CSC135_Lu
Nhat Doan

Test 3

1) Give a description of Chomsky hierarchy of grammar in a table.

Type	Language generated	production restriction $X \to Y$	accepter
0	Phrase-structure = recursively enumerable	X = any string with nonterminals Y = any string.	TM
1	Context-sensitive	X = any string with nonterminals. Y = any string as long as or longer than X	TM's with bounded (not infinite) Tape, called linear-bounded automata LBA's
2	Context-free	X = one nonterminal Y = any string.	PDA
3	Regular	X = one nonterminal. Y = tN or Y = t t terminal N nonterminal.	FA

2) a) $L(\{a^n b^n a^n, n \geq 1\})$

$S \to aba \mid a\#ba$

$\#b \to b\#$

$\#a \to Bbaa$

$bB \to Bb$

$aB \to aa \mid aa\#$

showcase: $n = 2 \Rightarrow a^2b^2c^2$

$S \Rightarrow a\underline{\#ba} \Rightarrow ab\underline{\#a} \Rightarrow ab\underline{B}baa$

$\Rightarrow \underline{aB}bbaa \Rightarrow \boxed{aabbaa}$ (Y)

Chomsky hierachy type: 0, 1

- not (3): we can prove by Pumping Lemma.
- not (2) because it has 3 nonterminals
- in (1) because $|x| \leq |y|$, X is any strings with nonterminals
- in (0) because X is any string with nonterminals

2) b) $L = \{ a^{2n} b^n, n \geq 0 \}$

$S \rightarrow aaSb \mid \lambda$

Show case: $n = 3 \Rightarrow w = aaa\ aaa\ bbb$

$S \rightarrow aaSb \rightarrow aaaaSbb \rightarrow aaaaaaSbbb \Rightarrow aaaaaa\ bbb$ ✓

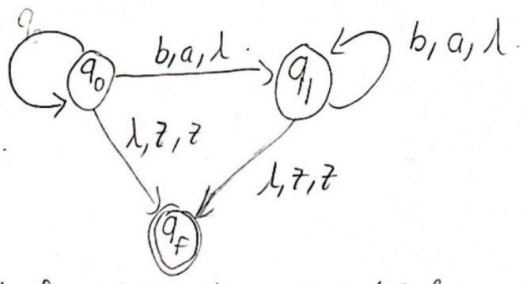
Chomsky hierarchy type: 0, 2

- in (0) because X = any string with no terminals
- not in (1) because $|X| > |Y|$ when $Y = \lambda$.
- in (2) because X has only one nonterminal.
- not in (3) because we compare by Pumping Lemma.

3) $L = \{ a^n b^m : n \leq m \leq 2n \}$

a) When each "a" is read, we push 1 or 2 tokens (a) to be consumed on the stack. When a "b" is read, we change state and each "b" is read, consume one token (a).

b) a, z, az
a, z, aaz
a, a, aa
a, a, aaa.

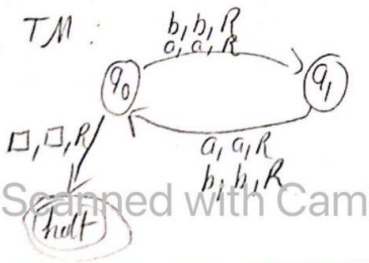


4) $\{a,b\}$ $L = \{ w : |w| \neq 0$ and is multiple of 2 $\}$. $\Rightarrow$ even

a) RE: $((ab)(ab))^*$

$\Rightarrow S \rightarrow aaS \mid abS \mid bbS \mid baS \mid \lambda$

b) TM:

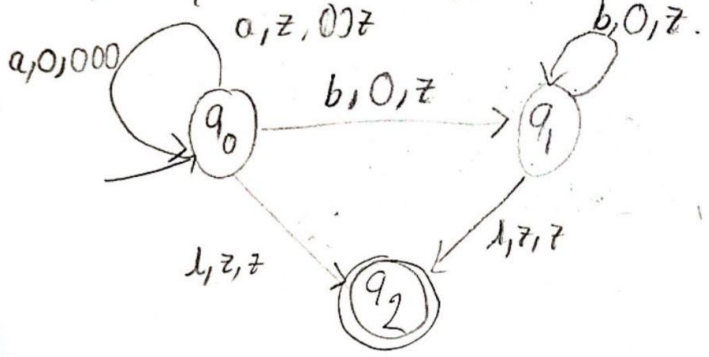


Chapter 7:

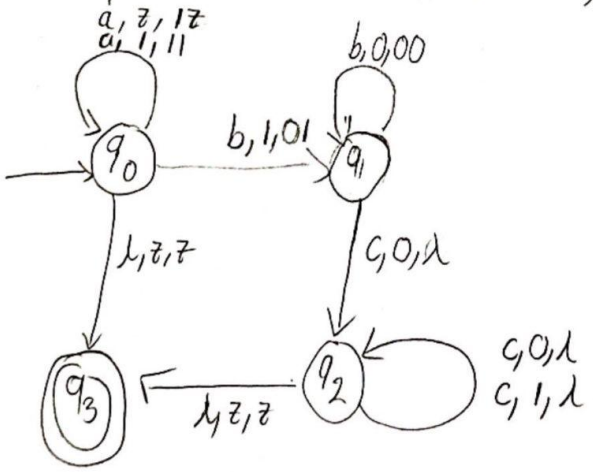
Nhat Doan.

4) a, c, d, f . . Construct npda's: $\Sigma = \{a, b, c\}$.

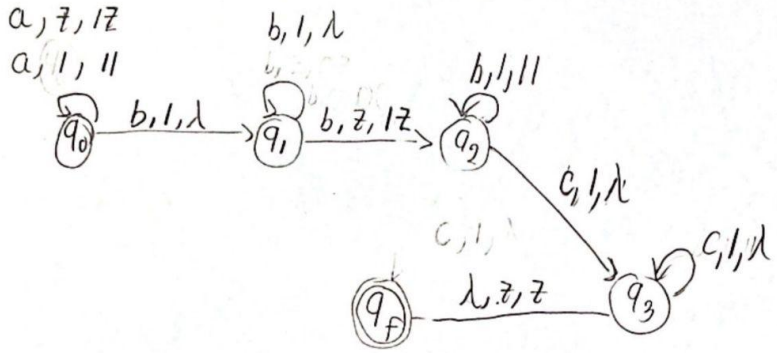
a) $L = \{a^n b^{2n} : n \geq 0\}$



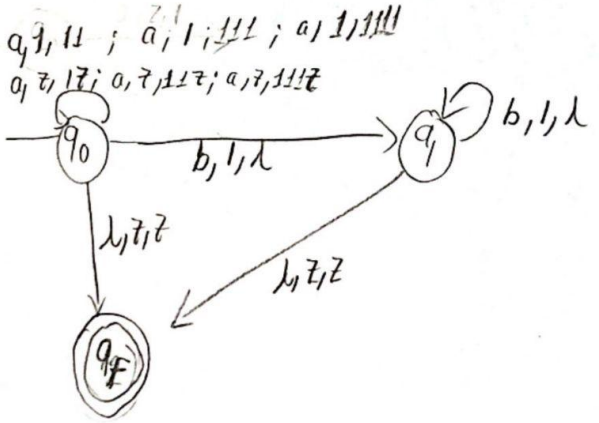
c) $L = \{a^n b^m c^{n+m} : n \geq 0, m \geq m\}$



d) $L = \{ a^m b^{n+m} c^m : n \geq 0,\ m > 1 \}$



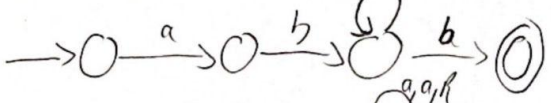
f) $L = \{ a^n b^m : n \leq m \leq 3n \}$



5) $L = \{ ab^* + b^* a (a+b)^* \}$

7) a) $L = L_1(aba^*b)$.

FA:

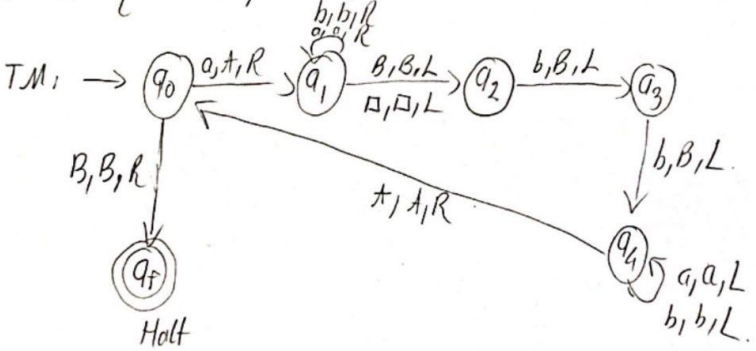


TM:

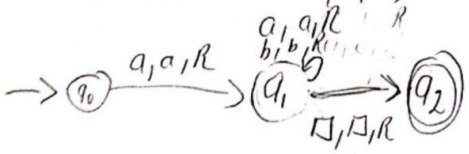
TM: $L_1 = L_2(aba^*b(a+b)^*)$

h) $L = \{ a^n b^{2n} ; n \geq 1 \}$

TM:



2) $L = (a(a+b)^*)$; $\Sigma = \{a, b\}$.



Yes, it is possible.

examining the first symbol and ignore the rest.

Chapter II:

1) b) $L = \{ a^n b^m c^{2n} : n \geq 1 \}$.

$S \rightarrow aAbcc \mid abcc$.

$Ab \rightarrow bA$

$Ac \rightarrow Bbcc$

$bB \rightarrow Bb$

$aB \rightarrow aa \mid aaA$.

Show case:

aabbcccc.

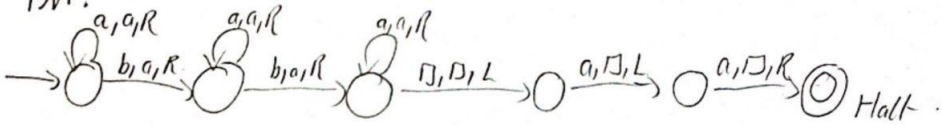
$S \rightarrow aAbcc. \rightarrow abAcc \rightarrow abBbcccc$

$\rightarrow aBbbcccc.$

$\rightarrow aabbcccc.$ ✓

*: 3 integer adder.

TM:



*: add x integers:

TM: