TDT4171

Artificial Intelligence Methods

Exercise 2

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Part A

- There is only one unobserved variable for a given time-slice t, and that is *Rain*
- There is also only one observed variable for a given time-slice t, and that is *Umbrella*
- The *dynamic model* $\mathbf{P(X_t—X_{t-1})}$ as a matrix is:

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

and the *observation model* $\mathbf{P(E_t—X_t)}$ is:

$$\begin{bmatrix} 0.9 & 0.0 \\ 0.0 & 0.2 \end{bmatrix}$$

For both the *transition model* and the *sensor model*, the assumption made is a Markov assumption. This states that the current state is only dependent on a finite fixed number of previous states. In this case, the current state only depends on the previous state, making it a first-order Markov process. It is also assumed that the changes in state are caused by a *stationary process*. This means that the laws concerning state transitions don't change.

For this example, these assumptions are reasonable, but not necessarily realistic. Predicting the weather is a very complex process, and the current state would be dependent on more than the previous one.

Part B

Running the program gives the following normalized forward messages:

	Rain	Not rain
f1:	0.81818182	0.18181818
f2:	0.88335704	0.11664296
f3:	0.19066794	0.80933206
f4:	0.730794	0.269206
f5:	0.86733889	0.13266111

We can see that the probablity of rain on day 5 is 0.867

Part C

Running the FORWARD-BACKWARD algorithm gives the following probabilities:

	Rain	Not rain
Day 1:	0.867338889575	0.132661110425
Day 2:	0.820419053624	0.179580946376
Day 3:	0.307483576007	0.692516423993
Day 4:	0.820419053624	0.179580946376
Day 5:	0.867338889575	0.132661110425

We can see that the probability of rain on day 1 is 0.867.

We also get the following backward messages:

	Rain	Not rain
b5:	0.69	0.41
b4:	0.4593	0.2437
b3:	0.090639	0.150251
b2:	0.06611763	0.04550767
b1:	0.04438457	0.02422283