Syntactic Analysis (Practice)

ICS312

Machine-Level and Systems Programming

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(q1) CFG

- Write a CFG for the language of strings that contain an odd and >=1 number of a's
  - a, aaa, aaaaa, ..

(q1) Solution

- Write a CFG for the language of strings that contain an odd and >=1 number of a's
  - a, aaa, aaaaa, ..

$$S \rightarrow aa\ S \mid a$$

(q2) CFG

- Write a CFG for the language of all strings that consist of n a's, then 1 b, and then n a's (e.g., b, aba, aabaa, aaabaaa)

(q2) Solutions

- Write a CFG for the language of all strings that consist of n a's, then 1 b, and then n a's (e.g., b, aba, aabaa, aaabaaa)

$$S \rightarrow a\ S\ a \mid b$$

Note the recursion here that "book ends" S with two a's, one of the left and one on the right

(q2) WRONG Solutions!!

- Write a CFG for the language of all strings that consist of n a's, then 1 b, and then n a's (e.g., b, aba, aabaa, aaabaaa)

COMMONLY WRONG SOLUTION

S → A b A

A → Aa | epsilon

This is the same as Regex: a* b a*

Does not enforce matching numbers of a's

(q3) CFG

- Write the CFG over the alphabet {a,b} that describes all strings that are palindromes

(q3) Solutions

- Write the CFG over the alphabet {a,b} that describes all strings that are palindromes

S → epsilon | a | b

S → a S a

S → b S b

(q4) CFG

- Write a CFG over the alphabet {0,1} that describes all strings that end with a sequence of n 0's and n 1's (for any n>0)
  - example: 0101101000101010**00001111**
  - example: **000000001111111**

(q4) Solutions

- Write a CFG over the alphabet {0,1} that describes all strings that end with a sequence of n 0's and n 1's (for any n>0)
  - example: 0101101000101010**00001111**
  - example: **000000001111111**

$S \rightarrow A\ B$

$A \rightarrow 0\ A \mid 1\ A \mid \varepsilon$

$B \rightarrow 0\ B\ 1 \mid 01$

(q5) CFG

- Write a CFG for the language of well-formed parenthesized expressions
  - (), (()), ()(), (()()), (())(()), etc.: OK
  - ()),)(, ((()), (((, etc.: not OK
- This is a “do you really understand recursion?” test :)

(q5) Solutions

- Write a CFG for the language of well-formed parenthesized expressions
  - (), (()), ()(), (()()), (())(()), etc.: OK
  - ()),)(, ((()), (((, etc.: not OK

S → ‘(‘)’ | SS | ‘(’S’)’

(q6) CFG

- Write a CFG for the language of all strings over alphabet {a,b} that consist of a sequence of n a's, m b's, and n a's, where
  - n is an integer that is >0
  - m is an integer that is >=0 and even

(q6) Solutions

- Write a CFG for the language of all strings over alphabet {a,b} that consist in sequence of n a's, m b's, and n a's, where
  - n is an integer that is >0
  - m is an integer that is >=0 and even

S → a S a | a B a

B → epsilon | bbB