Modelli Probabilistici per le Decisioni

Enza Messina

DISCo

Università degli Studi di Milano-
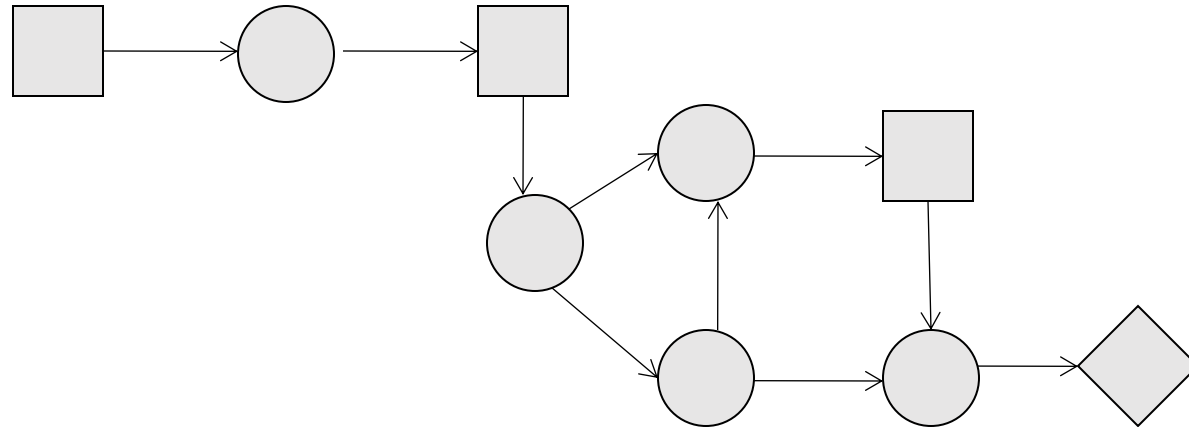
Bicocca

Viale Sarca, 336

20126 Milano

messina@disco.unimib.it

Reti Bayesiane

D-Separazione

Determinare se due variabili sono d-separate può essere utile per capire se apprendere il valore di una delle due variabili può aiutarci ad avere informazione aggiuntiva rispetto all'altra.

Vediamo le tre regole che ci aiutano …

D-separation: Case 1

X and Y are separated (conditionally independent) if there exists a node N on the path such that

- It is in the evidence set *E* (shaded grey)

- The arcs putting *N* in the path are "tail-to-tail".

X ←—— N ——→ Y
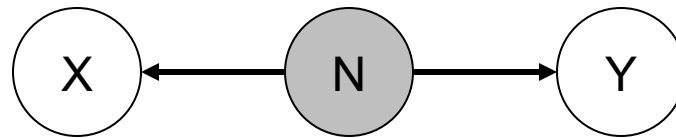
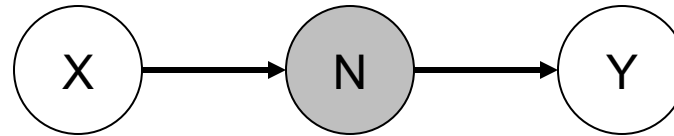X = "Owns expensive car" N = "Rich" Y = "Owns expensive home"

The path between X and Y is blocked by N

D-separation: Case 2

X and Y are separated if there exists a node N on the path such that

- It is in the evidence set *E*

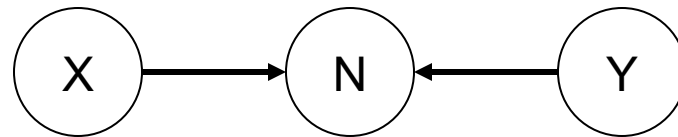- The arcs putting N in the path are "tail-to-head".

X=Education   N=Job   Y=Rich

The path between X and Y is blocked by N

D-separation: Case 3

X and Y are separated if there exists a node N on the path such that

- It is NOT in the evidence set E (not shaded)

- Neither are any of its descendants

- The arcs putting N in the path are "head-to-head".

The path between X and Y is blocked by N
(Note N is not in the evidence set)

Un esempio...

"icy road" example

- Inspector Smith is waiting for Holmes and Watson who are both late for an appointment.
- Smith is worried that if the roads are icy one or both of them may have crashed his car.
- Suddenly Smith learns that Watson has crashed.
- Smith thinks: *If Watson has crashed, probably the roads are icy, then Holmes has probably crashed too!*
- Smith then learns it is warm outside and roads are salted
- Smith thinks: *Watson was unlucky; Holmes should still make it.*

Holmes and Watson: "Icy roads" example
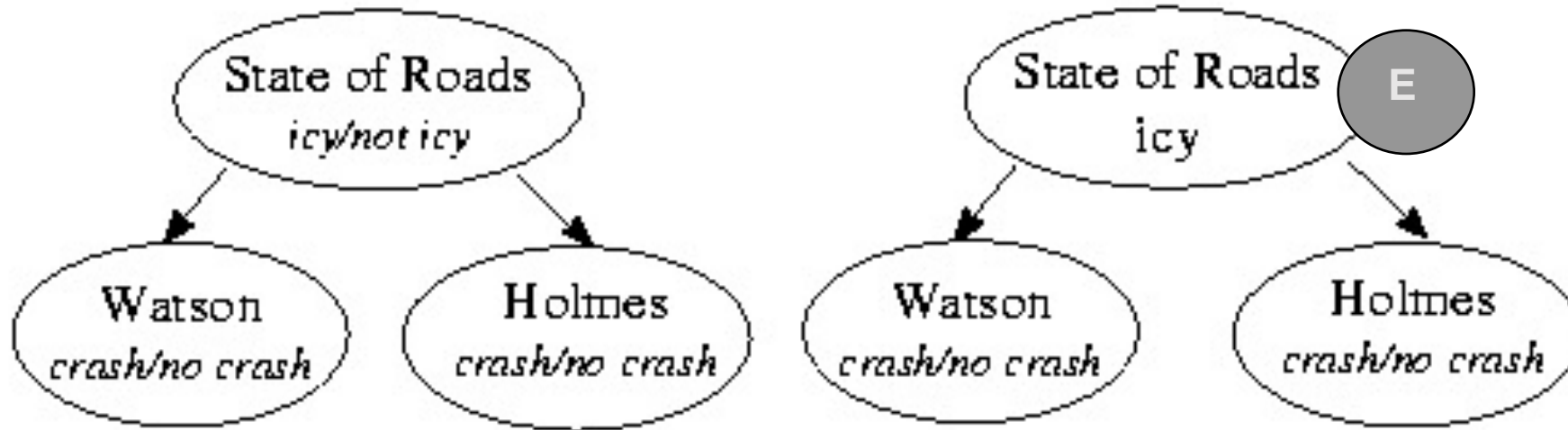
Watson and Holmes are d-connected given no evidence, but
Watson and Holmes are d-separated given State of Roads

Holmes and Watson: "Wet grass" example

- One morning as Holmes leaves for work, he notices that his grass is wet. He wonders whether he has left his sprinkler on, or it has rained.
- Glancing over to Watson's lawn he notices that it is also wet.
- Holmes thinks: *Since Watson's lawn is wet, it probably rained last night.*
- He then thinks: *If it rained then that explains why my is wet, so probably the sprinkler is off.*
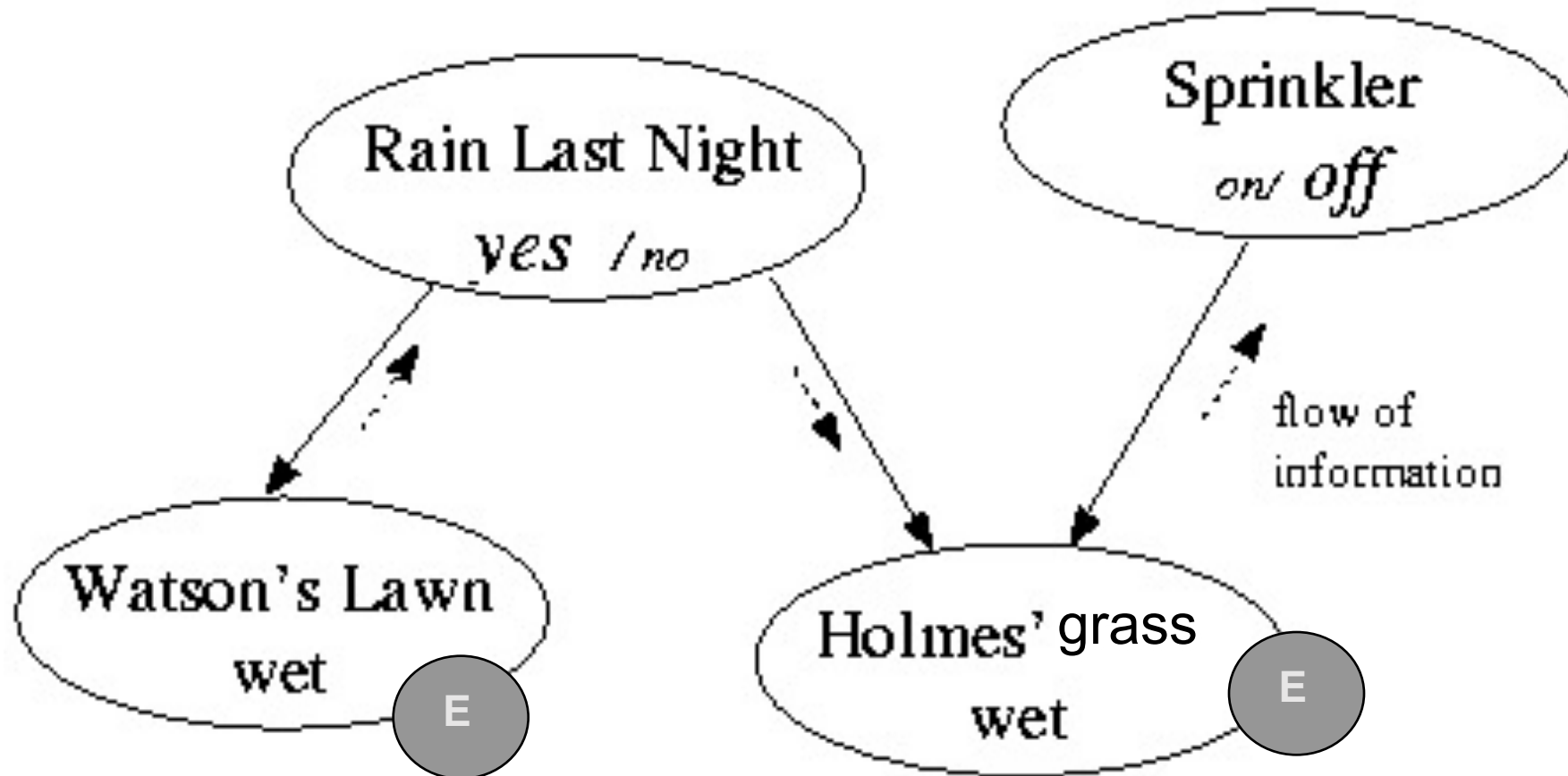
# Casual Relationships
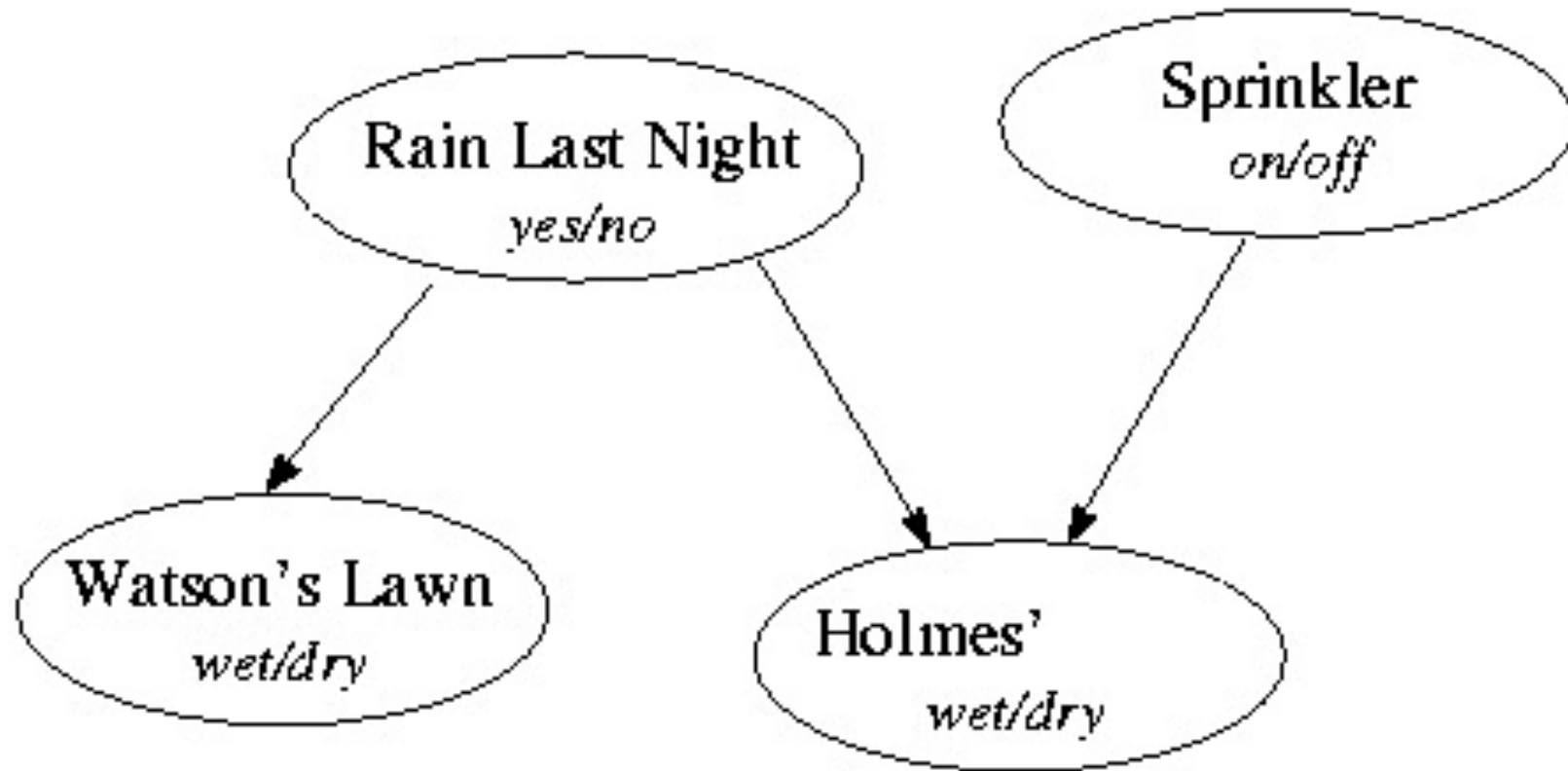
Holmes' grass is wet
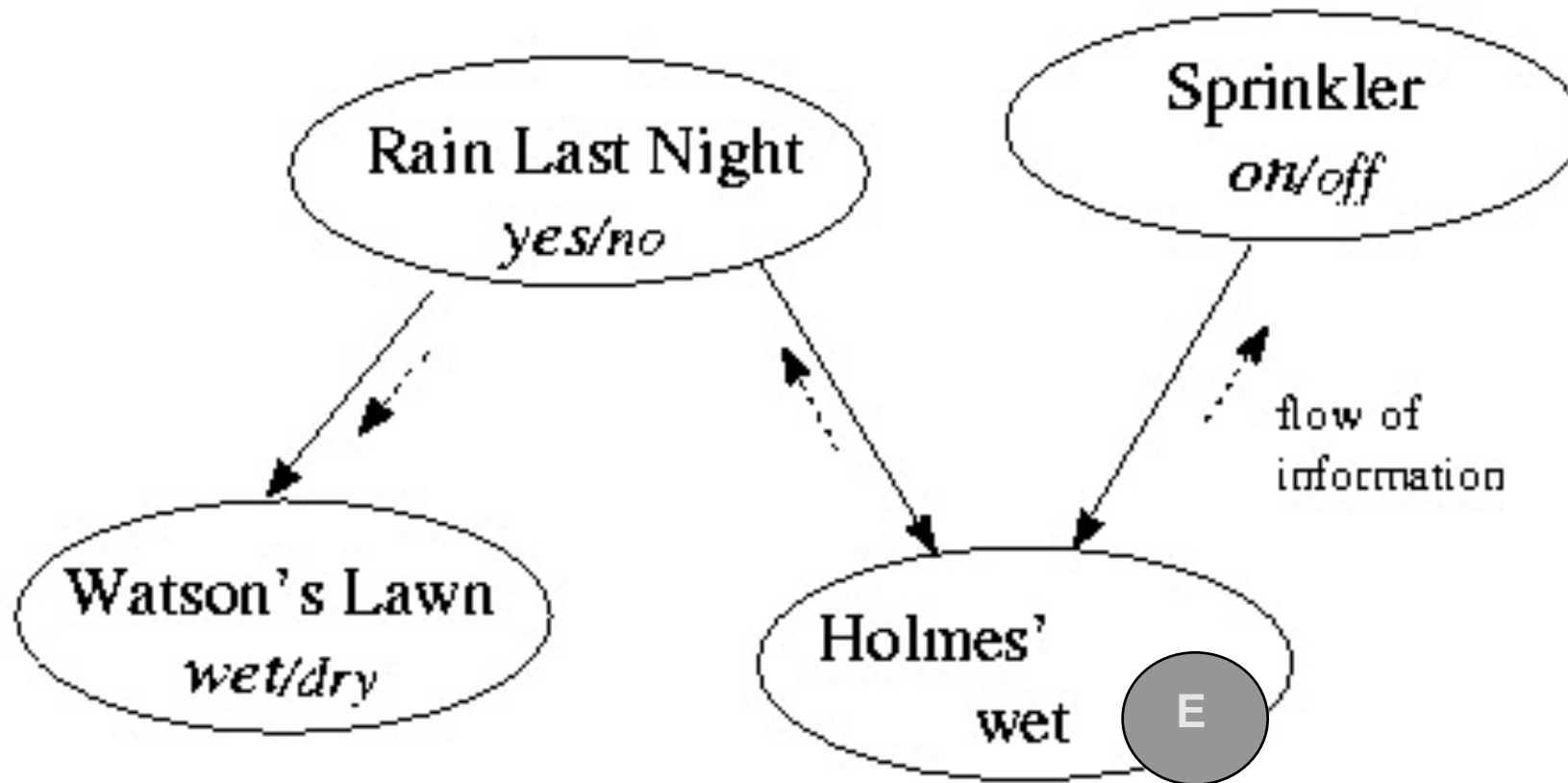
Watsons' lawn is also wet !

"Burglar alarm" example

- Holmes is at work when he receives a call from Watson, informing him that his alarm has gone off.
- Holmes thinks it is likely that the alarm really went off, although Watson sometimes play practical jokes.
- Holmes is on his way home when he hears a report on the radio, that there was an earthquake in the vicinity.
- Since the burglar alarm has been known to go off when there is an earthquake, Holmes reckons that a burglary is unlikely.
- Holmes goes back to work. (Leaving the noise for Watson)

Causal relationships
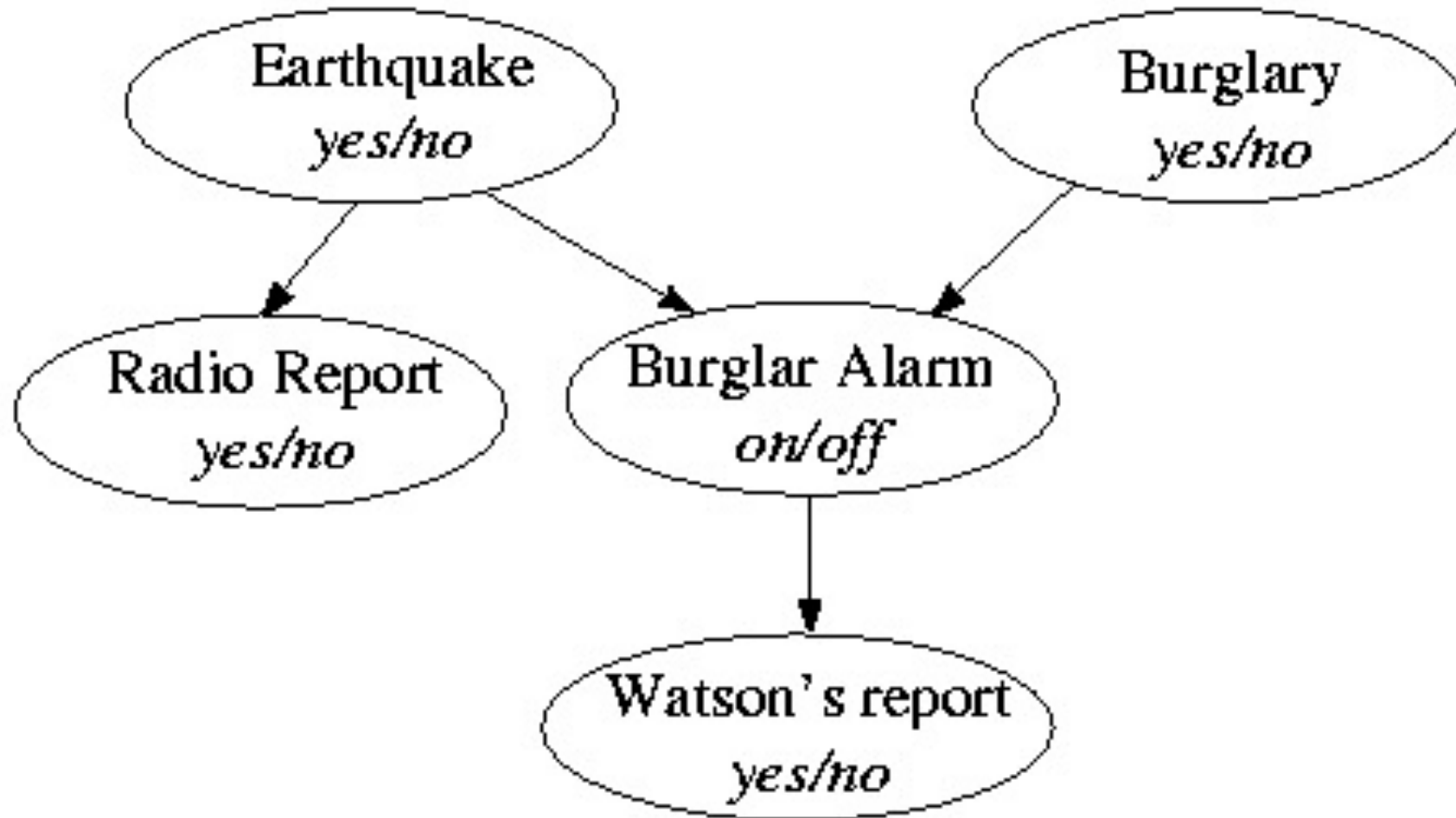
Watson reports about alarm
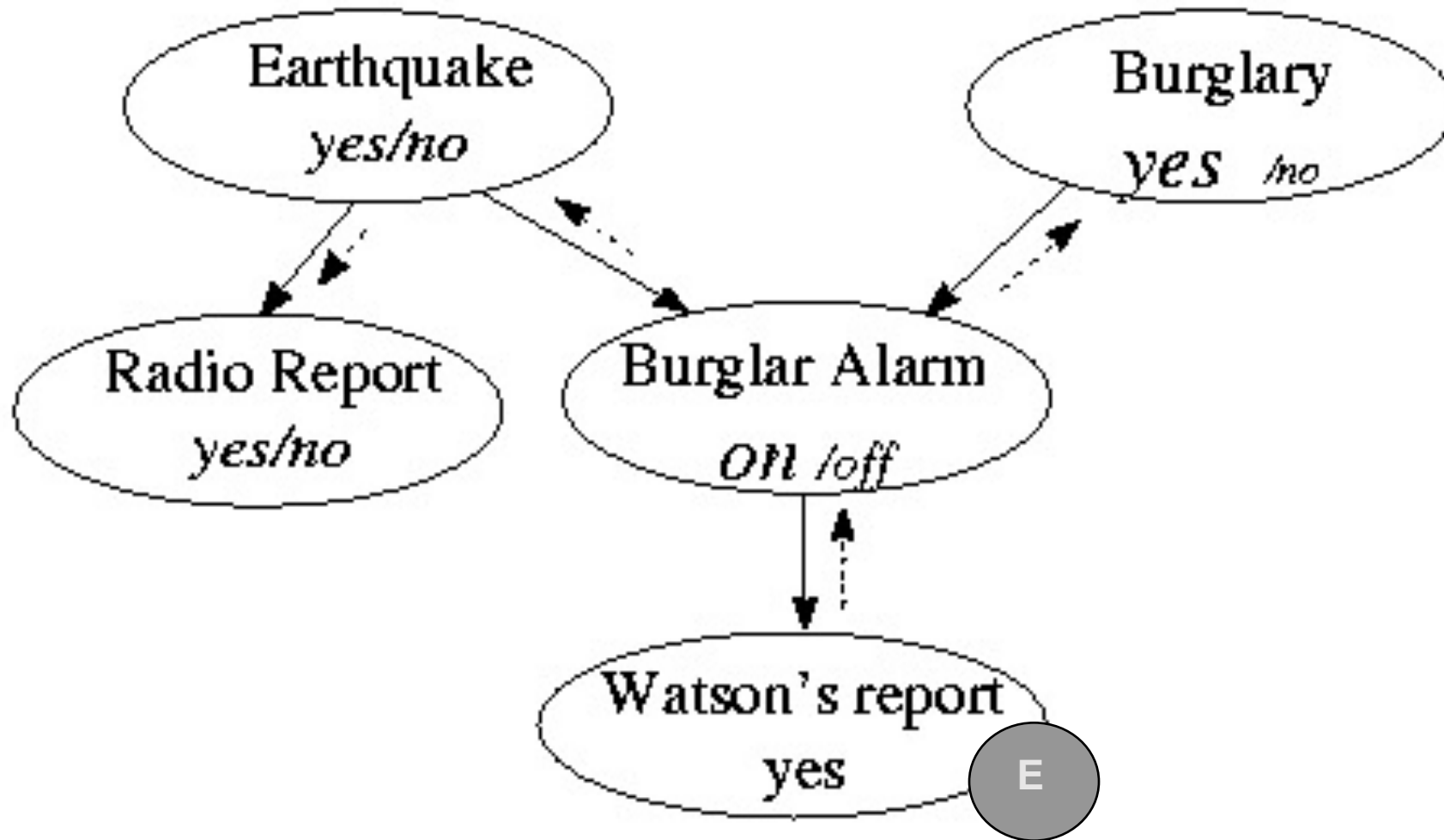
Radio reports about earthquake