Bayesian network example

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Bioinformatics

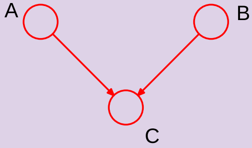
A toy regulatory network

Conditional probability tables

- Genes *A* and *B* have independent prior probabilities:

gene	value	P(value)
A	`active`	0.3
A	`inactive`	0.7

gene	value	P(value)
B	`active`	0.3
B	`inactive`	0.7

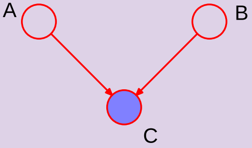


- Gene *C* can be enhanced by both *A* and *B*:

		A			
		`active`		`inactive`	
		B		B	
		`active`	`inactive`	`active`	`inactive`
C	`active`	0.9	0.6	0.7	0.1
C	`inactive`	0.1	0.4	0.3	0.9

A toy regulatory network

Probability of A active (1)



- Prior:

$$P(A=1) = 1 - P(A=0) = 0.3$$

- Posterior after observing active C:

$$P(A=1|C=1) = \frac{P(C=1|A=1)P(A=1)}{P(C=1)} \simeq 0.514$$

Note

The probability that A is active *increases* from observing that its regulated gene C is active

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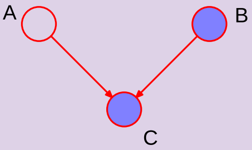
Probability of A active

- Posterior after observing that B is also active:



$$P(A=1|C=1,B=1) =$$

$$\frac{P(C=1|A=1,B=1)P(A=1|B=1)}{P(C=1|B=1)} \simeq 0.355$$

Note

- The probability that A is active *decreases* after observing that B is also active
- The B condition *explains away* the observation that C is active
- The probability is still greater than the prior one (0.3), because the C active observation still gives some evidence in favour of an active A