CS3311
October 26, 2012
Friday (1)

Last time:

Process the grammar in this order

1. Make the start symbol non-recursive
2. Remove λ-rules
3. Remove chain rules.
4. Remove variables that do not strings of terminals
5. Remove variables that are not reachable from the start symbol.
6. Convert to Chomsky Normal Form (CNF)

A grammar $G = (V, \Sigma, P, S)$ is in Chomsky Normal Form if each rule has one of the following forms:

(i) $A \to BC$

(ii) $A \to a$

(iii) $S \to \lambda$

$A \to BCDE$

T_1

$A \to BT_1$

$T_1 \to CT_2$

$T_2 \to DE$

$A \to BT_1$

$T_1 \to CDE$ $\quad T_1 \to CT_2$

$T_2 \to DE$

$A \rightarrow T_1\ T_2$ $\qquad$ $A \rightarrow BCD$

$T_1 \rightarrow$ ~~BBB~~ BC

$T_2 \rightarrow DE$

format: $A \rightarrow BC$, $A \rightarrow a$, $S \rightarrow \lambda$

$A \rightarrow aBCDb$

$A \rightarrow T_1 BCDT_2$ $\qquad$ $T_1 \rightarrow a$, $T_2 \rightarrow b$

$A \rightarrow T_1\ T_2$

$T \rightarrow a$

$T_2 \rightarrow B\ T_3$

$T_3 \rightarrow C\ T_4$

$T_4 \rightarrow D\ T_5$

$T_5 \rightarrow b$

$A \rightarrow T_1\ T_3$

$T_3 \rightarrow B\ T_4$

$T_4 \rightarrow C\ T_5$

$T_5 \rightarrow D\ T_2$

$T_1 \rightarrow a$

$T_2 \rightarrow b$

$A \rightarrow abc$

$A \rightarrow T_1\ T_2 T_3$

$T_1 \rightarrow a$

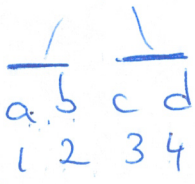
$T_2 \rightarrow b$

$T_3 \rightarrow c$

If a grammar is in Chomsky Normal form, then the derivation tree is binary at the intermediate levels and each terminal node has a unique parent.

G_1

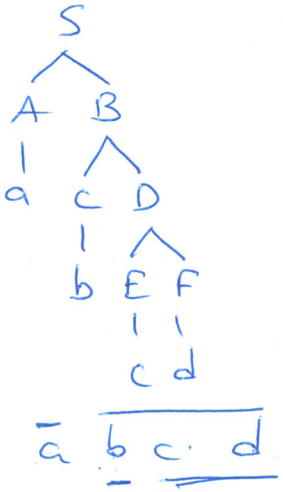
$S \to AB$
$A \to CD$
$B \to EF$
$C \to a$
$D \to b$
$E \to c$
$F \to d$



$X_{1,1}$

G_2

$S \to AB$
$A \to a$
$B \to CD$
$C \to b$
$D \to EF$
$E \to c$
$F \to d$



CD

How was a string generated?

X

	1	2	3	4
1	C	A	$\emptyset$	S
2		D	$\emptyset$	$\emptyset$
3			E	B
4				F

each cell refers to the variables that could have generated that substring.

$X_{1,1}$ $X_{1,2}$

$X_{1,2}$ $X_{1,1}$ $X_{2,2}$

C D

A

$X_{2,3}$ $X_{2,2}$ $X_{3,3}$

D E

$X_{3,4}$ $X_{3,3}$ $X_{4,4}$

E F

B

$X_{1,3}$ $X_{1,1}$ $X_{2,2}$ $X_{3,3}$

If a string has n characters $n \geq 2$

how many ways are there to split it into two parts? $n-1$

$X_1 \cdot X_2 \cdot X_3 \cdots X_{n-1} X_n$

$X_{1,1} \cdot X_{2,2} X_{3,3}$ $\quad$ $X_{1,1} X_{22} / X_{33}$

$X_{1,1}$ $X_{2,3}$ $\quad$ $X_{1,2}$ $X_{3,3}$

C $\quad$ $\emptyset$ $\quad$ A $\quad$ E

$\emptyset$

$X_{2,4}$

$X_{2,2}$ $X_{3,4}$

D B

ϕ

$X_{2,3}$ $X_{4,4}$

ϕ F

ϕ

$X_{1,4}$

$X_{1,1}$ $X_{2,4}$

C ϕ

ϕ

$X_{1,2}$ $X_{3,4}$

A B

S

$X_{1,3}$ $X_{4,4}$

ϕ F

ϕ