Team Assignment 11

Team Number and Initials _____ ____ _____

Regular Languages

Design finite automata and regular expressions for the following languages (where $\Sigma = \{a, b, c\}$).

1. $\{w \mid w \text{ begins and ends with } a\}$

2. $\{w \mid w \text{ has an odd number of } b's\}$

3. $\{w \mid w \text{ has a length evenly divisible by 5}\}$

4. $\{w \mid w \text{ has an } a \text{ in the fourth position from the end}\}$

Context-Free Languages

For the following context-free grammar G_1 :

 $S \rightarrow SaA \mid A$ $A \rightarrow B \mid BC$ $B \rightarrow bB \mid b$ $C \rightarrow cC \mid \epsilon$

Derive the following strings or indicate this isn't possible:

5. bab

6. bbabc

7. bbccbb

8. ϵ

9. bbcc

10. ccbb

11. Create a CFG for the language { $w \mid w$ begins and ends with the same symbol } where $\Sigma = \{0, 1\}$.

12. Create a CFG for the language { $w \mid w$ is a well-formed boolean expression in 3-cnf } where $\Sigma = \{\land, \lor, \sim, (,), x, y, z\}.$

13. Create a PDA for the language $\{w \mid w \text{ has odd length and an } a \text{ in the middle}\}$

Computability

14. Create a Turing machine description for the language $\{w \mid w \text{ at least half of the symbols in } w \text{ are } a's\}$.

15. Show that the language $\{w \mid w \text{ contains } aba \text{ or } bab\}$ is a decidable language.

16. Is it possible to design a Turing machine which reads in another Turing machine's description, and outputs the number of steps the Turing machine will take in computing a given string? Argue why or why not.

Complexity

17. Show that the language $\{w \mid w \text{ at least half of the symbols in } w \text{ are } a's\}$ belongs in *P*.

18. Show that the subset sum problem is in *NP*. This is the problem where you are given a list of numbers and are asked whether any of them add up to a value *t*.

19. What is the complexity of the following sorting algorithm?

Given a list of N items:
1. For each spot in the list from 1 to N:
 1.1. Scan forward looking for the smallest item.
 1.2. Swap this smallest item with the one in the current spot.
2. Print the now sorted list.