Homework 0 – Due Friday, September 6, 2019 before noon

Submit your signed copy of the Collaboration and Honesty Policy as well as solutions to problems 1 and 2 on Gradescope.

Page limit You can submit **at most** 1 page per problem, even if the problem has multiple parts. If you submit a longer solution for some problem, only the first page will be graded. For each problem, specify your **name** and **collaborators** (or state "Collaborators: none") at the top of the sheet.

Exercises Please practice on exercises and solved problems in Sipser, Chapter 0 and odd-numbered exercises in Hammack, Chapters 1,2, 4–6 (solutions are provided on the book's web page). The material they cover may appear on exams.

Problems

0. (**0 points**) The following steps are required to get you started in the course.

   (a) Sign up on piazza at `www.piazza.com/bu/fall2019/cs332`.

   (b) Sign up as a student on Gradescope at `www.gradescope.com`, with course entry code **M4DG46**. Use your **BU email ID** to sign up on Gradescope.

   (c) Read and sign the Collaboration and Honesty Policy and submit it on Gradescope. We will be able to grade your homework only after you hand this in.

   (d) Check out the following links and resources:

      i. course webpage: `https://cs-people.bu.edu/sofya/cs332/`;

      ii. supplementary textbook to review proof techniques:
      Richard Hammack. *Book of Proof*: `http://www.people.vcu.edu/~rhammack/BookOfProof/`

      iii. practice with automata: `http://automatatutor.com/` and `http://jflap.org/`.

   (e) Fill the sample nameplate on the course webpage with your name, print it, and bring to every class.

1. (**Logic and sets review, 10 points**) Negate the following statements:

   (a) The first DFA has an even number of states, but the second DFA does not.

   (b) What doesn't kill you, makes you stronger.

   Write the contrapositive of the following statement:

   (c) Your homework assignment is not graded if you have not handed in a signed copy of the Collaboration policy.

   Answer the following questions about basic set operations:

   (d) If $A = \{x, y, z\}$ and $B = \{x, y\}$, what is $A \times B$? What is its size?

   (e) If $A = \{x, y, z\}$, what is the power set of A? What is its size?

2. (**Proof techniques review, 10 points**) Type (preferred) or write the answer to this problem on a single sheet of paper. Specify your **name, section** and **collaborators** (or state "Collaborators: none") at the top of the sheet.

   (a) (**Induction.**) Find the error in the following proof that all BU students have the same GPA. Indicate the **first sentence in the proof** that is incorrect. (There must be an incorrect statement in the proof, since the claim is wrong.)

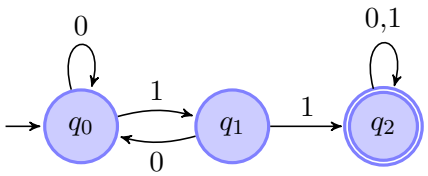
   CLAIM: In every set of n BU students, all students have the same GPA.

   PROOF: By induction on n.

   Base case: $n = 1$. In every set containing just one BU student, all students clearly have the same GPA.

   Induction step: For $k \geq 1$ assume that the claim holds for $n = k$ and prove that it holds for $n = k + 1$. Take any set S of $k + 1$ BU students. Remove one student from this set to obtain the set S_1 with k students. By the induction hypothesis, all students in S_1 have the same GPA. Now replace the removed student and remove a different one to obtain the set S_2. By the same argument, all students in S_2 have the same GPA. Therefore, all the students in S must have the same GPA.

   (b) (**Direct proof.**) Give a direct proof that the following automaton accepts an infinite number of strings.



   (c) (**Contradiction.**) Prove the same thing as in part (b) by contradiction.