DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

AUTOMATA THEORY & COMPUTABILITY – SELF–STUDY ACTIVITY & ASSIGNMENT

Instructions to Students

1. This activity is to be completed individually or in a team of maximum 2 members.
2. You are required to self-learn the JFLAP tool and use it to solve the assigned automata construction problems.
3. There are 3 sets of problems. You must solve and automate minimum 5 problems from each set (total at least 15 problems).
4. For every solved problem:
    - Construct the appropriate automaton in JFLAP (DFA/NFA/ε-NFA/CFG/PDA/TM as applicable).
    - Take a clear screenshot/printout of the automaton and test cases.
    - Ensure the design is correct, complete, and neatly presented.
5. Prepare a single consolidated report that includes:
    - Brief introduction to JFLAP
    - Method/procedure followed
    - Screenshots of all constructed automata
    - Output traces wherever required
    - Observations and learning outcomes
6. Submit the final report (PDF format) on Google Classroom before the deadline.
7. Zero tolerance for plagiarism.
   All work must be original. Copying from peers or online sources will result in strict action.
8. Viva-voce will be conducted after submission:
    - Students must carry their own laptop with JFLAP installed.
    - You should be able to demonstrate your work and make modifications on the spot.
    - Your understanding of both automata theory and JFLAP operations will be assessed.
9. Deadline for submission: 30/11/2025, 5:00 PM
   No late submissions will be accepted.
10. Evaluation will be based on:
    - Correctness and completeness of automata
    - Clarity and organization of report
    - Ability to use JFLAP effectively
    - Viva-voce performance
    - Originality of work

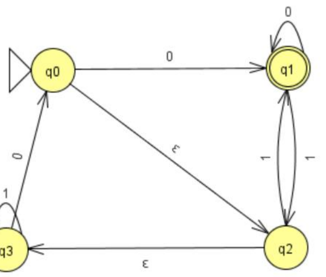
User Manual:

[JFLAP .pdf]

https://www.jflap.org/tutorial/

How to download and work with JFLAP: https://youtu.be/3SX43rZaBa4

Note: Students are required to select **any two activities from SET-1**, **any two from SET-2**, and **any one from SET-3** for completion.

	SET – 1: Construct the Automaton in JFLAP
1.	• Build a DFA for the following language L over the alphabet Σ = {a, b}. L = {w ∈ Σ ∗ |w has an even number of a's and an odd number of b's}. • Design a non deterministic PDA for accepting the language L = $\{a^n b^n \mid n>=1\}$ • Construct finite automata which accepts the languages defined by the following regular expressions $b(aab* \cup a^4)b * a$
2.	• Construct a DFA for $L = \{ab^n a^m : n \geq 2, m \geq 3\}$. • Construct nondeterministic pushdown automata (npda) that accept the following regular languages. (a) L1 = L(aaa∗ b) (b) L2 = L(abb∗aba∗) c) the union of L1 and L2 • Construct finite automata which accepts the languages defined by the following regular expressions $\emptyset*1* \cup (0\emptyset)*$
3.	• Draw a DFA for the language accepting strings ending with '0011' over input alphabets ∑ = {0, 1} • Construct npda's that accept the following languages on Σ = {a, b, c}. • $L = \{a^n b^{2n} : n \geq 0\}$ • Construct finite automata which accepts the languages defined by the following regular expressions $b(ab*ab* \cup a^3)b*a*$
4.	• Convert the following NFA to an equivalent DFA. • Construct npda's that accept the following languages on Σ = {a, b, c}. $L = \{a^n b^m c^{n+m} : n \geq 0, m \geq 0\}$ 

	• Construct finite automata which accepts the languages defined by the following regular expressions a∗ba∗ab∗
5.	• Construction of a minimal DFA accepting set of strings over {a, b} in which every 'a' is never be followed by 'bb'. • . Find an npda on $\Sigma = \{a, b, c\}$ that accepts the language $L = \{w_1cw_2 : w_1, w_2 \in \{a, b\}^*, w_1 != w^R{}_2\}$ • Construct finite automata which accepts the languages defined by the following regular expressions $b(aab^* \cup a^2)b^* ab^*$
6.	• Build a DFA for the following language L over the alphabet $\Sigma = \{a, b\}$. $L = \{w \in \Sigma^* \mid$ The number of a's in w is a multiple of 3} • Construct an npda corresponding to the grammar $S \rightarrow aABB \mid aAA$, $A \rightarrow aBB \mid a$, $B \rightarrow bBB \mid A$ • Construct finite automata which accepts the languages defined by the following regular expressions $b(ab^*ab^* \cup a^3)b^*a^*$
7.	• Construction of a minimal DFA accepting set of strings over {a, b} in which every 'a' is followed by a 'bb'. • Show that the language $L = \{ww : w \in \{a, b\}^*\}$ is not context-free. • Construct finite automata which accepts the languages defined by the following regular expressions a∗ba∗ab∗a*
8.	• Build a DFA for the following language L over the alphabet $\Sigma = \{a, b\}$. $L = \{w \in \Sigma^* \mid$w has an odd number of a's and an odd number of b's} • Design a non deterministic PDA for accepting the language $L = \{ww^R\ w \in (a, b)+\}$ • Construct finite automata which accepts the languages defined by the following regular expressions $(\varepsilon \cup 1)(1 \cup 0)^*01^*$
9.	• Draw a DFA for the language accepting strings ending with '01' over input alphabets $\sum = \{0, 1\}$ • Design a non deterministic PDA for accepting the language $L = \{a^m b^n c^m (m+n)\} \mid m,n \geq 1\}$ • Construct finite automata which accepts the languages defined by the following regular expressions $(aabb^*aab^*a)^* \cup (ba^*b)$
10.	• Draw a deterministic and non-deterministic finite automate which accept 00 and 11 at the end of a string containing 0, 1 in it, e.g., 01010100 but not 000111010. • Design a non deterministic PDA for accepting the language $L = \{ a^m b^n c^m \mid m, n>=1\}$ • Construct finite automata which accepts the languages defined by the following regular expressions $b(ab^*ab^* \cup a^3)b^*a^*$

11.	• Given the Alphabet {a,b,c} construct a DFA which accepts (a|b)*c • Design a non deterministic PDA for accepting the language $L = \{a^i b^j c^k d^l : i{==}k$ or $j{==}l, i{>=}1, j{>=}1\}$ • Construct finite automata which accepts the languages defined by the following regular expressions $\{w \mid w \in \{0, 1\}* \wedge$ w doesn't end in 01$\}$
	SET – 2: Construct the Automaton in JFLAP
12.	• Construct an NFA that accepts the language {ab, abc}*. This is the set of strings where ab and abc may be repeated. Example strings include abcab, ababcab, abcabcabc, and the empty string. • Design a non deterministic PDA for accepting the language $L = \{a^{2m}b^{3m} \mid m \geq 1\}$ • Construct finite automata which accepts the languages defined by the following regular expressions $\emptyset{*}1{*} \cup (0\emptyset){*}$
13.	• Draw a DFA for the language accepting strings ending with 'abb' over input alphabets $\sum = \{a, b\}$. • NPDA for accepting the language $L = \{a^m b^{2m} \mid m{>=}1\}$ • Construct finite automata which accepts the languages defined by the following regular expressions ab (ba)∗ ∪ bbb ∗ ∪ a ∗ b
14.	• Draw a DFA for the language accepting strings ending with 'abba' over input alphabets $\sum = \{a, b\}$ • Construct pushdown automata for the following languages. Acceptance either by empty stack or by final state. $\{ a^n b^m a^n \mid m, n \in N \}$ • Construct finite automata which accepts the languages defined by the following regular expressions (ε ∪ 1)(1 ∪ 0)∗01∗
15.	• Draw a deterministic and non-deterministic finite automata which accept a string containing "the" anywhere in a string of {a-z}, e.g., "there" but not "those". • NPDA for $L = \{0^i1^j2^k \mid i{==}j$ or $j{==}k ; i , j , k >= 1\}$ • Construct finite automata which accepts the languages defined by the following regular expressions ab (ba)∗ ∪ babba ∗ ∪ a ∗ ba
16.	• Draw a deterministic and non-deterministic finite automata which accept a string containing "ing" at the end of a string in a string of {a-z}, e.g., "anything" but not "anywhere". • Construct pushdown automata for the following languages. Acceptance either by empty stack or by final state $\{ a^n b^m c^m \mid m, n \in N \}$ • Construct finite automata which accepts the languages defined by the following regular expressions b∗a(b+ab∗a)∗

17.	• Construction of a minimal NFA accepting a set of strings over {a, b} in which each string of the language starts with 'ab'. • Construct pushdown automata for the following languages. Acceptance either by empty stack or by final state. $\{a^i b^j c^k \mid i, j, k \in N, i + j = k\}$ • Construct finite automata which accepts the languages defined by the following regular expressions $a(aa \cup ab)*$
18.	• Construction of a minimal NFA accepting a set of strings over {a, b} in which each string of the language contain 'a' as the substring. • NPDA for accepting the language $L = \{a^n b^m \mid n,m \geq 1 \text{ and } n \neq m\}$ • Construct finite automata which accepts the languages defined by the following regular expressions $ab\ (ba)* \cup bbb * \cup a * b$
19.	• Construction of a minimal NFA accepting a set of strings over {a, b} in which each string of the language is not containing 'a' as the substring. • Construct pushdown automata for the following languages. Acceptance either by empty stack or by final state. $\{ a^n b^{m-n} a^n \mid m, n \in N \}$ • Construct finite automata which accepts the languages defined by the following regular expressions $(b^+a(b \cup ab*a))* (ab* \cup b+a(\varepsilon \cup ab*)$
20.	• Construction of a minimal DFA accepting set of strings over {a, b} in which every 'a' is followed by a 'b'. • Construct Pushdown automata for $L = \{0^n 1^m 2^m 3^n \mid m,n \geq 0\}$ • Construct finite automata which accepts the languages defined by the following regular expressions $(a \cup baa)*b(a \cup \varepsilon)$
21.	• Construction of a minimal DFA accepting set of strings over {a, b} in which every 'a' is never be followed by 'b' • Construct pushdown automata for the following languages. Acceptance either by empty stack or by final state. $\{a^n b^m \mid n \leq m \leq 2n \}$ • Construct finite automata which accepts the languages defined by the following regular expressions i) $b*a$ (ii) $b*a(a \cup b)*$
22.	• Construction of a minimal DFA accepting set of strings over {a, b} in which anbm, where n and m is greater than or equal to 1. • Construct pushdown automata for the following languages. Acceptance either by empty stack or by final state. $\{a^i b^j c^k \mid i, j, k \in N, i > j\}$ • Construct finite automata which accepts the languages defined by the following regular expressions
23.	• Construction of a minimal NFA accepting a set of strings over {a, b} in which each string of the language is not starting with 'ab'.

	• Construct Pushdown automata for $L = \{0^n1^m2^m3^n \mid m,n \geq 0\}$ • Construct finite automata which accepts the languages defined by the following regular expressions $ab(bba)* \cup bbab * \cup a * bba$
SET – 3: Construct the Turing Machines in JFLAP	
24.	Design a Turing Machine to accept the language $L=\{ 0^n1^n \mid n \geq 1 \}$.
25.	Design a Turing Machine to accept the language $L=\{0^n 1^n 2^n \mid n \geq 1\}$.
26.	Construct a Turing Machine to accept the language L={ w |w €(0+1)* } Containing the substring 001.
27.	Construct a Turing Machine to accept the language L={ w |w €(0+1)* } ending with 001.
28.	Construct the Turing machine to accept the language L={ w| w is even and ∑={a, b}.
29.	Design a Turing machine to accept a palindrome consisting of a's and b's of any length.
30.	Construct a TM to accept the language $L=\{ww^R \mid w€(a+b)^*\}$.