CIS 620 — Advanced Topics in AI
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Problem Set 7
Distributed: Monday, March 25, 2002
Due: Monday, April 1, 2002

1. Recall the "burglar" Bayesian network from class (reproduced in Figure), with the following conditional probability tables:

   $P(E=1)=.002$

   $P(B=1)=.001$

   $P(A=1|E=0,B=0)=.001$; $P(A=1|E=0,B=1)=.94$; $P(A=1|E=1,B=0)=.29$; $P(A=1|E=1,B=1)=.95$

   $P(J=1|A=0)=.05$; $P(J=1|A=1)=.90$

   $P(M=1|A=0)=.01$; $P(M=1|A=1)=.70$

   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 *season* determines what season of year it is. Given the *season*, there is some probability of *rain*, and also some probability we would find the *sprinkler* on. Either of these events causes the sidewalk to be *wet* with some probability, and the sidewalk being *wet* leads to some probability of the sidewalk being *slippery*.

   List *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 $X,Y\in\{$*season,rain,sprinkler,wet,slippery*$\}$, $X\neq Y$, and $S\subseteq\{$*season,rain,sprinkler,wet,slippery*$\}$, $X,Y\notin S$. Remember to consider the case $S=\emptyset$.

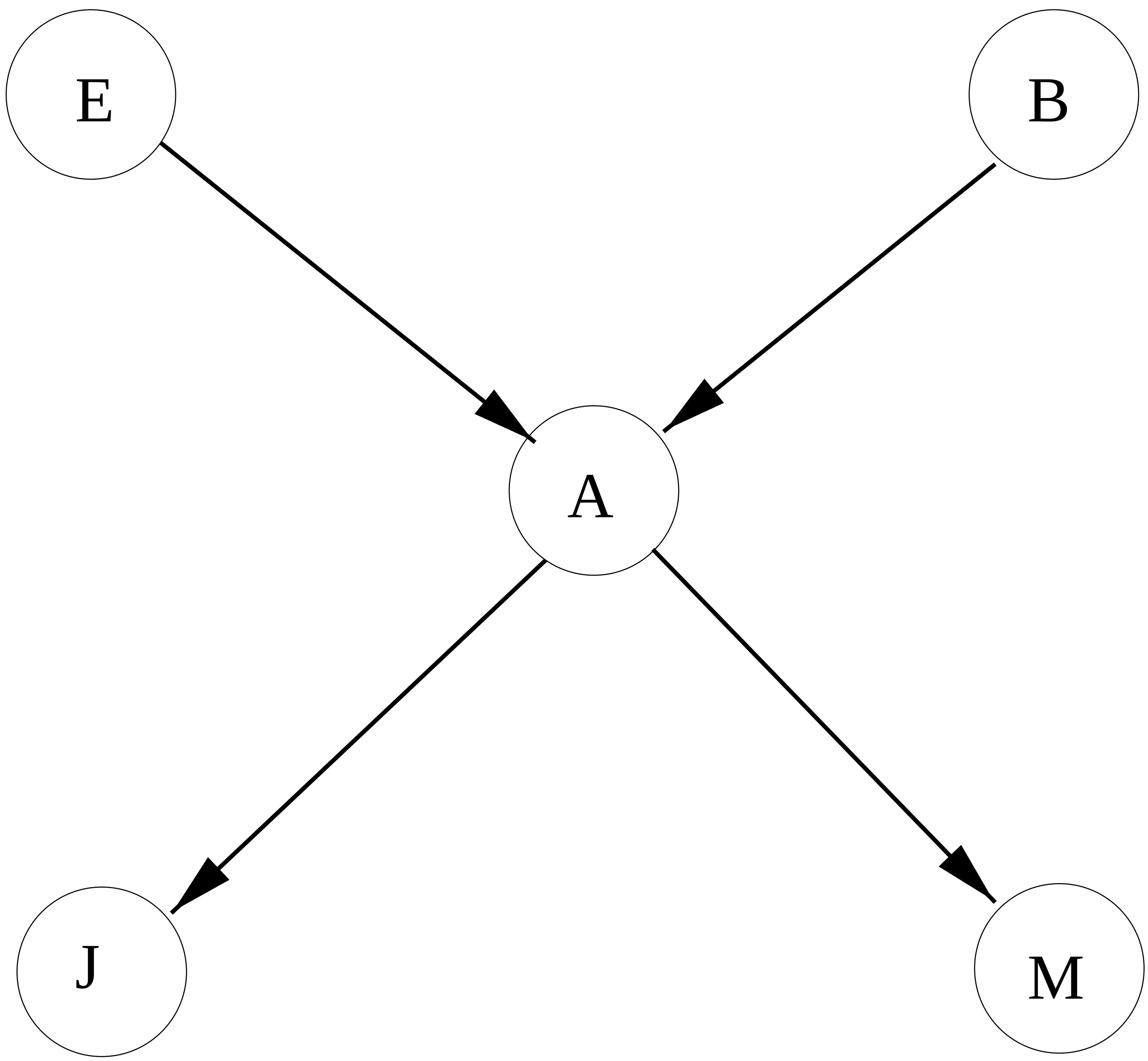

Figure 1: DAG for Burglar Bayesian Network.

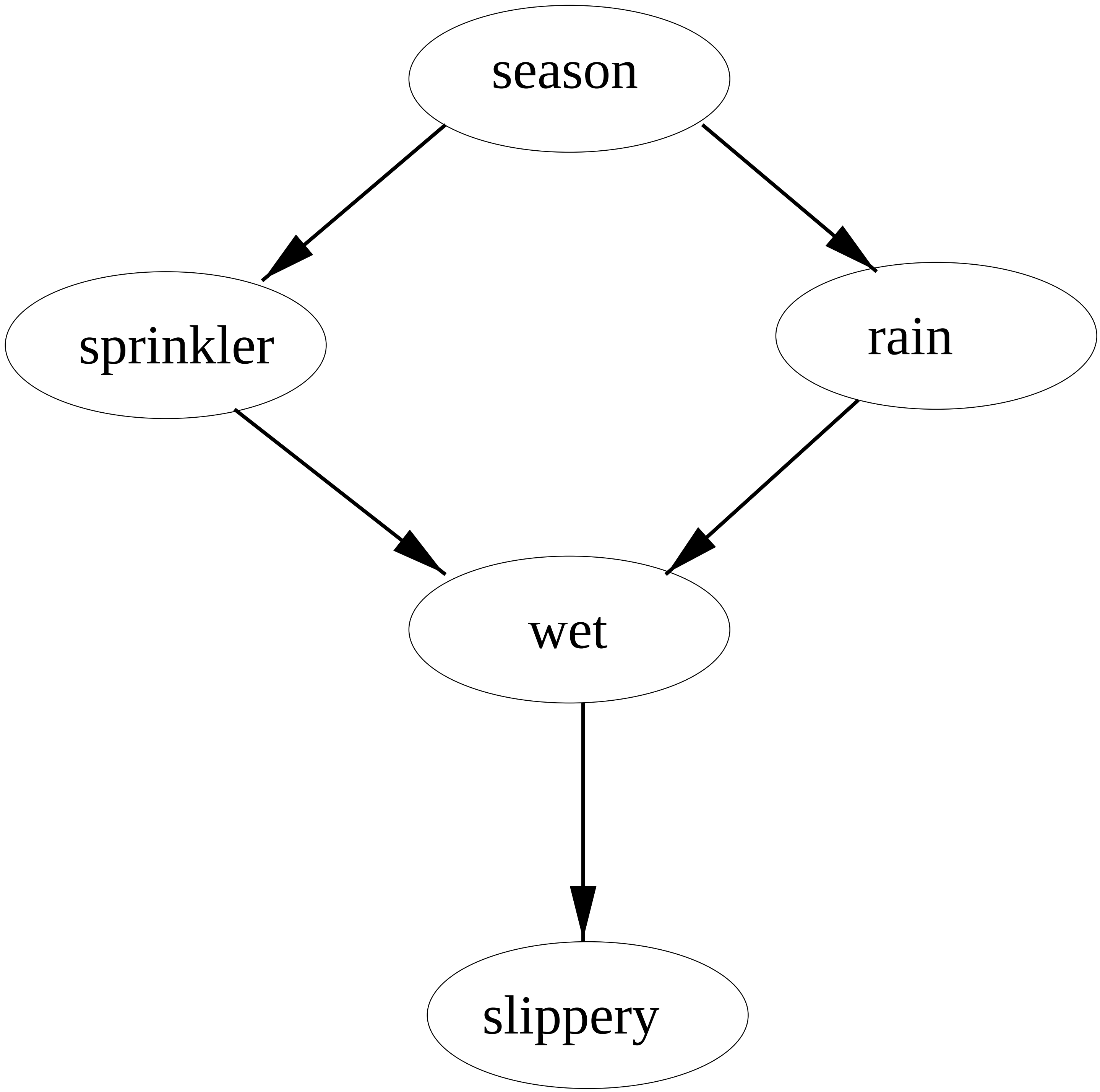

Figure 2: DAG for the Rain Bayesian Network.