

# Sample Assignment # 6.1 Key

1. Write a CFG for the following languages:

$L = \{ c^k a^n b^m \mid n < m, \text{ if } k=0; n > k+m, \text{ if } k>0 \}$ .

$S \rightarrow S1 \mid S2$

$S1 \rightarrow a S1 b \mid S1 b \mid b$

$S2 \rightarrow c C a B$

$C \rightarrow c C a \mid C a \mid a$

$B \rightarrow a B b \mid \lambda$

# Sample Assignment # 6.2a Key

2. Convert the following grammar to a CNF equivalent grammar. Show all steps.

$G = (\{S, B, L, P, E\}, \{i, t, s, e, \{, \}, ;, 0, 1\}, R, S)$ , where  $R$  is

$S \rightarrow iPtSE \mid s \mid B$

$B \rightarrow \{sL\}$

$L \rightarrow \lambda \mid ;sL$

$P \rightarrow 0 \mid 1$

$E \rightarrow \lambda \mid eS$

Remove lambda rules

Nullables =  $\{L, E\}$

$S \rightarrow iPtSE \mid iPtS \mid s \mid B$

$B \rightarrow \{sL\} \mid \{s\}$

$L \rightarrow ;sL \mid ;s$

$P \rightarrow 0 \mid 1$

$E \rightarrow eS$

# Sample Assignment # 6.2b Key

## Remove Unit Rules

Chain(S) = {S, B}; Chain B = {B}; Chain (L) = {L}; Chain(P) = {P}; Chain(E) = {E}

$S \rightarrow iPtSE \mid iPtS \mid s \mid \{sL\} \mid \{s\}$

$B \rightarrow \{sL\} \mid \{s\}$

$L \rightarrow ;sL \mid ;s$

$P \rightarrow 0 \mid 1$

$E \rightarrow eS$

## Remove Non-Productive Symbols

Productive = {S, B, L, P, E}

NO CHANGE

## Remove Unreachable Symbols

Reachable= {S, P, E, L}

$S \rightarrow iPtSE \mid iPtS \mid s \mid \{sL\} \mid \{s\}$

$L \rightarrow ;sL \mid ;s$

$P \rightarrow 0 \mid 1$

$E \rightarrow eS$

# Sample Assignment # 6.2c Key

Convert to CNF

$S \rightarrow \langle\langle i \rangle P \langle t \rangle S \rangle E \mid \langle\langle i \rangle P \langle t \rangle \rangle S \mid s \mid \langle\langle \{ \rangle \langle s \rangle L \rangle \langle \} \rangle \mid \langle\langle \{ \rangle \langle s \rangle \rangle \langle \} \rangle$

$L \rightarrow \langle\langle ; \rangle \langle s \rangle \rangle L \mid \langle ; \rangle \langle s \rangle$

$P \rightarrow 0 \mid 1$

$E \rightarrow \langle e \rangle S$

$\langle\langle i \rangle P \langle t \rangle S \rangle \rightarrow \langle\langle i \rangle P \langle t \rangle \rangle S$

$\langle\langle i \rangle P \langle t \rangle \rangle \rightarrow \langle\langle i \rangle P \rangle \langle t \rangle$

$\langle\langle i \rangle P \rangle \rightarrow \langle i \rangle P$

$\langle\langle \{ \rangle \langle s \rangle L \rangle \rightarrow \langle\langle \{ \rangle \langle s \rangle \rangle L$

$\langle\langle \{ \rangle \langle s \rangle \rangle \rightarrow \langle \{ \rangle \langle s \rangle$

$\langle\langle ; \rangle \langle s \rangle \rangle \rightarrow \langle ; \rangle \langle s \rangle$

$\langle e \rangle \rightarrow e$

$\langle i \rangle \rightarrow i$

$\langle s \rangle \rightarrow s$

$\langle t \rangle \rightarrow t$

$\langle \{ \rangle \rightarrow \{$

$\langle \} \rangle \rightarrow \}$

$\langle ; \rangle \rightarrow ;$

# Sample Assignment # 6.3

3. Present the **CKY** recognition matrix for the string **babba** assuming the Chomsky Normal Form grammar,

$G = (\{S,A,B,C,D\}, \{a,b\}, R, S)$ , specified by the rules **R**:

$S \rightarrow AB \mid BA \mid SC$

$A \rightarrow CS \mid CD \mid a$

$B \rightarrow DS \mid b$

$C \rightarrow a$

$D \rightarrow b$

	b	a	b	b	a
1	B,D	A,C	B,D	B,D	A,C
2	S	S,A		S	
3	S,B	S	B		
4	B	S			
5	B,S				