Executive Summary: Bayes Nets

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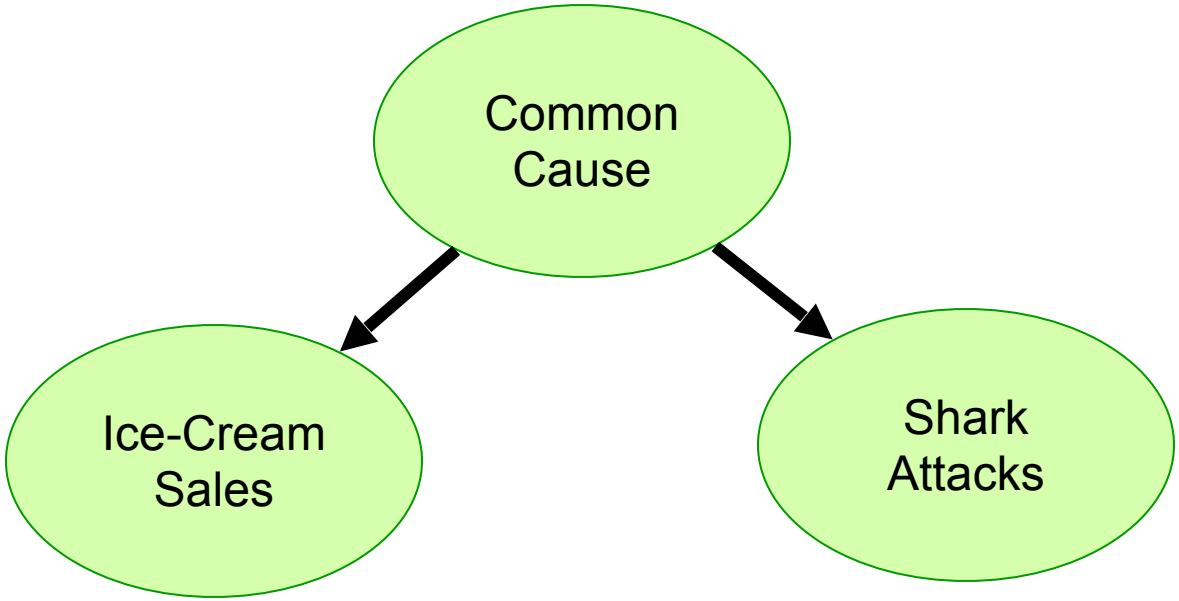
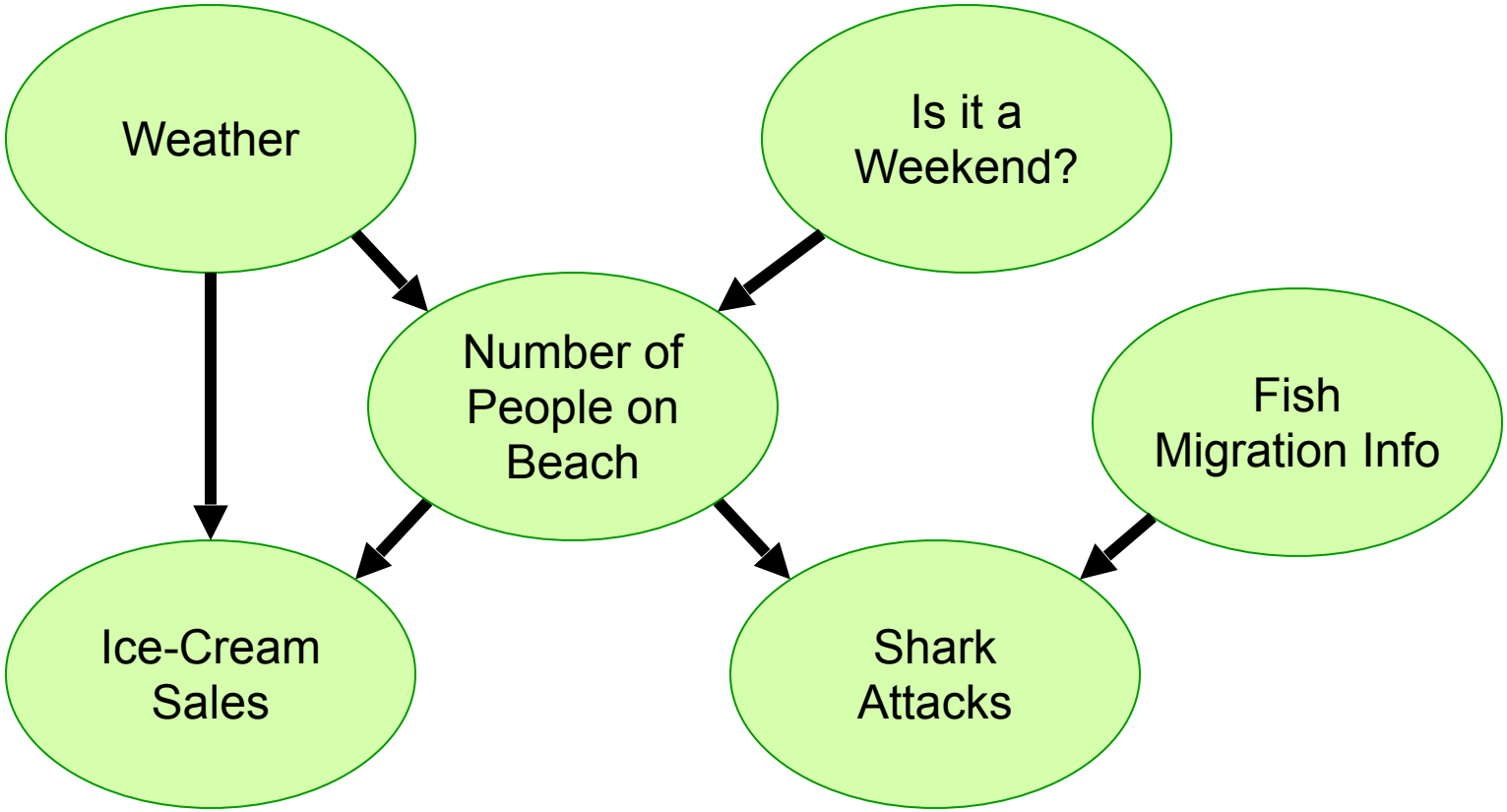
Ice-Cream and Sharks Spreadsheet

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



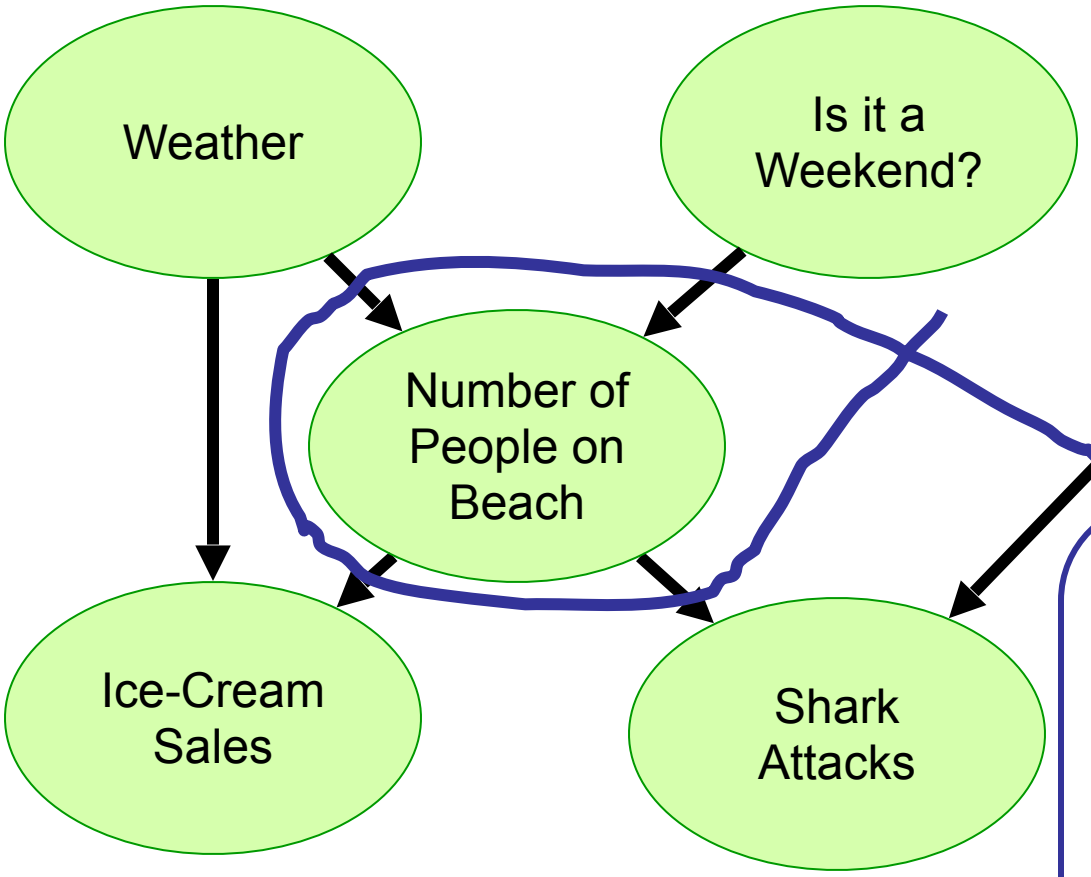
A bigger Bayes Net



These arrows can be interpreted…

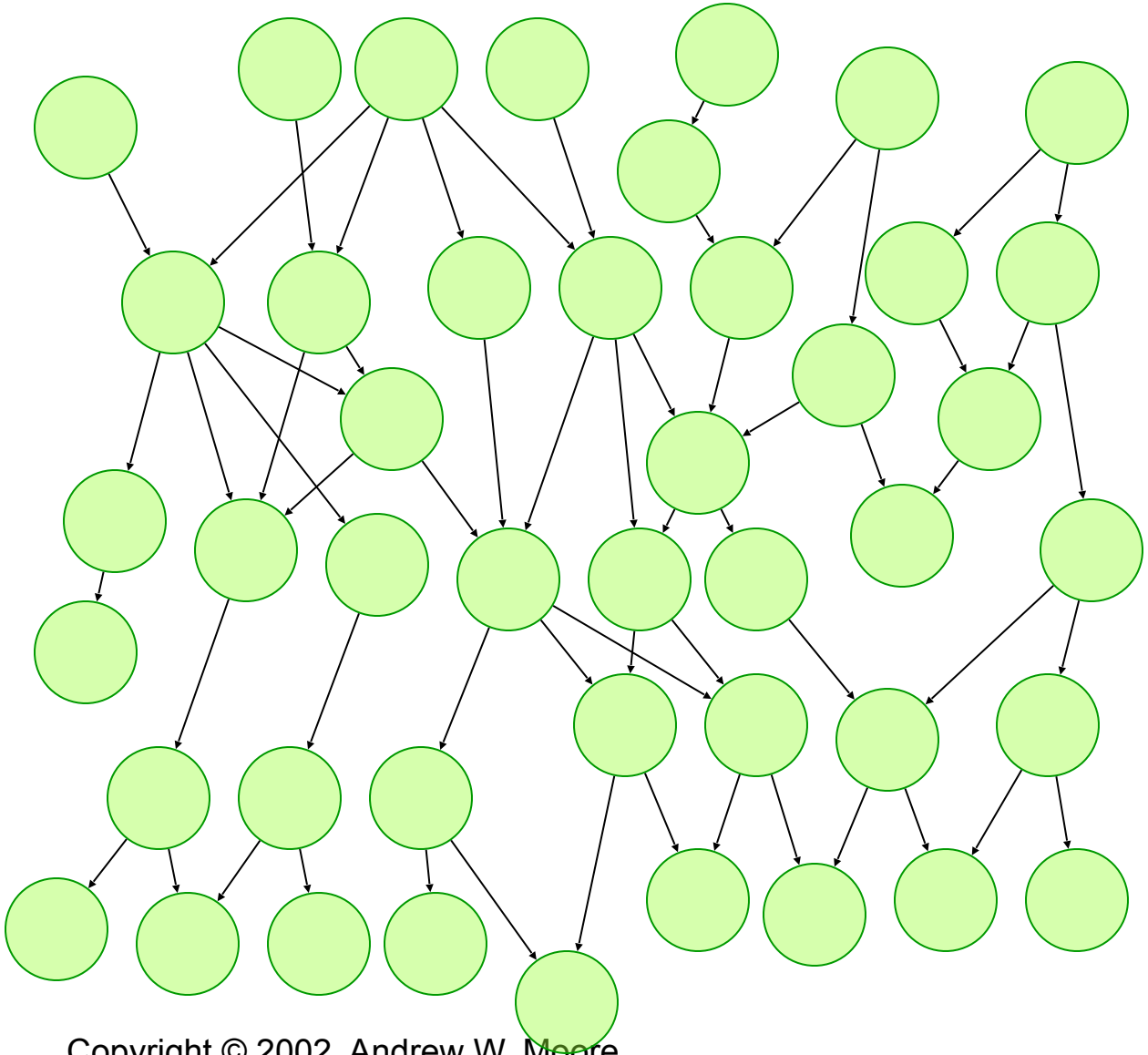
- Causally *(Then it's called an influence diagram)*
- Probabilistically *(if I know the value of my parent nodes, then knowing other nodes above me would provide no extra information: Conditional Independence*

The Guts of a Bayes Net



- If Sunny and Weekend then
  Prob (Beach Crowded) = 90%
- If Sunny and Not Weekend then
  Prob (Beach Crowded) = 40%
- If Not Sunny and Weekend then
  Prob (Beach Crowded) = 20%
- If Not Sunny and Not Weekend then
  Prob (Beach Crowded) = 0%

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.

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.

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.

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)