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*. 
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.