

Homework 9

CS 4313 – Spring 2003
Tom Bylander, Instructor

assigned April 2, 2003
due date April 9, 2003

1. (25 pts.) Suppose that I want to make sure that every email that mentions “Aggies” are rejected. Suppose we write a regular expression like $\Sigma^* \text{Aggies} \Sigma^*$ to detect this. Show five different techniques to circumvent this pattern, i.e., when I read the email, I will interpret the sequence of characters as “Aggies”. Changing the case of the characters is an example of one technique.
2. (25 pts.) Show a TM transition graph for recognizing the language:

$$L = \{b^n a^{n^2} : n \geq 1\}$$

Hint: $n^2 = (n - 1)^2 + 2n - 1$, so for every b , erase 2 a 's, then change the last b to an a . Accept if you eventually reach ba . For example, your intermediate computations might look like:

```
__bbbaaaaaaaaa__  
__cbbbaaaaaa____  
__ccbbaaaaa_____   
__cccaa_____   
__bbaaaa_____   
__cbaa_____   
__cc_____   
__ba_____
```

3. (Extra Credit) Show that your answer for the above exercise is correct using the Turing machine simulator that you can download from the course web site.
4. (25 pts.) Describe how the language

$$L = \{a^{n^2} : n \geq 1\}$$

can be recognized nondeterministically.

5. (25 pts.) Consider the set of numbers that can be obtained by starting with positive integers and applying a finite number of additions, subtractions, multiplications, divisions, and square roots. Show that this set of numbers is countable. Hint: show that all strings applying these operations are countable.