Assignment 1

Regular Expressions

- Find a regular expression to describe each of the following **five** languages.

$\{\Lambda, a, abb, abbbb, \ldots, ab^{2n}, \ldots\}$.
$\{\Lambda, a, b, c, aa, bb, cc, \ldots, a^n, b^n, c^n, \ldots\}$.
$\{\Lambda, a, b, ca, bc, cca, bcc, \ldots, c^n a, bc^n, \ldots\}$.
$\{a^{2k} \mid k \in \mathbb{N}\} \cup \{b^{2k+1} \mid k \in \mathbb{N}\}$.
$\{a^m b c^n \mid m, n \in \mathbb{N}\}$.

- Find a regular expression over the alphabet (0, **1)** to describe the set of all binary numerals without leading zeros (except 0 itself). So the language is the set (0, 1, 10, 11, 100, 101, 110, 111, **...).**
- Find a regular expression for each of the following languages over the alphabet (a,**b).**
    a. Strings with even length (empty string is included).
    b. Strings whose length is a multiple of 3.
    c. Strings in which the letter b is never tripled. This means that no word contains the substring bbb.
    d. Strings with an odd number of a's and an odd number of b's.
- Describe in English phrases the languages associated with the following regular expression:
    - a*b(a*ba*b)*a*
    - ((a + b)3)*(Λ + a + b) .
    - (b + ab)*(a + ab)
- Construct a regular expression defining each of the following languages over the alphabet {a b}:
    - All strings in which the total number of a's is divisible by 3 no matter how they are distributed, such as aabaabbaba.

- Describe (in English phrases) the languages associated with the following regular expressions:
    - (a + b)*a(A + bbbb)
    - (a(a + bb)*)*
    - (a(aa)*b(bb)*)*
    - (b(bb)*)*(a(aa)*b(bb)*)*
    - (b(bb)*)*(a(aa)*b(bb)*)*(a(aa)*)*
    - ((a + b)a)*

- Show that the following pairs of regular expressions define the same language over the alphabet {a,b}

- (ab)*a and a(ba)*
- (a* + b)* and (a + b)*
- (a* + b*)* and and (a + b)*.
- (a*bbb)*a* and a*(bbba*)*

Finite Automata

DFA

- Transform each of the following regular expressions into a DFA.
  - a*b*.
  - ***(a+** b)*.
  - *a** **+***b**.*
- Design a DFA that accepts all strings over {a, b}
  - All strings that do not end with aa.
  - All strings that contain an even number of b's
  - All strings which do not contain the substring ba

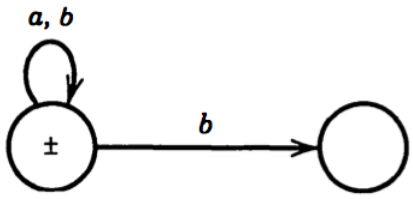
NFA

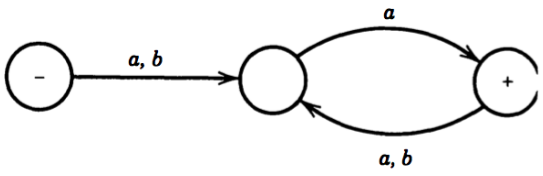
Draw NFA for each of the following languages over the alphabet {a,b}

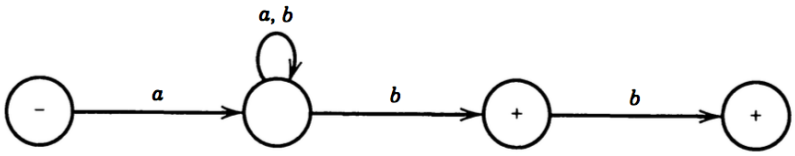
- All strings that contain two a's separated by a substring whose length is a multiple of 3.
- All strings that contain an even number of b's.
- All strings which do not contain the substring ba.

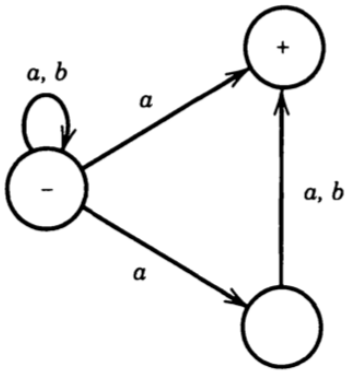
NFA to DFA

Convert the following NFA to DFA









Submission :

- Deadline is Thursday 30-March @11:59PM through google form:

  https://forms.gle/EgioAcPQRYLxNKa9A

- Write your answers in clean format, then scan your answer and upload to google form.
- The assignment is a group of 2, belonging to the same TA.
- Only one member of your team will submit the assignment.
- Both Team members must show up for assignment discussion.
- Cheating could get zero in the assignment.