Pathfinder: Key Points

- Based on *decision theory*: maximize expected utility.
- A *utility function* gives a score to every outcome (in this case, every <disease, diagnosis> pair).
- Expected utility is just the sum over every outcome of the probability times utility for that outcome.

Key Points (Continued)

- Different people have different utility functions, so…
- Pathfinder focuses on assessing *differential probabilities* -- the differences in probabilities for different outcomes. Various utility functions can then be added "on top" of the probability assessments.

Simplifying Assumptions

- Single disease, ie., single cause of the symptoms. This allows it to get by with one *Disease* variable that can take on multiple values, rather than having a different Boolean disease node for every disease (as in QMR-DT, where clique sizes are enormous).
- Prior probabilities of diseases are equal.

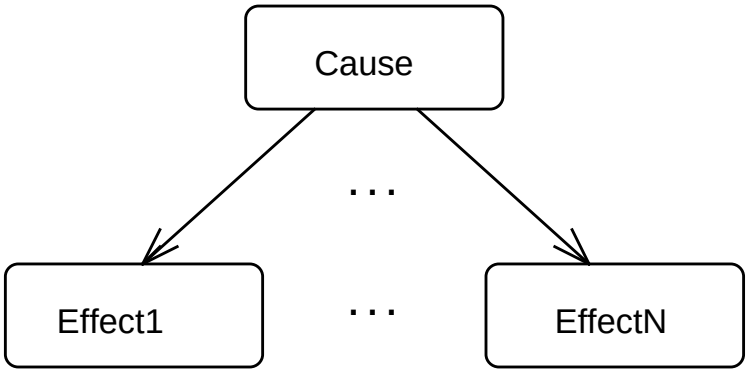
Simplifying Assumptions (Continued)

- Any two symptoms are conditionally independent of one another given the disease (*Naïve Bayes* Assumption).

Key Result of Part I (Naïve Bayes Pathfinder)

- Naïve Bayes outperformed logical rules, confidence factors, Dempster-Shafer theory, and other formalisms both in the expert's eyes and under rigorous experiments.
- Unfortunately the details of the rigorous experiments are not provided in the paper.

Naïve Bayes



Pathfinder Part II

- From Naïve Bayes to a more detailed Bayes Net, since some symptoms directly influence others (are not conditionally independent given the disease).
- Comparison between I and II was based on returning to utilities. 53 patients were used. The average increase in utility (in dollars) by going from I to II was $6000.

New Tool for Bayes Net Construction

- Because of the number of, and complex interactions among, diseases and symptoms, help was needed in constructing the more detailed Bayes Net.
- *Similarity Networks*: show which diseases are related and hence yield a difficult differential diagnosis task.
- For each link in the similarity network, a

Similarity Networks (Continued)

- (Continued)… *local Bayes Net* is built. The local Bayes Net has only the variables needed to discriminate between the two diseases.
- The *global Bayes Net* is then simply the graph union of all the local Bayes Nets. (Take the union of all sets of variables, and add every edge in any local Bayes Net).