Linguistics 439/539
Hammond
Fall '14

Forward probabilities

(1) $V_i \rightarrow V_j\ V_k$
$V_i \rightarrow w_j$

(2) Outside probability $\alpha_j(p,q) = \mathrm{p}(w_{1(p-1)}, V^j_{pq}, w_{(q+1)m}|G)$
Inside probability $\beta_j(p,q) = \mathrm{p}(w_{pq}|V^j_{pq}, G)$

(3) Base case: $\beta_j(k,k) = \mathrm{p}(w_k|V^j_{kk}, G)$
$= \mathrm{p}(V^j \rightarrow w_k|G)$

(4) Induction: $\beta_j(p,q) = \mathrm{p}(w_{pq}|V^j_{pq}, G)$
$= \sum_{r,s}\sum_{d=p}^{q-1} \mathrm{p}(V^j \rightarrow V^r\ V^s)\beta_r(p,d)\beta_s(d+1,q)$

(5)

$S \rightarrow NP\ VP$	1.0	$NP \rightarrow NP\ PP$	0.4
$PP \rightarrow P\ NP$	1.0	$NP \rightarrow$ *astronomers*	0.1
$VP \rightarrow V\ NP$	0.7	$NP \rightarrow$ *ears*	0.18
$VP \rightarrow VP\ PP$	0.3	$NP \rightarrow$ *saw*	0.04
$P \rightarrow$ *with*	1.0	$NP \rightarrow$ *stars*	0.18
$V \rightarrow$ *saw*	1.0	$NP \rightarrow$ *telescopes*	0.1

(6)

	1	2	3	4	5
1	$\beta_{\mathbf{NP}} = \mathbf{0.1}$		$\beta_S = 0.0126$		$\beta_S = 0.0015$
2		$\beta_{\mathbf{NP}} = \mathbf{0.04}$ $\beta_{\mathbf{V}} = \mathbf{1.0}$	$\beta_{\mathbf{VP}} = \mathbf{0.126}$		$\beta_{VP} = 0.0158$
3			$\beta_{\mathbf{NP}} = \mathbf{0.18}$		$\beta_{NP} = 0.0129$
4				$\beta_{\mathbf{P}} = \mathbf{1.0}$	$\beta_{\mathbf{PP}} = \mathbf{0.18}$
5					$\beta_{\mathbf{NP}} = \mathbf{0.18}$
	astr-ers	*saw*	*stars*	*with*	*ears*