

Handout 1: Homework 1

Instructor: Susan Hohenberger

This assignment is due by the start of lecture on Monday, September 21. Please clearly indicate your collaborators.

1. (24 points) Show that the following languages are regular by giving FAs that exactly recognize them. For all languages, let $\Sigma = \{0, 1\}$.
 - (a) $A_1 = \emptyset^*$.
 - (b) $A_2 = \{0^i 10^j \mid i \equiv j \pmod{4}\}$.¹
 - (c) $A_3 = \{w \mid w \text{ contains an odd number of 0's and ends with a 1}\}$.
2. (16 points) For any two of the above languages, provide regular expressions exactly recognizing them. (Hint: consider using the algorithm for converting a DFA to a regular expression in Section 1.3.)
3. (30 points) Show that the following languages are not regular. For all languages, let $\Sigma = \{0, 1\}$.
 - (a) $A_4 = \{0^i 10^j \mid i = j\}$.
 - (b) $A_5 = \{0^i 10^j \mid i \neq j\}$.
 - (c) $A_6 = \{w \mid w \text{ contains a prime number of 0's and ends with a 1}\}$.
4. (10 points) Book, 1.31. [regular closure under reverse]
5. (10 points) Book, 2.20. [context-free and regular languages]
6. (10 points) Book, 2.19*. [understanding a CFG]

¹Note that this is written in unary, where $0^3 = 000$.