Cairo University
Faculty of Computers & Artificial Intelligence
Theory of Computations

Assignment 2

Context Free Grammar

Q1: Find a CFG for each of the following languages over the alphabet (a, b).

a. All strings have even length.
b. All strings have a length multiple of 3.
c. All strings that end in a double letter.

Q2: Find a cfg grammar of this form for the language of each of the following regular expressions.

a. a(ab)*.
b. (ab)*a.
c. (ab)*c(a + b)*

Q3: Find the leftmost derivation of the word abba in grammar. Draw a derivation tree.

$$S \rightarrow AA$$
$$A \rightarrow aB$$
$$B \rightarrow bB \mid \Lambda$$

Q4: Find the leftmost derivation of the word abbabaabbbabbab in the CFG. Draw a derivation tree.

$$S \rightarrow SSS \mid aXb$$
$$X \rightarrow ba \mid bba \mid abb$$

Q5: For the following CFGs, find regular expressions that define the same language and describe the language.

(i) $S \rightarrow aS \mid bX \mid a$
$X \rightarrow aX \mid bY \mid bZ \mid a$
$Y \rightarrow aY \mid a$
$Z \rightarrow aZ \mid bW$
$W \rightarrow aW \mid a$

(ii) $S \rightarrow bS \mid aX$
$X \rightarrow bS \mid aY$
$Y \rightarrow aY \mid bY \mid a \mid b$

Push Down Automaton

Q6: Find a pushdown automaton for each of the following languages.

a. All strings over (a, b} with the same number of a's and b's.

b. The palindromes of odd length over (a, b).

c. $\{a^n b^{n+2} | \, n \geq 0\}$

Q7: For each of the CFGs below in Problems construct a PDA that accepts the same language they generate

1. (i) $S \rightarrow aSbb \mid abb$
   (ii) $S \rightarrow SS \mid a \mid b$
2. $S \rightarrow XaaX$
   $X \rightarrow aX \mid bX \mid \Lambda$
3. $S \rightarrow aS \mid aSbS \mid a$
4. $S \rightarrow XY$
   $X \rightarrow aX \mid bX \mid a$
   $Y \rightarrow Ya \mid Yb \mid a$

Submission :

- Deadline is Tuesday 16-May @11:59PM through google form:

  https://forms.gle/rcRqKeF2CtbmsLMa8

- Write your answers in clean format, then scan your answer and upload to google form.
- The assignment is a group of 3, belonging to the same TA.
- Only one member of your team will submit the assignment.
- If an assignment discussion is held, All Team members must show up for the discussion.
- Cheating could get zero in the assignment.