

# Homework 10

CS 4313 – Spring 2003  
Tom Bylander, Instructor

assigned April 9, 2003  
due date April 16, 2003

1. (25 pts.) Suppose that I want to make sure that every email that has a clever way of embedding “Aggies” is rejected. This time I propose the regular expression:

$$\Sigma^* (A + a) \Sigma^* (G + g) \Sigma^* (G + g) \Sigma^* (I + i) \Sigma^* (E + e) \Sigma^* (S + s) \Sigma^*$$

What is wrong with this proposal? Specify one problem when it matches and one problem when it doesn't match.

2. (25 pts.) Do Exercise 11.1.16.
3. (25 pts.) Provide a context-sensitive grammar for the language

$$L = \{ab^{2^n}c : n \geq 0\}$$

That is, the number of  $b$ 's is a power of 2. For example, some intermediate points in a derivation of  $ab^8c$  might be:

$aXc$   
 $abYc$   
 $aYbc$   
 $aXbc$   
 $abbXc$   
 $abbbYc$   
 $aYbbbc$   
 $aXbbbc$   
 $aXbbbc$   
 $aXbbbc$   
 $abbbbbXc$   
 $abbbbbYc$   
 $aYbbbbbc$   
 $aXbbbbbc$   
 $abbbbbbc$

4. (Extra Credit) Provide a context-sensitive grammar for the language

$$L = \{b^{2^n} : n \geq 0\}$$

Remember that the left-hand side of each production in a context-sensitive grammar cannot be longer than the right-hand side. For example, a context-sensitive grammar cannot have any  $\lambda$  productions.

5. (25 pts.) Classify each of the languages over the alphabet  $\{0, 1\}$  below as:

- regular
- context-free, but not regular
- recursive, but not context-free
- recursively enumerable, but not recursive
- not recursively enumerable

(a)  $\{x : x = 2n \text{ for some } n \geq 1\}$

(b)  $\{x : x = n^2 \text{ for some } n \geq 1\}$

(c)  $\{x : x = 2^n \text{ for some } n \geq 1\}$

(d)  $\{xy : |x| = |y| \text{ and } x = y\}$

(e)  $\{xy : |x| = |y| \text{ and } x \neq y\}$