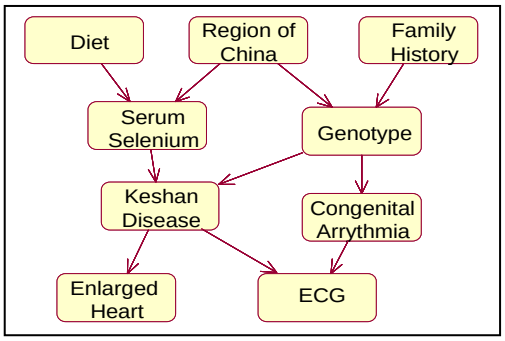
Spring 2014 Course: Bayesian Networks and Decision Graphs

CSCE 582 (cross-listed as **STAT 582**)

Swearingen 2A22, TTh 1450-1605

Bayesian Networks and Decision Graphs



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http://www.cse.sc.edu/~mgv/

Bayesian networks are graph-based representations of probability distributions. They are used to model and reason efficiently in domains where naïve approaches are impossibly complex, by exploiting conditional and unconditional independence relationships. Decision graphs extend Bayesian networks by representing actions and utilities and include decision trees and influence diagrams. Bayesian networks, invented about 30 years ago, and decision graphs have since been applied in many fields, including medical diagnosis, troubleshooting of complex artifacts, intelligent and active user interfaces, image recognition, intelligence analysis, monitoring of power plants, reliability analysis, coding, forensics, and genetics. Hidden Markov models and Kalman (Thiele) filters were shown to be special cases of Bayesian networks, an insight closely connected to the development of dynamic (time-repeating) Bayesian networks. From an algorithmic perspective, Bayesian networks have proven to be a fertile ground for the use of graph algorithms, non-serial dynamic programming, and other advanced techniques.

The obectives of the course are to appreciate the foundations, power, and limitations of probabilistic and causal modeling with Bayesian networks, to solve computer-based decision analysis problems using the Bayesian network and influence diagram tool Hugin, and to understand and implement both iterative (simulation-based) and non-iterative (structure-based) algorithms for probability update in graphical models. Students interested in research in Bayesian network and decision graphs will obtain the foundations to branch into research on advanced topics in learning, adaptation, uncertain evidence, support for multi-agent systems, causal Bayesian networks, and the integration of logical and probabilistic reasoning.

Course text: Finn V. Jensen and Thomas D. Nielsen. *Bayesian Networks and Decision Graphs, 2nd edition*, Springer, 2007.