Institute of Engineering & Management
Department of Computer Science & Engineering
Design & Analysis of Algorithm Lab for 3rd year 5th semester 2018
Code: CS 591

Date: 29/08/18

WEEK-3

Assignment-1

Problem Statement: KMP String Matching: Given a text txt[0..n-1] and a pattern pat[0..m-1], write a function search(char pat[], char txt[]) that prints all occurrences of pat[] in txt[]. You may assume that n > m.

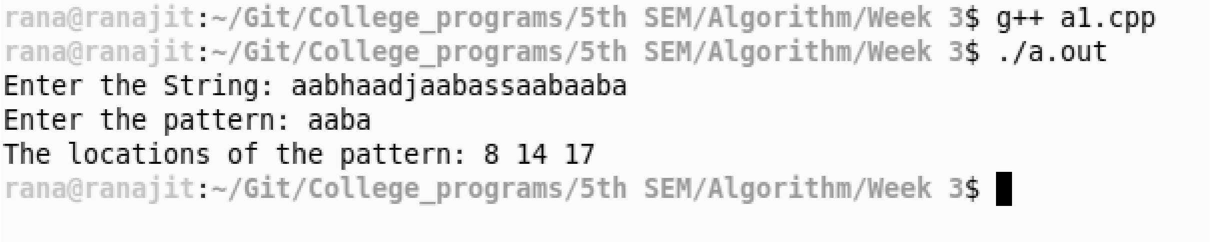
Algorithm:

Source code:

```
#include <iostream>
#include <vector>

void preprocess(std::string &pat, std::vector<int> &vect)
{
  vect[0]=0;
  int i=1, j=0, n = pat.length();
  while(n>i)
  {
        if(pat[j] == pat[i])
        {
              vect[i] = j+1;
              i++; j++;
        }
        else{
              if(j>0)
                    j = vect[j-1];
              else{
                    vect[i] = 0;
                    i++;
              }
        }
  }
}

void kmp(std::string &str, std::string &pat)
{
  int i=0, j=0, n=str.length();
  std::vector<int> lps(pat.length(), 0);
  preprocess(pat, lps);
  std::cout<<"The locations of the pattern: ";
  while(i<n)
  {
        if(pat[j] == str[i])
        {
              if(j == pat.length()-1)
              {
                    std::cout<<i-pat.length()+1<<" ";
                    j = lps[j];
                    i++;
              }
              else{
                    i++; j++;
              }
        }
        else
        {
              if(j == 0)
                    i++;
              else{
                    j = lps[j-1];
              }
        }
  }
  std::cout<<std::endl;
}

int main()
{
  std::string str, pat;
```

```
    std::cout<<"Enter the String: ";
    std::cin>>str;
    std::cout<<"Enter the pattern: ";
    std::cin>>pat;
    kmp(str, pat);
}
```

Screen-Shot:



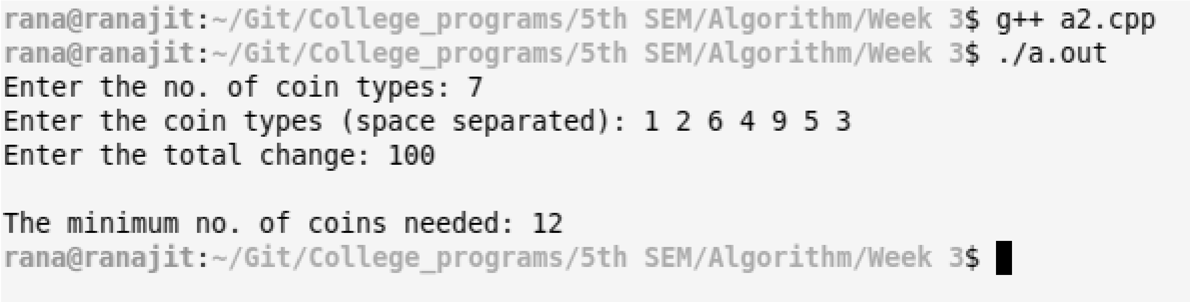
```
rana@ranajit:~/Git/College_programs/5th SEM/Algorithm/Week 3$ g++ a1.cpp
rana@ranajit:~/Git/College_programs/5th SEM/Algorithm/Week 3$ ./a.out
Enter the String: aabhaadjaabassaabaaba
Enter the pattern: aaba
The locations of the pattern: 8 14 17
rana@ranajit:~/Git/College_programs/5th SEM/Algorithm/Week 3$ 
```

Time Complexity:

Source code:

```
#include <iostream>
#include <vector>

int main()
{
    int n, coin_no;
    std::cout<<"Enter the no. of coin types: ";
    std::cin>>coin_no;
    std::vector<int> coins(coin_no);
    std::cout<<"Enter the coin types (space separated): ";
    for(auto &i: coins)
          std::cin>>i;
    std::cout<<"Enter the total change: ";
    std::cin>>n;
    std::vector<int> mem(n+1, 0);
    for(int i=1;i<=n;i++)
    {
          int minimum = (i<coins[0])? i : mem[i-coins[0]];
          for(int j=1;j<coin_no;j++)
                minimum = std::min(minimum, ((i<coins[j])? i : mem[i-
                                                          coins[j]]));
          mem[i] = minimum+1;
    }
    std::cout<<"\nThe minimum no. of coins needed: "<<mem[n]<<std::endl;
}
```

Screen-Shot:



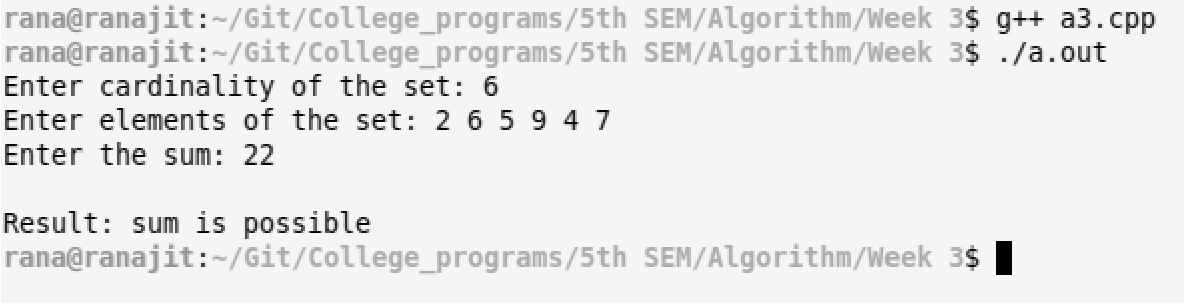
```
rana@ranajit:~/Git/College_programs/5th SEM/Algorithm/Week 3$ g++ a2.cpp
rana@ranajit:~/Git/College_programs/5th SEM/Algorithm/Week 3$ ./a.out
Enter the no. of coin types: 7
Enter the coin types (space separated): 1 2 6 4 9 5 3
Enter the total change: 100

The minimum no. of coins needed: 12
rana@ranajit:~/Git/College_programs/5th SEM/Algorithm/Week 3$ 
```

Time Complexity:

Source code:

```
#include <iostream>
#include <vector>

int main()
{
  int n, card;
  std::cout<<"Enter cardinality of the set: ";
  std::cin>>card;
  std::vector<int> set(card);
  std::cout<<"Enter elements of the set: ";
  for(auto &i: set)
        std::cin>>i;
  std::cout<<"Enter the sum: ";
  std::cin>>n;
  std::vector<std::vector<bool>> mem(n+1, std::vector<bool>(card+1));
  for(auto &i: mem)
        i[0] = false;
  mem[0] = std::vector<bool>(card+1, true);
  for(int i=1;i<=n;i++)
  {
        for(int j=1;j<=card;j++)
        {
              mem[i][j] = mem[i][j-1]
                    || ((i<set[j-1])? false : mem[i-set[j-1]][j-1]);
        }
  }
  std::cout<<"\nResult: ";
  if(mem[n][card]==true)
        std::cout<<"sum is possible"<<std::endl;
  else std::cout<<"sum is not possible"<<std::endl;
}
```

Screen-Shot:



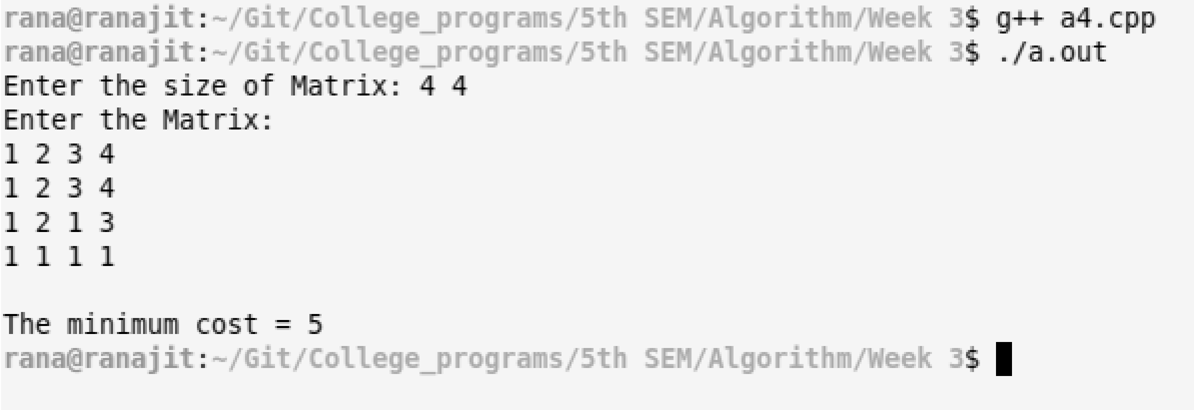
```
rana@ranajit:~/Git/College_programs/5th SEM/Algorithm/Week 3$ g++ a3.cpp
rana@ranajit:~/Git/College_programs/5th SEM/Algorithm/Week 3$ ./a.out
Enter cardinality of the set: 6
Enter elements of the set: 2 6 5 9 4 7
Enter the sum: 22

Result: sum is possible
rana@ranajit:~/Git/College_programs/5th SEM/Algorithm/Week 3$ 
```

Time Complexity:

Source code:

```
#include <iostream>
#include <vector>

int main()
{
  int m, n, minimum;
  std::cout<<"Enter the size of Matrix: ";
  std::cin>>m>>n;
  std::vector<std::vector<int>> matrix(m, std::vector<int>(n));
  std::cout<<"Enter the Matrix:"<<std::endl;
  for(auto &i: matrix)
        for(auto &j: i)
              std::cin>>j;
  for(int i=0;i<m;i++)
        for(int j=0;j<n;j++)
        {
              if(i == 0)
              {
                    if(j == 0)
                          minimum = 0;
                    else minimum = matrix[i][j-1];
              }
              else{
                    if(j == 0)
                          minimum = matrix[i-1][j];
                    else minimum = std::min(matrix[i-1][j-1],
                                std::min(matrix[i][j-1],matrix[i-1][j]));
              }
              matrix[i][j] += minimum;
        }
  std::cout<<"\nThe minimum cost = "<<matrix[m-1][n-1]<<std::endl;
}
```

Screen-Shot:



```
rana@ranajit:~/Git/College_programs/5th SEM/Algorithm/Week 3$ g++ a4.cpp
rana@ranajit:~/Git/College_programs/5th SEM/Algorithm/Week 3$ ./a.out
Enter the size of Matrix: 4 4
Enter the Matrix:
1 2 3 4
1 2 3 4
1 2 1 3
1 1 1 1

The minimum cost = 5
rana@ranajit:~/Git/College_programs/5th SEM/Algorithm/Week 3$ 
```

Time Complexity: