CS 2802: Homework 10

May 3, 2020

Handed out May 4, due May 12. This is the last homework :-) It's slightly long, so I'm giving you until Tuesday at 5 PM to do it. But it must be handed in by then; you can't hand it in late.

- Re(read) Chapter 3 in MCS
- Do the following problems (the first four are from the Rosen handout, the rest from MCS):
  - 13.4, 3(a),(c),(d) ("yes" or "no" suffices here)
  - 13.4, 7(a),(b) (Just write down the regular expression.)
  - 13.4, 23
  - 13.4, 24
  - 3.25 (It's enough to say "equivalent" or "not equivalent" here.)
  - 3.26
  - 3.28
  - 3.32 (Provide a careful proof of (e)!)
  - 3.39
  - 3.42(a)
  - 3.44
  - Extra problem: In the class notes, given a DFA $M_A = (S_A, I, f_A, s_A, F_A)$, I described an automaton $M_{A^*} = (S_A \cup \{s_0\}, I, f_{A^*}, s_0, F_A \cup \{s_0\})$, where
    * s_0 is a new state, not in S_A;
    * $f_{A^*}(s,i) = \begin{cases} f_A(s,i) & \text{if } s \in S_A - F_A; \\ f_A(s,i) \cup f_A(s_A,i) & \text{if } s \in F_A; \\ f_A(s_A,i) & \text{if } s = s_0. \end{cases}$

    Prove carefully that M_{A*} accepts A^*. (Hint: induction helps for both directions of the proof.)

- Challenge problem (you don't have to hand this in): (Adapted from *What is the Name of This Book?*, by Raymond Smullyan.)

  Suppose that on an island there are three types of people: knights, knaves, and normals. Knights always tell the truth, knaves always lie, and normals sometimes lie and sometimes tell the truth. Detectives questioned three inhabitants of the island–Amy, Brenda, and Claire–as part of the investigation of a crime. The detectives knew that one of the three committed the crime, but not which one. They also knew that the criminal was a knight, and that the other two were not. Additionally, the detectives recorded these statements: Amy: I am innocent. Brenda: What Amy says is true. Claire: Brenda is not a normal. After analyzing their information, the detectives positively identified the guilty party.

  (a) Express all the information above using propositional logic.

  (b) Who is the guilty party? You have to provide an explanation for your conclusion, but you can do the reasoning in English, without writing it down in propositional logic. (You should be able to write it down using propositional logic though!)