1. Recall the “burglar” Bayesian network from class (reproduced in Figure ), with the following condi-
tional probability tables:

\begin{align*}
P(E = 1) &= .002 \\
P(B = 1) &= .001 \\
P(A = 1|E = 0, B = 0) &= .001; P(A = 1|E = 0, B = 1) = .94; \ P(A = 1|E = 1, B = 0) = .20; \ P(A = 1|E = 1, B = 1) = .95 \\
P(J = 1|A = 0) = .05; P(J = 1|A = 1) = .90 \\
P(M = 1|A = 0) = .01; P(M = 1|A = 1) = .70
\end{align*}

Compute numeric values for each of the probabilities below. You should use d-separation whenever possible. Please show your work.

(a) \(P(M = 1)\)
(b) \(P(M = 1|E = 1, B = 0)\)
(c) \(P(E = 1|A = 1)\)
(d) \(P(E = 1|A = 1, J = 1)\)
(e) \(P(E = 1|A = 1, M = 0)\)
(f) \(P(E = 1|A = 1, J = 1, M = 0)\)
(g) \(P(B = 1|J = 1)\)
(h) \(P(B = 1|J = 1, E = 1)\)
(i) \(P(J = 1|M = 1)\)
(j) \(P(J = 1|A = 0, M = 1)\)
(k) \(P(J = 1|A = 1, M = 1)\)

2. Consider the DAG for a Bayesian network given in Figure , which can be motivated by the following story. The root variable \textit{season} determines what season of year it is. Given the \textit{season}, there is some probability of \textit{rain}, and also some probability we would find the \textit{sprinkler} on. Either of these events causes the sidewalk to be \textit{wet} with some probability, and the sidewalk being \textit{wet} leads to some probability of the sidewalk being \textit{slippery}.

List \textit{all} conditional independences that hold must hold in any probability distribution represented by this DAG. More specifically, give a list of all tuples \((X, Y, S)\) such that \(P(X, Y|S) = P(X|S)P(Y|S)\), where \(X, Y \in \{\text{season, rain, sprinkler, wet, slippery}\}\), \(X \neq Y\), and \(S \subseteq \{\text{season, rain, sprinkler, wet, slippery}\}\), \(X, Y \notin S\). Remember to consider the case \(S = \emptyset\).
Figure 1: DAG for Burglar Bayesian Network.
Figure 2: DAG for the Rain Bayesian Network.