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# Applied Artificial Intelligence - Decision Network using Netica

This project creates a Bayesian Network to give a decision of whether to perform heart surgery on a patient given a heart disease. To build the network, the **Netica** application tool is used. Among the different nodes, the various levels (states) of the variables were entered. For variables without parents, prior probabilities of the various states were entered. For the variables with one or more parents in the model, conditional probabilities were assigned in the network.

Out of the 20 variables, 13 are considered to be predecessors to the heart disease node while 4 are children to the heart disease node. The children nodes includes ECG, Angina Pectoris, Miocardial infraction and rapid heartbeats. These are the observable traits in the patient as symptoms in case of a diseased heart. The other 13 parent nodes encompasses the habitual pattern of the patient mainly which are believed to be contributory to the patients possible heart condition. These nodes includes: Atherosclerosis, High BP, Family History, Serum Selenium and Adverse Medicine. Some of the predecessors do not influence heart disease directly but influence through their respective parent/child nodes. For example, smoking and alcohol and obesity do not influence heart disease directly but through their common child node: High BP.

**Decision Making:**

The nodes MajorPastSurgeriesUnderwent and PastSurgicalComplications takes into account of the fact of whether the patient had any prior medical surgeries and if yes then what are the level of complications. The complications will govern the extent of the feasibility of the heart surgery given a heart disease.

The utility node considers the probability of the heart disease and the prior surgical complications to find how much feasible a new heart surgery is for the patient. It is obvious if the complications from prior surgeries are severe for major anatomical areas then performing a new heart surgery may jeopardize the patient's life. This is reflected as a lower utility value when the network is compiled with severe complications and also a heart ailment possibility. Similarly, with stable conditions and heart disease the utility of surgery increases the value for "Yes" to perform surgery.

**Test Cases:**

Parent nodes established predictive (or causal) reasoning, i.e. cause to effect, and children nodes established diagnostic (or evidential) reasoning, i.e. effect to cause.

1. Change the probability of ECG such that abnormal is set high. Also change the angina pectoris to high. Change the PastSurgicalComplications with "Stable" to 100%.
   Result: The probabilities back propagates to the nodes upwards setting heart disease as highly probable with its corresponding parents being affected as well. The Decision node sets "Yes" value to be **more** than the "No" value.
2. Change the probability of Diet as "Bad" and ModerateExercice as "No". This also increases the heart disease probabilities and the corresponding probabilities of the observable symptom children nodes. Set PastSurgicalComplications with Severe at 100%. The Decision node sets "Yes" value to be **less** than the "No" value.

**References**

[1] Probabilistic Bayesian Network Model Building of Heart Disease by Jayanta K. Ghosh and Marco Valtorta