

## 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

Transition Matrix

Emission 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

  

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

## 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 .11 * .5 * .4 = <b>.022</b> 0 * 0 * .4 = 0 bp=1	.022 * 0 * 0 = <b>0</b> 0 * .5 * 0 = 0 0 * 0 * 0 = 0 bp=0	0 * 0 * 0 = <b>0</b> .0016 * .5 * 0 = 0 .0052 * 0 * 0 = 0 bp=0
N	.6 * .18 =.11	.24 * .4 * 0 = <b>0</b> .11 * .17 * 0 = 0 0 * 1 * 0 = 0 bp=0	.022 * .4 * .18 = <b>.0016</b> 0 * .17 * .18 = 0 0 * 1 * .18 = 0 bp=0	0 * .4 * .091 = 0 .0016 * .17 * .091 = 2.4e-05 .0052 * 1 * .091 = <b>.00048</b> bp=2
V	0 * 0 =0	.24 * .6 * 0 = <b>0</b> .11 * .33 * 0 = 0 0 * 0 * 0 = 0 bp=0	.022 * .6 * .4 = <b>.0052</b> 0 * .33 * .4 = 0 0 * 0 * .4 = 0 bp=0	0 * .6 * .2 = 0 .0016 * .33 * .2 = <b>.00011</b> .0052 * 0 * .2 = 0 bp=1

Predicted: N M V N

Decoding sentence: can will pat spot

	can $\pi * P(w T)$	will $V_{t-1} * P(T_t T_{t-1}) * P(w T)$	pat $V_{t-1} * P(T_t T_{t-1}) * P(w T)$	spot $V_{t-1} * P(T_t T_{t-1}) * P(w T)$
M	.4 * .4 =.16	.16 * 0 * .6 = <b>0</b> 0 * .5 * .6 = 0 0 * 0 * .6 = 0 bp=0	0 * 0 * 0 = <b>0</b> .012 * .5 * 0 = 0 0 * 0 * 0 = 0 bp=0	0 * 0 * 0 = <b>0</b> .00018 * .5 * 0 = 0 .00078 * 0 * 0 = 0 bp=0
N	.6 * 0 =0	.16 * .4 * .18 = <b>.012</b> 0 * .17 * .18 = 0 0 * 1 * .18 = 0 bp=0	0 * .4 * .091 = 0 .012 * .17 * .091 = <b>.00018</b> 0 * 1 * .091 = 0 bp=1	0 * .4 * .18 = 0 .00018 * .17 * .18 = 5.3e-06 .00078 * 1 * .18 = <b>.00014</b> bp=2
V	0 * 0 =0	.16 * .6 * 0 = <b>0</b> 0 * .33 * 0 = 0 0 * 0 * 0 = 0 bp=0	0 * .6 * .2 = 0 .012 * .33 * .2 = <b>.00078</b> 0 * 0 * .2 = 0 bp=1	0 * .6 * .4 = 0 .00018 * .33 * .4 = <b>2.4e-05</b> .00078 * 0 * .4 = 0 bp=1

Predicted: M N V N