Midterm Exam 1 Study Guide

CSE 30151 Spring 2020

Exam date: 2018/02/13

- The exam has six questions, worth 10 points each, for a total of 60 points (10% of your grade).
- You have the whole class period of 75 minutes to write your solutions.
- You may use your textbook and paper notes, but computers, smartphones, and tablets are **not** allowed.
- You may use the textbook, lectures, and lecture notes for this course without citation. However, you may **not** copy or quote from any other materials in your notes that you are not the author of.
- On the first page, please write your name and NetID, but please don't write any solutions. On the second page and following (front and back), please write your solutions, but please don't write your name.

The exam covers HW1 and HW2, as well as regular expressions (including converting to/from NFAs). The six questions will be of the following types. (Exercise/problem numbers are from the 3rd US edition of Sipser; if the 3rd international edition has a different number, it is indicated by "intl.")

- Design: Two out of three of the following types of questions.
  - Write a DFA that recognizes a given language (like HW2 Q1, HW3 Q2a, Exercise 1.4–6).
  - Write a NFA that recognizes a given language (like HW2 Q2a, HW3 Q2a, Exercise 1.7).
  - Write a regular expression that matches a given language (like Exercise 1.18).
- Construction: Two out of the following three types of questions.
  - Convert a NFA to a DFA (like HW2 Q2c, Exercise 1.16).
  - Convert a regular expression to a NFA (like Exercise 1.28).
  - Convert a NFA to a regular expression (like Exercise 1.21).
- Proofs: Two questions

- Show that regular languages are closed under some operation (like HW2 Q3, Exercise 1.31 (intl. 1.36), Problem 1.40a (intl. 1.45a), 1.44 (intl. 1.34), 1.66a (intl. 1.60a)).
- Show that two variations on finite automata are equivalent (like Exercise 1.11).
- Proving languages nonregular using the pumping lemma will **not** be on this exam.

Solutions to Selected Exercises

1.18 (a) $\mathtt{1}\Sigma^*\mathtt{0}$

(b) $\Sigma^*\mathtt{1}\Sigma^*\mathtt{1}\Sigma^*\mathtt{1}\Sigma^*$

(c) $\Sigma^*\mathtt{0101}\Sigma^*$

(d) $\Sigma\Sigma\mathtt{0}\Sigma^*$

(e) $(\mathtt{0} \cup \mathtt{1}\Sigma)(\Sigma\Sigma)^*$

(f) $\mathtt{0}^*(\mathtt{100}^*)^*\mathtt{1}^*$

(g) $(\Sigma \cup \varepsilon)(\Sigma \cup \varepsilon)(\Sigma \cup \varepsilon)(\Sigma \cup \varepsilon)(\Sigma \cup \varepsilon)$

(h) $\Sigma^*\mathtt{0}\Sigma^* \cup \varepsilon \cup \mathtt{1} \cup \mathtt{11111}^*$

(i) $(\mathtt{1}\Sigma)^*(\mathtt{1} \cup \varepsilon)$

(j) $\mathtt{0}^*(\mathtt{00} \cup \mathtt{100} \cup \mathtt{010} \cup \mathtt{001})\mathtt{0}^*$

(k) $\varepsilon \cup \mathtt{0}$

(l) $\mathtt{1}^*(\mathtt{01}^*\mathtt{01}^*)^* \cup \mathtt{0}^*\mathtt{10}^*\mathtt{10}^*$

(m) $\emptyset$

(n) $\Sigma\Sigma^*$