

# COV884 - Uncertainty in AI

## Writeup

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For learning the Bayesian Network, we use the Expectation Maximization (EM) algorithm since there may be missing values in the data.

Firstly, we initialize the Conditional Probability Table using Uniform Distribution. Then, we start the Expectation and Maximization step. In the Expectation step, we calculate the weights associated with each possible datapoint (after replacing a missing value with one of the possible ones). For datapoints with no missing value, weight is taken to be 1. Else, we find the weight by calculating the probability of the missing value to assume one of the possible values given it's Markov Blanket.

After all the weights associated with each possible datapoint has been calculated, we move to the Maximization step. In this step, we simply compute the CPT by counting over the weights of all datapoints. A smoothing factor of 0.001 is used. Also, due to the fact that we are allowed to use values upto 4 decimal places, there may be scenarios where a CPT entry becomes too small that it is equal to 0 upto 4 decimal places. In that case, we fix the probability to 0.0001 (i.e. the smallest non-zero possible probability).

The Expectation and Maximization steps are executed until convergence. It takes about about 10 seconds to do so. For the given data, **computed score = 23.1714**. Finally, the resulting network is written in **solved\_alarm.bif**.