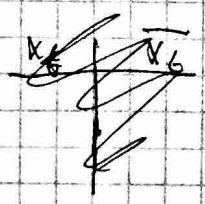
Assignment 2 TDT4171 Eirik Sæther

~~The set of unobserved variables is whether it rained or not yesterday and today~~

Part A:

- The set of unobserved variable for given time-slice t, X_t:
  Wheter it rains or not: $Rain_t = R_t$
- The set of observable variable for given time-slice t, E_t:
  Director bringing umbrella: $Umbrella_t = U_t$

- $P(X_t | X_{t-1})$



$$T = \begin{array}{c} \\ X_{t-1} \\ \neg X_{t-1} \end{array} \begin{array}{c} \begin{array}{cc} X_t & \neg X_t \end{array} \\ \begin{bmatrix} 0,7 & 0,3 \\ 0,3 & 0,7 \end{bmatrix} \end{array} \Rightarrow \begin{array}{c} \\ R_{t-1} \\ \neg R_{t-1} \end{array} \begin{array}{c} \begin{array}{cc} R_t & \neg R_t \end{array} \\ \begin{bmatrix} 0,7 & 0,3 \\ 0,3 & 0,7 \end{bmatrix} \end{array}$$

- $P(E_t | X_t)$

$$O_t = \begin{array}{c} \\ X_t \\ \neg X_t \end{array} \begin{array}{c} \begin{array}{cc} E_t & \neg E_t \end{array} \\ \begin{bmatrix} 0,9 & 0,1 \\ 0,2 & 0,8 \end{bmatrix} \end{array} \Rightarrow \begin{array}{c} \\ R_t \\ \neg R_t \end{array} \begin{array}{c} \begin{array}{cc} U_t & \neg U_t \end{array} \\ \begin{bmatrix} 0,9 & 0,1 \\ 0,2 & 0,8 \end{bmatrix} \end{array}$$

U = true: $O_t = \begin{bmatrix} 0,9 & 0 \\ 0 & 0,2 \end{bmatrix}$ | U = false: $O_t = \begin{bmatrix} 0,1 & 0 \\ 0 & 0,8 \end{bmatrix}$

- Assumptions encoded in this model:
  Firstly, there is a Markov assumption, making it a first order Markov process model, which means that the probability of it raining a certain day only depends on wether or not it rained on the previous day, not depending on any of the days before that. ⇒ The current state only depends on a finite number of previous states, in this case; one.

- In addition there is the assumption that changes in the state are caused ~~by static~~ by a stationary process. The distribution is the same for all, infinitely many possible values of t.
- The model is assuming that $Rain_t$ only depends on $Rain_{t-1}$ ($\sum_{n=1}^{t} Rain_{t-n}$, if not for the Markov assumption), and not on any other state variables, such as $Season_t$, $Temperature_t$, $Humidity_t$ etc, ...
- Also assuming that the evidence variable ($U_t = U_t$) is only depending on R_t, not R_{t-1}..., ~~and not~~. Also not on ~~other~~ other state variables: e.g. that the director forgot his/her umbrella in the car the other day.

The assumptions are fairly reasonable, even though certain places in the world only have more than two days of rain, or very defined ~~rainseasons~~ rainseasons.

~~Often with rainy days in a~~

Other places, rainy days have a tendency to persist such that the probability of it raining a fourth day in a row, will be greater than ~~simply~~ the probability of it simply raining a second day continously.