

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

9. bbcc

10. ccbb

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

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

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



## Complexity

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