AAA1-16 Tutorial

CP-nets

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Conditional Preferences

- If I attend two tutorials today, I would prefer to skip the Ethics & AI workshop tomorrow, but if I only attend one tutorial, I prefer to attend the workshop.
- I prefer to attend the CP-nets tutorial, rather than sleeping in today ($\Rightarrow \geq 1$ tutorial!)
- I prefer to explore Phoenix this afternoon ($\Rightarrow < 2$ tutorials!)
Formal Definition of CP-Nets

■ CP-nets are qualitative representations of preferences.
■ A CP-net consists of a graph, where nodes represent preference variables or features of possible outcomes, edges represent conditional dependence, plus conditional preference tables for each node.
  – Boutilier, Brafman, Hoos, Poole. UAI. 1999
■ A CP-net defines a partial order on outcomes.
Pasta at Monday Night’s Reception

- Bowtie, Penne
- Tomato (Red) sauce, White sauce
- Cheese
- Mushrooms
- Peppers
- Other toppings

What are your preferences?
The CP-Net Visualizer by Shafran and Saarinen

- Using the CP-net visualizer
CP-Net Visualizer for download

- Github.com/zelbrium/cp-net-visualizer
  - Aidan Shafran and Sam Saarinen
A Few CP-Net Applications

- Facilitating communication with “shut-ins” with traumatic brain injury or ALS
  - Dorr, Galescu, Golob, Venable, Y Wilks. *Companion-Based Ambient Robust Intelligence (CARING).* Workshops at AAAI 2015.

- Interest matching in social networks
A Few CP-Net Applications

- **Web service selection**

- **Choosing security measures**
Multi-Agent CP-Net Applications

- Automated negotiation
Multi-Agent CP-Net Applications

- Collective decision making

- Auctions
What Can CP-Nets Compute?

■ What is the most preferred item?
  – *Penne with red sauce and cheese*?

■ What are the k most preferred items?
  – *In case they run out of something, or have pre-prepared dishes*

■ Which of these two is preferred?
  – <*Bowtie, Red, NoCheese*> or <*Penne, White, NoCheese*>?

■ If o is preferred to o’, we say that o **dominates** o’.
Finding the Most-Preferred Outcome

- Topologically order the nodes (assumes acyclic CP-net)
- Choose best values for each root node
- For each child node in order, choose best value, given (best) value of parents
- Done.
Computational Complexity

- Finding the best or $k$ best is in P.
- Dominance is NP-hard.
  - *Boutilier Brafman, Domshlak, Hoos, Poole.* JAIR. 2004.
- Dominance in *generalized* CP-nets is PSPACE-complete [allowing cycles in CP-net graph, multi-valued variables, and succinct representations of CPTs]