

### CSE 303 Assignment 3

1a)  $\{w \mid w \in (0+1)^*, w \text{ containing at least three } 0s\}$

$S \Rightarrow ABAOAOA$

$A \Rightarrow AA10111E$

- b)  $\{w \mid w \in (0+1)^*, w \text{ length is odd}\}$

$S \Rightarrow SSS1011$

2. a) PDA for  $\{0^n 2^m 0^n \mid n, m \geq 0\}$

State	input	TOS	Action	Comment
$q_0$	0	$z_0$	$(q_0, 0z_0)$	Push 0 when stack is empty
$q_0$	0	0	$(q_0, 00)$	push 0 when TOS is 0
$q_0$	1	0	$(q_0, 10)$	push first 1 while TOS is 0
$q_0$	1	1	$(q_0, 11)$	push all following 1s
$q_0$	0	1	$(q_1, \epsilon)$	pop 1 for every 0, go $q_1$
$q_1$	0	0	$(q_1, \epsilon)$	pop 0 for every 0
$q_1$	$\epsilon$	$z_0$	$(q_F, z_0)$	Done
$q_0$	$\epsilon$	$z_0$	$(q_F, z_0)$	Accept $w = \epsilon$
$q_0$	1	$z_0$	$(q_0, 1z_0)$	When $n=0$ , accept 1, TOS $z_0$
$q_0$	$\epsilon$	0	$(q_1, 0)$	non deterministically check for cases when $m=0$

b) PDA for  $\{w \mid w \in (0+1)^*, w \text{ has more } 0s \text{ than } 1s\}$

State	input	TOS	Action	Comment
$q_0$	0	$z_0$	$(q_0, 0z_0)$	Push 0 when stack is empty
$q_0$	1	$z_0$	$(q_0, 1z_0)$	Push 1 when stack is empty
$q_0$	0	0	$(q_0, 00)$	push 0 when TOS is 0
$q_0$	1	1	$(q_0, 11)$	push 0 when TOS is 1
$q_0$	0	1	$(q_0, \epsilon)$	pop 1 when input is 0
$q_0$	1	0	$(q_0, \epsilon)$	pop 0 when input is 1
$q_0$	$\epsilon$	0	$(q_F, 0)$	when at end of $w$ , 0 is still in stack accept