R. Inkulu

8. [21st Jan]

   (i) For Example 4.3 on pg 82 of [HU], complete the proof of the remaining five propositions which were not done in class.

   (iii) Give CFGs for [Sip] pg 155 exer 2.4(b) and 2.4(c). Prove these CFGs precisely define the respective languages of interest.

7. [16th Jan]

   (i) For the input string $0001\#0001$, write every possible ID, immediately after executing any of the transitions $\# \rightarrow \#, R$ by M_1 on pg 173 of [Sip].

   (ii) Draw the automata corresponding to each of the DTMs M_3 and M_4 described in [Sip] pg 174-175.

   (iii) [Sip] pg 188 exer 3.8(c).

   (iv) In the NTM given in class to generate all unary strings with alphabet 1, determine whether converting the last state (in the automata diagram) to a final state helps at all.

6. [15th Jan]

   (i) For accepting the language in Problem 5(ii)(d), give three machines: (a) an NFA, (b) a PDA, and (c) a TM.

5. [13th Jan]

   (i) [Sip] pg 86 exer 1.20. And, describe the language each of these regular expressions denote.

   (ii) Describe the languages corresponding to each of these regular expressions:
   (a) $(0 \cup 1)^*000(0 \cup 1)^*$, (b) $0 \cup 1^*0000 \cup 1^*$, (c) $(((00)^*(11)) \cup 01)^+$, and (d) $00^*(11) \cup 01^+$.

4. [9th Jan]

   (i) Draw the computation tree T that corresponds to determining whether $w : 001100$ belongs to $L(M_3)$, where M_3 is as defined on [Sip] pg 116. At the first node v along every branch of computation (resulted due to spawning a new thread) in T, mention the (a) execution context passed to v by its partent thread, and (b) the ID at v just after completing the computation at v.

   (ii) Determine whether M_1 on [Sip] pg 115 continues to accept the language $\{0^n1^n | n > 0\}$, after deleting states q_1 and q_4, and q_2 is made as the start state and F is set to $\{q_3\}$. (Deleting a node v' from a graph G, removes v' and all the arcs incident to v' from G.)

   (iii) Give PDAs for the following: [Sip] pg 155 exer 2.4(c), 2.4(e), 2.6(b), and $\{w | w$ is over $\Sigma = \{0, 1\}$ and the number of 1 that occur in w is equal to twice the number of 0s that occur in $w\}$

3. [8th Jan]

   (i) Give an example NFA M and an input string w over $\Sigma = \{0, 1\}$, so that the number of threads instantiated in processing M on w is not equal to the number of leaves in the corresponding computation tree. If this is not possible, give an argument for the same.

(ii) [Sip] pg 83 exer 1.4(f), pg 84 exer 1.6(j), 1.7(c).

(iii) [HU] pg 48 exer 2.4(c), 2.6.

2. [7th Jan]

   (i) Write a C program to output whether any input string with symbols from $\{0, 1, 2\}$ belong to $L(M_3)$, wherein DFA M_3 is as shown on [Sip] pg 38. Your program should use the transition function as given by M_3.

   (ii) What does each state of DFA M_4 on [Sip] pg 38 remembering?

   (iii) Give a formal argument to show every string not in $\{w \mid w \text{ has } 001 \text{ as a substring}\}$ is rejected by the DFA shown on [Sip] pg 44.

1. [2nd Jan]

   (i) Define formal languages, consisting of (a) strings that contain symbol 1 in every even position, and (b) strings that represent undirected graphs.

   (ii) Give at least two example combinatorial problems (not mentioned in class) for each of the following classes of problems: (a) computable, (b) uncomputable, (c) tractable, and (d) intractable.