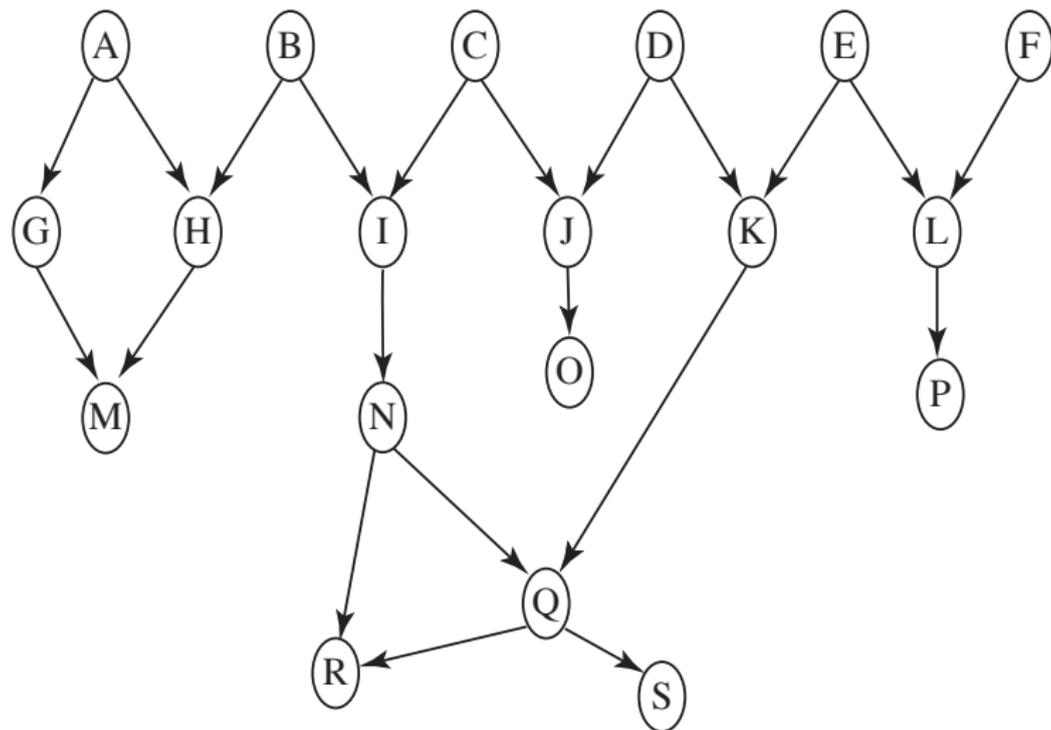


# Understanding independence: example



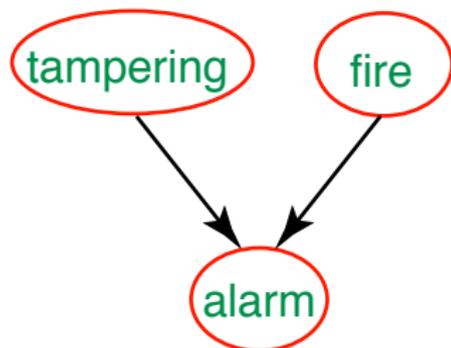
# Understanding independence: questions

- 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?

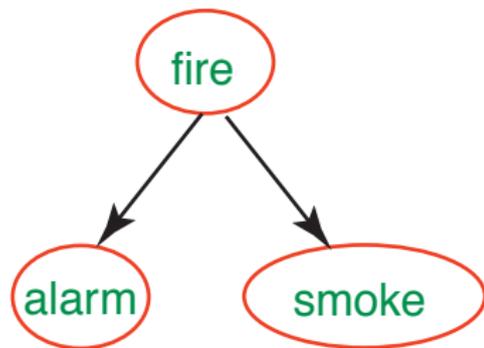
- If you observe variable  $\bar{Y}$ , the variables whose posterior probability is different from their prior are:
  - ▶ The ancestors of  $\bar{Y}$  and
  - ▶ their descendants.
- Intuitively (if you have a causal belief network):
  - ▶ You do **abduction** to possible causes and
  - ▶ **prediction**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

# Common descendants

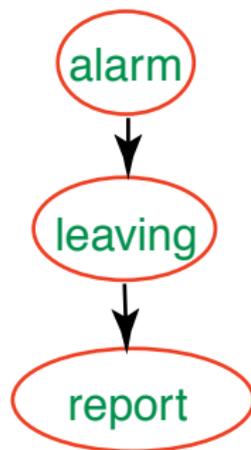


- *tampering* and *fire* are independent
- *tampering* and *fire* are dependent given *alarm*
- Intuitively, *tampering* can explain away *fire*

# 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*.



- *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  $P(X|e_1 \dots e_k)$ :

- Prune any variables that have no observed or queried descendants.
- 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.