1. Design a context-free grammar (CFG) for the below language:

$\{a^i b^j \mid i \neq j\}$

L: $i < j$

G: $i > j$

$S \to L \mid G$

$L \to aLb \mid bB$

$G \to aGb \mid aA$

$A \to aA \mid \lambda$

$B \to bB \mid \lambda$

Ex:
aaabb
$S \to G$
$G \to aGb$
$aGb \to aaGbb$
$\to aaa\lambda bb$

2. Design a context-free grammar (CFG) for the below language:

$a^n b^n a^*$

$S \to aLbT$

$L \to aLb \mid \lambda$

$T \to aT \mid \lambda$

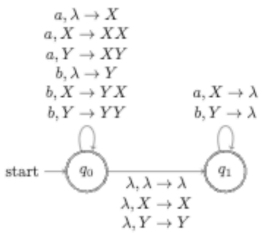
3. Simplify the below grammar:

$S \to aS \mid A \mid C$
$A \to a$
$B \to aa$
$C \to aCb$

$S \to aS \mid A \mid C$

$C \to aCb$

4. Convert the below pushdown automata (PDA) to a context-free grammar (CFG). Both states are accepting states.



$S \to \lambda \mid aX \mid bY$

$X \to aXa \mid bYa \mid a$

$Y \to aXb \mid bYb \mid b$

5. Convert the below context-free grammar (CFG) to a pushdown automata (PDA):

$$S \to \lambda \mid aB \mid bA$$
$$A \to aS \mid bAA$$
$$B \to bS \mid aBB$$