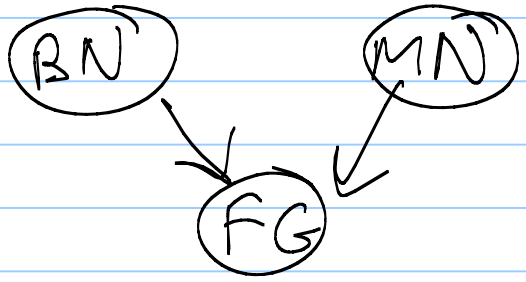
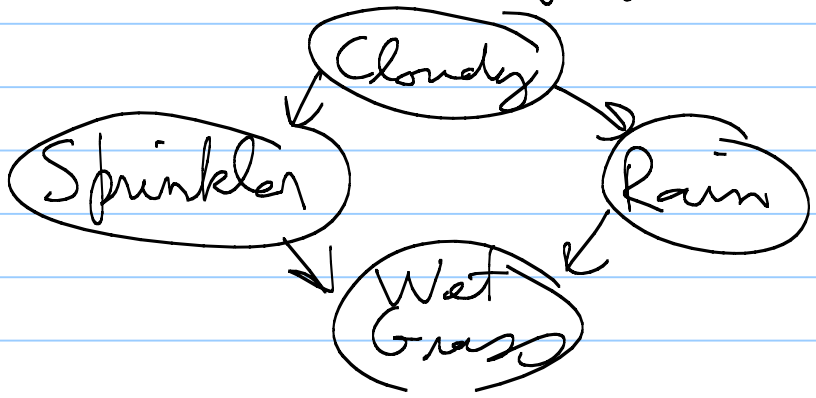
Lecture 4

Note Title 9/22/2005

Graphical models:
- Bayes nets (belief networks)
- Markov networks (Markov Random Fields)
- Factor graphs



Bayes Nets:
- directed acyclic graph



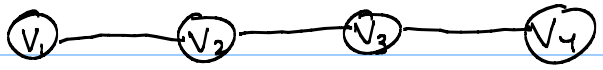
Links:
- conditional dependency (causal relationship)
- for each node v, conditional probability distribution
  $Pr(v \mid \text{parents}(v))$
  $Pr(WG \mid \text{Sprinkler}, \text{Rain})$
- Joint distribution:

- Joint distribution;

$$Pr(v_1, v_2, \ldots, v_n) = \prod_i Pr(v_i \mid \text{parents}(v_i))$$

Markov Networks

- Undirected graph



- Joint distribution

$$Pr(v_1, v_2, \ldots v_n) = \prod_j f_j(c_j) \Big/ \sum_{v_i} \prod_j f_j(c_j)$$

where: - c_j is a maximal clique in the graph
- f_j is a function (factor or potential) on clique c_j

ex: $c_j = \{v_1, v_2\}$

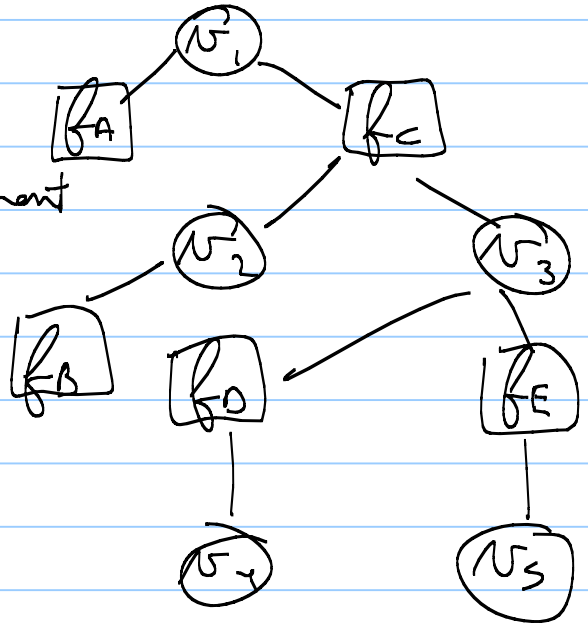
$f_j(c_j) =$

v_1 \ v_2	T	F
T	0.5	10
F	2	3

Factor Graphs:

- Bipartite graph
  - factor nodes
  - variable nodes

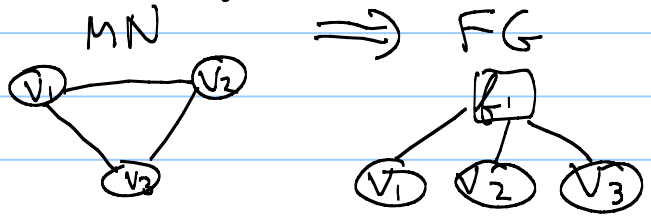
- edge (v_i, f_j): v_i is an argument of f_j

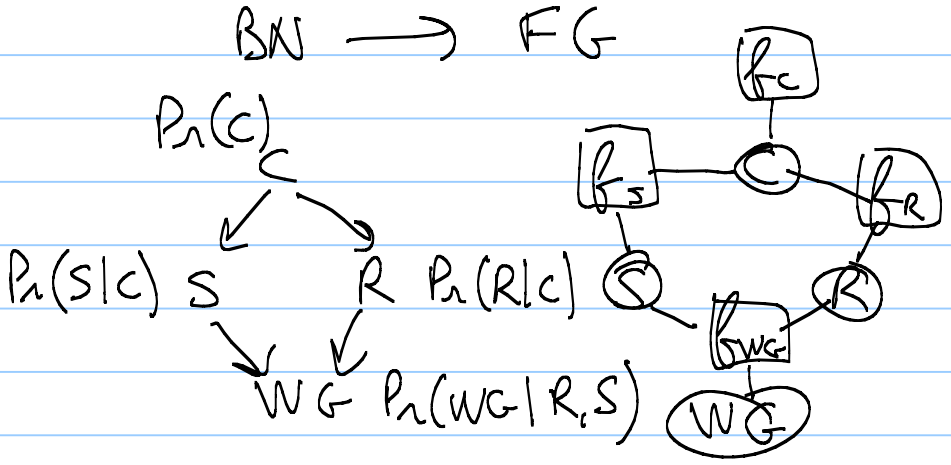


- joint distribution:

$$P_N(v_1, \dots v_n) = \frac{\prod_j f_j(\arg(f_j))}{\sum_{v_i} \prod_j f_j(\arg(f_j))}$$

MN $\rightarrow$ FG
- add factor nodes for each maximal clique





add a factor for each node corresponding to the conditional distribution of each node.