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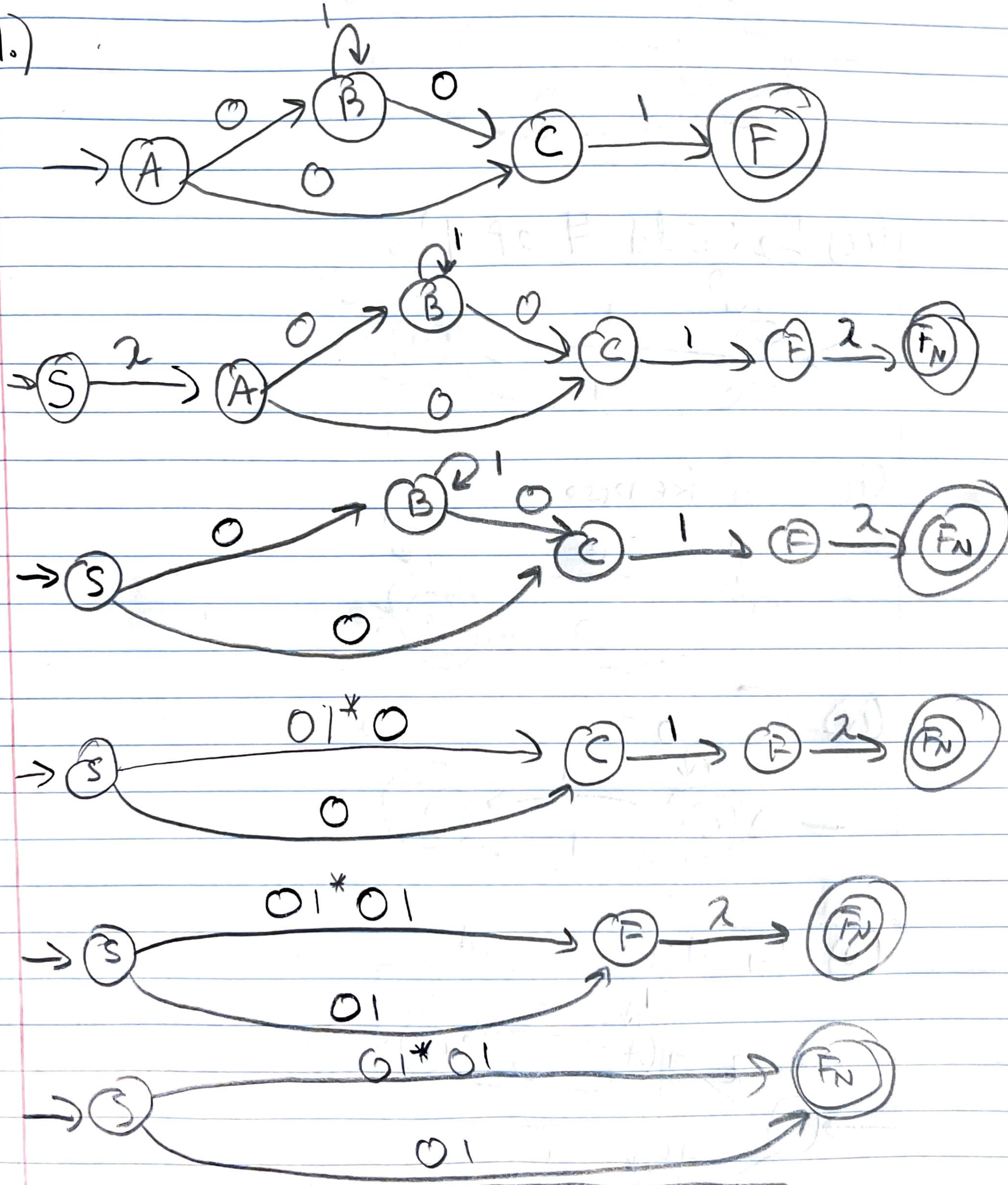
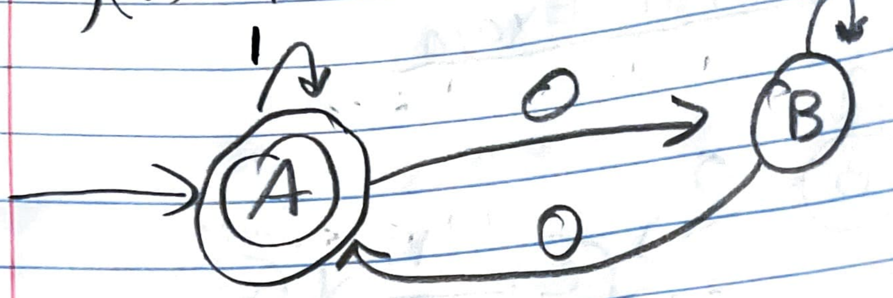
# CS 3186 Final Exam

1.)

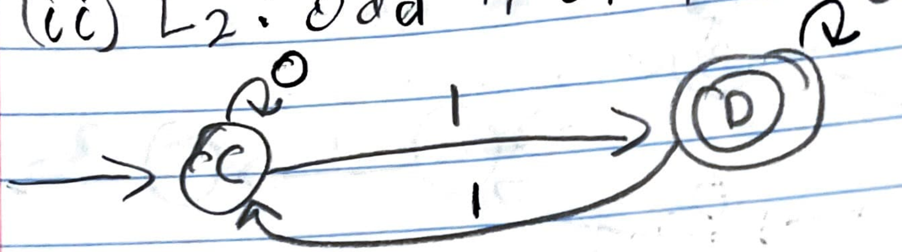



$\boxed{\text{Regular expression: } (01^*0+0)1}$

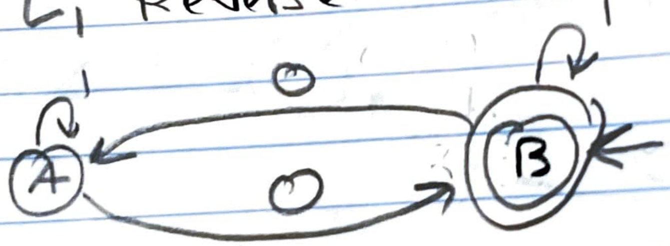
2.) (i) $L_1$ : even # of 0's



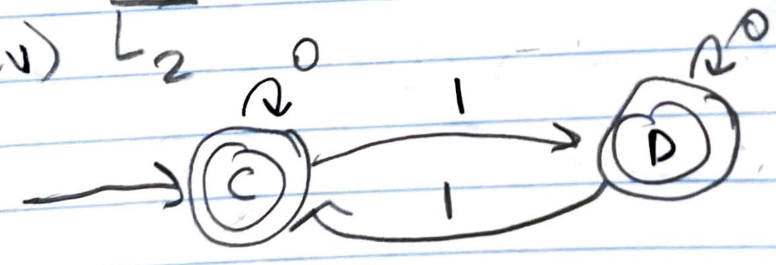

(ii) $L_2$ : Odd # of 1's



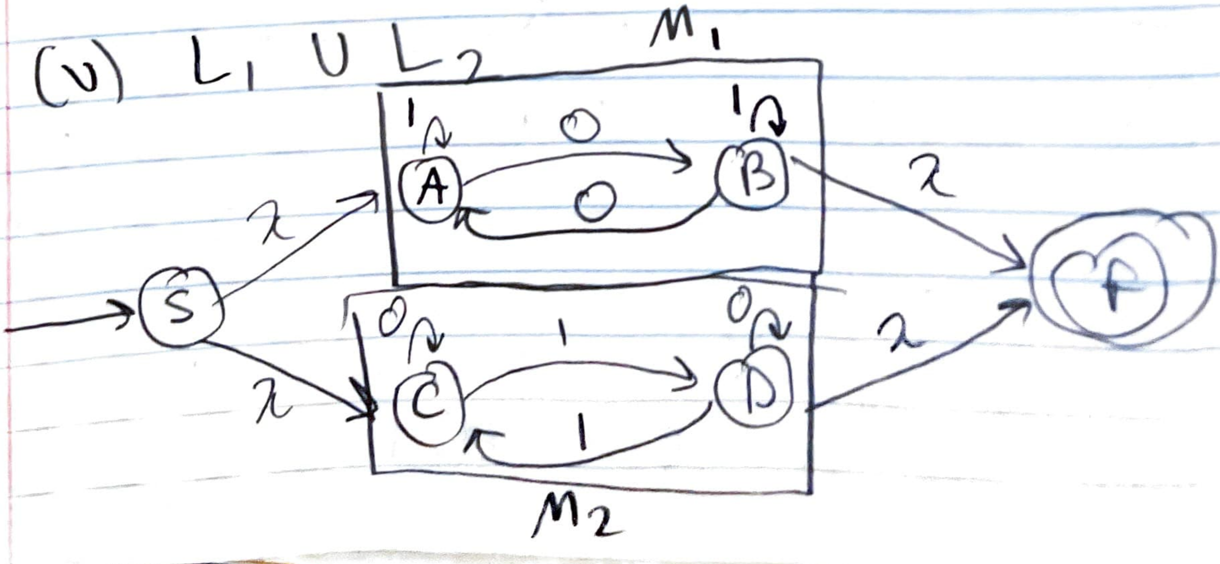

(iii.) $L_1$ Reverse




(iv) $\overline{L_2}$




(v) $L_1 \cup L_2$



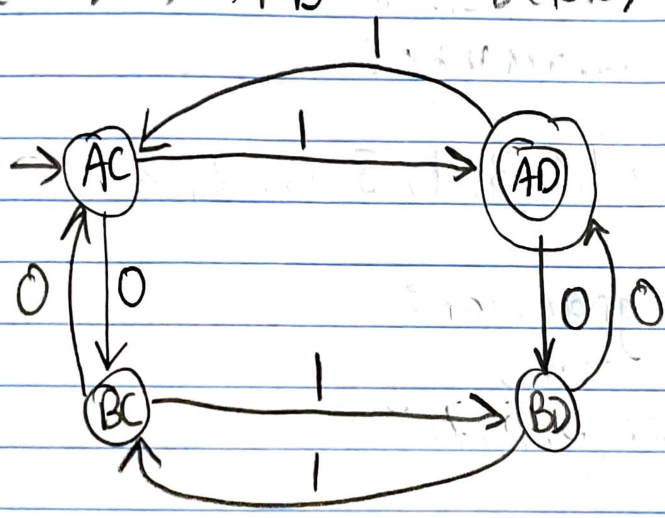
(vi) $L_1 \cap L_2$

$\delta(AC, 0) = BC$ $\delta(AC, 1) = AD$

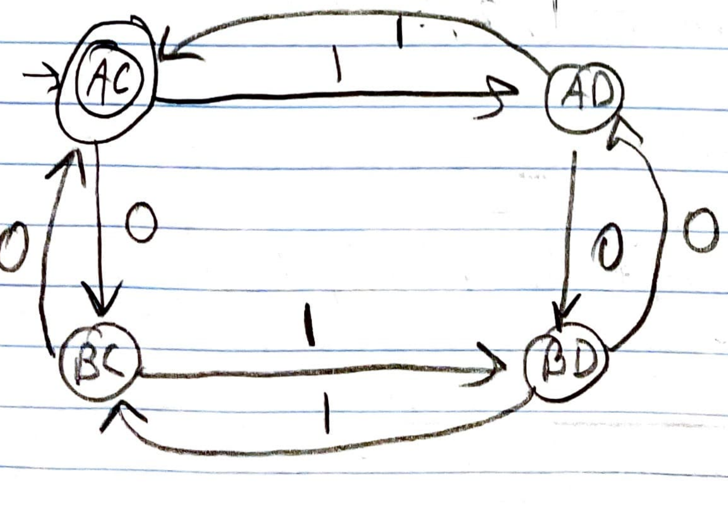
$\delta(AD, 0) = BD$ $\delta(AD, 1) = AC$

$\delta(BC, 0) = AC$ $\delta(BC, 1) = BD$

$\delta(BD, 0) = AD$ $\delta(BD, 1) = BC$




(vii) $L_1 - L_2 = L_1 \cap \overline{L_2}$



3.) 1. $S \to 0A$
2. $S \to 1A$
3. $S \to A0$
4. $S \to AB$
5. $S \to 0$
6. $S \to 0A1$
7. $A \to 1$
8. $S \to \lambda$

(i) Context-free grammar:

Production rules: 1, 2, 3, 4, 5, 6, 7, 8

(ii) Left-linear grammar:

Production rules: 3, 5, 7, 8

(iii) Right Linear regular grammar:

Production rules: 1, 2, 5, 7, 8

(iv) Linear grammar:

Production rules: 1, 2, 3, 5, 7, 8.

4.) Use pumping lemma to show $L = \{a^m b^m c^{m+1}\}$

Given L is an infinite language, assume L is context free

There exists a PDA with "n" of production rules * # of variables

Choose $w = a^n b^n c^{n+1}$

$|w| = 3n+1 \geq n$ (as desired)

$w = a^n b^n c^{n+1} = uvxyz$

Since $|vxy| \leq n$, leads to many cases

Case 1: vxy is within a's

For $i=0$; you have less # of a's than b's (Since $|vy| \geq 1$)

Case 2: vxy is within b's

For $i=0$; you have less # of b's than a's (Since $|vy| \geq 1$)

Case 3: vxy is within c's

For $i=0$; you have same or less # of c's than a's and b's (Since $|vy| \geq 1$)

Case 4: $vxy$ spans a's and b's

For $i=0$; you have at least less than 2 a's or b's than c's. (Since $|vy| \geq 1$).

Case 5: $vxy$ spans b's and c's

For $i=0$; you have less # of b's or same # of c's than a's (Since $|vy| \geq 1$)

Example I used $i=0$; $uxz \in L$

All the cases lead to a contradiction

Hence, our assumption that $L$ is context f... is not true. $L$ is not a CFL.

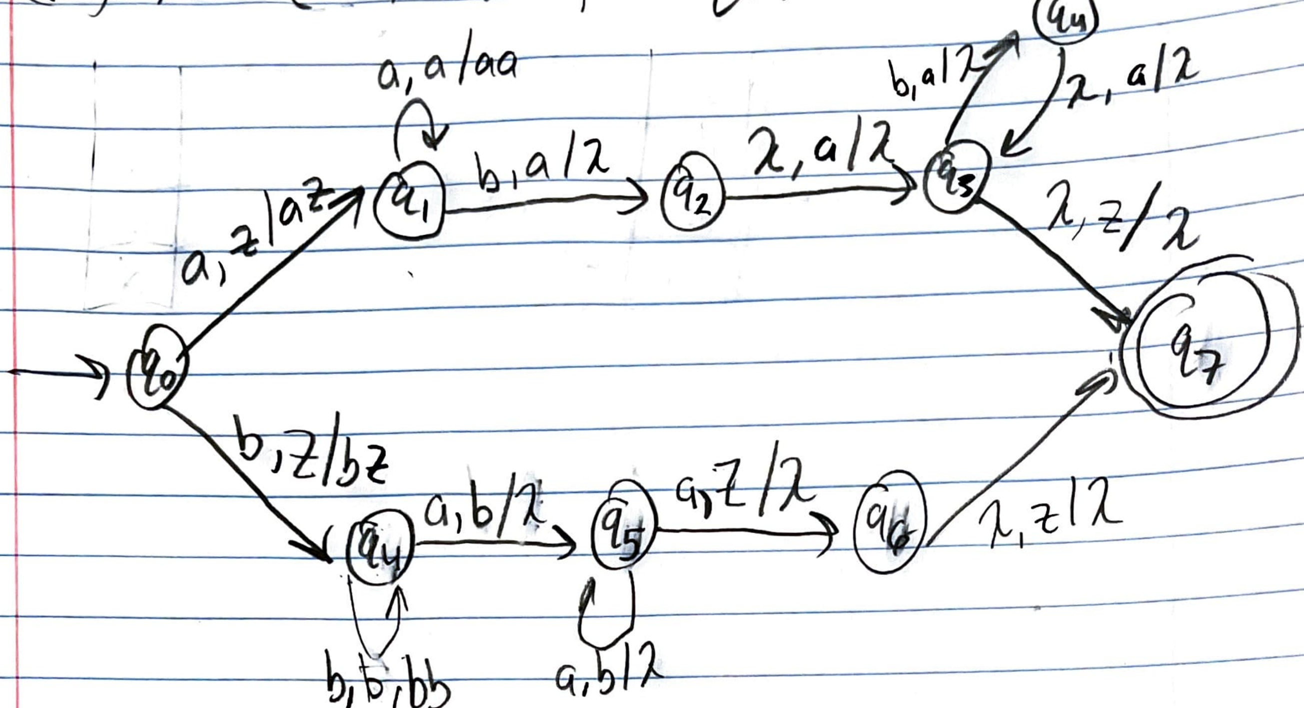
5.) $L = \{a^{2n} b^n \mid n \geq 1\} \cup \{b^{n+1} a^n \mid n \geq 1\}$

(i) Algorithm:

If the first letter is a, then:
When a, if top is Z or a, then push a
when b, if top is a, then pop two a's

If the first letter is b, then:
When b, if top is Z or b, push a b
When a, if top is b, pop, pop (n+1) bs
When a, if top is Z, do nothing

(ii) $M = (Q, \Sigma, \Gamma, \delta, q_0, z, F)$




Complete 7-tuple: $(\{q_0, q_1, q_2, q_3, q_4, q_5, q_6, q_7\}, \{a, b\}, \{Z, a, b\}, \delta, q_0, Z, \{q_7\})$

(iii.) Show bbba leads to rejection

$\delta(q_0, bbba, Z) \vdash \delta(q_4, bba, bZ) \vdash \delta(q_4, ba, bbZ)$

$\vdash \delta(q_4, a, bbbZ) \vdash \delta(q_5, \lambda, bbZ)$

No transistion defined leads to rejection.