CS154

Name: _____ Date: _____

Note: The purpose of the following questions is:

• *Enhance learning*	• *Summarized points*	• *Analyze abstract ideas*

Class 5: Grammars

1. To study languages mathematically, we need a mechanism to describe them. Everyday language is imprecise and ambiguous, so informal descriptions in English are often inadequate. A grammar for the English language tells us whether a particular sentence is well-formed or not. A typical rule of English grammar is "a sentence can consist of a `noun` phrase followed by a `predicate`."
   The following examples illustrate the definition of a general concept in terms of simple ones. Start with the top-level concept, here `<sentence>`, and successively reduce it to the irreducible building blocks of the language. The generalization of these ideas leads us to `formal grammars`.

   Show the derivation by using the `grammar` to check if the following sentences are properly formed:

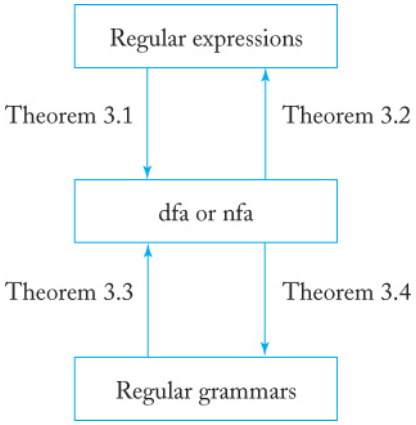
   "the dog walks"
   "a cat runs"
2. What language does the grammar with these productions generate?
   S → aSb
   S → λ
3. A grammar ***G*** is defined as a quadruple

   G = (V, T, S, P),

   V: Set of variables
   T: Set of terminal symbols
   S: Start variable
   P: Set of Production rules

   Define ***V, T, S*** and ***P*** in the previous example.
4. What language does the grammar with these productions generate?
   S → Ab
   A → aAb
   A → λ
5. What is `Linear Grammars`? give example
6. What is `Non-Linear Grammars`? give example
7. What is `Right-Linear Grammars`? give example
8. What is `Left-Linear Grammars`? give example

9. What is `regular grammar`?
10. Consider the following Theorems:
    - 3.1 Let ***r*** be a regular expression. Then there exists some nondeterministic finite acceptor that accepts ***L(r).*** Consequently, ***L(r)*** is a regular language.
    - 3.2 Let ***L*** be a regular language. Then there exists a regular expression ***r*** such that ***L = L(r).***
    - 3.3 Let ***G = (V, T, S, P)*** be a right-linear grammar. Then ***L(G)*** is a regular language.
    - 3.4 If ***L*** is a regular language on the alphabet ***Σ***, then there is exists a right-linear grammar ***G = (V, Σ, S, P)*** such that ***L = L(G).***



Show a proof idea for Theorem 3.3

11. For the following right-linear Grammar ***G***, construct NFA ***M*** for it and find the language such that ***L(M) = L(G).***

    $S \rightarrow aA|B$

    $A \rightarrow aaB$

    $B \rightarrow bB|a$

12. Show a proof idea for Theorem 3.3, the case of `Left-Linear Grammars.`
13. Show a proof idea for Theorem 3.4
14. For the following NFA ***M***, convert ***M*** to a right-linear grammar ***L***, such that ***L = L(M)***.