CSE331: Automata and Computability
Worksheet 4 (PDA)

1. Design pushdown automata for the following languages.

a) L= {w | w contains at least three 1's}.

b) L={w | w starts and ends with the same symbol}.

d) L={w | the length of w is odd and its middle is 0}. Show that your PDA works for the following string "10011" using instantaneous descriptions.

e) L={w | w contains twice as many 1s as 0s}

f) L(G) = $\{ 0^n 1^m 0^m \mid n, m \geq 0\}$ over the terminals {0,1}

g) L(G) = $\{ a^n b^m c^k \mid n, m, k \geq 0$ and $n=2m+3k\}$ over $\sum=\{a,b,c\}$

h) L(G) = $\{ a^n b^m \mid 0 < n < m < 3n\}$.$\sum=\{a,b\}$. Give the instantaneous descriptions for the following string "aabbbbb"

i) L(G) = $\{ a^i b^j c^k \mid i, j, k \geq 0$ and i=j or j=k$\}$.$\sum=\{a,b,c\}$

j) L(G) = $\{ a^i b^j c^k \mid j \neq i+k \}$.$\sum=\{a,b,c\}$

k) L(G) = $\{ a^n b^m c^m d^{2n} \mid n \geq 0, m > 0\}$,$\sum=\{a,b,c,d\}$

l) L=$\{a^{2m} b^{n/3} c^n a^m \mid m>=1, n>=1 \}$ $\Sigma = \{a, b, c\}$

2. Convert the following context free grammars to its equivalent pushdown automata.

a) S → A 1 B

A → 0A | ε

B → 0B |1B| ε

b) $S \rightarrow aSa \mid aBa$

$B \rightarrow bB \mid b$

c) S → EcC | aAE | AU
A → aA | ε
B → bB | ε
C → cC | ε
E → aEc | F
F→ bFc | ε

U → aUc | V
V → bVc | bB

d) S → aSbb | Z
Z → aZb | ε

e) S → aaaSc | Z
Z → aaZb | ε