COSC 2001(A and B) 3.0—Fall 2000

Date: Sep 26, 2000
Due: Oct 17, 2000

Problem Set No. 1

Papers ***must*** **be typed or word-processed (the "*must*" does not apply to diagrams)**, and deposited to a course drop-box on the due date.

► Due time, and location of this box, will be announced soon! ◄

In this Problem Set it is allowed—but not required!—to submit **ONE joint paper that has a total of TWO co-authors from the same section**. The same mark, as assigned to such a joint paper, will be given to **each** of its two authors.

► **IFF** you are submitting Problem Set #1 ***with*** a partner, then you ***must*** notify us as described below, **Prtnr1.**–**Prtnr4.:**

Prtnr1. Make a file called "partner" (no quotes). [Please do ***not*** call it "Partner" or "PARTNER" or "a1partner" or anything other than "partner"].

Prtnr2. Put in it your name and "ariel" login, ***and*** the name and ariel login of your partner as well.

Prtnr3. Give the following command on ariel

"**submit 2001 a1 partner**"

NOT later than Sep. 29, 2000.

Prtnr4. Only ***one*** submission (**Prtnr3.**, above) ***per pair*** please! ◄

If you do NOT plan to work with a partner please do NOT submit any co-author information!

(1) This teamwork is **strictly for "declared" pairs**, and strictly for Problem Set #1. Teamwork may not be allowed on later assignments.

(2) Any strong similarity between different papers will be seriously frowned upon. (To learn more about this issue please follow the link "**Senate Policies**" found on the URL: http://www.cs.yorku.ca/∼gt/courses/)

1. Define a new type of a nondeterministic automaton, $M = (\Sigma, Q, Q_0, \delta, F)$, exactly as in class/text. **Except**: "Q_0" is now—in general—not just one state, but a non-empty **set** of **start states**. Q_0 may contain **more than one** state.

A string x is accepted by this model iff there is a path with label x **from some** state in Q_0 **to some** state in F.

Prove that this model still recognizes exactly the regular languages.

2. Read carefully the definition of acceptance of a string by a DFA (p. 40, Sipser). Then prove that a DFA M accepts ε (the empty string) iff its start state is final ($q_0 \in F$). (***Note the "iff".***)

3. From the text (Sipser) do:

(A) **p.84: #1.4(i)(j)(k)**;

(B) **p.84: #1.5(e)(f)**;

(C) **p.85: #1.10** [**Note.** Part (a) needs a general proof, while part (b) just needs an example, a so-called "counterexample". Choose as simple an example as you can for part (b). Part (a) does not need a proof by induction, but it DOES need a **careful** general proof, especially in view of the—perhaps unexpected—difference between parts (a) and (b).];

(D) **p.85: #1.12(b)**;

(E) **p.86: #1.14(c)** [the procedure of Lemma 1.29 **must** be used; do not give an unjustified direct answer];

(F) **p.86: #1.16(b)**[the procedure of Lemma 1.32 **must** be used; do not give an unjustified direct answer].

4. Let $\Sigma = \{0\}$. Which of the following languages over Σ is regular, and why?

An answer without proof is defined to be a "guess", and is discarded.

(a) $\{x : |xx| \text{ is odd}\}$

(b) $\{x : |x| \text{ is odd}\}$

(c) $\{x : |xx| \text{ is not a prime}\}$

(d) $\{x : |x| \text{ is not a prime}\}$

(e) $\{x : |x| \text{ is a perfect cube}\}$

5. For any string x over $\Sigma = \{0, 1\}$, let x^R mean its reversal (i.e., x^R reads right-to-left exactly as x does left-to-right).

Is $\{xwx^R : x \in \Sigma^+ \ \& \ w \in \Sigma^+\}$ regular?

Why "yes" or why "no(t)"? (**A proof is expected for either possible answer.**)