Conditional Probability Query

- Evidence: $E = e$
- Query: a subset of variables Y
- Task: compute $P(Y \mid E = e)$

- Applications
  - Medical/fault diagnosis
  - Pedigree Analisys

NP-Hardness

- The following are all NP-HARD
  - Given a PGM P_Φ, a variable X and a value $x \in Val(X)$, compute $P_\Phi(X = x) > 0$
  - Let $\epsilon < 0.5$ Given a PGM P_Φ, a variable X and a value $x \in Val(X)$, and observation $e \in Val(E)$, find a number p that has $|P_\Phi(X = x \mid E = e) - p| < \epsilon$

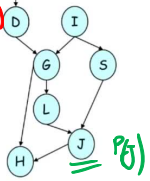
Sum-Product

Bayesian Net

$$\sum_{C,D,I,G} \phi_C(C)\phi_D(C,D)\phi_I(I)\phi_G(G,I,D)\phi_S(S,I)\phi_L(L,G)\phi_J(J,L,S)\phi_H(H,G,J)$$

P(C) coherence.

P(G|I,D)



P(J)

Daphne Keller

joint distribution

chain Rule

marginalize out all variables except J