Expert Systems and Bayesian Networks

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Expert Systems

An *expert system* attempts to crystallise and codify knowledge of experts into a tool, usable by non-specialist

The *knowledge base* encodes the knowledge of the domain

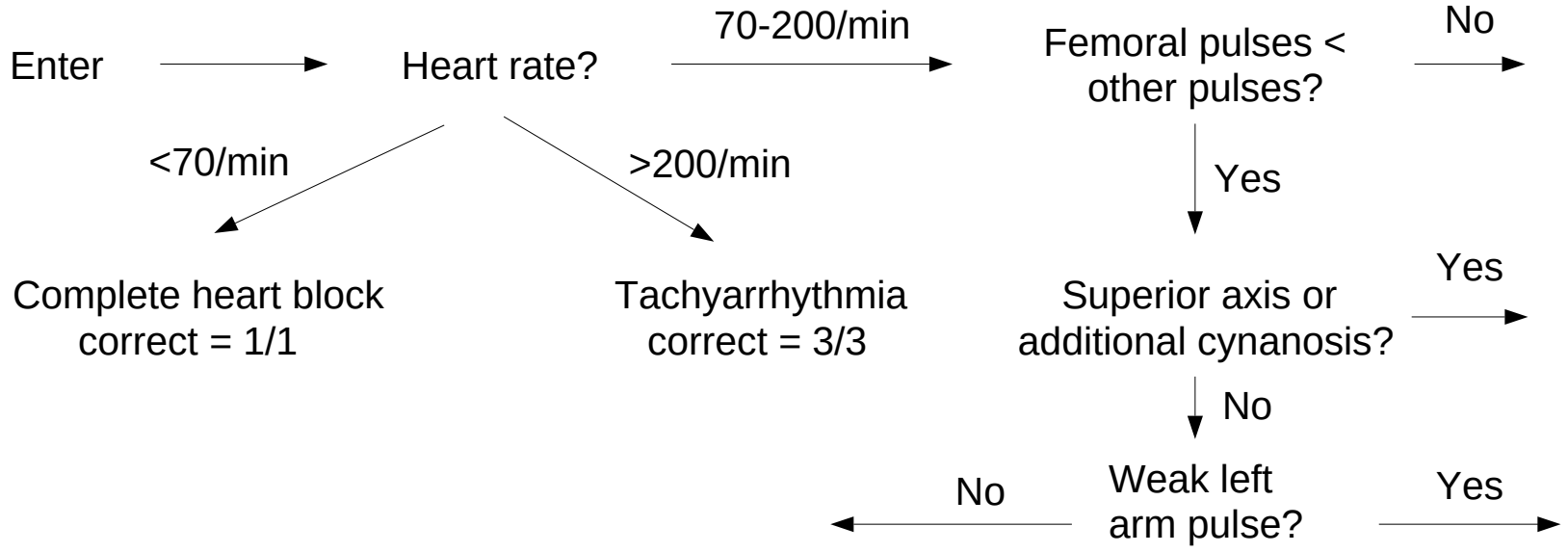
The *inference engine* consists of algorithms for processing knowledge base and specific information to obtain conclusions

Reliability is important when non-experts are involved.

Classical expert systems *make model of expert.*

Probabilistic expert systems *model the domain* and use Bayesian reasoning.

Classification trees



Not necessarily computerized. Can be constructed using e.g. CART.

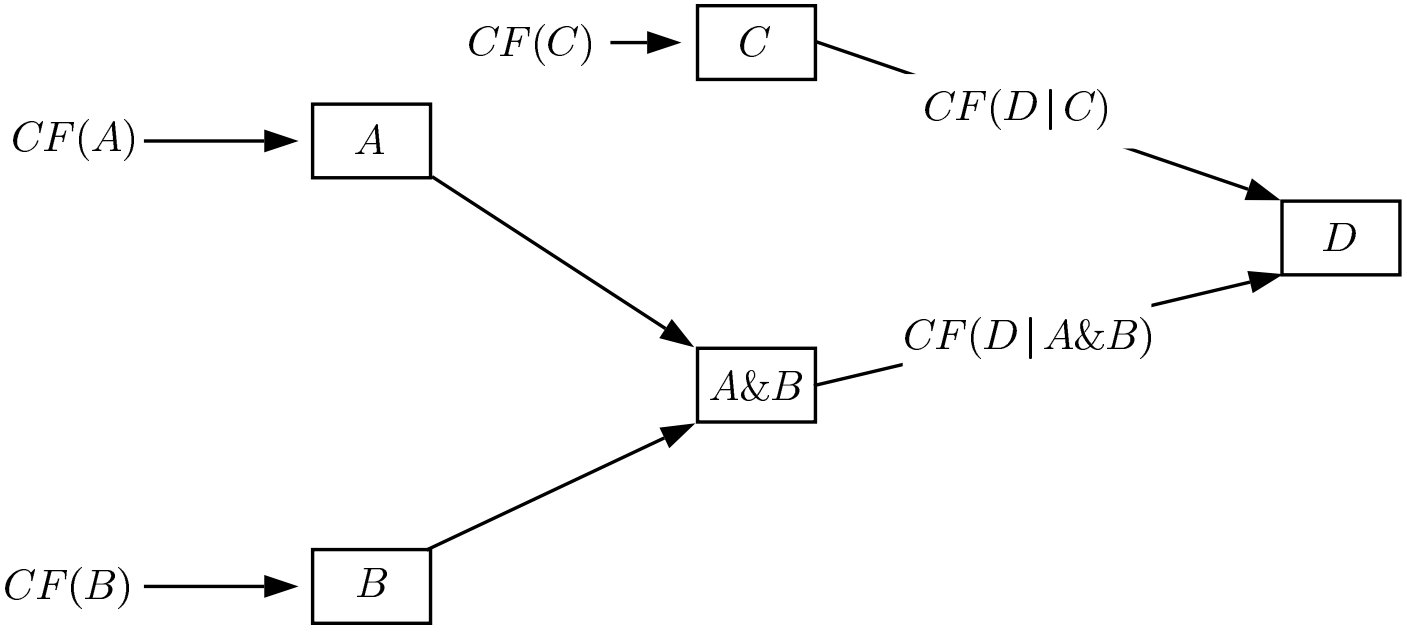
Production systems

Uses *rules:* IF $(A_1$ & A_2 & $\ldots$ & $A_k)$ THEN B; for example

- IF the animal has hair THEN it is a mammal.
- IF the animal gives milk THEN it is a mammal.
- IF the animal has feathers THEN it is a bird.
- IF the animal flies AND it lays eggs THEN it is a bird.

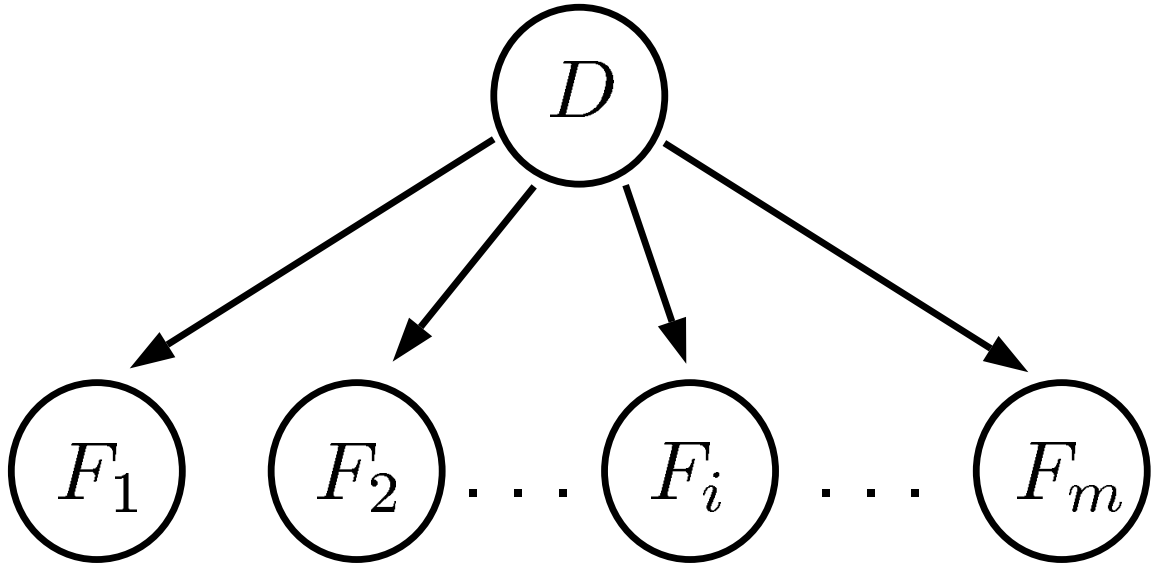
Inference "chaining" (forwards and backwards)

Certainty factors



Production rules with "certainty factor". Need calculus to combine certainty factors.

Naive Bayes



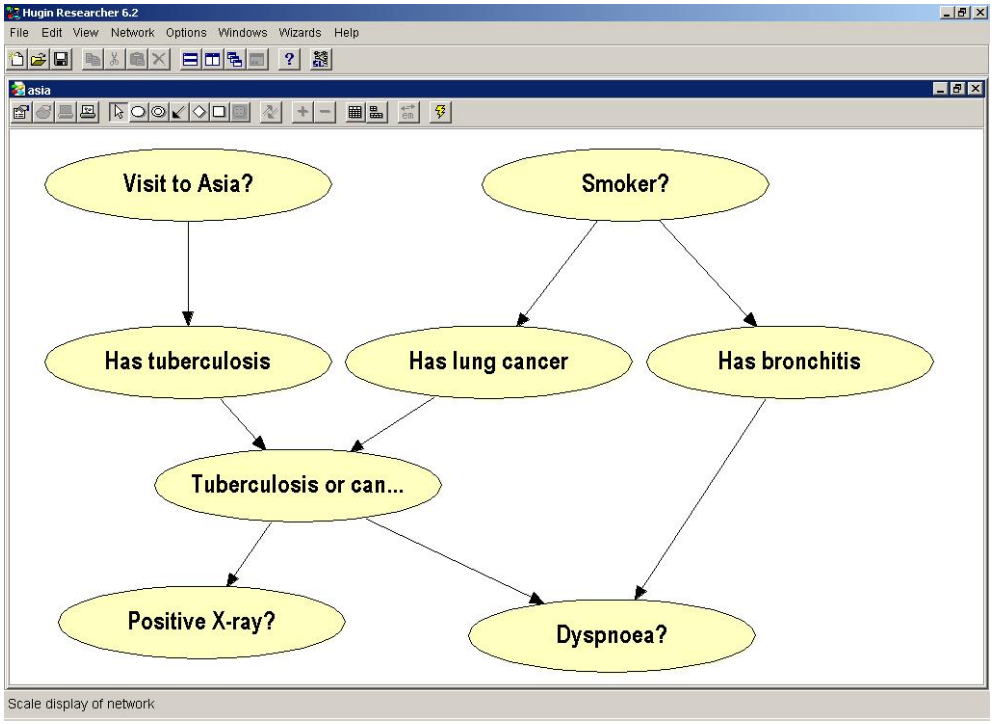
Disease probabilities D used. F_i are findings and $P(F_i \mid D)$ are specified.

$P(D \mid F_1, \ldots, F_m)$ is calculated by Bayes' formula.

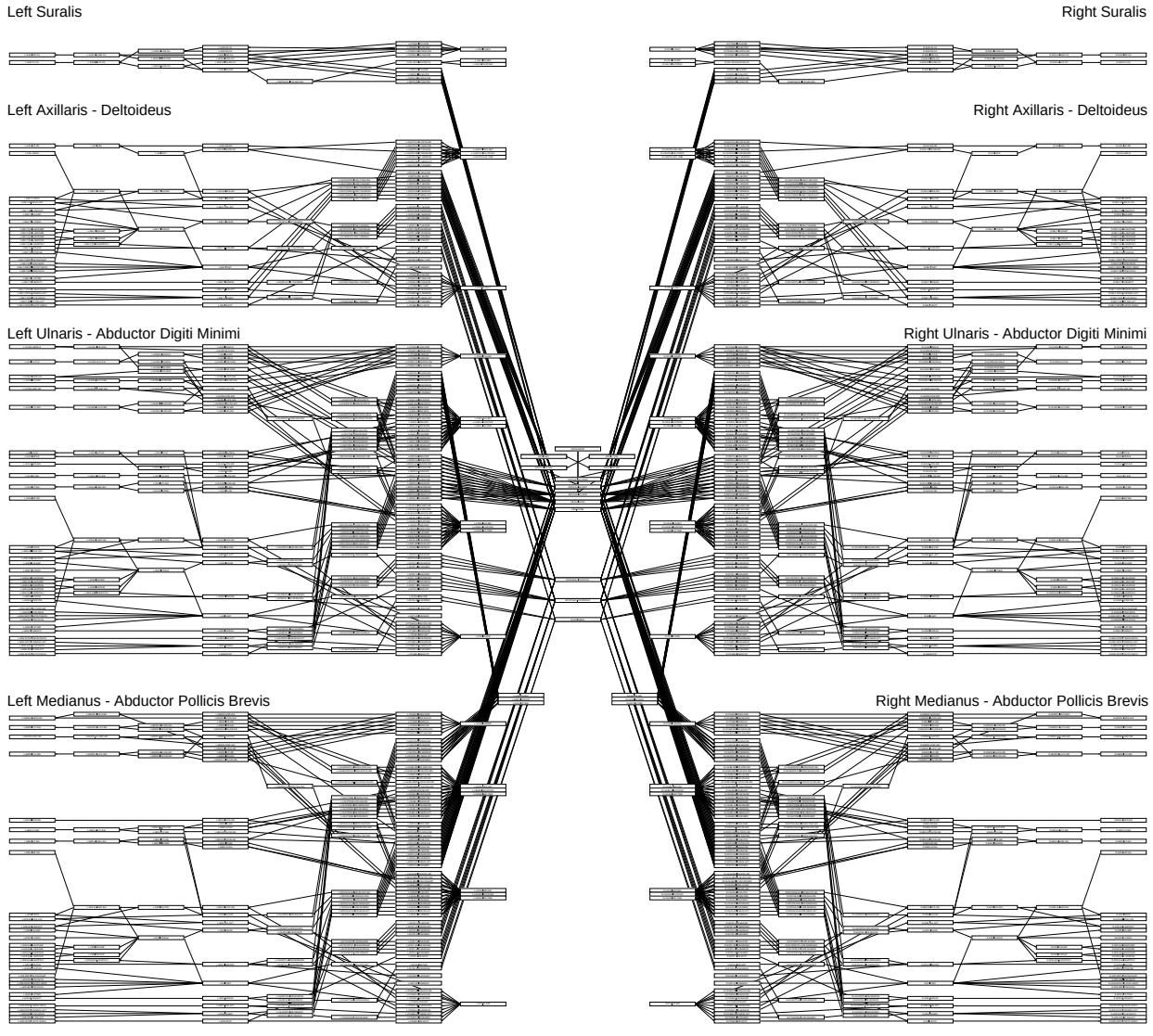
Bayesian network

Directed graphical model, to be used for reasoning.

"Bayesian" because it reasons "reversely", from symptoms to causes.



MUNIN


Left Suralis
Right Suralis
Left Axillaris - Deltoideus
Right Axillaris - Deltoideus
Left Ulnaris - Abductor Digiti Minimi
Right Ulnaris - Abductor Digiti Minimi
Left Medianus - Abductor Pollicis Brevis
Right Medianus - Abductor Pollicis Brevis