Sample Assignment # 6.1

1. **Write a CFG for the following languages:**
   $L = \{ c^k a^n b^m \mid n < m, \text{ if } k=0; n > k+m, \text{ if } k>0 \}$.

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

   $S \rightarrow i\ P\ t\ S\ E \mid s \mid B$

   $B \rightarrow \{\ s\ L\ \}$

   $L \rightarrow \lambda \mid ;\ s\ L$

   $P \rightarrow 0 \mid 1$

   $E \rightarrow \lambda \mid e\ S$

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 | BA | SC
A	$\rightarrow$	CS | CD | a
B	$\rightarrow$	DS | b
C	$\rightarrow$	a
D	$\rightarrow$	b

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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 → i P t S E | s | B

B → { s L }

L → λ | ; s L

P → 0 | 1

E → λ | e S

Remove lambda rules

Nullables = {L, E }

S → i P t S E | i P t S | s | B

B → { s L } | { s }

L → ; s L | ; s

P → 0 | 1

E → e S

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 → i P t S E | i P t S | s | { s L } | { s }

B → { s L } | { s }

L → ; s L | ;s

P → 0 | 1

E → e S

Remove Non-Productive Symbols

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

NO CHANGE

Remove Unreachable Symbols

Reachable= {S, P, E, L}

S → i P t S E | i P t S | s | { s L } | { s }

L → ; s L | ;s

P → 0 | 1

E → e S

Sample Assignment # 6.2c Key

Convert to CNF

S → <<i> P <t> S> E | <<i> P <t>> S | s | <<{> <s> L> <}> | <<{> <s> > <}>

L → <<;> <s>> L | <;> <s>

P → 0 | 1

E → <e> S

<<i> P <t> S> → <<i> P <t>> S

<<i> P <t>> → <<i> P > <t>

<<i> P> → <i> P

<<{> <s> L> → <<{> <s>> L

<<{> <s>> → <{> <s>

<<;> <s>> → <;> <s>

<e> → e

<i> → i

<s> → s

<t> → t

<{> → {

<}> → }

<;> → ;

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 → AB | BA | SC

   A → CS | CD | a

   B → DS | b

   C → a

   D → 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				