CS 334 Fall 2020: Problem Set 3.

Problem 1. (15 points) For each regular expression below, construct an equivalent NFA.

a. $(0 \cup 1)^* 000 (0 \cup 1)^*$
b. $\big(((00)^* 11) \cup 01\big)^*$
c. ϕ^*

Problem 2. (15 points) Give regular expressions to generate each language below:

a. $\{w \in \{a, b\}^* : w \text{ does not end } in\ ba\}$
b. $\{w \in \{0,1\}^* : w = \alpha \circ \beta,\ \alpha \text{ has an even number of } 1's \text{ and } \beta \text{ has an even number of } 0's\}$

Problem 3. (10 points) In some programming languages, comments appear between delimiters such as /# and #/. Let C be the language of all valid delimited comment strings. Each member of C must begin with /# and end with #/ but have no intervening #/. For simplicity, let the alphabet be {a, b, /, #}. Give a regular expression to describe C.

Problem 4. (15 points) Prove that the following languages are regular (your answer can be any one of: DFA/NFA/regular expression). Unless stated otherwise, $\Sigma = \{a, b\}$.

a. $\{w: w\ starts\ and\ ends\ with\ the\ same\ symbol\}$
b. Let $\Sigma = \{a, b, c, d\}$. The language L consists of all strings in which at least one symbol of Σ is missing.
c. $\{w : w \text{ has even length and an odd number of } a's\}$

Optional Problem 5. (10 points) Using regular expressions only (no NFA/DFA involved) prove that the reverse of every regular language is also regular.

Optional Problem 6. (20 points) For any language A, define $REMOVE(A)$ to be the language consisting of all strings in A but with exactly one symbol missing. Formally,

$$REMOVE(A) = \{\alpha\beta : \alpha y \beta \in A, y \in \Sigma, and\ \alpha, \beta \in \Sigma^*\}$$

Note: For convenience, removing a symbol from the empty string results in the empty string. Construct an NFA to show that if A is regular then so is $REMOVE(A)$. Next, prove this using regular expressions only.