Assignment 05 | Advance Algorithms CE-092

Assignment submission for Advance Algorithms subject week 5.

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Task 1:

Implement finite automata based string matching algorithm.

Code:

1. **CPP Implementation**

```
/*
* @Author: nevil
* @Date:   2020-08-07 15:51:28
* @Last Modified by:   nevil
* @Last Modified time: 2020-08-19 02:25:36
*/

/*
finite automata based string matching algorithm.
It creates the table and checks for the matching string
in the text on its own.
*/

#include <bits/stdc++.h>
using namespace std;
#define NO_OF_CHARS 256
```

```
int getNextState(string pat, int M, int state, int x)
{
    if (state < M && x == pat[state])
        return state + 1;

    int ns, i;

    for (ns = state; ns > 0; ns--)
    {
        if (pat[ns - 1] == x)
        {
            for (i = 0; i < ns - 1; i++)
                if (pat[i] != pat[state - ns + 1 + i])
                    break;
            if (i == ns - 1)
                return ns;
        }
    }

    return 0;
}

void computeTF(string pat, int M, int
TF[][NO_OF_CHARS])
{
    int state, x;
    for (state = 0; state <= M; ++state)
        for (x = 0; x < NO_OF_CHARS; ++x)
            TF[state][x] = getNextState(pat, M, state,
x);
}
```

```
void search(string pat, string txt)
{
    int M = pat.size();
    int N = txt.size();

    int TF[M + 1][NO_OF_CHARS];

    computeTF(pat, M, TF);
    bool found = false;
    int i, state = 0;
    for (i = 0; i < N; i++)
    {
        state = TF[state][txt[i]];
        if (state == M)
        {
            found = true;
            cout << " Pattern found at index " << i - M
+ 1 << endl;
        }
    }

    if(!found)
        cout << "Pattern Not Found" << endl;
}

int main()
{
    string txt, pat;
    cout << "Enter Text : ";
    cin >> txt;

    cout << "Enter your pattern to be searched :";
    cin >> pat;

    search(pat, txt);
    return 0;
}
```

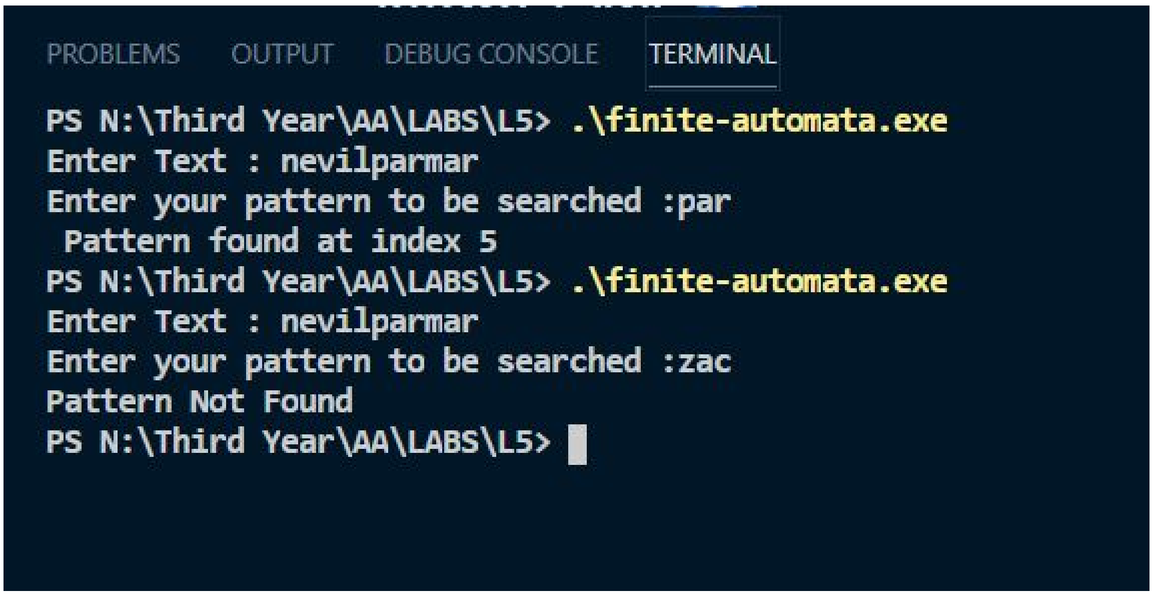
2. Python 3 Implementation

```
# -*- coding: utf-8 -*-
# @Author: nevil
# @Date:   2020-08-07 15:49:25
# @Last Modified by:   nevil
# @Last Modified time: 2020-08-07 15:49:40



# Python program for Finite Automata
# Pattern searching Algorithm

numChars = 256

def nextForm(PATTERN, M, state, x):

    if state < M and x == ord(PATTERN[state]):
        return state+1

    i=0

    for nosaj in range(state,0,-1):
        if ord(PATTERN[nosaj-1]) == x:
            while(i<nosaj-1):
                if PATTERN[i] !=
PATTERN[state-nosaj+1+i]:
```

```
                    break
                i+=1
            if i == nosaj-1:
                return nosaj
    return 0

def MakeAutomata(PATTERN, M):

    global numChars

    TF = [[0 for i in range(numChars)]\
           for _ in range(M+1)]

    for state in range(M+1):
        for x in range(numChars):
            z = nextForm(PATTERN, M, state, x)
            TF[state][x] = z

    return TF

def search(PATTERN, TEXT):
    strout = ""
    global numChars
    M = len(PATTERN)
    N = len(TEXT)
    TF = MakeAutomata(PATTERN, M)

    state=0
    for i in range(N):
        state = TF[state][ord(TEXT[i])]
        if state == M:
            strout += str(i-M+1)
```

```python
            strout += " "
    return strout

def main():
    with open("input.txt", "r") as ins:
        array = []
        for line in ins:
            array.append(line.strip('\n'))

    file = open("output.txt","w")
    TEXT = array[1]
    PATTERN = array[0]
    reverseTXT = TEXT[::-1]
    file.write(str(search(PATTERN, TEXT)))
    file.write(str(search(PATTERN, reverseTXT)))
    file.write('\n')

    ins.close()
    file.close()

if __name__ == '__main__':
    main()
```

Output:



```
PS N:\Third Year\AA\LABS\L5> .\finite-automata.exe
Enter Text : nevilparmar
Enter your pattern to be searched :par
 Pattern found at index 5
PS N:\Third Year\AA\LABS\L5> .\finite-automata.exe
Enter Text : nevilparmar
Enter your pattern to be searched :zac
Pattern Not Found
PS N:\Third Year\AA\LABS\L5>
```

Complexity :

In a Finite Automata based string matching algorithm, the pattern need to be pre-processed and a state table (2-D array) is to be generated for the finite automata and then each character in the text is mapped with the corresponding state in the state table and the next state is determined. Finally, if we reach the accepting state in the state table, it means we have found the required pattern.
Hence the searching time complexity for the average case will be O(n).

Comparison :

Algorithms	Time complexity (Average case)
Naive string matching	O(m*n)
Horsepool's algorithm	O(n)
Rabin Karp's algorithm	O(m+n)
Finite Automata based algorithm	O(n)