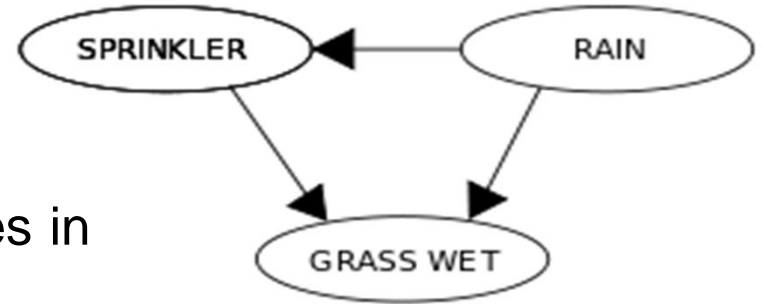


Introduction to Bayesian networks and decision support models

Laura Uusitalo

Bayesian network is

- a statistical model that represents
 - a set of variables (bubbles)
 - their conditional dependencies (edges)
- variables are random variables in the Bayesian sense



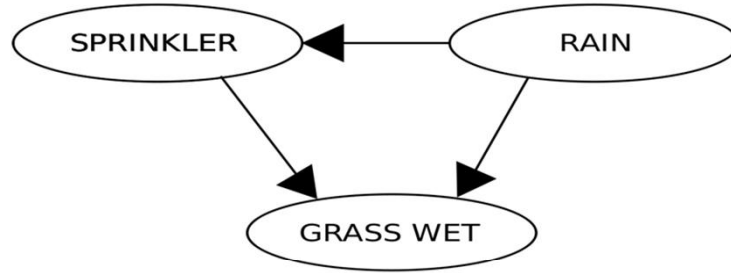
Picture source: Wikipedia

Bayesian network qualities

- Bayesian network is always
 - Directed: arrows, not just lines joining two nodes
 - Acyclic: the arrows may not form a directed loop
- Each variable includes a probability distribution
 - the probabilities of each of the possible outcomes (must cover all possible options!)
 - If a variable has incoming edges (*parents*), it has a *conditional distribution*: one probability distribution corresponding to each combination of the parents' values

(Conditional) probability distributions

RAIN	SPRINKLER	
	T	F
F	0.4	0.6
T	0.01	0.99


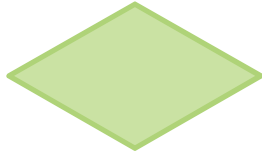


	RAIN	
	T	F
	0.2	0.8

SPRINKLER	RAIN	GRASS WET	
		T	F
F	F	0.0	1.0
F	T	0.8	0.2
T	F	0.9	0.1
T	T	0.99	0.01

Source:
Wikipedia

Decision support models

- DSM also include *decision* and *utility* variables 
- Decision: something we can decide. Management options etc.
 - Strict measures / Business-as-usual / laizzes-faire...
- Utility: benefit and/or harm resulting from the state of the system.
 - The fish yield
 - The value of yield
 - Value of ecosystem services
 - Etc.

Some side notes

- Bayesian network doesn't have to represent causal connections! It is a statistical, not mechanistic, model.
 - However, making the models mimic causal connections is often useful, especially in decision analysis.
- Theoretically, the values of the variables do not need to be a discrete set.
 - In practise, however, the modern BN algorithms are mostly unable to deal with anything else than discrete value sets, so we will mostly talk about discrete cases.