

Exercises 3

Hidden Markov Models

Tim works underground in a secret bunker. He does not get to see outside or talk to anyone. But he does see if Sally, who is allowed out, brings her umbrella to work each day.

Tim thinks that if its raining today, its 80% likely to be so tomorrow. If it is sunny today, it is 75% likely to be so tomorrow. He also knows Sally from before this job, and knows she doesn't like getting rained on. He believes that 99% of the time that it is raining, she would have an umbrella, and that 50% of the time it is not raining she would still have one.

Create the tranmission and emission matrices of a hidden markov model representing Tim's beliefs, where the state are {raining, not raining}.

Hidden Markov Models

Tim starts work Sunday night. He knows that it was raining on Sunday. Today is Friday, and he has seen the sequence $\langle -U, -U, U, -U, U \rangle$. What is the probability it will rain tomorrow (Saturday)?

What is the probability it rained on Wednesday?

What is the most likely sequence of weather states given the sequence of observations?

Restricted Boltzmann Machines, Markov Random Fields and Gibbs Sampling

- You have a RBM that has been trained to model the patterns found in a dataset of three binary variables. The weights are as in the diagram.
- You have an incomplete datum, $d=\langle 1,?,1\rangle$, and you want to find the probability distribution over the missing value given your RBM model using Gibbs Sampling.
- Describe the complete process for using Gibbs Sampling in this case.
- Find the first sample (ignoring the original completely random value assignment), presuming that the most probable value is always the one sampled.

Weight	Value
$w_{1,1}$	2.7
$w_{1,2}$	1.6
$w_{1,3}$	-1.1
$w_{2,1}$	14.5
$w_{2,2}$	2.4
$w_{2,3}$	1
$w_{3,1}$	0.01
$w_{3,2}$	-7.6
$w_{3,3}$	-2.3