Assisgnment 1, TDT4171

Martin Bjerke

February 26, 2018

1 Part A

- The set of unobserved variables for a given time-slice t, contains only the rain variable, $R_t = \{0, 1\}$.

- The set of observable variables for a given time-slice t, contains only the umberella variable, $U_t = \{0, 1\}$.

- The dynamic model $P(R_t \mid R_{t-1})$,$T =$

$$\begin{bmatrix} P(R_t = 0 \mid R_{t-1} = 0) & P(R_t = 0 \mid R_{t-1} = 1) \\ P(R_t = 1 \mid R_{t-1} = 0) & P(R_t = 1 \mid R_{t-1} = 1) \end{bmatrix} = \begin{bmatrix} 0.7 & 0.3 \\ 0.3 & 0.7 \end{bmatrix}$$

  and the observation model $P(E_t \mid X_t)$, $O_{Umberella=0} =$

$$\begin{bmatrix} P(u_t = 0 \mid R_t = 0) & 0 \\ 0 & P(u_t = 0 \mid R_t = 1) \end{bmatrix} = \begin{bmatrix} 0.1 & 0 \\ 0 & 0.8 \end{bmatrix}$$

  and $O_{Umberella=1} =$

$$\begin{bmatrix} P(u_t = 1 \mid R_t = 0) & 0 \\ 0 & P(u_t = 1 \mid R_t = 1) \end{bmatrix} = \begin{bmatrix} 0.9 & 0 \\ 0 & 0.2 \end{bmatrix}$$

- In this model its assuemd that the current state only depends on the previous state(i.e. this is a first-order Markov process), that the probability that it rained on day 0, is 0.5. The assumptions are reasonable, for a random place, but if we were given a more specific place and time of year the assumptions could be completly different, for example if the place was Bergen, the chance of rain of day one should have been alot more(avrage number of raindays divided by 365 for example).

2 Part B

The normalized forward messages for $e_{1:5} = \{Umbrella_1 = true, Umbrella_2 = true, Umbrella_3 = false, Umbrella_4 = true, Umbrella_5 = true\}$ is;

$f_{1:1} =< 0.82, 0.18 >$

$f_{1:2} =< 0.88, 0.12 >$

$f_{1:3} =< 0.19, 0.81 >$

$f_{1:4} =< 0.73, 0.27 >$

$f_{1:5} =< 0.87, 0.13 >$

3 Part C

The backward messages for $e_{1:5} = \{Umbrella_1 = true, Umbrella_2 = true, Umbrella_3 = false, Umbrella_4 = true, Umbrella_5 = true\}$ is;

$b_{2:t} =< 0.69, 0.41 >$

$b_{3:t} =< 0.46, 0.24 >$

$b_{4:t} =< 0.09, 0.15 >$

$b_{5:t} =< 0.07, 0.05 >$

$b_{6:t} =< 0.04, 0.02 >$