CSE 390Z: Mathematics for Computation Workshop

Week 9 Workshop

0. Constructing DFAs

For each of the following, construct a DFA for the specified language over the alphabet $\Sigma = \{a, b\}$.

(a) Strings with odd length.

(b) Strings with an even number of a's.

(c) Strings with an odd number of b's.

(d) Strings with an even number of a's **or** an odd number of b's.

1. Constructing DFAs 2

Let $\Sigma := \{0, 1, 2, 3, 4, 5\}$. For an arbitrary string x over Σ, we can write $x = x_0 x_1 \cdots x_n$, where $x_0, x_1, ..., x_n \in \Sigma$. Define a language L over Σ as follows:

$x \in L$ iff for every position i from 0 to n, if the value of x_i is odd, then every digit (character) that comes after x_i must be **greater** than x_i.

For example, the string $2124 \in L$ because 1 is the only odd digit and every digit after 1 is greater than 1.
The string $21254 \notin L$ because 5 is an odd digit, 4 comes after 5, and $4 < 5$.
The string $211 \notin L$ because 1 comes after 1 and $1 \not> 1$.

(a) List 3 strings in L and 3 strings not in L. The strings should be over the alphabet Σ.

(b) Construct a regular expression for the language L.

(c) Construct a CFG for the language L.

(d) Construct a DFA for the language L.

2. NFAs 1

(a) Construct an NFA for the language "all binary strings ending in either 011 or 110".

(b) **After you learn this on Wednesday:** Construct an equivalent DFA for the same language.

3. NFAs 2

(a) Construct an NFA for the language "all strings from the alphabet $\Sigma = \{0, 1, 2\}$ containing only 0's and 1's, and at most one 1".

For instance, the strings 0000, 0010, 1000, 0, 1, and ϵ should be accepted. The strings 0101, 2, 000020, 102000, 011, should be rejected.

(b) Construct an NFA for the language "all binary strings that have a 1 as one of the last three digits".