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CS150 Homework 4

due Wednesday, November 17th 5:00 PM

Problem 1.
(a) Construct a CFG for the set of all binary strings of the form $0^i1^j0^k$, where i+k = j.

1. S $\rightarrow$ AB
2. A $\rightarrow$ 0A1 | ϵ
2. B $\rightarrow$ 1B0 | ϵ

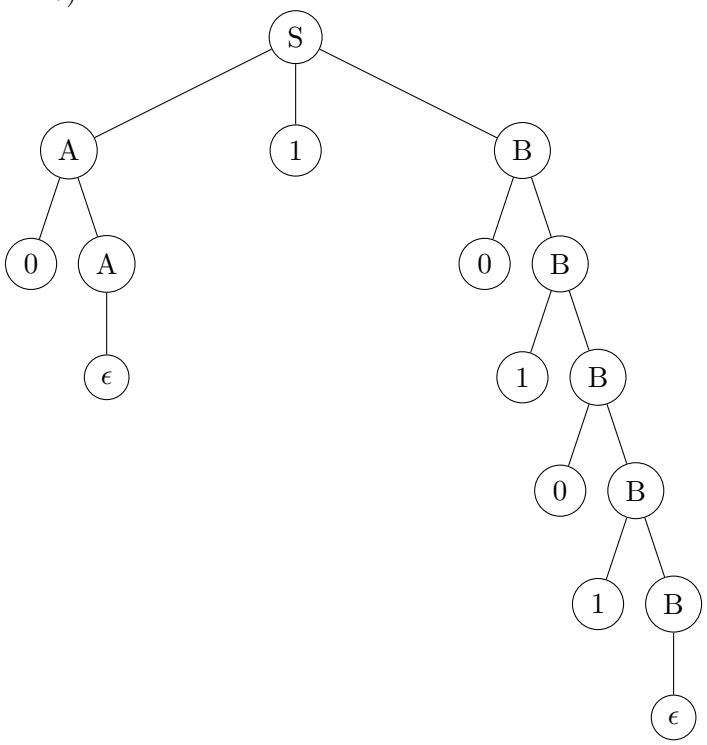
(b) $0^i1^j0^k$, where i+k = 2j.

1. S $\rightarrow$ AB | 0A1B0
(first prod: i and k are even, second prod: i and k are odd; no other option otherwise i + k is odd)
2. A $\rightarrow$ 00A1 | ϵ
2. B $\rightarrow$ 1B00 | ϵ

Problem 2.
For the grammar:
S $\rightarrow$ A1B
A $\rightarrow$ 0A | ϵ
B $\rightarrow$ 0B | 1B | ϵ
and string 010101, give the a) leftmost derivation and b) parse tree.

a) S $\Rightarrow$ A1B $\Rightarrow$ 0A1B $\Rightarrow$ 01B $\Rightarrow$ 010B $\Rightarrow$ 0101B $\Rightarrow$ 01010B $\Rightarrow$ 010101B $\Rightarrow$ 010101

b)



Problem 3.
For this grammar,
S $\rightarrow$ A1B
A $\rightarrow$ 0A | ϵ
B $\rightarrow$ 0B | 1B | ϵ

a) Show that this grammar is unambiguous.

Algorithm for reading input string with production:
1) Scan the string from left-to-right
2) There is only 1 production for expanding S, don't read any input when expanding S.
3) If it's required to expand A, use A $\rightarrow$ 0A if the next symbol is a 0, otherwise if it's 1 or at the end, use A $\rightarrow \epsilon$
4) If it's required to expand B, use B $\rightarrow$ 0B if the next symbol is a 0, use B $\rightarrow$ 1B if the next symbol is a 1, and use B $\rightarrow \epsilon$ if at the end of input string.
This will produce a unique leftmost derivation for any given input string.

Input string: 001010

Remaining input	Steps of left most derivation
001010	S
001010	A1B
01010	0A1B
1010	00A1B
1010	001B
010	001B
10	0010B
0	00101B
	001010B
	001010

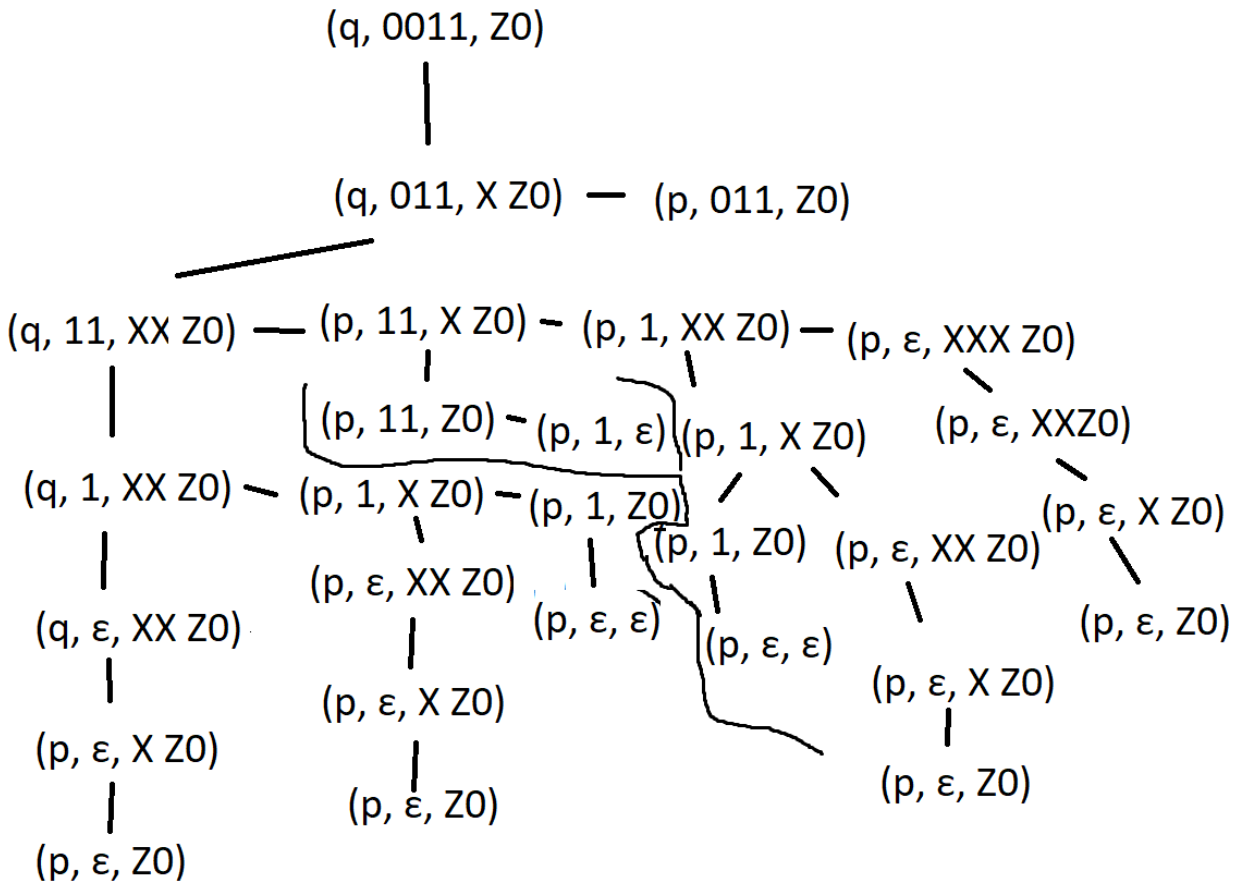
Therefore, this grammar is unambiguous.

b) Find a grammar for the same language that is ambiguous, and demonstrate its ambiguity.

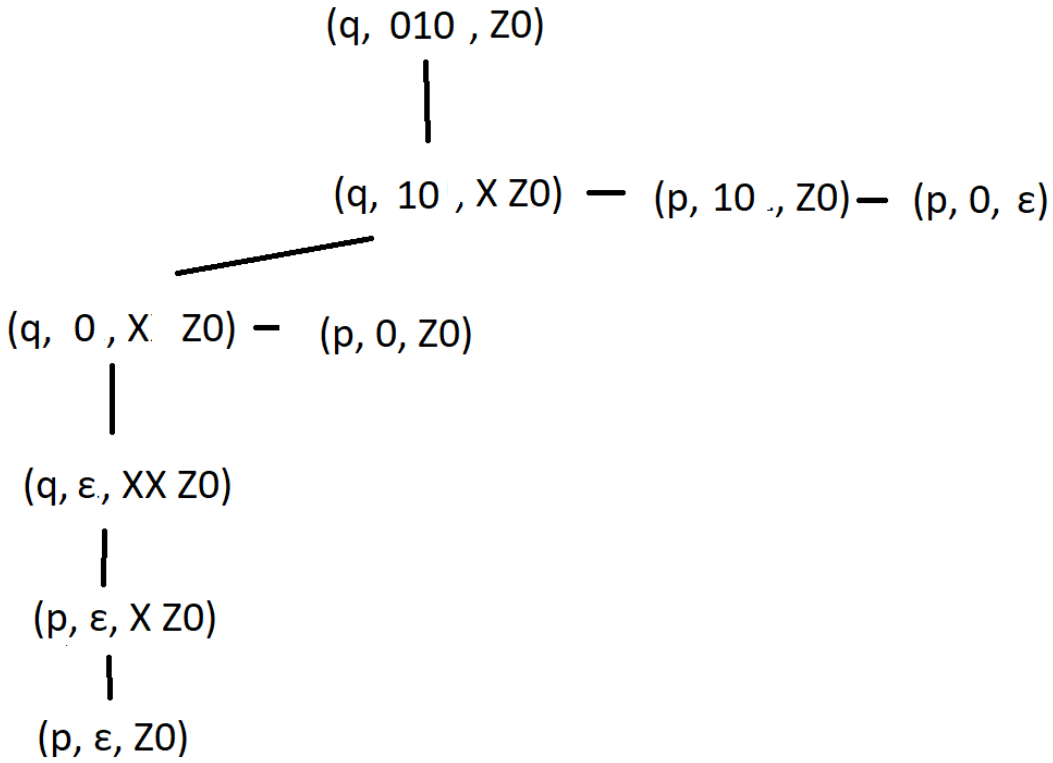
S $\rightarrow$ A1B
A $\rightarrow$ 0A | ϵ
B $\rightarrow$ 0B | B0 | 1B | ϵ

For string w = 10, there exist 2 left most derivations as follows:
1) S $\Rightarrow$ A1B $\Rightarrow$ 1B $\Rightarrow$ 10B $\Rightarrow$ 10
2) S $\Rightarrow$ A1B $\Rightarrow$ 1B $\Rightarrow$ 1B0 $\Rightarrow$ 10
Thus, this grammar is ambiguous.

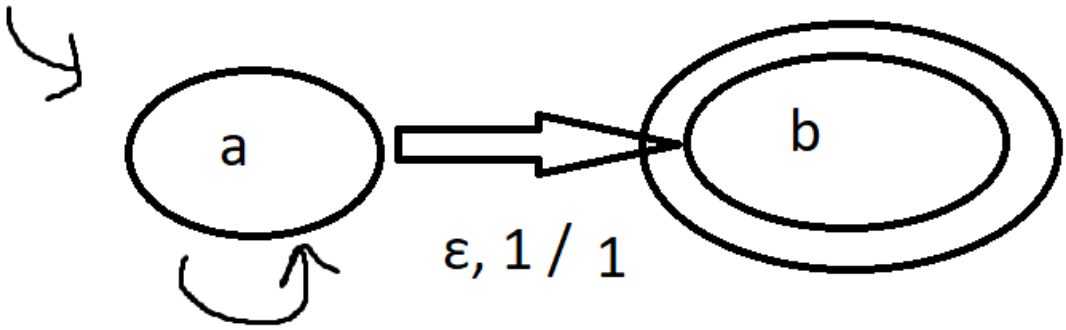
Problem 4.
b) Show all reachable IDs with input w 0011



c) Show all reachable IDs with input w 010



Problem 5.
a) PDA for The set of all binary strings with more 1's than 0's. (Transition Diagram)



0, Z0 / 0 Z0
1, Z0 / 1 Z0
0, 0 / 00
1, 1 / 11
0, 1 / ε
1, 0 / ε

b) $0^i1^j0^k$, where i+k = j.