I have a prior belief that given that my alarm goes off, I will oversleep with probability .08, and if my alarm doesn't go off, I will oversleep with probability .98. I also have a prior belief that my oversleeping does not have any effect on whether my classmate is late for class.

Also from my experience, I have a prior belief that the bus will be late (B) with probability .2. I estimate that if the bus is late and I oversleep, I will be late with probability .96. If the bus is late and I don't oversleep, I will be late with probability .78. If the bus isn't late and I oversleep, I'll be late with probability .8. If the bus isn't late and I don't oversleep, I'll be late with probability .03. If the bus is late, I estimate that my classmate will be late with probability .8. If the bus isn't late, I estimate that my classmate will be late with probability .1 These probabilities are summarized in the tables below:

$$P(A) = 0.96$$
$$P(B) = .2$$

	A = false	A = true
O = false	0.02	0.92
O = true	0.98	0.08

	B = false, O = false	B = false, O = true	B = true, O = false	B = true, O = true
L = false	0.97	0.2	0.22	0.04

	B = false, O = false	B = false, O = true	B = true, O = false	B = true, O = true
L = true	0.03	0.8	0.78	0.96

	B = false	B = true
C = false	0.9	0.2
C = true	0.1	0.8

The model can be presented in the following graph:

We would like to know, if I am late to class and my classmate isn't, what is the probability that my alarm went off?

$$P(A \mid L, \bar{C}) = ?$$

2.2 Programatic Model Setup

```
In [2]: from pgmpy.models import BayesianModel as bysmodel
        from pgmpy.factors.discrete import TabularCPD as tcpd

In [3]: model = bysmodel([['A','O'],['O','L'],['B','L'],['B','C']])

In [4]: priorA = tcpd(variable='A', variable_card=2, values=[[0.04, 0.96]])
        priorB = tcpd(variable='B', variable_card=2, values=[[.8,.2]])

In [5]: cpdO = tcpd(variable='O', variable_card=2,
                    evidence=['A'], evidence_card=[2],
                    values=[[0.02, 0.92],
                            [0.98, 0.08]]
                   )
        cpdL = tcpd(variable='L', variable_card=2,
                    evidence=['O', 'B'], evidence_card=[2,2],
                    values=[[.97, .2, .22, .04],
                            [.03, .8, .78, .96]]
                   )
        cpdC = tcpd(variable='C', variable_card=2,
                    evidence=['B'], evidence_card=[2],
                    values=[[.9, .2],
                            [.1, .8]])

In [6]: model.add_cpds(priorA, priorB, cpdO, cpdL, cpdC)
```

Now we can check if our model is valid:

```
In [7]: model.check_model()

Out[7]: True
```

Our model is now set up in pgmpy. We can check the conditional probabilities of each variable to confirm that our model matches the setup of the problem.