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LAB REPORT
On

ANALYSIS AND DESIGN OF ALGORITHMS (23CS4PCADA)

Submitted by

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in partial fulfillment for the award of the degree of
BACHELOR OF ENGINEERING
in
COMPUTER SCIENCE AND ENGINEERING

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This is to certify that the Lab work entitled **"ANALYSIS AND DESIGN OF ALGORITHMS"** carried out by **CHAITHANYA SUDHAN(1BM23CS073)**, who is bonafide student of **B. M. S. College of Engineering**. It is in partial fulfillment for the award of **Bachelor of Engineering in Computer Science and Engineering** of the Visvesvaraya Technological University, Belgaum during the year 2024-25. The Lab report has been approved as it satisfies the academic requirements in respect of Analysis and Design of Algorithms Lab - **(23CS4PCADA)** work prescribed for the said degree.

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Course outcomes:

CO1	Analyze time complexity of Recursive and Non-recursive algorithms using asymptotic notations.
CO2	Apply various design techniques for the given problem.
CO3	Apply the knowledge of complexity classes P, NP, and NP-Complete and prove certain problems are NP-Complete
CO4	Design efficient algorithms and conduct practical experiments to solve problems.

Lab program 1:

Write program to obtain the Topological ordering of vertices in a given digraph.

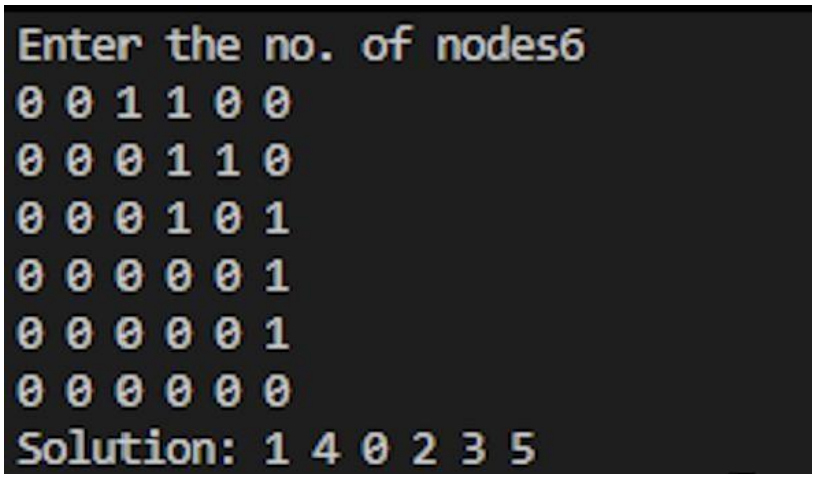
CODE-

DFS:

```
#include <stdio.h> int n, a[10][10],

res[10], s[10], top = 0;

void dfs(int, int, int[][10]);
void dfs_top(int, int[][10]);

int main() { printf("Enter the no.
   of nodes");
   scanf("%d", &n);
   int i, j;
   for (i = 0; i < n; i++) { for
      (j = 0; j < n; j++) {
         scanf("%d", &a[i][j]);
      }  }  dfs_top(n,  a);
   printf("Solution: "); for (i
   = n - 1; i >= 0; i--) {
   printf("%d ", res[i]);
   } return
   0;
}

void dfs_top(int n, int a[][10]) { int
   i;
   for (i = 0; i < n; i++) {
   s[i] = 0; }
   for (i = 0; i < n; i++) {
      if (s[i] == 0) { dfs(i,
      n, a);
      }
   }
}

void dfs(int j, int n, int a[][10]) {
   s[j] = 1; int i;
   for (i = 0; i < n; i++) { if (a[j][i]
      == 1 && s[i] == 0) { dfs(i, n,
      a);
```

```
    } }
  res[top++] =
  j;
}
```

OUTPUT-



Source removal method: #include

<stdio.h>

```
int a[10][10], n, t[10], indegree[10]; int
stack[10], top = -1;

void computeIndegree(int, int [][10]); void
tps_SourceRemoval(int, int [][10]);

int main() {
  printf("Enter the no. of nodes: ");
  scanf("%d", &n); int i, j; for (i =
  0; i < n; i++) {
    for (j = 0; j < n; j++) {
      scanf("%d", &a[i][j]);
    } } computeIndegree(n,
  a); tps_SourceRemoval(n,
  a);  printf("Solution:  ");
  for (i = 0; i < n; i++) {
    printf("%d ", t[i]);
  }  return
  0;
}
void computeIndegree(int n, int a[][10]) {
```

```
    int i, j, sum = 0;
    for (i = 0; i < n; i++) {
        sum = 0; for (j = 0; j <
        n; j++) {
            sum = sum + a[j][i];
        }   indegree[i]   =
        sum;
    }
}

void tps_SourceRemoval(int n, int a[][10]) {
    int i, j, v; for (i = 0; i < n; i++) { if
    (indegree[i] == 0) {
            stack[++top] = i;
        }
    }

    int k = 0; while
    (top != -1) {
        v    =    stack[top--];
        t[k++] = v; for (i = 0;
        i < n; i++) {
            if (a[v][i] != 0) {
                indegree[i] = indegree[i] - 1; if
                (indegree[i] == 0) {
                    stack[++top] = i;
                }
            }
        }
    }
}
```

```
Enter the no. of nodes: 5
0 0 1 0 0
1 0 0 1 0
0 0 0 0 1
0 0 1 0 1
0 0 0 0 0
Solution: 1 3 0 2 4
```

LeetCode Program related to Topological sorting Code

```
bool canFinish(int numCourses, int** prerequisites, int prerequisitesSize, int*
prerequisitesColSize) {


N* adjList[numCourses];


int visited[numCourses];


int recStack[numCourses];


for(int i=0;i<numCourses;i++){
    visited[i]=0;
    recStack[i]=0;
}
```

Lab Program 2:

Implement Johnson Trotter algorithm to generate permutations.

CODE-

```
#include <stdio.h>
#include <stdlib.h>

void swap(int* a, int* b) {
    int temp = *a; *a
    = *b;
    *b = temp;
}

void generatePermutations(int arr[], int start, int end) {
    if (start == end) {
        for (int i = 0; i <= end; i++) {
            printf("%d ", arr[i]);
        }
        printf("\n");
    } else { for (int i = start; i <= end;
        i++) {
            swap(&arr[start], &arr[i]);
            generatePermutations(arr, start + 1, end);
            swap(&arr[start], &arr[i]);
```

```
        }
    }
}

int main() {
    int n;
    printf("Enter the number of elements: ");
    scanf("%d", &n);

    int* arr = (int*)malloc(n * sizeof(int));
    printf("Enter the elements: "); for (int
    i = 0; i < n; i++) { scanf("%d",
    &arr[i]);
    }
    generatePermutations(arr, 0, n - 1);
    free(arr);
    return 0;
}
```

OUTPUT-

```
Enter the number of elements: 4
Enter the elements: 1 2 3 4
1 2 3 4
1 2 4 3
1 3 2 4
1 3 4 2
1 4 3 2
1 4 2 3
2 1 3 4
2 1 4 3
2 3 1 4
2 3 4 1
2 4 3 1
2 4 1 3
3 2 1 4
3 2 4 1
3 1 2 4
3 1 4 2
3 4 1 2
3 4 2 1
4 2 3 1
4 2 1 3
4 3 2 1
4 3 1 2
4 1 3 2
4 1 2 3
```

Lab program 3:

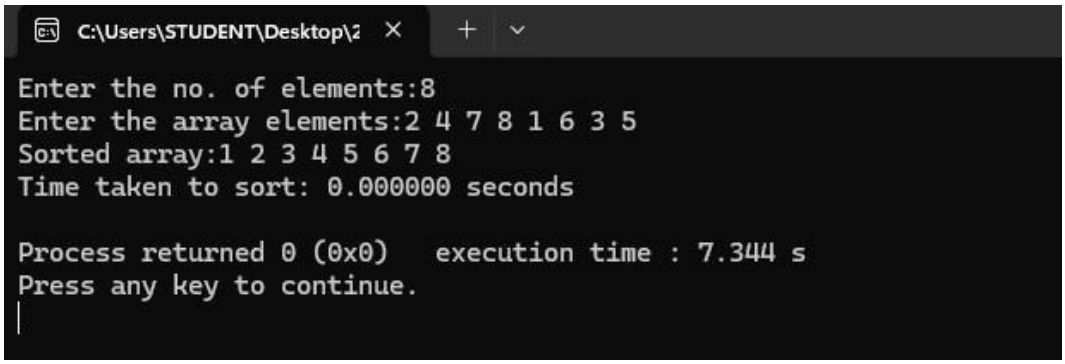
Sort a given set of N integer elements using Merge Sort technique and compute its time taken. Run the program for different values of N and record the time taken to sort.

CODE-

```
#include <stdio.h>
#include<time.h>
int a[20],n;
void simple_sort(int [],int,int,int);
void  merge_sort(int[],int,int);  int
main()
{  int  i;  clock_t  start,  end;  double
   time_taken; printf("Enter the no. of
   elements:");
    scanf("%d", &n); printf("Enter the
    array elements:"); for (i = 0; i < n;
    i++) {
        scanf("%d", &a[i]);
    }    start    =    clock();
    merge_sort(a, 0, n - 1);
    end = clock();
    time_taken = (double)(end - start) / CLOCKS_PER_SEC;
    printf("Sorted array:"); for
    (i = 0; i < n; i++) {
        printf("%d ", a[i]);
    }
    printf("\n");
   printf("Time taken to sort: %f seconds\n", time_taken);
return 0; }
void merge_sort(int a[],int low, int high){
    if(low<high){
        int mid=(low+high)/2;
        merge_sort(a,low,mid);
        merge_sort(a,mid+1,high);
        simple_sort(a,low,mid,high);
    } }
void simple_sort(int a[],int low, int mid, int high){
    int i=low,j=mid+1,k=low; int
    c[n];
    while(i<=mid          &&          j<=high){
        if(a[i]<a[j]){
            c[k++]=a[i];
            i++;
```

```
        }else{
            c[k++]=a[j];
            j++;
        }
    }
    while(i<=mid){
        c[k++]=a[i];
    i++; }
    while(j<=high)
    { c[k++]=a[j];
    j++; }
    for(i=low;i<=high;i++){
        a[i]=c[i];
    }
}
```

OUTPUT-



LeetCode Program related to sorting. Code

```
def countRangeSum(self, nums, lower, upper):
    first = [0]
    for num in nums:
        first.append(first[-1] + num)
    def sort(lo, hi):
        mid = (lo + hi) / 2
        if mid == lo:
            return 0
        count = sort(lo, mid) + sort(mid, hi)
i = j = mid
```

```
        for left in first[lo:mid]:
            while i < hi and first[i] - left <  lower: i += 1
              while j < hi and first[j] - left <= upper: j += 1
            count          +=          j          -          i
      first[lo:hi]             =              sorted(first[lo:hi])
    return                                                 count
return sort(0, len(first)
```

Lab program 4:

Sort a given set of N integer elements using Quick Sort technique and compute its time taken.

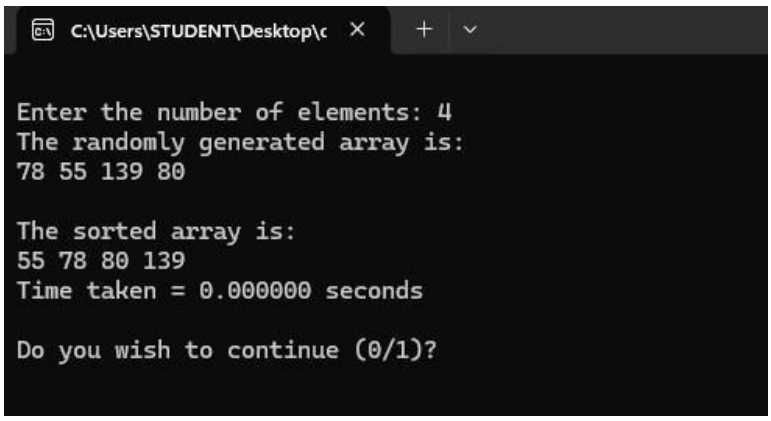
CODE-

```
#include  <time.h>  #include
<stdio.h>
#include <stdlib.h>

#define MAX 5000

void quicksort(int[], int, int); int
partition(int[], int, int);
```

```
int main() { int i, n,
   a[MAX], ch = 1;
    clock_t start, end;

    while (ch == 1) { printf("\nEnter the number
       of elements: ");
       scanf("%d", &n);

       if (n <= 0 || n > MAX) { printf("Invalid input! Please enter a number
          between 1 and %d.\n", MAX); continue;
       }

       printf("Enter the array elements:\n");
       for (i = 0; i < n; i++) scanf("%d",
          &a[i]);

       printf("The entered array is:\n");
       for (i = 0; i < n; i++) printf("%d
       ", a[i]);

       start = clock(); quicksort(a,
       0, n - 1);
       end = clock();

       printf("\n\nThe sorted array elements are:\n");
       for (i = 0; i < n; i++) printf("%d\n", a[i]); printf("Time taken = %f seconds\n",
       (double)(end - start) / CLOCKS_PER_SEC);

       printf("\n\nDo you wish to continue? (1 for Yes / 0 for No): ");
       if (scanf("%d", &ch) != 1) { printf("Invalid input! Exiting
       program.\n"); break;
       }

       if (ch != 1) break;
    }

    return 0;
}

void quicksort(int a[], int low, int high) {
   int mid; if (low < high) { mid =
   partition(a, low, high); quicksort(a,
   low, mid - 1); quicksort(a, mid + 1,
   high);
    }
}

int partition(int a[], int low, int high) {
```

```
    int key, i, j, temp, k;
    key = a[low]; i =
    low + 1; j = high;

    while (i <= j) { while (i <= high &&
       key >= a[i])
          i = i + 1;
       while (key < a[j])
          j = j - 1;

       if (i < j) {
          temp =
          a[i]; a[i] =
          a[j]; a[j] =
          temp;
       } else { k = a[j];
          a[j] = a[low];
          a[low] = k;
       } }
    return
    j;
}
```

OUTPUT-



LeetCode Program related to sorting. Code

```
class Solution:
    def findKthLargest(self, nums: List[int], k: int) -> int:
        maxHeap = nums
        for i in range(len(maxHeap)):
            maxHeap[i] = -maxHeap[i]
        heapify(maxHeap)
```

```
        for i in range(k-1):
            heappop(maxHeap)
    return -maxHeap[0]
```

Lab program 5:

Sort a given set of N integer elements using Heap Sort technique and compute its time taken.

CODE-

```
#include <stdio.h> #include
<conio.h>
#include <time.h>

void heapcom(int a[], int n)
{ int i, j, k, item; for(i =
   1; i <= n; i++)
   { item = a[i];
     j = i; k = j /
     2;
     while(k != 0 && item > a[k])
     { a[j] = a[k];
       j = k; k = j
       / 2;
     } a[j] =
     item; }
}

void adjust(int a[], int n)
{ int item, i, j;
   j = 1; item =
   a[j]; i = 2 *
   j;  while(i <
   n)
   { if((i + 1) < n)
     { if(a[i] < a[i + 1])
         i++; }
     if(item < a[i])
     { a[j] = a[i];
     j = i; i = 2 *
     j; } else
       break
; } a[j] =
item; }
```

```
void heapsort(int a[], int n)
{ int i, temp;
   heapcom(a, n); for(i
   = n; i >= 1; i--)
   { temp = a[1];
      a[1]  =  a[i];
      a[i] = temp;
      adjust(a, i);
   } }

void main()
{ int i, n, a[20], ch = 1;
   clock_t   start,   end;
   while(ch)
   { printf("enter the number of elements to sort\n");
      scanf("%d",  &n);  printf("enter  the
      elements to sort\n"); for(i = 1; i <= n;
      i++)
         scanf("%d", &a[i]);
      start = clock();
      heapsort(a,  n);
      end = clock();
      printf("the sorted list of elements is\n"); for(i
      = 1; i <= n; i++)
         printf("%d\n", a[i]);
      printf("Time taken is %lf CPU cycles\n", (end - start) / CLK_TCK);
      printf("do u wish to run again (0/1)\n");
      scanf("%d", &ch);
   }
}
```

OUTPUT-

```
enter the number of elements to sort
6
enter the elements to sort
5 9 3 7 4 6
the sorted list of elements is
3
4
5
6
7
9
Time taken is 0.000000 CPU cycles
do u wish to run again (0/1)
0
```

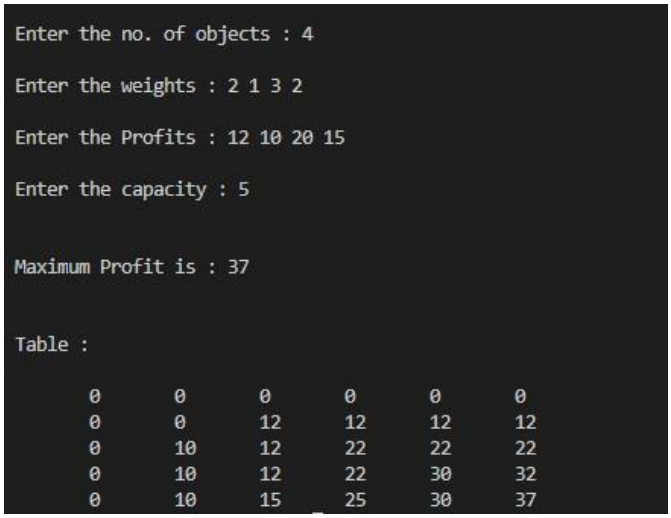
Lab program 6:

Implement 0/1 Knapsack problem using dynamic programming.

CODE-

```
#include <stdio.h>

int i, j, n, c, w[10], p[10], v[10][10];

void knapsack(int n, int w[10], int p[10], int c) {
   int max(int, int); for (i =
   0; i <= n; i++) { for (j = 0;
   j <= c; j++) { if (i == 0 || j
   == 0) v[i][j] = 0;
         else if (w[i] > j) v[i][j]
            = v[i - 1][j];
         else v[i][j] = max(v[i - 1][j], (v[i - 1][j - w[i]] +
      p[i])); }
   }

   printf("\n\n Maximum Profit is : %d ", v[n][c]);
   printf("\n\n\n Table : \n\n"); for (i = 0; i <= n;
   i++) { for (j = 0; j <= c; j++) {
         printf("\t%d", v[i][j]);
      }
      printf("\n");
   }
}

int max(int a, int b) {
   return ((a > b) ? a : b);
}

void main() {
   printf("\n Enter the no. of objects : ");
   scanf("%d", &n); printf("\n Enter the
   weights : "); for (i = 1; i <= n; i++) {
      scanf("%d", &w[i]);
   } printf("\n Enter the Profits :
   "); for (i = 1; i <= n; i++) {
      scanf("%d", &p[i]);
   }
   printf("\n Enter the capacity : ");
   scanf("%d",  &c);  knapsack(n,
   w, p, c);
}
```

OUTPUT-



LeetCode Program related to Knapsack problem or Dynamic Programming. Code

```
class Solution:
    def maxSizeSlices(self, slices: List[int]) -> int:
        n = len(slices) // 3
        def linear(arr):
            eat = [[0] + [-math.inf]*n] * 2
            for x in arr:
                eat.append([i and max(eat[-1][i], eat[-2][i-1]+x) for i in range(n+1)])
            return max(l[n] for l in eat)
        return max(linear(slices[1:]), linear(slices[:-1]))
```

Lab Program 7:

Implement All Pair Shortest paths problem using Floyd's algorithm.

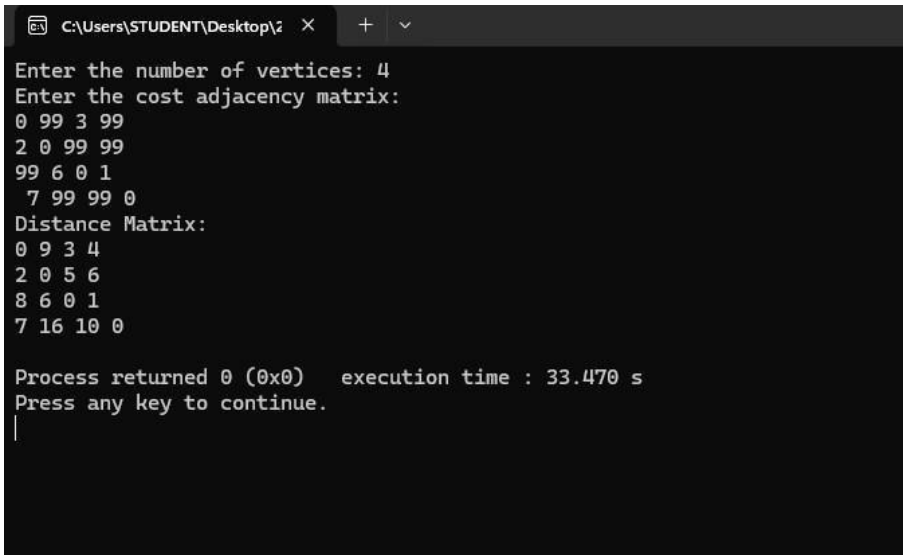
CODE-

```
#include <stdio.h> int
a[10][10], D[10][10], n;
void floyd(int [][10], int);
```

```
int min(int, int); int main()
{
    printf("Enter the number of vertices: "); scanf("%d",
    &n);
    printf("Enter the cost adjacency matrix:\n");
    int i, j; for (i = 0; i < n;
    i++) {
        for (j = 0; j < n; j++) {
            scanf("%d", &a[i][j]);
        }
    }
      floyd(a, n);

    printf("Distance      Matrix:\n");
    for (i = 0; i < n; i++) {
        for (j = 0; j < n; j++) {
            printf("%d ", D[i][j]);
        }
        printf("\n");
    } return
0; }
void floyd(int a[][10], int n) {
    int i, j, k; for (i = 0; i < n;
    i++) { for (j = 0; j < n; j++)
    { D[i][j] = a[i][j];
        }
    }
```

```
    for (k = 0; k < n; k++) {
        for (i = 0; i < n; i++) {
        for (j = 0; j < n; j++) {
        D[i][j] = min(D[i][j],
        D[i][k] + D[k][j]);
            }
        }
    } }
int min(int a, int b) {
    return (a < b) ? a : b;
}
```

OUTPUT-



LeetCode Program related to shortest distance calculation. Code

```
import heapq

from collections import defaultdict
import sys

def countPaths(n, roads):

    mod = 10**9 + 7

    adj = defaultdict(list)
```

```
    for u, v, t in roads:

      adj[u].append((v, t))

     adj[v].append((u, t))

shortesttime = [sys.maxsize] * n
    cnt = [0] * n
    pq = [(0, 0)]  # (time, node)

 shortesttime[0] = 0

  cnt[0] = 1

 while pq:

   time, node = heapq.heappop(pq)

    if time > shortesttime[node]:
       continue


    for nbr, rtime in adj[node]:
           if time + rtime < shortesttime[nbr]:

              shortesttime[nbr] = time + rtime

        cnt[nbr] = cnt[node]

            heapq.heappush(pq,(shortesttime[nbr], nbr))

          elif time + rtime == shortesttime[nbr]:

              cnt[nbr] = (cnt[nbr] + cnt[node]) % mod

return cnt[-1]
```

Lab program 8:

1. Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm.

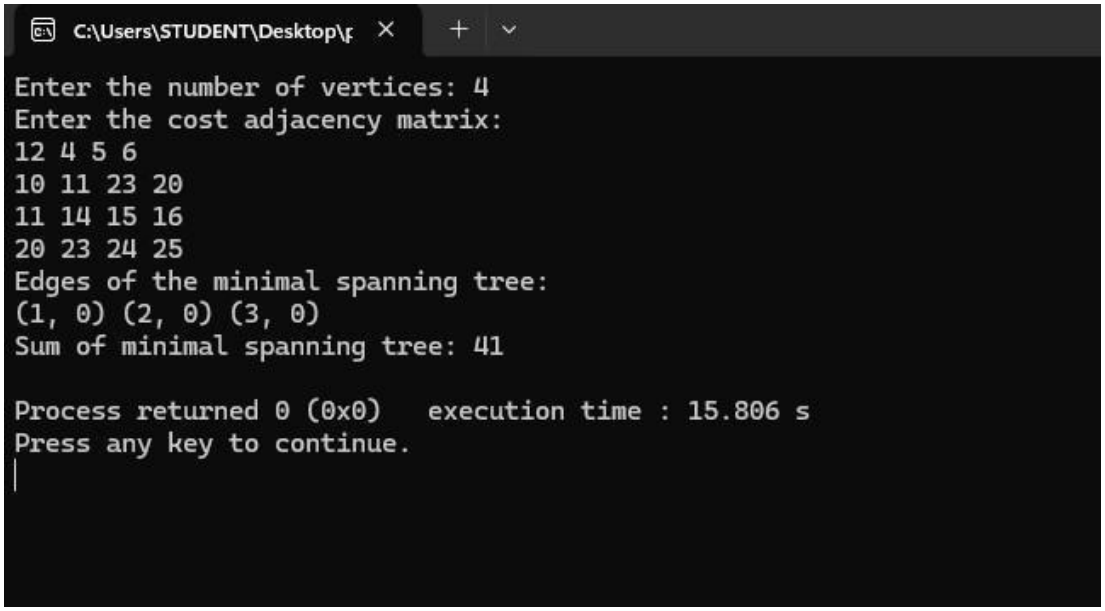
CODE-

```
#include <stdio.h>
int cost[10][10], n, t[10][2], sum;
void prims(int cost[10][10], int n);
int main() { int i, j;
    printf("Enter the number of vertices: ");
    scanf("%d", &n);

    printf("Enter the cost adjacency matrix:\n"); for
    (i = 0; i < n; i++) {
        for (j = 0; j < n; j++) {
            scanf("%d", &cost[i][j]);
        }
    }

    prims(cost, n);

    printf("Edges of the minimal spanning tree:\n"); for
    (i = 0; i < n - 1; i++) {
        printf("(%d, %d) ", t[i][0], t[i][1]);
    }

    printf("\nSum of minimal spanning tree: %d\n", sum);

   return 0; }
void prims(int cost[10][10], int n) {
   int i, j, u, v; int min, source;
```

```
int p[10], d[10], s[10];


min = 999;
source = 0;


for (i = 0; i < n; i++) {
   d[i]                    =
cost[source][i]; s[i] = 0;
p[i]    =    source;    }
s[source] = 1;
sum = 0;


int k = 0;


for (i = 0; i < n - 1; i++) {
   min = 999;
   u = -1;


   for (j = 0; j < n; j++) {
      if (s[j] == 0 && d[j] < min) {
         min = d[j]; u
         = j;
      }
   }


   if (u != -1) {
      t[k][0] = u; t[k][1] =
      p[u];  k++;  sum  +=
      cost[u][p[u]];  s[u]  =
      1;
```

```
        for (v = 0; v < n; v++) {
            if (s[v] == 0 && cost[u][v] < d[v]) {
                d[v] = cost[u][v]; p[v]
                = u;
            }
        }
    }
  }
}
```

OUTPUT-



2. Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm.

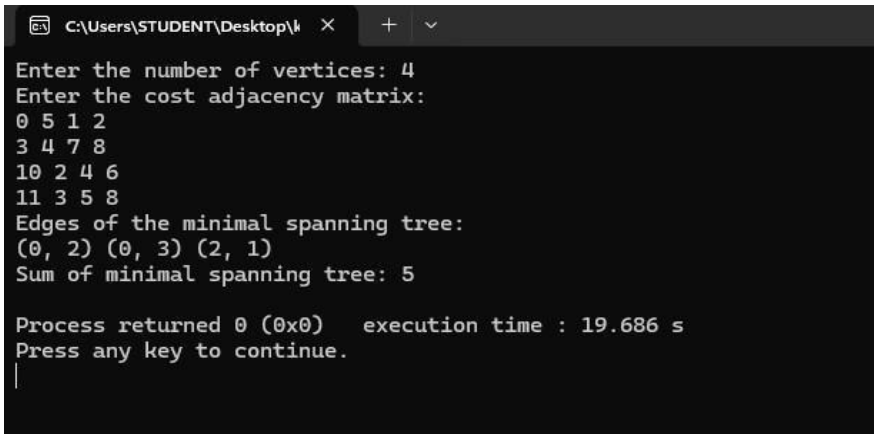
CODE-

```
#include <stdio.h>

int cost[10][10], n, t[10][2], sum;

void kruskal(int cost[10][10], int n);
int find(int parent[10], int i);
```

```
int main() { int
   i, j;

   printf("Enter the number of vertices: ");
   scanf("%d", &n);

   printf("Enter the cost adjacency matrix:\n");
   for (i = 0; i < n; i++) {
      for (j = 0; j < n; j++) {
         scanf("%d", &cost[i][j]);
      }
   }

   kruskal(cost, n);

   printf("Edges of the minimal spanning tree:\n");
   for (i = 0; i < n - 1; i++) {
      printf("(%d, %d) ", t[i][0], t[i][1]);
   }

   printf("\nSum of minimal spanning tree: %d\n", sum);

   return 0;
}

void kruskal(int cost[10][10], int n) {
   int min, u, v, count, k;
   int parent[10];

   k = 0; sum
   = 0;

   for (int i = 0; i < n; i++) {
      parent[i] = i;
   }

   count = 0;

   while (count < n - 1) {
      min = 999;
      u = -1; v =
      -1;

      for (int i = 0; i < n; i++) {
         for (int j = 0; j < n; j++) {
            if (find(parent, i) != find(parent, j) && cost[i][j] < min) {
               min = cost[i][j];
```

```
                u = i; v
                = j;
              }
          } } int root_u =
      find(parent, u); int root_v =
      find(parent, v);

      if (root_u != root_v) {
         parent[root_u]          =
         root_v;   t[k][0]   =   u;
         t[k][1] = v; sum += min;
         k++;
         count++;
      }
   }
}

int find(int parent[10], int i) {
   while (parent[i] != i) {
      i =
   parent[i]; }
   return i;
}
```

OUTPUT-



Lab program 9:

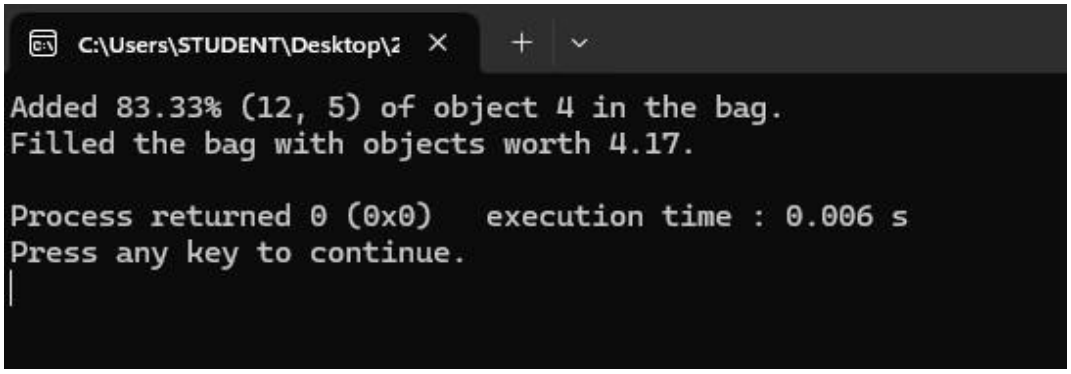
Implement Fractional Knapsack using Greedy technique.

CODE-

```
#include <stdio.h>
```

```
int n = 5;

int p[10] = {3, 3, 2, 5, 1}; int
w[10] = {10, 15, 10, 12, 8}; int
W = 10;

int main() { int
   cur_w; float tot_v
   = 0.0; int i, maxi;
   int used[10] = {0};
   cur_w = W;

   while (cur_w > 0) { maxi = -1; for (i = 0; i < n; ++i) { if (used[i] == 0 && (maxi == -
      1 || (float)p[i] / w[i] > (float)p[maxi] / w[maxi])) { maxi = i;
         }
      }

      used[maxi] = 1;
      if (w[maxi] <= cur_w) {

         cur_w -= w[maxi]; tot_v
         += p[maxi];
         printf("Added object %d (%d, %d) completely in the bag. Space left: %d.\n", maxi +
         1, w[maxi], p[maxi], cur_w);
      } else {

         tot_v += (float)p[maxi] * cur_w / w[maxi];
         printf("Added %.2f%% (%d, %d) of object %d in the bag.\n", (float)(cur_w * 100) /
         w[maxi], w[maxi], p[maxi], maxi + 1); cur_w = 0;
      }
   }

   printf("Filled the bag with objects worth %.2f.\n", tot_v); return
   0;
}
```

OUTPUT-



LeetCode Program related to Greedy Technique algorithms.

Code

```
def maximumUnits(self, boxTypes: List[List[int]], truckSize: int) -> int:
        boxTypes.sort(key=lambda   a:-a[1])
        max_units = 0 for box in
        boxTypes:
           if truckSize < 0 :
          break  max_units+= min(truckSize,
        return max_units
```

Lab program 10:

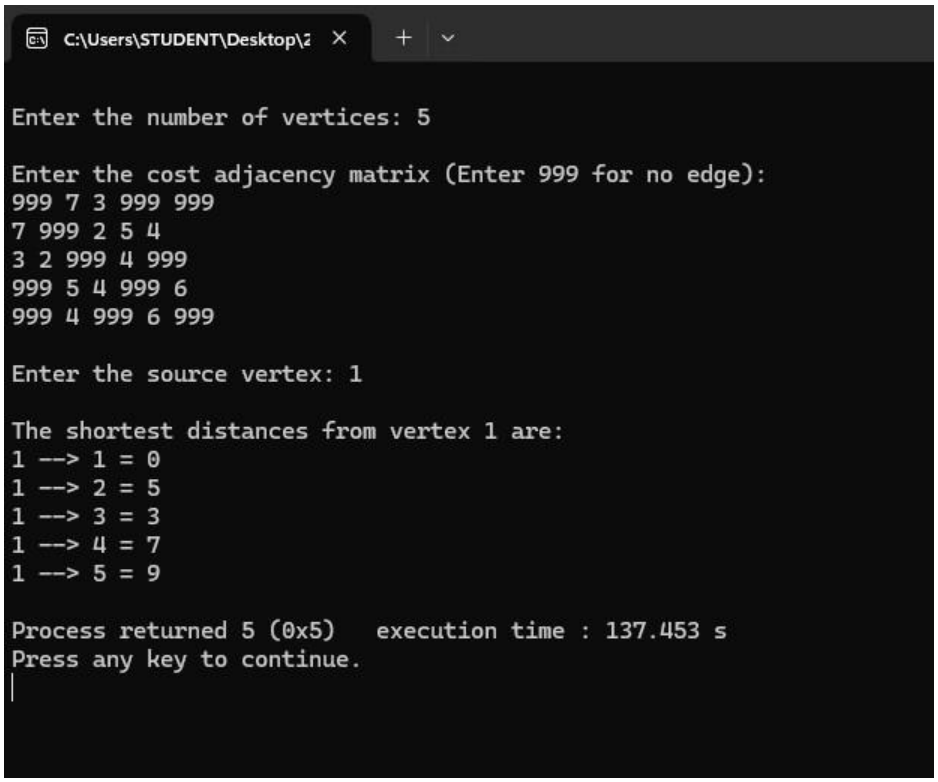
From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm.

CODE-

```
#include <stdio.h> #define

INF 999

void main() { int i, j, n, v, k, min, u, c[20][20],
   s[20], d[20]; printf("\nEnter the number of
   vertices: "); scanf("%d", &n);

   printf("\nEnter the cost adjacency matrix (Enter 999 for no edge): \n"); for(i
   = 1; i <= n; i++) {
      for(j = 1; j <= n; j++) {
         scanf("%d", &c[i][j]);
      }
   }

   printf("\nEnter the source vertex: ");
   scanf("%d", &v);

   for(i = 1; i <= n; i++) {
      s[i]  =  0;  d[i]  =
      c[v][i];
```

```
    }

    d[v] = 0; s[v]
    = 1;


    for(k = 2; k <= n; k++) {
       min = INF; for(i = 1; i
       <= n; i++) {
          if(s[i] == 0 && d[i] < min) {
             min = d[i]; u
             = i;
          }
       }

       s[u] = 1;


       for(i = 1; i <= n; i++) {
          if(s[i] == 0) {
             if(d[i] > (d[u] + c[u][i])) {
                d[i] = d[u] + c[u][i];
             }
          }
       }
    }


    printf("\nThe shortest distances from vertex %d are:\n", v); for(i
    = 1; i <= n; i++) {
       if(d[i] == INF) {
          printf("%d --> %d = No Path\n", v, i);
       } else { printf("%d --> %d = %d\n", v, i,
       d[i]); }
    }
}
```

OUTPUT-



Lab program 11:

Implement “N-Queens Problem” using Backtracking.

CODE-

```
#include <stdio.h> #include
<conio.h>
#include <math.h>

int x[20], count = 1;

void queens(int, int);
int place(int, int);

void main()
{ int n, k = 1;
   printf("\n enter the number of queens to be placed\n");
    scanf("%d", &n); queens(k,
    n);
}
void queens(int k, int n)
{
    int i, j;
    for(j = 1; j <= n; j++)
    { if(place(k, j))
```

```
      { x[k] = j;
        if(k ==
        n)
        { printf("\n %d solution", count);
          count++; for(i = 1; i
          <= n; i++)
            printf("\n \t %d row <--- %d column", i, x[i]);
          getch();
        } else
          queens(k + 1, n);
      }
   }
}

int place(int k, int j)
{ int i; for(i = 1; i < k;
  i++)
     if((x[i] == j) || (abs(x[i] - j)) == abs(i - k))
        return 0;
  return 1;
}
```

OUTPUT-

```
 enter the number of queens to be placed
4

 1 solution
         1 row <--- 2 column
         2 row <--- 4 column
         3 row <--- 1 column
         4 row <--- 3 column
 2 solution
         1 row <--- 3 column
         2 row <--- 1 column
         3 row <--- 4 column
         4 row <--- 2 column
```