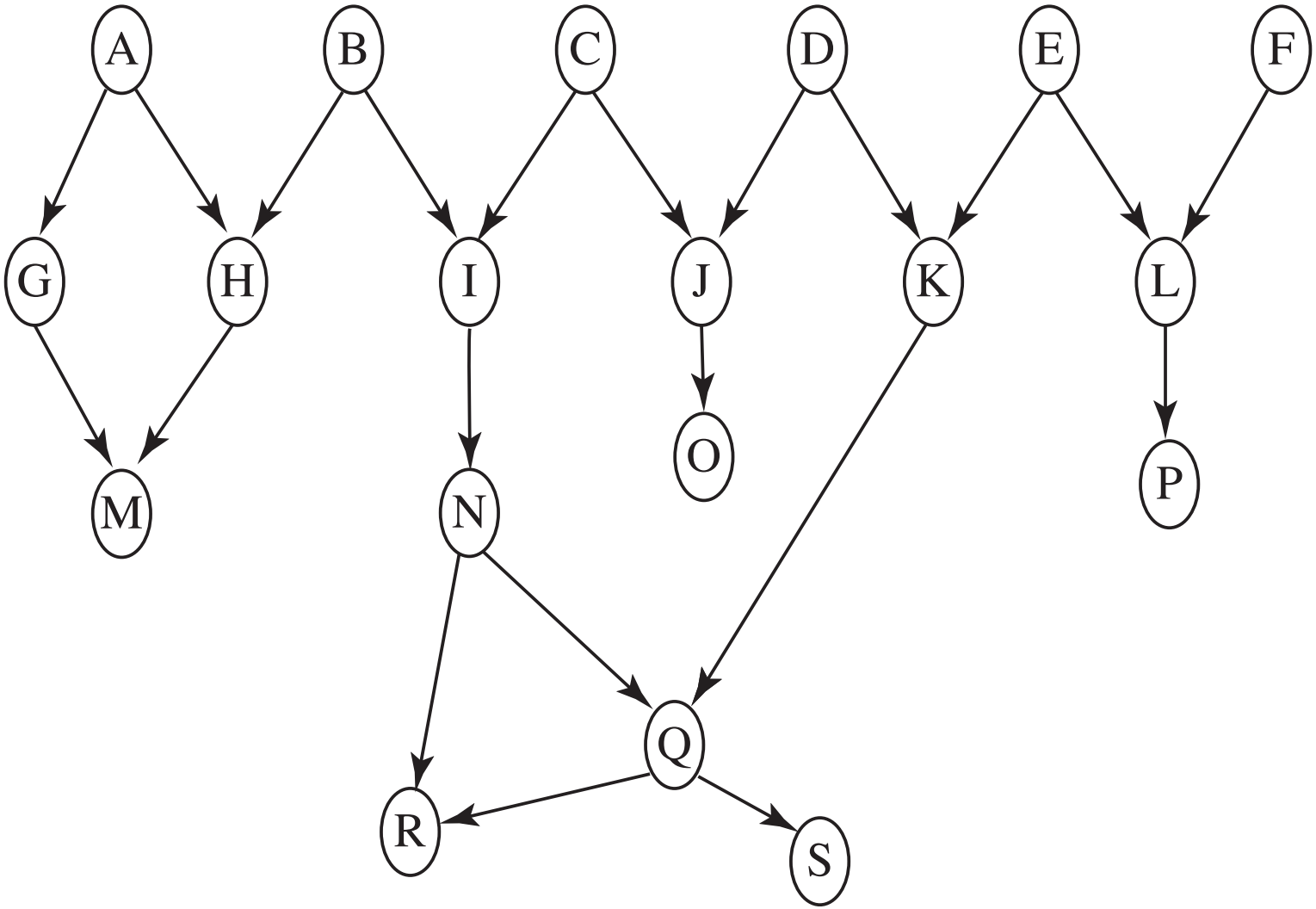
Understanding independence: example



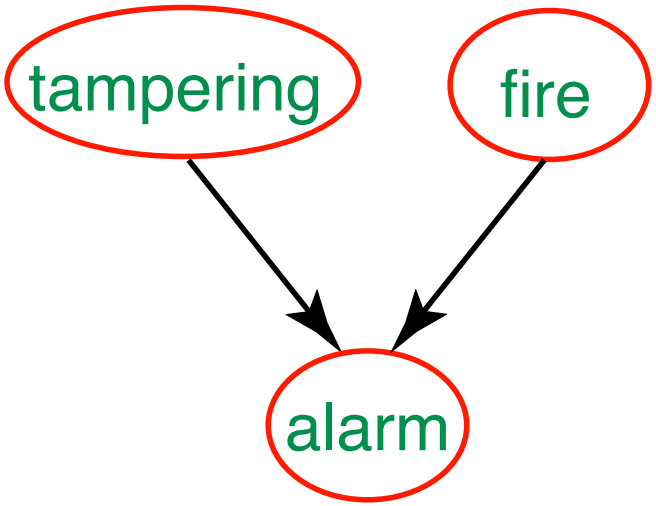
Understanding independence: questions

- On which given probabilities does $P(N)$ depend?
- If you were to observe a value for B, which variables' probabilities will change?
- If you were to observe a value for N, which variables' probabilities will change?
- Suppose you had observed a value for M; if you were to then observe a value for N, which variables' probabilities will change?
- Suppose you had observed B and Q; which variables' probabilities will change when you observe N?

What variables are affected by observing?

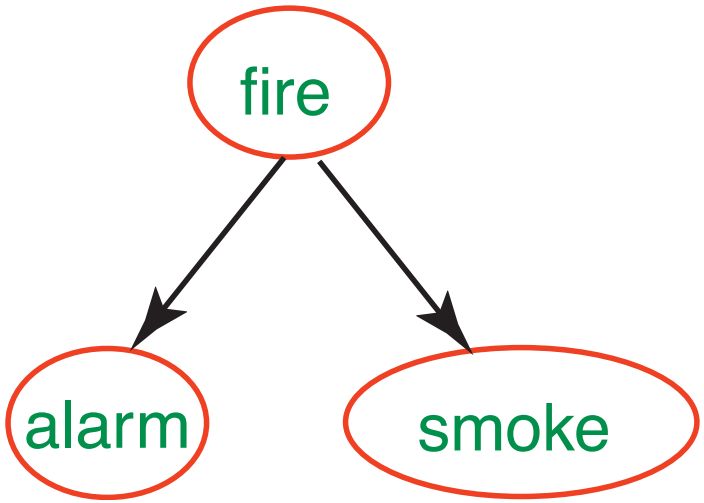
- If you observe variable $\overline{Y}$, the variables whose posterior probability is different from their prior are:
  - The ancestors of $\overline{Y}$ and
  - their descendants.
- Intuitively (if you have a causal belief network):
  - You do abduction to possible causes and
  - prediction from the causes.

Common descendants



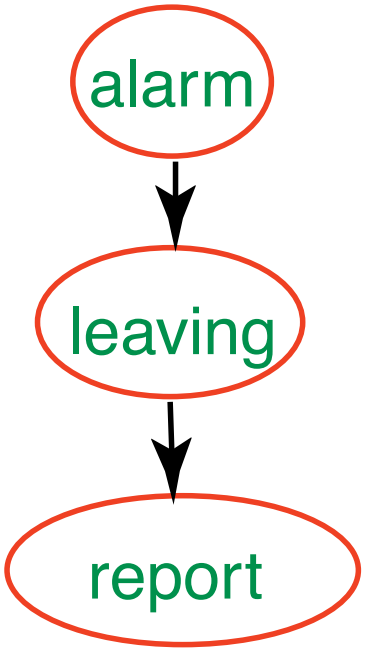
- *tampering* and *fire* are independent
- *tampering* and *fire* are dependent given *alarm*
- Intuitively, *tampering* can explain away *fire*

Common ancestors



- *alarm* and *smoke* are dependent
- *alarm* and *smoke* are independent given *fire*
- Intuitively, *fire* can explain *alarm* and *smoke*; learning one can affect the other by changing your belief in *fire*.

Chain



- *alarm* and *report* are dependent
- *alarm* and *report* are independent given *leaving*
- Intuitively, the only way that the *alarm* affects *report* is by affecting *leaving*.

Pruning Irrelevant Variables

Suppose you want to compute $P(X|e_1 \ldots e_k)$:

- Prune any variables that have no observed or queried descendents.
- Connect the parents of any observed variable.
- Remove arc directions.
- Remove observed variables.
- Remove any variables not connected to X in the resulting (undirected) graph.