CEN405
FORMAL LANGUAGES AND AUTOMATA THEORY
Spring2018

LAB 10: DFA, NFA, RegEx, CFG, PDA and TM Design using JFLAP

In this LAB you are given two executable JARs that you can use for designing various FAs, RegEx, CFG, PDA and TMs. Before starting you have to download the following this JAR:

- regexChecker.jar
- JFLAP.jar

You can run the **regexChecker.jar** program with the command

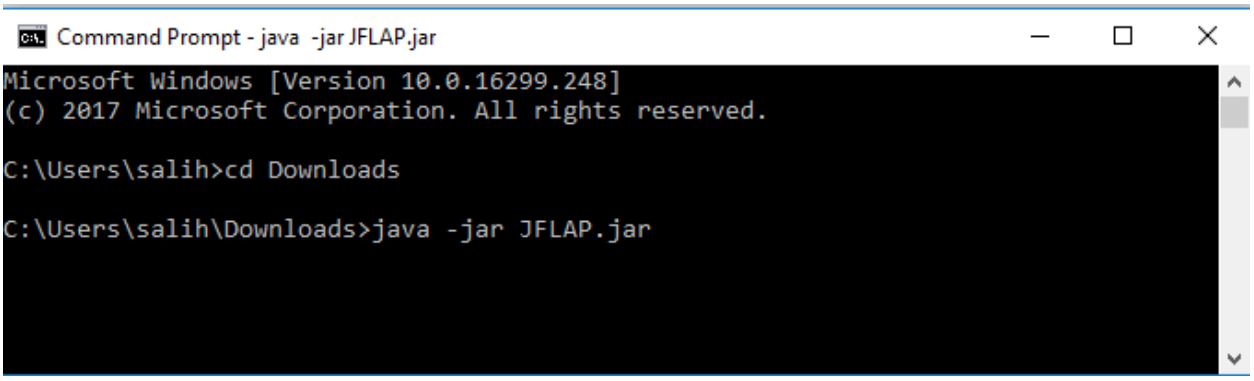
```
java -jar regexChecker.jar
```

The program allows you to type in a regular expression and then match it against some strings. For each string, the program will tell you whether or not the string matches the regular expression. A sample usage is given as follows:

You can run the **JFLAP.jar** program with the command

```
java -jar JFLAP.jar
```

A sample usage is given as follows:



Your Task

Design Turing Machines recognizing the following languages:

1) Give a DFA for $\Sigma = \{0, 1\}$ and strings that have an odd number of 1's and any number of 0's.

2) Give a DFA for $\Sigma = \{a, b\}$ that accepts any string with aababb as a substring.

3) Give an NFA for $\Sigma = \{0, 1\}$ and that accepts all binary strings that end with 101.

4) Give an NFA for RegEx: $a * | (ab) *$

5) Give an NFA for The language $\{w \in \Sigma* \mid$ w contains at least two 0s, or exactly two 1s $\}$ with six states.

6) Write regular expression (RegEx) that define the language L. L=All strings of 0's and 1's such that the third position from the right end is 1.

7) Write regular expression (RegEx) that define the language L. $\Sigma = \{a, b, c, A, B, C\}$. L=All strings of lower-case letters that are in sorted order.

8) Write CFG for the languages L_1, L_2, and L_3.

- $L_1 = \{a^i b^j c^k : i = k\}$
- $L_2 = \{a^i b^j c^k : i = j\}$
- $L_3 = \{a^i b^j c^k : i = j + k\}$

9) Design PDAs for the following languages:

- $L_1 = \{a^i b^j c^k : i = k\}$
- $L_2 = \{a^i b^j c^k : i = j\}$
- $L_3 = \{a^i b^j c^k : i = j + k\}$

10) Design a Turing Machine (TM) recognizing the following language:

$L = \{ a^i b^j c^k \mid i x j = k \text{ and } i, j, k >= 1\}$