

Executive Summary: Bayes Nets

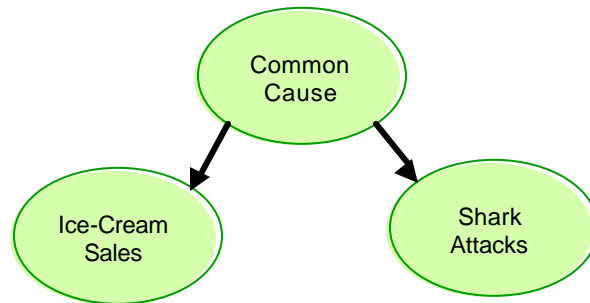
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Ice-Cream and Sharks Spreadsheet

Recent Dow-Jones Change	Number of Ice-Creams sold today	Number of Shark Attacks today
UP	3500	4
STEADY	41	0
UP	2300	5
DOWN	3400	4
UP	18	0
STEADY	105	0
STEADY	4	0
STEADY	6310	3
UP	70	0

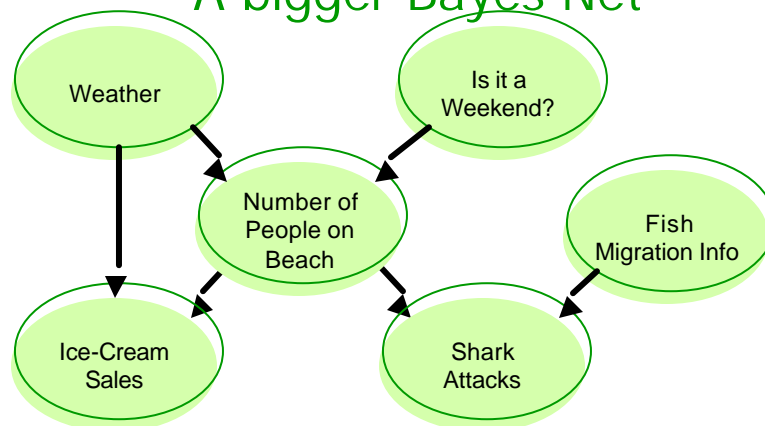
A simple Bayes Net



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Short Bayes Nets: Slide 3

A bigger Bayes Net



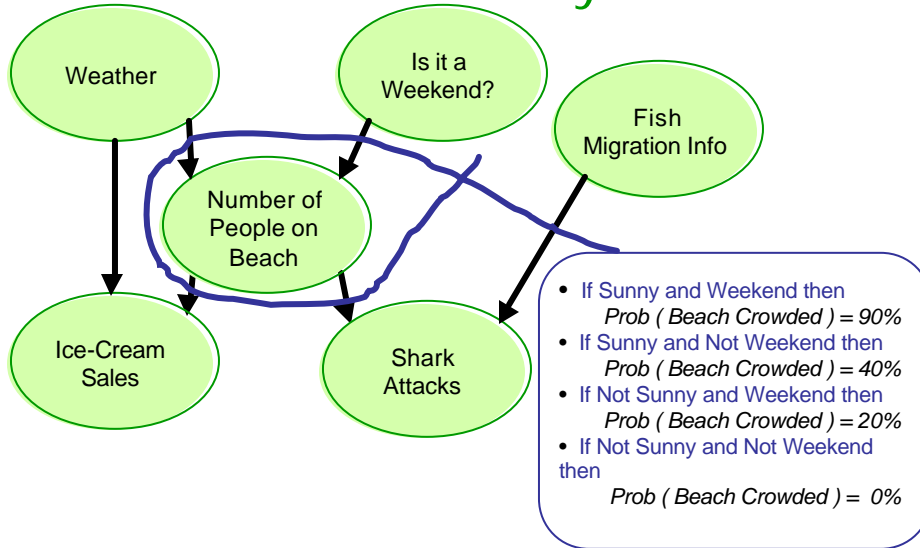
These arrows can be interpreted...

- **Causally** (Then it's called an influence diagram)
- **Probabilistically** (if I know the value of my parent nodes, then knowing other nodes above me would provide no extra information: *Conditional Independence*)

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Short Bayes Nets: Slide 4

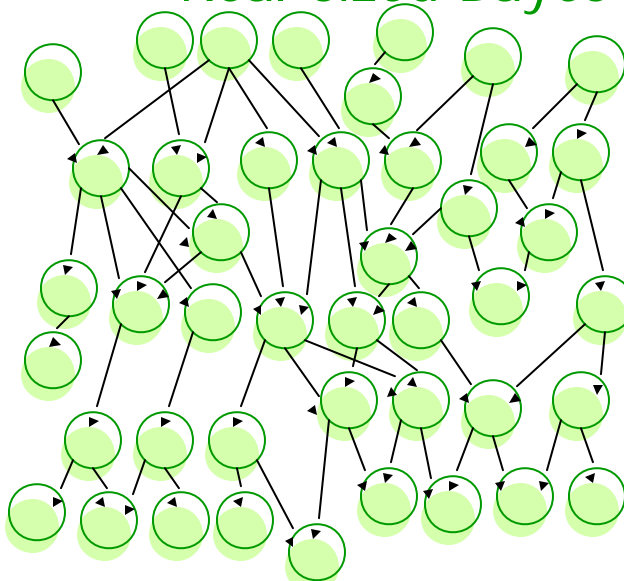
The Guts of a Bayes Net



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Short Bayes Nets: Slide 5

Real-sized Bayes Nets



How do you build them?
 From Experts and/or from Data!

How do you use them? Predict values that are expensive or impossible to measure. Decide which possible problems to investigate first.

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Short Bayes Nets: Slide 6

Building Bayes Nets

- Bayes nets are sometimes built manually, consulting domain experts for structure and probabilities.
- More often the structure is supplied by experts, but the probabilities learned from data.
- And in some cases the structure, as well as the probabilities, are learned from data.

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Short Bayes Nets: Slide 7

Example: Pathfinder

Pathfinder system. (Heckerman, *Probabilistic Similarity Networks*, MIT Press, Cambridge MA).

- Diagnostic system for lymph-node diseases.
- 60 diseases and 100 symptoms and test-results.
- 14,000 probabilities.
- Expert consulted to make net.
 - 8 hours to determine variables.
 - 35 hours for net topology.
 - 40 hours for probability table values.
- Apparently, the experts found it quite easy to invent the causal links and probabilities.

Pathfinder is now outperforming the world experts in diagnosis. Being extended to several dozen other medical domains.

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Short Bayes Nets: Slide 8

Other Bayes Net Examples:

- Further Medical Examples (Peter Spirtes, Richard Scheines, CMU)
- Manufacturing System diagnosis (Wray Buntine, NASA Ames)
- Computer Systems diagnosis (Microsoft)
- Network Systems diagnosis
- Helpdesk (Support) troubleshooting (Heckerman, Microsoft)
- Information retrieval (Tom Mitchell, CMU)
- Customer Modeling
- Student Retention (Clarke Glymour, CMU)
- Nomad Robot (Fabio Cozman, CMU)