I. Write C/C++ programs to implement the following algorithm using Backtracking technique.
i) Subset Sum

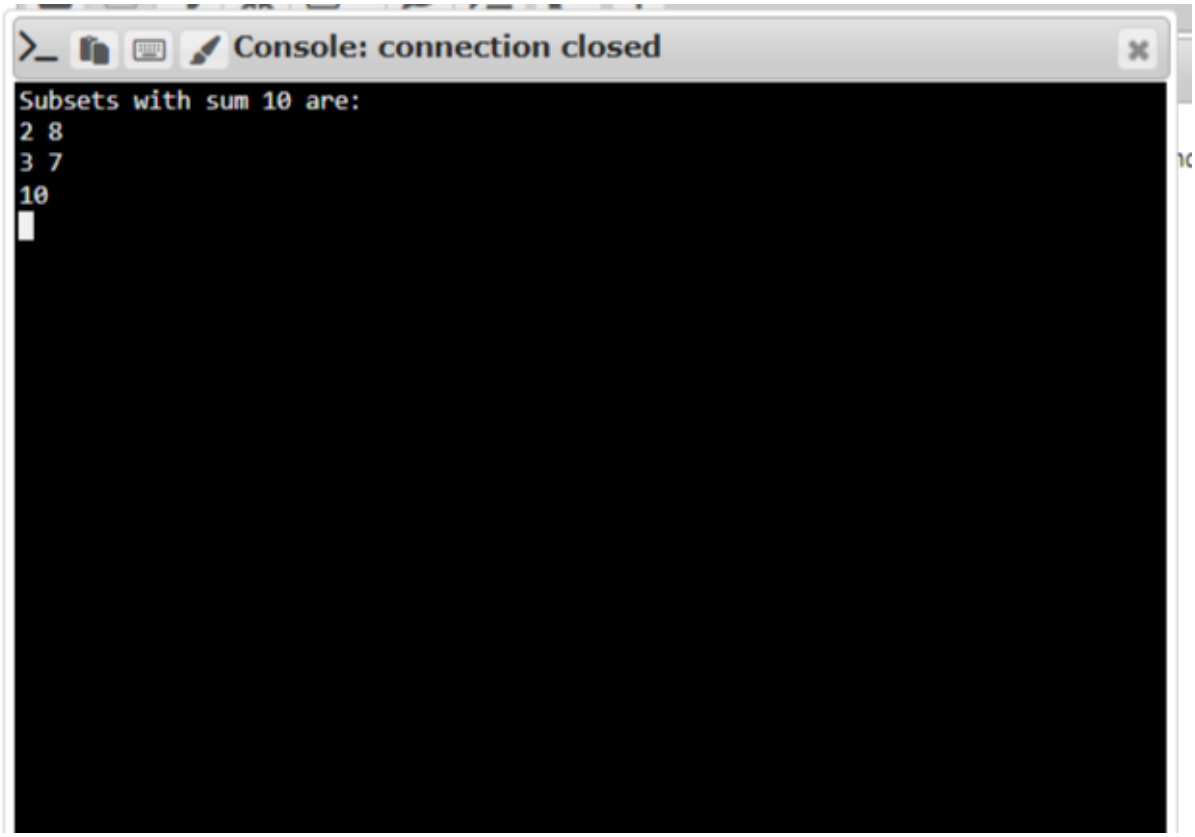
1.

Code:

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

using namespace std;

void subsetSum(vector<int>& nums, int target, vector<int>& subset, int index) {
   if (target == 0) {

      for (int num : subset)
         cout << num << " ";
      cout << endl;
      return;
   }

   if (index == nums.size() || target < 0)
      return;

   subset.push_back(nums[index]);
   subsetSum(nums, target - nums[index], subset, index + 1);

   subset.pop_back();
   subsetSum(nums, target, subset, index + 1);
}

int main() {
   vector<int> nums = {2, 3, 7, 8, 10};
```

```
    int target = 10;
    vector<int> subset;

    cout << "Subsets with sum " << target << " are:\n";
    subsetSum(nums, target, subset, 0);

    return 0;
}
```

Output:



2.

II. Write C/C++ programs to implement the following algorithm using Branch and Bound technique.
i)0/1 Knapsack problem
ii) Job Selection problwm

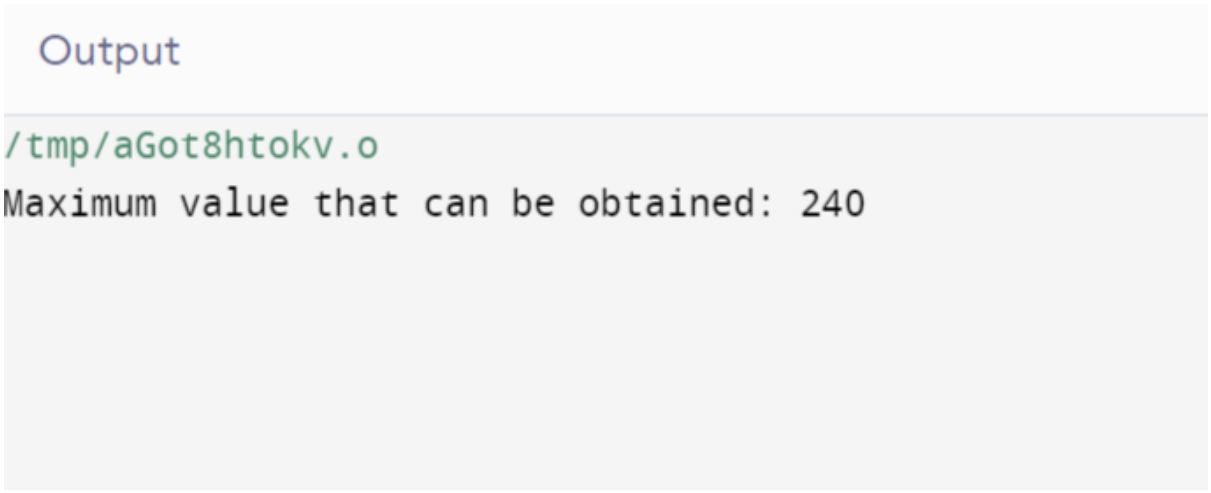
0/1 :

```
#include <iostream>
```

```
#include <vector>
#include <algorithm>

using namespace std;

struct Item {
    int weight;
    int value;
    double ratio;
};

bool compare(Item a, Item b) {
    return a.ratio > b.ratio;
}

int knapsackBranchBound(int capacity, vector<Item>& items, int n) {

    sort(items.begin(), items.end(), compare);

    int currentWeight = 0;
    int currentValue = 0;
    int maxPossibleValue = 0;

    for (int i = 0; i < n; i++) {

        if (currentWeight + items[i].weight <= capacity) {
            currentWeight += items[i].weight;
            currentValue += items[i].value;
        } else {

            int remainingCapacity = capacity - currentWeight;
```

```
            double fraction = (double)remainingCapacity / items[i].weight;
            currentValue += items[i].value * fraction;
            break;
        }
    }

    return currentValue;
}

int main() {
    vector<Item> items = {{10, 60}, {20, 100}, {30, 120}};
    int capacity = 50;
    int n = items.size();

    int maxValue = knapsackBranchBound(capacity, items, n);

    cout << "Maximum value that can be obtained: " << maxValue << endl;

    return 0;
}
```

Output:



Job selection:

Code:

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

using namespace std;

struct Job {
    int start;
    int finish;
};

bool compareJobs(const Job& a, const Job& b) {
    return a.finish < b.finish;
}

int maxNonOverlappingJobs(const vector<Job>& jobs) {
    int n = jobs.size();
    if (n == 0) return 0;

    vector<Job> sortedJobs = jobs;
    sort(sortedJobs.begin(), sortedJobs.end(), compareJobs);

    int count = 1;
    int prevFinish = sortedJobs[0].finish;

    for (int i = 1; i < n; ++i) {
        if (sortedJobs[i].start >= prevFinish) {
```

```
            count++;
            prevFinish = sortedJobs[i].finish;
        }
    }

    return count;
}

int main() {
    vector<Job> jobs = {{1, 3}, {2, 5}, {3, 8}, {5, 9}, {6, 10}, {8, 11}};
    cout << "Maximum number of non-overlapping jobs: " << maxNonOverlappingJobs(jobs) << endl;
    return 0;
}
```

Output

```
/tmp/aGot8htokv.o
Maximum number of non-overlapping jobs: 3
```

IV. Write C/C++ programs to implement the following String matching algorithms
i) Naïve string Matching alg
ii) Rain Karp alg.

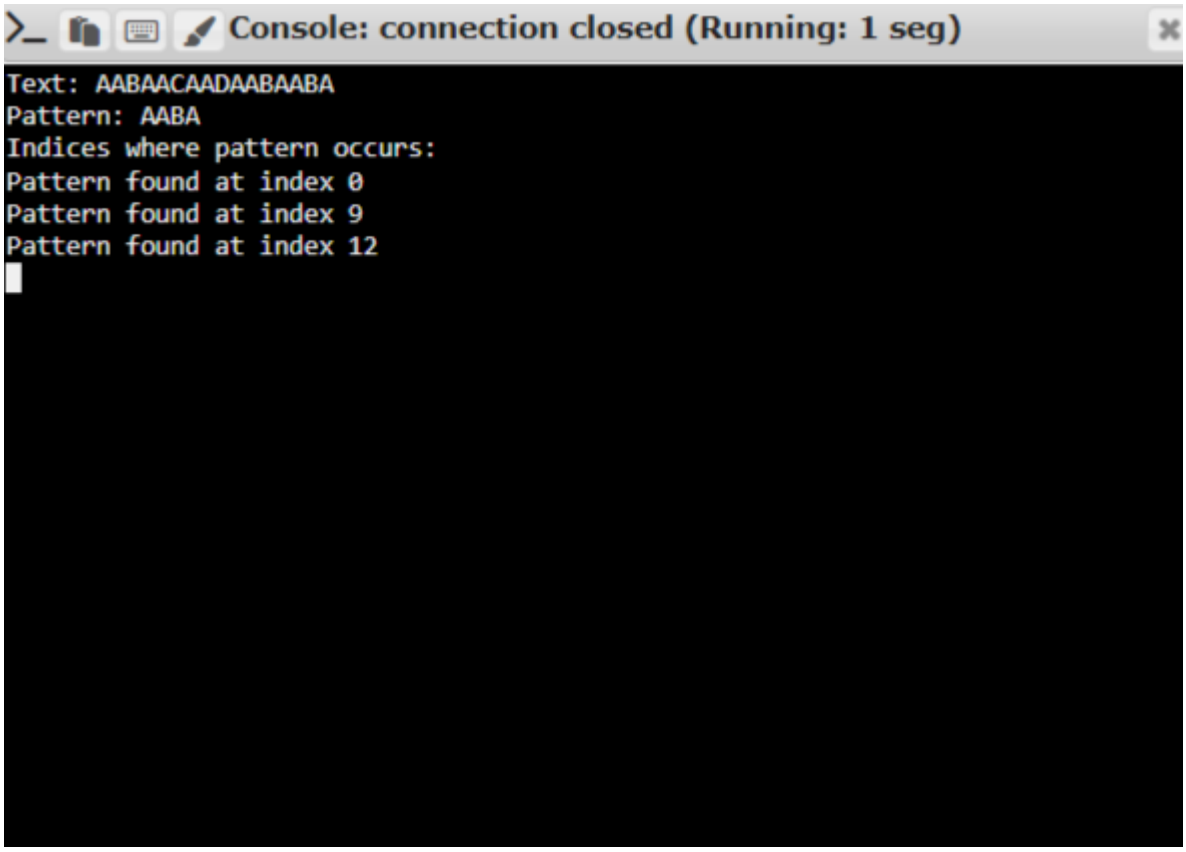
1.Naive string matching:

Code:

```
#include <iostream>
#include <string>
```

```
using namespace std;

void naiveStringMatch(const string& text, const string& pattern) {
    int n = text.length();
    int m = pattern.length();

    for (int i = 0; i <= n - m; ++i) {
        int j;
        for (j = 0; j < m; ++j) {
            if (text[i + j] != pattern[j])
                break;
        }
        if (j == m) {
            cout << "Pattern found at index " << i << endl;
        }
    }
}

int main() {
    string text = "AABAACAADAABAABA";
    string pattern = "AABA";

    cout << "Text: " << text << endl;
    cout << "Pattern: " << pattern << endl;

    cout << "Indices where pattern occurs:" << endl;
    naiveStringMatch(text, pattern);

    return 0;
}
```

Output:



Rabin karp:

Code:

```
#include <iostream>

#include <string>

#include <cmath>


using namespace std;


void rabinKarp(const string& text, const string& pattern) {

    int n = text.length();

    int m = pattern.length();

    int prime = 101;

    int d = 256;

    int patternHash = 0;

    int textHash = 0;
```

```
for (int i = 0; i < m; ++i) {
   patternHash = (d * patternHash + pattern[i]) % prime;
   textHash = (d * textHash + text[i]) % prime;
}



int h = 1;
for (int i = 0; i < m - 1; ++i)
   h = (h * d) % prime;

for (int i = 0; i <= n - m; ++i) {

   if (patternHash == textHash) {

      int j;
      for (j = 0; j < m; ++j) {
         if (text[i + j] != pattern[j])
            break;
      }
      if (j == m)
         cout << "Pattern found at index " << i << endl;
   }



   if (i < n - m) {
      textHash = (d * (textHash - text[i] * h) + text[i + m]) % prime;
      if (textHash < 0)
         textHash = (textHash + prime);
   }
}
```

```
}

int main() {
    string text = "AABAACAADAABAABA";
    string pattern = "AABA";

    cout << "Text: " << text << endl;
    cout << "Pattern: " << pattern << endl;

    cout << "Indices where pattern occurs:" << endl;
    rabinKarp(text, pattern);

    return 0;
}
```