Homework Assignment 7  
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Due on Nov. 24, 2003 by 1pm

1 Exercise 1

Show whether each of the following languages is regular or not. That is, if a language is regular, give a FSA that recognizes it; if a language is not regular, show it using the Pumping Lemma (reasoning abstractly about $p$).

a) $A = 1^n 01^n$, where $n \geq 0$.
b) $B = 1^n 01^n$.
c) $C = 0^n 1^m$, where $n \geq 0$.
d) $D = 0^n 1^m$, where $n > m - 2$.

2 Exercise 2 (Optional, extra points)

Show whether the following language is regular or not.

e) $E = 001^n 01^m$, where $n \geq 0$, $m \geq 0$, and $m \neq n$.

3 Exercise 3

For each of the following languages, construct a FSA (deterministic or not) and its corresponding Right Linear Grammar:

i) $110^*01^*$
ii) $\{w : w \text{ is 10, 11, 01 or 00 followed by any number of 1s}\}$
iii) $\{w : w \text{ contains exactly } n \text{-many 1s and no 0s, where } n \text{ is a multiple of 3}\}$

4 Exercise 4

The following English sentences illustrate a long distance dependency. Based on this dependency, construct a detailed proof showing that English is not a regular language (cf. Relative Clause proof in class). If the proof relies on the claim that some other language is regular or not regular, prove that claim too.

(1) a. John and Mary like to eat and sleep respectively.
   b. John, Mary, and Sue like to eat, sleep and dance respectively.
   c. John, Mary, Sue, and Bob like to eat, sleep, dance and cook respectively.
   d. Etc.
5 Exercise 5

The context-free grammar G1 has the following rules:

S → NP VP
NP → Det N'
N' → (Adj) N' (PP)
N' → N Conj N'
N' → N
VP → V_{trans} NP (PP)
VP → V_{intrans} (PP)
PP → P NP
Det → the | some | its |
N → men | women | boy | Philadelphia | dogs | cats
Adj → tall | black
V_{trans} → visited | like(s/d)
V_{intrans} → sneezed
P → from
Conj → and

i. For each of the following sentences, specify whether this grammar generates a tree. If it does, draw the tree. If it doesn’t, say how you would amend the grammar (while keeping it as close as possible to a grammar for English) so that it will generate a tree for that sentence.

The men and women visited Philadelphia.
The tall boy likes dogs.
The boy from Philadelphia likes the town and hates its dogs.

ii. Take the original G1 grammar above. How many times is the following sentence ambiguous according to G1? Draw all the trees that G1 generates for the sentence and explain their corresponding meaning (unambiguously) in your own words. (Sometimes two trees may yield indistinguishable readings.)

Some black dogs and cats from Philadelphia sneezed.