COSC 3431.03

W. 2000

Date: Feb. 7, 2000
Due: Feb. 28, 2000—At the beginning of class, no extensions

Problem Set No. 2

General Remark. Each problem must have *adequate explanation* of why it answers the relevant question. While examples can help to understand your point of view, *they are NO substitutes* for a logical argument (this may be a "proof") that your answer is *general*, that is, it "works in all cases".

1. Consider a new kind of finite automaton called an *all-paths-NFA*. An all-paths-NFA M is the same as our familiar NFA in all aspects *except that* it recognizes $x \in \Sigma^*$ if *every* possible computation of M on x ends in a state from F. [Recall that an ordinary NFA accepts a string if *some* computation ends in an accept state.]

Prove that all-paths-NFAs recognize exactly the class of regular languages.

NB. There are two things to prove: One, that all regular languages are recognizable, and two, that only regular languages are recognizable. *You may simplify your task by assuming that ε-moves are not allowed.*

Hint. Consider the "ordinary NFA-to-DFA" construction (class/text) and see if it works (with minor amendments that you have to spell out and justify) for the "all paths NFA".

2. From the text (Sipser) do:

p.120 onwards: #2.2, #2.4(b, f), #2.11 [**BUT** use the procedure from class, **not** from text—recall that we "adjusted" somewhat the definition of PDA, and how they accept a string], **#2.14, #2.18(a, b), #2.19, #2.20** [**Erratum**: should say "... using a derivation with at least 2^b steps, $L(G)$ is infinite."];

3. Show that a grammar with *mixed* regular productions of the form $A \to a$ and $A \to Ba$ *and* $A \to aB$ *may* produce a *non*-regular context free language.

(*Hint.* Find a *simple* CFG with mixed productions that generates a CFL that is known *not* to be Regular. As always, unless your grammar **obviously** produces the language in question, you have to give a good *general* argument that it does.)

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