1. (5 marks) Consider the following information:

Tick bites are more common when it is hot. A rash may result from a tick bite; as well, a rash may be caused by the weather being hot. Having the flu is a possible cause of having a fever, as is having a tick bite.

(a) Represent these facts in a Bayes network. Your network should contain 5 nodes, corresponding to the following binary random variables:

- **bite** – person has a tick bite
- **hot** – the outside temperature is hot
- **rash** – the person has a rash
- **flu** – the person has the flu.
- **fever** – the person has a fever.

Let *bite* stand for “tick bite”, *hot* for “the weather is hot”, *rash* for “having a rash”, *flu* for “having the flu”, and *fever* for “having a fever”.

(b) Give an example of a conditional independence assumption that is implicit in this network, and explain why it holds.

(c) Suppose the following probabilities are given:

\[
\begin{align*}
Pr(heat) &= .6 & Pr(\text{flu}) &= .01 \\
Pr(bite|heat) &= .2 & Pr(bite|\neg heat) &= .001 \\
Pr(rash|bite, heat) &= .9 & Pr(rash|bite, \neg heat) &= .7 \\
Pr(rash|\neg bite, heat) &= .1 & Pr(rash|\neg bite, \neg heat) &= .001 \\
Pr(fever|flu, bite) &= .95 & Pr(fever|flu, \neg bite) &= .8 \\
Pr(fever|\neg flu, bite) &= .4 & Pr(fever|\neg flu, \neg bite) &= .0001
\end{align*}
\]
i. What is the probability that it is hot, the person has a tick bite and a rash and a fever, but not the flu?

ii. With no observations at all, what is the probability that the person has a rash?

iii. If we observe that the person has the flu, what is the probability that they have a rash?

iv. If we observe that the person has a fever, what is the probability that they have a rash?

v. You observe that the person has a fever and a rash. Assuming that they don’t have both a tick bite and the flu, is it more likely that they have the flu or a tick bite?

vi. You observe that it is not hot. How do your probabilities in the previous part change?

2. (5 marks) Decision trees. To follow . . .