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DATE

CSE 303 Final Exam

1 a) $S \rightarrow 0S0 \mid 2S2 \mid 2 \mid 0$

This language produces a palindrome of odd length

b) $(02 + 20)^* (02 + 002)^+$

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2 $S \to 0S0 \mid 1S1 \mid \varepsilon$ Eliminate ε $S \to 0S0 \mid 1S1 \mid 00 \mid 11$
$A \to 0B1 \mid 1B0$ $\longrightarrow$ $A \to 0B1 \mid 1B0 \mid 01 \mid 10$
$B \to 0B \mid 2B \mid \varepsilon$ $B \to 0B \mid 2B \mid 0 \mid 2$

Eliminate Unit $\to$ no unit productions

3.

State	input	TOS	Action	Comment
q_0	ϵ	Z_0	(q_F, Z_0)	Accept empty string
q_0	0	Z_0	$(q_0, 00Z_0)$	push two zeroes
q_0	0	0	$(q_0, 000)$	push all subsequent zeroes as 2
q_0	1	0	(q_1, ϵ)	pop a zero for 1
q_1	2	0	(q_1, ϵ)	pop subsequent 2's for zeroes
q_1	ϵ	Z_0	(q_F, Z_0)	Accept when stack empty

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4. Given the pumping Lemma constant N, assume the string $0^N 1^{N+1} 2^{N+2}$ is context free. Then, String S, $|S| = 3N+3 \geq N$.
Given $S = uvwxy$ and $|vwx| \leq N$ where $v, x \neq \varepsilon$

cases 1) if vwx is the String of zeroes, pumping it up will increase zeroes more than N and is no longer part of the language
2) if vwx is the String of ones, pumping it up will increase ones more than N and is no longer part of the language.
3) if vwx is the String of 2's, pumping it up will increase 2's more than N and is no longer part of the language
4) if vwx is the String of 0's and 1's, v has at least one 0 and x has at least one 1.
i) v has only zeroes and pumping up will make $i \geq j$ and no longer part of language
ii) v has zeroes and ones and pumping up will make $j > i \geq k$ and is no longer part of language
5) vwx is the String of ones and twoes, v has at least one 1 and x has at least one 2.
i) v has only 2's and pumping up will make $j \geq k$ and no longer part of the language
ii) v has 1's and 2's pumping it down will make $k \leq i$ and is no longer part of the language

Due to contradictions, there are no cases where language $\{0^i 1^j 2^k \mid i < j < k\}$ is context-free

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5.

Tape Symbol

State	B	0	2	X	Y
q_0	(q_F, B, L)	(q_1, X, R)	(q_2, X, R)	(q_0, X, R)	
q_1		$(q_1, 0, R)$	(q_3, X, L)	(q_1, X, R)	
q_2		(q_3, X, L)	$(q_2, 2, R)$	(q_2, X, R)	
q_3	(q_0, B, R)	$(q_3, 0, L)$	$(q_3, 2, L)$	(q_3, X, L)	
q_F					

Algorithm: - Mark first number read with X
- If input was 0, go right until 2 and mark X
- If input was 2, go right until 0 and mark X
- go left until B
- repeat from ~~2~~ step 1
- If input is only X's while scanning for number and hits B, accept

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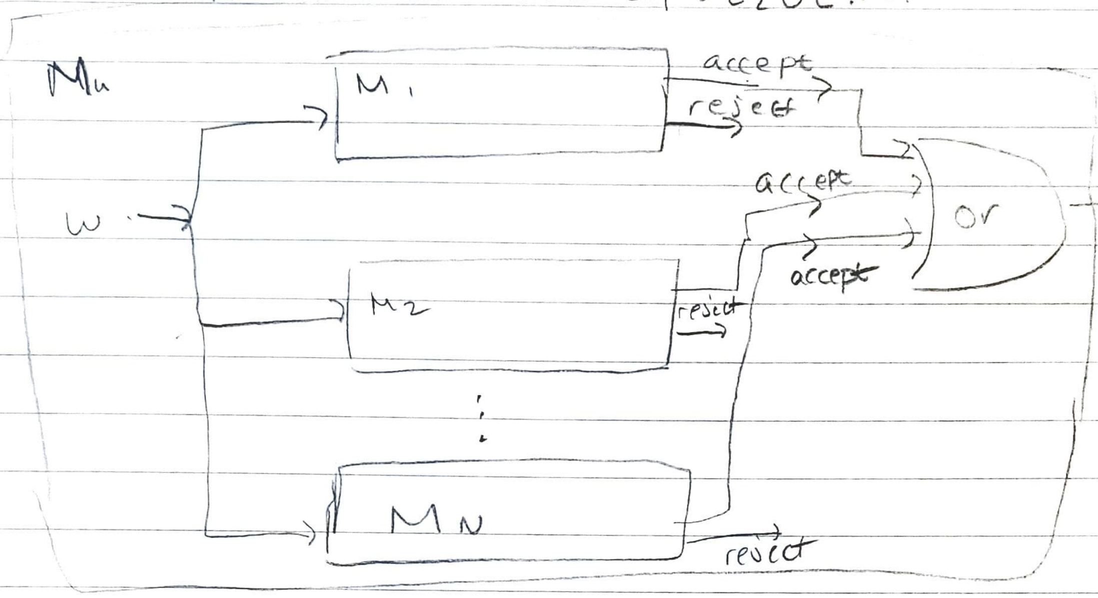
6. a) Yes, L is recursive. If L is the union of $L_1, L_2, \ldots$
A TM could be made $L_1 \cup L_2 \cup L \ldots$



Where,
M_u = TM for $L_1 \cup L_2 \cup L \ldots N$. Using or logic, at least one accept state is needed for M_u to accept. Else, it rejects.

b) It is undecideable. There exists no machines that could determine whether a program will perform as advertised based on all inputs. One example is a program is advertised to determine the halting problem for any input. Such statement cannot be proven since the halting problem itself is undecideable.