

AAAI-16 Tutorial

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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 (→ ≥ 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.
 <u>Companion-Based Ambient Robust Intelligence</u> (CARING). Workshops at AAAI 2015.
- Interest matching in social networks
 - Wicker and Doyle. "Interest-matching comparisons using CP-nets." AAAI 1999.

A Few CP-Net Applications

Web service selection

- Wang, Xu, Li, and Hung. "Incomplete preference-driven web service selection." In Services Computing, 2008.

Choosing security measures

- Bistarelli, Fioravanti, and Peretti. "Using CP-nets as a guide for countermeasure selection." ACM symposium on Applied computing. ACM, 2007.

Multi-Agent CP-Net Applications

Automated negotiation

- Cadilhac, Asher, Benamara, Popescu, and Seck.
 Preference Extraction From Negotiation Dialogues. ECAI.
 2012.
- Aydoğan, Baarslag, Hindriks, Jonker, and Yolum, Heuristic-based approaches for CP-nets in negotiation.
 Complex automated negotiations: theories, models, and software competitions. 2013.

Multi-Agent CP-Net Applications

- Collective decision making
 - Purrington and Durfee. "Agreeing on social outcomes using individual CP-nets." Multiagent and Grid Systems. 2009.
 - Li, Vo, and Kowalczyk. An Efficient Procedure for Collective Decision-making with CP-nets, ECAI 2010.
- Auctions
 - Ghavamifar, Sadaoui, and Mouhoub. "Preference Elicitation and Winner Determination in Multi-Attribute Auctions." FLAIRS. 2011.

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 <u>o dominates o'</u>.

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]
 - Goldsmith, Lang, Truszczynski, Wilson. JAIR. 2008.