Theory of Computing
Finite Automata : DFA

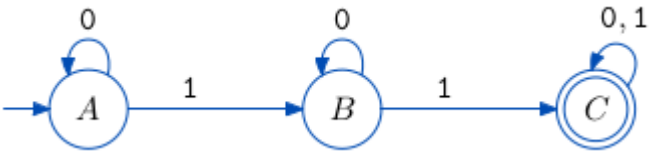
TD 2

2ND YEAR - ENSIA

PRE-TUTORIAL EXERCISE

For the following FA, determine which of the following strings/words are accepted.

1. 0110
2. 1
3. 1011010
4. 00000
5. 010001
6. Empty string
7. 0



EXERCISES

Exercise C1 :

1. For the alphabet {0, 1}, give DFAs for each language:
    a. All strings containing at least two 0s
    b. All strings containing exactly two 0s
    c. All strings containing 00 as substring
    d. All strings containing 00 as substring exactly once

Exercise C2 :

Give state diagrams of DFAs recognizing the following languages. In all parts, the alphabet is {0,1}.

1. {w| w begins with a 1 and ends with a 0}
2. {w| w contains at least three 1s}
3. {w| w contains the substring 0101 (i.e., w = x0101y for some x and y)}
4. {w| w has length at least 3 and its third symbol is a 0}
5. {w| w starts with 0 and has odd length, or starts with 1 and has even length}

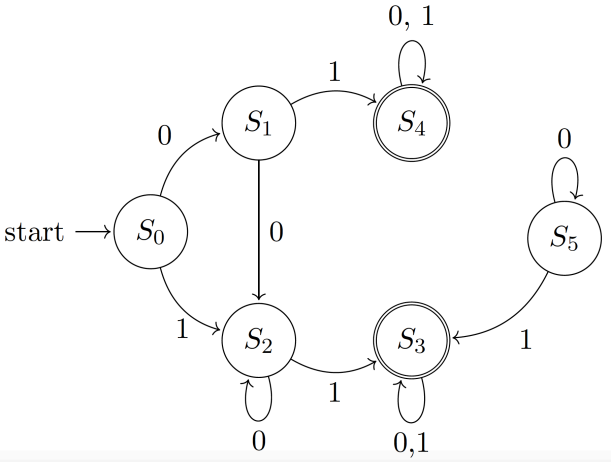
Exercise C3 :

Each of the following languages is the complement of a simpler language. In each part, construct a DFA for the simpler language, then use it to give the state diagram of a DFA for the language given. In all parts, Σ = {a, b}.

1. {w| w does not contain the substring ab}
2. {w| w does not contain the substring baba}
3. {w| w contains neither the substrings ab nor ba}
4. {w| w is any string not in a* ∪ b* } (∪ is the union)

Exercise A1 (Assignment due : Friday 16 Feb 2024 Via Google Classroom) :

1. Find a DFA for the following languages over the alphabet Σ={0, 1} :
    a. L = {w | w is a binary string that is multiple of 3}. (i.e.the binary number when converted to decimal, it is multiple of 3).
    b. L = {w | w contains an even number of zeroes **and** an odd number of ones}.
2. Minimize the following DFA defined over the alphabet Σ={0, 1}.



Exercise P1 (Optional) :

Give the state diagrams of DFAs recognizing the following languages. In all parts, the alphabet is {0,1}.

1. {w| w doesn't contain the substring 110}
2. {w| the length of w is at most 5}
3. {w| w is any string except 11 and 111}

Exercise P2 (Optional) :

Each of the following languages is the complement of a simpler language. In each part, construct a DFA for the simpler language, then use it to give the state diagram of a DFA for the language given. In all parts, Σ = {a, b}.

1. {w| w is any string that doesn't contain exactly two a's}
2. {w| w is any string except a and b}

Exercise P3 (Optional):

1. Give state diagrams of DFAs recognizing the following languages. In all parts, the alphabet is {0,1}.
   a. {w| every odd position of w is a 1}
   b. {w| w contains at least two 0s and at most one 1}
   c. {ε, 0}
   d. {w| w contains an even number of 0s, or contains exactly two 1s}
   e. The empty set
   f. All strings except the empty string

Exercise P4 (Optional):

Let D = {w| w contains an even number of a's and an odd number of b's and does not contain the substring ab}. Give a DFA with five states that recognizes D. (Suggestion: Describe D more simply.)

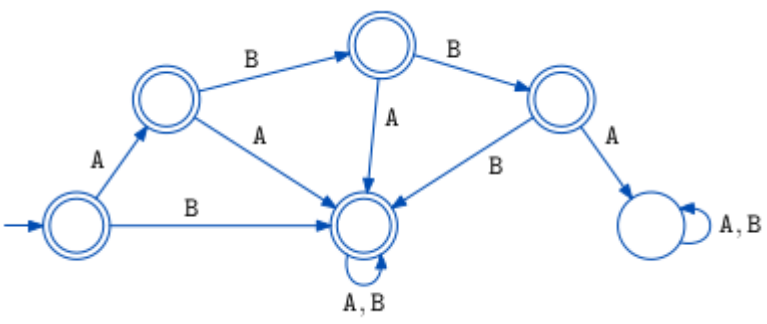
Exercise P5 (Optional):

Draw a deterministic FA for the set of all binary strings with the property that: they contain exactly two blocks of 1's and both these blocks have odd length.
For example, 1010 and 01001110000 should be accepted, but not 00110001 or 10101.

Exercise P6 (Optional)

Determine the language of each of the following FAs:

1.



2.

3.