TDT4171 Artificial Intelligence Methods

Exercise 2

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Part A The Umbrella domain as an HMM

- The set of unobserved variable for a given time-slice t is the single variable $Rain_t$.
- The set of observed variables, or evidence, for a given time-slice is the single variable $Umbrella_t$.
- The *dynamic model* $\mathrm{P}(X_t|X_{t-1})$ is:

$$\begin{pmatrix} 0.7 & 0.3 \\ 0.3 & 0.7 \end{pmatrix}$$

  where each $value_{i,j}$ is the probability for changing from state i to state j.
- The *observation model* $\mathrm{P}(E_t|X_t)$ is:

$$\begin{pmatrix} 0.9 & 0 \\ 0 & 0.2 \end{pmatrix}$$

  where the observation $Umbrella_t$ is *true*,

$$\begin{pmatrix} 0.1 & 0 \\ 0 & 0.8 \end{pmatrix}$$

  where the observation is *false*. Notice that the matrix for *false* is the *identity*-matrix - the *true*-matrix.
- In this model, we assume that the process is a *stationary process*. A *stationary process* is a process where the laws that transist the state from one to another never changes. In this specific case, this means that we assume that the probaility for rain today given rain (or not rain) yesterday is always the same. Yet we also assumes that rain today only depends on rain yesterday, thus making it a *first-order Markov process*.

These assumptions are probably not sufficient for a weather-forecasting-system, but introducing either more sensors or more orders to the Markov process will add much complexity and add little value to this example scenario.

Part B Filtering with `FORWARD`

The calculation is given in the MATLAB-file *partB.m*. Since MATLAB indexing starts with 1 and not 0, the probabilities for day 2 is in $ans(1:1:3)$.

Part C Smoothing using `FORWARD-BACKWARD`