

CSE 390Z: Mathematics for Computation Workshop

Week 9 Workshop

0. Conceptual Review

(a) Regular expression rules:

Basis: ϵ , a for $a \in \Sigma$

Recursive: If A, B are regular expressions, $(A \cup B)$, AB , and A^* are regular expressions.

1. Regular Expressions Warmup

Consider the following Regular Expression (RegEx):

$$1(45 \cup 54)^*1$$

List 5 strings accepted by the RegEx and 5 strings from $T := \{1, 4, 5\}^*$ rejected by the RegEx. Then, summarize this RegEx in your own words.

2. Context Free Grammars Warmup

Consider the following CFG which generates strings from the language $V := \{0, 1, 2, 3, 4\}^*$

$$S \rightarrow 0X4$$

$$X \rightarrow 1X3 \mid 2$$

List 5 strings generated by the CFG and 5 strings from V not generated by the CFG. Then, summarize this CFG in your own words.

3. Constructing RegExs and CFGs

For each of the following, construct a regular expression and CFG for the specified language.

(a) Strings from the language $S := \{a\}^*$ with an even number of a 's.

(b) Strings from the language $S := \{a, b\}^*$ with an even number of a 's.

(c) Strings from the language $S := \{a, b\}^*$ with odd length.

(d) (Challenge) Strings from the language $S := \{a, b\}^*$ with an even number of a 's or an odd number of b 's.

4. Constructing DFAs

For each of the following, construct a DFA for the specified language.

(a) Strings of a 's and b 's with odd length ($\Sigma = \{a, b\}$).

(b) Strings with an even number of a 's ($\Sigma = \{a, b\}$).

(c) Strings with an odd number of b 's ($\Sigma = \{a, b\}$).

(d) Strings with an even number of a 's or an odd number of b 's ($\Sigma = \{a, b\}$).

5. Challenge: Constructing DFAs 2

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 3 strings in L and 3 strings from Σ^* not in L .

(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 .