Lab: HMMs

Worked Example

Training Data:

mary ann can see will	N N M V N
spot will see mary	N M V N
will ann spot mary	M N V N
mary will pat spot	N M V N
can pat spot will	M N V N

This example does not include sentence markers, smoothing, or OOV handling.

pi

M	N	V
2	3	0

M	N	V
.4	.6	0

Transition Matrix

counts	M	N	V
M	0	2	3
N	3	1	2
V	0	5	0

probs	M	N	V
M	0	.4	.6
N	.5	.17	.33
V	0	1	0

$P(T_2|T_1)$

Emission Matrix

counts	ann	can	mary	pat	see	spot	will
M	0	2	0	0	0	0	3
N	2	0	4	1	0	2	2
V	0	0	0	1	2	2	0

probs	ann	can	mary	pat	see	spot	will
M	0	.4	0	0	0	0	.6
N	.18	0	.36	.091	0	.18	.18
V	0	0	0	.2	.4	.4	0

$P(pat|V)$ $P(w|T)$

Decoding with Viterbi

Decoding sentence: will can spot pat

	will pi * $P(w\|T)$	can V_{t-1} * $P(T_t\|T_{t-1})$ * $P(w\|T)$	spot V_{t-1} * $P(T_t\|T_{t-1})$ * $P(w\|T)$	pat V_{t-1} * $P(T_t\|T_{t-1})$ * $P(w\|T)$
M	.4 * .6 =.24	.24 * 0 * .4 = 0 from M .11 * .5 * .4 = **.022** from N 0 * 0 * .4 = 0 from V bp=1	.022 * 0 * 0 = **0** 0 * .5 * 0 = 0 0 * 0 * 0 = 0 bp=0	0 * 0 * 0 = **0** .0016 * .5 * 0 = 0 .0052 * 0 * 0 = 0 bp=0
N	.6 * .18 =.11	.24 * .4 * 0 = **0** from M .11 * .17 * 0 = 0 from N 0 * 1 * 0 = 0 from V bp=0	.022 * .4 * .18 = **.0016** 0 * .17 * .18 = 0 0 * 1 * .18 = 0 bp=0	0 * .4 * .091 = 0 .0016 * .17 * .091 = 2.4e-05 .0052 * 1 * .091 = **.00048** bp=2
V	0 * 0 =0	.24 * .6 * 0 = **0** from M .11 * .33 * 0 = 0 from N 0 * 0 * 0 = 0 from V bp=0	.022 * .6 * .4 = **.0052** 0 * .33 * .4 = 0 0 * 0 * .4 = 0 bp=0	0 * .6 * .2 = 0 .0016 * .33 * .2 = **.00011** .0052 * 0 * .2 = 0 bp=1

Predicted: N M V N

Decoding sentence: can will pat spot

	can	will	pat	spot
M				
N				
V				