

CSE 311: Foundations of Computing I

Section 8: RegEx, CFG, DFA, NFA

1. Regular Expressions

- (a) Write a regular expression that matches base 10 non-negative numbers.
(Note that there should be no leading zeroes.)
- (b) Write a regular expression that matches all binary strings that do not have any consecutive 0's or 1's.
- (c) Write a regular expression that matches all binary strings that contain the substring "111", but not the substring "000".

2. CFGs

Give CFGs for each of the following languages.

- (a) All binary strings that end in 00.
- (b) All binary strings that contain at least three 1's.
- (c) All binary strings with the same number of 1s and 0s.

3. DFAs

Construct DFAs to recognize each of the following languages.

- (a) All strings over the alphabet $\Sigma = \{0, 1, 2, 3\}$ that contain at least one 3 but no 2.
- (b) All strings over the alphabet $\Sigma = \{0, 1, 2, 3\}$ whose digits sum to an even number.
- (c) Binary strings that do not contain the substring 101.
- (d) Binary strings that contain an even number of 1s and odd number of 0's and do not contain the substring 10.

4. NFAs

Construct NFAs to recognize each of the following languages.

- (a) Binary strings ending in either 011 or 110.
- (b) Binary strings that have a 1 as one of the last three digits.

5. All the Machines!

Using the alphabet $\Sigma = \{0, 1, 2, 3, 4, 5\}$, define the language L as follows. If x is a string from Σ^* with characters x_0, \dots, x_n , then $x \in L$ iff: for every i between 0 and n , if x_i is an odd digit, then $x_k > x_i$ for every $k > i$. For example, if one of the digits is a 3, every digit after it must be a 4 or higher.

- (a) List 5 strings in L and 5 strings not in L .
- (b) Construct a regular expression, a DFA, and a CFG for the language L .