Exercise 10.1
Two astronomers in different parts of the world make measurements $M_1, M_2$ of the number of stars $N$ in some small region of the sky, using their telescopes. Normally, there is a small possibility of error by up to one star in each direction. Each telescope can also with a small probability be badly out of focus (events $F_1, F_2$), in which case the scientist will undercount. Consider the following Bayesian networks:

1. Which of these networks are correct (but not necessarily efficient) representations of the information above? Explain your answer.

2. Which is the best network? Explain your answer.

3. Now let’s assume $N \in \{1, 2, 3\}$. How many independent values are contained in the joint probability distribution for the 5 nodes, assuming that no conditional independence relations are known to hold among them? How many independent probability values do the tables of the best network contain?

Exercise 10.2
Consider a different instantiation of the alarm Bayesian network below. Infer the probabilities for:

- The causal case $P(Johncalls \mid Burglary)$
- The diagnostic case $P(Burglary \mid Johncalls)$
- The intercausal case $P(Burglary \mid Alarm, Earthquake)$

1Please use the cover sheet from the home page to stitch all sheets together.
Show your solution steps for at least one of the cases.

Exercise 10.3
Oscar, the robot juggler, drops balls quite often when its battery is low. In previous tests, it has been determined that the probability that it will drop a ball when its battery is low is 0.9. Whereas when its battery is not low, the probability that it drops the ball is only 0.01. The battery was recharged not so long ago, and our best guess is that the probability that the battery currently is low is 10%. A robot observer, with a somewhat unreliable vision system, reports that Oscar dropped a ball. The reliability of the observer is given by the following probabilities:

\[
P(\text{observer says that Oscar drops} | \text{Oscar does drop}) = 0.9 \\
P(\text{observer says that Oscar drops} | \text{Oscar doesn’t drop}) = 0.2
\]

1. Draw the Bayes network.

2. Calculate the probability that the battery is low given the observers’ report.