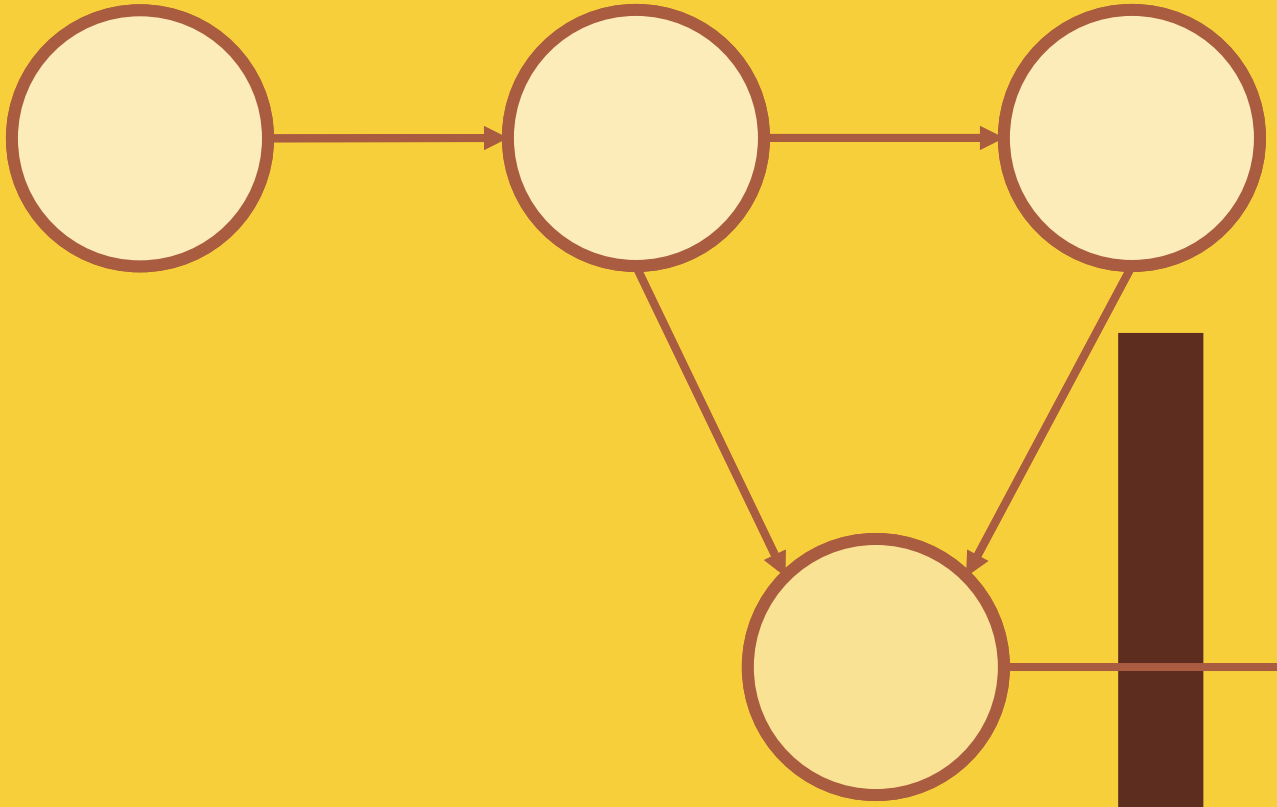
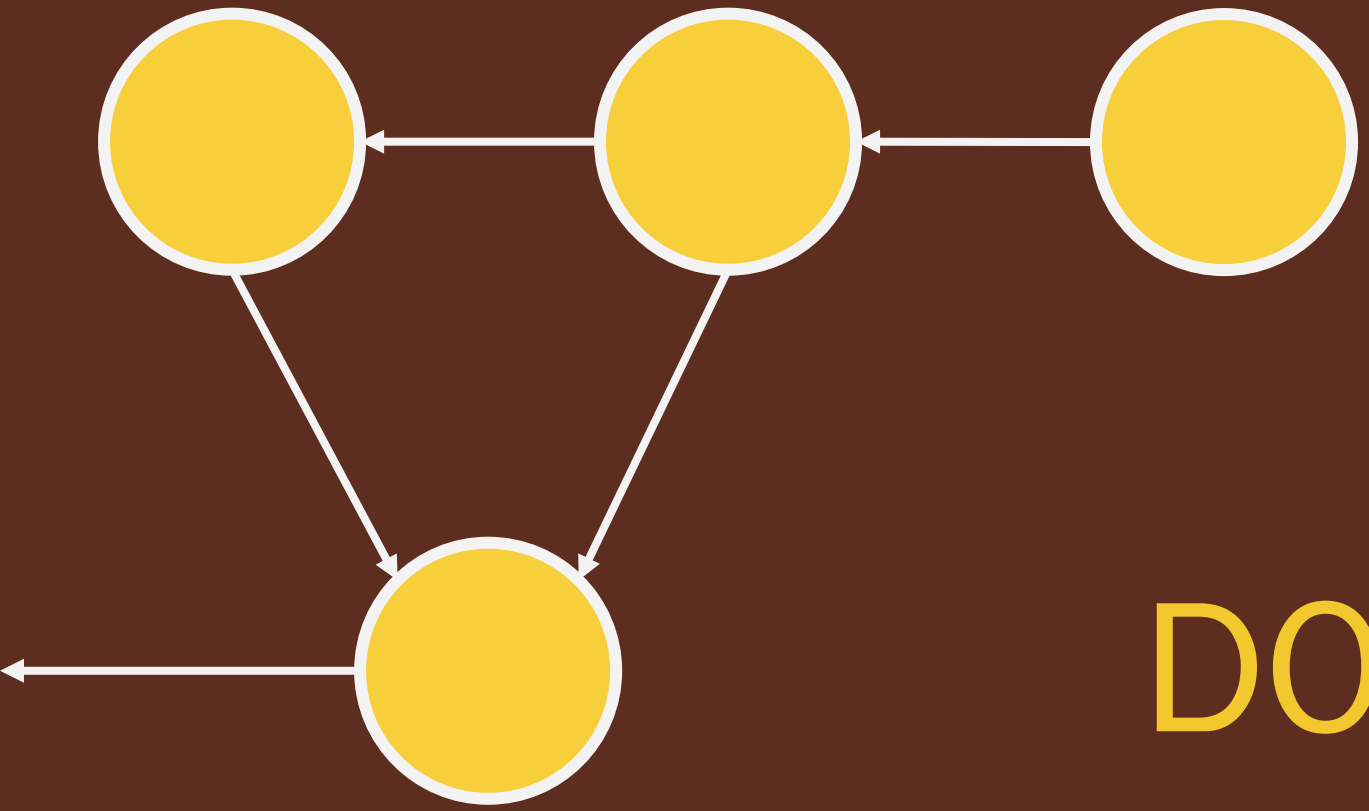


AAAI-16 Tutorial

CP-nets

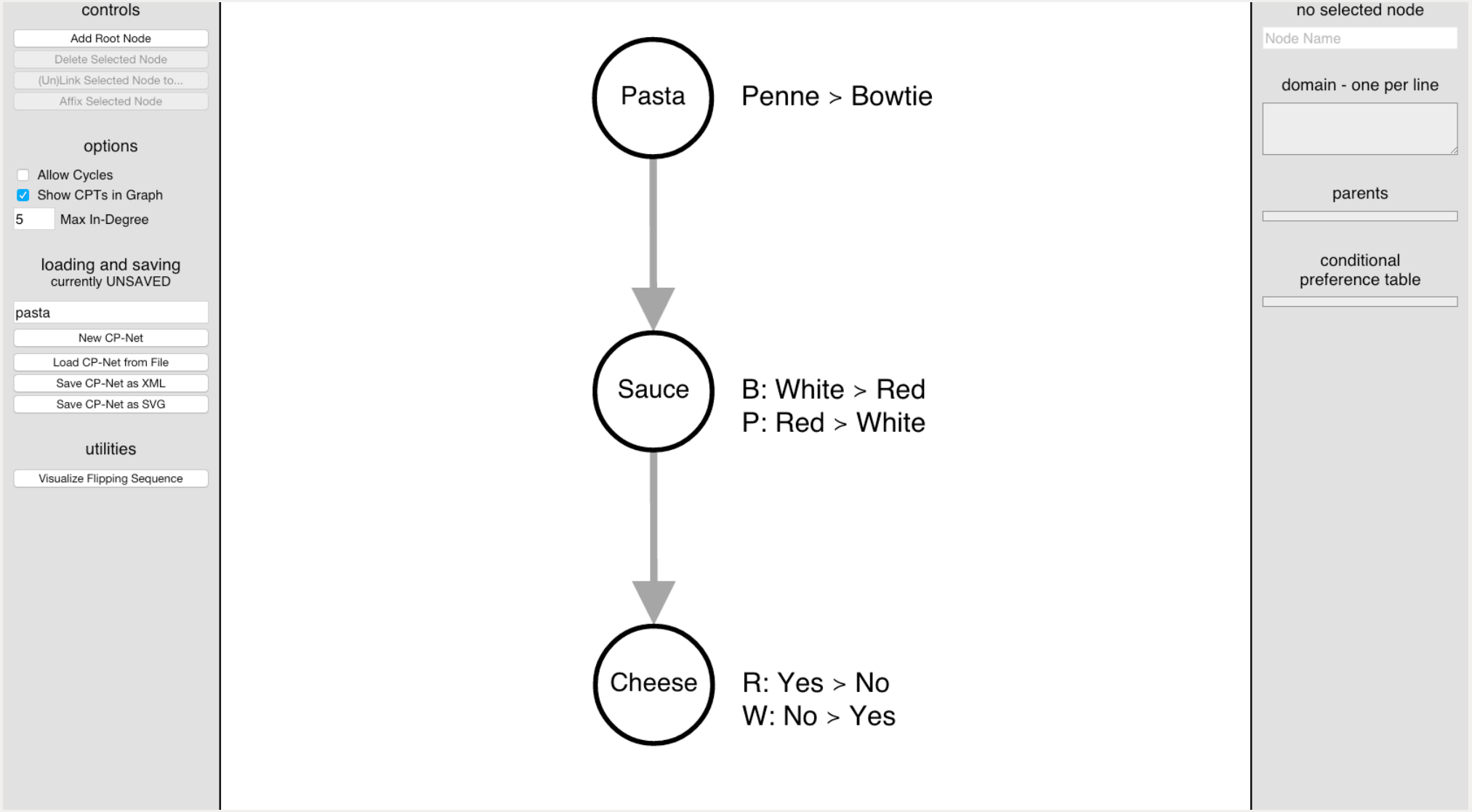
- Thomas E. Allen
- Judy Goldsmith
- Francesca Rossi



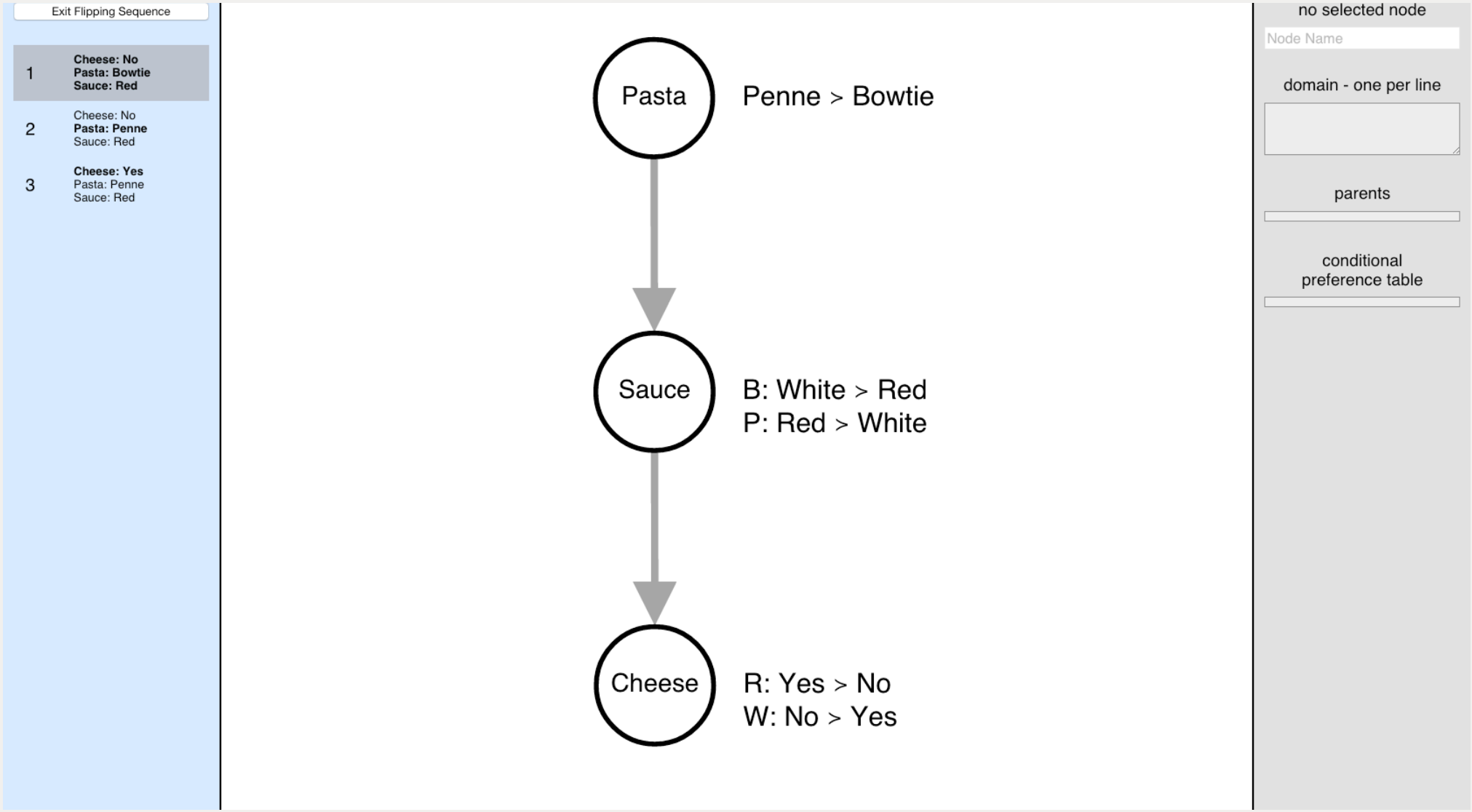
DOMINANCE

Judy Goldsmith

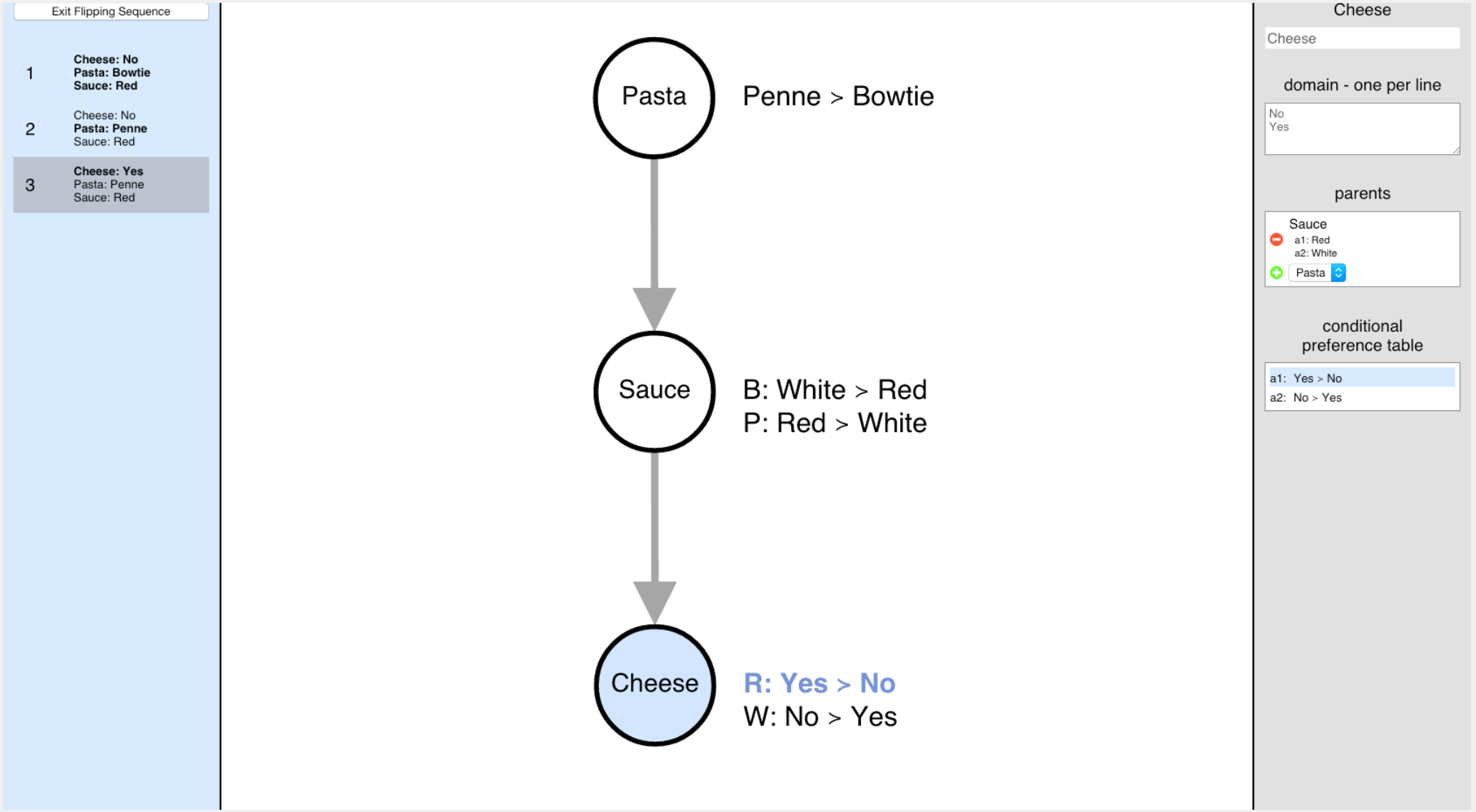
Simple CP-net: Monday Reception Food



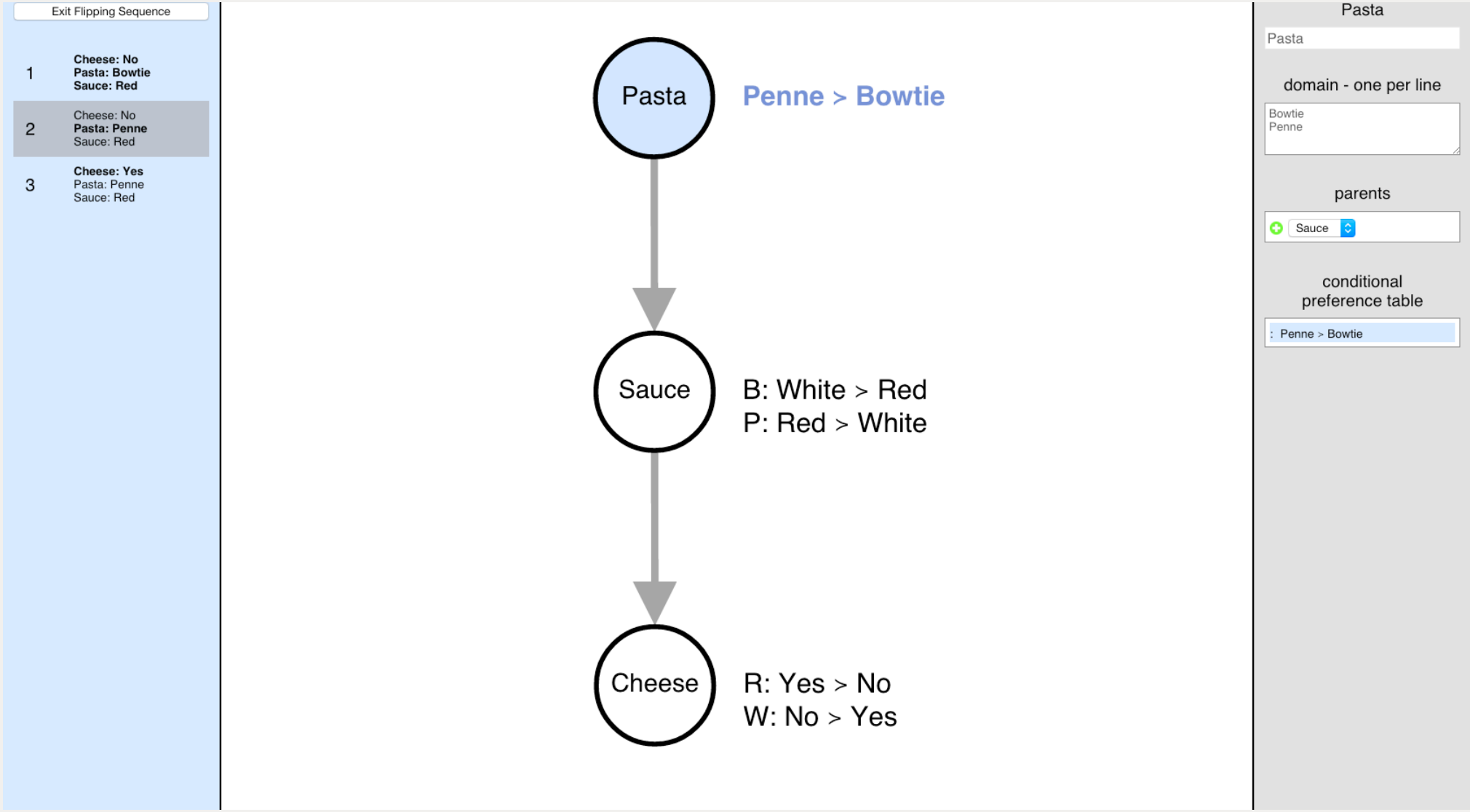
Bowties, Red, NoCh < Penne, Red, Cheese



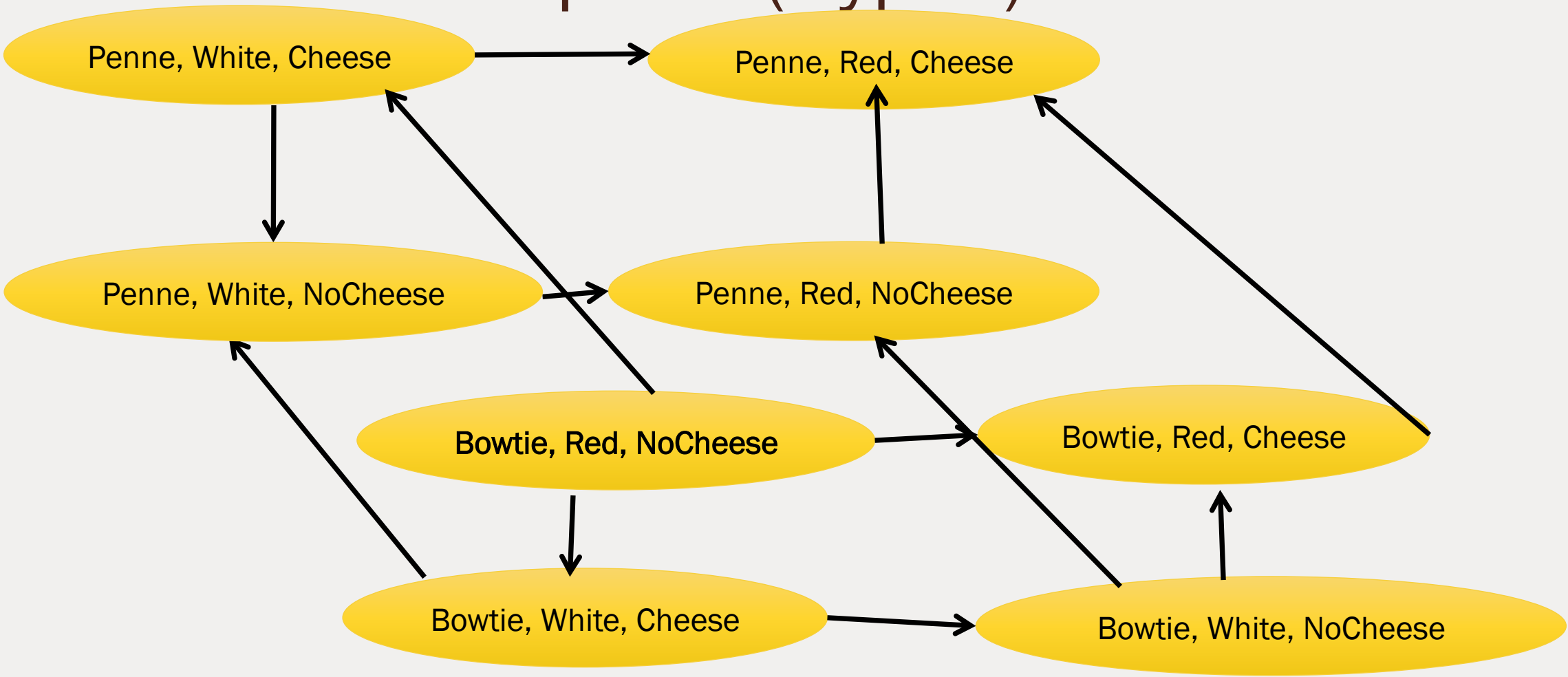
Bowties, Red, NoCh < Bowtie, Red, Cheese



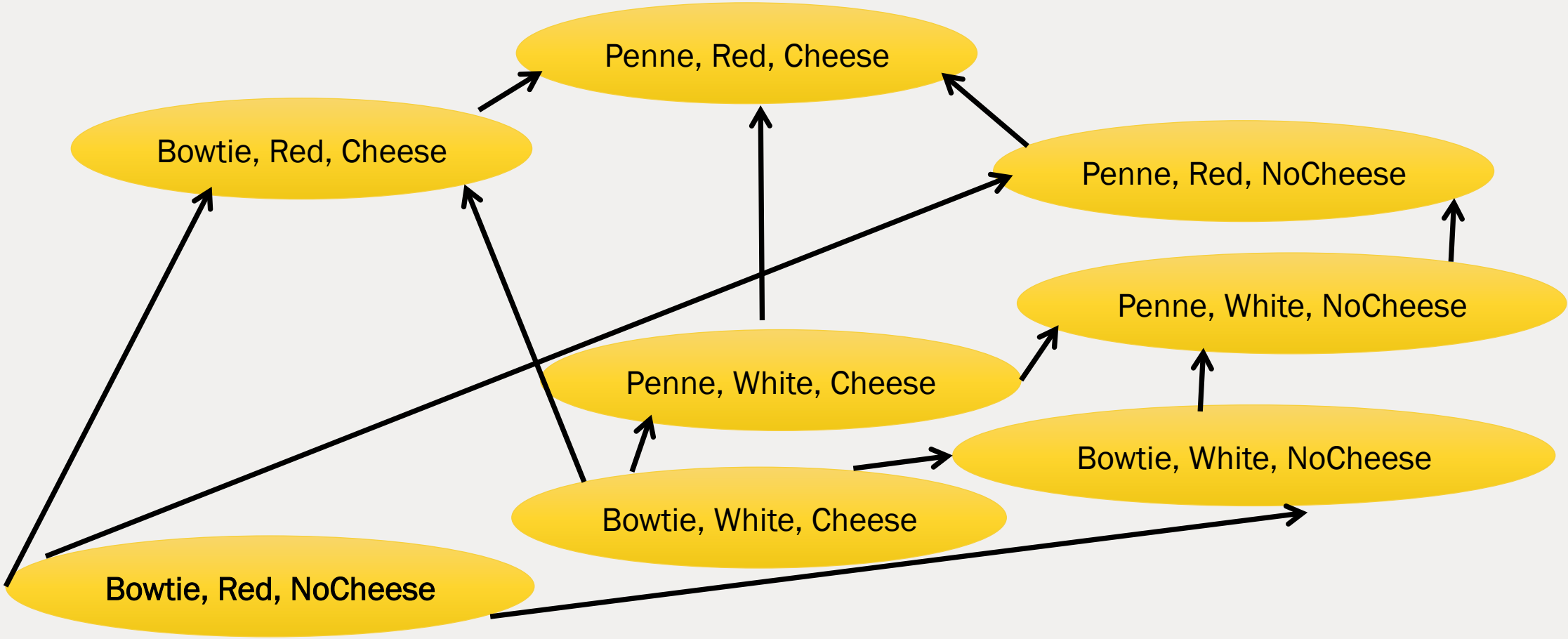
Bowties, Red, Cheese < Penne, Red,Cheese



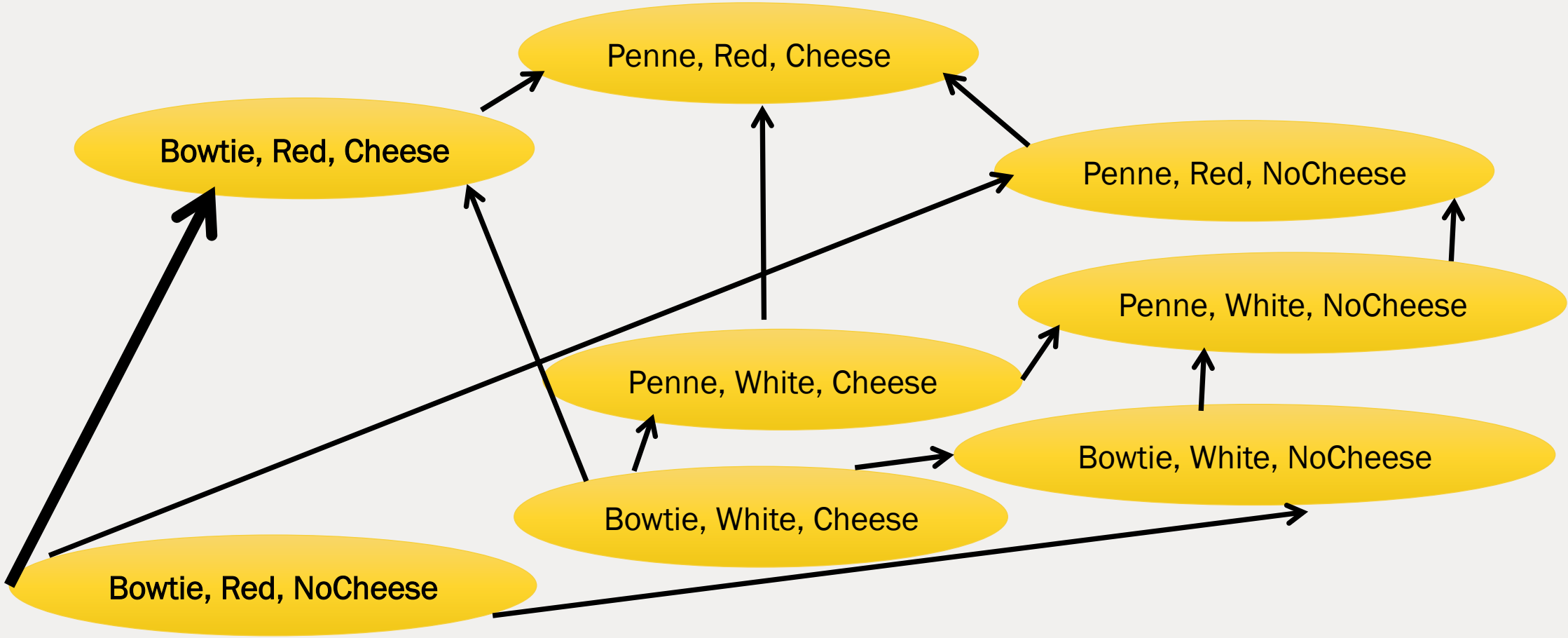
Preference Graph as (Hyper-)Cube



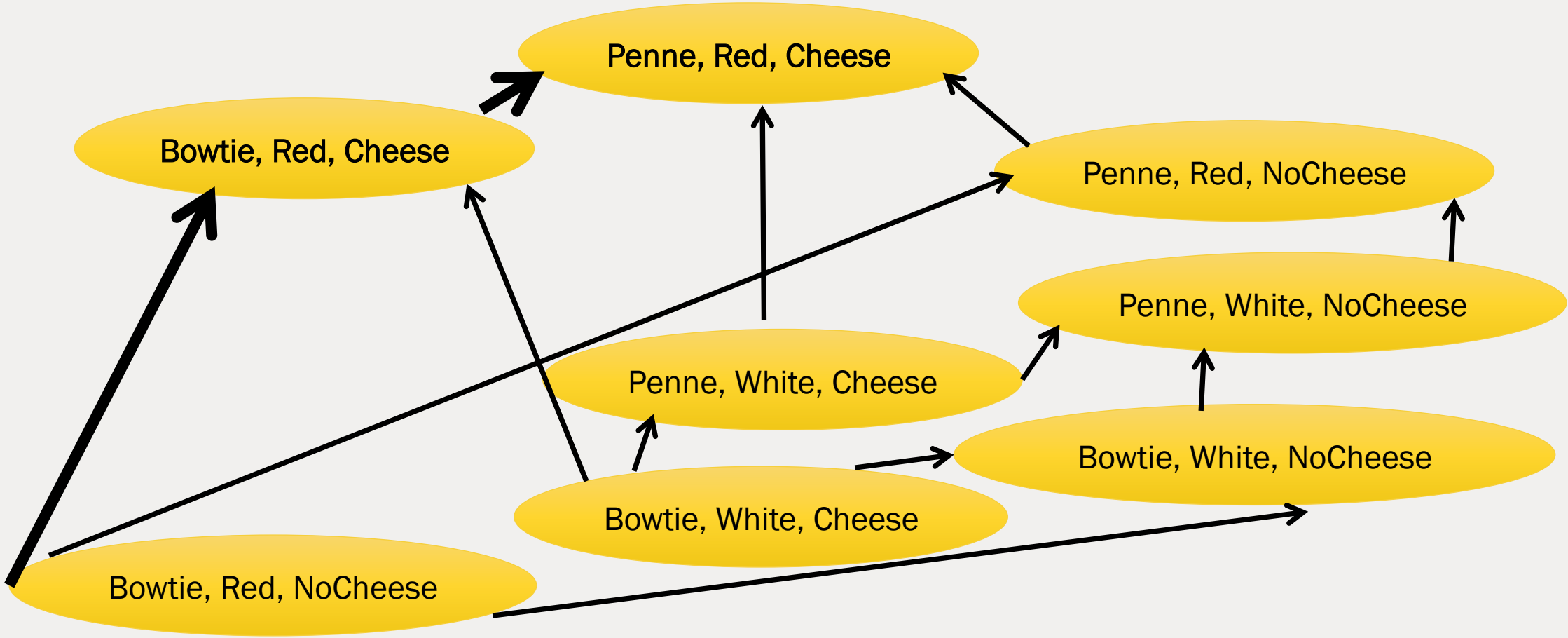
Preference Graph (almost planar layout)



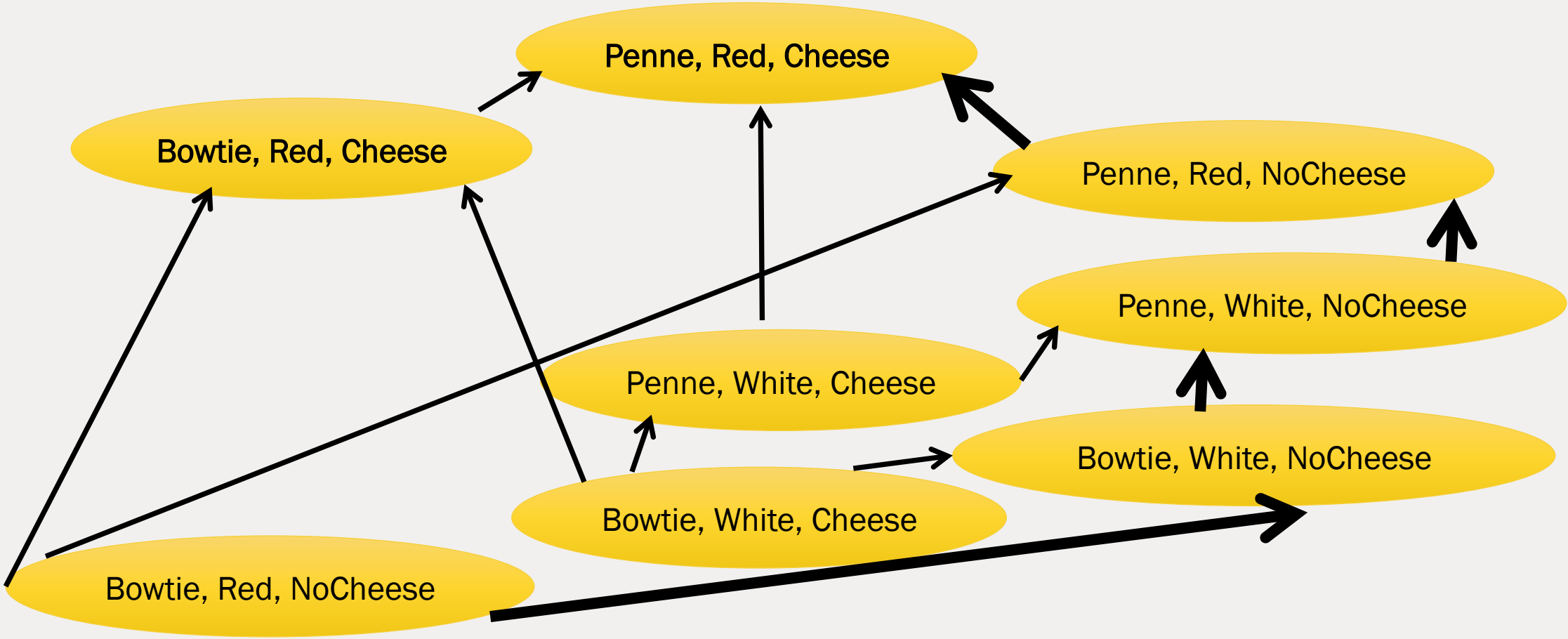
Dominance in the Preference Graph



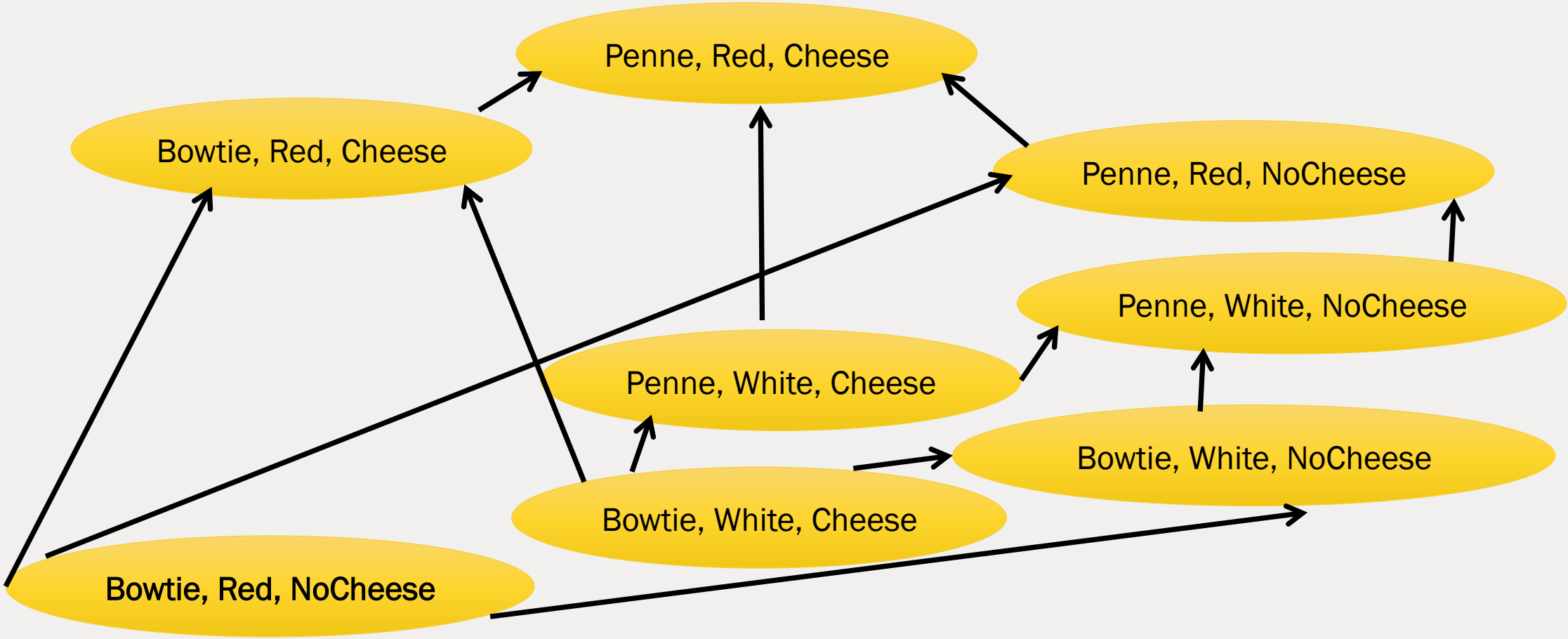
Bowties, Red, NoCh < Penne, Red, Cheese



Bowties, Red, NoCh < Penne, Red, Cheese



Notice that B,R,N is incomparable to B,W,C



Finding Flipping Sequences

- Dominance as graph search

Complexity

- Dominance is NP-hard
  - *Boutilier, et al. 2004*
- For trees and polytrees, Dominance is in P
  - *Boutilier, et al. 2004*
- In fact, for trees, it's linear
  - *Bigot, Zanuttini, Fargier, Mengin, UAI, 2013*

Complexity

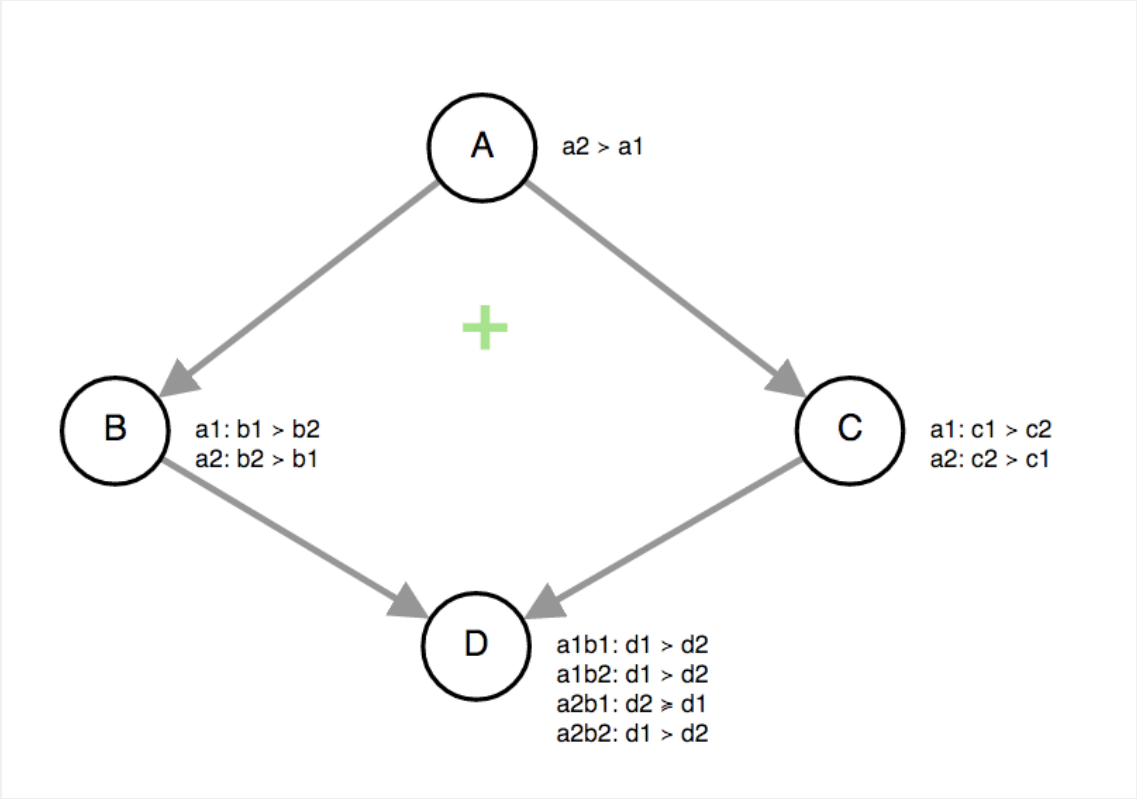
- Flipping sequence search over multi-valued CP-nets with partially specified preferences is not in NP.
  - *Boutilier, et al. 2004*
- In generalized CP-nets, Dominance is PSPACE-complete
  - *Assumes cycles allowed, multi-valued variables, succinctly represented CPTs; Goldsmith, Lang, Truszczynski, Wilson, JAIR, 2008*

Boutilier, Et Al. Heuristics

- "Ordering queries": $o >_d o'$ iff for every x, if
  - $o[Pa(x)] = o'[Pa(x)]$ *and*
  - $o[x] \neq o'[x]$
  - $O[Pa(x)]$: $o[x] > o'[x]$
- If $o > o'$ *then* $o >_d o'$
- $o >_d o'$ *can be determined in polynomial time*

Ordering Query Example

- Hunh?
- Consider the comparison $a_2b_1c_1d_1$, $a_2b_2c_1d_2$. We know that we can't have $a_2b_1c_1d_1 > a_2b_2c_1d_2$ because a_2: $b_2 > b_1$.



- Thus, this the ordering query returns "No."

Boutilier, Et Al. Heuristics

- Suffix fixing (leveraging topological ordering of nodes)
- Least-variable flipping
- Forward pruning

Reduction to Planning

Sauce	Mushrooms	Cheese
Red	Yes	No
Red	No	Yes
White	Yes	No
White	No	No

BECOMES 4 STRIPS OPERATORS:

Red and Mush

Not(Cheese)

Red and not(Mush)

Cheese

White and Mush

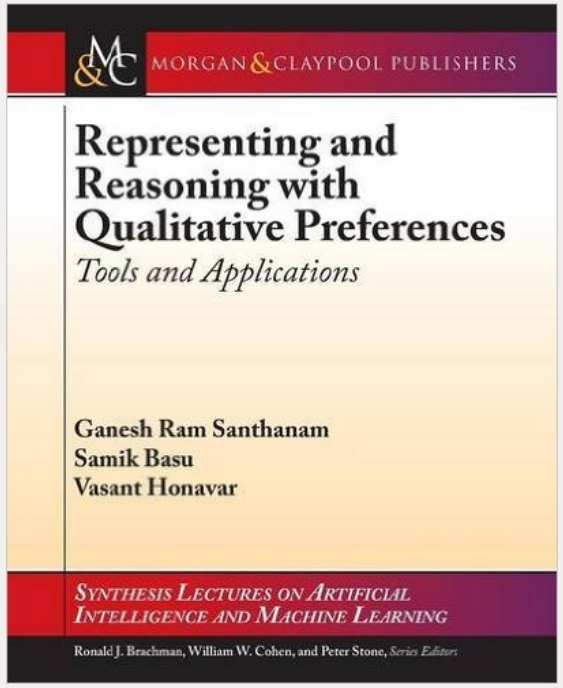
Not(Cheese)

White and not(Mush)

Not(Cheese)

Ganesh Ram Santhanam's Approach

- Reduction to model checking: CRISNER
  - *Santhanam, Basu, Honavar, AAAI '10; KR '10; AAAI '14 tutorial*



Li, Vo, and Kowalczyk's Approach

- DT*: an A*-like search algorithm
  - *Li, Vo, and Kowalczyk, AAMAS 2011*

Domshlak, Prestwich, Rossi, Venable, and Walsh

- Soft constraints (for acyclic CP-nets)
  - *Domshlak, Prestwich, Rossi, Venable, and Walsh, Journal of Heuristics, 2006*

Dominance Testing Contest

- Coming soon, to an AI meeting near you
- http://cs.uky.edu/~jcsi225/dtcompetition.html
- Cory Siler will be managing the contest

Judy Goldsmith
University of
Kentucky