Cairo University
Faculty of Computers & Artificial Intelligence
Theory of Computations

Assignment 2 (DFA & NFA)

Instructions

- The assignment is submitted in groups of **minimum 2 and maximum 4** students from the **same lab** or the **same TA**.

- The Deadline for submission is on **Tuesday 23/4 at 11:59 pm.**

- Submission will be on Google Classroom. No late submission, or through e-mail submission is allowed.

- Please submit one compressed folder with the **.java files and pdf file**. The folder name should follow this structure: ID1_ID2_ID3_ID4_GROUP.zip

- In case of Cheating, you will get a negative grade whether you give the code to someone, take the code from someone/internet, or even send it to someone for any reason.

Requirements

- Solve all the 10 problems.

- For each problem, you should submit the **drawn FSA** and **Java code** that solves it.

- For all problems write in **Java Language**.

- Submit a **pdf file** that contains the drawn DFA or NFA for the problems.

- The Java program will take **ONE** input text file containing the input values for each problem, the program must save the output of each problem in **ONE** output text file following the required format for each problem.

Input file:

Starts with the number of the problem, followed by the input values for the problem, then "end" to indicate the input for this problem is finished and to move to the next problem.

Output file:

Starts with the number of the problem, followed by the corresponding output values of the input for the problem, then "x" to indicate the output for this problem is finished and to move to the next problem.
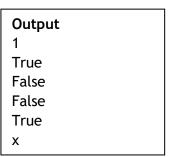
DFA

Simulate a Deterministic Finite Automaton:

- The DFA's states

- The alphabet

- The transition function

- The start state

- The set of accepting states

Problem 1

Design a DFA that accepts all strings which do not contain the substring ba over {a, b}
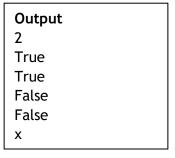
```
Input
1
ab
ba
aba
bbb
end
```

```
Output
1
True
False
False
True
x
```

Problem 2

Design a DFA that accepts all strings that contains even number of 0's followed by single 1 over {0, 1}

```
Input
2
1
001
00
0011
end
```

```
Output
2
True
True
False
False
x
```

Problem 3

Design a DFA that accepts all strings that contain odd number of x's over {x, y}.

Input	Output
Input	**Output**
3	3
x	True
xyxyxyy	True
yyy	False
yxxxy	True
end	x

Problem 4

Design a DFA that accepts strings starting and ending with the same characters over {a,b}.

Input	Output
Input	**Output**
4	4
aa	True
bab	True
baaabab	True
aaab	False
end	x

Problem 5

Design a DFA that accepts all the strings that binary integers divisible by 4 over {0,1}.

Input	Output
Input	**Output**
5	5
0	True
10000	True
100	True
101	False
end	x

Problem 6

Construct an DFA that accepts all strings {W | W is any string except 11 and 111}

Input
6
1000
101
0000
111
end

Output
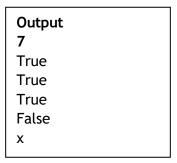**6**
True
True
True
False
x

NFA

Simulate a Nondeterministic Finite Automaton (NFA):
- The NFA's states
- The alphabet
- The transition function.
- The start state(s)
- The set of accepting states

Problem 7

Construct an NFA that accepts all strings over the alphabet {0, 1} containing an equal number of occurrences of '01' and '10'.
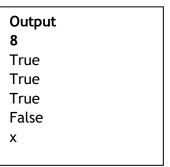
Input
7
010110
1001
0101010101010
101010
end

Output
7
True
True
True
False
x

Problem 8

Design an NFA that accepts all strings over the alphabet {0, 1} that contain the substring "101" or "010".

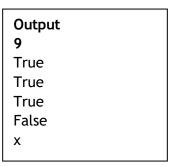| Input	Output
8	**8**
101010	True
001010	True
010	True
1001	False
end	x

Problem 9

Design an NFA that accepts all strings over the alphabet {0, 1} where no two consecutive characters are the same.

Input	Output
9	**9**
01	True
10	True
010101010101	True
000	False
end	x

Problem 10

Design an NFA that recognizes strings over the alphabet {0, 1} where every '0' is followed by at least one '1'.

Input	Output
10	**10**
1	True
010111	True
010101111	True
010	False
End	x