323-35 Project 6: SSS C++

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Project Due Date: 10/30/2020

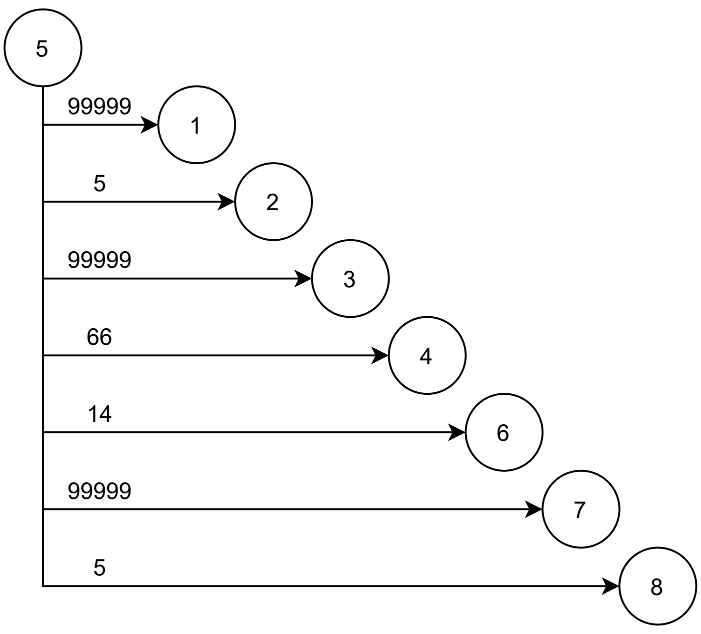
```
**************************************
V. main (…)
**************************************
step 0: open inFile, SSSfile, deBugFile
numNodes  get from inFile
Allocate and initialize all members in the DijktraSSS class
accordingly
step 1: loadCostMatrix (inFile)
sourceNode  1
step 2: setBestCostAry (sourceNode)
4
setFatherAry (…)
setMarkedAry (sourceNode)
step 3: minNode  findMinNode(…)
 markedAry[minNode]  1
debugPrint (…)

step 4: // expanding the minNode
 currentNode  1
step 5: if markedAry[currentNode] == 0
 newCost  computeCost(minNode, currentNode)
if newCost < bestCostAry [currentNode]
bestCostAry[currentNode]  newCost
fatherAry[currentNode]  minNode
 debugPrint (…)
Step 6: currentNode ++
Step 7: repeat step 5 to step 6 while currentNode <= numNodes
step 8: repeat step 3 to step 7 until all nodes are marked
// begin printing the paths
step 9: currentNode  1
step 10: printShortestPath (currentNode, sourceNode, SSSfile)
step 11: currentNode ++
step 12: repeat 10 and step 11 while currentNode <= numNodes
step 13: sourceNode ++
step 14: repeat step 2 to step 13 while sourceNode <= numNodes
step 15: close all files
```

Cost Matrix

0	1	2	3	4	5	6	7	8
1	0	30	5	19	29	∞	∞	∞
2	∞	0	5	3	∞	17	∞	2
3	∞	7	0	5	∞	∞	28	9
4	6	∞	33	0	8	3	∞	∞
5	∞	5	∞	66	0	14	∞	5
6	6	∞	6	24	∞	0	9	∞
7	∞	15	4	4	∞	3	0	∞
8	6	∞	∞	∞	2	7	32	0

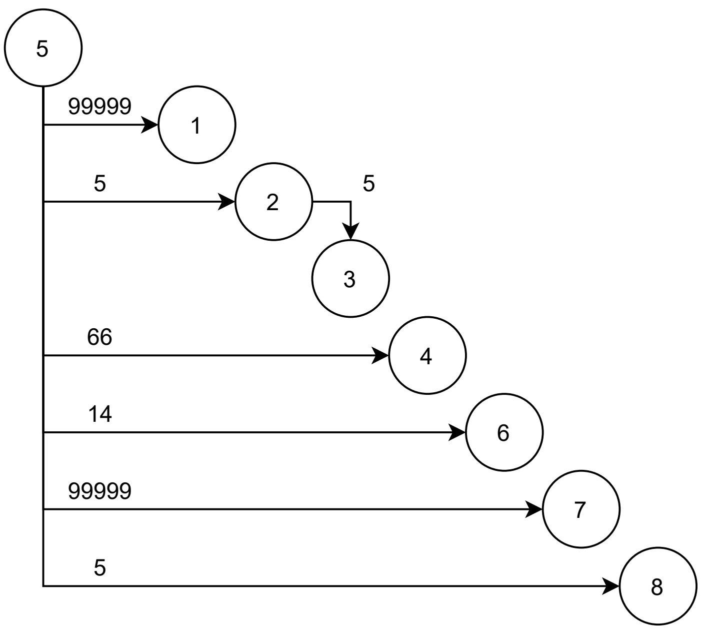
Source Node ID = 5

Initial Graph



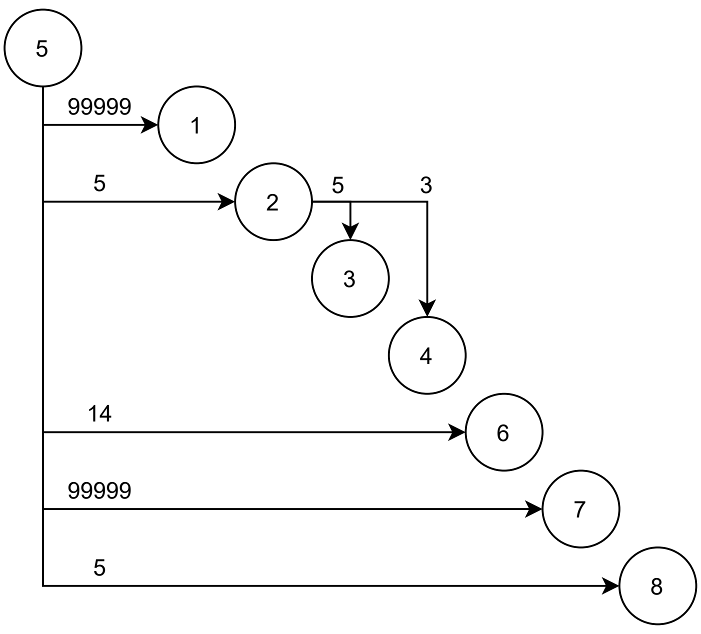
```
Initial Array Values:
Best Cost Array = 99999 05 99999 66 00 14 99999 05
Marked Array = 00 01 00 00 01 00 00 00
Father Array = 01 02 03 04 05 06 07 08
```

loop 1



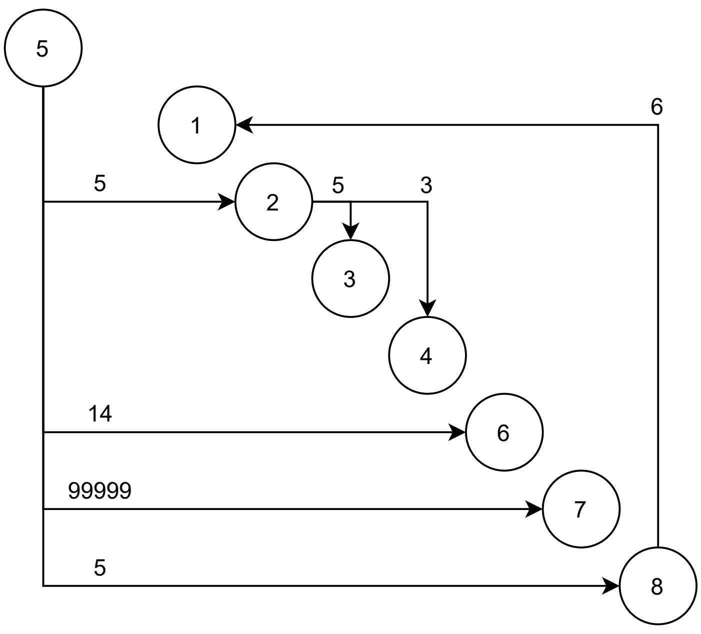
```
Loop 1
Best Cost Array = 99999 05 10 66 00 14 99999 05
Marked Array    = 00 01 00 00 01 00 00 00
Father Array    = 01 02 02 04 05 06 07 08
```

loop 2



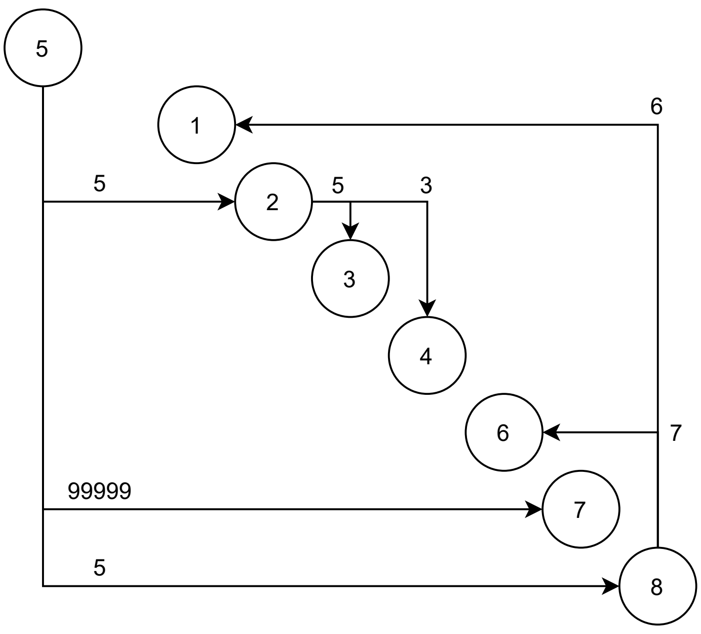
```
Loop 2
Best Cost Array = 99999 05 10 08 00 14 99999 05
Marked Array =     00 01 00 00 01 00 00 00
Father Array =     01 02 02 02 05 06 07 08
```

loop 3



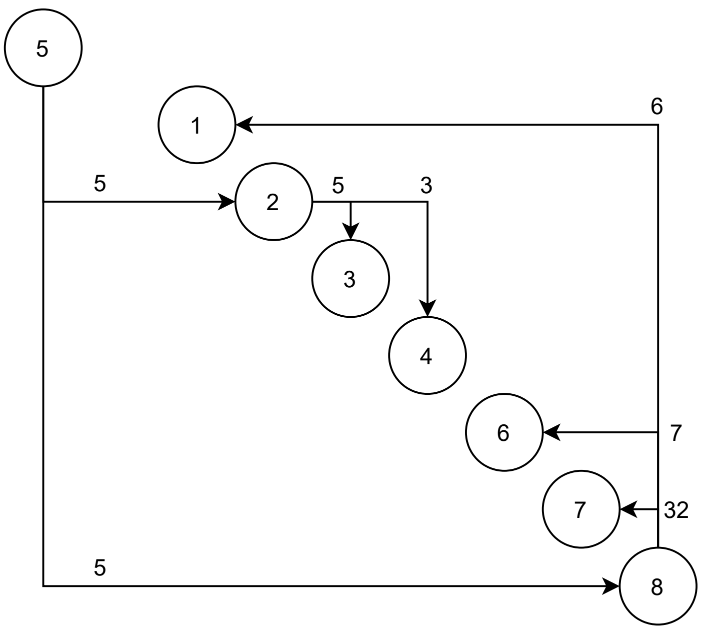
```
Loop 3
Best Cost Array = 11 05 10 08 00 14 99999 05
Marked Array =     00 01 00 00 01 00 00    01
Father Array =     08 02 02 02 05 06 07    08
```

loop 4



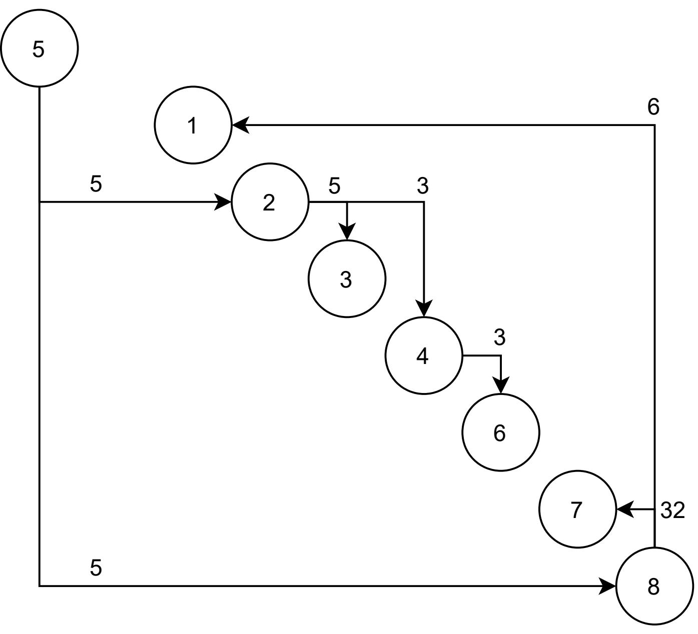
```
Loop 4
Best Cost Array = 11 05 10 08 00 12 99999 05
Marked Array    = 00 01 00 00 01 00 00    01
Father Array    = 08 02 02 02 05 08 07    08
```

loop 5



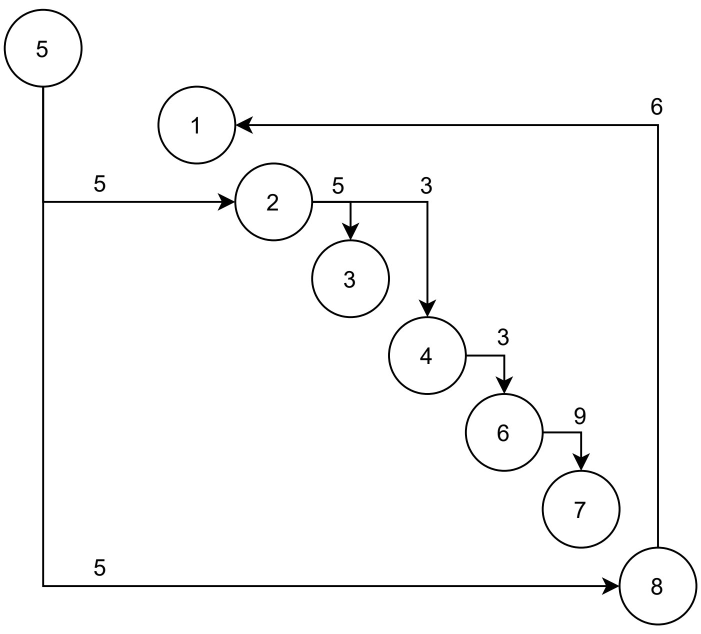
```
Loop 5
Best Cost Array = 11 05 10 08 00 12 37 05
Marked Array    = 00 01 00 00 01 00 00 01
Father Array    = 08 02 02 02 05 08 08 08
```

loop 6



```
Loop 6
Best Cost Array = 11 05 10 08 00 11 37 05
Marked Array    = 00 01 00 01 01 00 00 01
Father Array    = 08 02 02 02 05 04 08 08
```

loop 7 and final graph



```
Loop 7
Best Cost Array = 11 05 10 08 00 11 20 05
Marked Array    = 01 01 01 01 01 01 00 01
Father Array    = 08 02 02 02 05 04 06 08
```

SOURCE CODE

```
#include <iostream>
#include <fstream>
#include <stdlib.h>
using namespace std;

class dijktra{
      public:
      //instance variables
      int numNodes;
      int sourceNode;
      int minNode;
      int currentNode;
      int newCost;
      //pointers
      int** costMatrix;
      int* fatherAry;
      int* markedAry;
      int* bestCostAry;
      //constructor
      dijktra(){
            this->numNodes = 0;
            this->sourceNode = 1;
            this->minNode = 0;
            this->currentNode = 1;
            this->newCost = 0;
      }
      //methods
      void loadCostMatrix(ifstream& input, ofstream& debug){
            int val1;
            int val2;
            int cost;
            input >> val1;
            while(input >> val1){
                  input >> val2;
                  input >> cost;
                  this->costMatrix[val1][val2] = cost;
            }
            debug<<"Printing Cost Matrix\n";
            for(int i=0;i<=this->numNodes;i++)
                  debug<<i<<"\t";
            debug<<endl;
            for(int i=1;i<=this->numNodes;i++){
                  debug<<i<<"\t";
                  for(int j=1;j<this->numNodes + 1;j++){
                        debug<<this->costMatrix[i][j]<<"\t";
                  }
                  debug<<endl;
            }
      }
      void setBestCostAry(int sourceNode){
            for(int i=1;i<this->numNodes+1;i++){
                  this->bestCostAry[i] = this->costMatrix[sourceNode][i]; //if
doesnt work flip sourcenode and i
            }
      }
      void setFatherAry(){
            for(int i=1;i<this->numNodes+1;i++){
                  this->fatherAry[i] = i;
            }
      }
      void setMarkedAry(int sourceNode){
            for(int i=1;i<=this->numNodes;i++)
                  this->markedAry[i] = 0;
            this->markedAry[sourceNode] = 1;
      }
      int findMinNode(){
            int minCost = 99999;
            this->minNode = 0;
            int index = 1;
            while(index <= this->numNodes){
                  if(this->markedAry[index] == 0){
                        if(this->bestCostAry[index] < minCost){
                              minCost = this->bestCostAry[index];
                              this->minNode = index;
                        }
                  }
                  index++;
            }
            return minNode;
      }
      int computeCost(int minNode,int currentNode){
            int bestCost;
            bestCost = this->bestCostAry[minNode] +
this->costMatrix[minNode][currentNode];
            return bestCost;
      }
      void debugPrint(ofstream& debug, string location){

debug<<"\n~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~\n";
            debug<<location<<endl;
            debug<<"=============================\nPrinting Father Array\n";
            for(int i=1;i<this->numNodes + 1;i++){
                  debug<<this->fatherAry[i]<<" ";
            }
```

```
            debug<<"\n=============================\nPrinting Best Cost
Array\n";
            for(int i=1;i<this->numNodes + 1;i++){
                  debug<<this->bestCostAry[i]<<" ";
            }
            debug<<"\n=============================\nPrinting Marked Array\n";
            for(int i=1;i<this->numNodes + 1;i++){
                  debug<<this->markedAry[i]<<" ";
            }
            debug<<"\n=============================\nPrinting Values\n";
            debug<<"numNodes = "<<this->numNodes<<endl;
            debug<<"sourceNode = "<<this->sourceNode<<endl;
            debug<<"minNode = "<<this->minNode<<endl;
            debug<<"currentNode = "<<this->currentNode<<endl;
            debug<<"newCost = "<<this->newCost<<endl;
      }
      //todo
      void printShortestPath(int currentNode, int sourceNode, ofstream&
output){
            int cost = this->bestCostAry[currentNode];
            output<<"The path from "<<sourceNode<<" to "<<currentNode<<" : ";
            while(currentNode != this->fatherAry[currentNode]){
                  output<<currentNode<<"<-";
                  currentNode = fatherAry[currentNode];
            }
            output<<currentNode<<"<-"<<sourceNode<<" : cost = "<<cost<<endl;
      }
      bool completelyMarked(){
            for(int i=1;i<this->numNodes + 1;i++){
                  if(this->markedAry[i] != 1){
                        return false;
                  }
            }
            return true;
      }
};
int main(int argc, char* argv[]){
      //checks that correct args were supplied
      if(argc != 4){
            cout<<"Must have 3 arguments in this command to run
correctly.\nDatafile, Results, Debug\n";
            return -1;
      }
      //creates input stream and checks that its readable
      ifstream input(argv[1]);
      if(!input.good()){
            cout<<"Failed to read input file, was name typed correctly?\n";
            return -1;
```

```
    }
    ofstream output(argv[2]);
    ofstream debug(argv[3]);
    //creates dijktra class
    dijktra path;
    //discovers node amount
    input >> path.numNodes;
    input.close();
    output<<"==============================\n";
    output<<"There are "<<path.numNodes<<" in the input graph. Below are all
the pairs of shortest paths:\n";
    output<<"==============================\n";
    output.close();
    //initializing arrays based on number
    //2d array
    path.costMatrix = new int*[path.numNodes + 1];
    for(int i=1;i<path.numNodes+1;i++){
        path.costMatrix[i] = new int[path.numNodes + 1];
    }
    for(int i=1;i<path.numNodes+1;i++){
        for(int j=1;j<path.numNodes+1;j++){
            if(i == j)
                path.costMatrix[i][j] = 0;
            else
                path.costMatrix[i][j] = 99999;
        }
    }

    //1d arrys
    path.fatherAry = new int[path.numNodes + 1];
    path.markedAry = new int[path.numNodes + 1];
    for(int i=1;i<path.numNodes+1;i++){
        path.markedAry[i] = 0;
    }
    path.bestCostAry = new int[path.numNodes + 1];
    for(int i=1;i<path.numNodes+1;i++){
        path.bestCostAry[i] = 9999;
    }
    //loads cost matrix
    input.open(argv[1]);
    path.loadCostMatrix(input, debug);
    input.close();
    debug.close();
    //sets best cost array
    path.sourceNode = 1;
    while(path.sourceNode <= path.numNodes){
        path.setBestCostAry(path.sourceNode);
        //sets father array
```

```
            path.setFatherAry();
            //sets marked array
            path.setMarkedAry(path.sourceNode);
            //step 3
            while(!path.completelyMarked()){
                  path.currentNode = 1;
                  path.minNode = path.findMinNode();
                  path.markedAry[path.minNode] = 1;
                  //debug print
                  debug.open(argv[3],ios::app);
                  path.debugPrint(debug,"printing from outside");
                  debug.close();
                  //sets current node
                  //loop of steps 5 to 6
                  while(path.currentNode <= path.numNodes){
                        if(path.markedAry[path.currentNode] == 0){
                              path.newCost = path.computeCost(path.minNode,
path.currentNode);
                              if(path.newCost <
path.bestCostAry[path.currentNode]){
                                    path.bestCostAry[path.currentNode] =
path.newCost;
                                    path.fatherAry[path.currentNode] =
path.minNode;
                                    debug.open(argv[3], ios::app);
                                    path.debugPrint(debug, "printing from
inside");
                                    debug.close();
                              }
                        }
                        path.currentNode++;
                  }
            }
            //path printing begins
            path.currentNode = 1;
            output.open(argv[2],ios::app);
            output<<"Source node = "<<path.sourceNode<<endl<<endl;
            while(path.currentNode <= path.numNodes){
                  path.printShortestPath(path.currentNode, path.sourceNode,
output);
                  path.currentNode++;
            }
            output<<"==============================\n";
            output.close();
            path.sourceNode++;
      }
      return 0;
}
```

SSS OUTPUT FILE

```
==============================
There are 8 in the input graph. Below are all the pairs of shortest paths:
==============================
Source node = 1

The path from 1 to 1 : 1<-1 : cost = 0
The path from 1 to 2 : 2<-3<-1 : cost = 12
The path from 1 to 3 : 3<-1 : cost = 5
The path from 1 to 4 : 4<-3<-1 : cost = 10
The path from 1 to 5 : 5<-8<-3<-1 : cost = 16
The path from 1 to 6 : 6<-4<-3<-1 : cost = 13
The path from 1 to 7 : 7<-6<-4<-3<-1 : cost = 22
The path from 1 to 8 : 8<-3<-1 : cost = 14
==============================
Source node = 2

The path from 2 to 1 : 1<-8<-2 : cost = 8
The path from 2 to 2 : 2<-2 : cost = 0
The path from 2 to 3 : 3<-2 : cost = 5
The path from 2 to 4 : 4<-2 : cost = 3
The path from 2 to 5 : 5<-8<-2 : cost = 4
The path from 2 to 6 : 6<-4<-2 : cost = 6
The path from 2 to 7 : 7<-6<-4<-2 : cost = 15
The path from 2 to 8 : 8<-2 : cost = 2
==============================
Source node = 3

The path from 3 to 1 : 1<-4<-3 : cost = 11
The path from 3 to 2 : 2<-3 : cost = 7
The path from 3 to 3 : 3<-3 : cost = 0
The path from 3 to 4 : 4<-3 : cost = 5
The path from 3 to 5 : 5<-8<-3 : cost = 11
The path from 3 to 6 : 6<-4<-3 : cost = 8
The path from 3 to 7 : 7<-6<-4<-3 : cost = 17
The path from 3 to 8 : 8<-3 : cost = 9
==============================
Source node = 4

The path from 4 to 1 : 1<-4 : cost = 6
The path from 4 to 2 : 2<-5<-4 : cost = 13
The path from 4 to 3 : 3<-6<-4 : cost = 9
The path from 4 to 4 : 4<-4 : cost = 0
The path from 4 to 5 : 5<-4 : cost = 8
The path from 4 to 6 : 6<-4 : cost = 3
The path from 4 to 7 : 7<-6<-4 : cost = 12
The path from 4 to 8 : 8<-5<-4 : cost = 13
```

```
==============================
Source node = 5

The path from 5 to 1 : 1<-8<-5 : cost = 11
The path from 5 to 2 : 2<-5 : cost = 5
The path from 5 to 3 : 3<-2<-5 : cost = 10
The path from 5 to 4 : 4<-2<-5 : cost = 8
The path from 5 to 5 : 5<-5 : cost = 0
The path from 5 to 6 : 6<-4<-2<-5 : cost = 11
The path from 5 to 7 : 7<-6<-4<-2<-5 : cost = 20
The path from 5 to 8 : 8<-5 : cost = 5
==============================
Source node = 6

The path from 6 to 1 : 1<-6 : cost = 6
The path from 6 to 2 : 2<-3<-6 : cost = 13
The path from 6 to 3 : 3<-6 : cost = 6
The path from 6 to 4 : 4<-3<-6 : cost = 11
The path from 6 to 5 : 5<-8<-3<-6 : cost = 17
The path from 6 to 6 : 6<-6 : cost = 0
The path from 6 to 7 : 7<-6 : cost = 9
The path from 6 to 8 : 8<-3<-6 : cost = 15
==============================
Source node = 7

The path from 7 to 1 : 1<-6<-7 : cost = 9
The path from 7 to 2 : 2<-3<-7 : cost = 11
The path from 7 to 3 : 3<-7 : cost = 4
The path from 7 to 4 : 4<-7 : cost = 4
The path from 7 to 5 : 5<-4<-7 : cost = 12
The path from 7 to 6 : 6<-7 : cost = 3
The path from 7 to 7 : 7<-7 : cost = 0
The path from 7 to 8 : 8<-3<-7 : cost = 13
==============================
Source node = 8

The path from 8 to 1 : 1<-8 : cost = 6
The path from 8 to 2 : 2<-5<-8 : cost = 7
The path from 8 to 3 : 3<-1<-8 : cost = 11
The path from 8 to 4 : 4<-2<-5<-8 : cost = 10
The path from 8 to 5 : 5<-8 : cost = 2
The path from 8 to 6 : 6<-8 : cost = 7
The path from 8 to 7 : 7<-6<-8 : cost = 16
The path from 8 to 8 : 8<-8 : cost = 0
==============================
```

DEBUG FILE

```
Printing Cost Matrix
0     1     2     3     4     5     6     7     8
1     0     30    5     19    29    99999 99999 99999
2     99999 0     5     3     99999 17    99999 2
3     99999 7     0     5     99999 99999 28    9
4     6     99999 33    0     8     3     99999 99999
5     99999 5     99999 66    0     14    99999 5
6     6     99999 6     24    99999 0     9     99999
7     99999 15    4     4     99999 3     0     99999
8     6     99999 99999 99999 2     7     32    0

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 2 3 4 5 6 7 8
=============================
Printing Best Cost Array
0 30 5 19 29 99999 99999 99999
=============================
Printing Marked Array
1 0 1 0 0 0 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 1
minNode = 3
currentNode = 1
newCost = 0

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 3 3 4 5 6 7 8
=============================
Printing Best Cost Array
0 12 5 19 29 99999 99999 99999
=============================
Printing Marked Array
1 0 1 0 0 0 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 1
minNode = 3
```

```
currentNode = 2
newCost = 12

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 3 3 3 5 6 7 8
=============================
Printing Best Cost Array
0 12 5 10 29 99999 99999 99999
=============================
Printing Marked Array
1 0 1 0 0 0 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 1
minNode = 3
currentNode = 4
newCost = 10

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 3 3 3 5 6 3 8
=============================
Printing Best Cost Array
0 12 5 10 29 99999 33 99999
=============================
Printing Marked Array
1 0 1 0 0 0 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 1
minNode = 3
currentNode = 7
newCost = 33

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 3 3 3 5 6 3 3
=============================
Printing Best Cost Array
```

```
0 12 5 10 29 99999 33 14
=============================
Printing Marked Array
1 0 1 0 0 0 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 1
minNode = 3
currentNode = 8
newCost = 14

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 3 3 3 5 6 3 3
=============================
Printing Best Cost Array
0 12 5 10 29 99999 33 14
=============================
Printing Marked Array
1 0 1 1 0 0 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 1
minNode = 4
currentNode = 1
newCost = 14

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 3 3 3 4 6 3 3
=============================
Printing Best Cost Array
0 12 5 10 18 99999 33 14
=============================
Printing Marked Array
1 0 1 1 0 0 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 1
minNode = 4
currentNode = 5
```

```
newCost = 18

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 3 3 3 4 4 3 3
=============================
Printing Best Cost Array
0 12 5 10 18 13 33 14
=============================
Printing Marked Array
1 0 1 1 0 0 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 1
minNode = 4
currentNode = 6
newCost = 13

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 3 3 3 4 4 3 3
=============================
Printing Best Cost Array
0 12 5 10 18 13 33 14
=============================
Printing Marked Array
1 1 1 1 0 0 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 1
minNode = 2
currentNode = 1
newCost = 100009

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 3 3 3 4 4 3 3
=============================
Printing Best Cost Array
0 12 5 10 18 13 33 14
```

```
=============================
Printing Marked Array
1 1 1 1 0 1 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 1
minNode = 6
currentNode = 1
newCost = 14

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 3 3 3 4 4 6 3
=============================
Printing Best Cost Array
0 12 5 10 18 13 22 14
=============================
Printing Marked Array
1 1 1 1 0 1 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 1
minNode = 6
currentNode = 7
newCost = 22

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 3 3 3 4 4 6 3
=============================
Printing Best Cost Array
0 12 5 10 18 13 22 14
=============================
Printing Marked Array
1 1 1 1 0 1 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 1
minNode = 8
currentNode = 1
newCost = 100012
```

```
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 3 3 3 8 4 6 3
=============================
Printing Best Cost Array
0 12 5 10 16 13 22 14
=============================
Printing Marked Array
1 1 1 1 0 1 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 1
minNode = 8
currentNode = 5
newCost = 16

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 3 3 3 8 4 6 3
=============================
Printing Best Cost Array
0 12 5 10 16 13 22 14
=============================
Printing Marked Array
1 1 1 1 1 1 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 1
minNode = 5
currentNode = 1
newCost = 46

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 3 3 3 8 4 6 3
=============================
Printing Best Cost Array
0 12 5 10 16 13 22 14
=============================
```

```
Printing Marked Array
1 1 1 1 1 1 1 1
=============================
Printing Values
numNodes = 8
sourceNode = 1
minNode = 7
currentNode = 1
newCost = 100015

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 2 3 4 5 6 7 8
=============================
Printing Best Cost Array
99999 0 5 3 99999 17 99999 2
=============================
Printing Marked Array
0 1 0 0 0 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 2
minNode = 8
currentNode = 1
newCost = 100015

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
8 2 3 4 5 6 7 8
=============================
Printing Best Cost Array
8 0 5 3 99999 17 99999 2
=============================
Printing Marked Array
0 1 0 0 0 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 2
minNode = 8
currentNode = 1
newCost = 8
```

```
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
8 2 3 4 8 6 7 8
=============================
Printing Best Cost Array
8 0 5 3 4 17 99999 2
=============================
Printing Marked Array
0 1 0 0 0 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 2
minNode = 8
currentNode = 5
newCost = 4

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
8 2 3 4 8 8 7 8
=============================
Printing Best Cost Array
8 0 5 3 4 9 99999 2
=============================
Printing Marked Array
0 1 0 0 0 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 2
minNode = 8
currentNode = 6
newCost = 9

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
8 2 3 4 8 8 8 8
=============================
Printing Best Cost Array
8 0 5 3 4 9 34 2
=============================
Printing Marked Array
```

```
0 1 0 0 0 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 2
minNode = 8
currentNode = 7
newCost = 34

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
8 2 3 4 8 8 8 8
=============================
Printing Best Cost Array
8 0 5 3 4 9 34 2
=============================
Printing Marked Array
0 1 0 1 0 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 2
minNode = 4
currentNode = 1
newCost = 34

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
8 2 3 4 8 4 8 8
=============================
Printing Best Cost Array
8 0 5 3 4 6 34 2
=============================
Printing Marked Array
0 1 0 1 0 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 2
minNode = 4
currentNode = 6
newCost = 6

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
```

```
printing from outside
=============================
Printing Father Array
8 2 3 4 8 4 8 8
=============================
Printing Best Cost Array
8 0 5 3 4 6 34 2
=============================
Printing Marked Array
0 1 0 1 1 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 2
minNode = 5
currentNode = 1
newCost = 100002

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
8 2 3 4 8 4 8 8
=============================
Printing Best Cost Array
8 0 5 3 4 6 34 2
=============================
Printing Marked Array
0 1 1 1 1 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 2
minNode = 3
currentNode = 1
newCost = 100003

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
8 2 3 4 8 4 3 8
=============================
Printing Best Cost Array
8 0 5 3 4 6 33 2
=============================
Printing Marked Array
0 1 1 1 1 0 0 1
```

```
=============================
Printing Values
numNodes = 8
sourceNode = 2
minNode = 3
currentNode = 7
newCost = 33

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
8 2 3 4 8 4 3 8
=============================
Printing Best Cost Array
8 0 5 3 4 6 33 2
=============================
Printing Marked Array
0 1 1 1 1 1 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 2
minNode = 6
currentNode = 1
newCost = 33

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
8 2 3 4 8 4 6 8
=============================
Printing Best Cost Array
8 0 5 3 4 6 15 2
=============================
Printing Marked Array
0 1 1 1 1 1 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 2
minNode = 6
currentNode = 7
newCost = 15

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
```

```
=============================
Printing Father Array
8 2 3 4 8 4 6 8
=============================
Printing Best Cost Array
8 0 5 3 4 6 15 2
=============================
Printing Marked Array
1 1 1 1 1 1 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 2
minNode = 1
currentNode = 1
newCost = 15

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
8 2 3 4 8 4 6 8
=============================
Printing Best Cost Array
8 0 5 3 4 6 15 2
=============================
Printing Marked Array
1 1 1 1 1 1 1 1
=============================
Printing Values
numNodes = 8
sourceNode = 2
minNode = 7
currentNode = 1
newCost = 100007

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 2 3 4 5 6 7 8
=============================
Printing Best Cost Array
99999 7 0 5 99999 99999 28 9
=============================
Printing Marked Array
0 0 1 1 0 0 0 0
=============================
```

```
Printing Values
numNodes = 8
sourceNode = 3
minNode = 4
currentNode = 1
newCost = 100007

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
4 2 3 4 5 6 7 8
=============================
Printing Best Cost Array
11 7 0 5 99999 99999 28 9
=============================
Printing Marked Array
0 0 1 1 0 0 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 3
minNode = 4
currentNode = 1
newCost = 11

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
4 2 3 4 4 6 7 8
=============================
Printing Best Cost Array
11 7 0 5 13 99999 28 9
=============================
Printing Marked Array
0 0 1 1 0 0 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 3
minNode = 4
currentNode = 5
newCost = 13

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
```

```
Printing Father Array
4 2 3 4 4 4 7 8
=============================
Printing Best Cost Array
11 7 0 5 13 8 28 9
=============================
Printing Marked Array
0 0 1 1 0 0 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 3
minNode = 4
currentNode = 6
newCost = 8

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
4 2 3 4 4 4 7 8
=============================
Printing Best Cost Array
11 7 0 5 13 8 28 9
=============================
Printing Marked Array
0 1 1 1 0 0 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 3
minNode = 2
currentNode = 1
newCost = 100004

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
4 2 3 4 4 4 7 8
=============================
Printing Best Cost Array
11 7 0 5 13 8 28 9
=============================
Printing Marked Array
0 1 1 1 0 1 0 0
=============================
Printing Values
```

```
numNodes = 8
sourceNode = 3
minNode = 6
currentNode = 1
newCost = 9

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
4 2 3 4 4 4 6 8
=============================
Printing Best Cost Array
11 7 0 5 13 8 17 9
=============================
Printing Marked Array
0 1 1 1 0 1 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 3
minNode = 6
currentNode = 7
newCost = 17

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
4 2 3 4 4 4 6 8
=============================
Printing Best Cost Array
11 7 0 5 13 8 17 9
=============================
Printing Marked Array
0 1 1 1 0 1 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 3
minNode = 8
currentNode = 1
newCost = 100007

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
```

```
4 2 3 4 8 4 6 8
=============================
Printing Best Cost Array
11 7 0 5 11 8 17 9
=============================
Printing Marked Array
0 1 1 1 0 1 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 3
minNode = 8
currentNode = 5
newCost = 11

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
4 2 3 4 8 4 6 8
=============================
Printing Best Cost Array
11 7 0 5 11 8 17 9
=============================
Printing Marked Array
1 1 1 1 0 1 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 3
minNode = 1
currentNode = 1
newCost = 41

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
4 2 3 4 8 4 6 8
=============================
Printing Best Cost Array
11 7 0 5 11 8 17 9
=============================
Printing Marked Array
1 1 1 1 1 1 0 1
=============================
Printing Values
numNodes = 8
```

```
sourceNode = 3
minNode = 5
currentNode = 1
newCost = 100010

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
4 2 3 4 8 4 6 8
=============================
Printing Best Cost Array
11 7 0 5 11 8 17 9
=============================
Printing Marked Array
1 1 1 1 1 1 1 1
=============================
Printing Values
numNodes = 8
sourceNode = 3
minNode = 7
currentNode = 1
newCost = 100010

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 2 3 4 5 6 7 8
=============================
Printing Best Cost Array
6 99999 33 0 8 3 99999 99999
=============================
Printing Marked Array
0 0 0 1 0 1 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 4
minNode = 6
currentNode = 1
newCost = 100010

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 2 6 4 5 6 7 8
```

```
=============================
Printing Best Cost Array
6 99999 9 0 8 3 99999 99999
=============================
Printing Marked Array
0 0 0 1 0 1 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 4
minNode = 6
currentNode = 3
newCost = 9

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 2 6 4 5 6 6 8
=============================
Printing Best Cost Array
6 99999 9 0 8 3 12 99999
=============================
Printing Marked Array
0 0 0 1 0 1 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 4
minNode = 6
currentNode = 7
newCost = 12

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 2 6 4 5 6 6 8
=============================
Printing Best Cost Array
6 99999 9 0 8 3 12 99999
=============================
Printing Marked Array
1 0 0 1 0 1 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 4
```

```
minNode = 1
currentNode = 1
newCost = 100002

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 1 6 4 5 6 6 8
=============================
Printing Best Cost Array
6 36 9 0 8 3 12 99999
=============================
Printing Marked Array
1 0 0 1 0 1 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 4
minNode = 1
currentNode = 2
newCost = 36

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 1 6 4 5 6 6 8
=============================
Printing Best Cost Array
6 36 9 0 8 3 12 99999
=============================
Printing Marked Array
1 0 0 1 1 1 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 4
minNode = 5
currentNode = 1
newCost = 100005

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 5 6 4 5 6 6 8
=============================
```

```
Printing Best Cost Array
6 13 9 0 8 3 12 99999
=============================
Printing Marked Array
1 0 0 1 1 1 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 4
minNode = 5
currentNode = 2
newCost = 13

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 5 6 4 5 6 6 5
=============================
Printing Best Cost Array
6 13 9 0 8 3 12 13
=============================
Printing Marked Array
1 0 0 1 1 1 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 4
minNode = 5
currentNode = 8
newCost = 13

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 5 6 4 5 6 6 5
=============================
Printing Best Cost Array
6 13 9 0 8 3 12 13
=============================
Printing Marked Array
1 0 1 1 1 1 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 4
minNode = 3
```

```
currentNode = 1
newCost = 13

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 5 6 4 5 6 6 5
=============================
Printing Best Cost Array
6 13 9 0 8 3 12 13
=============================
Printing Marked Array
1 0 1 1 1 1 1 0
=============================
Printing Values
numNodes = 8
sourceNode = 4
minNode = 7
currentNode = 1
newCost = 18

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 5 6 4 5 6 6 5
=============================
Printing Best Cost Array
6 13 9 0 8 3 12 13
=============================
Printing Marked Array
1 1 1 1 1 1 1 0
=============================
Printing Values
numNodes = 8
sourceNode = 4
minNode = 2
currentNode = 1
newCost = 100011

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printing from outside
=============================
Printing Father Array
1 5 6 4 5 6 6 5
=============================
Printing Best Cost Array
```

```
6 13 9 0 8 3 12 13
=============================
Printing Marked Array
1 1 1 1 1 1 1 1
=============================
Printing Values
numNodes = 8
sourceNode = 4
minNode = 8
currentNode = 1
newCost = 15

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 2 3 4 5 6 7 8
=============================
Printing Best Cost Array
99999 5 99999 66 0 14 99999 5
=============================
Printing Marked Array
0 1 0 0 1 0 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 5
minNode = 2
currentNode = 1
newCost = 15

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 2 2 4 5 6 7 8
=============================
Printing Best Cost Array
99999 5 10 66 0 14 99999 5
=============================
Printing Marked Array
0 1 0 0 1 0 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 5
minNode = 2
currentNode = 3
```

```
newCost = 10

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printing from inside
=============================
Printing Father Array
1 2 2 2 5 6 7 8
=============================
Printing Best Cost Array
99999 5 10 8 0 14 99999 5
=============================
Printing Marked Array
0 1 0 0 1 0 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 5
minNode = 2
currentNode = 4
newCost = 8

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printing from outside
=============================
Printing Father Array
1 2 2 2 5 6 7 8
=============================
Printing Best Cost Array
99999 5 10 8 0 14 99999 5
=============================
Printing Marked Array
0 1 0 0 1 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 5
minNode = 8
currentNode = 1
newCost = 7

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
8 2 2 2 5 6 7 8
=============================
Printing Best Cost Array
11 5 10 8 0 14 99999 5
```

```
=============================
Printing Marked Array
0 1 0 0 1 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 5
minNode = 8
currentNode = 1
newCost = 11

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
8 2 2 2 5 8 7 8
=============================
Printing Best Cost Array
11 5 10 8 0 12 99999 5
=============================
Printing Marked Array
0 1 0 0 1 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 5
minNode = 8
currentNode = 6
newCost = 12

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
8 2 2 2 5 8 8 8
=============================
Printing Best Cost Array
11 5 10 8 0 12 37 5
=============================
Printing Marked Array
0 1 0 0 1 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 5
minNode = 8
currentNode = 7
newCost = 37
```

```
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
8 2 2 2 5 8 8 8
=============================
Printing Best Cost Array
11 5 10 8 0 12 37 5
=============================
Printing Marked Array
0 1 0 1 1 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 5
minNode = 4
currentNode = 1
newCost = 37

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
8 2 2 2 5 4 8 8
=============================
Printing Best Cost Array
11 5 10 8 0 11 37 5
=============================
Printing Marked Array
0 1 0 1 1 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 5
minNode = 4
currentNode = 6
newCost = 11

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
8 2 2 2 5 4 8 8
=============================
Printing Best Cost Array
11 5 10 8 0 11 37 5
=============================
```

```
Printing Marked Array
0 1 1 1 1 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 5
minNode = 3
currentNode = 1
newCost = 100007

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
8 2 2 2 5 4 8 8
=============================
Printing Best Cost Array
11 5 10 8 0 11 37 5
=============================
Printing Marked Array
1 1 1 1 1 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 5
minNode = 1
currentNode = 1
newCost = 38

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
8 2 2 2 5 4 8 8
=============================
Printing Best Cost Array
11 5 10 8 0 11 37 5
=============================
Printing Marked Array
1 1 1 1 1 1 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 5
minNode = 6
currentNode = 1
newCost = 100010
```

```
~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
8 2 2 2 5 4 6 8
=============================
Printing Best Cost Array
11 5 10 8 0 11 20 5
=============================
Printing Marked Array
1 1 1 1 1 1 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 5
minNode = 6
currentNode = 7
newCost = 20

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
8 2 2 2 5 4 6 8
=============================
Printing Best Cost Array
11 5 10 8 0 11 20 5
=============================
Printing Marked Array
1 1 1 1 1 1 1 1
=============================
Printing Values
numNodes = 8
sourceNode = 5
minNode = 7
currentNode = 1
newCost = 20

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 2 3 4 5 6 7 8
=============================
Printing Best Cost Array
6 99999 6 24 99999 0 9 99999
=============================
Printing Marked Array
```

```
1 0 0 0 0 1 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 6
minNode = 1
currentNode = 1
newCost = 20

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 1 3 4 5 6 7 8
=============================
Printing Best Cost Array
6 36 6 24 99999 0 9 99999
=============================
Printing Marked Array
1 0 0 0 0 1 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 6
minNode = 1
currentNode = 2
newCost = 36

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 1 3 4 1 6 7 8
=============================
Printing Best Cost Array
6 36 6 24 35 0 9 99999
=============================
Printing Marked Array
1 0 0 0 0 1 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 6
minNode = 1
currentNode = 5
newCost = 35

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
```

```
printing from outside
=============================
Printing Father Array
1 1 3 4 1 6 7 8
=============================
Printing Best Cost Array
6 36 6 24 35 0 9 99999
=============================
Printing Marked Array
1 0 1 0 0 1 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 6
minNode = 3
currentNode = 1
newCost = 100005

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 3 3 4 1 6 7 8
=============================
Printing Best Cost Array
6 13 6 24 35 0 9 99999
=============================
Printing Marked Array
1 0 1 0 0 1 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 6
minNode = 3
currentNode = 2
newCost = 13

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 3 3 3 1 6 7 8
=============================
Printing Best Cost Array
6 13 6 11 35 0 9 99999
=============================
Printing Marked Array
1 0 1 0 0 1 0 0
```

```
=============================
Printing Values
numNodes = 8
sourceNode = 6
minNode = 3
currentNode = 4
newCost = 11

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 3 3 3 1 6 7 3
=============================
Printing Best Cost Array
6 13 6 11 35 0 9 15
=============================
Printing Marked Array
1 0 1 0 0 1 0 0
=============================
Printing Values
numNodes = 8
sourceNode = 6
minNode = 3
currentNode = 8
newCost = 15

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 3 3 3 1 6 7 3
=============================
Printing Best Cost Array
6 13 6 11 35 0 9 15
=============================
Printing Marked Array
1 0 1 0 0 1 1 0
=============================
Printing Values
numNodes = 8
sourceNode = 6
minNode = 7
currentNode = 1
newCost = 15

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
```

```
=============================
Printing Father Array
1 3 3 3 1 6 7 3
=============================
Printing Best Cost Array
6 13 6 11 35 0 9 15
=============================
Printing Marked Array
1 0 1 1 0 1 1 0
=============================
Printing Values
numNodes = 8
sourceNode = 6
minNode = 4
currentNode = 1
newCost = 100008

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 3 3 3 4 6 7 3
=============================
Printing Best Cost Array
6 13 6 11 19 0 9 15
=============================
Printing Marked Array
1 0 1 1 0 1 1 0
=============================
Printing Values
numNodes = 8
sourceNode = 6
minNode = 4
currentNode = 5
newCost = 19

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 3 3 3 4 6 7 3
=============================
Printing Best Cost Array
6 13 6 11 19 0 9 15
=============================
Printing Marked Array
1 1 1 1 0 1 1 0
=============================
```

```
Printing Values
numNodes = 8
sourceNode = 6
minNode = 2
currentNode = 1
newCost = 100010

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 3 3 3 4 6 7 3
=============================
Printing Best Cost Array
6 13 6 11 19 0 9 15
=============================
Printing Marked Array
1 1 1 1 0 1 1 1
=============================
Printing Values
numNodes = 8
sourceNode = 6
minNode = 8
currentNode = 1
newCost = 15

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 3 3 3 8 6 7 3
=============================
Printing Best Cost Array
6 13 6 11 17 0 9 15
=============================
Printing Marked Array
1 1 1 1 0 1 1 1
=============================
Printing Values
numNodes = 8
sourceNode = 6
minNode = 8
currentNode = 5
newCost = 17

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
```

```
Printing Father Array
1 3 3 3 8 6 7 3
=============================
Printing Best Cost Array
6 13 6 11 17 0 9 15
=============================
Printing Marked Array
1 1 1 1 1 1 1 1
=============================
Printing Values
numNodes = 8
sourceNode = 6
minNode = 5
currentNode = 1
newCost = 17

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 2 3 4 5 6 7 8
=============================
Printing Best Cost Array
99999 15 4 4 99999 3 0 99999
=============================
Printing Marked Array
0 0 0 0 0 1 1 0
=============================
Printing Values
numNodes = 8
sourceNode = 7
minNode = 6
currentNode = 1
newCost = 17

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
6 2 3 4 5 6 7 8
=============================
Printing Best Cost Array
9 15 4 4 99999 3 0 99999
=============================
Printing Marked Array
0 0 0 0 0 1 1 0
=============================
Printing Values
```

```
numNodes = 8
sourceNode = 7
minNode = 6
currentNode = 1
newCost = 9

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
6 2 3 4 5 6 7 8
=============================
Printing Best Cost Array
9 15 4 4 99999 3 0 99999
=============================
Printing Marked Array
0 0 1 0 0 1 1 0
=============================
Printing Values
numNodes = 8
sourceNode = 7
minNode = 3
currentNode = 1
newCost = 100002

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
6 3 3 4 5 6 7 8
=============================
Printing Best Cost Array
9 11 4 4 99999 3 0 99999
=============================
Printing Marked Array
0 0 1 0 0 1 1 0
=============================
Printing Values
numNodes = 8
sourceNode = 7
minNode = 3
currentNode = 2
newCost = 11

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
```

```
6 3 3 4 5 6 7 3
=============================
Printing Best Cost Array
9 11 4 4 99999 3 0 13
=============================
Printing Marked Array
0 0 1 0 0 1 1 0
=============================
Printing Values
numNodes = 8
sourceNode = 7
minNode = 3
currentNode = 8
newCost = 13

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
6 3 3 4 5 6 7 3
=============================
Printing Best Cost Array
9 11 4 4 99999 3 0 13
=============================
Printing Marked Array
0 0 1 1 0 1 1 0
=============================
Printing Values
numNodes = 8
sourceNode = 7
minNode = 4
currentNode = 1
newCost = 13

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
6 3 3 4 4 6 7 3
=============================
Printing Best Cost Array
9 11 4 4 12 3 0 13
=============================
Printing Marked Array
0 0 1 1 0 1 1 0
=============================
Printing Values
numNodes = 8
```

```
sourceNode = 7
minNode = 4
currentNode = 5
newCost = 12

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
6 3 3 4 4 6 7 3
=============================
Printing Best Cost Array
9 11 4 4 12 3 0 13
=============================
Printing Marked Array
1 0 1 1 0 1 1 0
=============================
Printing Values
numNodes = 8
sourceNode = 7
minNode = 1
currentNode = 1
newCost = 100003

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
6 3 3 4 4 6 7 3
=============================
Printing Best Cost Array
9 11 4 4 12 3 0 13
=============================
Printing Marked Array
1 1 1 1 0 1 1 0
=============================
Printing Values
numNodes = 8
sourceNode = 7
minNode = 2
currentNode = 1
newCost = 100008

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printing from outside
=============================
Printing Father Array
6 3 3 4 4 6 7 3
```

```
=============================
Printing Best Cost Array
9 11 4 4 12 3 0 13
=============================
Printing Marked Array
1 1 1 1 1 1 1 0
=============================
Printing Values
numNodes = 8
sourceNode = 7
minNode = 5
currentNode = 1
newCost = 13

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
6 3 3 4 4 6 7 3
=============================
Printing Best Cost Array
9 11 4 4 12 3 0 13
=============================
Printing Marked Array
1 1 1 1 1 1 1 1
=============================
Printing Values
numNodes = 8
sourceNode = 7
minNode = 8
currentNode = 1
newCost = 17

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 2 3 4 5 6 7 8
=============================
Printing Best Cost Array
6 99999 99999 99999 2 7 32 0
=============================
Printing Marked Array
0 0 0 0 1 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 8
```

```
minNode = 5
currentNode = 1
newCost = 17

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 5 3 4 5 6 7 8
=============================
Printing Best Cost Array
6 7 99999 99999 2 7 32 0
=============================
Printing Marked Array
0 0 0 0 1 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 8
minNode = 5
currentNode = 2
newCost = 7

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 5 3 5 5 6 7 8
=============================
Printing Best Cost Array
6 7 99999 68 2 7 32 0
=============================
Printing Marked Array
0 0 0 0 1 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 8
minNode = 5
currentNode = 4
newCost = 68

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 5 3 5 5 6 7 8
=============================
```

```
Printing Best Cost Array
6 7 99999 68 2 7 32 0
=============================
Printing Marked Array
1 0 0 0 1 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 8
minNode = 1
currentNode = 1
newCost = 100001

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 5 1 5 5 6 7 8
=============================
Printing Best Cost Array
6 7 11 68 2 7 32 0
=============================
Printing Marked Array
1 0 0 0 1 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 8
minNode = 1
currentNode = 3
newCost = 11

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 5 1 1 5 6 7 8
=============================
Printing Best Cost Array
6 7 11 25 2 7 32 0
=============================
Printing Marked Array
1 0 0 0 1 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 8
minNode = 1
```

```
currentNode = 4
newCost = 25

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printing from outside
=============================
Printing Father Array
1 5 1 1 5 6 7 8
=============================
Printing Best Cost Array
6 7 11 25 2 7 32 0
=============================
Printing Marked Array
1 1 0 0 1 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 8
minNode = 2
currentNode = 1
newCost = 100005

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printing from inside
=============================
Printing Father Array
1 5 1 2 5 6 7 8
=============================
Printing Best Cost Array
6 7 11 10 2 7 32 0
=============================
Printing Marked Array
1 1 0 0 1 0 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 8
minNode = 2
currentNode = 4
newCost = 10

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 5 1 2 5 6 7 8
=============================
Printing Best Cost Array
```

```
6 7 11 10 2 7 32 0
=============================
Printing Marked Array
1 1 0 0 1 1 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 8
minNode = 6
currentNode = 1
newCost = 100006

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from inside
=============================
Printing Father Array
1 5 1 2 5 6 6 8
=============================
Printing Best Cost Array
6 7 11 10 2 7 16 0
=============================
Printing Marked Array
1 1 0 0 1 1 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 8
minNode = 6
currentNode = 7
newCost = 16

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 5 1 2 5 6 6 8
=============================
Printing Best Cost Array
6 7 11 10 2 7 16 0
=============================
Printing Marked Array
1 1 0 1 1 1 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 8
minNode = 4
currentNode = 1
```

```
newCost = 16

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 5 1 2 5 6 6 8
=============================
Printing Best Cost Array
6 7 11 10 2 7 16 0
=============================
Printing Marked Array
1 1 1 1 1 1 0 1
=============================
Printing Values
numNodes = 8
sourceNode = 8
minNode = 3
currentNode = 1
newCost = 100009

~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
printing from outside
=============================
Printing Father Array
1 5 1 2 5 6 6 8
=============================
Printing Best Cost Array
6 7 11 10 2 7 16 0
=============================
Printing Marked Array
1 1 1 1 1 1 1 1
=============================
Printing Values
numNodes = 8
sourceNode = 8
minNode = 7
currentNode = 1
newCost = 39
```