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Project Due Date: 10/30/2020

Algorithm Steps:

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) 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]</pre> 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

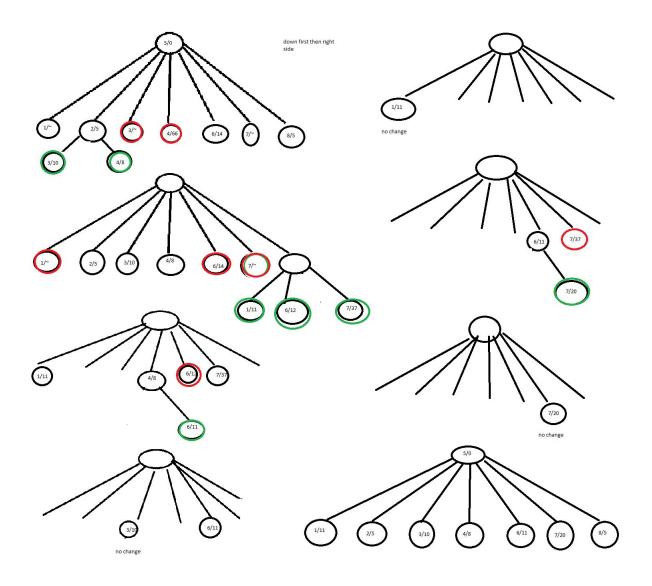
step 15: close all files

	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

Source node 5:

fatherAry	5	5	5	5	5	5	5	5
bestCostA								
ry	99999	5	99999	66	0	14	99999	5
markedAr								
у	0	1	0	0	1	0	0	0
fatherAry	5	5	2	2	5	5	5	5
bestCostA								
ry	99999	5	10	8	0	14	99999	5
markedAr								
у	0	1	0	0	1	0	0	1
fatherAry	8	5	2	2	5	8	8	5
bestCostA								
ry	11	5	10	8	0	12	37	5
markedAr								
у	0	1	0	1	1	0	0	1
fatherAry	8	5	2	2	5	4	8	5
bestCostA								
ry	11	5	10	8	0	11	37	5
markedAr								
У	0	1	1	1	1	0	0	1

fatherAry	8	5	2	2	5	4	8	5
bestCostA ry	11	5	10	8	0	11	37	5
markedAr y	1	1	1	1	1	0	0	1
fatherAry	8	5	2	2	5	4	8	5
bestCostA ry	11	5	10	8	0	11	37	5
markedAr y	1	1	1	1	1	1	0	1
fatherAry	8	5	2	2	5	4	6	5
bestCostA ry	11	5	10	8	0	11	20	5
markedAr y	1	1	1	1	1	1	1	1



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

using namespace std;

class DijkstraSSS {
 public:
    int numNodes;
    int sourceNode = 1;
    int minNode = 0;
    int currentNode = 1;
    int newCost = 99999;
```

```
int **costMatrix;
int *fatherAry;
int *markedAry;
int *bestCostAry;
DijkstraSSS(int n) {
        numNodes = n;
       costMatrix = new int*[numNodes + 1];
       for (int i = 1; i < numNodes + 1; i++) {
               costMatrix[i] = new int[numNodes + 1];
       }
       for (int i = 1; i < numNodes + 1; i++) {
               for (int j = 1; j < numNodes + 1; j++) {
                       if (i == j)
                               costMatrix[i][i] = 0;
                       else {
                               costMatrix[i][j] = 99999;
                       }
               }
       }
       fatherAry = new int[numNodes + 1];
       for (int i = 1; i < numNodes + 1; i++) {
               fatherAry[i] = i;
       }
       markedAry = new int[numNodes + 1];
       for (int i = 1; i < numNodes + 1; i++) {
               markedAry[i] = 0;
       }
        bestCostAry = new int[numNodes + 1];
       for (int i = 1; i < numNodes + 1; i++) {
               bestCostAry[i] = 99999;
       }
}
void loadCostMatrix(ifstream &inFile) {
       int node1;
       int node2;
       int cost;
       while (inFile) {
               inFile >> node1;
```

```
inFile >> node2;
               inFile >> cost;
               costMatrix[node1][node2] = cost;
       }
}
void setBestCostAry() {
       for (int i = 1; i < numNodes + 1; i++) {
               bestCostAry[i] = costMatrix[sourceNode][i];
       }
}
void setFatherAry() {
       for (int i = 1; i < numNodes + 1; i++) {
               fatherAry[i] = sourceNode;
       }
}
void setMarkedAry() {
       for (int i = 1; i < numNodes + 1; i++) {
               markedAry[i] = 0;
       markedAry[sourceNode] = 1;
}
int findMinNode() {
       int minCost = 99999;
       minNode = 0;
       int index = 1;
       while (index <= numNodes) {</pre>
               if (markedAry[index] == 0) {
                      if (bestCostAry[index] < minCost) {</pre>
                              minCost = bestCostAry[index];
                              minNode = index;
                      }
               }
               index++;
       return minNode;
}
int computeCost() {
       sum = bestCostAry[minNode] + costMatrix[minNode][currentNode];
```

```
return sum;
      }
      void debugPrint(ofstream &debugFile) {
             endl;
             debugFile << "The sourceNode is: " << sourceNode << endl;</pre>
             debugFile << "The fatherAry is: " << endl;</pre>
             for (int i = 1; i < numNodes + 1; i++) {
                    debugFile << fatherAry[i] << "\t";
             }
             debugFile << endl << "The bestCostAry is: " << endl;</pre>
             for (int i = 1; i < numNodes + 1; i++) {
                    debugFile << bestCostAry[i] << "\t";</pre>
             }
             debugFile << endl << "The markedAry is: " << endl;</pre>
             for (int i = 1; i < numNodes + 1; i++) {
                    debugFile << markedAry[i] << "\t";
             }
             debugFile << endl;</pre>
      }
      void printShortestPath(ofstream &SSSfile) {
             if (sourceNode == 1 && currentNode == 1) {
                    SSSfile << "======== " << endl:
                    SSSfile << "There are " << numNodes
                                  << " nodes in the input graph. Below are all pairs of the
shortest paths:"
                                  << endl;
             }
             if (currentNode == 1) {
                    SSSfile << "========" << endl;
                    SSSfile << "The source node = " << sourceNode << endl << endl;
             SSSfile << "The path from " << sourceNode << " to " << currentNode
                           << ": ":
             SSSfile << currentNode << "<-";
             int path = fatherAry[currentNode];
             int cost = bestCostAry[currentNode];
             while (path != sourceNode) {
```

```
SSSfile << path << "<-";
                      cost += bestCostAry[path];
                      path = fatherAry[path];
               SSSfile << sourceNode;
               SSSfile << ": cost = " << cost << endl;
       }
}
int main(int argc, const char *argv[]) {
       string in = argv[1];
       ifstream inFile = ifstream(in);
       string out = argv[2];
       ofstream SSSfile = ofstream(out);
       string out2 = argv[3];
       ofstream debugFile = ofstream(out2);
       int numNodes:
       inFile >> numNodes;
       DijkstraSSS sss = DijkstraSSS(numNodes);
       sss.loadCostMatrix(inFile);
       sss.sourceNode = 1;
       while (sss.sourceNode <= numNodes) {</pre>
               sss.setBestCostAry();
               sss.setFatherAry();
               sss.setMarkedAry();
               int flag = 1;
              while (flag) {
                      sss.minNode = sss.findMinNode();
                      sss.markedAry[sss.minNode] = 1;
                      sss.debugPrint(debugFile);
                      sss.currentNode = 1;
                      while (sss.currentNode <= numNodes) {</pre>
                             if (sss.markedAry[sss.currentNode] == 0) {
                                     sss.newCost = sss.computeCost();
                                     if (sss.newCost < sss.bestCostAry[sss.currentNode]) {</pre>
                                            sss.bestCostAry[sss.currentNode] = sss.newCost;
                                            sss.fatherAry[sss.currentNode] = sss.minNode;
```

```
sss.debugPrint(debugFile);
                                     }
                              }
                              sss.currentNode++;
                      }
                      flag = 0;
                      for (int i = 1; i < numNodes + 1; i++) {
                              if (sss.markedAry[i] == 0) {
                                     flag = 1;
                              }
                      }
               }
               sss.currentNode = 1;
               while (sss.currentNode <= numNodes) {</pre>
                      sss.printShortestPath(SSSfile);
                      sss.currentNode++;
               }
               sss.sourceNode++;
       }
       inFile.close();
       debugFile.close();
       SSSfile.close();
       return 0;
}
```

Debugfile

The sourceNode is: 1 The fatherAry is:

1 1	1	1	1	1	1	1
The bestCo	stArv is:	-				-
0 30	5	19	29	99999	99999	99999
The marked						
1 0	1	0	0	0	0	0
=======		=====	=====	=====	=====	=====
The source	Node is: 1					
The fatherA	ry is:					
1 3	1	1	1	1	1	1
The bestCo	stAry is:					
0 12	5	19	29	99999	99999	99999
The market	dAry is:					
1 0	1	0	0	0	0	0
=======		=====	=====	=====	=====	=====
The source						
The fatherA	ry is:					
1 3	1	3	1	1	1	1
The bestCo	•					
0 12	5	10	29	99999	99999	99999
The market	· .	_				
1 0	1	0	0	0	0	0
The serves	:======: Nada ia: 1	=====	=====		=====	=====
The source						
The father A	1 1 15.	3	1	1	3	1
The bestCo	•	3	1	I	J	I
0 12	5	10	29	99999	33	99999
The marked	_	10	29	99999	33	99999
1 0	u∧iyis. 1	0	0	0	0	0
	' :=====:	-====	=====	.=====		=====
The source	Node is: 1					
The father						
1 3	1	3	1	1	3	3
The bestCo	=	-	•	=	-	-
	5	10	29	99999	33	14
The market	_	. •		32300		
1 0	1	0	0	0	0	0
=======	:=====:	=====	=====	=====	=====	=====
The source	Node is: 1					
The fatherA	Ary is:					
1 3	1	3	1	1	3	3
The bestCo	stAry is:					
0 12	5	10	29	99999	33	14
The market	dAry is:					

1	0	1	1	0	0	0	0
====	======	=====	=====	=====	=====	=====	
	sourceNo						
	atherAry	' IS: 1	3	4	1	3	3
1 The h	3 pestCost	Ληνie:	3	4	1	3	3
0	12	Aiyis. 5	10	18	99999	22	14
	narkedA		10	10	99999	33	14
1	0	1 y 15. 1	1	0	0	0	0
' ====	=====	' =====	' ======	=====		=====	=====
The s	sourceNo	ode is: 1					
	atherAry						
1	3	1	3	4	4	3	3
The b	estCost	Arv is:					-
0	12	5	10	18	13	33	14
	narkedA	-					
1	0	1	1	0	0	0	0
====	=====	=====	=====	=====	=====	=====	=====
The s	sourceNo	ode is: 1					
The f	atherAry	is:					
1	3	1	3	4	4	3	3
The b	estCost	Ary is:					
0	12	5	10	18	13	33	14
The r	narkedA	ry is:					
1	1	1	1	0	0	0	0
====	=====	=====	=====	=====	=====	=====	=====
	sourceNo						
	atherAry	is:					
1	3	1	3	4	4	3	3
	pestCost						
	12		10	18	13	33	14
_	narkedA	ry is:				_	
1	1	1	1	0	1	0	0
====	:=====:		_=====	=====	=====	=====	=====
	sourceNo						
	atherAry		2	4	4	0	2
1 The l	3 tCt	1 ^ m / io/	3	4	4	6	3
	pestCost	-	10	10	12	22	1.1
0 Thor	12 narkod 4	5 rv is:	10	18	13	22	14
The r	markedA 1	ıyıs. 1	1	0	1	0	0
' 	ı 	' 	' 		' 		
		=		=	=		

The sourceNode is: 1 The fatherAry is:

1 3	1	3	4	4	6	3
	CostAry is:					
0 12		10	18	13	22	14
The mark	cedAry is:		_	_		
1 1	1	1	0	1	0	1
The second		:=====		=====	=====	=====
	ceNode is: 1					
The fathe	HAIYIS.	3	8	4	6	3
	CostAry is:	3	0	4	0	3
0 12	-	10	16	13	22	14
The mark	_	10	10	10		17
1 1	1	1	0	1	0	1
======	=======	· :=====	:=====	· =====	=====	· :=====
The sour	ceNode is: 1					
The father	erAry is:					
1 3	1	3	8	4	6	3
The best	CostAry is:					
0 12	2 5	10	16	13	22	14
The mark	cedAry is:					
1 1	1	1	1	1	0	1
======	=======	=====	=====	=====	=====	=====
	ceNode is: 1					
The fathe	_		_	_		
1 3	1	3	8	4	6	3
	CostAry is:	4.0	4.0	40	00	4.4
0 12	_	10	16	13	22	14
The mark	(edAry is:	4	4	4	4	4
1 1	 	1 	1 	1 	1 	1
The sour	 ceNode is: 2	·				
The sour		_				
2 2	2	2	2	2	2	2
	CostAry is:	_	_	_	_	_
99999 0	5	3	99999	17	99999	2
The mark	•	Ū	00000	• •	00000	_
0 1	0	0	0	0	0	1
======	=======	=====		=====	=====	=====
The sour	ceNode is: 2	2				
The father	erAry is:					
8 2	2	2	2	2	2	2
The best	CostAry is:					
8 0	5	3	99999	17	99999	2
The mark	cedAry is:					

0	1	0	0	0	0	0	1
==== The	:===== :ourceN	====== lode is: <i>1</i>	:====: 2	=====	=====	:====:	=====
	atherAr		_				
8	2	2	2	8	2	2	2
The I	estCos	tAry is:					
8	0	5	3	4	17	99999	2
The i	marked/	Ary is:					
0	1	0	0	0	0	0	1
====	=====			=====	=====		=====
The	sourceN	lode is: 2	2				
The f	atherAr	y is:					
8	2	2	2	8	8	2	2
	pestCos	•		_	_		_
8	0	5	3	4	9	99999	2
	marked/	Ary is:	•		•	•	4
0	1	0	0	0	0	0	1
Tho		 lada ia: '	-====: >		=====		
		lode is: 2	2				
8	atherAr 2	y is. 2	2	8	8	8	2
	estCos		2	O	O	O	_
8	0	5	3	4	9	34	2
_	narked <i>i</i>	_	Ū	•	Ü	0.	_
0	1	0	0	0	0	0	1
====	=====	======	=====	=====	=====		=====
The	sourceN	lode is: 2	2				
The f	atherAr	y is:					
8	2	2	2	8	8	8	2
The I	pestCos	tAry is:					
8	0	5	3	4	9	34	2
The i	marked	۹ry is:					
0	1	0	1	0	0	0	1
====	=====			=====	=====	:=====	=====
		lode is: 2	2				
	atherAr		_	_		_	_
8	2	2	2	8	4	8	2
	pestCos	•	0	4	0	0.4	0
8 The	0 markad	5 ^ m v i o :	3	4	6	34	2
	marked <i>i</i> 1	Ary IS:	1	0	0	Λ	1
0	' :===		' 	0 =====	0 =====	0	' ====

The sourceNode is: 2 The fatherAry is:

8	2	2	2	8	4	8	2
The be	stCost	Ary is:					
8	0	5	3	4	6	34	2
The ma	arkedA	ry is:					
0	1	0	1	1	0	0	1
=====	=====:		===== `	:=====	=====	=====	
		ode is: 2	<u> </u>				
The fat	eAy 2	15. 2	2	8	4	8	2
The be	_	_	2	0	4	0	2
8	0	5	3	4	6	34	2
The ma	-	-	3	7	O	-	_
0	1	1 y 13. 1	1	1	0	0	1
=====	' =====:	' ======	======	:=====:	-====	=====	' =====
The so	urceNo	ode is: 2	<u>)</u>				
The fat							
8	2	2	2	8	4	3	2
The be	stCost	Ary is:					
8	0	5	3	4	6	33	2
The ma	arkedA	ry is:					
0	1	1	1	1	0	0	1
=====	=====	=====	=====	=====	=====	=====	=====
The so	urceNo	ode is: 2	2				
The fat	herAry	is:					
8	2	2	2	8	4	3	2
The be	stCost	•					
8	0	5	3	4	6	33	2
The ma	arkedA	ry is:		_	_	_	
0	1	1	1	1	1	0	1
=====:	====:	======	===== `	:=====	=====	=====	=====
		ode is: 2	•				
The fat	_	_	2	0	4	6	2
8 The be	2 etCost	2 Any io:	2	8	4	6	2
The be	0	41 y 15. 5	3	4	6	15	2
The ma	•	-	3	4	6	15	2
0	1	1 y 13. 1	1	1	1	0	1
=====	' =====:	' =====	' =====	' :=====:	' =====	=====	' :=====
The so	urceNo	de is: 2	•				
The fat							
8	2	2	2	8	4	6	2
The be		_		-		-	
8	0	5	3	4	6	15	2
The ma	arkedA	ry is:					

1	1	1	1	1	1	0	1
====	====== N	:===== - d	=====	:=====	=====	=====	=====
	sourceN fatherAry		<u>′</u>				
8	2	y is. 2	2	8	4	6	2
	bestCos	_	2	O	7	O	_
8	0	5	3	4	6	15	2
_	marked <i>A</i>		Ü	•	Ü	10	_
1	1	1	1	1	1	1	1
====		=====	=====	:=====	=====	=====	=====
The	sourceN	ode is: 3	3				
The	fatherAry	y is:					
3	3	3	3	3	3	3	3
The	bestCos	tAry is:					
9999	9 7	0	5	99999	99999	28	9
The	marked <i>P</i>	Ary is:					
0	0	1	1	0	0	0	0
====		:=====	=====	:=====	=====	=====	=====
	sourceN		3				
	fatherAry			_			
4	3	3	3	3	3	3	3
	bestCos		_	00000	00000	00	•
11 The	7 	0	5	99999	99999	28	9
_	marked <i>A</i>	Ary is:	4	0	0	0	0
0	0 	I 	1 	0	0 	0 	0
The	sourceN	ode is: 3					
	fatherAry		,				
4	3	y 13. 3	3	4	3	3	3
	bestCos [.]	-	Ü	•	Ü	Ü	Ü
11	7	-	5	13	99999	28	9
The	marked <i>P</i>						
0	0	1	1	0	0	0	0
====	=====	=====	=====	=====	=====	=====	=====
The	sourceN	ode is: 3	3				
The	fatherAry	y is:					
4	3	3	3	4	4	3	3
The	bestCos	tAry is:					
11	7	0	5	13	8	28	9
The	marked <i>P</i>	Ary is:					
0	0	1	1	0	0	0	0
====			=====	:=====	=====	=====	=====

The sourceNode is: 3 The fatherAry is:

-	3	3	3	4	4	3	3
	_	stAry is:	_	40	•	00	•
11 The :	7	0	5	13	8	28	9
me i 0	marked 1	dAry is:	1	0	0	0	0
-===	' :=====	' :====::	' =====	=====	====:	======	 =======
The	source	Node is:	3				
_	fatherA						
4	3	3	3	4	4	3	3
The I	bestCo	stAry is:					
11	7	0	5	13	8	28	9
The	marked	dAry is:					
0	1	1	1	0	1	0	0
====	=====	:====::	====	=====	=====	=====	======
_		Node is:	3				
	fatherA		0	4	4	0	0
4 Tha 1	3 baatCa	3	3	4	4	6	3
1 ne 1 11		stAry is:	E	40	0	47	0
• •	7 markov	1Λην ic:	5	13	8	17	9
111 e 1 0	1	dAry is:	1	0	1	0	0
U				U		U	U
====	=====		====	=====	=====	=====	
==== The :	===== source	====== Node is:	==== 3	=====	====:	=====	======
		Node is:	==== 3	=====	====:	=====:	======
The 1	source father 3		===== 3 3	==== 4	===== 4	====== 6	3
The 1	fatherA	ry is:		4	4	6	3
The 1 4 The I	fatherA	ary is: 3		4 13	4 8	6 17	3
The 1 4 The 1 11	fatherA 3 bestCo 7	ary is: 3 ostAry is:	3	•	•	-	
The 1 4 The 1 11	fatherA 3 bestCo 7	ary is: 3 ostAry is: 0	3	•	•	-	
The 1 4 The 1 11 The 1 0	fatherA 3 bestCo 7 markeo 1	ary is: 3 9stAry is: 0 dAry is: 1	3 5 1	13	8	-	
The factor of th	fatherA 3 bestCo 7 markeo 1 =====	ary is: 3 ostAry is: 0 dAry is: 1 seeeeeeeeeee	3 5 1	13	8	-	
The factor of th	fatherA 3 bestCo 7 marked 1 ===== source fatherA	ary is: 3 9stAry is: 0 dAry is: 1 ======= Node is: ary is:	3 5 1 ===== 3	13 0 =====	8 1 =====	17 0 ======	9 1 ======
The factor of th	fatherA 3 bestCo 7 markeo 1 ===== source fatherA	ary is: 3 9stAry is: 0 dAry is: 1 ======= Node is: ary is: 3	3 5 1	13	8	-	
The factor of th	fatherA 3 bestCo 7 marked 1 ===== source fatherA bestCo	ary is: 3 ostAry is: 0 dAry is: 1 second is: Node is: ary is: 3 ostAry is:	3 5 1 ===== 3 3	13 0 ======	8 1 ======	17 0 ======	9 1
The factor of th	fatherA 3 bestCo 7 marked 1 ===== source fatherA 3 bestCo 7	ary is: 3 9stAry is: 0 dAry is: 1 ======= Node is: ary is: 3 9stAry is: 0	3 5 1 ===== 3	13 0 =====	8 1 =====	17 0 ======	9 1 ======
The factor of th	fatherA 3 bestCo 7 marked 1 ===== source fatherA bestCo 7 marked	ary is: 3 ostAry is: 0 dAry is: 1 second is: Node is: ary is: 3 ostAry is:	3 5 1 ===== 3 3 5	13 0 ====== 8 11	8 1 ====== 4 8	17 0 ===================================	9 1 ======= 3 9
The factor of th	fatherA 3 bestCo 7 marked 1 ===== source fatherA 3 bestCo 7	ary is: 3 9stAry is: 0 dAry is: 1 ======= Node is: ary is: 3 9stAry is: 0	3 5 1 ===== 3 3	13 0 ======	8 1 ======	17 0 ======	9 1
The factor of th	fatherA 3 bestCo 7 markeo 1 source fatherA 3 bestCo 7 markeo 1 =====	Ary is: 3 0stAry is: 0 dAry is: 1 SECULTION Node is: Ary is: 3 0stAry is: 0 dAry is: 1	3 5 1 ===== 3 3 5 1	13 0 ====== 8 11	8 1 ====== 4 8	17 0 ===================================	9 1 ======= 3 9
The factor of th	fatherA 3 bestCo 7 marked 3 bestCo 7 marked 1 =====	Ary is: 3 9stAry is: 0 dAry is: 1 ====== Node is: 3 9stAry is: 0 dAry is: 1 ====== Node is:	3 5 1 ===== 3 3 5 1	13 0 ====== 8 11	8 1 ====== 4 8	17 0 ===================================	9 1 ======= 3 9
The factor of th	fatherA 3 bestCo 1 ===== source fatherA 7 markeo 1 ===== source fatherA	Ary is: 3 0stAry is: 0 dAry is: 1 SECONDARY IS: 3 0stAry is: 0 dAry is: 1 SECONDARY IS: 1 SEC	3 5 1 ===== 3 5 1 =====	13 0 ====== 8 11 0 ======	8 1 ====== 4 8 1 =====	17 0 ===================================	9 1
The factor of th	fatherA 3 bestCo 7 marked 3 bestCo 7 marked 1 ===== source fatherA 3 source 1 ===== source fatherA	Ary is: 3 OstAry is: 0 dAry is: 1 SEESSE 3 OSTARY is: 0 dAry is: 1 SEESSE 1 SEESSE 1 SEESSE 3 Node is: 1 SEESSE 3 Node is: 3 Node is: 3 Node is: 3	3 5 1 ===== 3 3 5 1	13 0 ====== 8 11	8 1 ====== 4 8	17 0 ===================================	9 1 ======= 3 9
The factor of th	fatherA 3 bestCo 7 marked 3 bestCo 7 marked 1 ===== source fatherA 3 source 1 ===== source fatherA	Ary is: 3 0stAry is: 0 dAry is: 1 SECONDARY IS: 3 0stAry is: 0 dAry is: 1 SECONDARY IS: 1 SEC	3 5 1 ===== 3 5 1 =====	13 0 ====== 8 11 0 ======	8 1 ====== 4 8 1 =====	17 0 ===================================	9 1

1	1	1	1	0	1	0	1
===: The	source	:====== Node is: 3	:====: }	=====	=====	=====	=====
	fatherA		•				
4	3	3	3	8	4	6	3
		stAry is:	_				
11 The	7	0	5	11	8	17	9
The	marked	Ary is:	1	1	1	0	1
===:	' =====	' :======	' :====:	' =====	' =====	:=====	' :=====
The	source	Node is: 3	3				
The	fatherA	ry is:					
4	3	3	3	8	4	6	3
		stAry is:	_	44	0	47	•
11 Tho	7 marked	0 Μανία:	5	11	8	17	9
1	1	1741 y 15. 1	1	1	1	1	1
===:	======	:======	:=====	=====	' =====	:=====	:=====
The	source	Node is: 4	1				
The	fatherA	ry is:					
4	4	4	4	4	4	4	4
		stAry is:	•	•	•	00000	
6 Tho		99 33	0	8	3	99999	99999
0	marked 0	1741 y 15. O	1	0	1	0	0
===:	=====	:=====	' :====:	=====	' =====	:=====	:====
The	source	Node is: 4	1				
The	fatherA	ry is:					
4	4	6	4	4	4	4	4
		stAry is:	•				
	9999		0	8	3	99999	99999
o ne	marked 0	IAry IS: ∩	1	0	1	0	0
===:	=====	======	' :=====	=====	' =====	:=====	:====
The	source	Node is: 4	1				
The	fatherA	ry is:					
4	4	6	4	4	4	6	4
		stAry is:		_			
6 Th a		99 9	0	8	3	12	99999
The 0	marked 0	ıAry IS: ∩	1	0	1	0	0
===:	 ======	.======	' :=====		' =====	·=====	=====

The sourceNode is: 4 The fatherAry is:

	4	4	4	6	4
The bestCostAry is:					
6 99999 9	0	8	3	12	99999
The markedAry is:				_	
1 0 0	1	0	1	0	0
The sourceNode is:	 4				
The fatherAry is:	•				
4 1 6	4	4	4	6	4
The bestCostAry is:				-	
6 36 9	0	8	3	12	99999
The markedAry is:					
1 0 0	1	0	1	0	0
	=====	=====	=====	=====	=====
The sourceNode is:	4				
The fatherAry is:					
4 1 6	4	4	4	6	4
The bestCostAry is:					
6 36 9	0	8	3	12	99999
The markedAry is:	_	_	_	_	_
1 0 0	1	1	1	0	0
The sourceNode is: The fatherAry is: 4 5 6	4	4	4	6	4
The bestCostAry is:					
6 13 9	0	8	3	12	99999
The markedAry is:					
	1			_	_
1 0 0	1	1	1	0	0
1 0 0 ==================================	=====	1 =====	1 =====:	0 =====	0 =====
1 0 0 ==================================	=====	1 =====	1 :====:	0 =====	0 =====
The fatherAry is:	===== 4	-====	1 =====: 4	=====:	=====
The fatherAry is: 4 5 6	4	1 ====== 4	1 =====: 4	0 ====== 6	0 ====== 5
The fatherAry is: 4 5 6 The bestCostAry is:	4	-====	1 ====== 4 3	6	5 5
The fatherAry is: 4 5 6 The bestCostAry is: 6 13 9	4 4	4		=====:	=====
The fatherAry is: 4 5 6 The bestCostAry is:	4 4	4		6	5 5
The fatherAry is: 4 5 6 The bestCostAry is: 6 13 9 The markedAry is:	4 0	4 8	3	6 12	5 13
The fatherAry is: 4 5 6 The bestCostAry is: 6 13 9 The markedAry is:	4 4 0	4 8	3	6 12	5 13
The fatherAry is: 4 5 6 The bestCostAry is: 6 13 9 The markedAry is: 1 0 0 =================================	4 4 0	4 8	3	6 12	5 13
The fatherAry is: 4 5 6 The bestCostAry is: 6 13 9 The markedAry is: 1 0 0 =================================	4 4 0	4 8	3	6 12	5 13
The fatherAry is: 4 5 6 The bestCostAry is: 6 13 9 The markedAry is: 1 0 0 =================================	4 4 0 1 ======	4 8 1 =====	3 1 =====	6 12 0	5 13 0
The fatherAry is: 4 5 6 The bestCostAry is: 6 13 9 The markedAry is: 1 0 0 =================================	4 4 0 1 ======	4 8 1 =====	3 1 =====	6 12 0	5 13 0

1	0	1	1	1	1	0	0				
====	======	=====:	=====	=====	=====	=====	=====				
	The sourceNode is: 4										
	atherAry	_		4		0	_				
4 The set	5	6	4	4	4	6	5				
	estCost	-	0	0	0	40	40				
6 Tl	13	9	0	8	3	12	13				
_	narkedA	ry is:									
1	0	1	1	1	1	1	0				
====	======	=====:	=====	:====:	=====	=====	=====				
	sourceNo										
	atherAry -	_				_	_				
4	5	6	4	4	4	6	5				
The b	estCost	Ary is:									
6	13	9	0	8	3	12	13				
The r	narkedA	ry is:									
1	1	1	1	1	1	1	0				
====	=====	=====	=====	=====	=====	=====	=====				
The s	sourceNo	ode is: 4									
The f	atherAry	is:									
4	5	6	4	4	4	6	5				
The b	estCost	Ary is:									
6	13	9	0	8	3	12	13				
The r	narkedA	ry is:									
1	1	1	1	1	1	1	1				
====	=====	=====	=====	=====	=====	=====	=====				
The s	sourceNo	ode is: 5									
The f	atherAry	is:									
5	5	5	5	5	5	5	5				
The b	estCost	Arv is:									
	9 5		66	0	14	99999	5				
	narkedA										
0	1	0	0	1	0	0	0				
====	======	=====	=	· :=====:		_ =====	:====				
The s	sourceNo	nde is: 5									
	atherAry										
5	5	2	5	5	5	5	5				
	oestCost		5	0	5	3	5				
9999		71 y 13. 10	66	0	14	99999	5				
			00	J	17	99999	J				
_	narkedA 1	ıyı5. ∩	0	1	0	0	0				
0			0	I 		0	0				
====	_=====:	_= === :	_=====	.== == :	_=====	_=====	.== ==				

The sourceNode is: 5 The fatherAry is:

5 5	2	2	5	5	5	5
The bestCo						
99999 5	10	8	0	14	99999	5
The marke	dAry is:	0	4	0	0	0
0 1		0 		0 	0 	0
The source	Node is: F	 5				
The father		,				
5 5	2	2	5	5	5	5
The bestCo	ostAry is:					
99999 5	10	8	0	14	99999	5
The marke	dAry is:					
0 1	0	0	1	0	0	1
The source	Nodo is: F	:===== :	=====	=====	=====	=====
The father		,				
8 5	2	2	5	5	5	5
The bestCo		_				
11 5	10	8	0	14	99999	5
The marke	dAry is:					
0 1	0	0	1	0	0	1
=======	======	=====	=====	=====	=====	=====
The source		5				
The father	_	0	_	0	_	_
8 5	2 octAnvic:	2	5	8	5	5
The bestCo	10	8	0	12	99999	5
The marke	-	O	U	12	99999	5
0 1	0. 0	0	1	0	0	1
=======	======	:=====	· =====:	=====	=====	· :=====
The source	Node is: 5	5				
The father/	Ary is:					
8 5	2	2	5	8	8	5
The bestCo	ostAry is:					
11 5	10	8	0	12	37	5
The marke	dAry is:					
0 1	0	0	1	0	0	1
The source	 Node is: F	:===== 5	=====	=====	=====	
The father		,				
8 5	1 y 13.	2	5	8	8	5
The bestCo	_	_	Ū	Ū	-	-
11 5	10	8	0	12	37	5
The marke		-	-		-	-
	-					

0	1	0	1	1	0	0	1			
The s	The sourceNode is: 5									
The fatherAry is:										
8	5	2	2	5	4	8	5			
	estCos		_				_			
11	5	10	8	0	11	37	5			
_	narked <i>A</i>	Ary is:	4		0	0				
0	1 		1 	1 	0 =====	0	1 			
The s	ourceN	ode is: {	5							
	atherAry									
8	5	2	2	5	4	8	5			
The b	estCos	tAry is:								
11	5	10	8	0	11	37	5			
The m	narked <i>P</i>	Ary is:								
0	1	1	1	1	0	0	1			
====:		======	:====: -	=====	=====	=====	=====			
	ourceiv atherAry	ode is: {)							
8	5	y 13. 2	2	5	4	8	5			
	estCos	_	_	J	•	Ü	J			
11	5	10	8	0	11	37	5			
The m	narked <i>A</i>	Ary is:								
1	1	1	1	1	0	0	1			
====	=====	=====	=====	=====	=====	=====	=====			
		ode is: {	5							
	atherAry		0	_	4	0	_			
8 The b	5	2	2	5	4	8	5			
	estCos		8	0	11	37	5			
	arked <i>A</i>	. •	0	U	1.1	31	5			
1	1	1 y 13.	1	1	1	0	1			
====	-====	:=====	.=====	-=====	=====	:=====	-====			
The s	ourceN	ode is: 8	5							
The fa	atherAry	y is:								
8	5	2	2	5	4	6	5			
	estCos	-								
11	5	10	8	0	11	20	5			
	narked <i>P</i>	Ary is:	_	4	4	•	4			
1	1 	1	1	_1 	1 	0	1			
====	-====	=====	-====		=====		-====			

The sourceNode is: 5 The fatherAry is:

8	5	2	2	5	4	6	5
The I	pestCos	tAry is:					
11	5	10	8	0	11	20	5
The	markedA	Ary is:					
1	1	1	1	1	1	1	1
====	=====	=====	=====	=====	=====	=====	=====
The	sourceN	ode is: 6	6				
The f	fatherAry	/ is:					
6	6	6	6	6	6	6	6
The I	pestCos	tAry is:					
6	99999	9 6	24	99999	0	9	99999
The	marked <i>A</i>	Ary is:					
1	0	0	0	0	1	0	0
====	=====	=====	=====	=====		=====	=====
The	sourceN	ode is: 6	6				
The f	fatherAry	/ is:					
6	1	6	6	6	6	6	6
The I	bestCos	tAry is:					
6	36	6	24	99999	0	9	99999
The	markedA	Ary is:					
1	0	0	0	0	1	0	0
====	=====	=====	=====	=====	=====	=====	=====
The	sourceN	ode is: 6	6				
The f	fatherAry	/ is:					
6	1	6	6	1	6	6	6
The I	bestCos	tAry is:					
6	36	6	24	35	0	9	99999
The	markedA	Ary is:					
1	0	0	0	0	1	0	0
====	=====	=====	=====	=====		=====	=====
The	sourceN	ode is: 6	6				
The f	fatherAry	/ is:					
6	1	6	6	1	6	6	6
The I	bestCos	tAry is:					
6	36	6	24	35	0	9	99999
The	marked <i>A</i>	Ary is:					
1	0	1	0	0	1	0	0
====		=====	=====		-====	=====	=====
The	sourceN	ode is: 6	6				
The f	fatherAry	/ is:					
6		•					_
•	3	6	6	1	6	6	6
		-	6	1	6	6	6
	3 pestCost 13	-	6	1 35	6	9	99999
The l	bestCos	tAry is:					

1	0	1	0	0	1	0	0			
====	=====	======	=====	====	=====	=====	======			
	The sourceNode is: 6									
_	fatherA	ry is:	_		_	_	_			
6	3	6	3	1	6	6	6			
		stAry is:								
6	13	6	11	35	0	9	99999			
The	marked	Ary is:								
1	0	1	0	0	1	0	0			
====		======	=====	=====	=====	=====	=====			
The	sourcel	Node is: 6	3							
The	fatherA	ry is:								
6	3	6	3	1	6	6	3			
The	bestCo	stAry is:								
6	13	6	11	35	0	9	15			
The	marked	Ary is:								
1	0	1	0	0	1	0	0			
====	=====	======	=====	=====	=====	=====	======			
The	sourcel	Node is: 6	3							
	fatherA									
6	3	6	3	1	6	6	3			
		stAry is:		•			· ·			
6	13	6	11	35	0	9	15			
_	marked	•	• •	00	Ū	Ū	10			
1	0	1	0	0	1	1	0			
' ====	=====	' ======	=====	 =====	'	' ======	======			
The	eourcal	Node is: 6	3							
	fatherA		,							
6	3	6	3	1	6	6	3			
		-	3	•	U	U	3			
6	13	stAry is:	11	35	0	0	15			
			11	35	U	9	13			
	marked	Ary is:	4	0	4	4	^			
1	0	l 	1	0 	1	1 	0			
			·							
		Node is: 6)							
	fatherA				•	•	•			
6	3	6	3	4	6	6	3			
		stAry is:			_					
6	13	6	11	19	0	9	15			
	marked	Ary is:					_			
1	0	1	1	0	1	1	0			
====	=====	======	=====	====	=====	=====	======			

The sourceNode is: 6 The fatherAry is:

6 3	6	3	4	6	6	3
	CostAry i 3 6	s: 11	10	0	0	15
6 1:	cedAry is:		19	0	9	15
1 1	1	1	0	1	1	0
	ceNode i	s: 6				
The father	•		_	_		
6 3	6	3	4	6	6	3
	CostAry i 3 6	s: 11	10	0	0	15
6 1			19	0	9	15
1 1 1	cedAry is:	1	0	1	1	1
' '	' 	' 		' 	' ======	' :====
The sour	ceNode i	s [.] 6				
The fathe		J. 0				
6 3	6	3	8	6	6	3
The best	CostAry i	s:			-	
6 1	•	11	17	0	9	15
The mark	kedAry is:					
1 1	1	1	0	1	1	1
The fathe 6 3 The best	6 CostAry i	3 s [.]	8	6	6	3
	•		47	^	0	45
6 1:	3 6 kedAry is:	11	17	0	9	15
1 1	1 (CuAi y	1	1	1	1	1
·	· :======	· :======	· ======	· ===	=======	· :=====
The sour	ceNode i	s: 7				
The fathe	erAry is:					
7 7	7	7	7	7	7	7
The best	CostAry i	s:				
99999 1	5 4	4	99999	3	0	99999
The marl	kedAry is:					
0 0	0	0	0	1	1	0
				===	=======	=====
	ceNode is	s: 7				
The fathe		7	7	_	7	7
6 7	7	7	7	7	7	7
	CostAry i		00000	2	0	00000
9 1:	_	4	99999	3	0	99999
THE IIIAN	kedAry is:					

0	0	0	0	0	1	1	0				
====	The sourceNode is: 7										
The fatherAry is:											
6	7	7	7	7	7	7	7				
The I	bestCos	stAry is:									
9	15	4	4	99999	3	0	99999				
The	marked/	Ary is:									
0	0	1	0	0	1	1	0				
====	=====	=====	=====	=====	=====	=====	=====				
		lode is: 7	7								
	fatherAr										
6	3	7	7	7	7	7	7				
	pestCos										
9	11	4	4	99999	3	0	99999				
	marked/	Ary is:									
0	0	1	0	0	1	1	0				
====	:=====	====== 	===== ,	:=====	=====	=====	=====				
		lode is: 7									
6	fatherAr 3	y is. 7	7	7	7	7	3				
	oestCos	•	′	1	1	,	3				
9	11	4	4	99999	2	0	13				
_	marked <i>i</i>	•	7	99999	3	U	13				
0	0	1 y 13.	0	0	1	1	0				
====	.=====	' ======	=====	·=====	' =====	' ======	=====				
The	sourceN	lode is: 7	,								
	fatherAr										
6	3	7	7	7	7	7	3				
	pestCos	•	•	•	•	•	Ū				
	11	-	4	99999	3	0	13				
The	marked <i>i</i>	Arv is:	-								
0	0	1	1	0	1	1	0				
====			=====			=====	=====				
The	sourceN	lode is: 7	7								
The 1	fatherAr	y is:									
6	3	7	7	4	7	7	3				
The I	oestCos	stAry is:									
9	11	4	4	12	3	0	13				
The	marked/	Ary is:									
0	0	1	1	0	1	1	0				
====	=====	=====	=====		=====	=====	=====				
The second	N	lada :a. T	,								

The sourceNode is: 7 The fatherAry is:

6 3	7	7	4	7	7	3
The bestCost	Ary is:					
9 11	4	4	12	3	0	13
The markedA	ry is:					
1 0	1	1	0	1	1	0
The second N		=====	=====	=====	=====	=====
The sourceNo						
The fatherAry 6 3	7 is.	7	4	7	7	3
The bestCost	•	1	4	,	1	3
9 11	4	4	12	3	0	13
The markedA	•	•	12	O	Ü	10
1 1	1	1	0	1	1	0
	=====:	· =====	=====	· =====	=====	:====
The sourceNo	ode is: 7					
The fatherAry	is:					
6 3	7	7	4	7	7	3
The bestCost	Ary is:					
9 11	4	4	12	3	0	13
The markedA	ry is:					
1 1	1	1	1	1	1	0
=======	=====	=====	=====	=====	=====	=====
The sourceNo						
The fatherAry	is:					
6 3	7	7	4	7	7	3
The bestCost	•	_		_		
9 11	4	4	12	3	0	13
The markedA	ry is:	4	4	4	4	4
1 1	1	1	1	1	1	1
The sourceNo	=====: odo io: 0	=====	=====	=====	=====	=====
The fatherAry 8	/ IS. 8	8	8	8	8	8
The bestCost	-	0	0	O	0	O
	99999	99999	2	7	32	0
The markedA		33333	2	,	J2	U
0 0	η γ 10. Π	0	1	0	0	1
=======	=====:	_ =====	· ======	-====	=====	· :=====
The sourceNo	ode is: 8					
The fatherAry	is:					
8 5	8	8	8	8	8	8
The bestCost	Ary is:					
6 7		99999	2	7	32	0
The markedA	ry is:					

0	0	0	0	1	0	0	1			
The s	===== ourceN	===== ode is: 8	=====	:====:	=====	=====	:====			
The fa	The fatherAry is:									
8	5	8	5	8	8	8	8			
	estCost	•	00	0	7	20	0			
6 The m	7 narkedA	99999 rv is:	80	2	7	32	0			
0) ()	0 y 13.	0	1	0	0	1			
====	=====	=====	=====	.=====	=====	=====	.====			
The s	ourceN	ode is: 8								
	atherAry		_				_			
8 The section	5	8	5	8	8	8	8			
ine b	estCost 7	99999 99999	68	2	7	32	0			
	, narkedA		00	2	ı	52	U			
1	0	0	0	1	0	0	1			
=====	=====	=====:	=====	:====:	=====	=====	=====			
	atherAry	ode is: 8 , is [.]								
8	5	1	5	8	8	8	8			
	estCost	Ary is:								
6	7	11	68	2	7	32	0			
	narkedA	ry is:								
1	0	0	0	1	0	0	1			
The s	ourceNi	===== ode is: 8	=====	.====	=====	=====	=====			
	atherAry									
8	5	1	1	8	8	8	8			
The b	estCost	Ary is:								
·	7		25	2	7	32	0			
_	narkedA	ry is:	0	4	0	0	4			
1	0 	0 =====	0 =====	1 	0 =====	0	1			
The s	ourceN	ode is: 8								
	atherAry									
8	5	1	1	8	8	8	8			
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6 The second	7 1 ^	11	25	2	7	32	0			
The m	narkedA 1	√ry is: ∩	0	1	0	0	1			
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The sourceNode is: 8 The fatherAry is:

8 5 1	1 2	8	8	8	8	
The bestCostAr						
	11 10	2	7	32	0	
The markedAry	_					
1 1 () 0	1	0	0	1 	
The sourceMed						-==
The sourceNod The fatherAry is						
8 5 1	,. I 2	8	8	8	8	
The bestCostAr	_	· ·	J	J	J	
	11 10	2	7	32	0	
The markedAry	is:					
1 1 0		1	1	0	1	
========	======	====	=====		=====	===
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The fatherAry is	S:					
8 5 1	_	8	8	6	8	
The bestCostAr	•	_	_		_	
•	11 10	2	7	16	0	
The markedAry				0	4	
1 1 0) 0	1	1	0	1	
The sourceNode	.======: o.ic: 9	====	=====	=====	====:	===
The fatherAry is						
8 5 1	_	8	8	6	8	
The bestCostAr		· ·	J	J	J	
	11 10	2	7	16	0	
The markedAry	is:					
1 1 0) 1	1	1	0	1	
========	======	====	=====		=====	===
The sourceNod	e is: 8					
The fatherAry is	S:					
8 5 1	_	8	8	6	8	
The bestCostAr	-	_	_		_	
	11 10	2	7	16	0	
The markedAry		4	4	•	_	
1 1 1	l 1	1 	1 	0	1 	
The sourceNode	.======: o.ic: 9	====	=====	=====	====:	===
The fatherAry is 8 5 1		8	8	6	8	
The bestCostAr		J	0	U	J	
	y is. I 1 10	2	7	16	0	
The markedAry		_	•	. 3	•	
,						

SSSfile

There are 8 nodes in the input graph. Below are all pairs of the shortest paths:

The source node = 1

The path from 1 to 1: 1<-1: cost = 0

The path from 1 to 2: 2<-3<-1: cost = 17

The path from 1 to 3: 3<-1: cost = 5

The path from 1 to 4: 4<-3<-1: cost = 15

The path from 1 to 5: 5<-8<-3<-1: cost = 35

The path from 1 to 6: 6<-4<-3<-1: cost = 28

The path from 1 to 7: 7<-6<-4<-3<-1: cost = 50

The path from 1 to 8: 8<-3<-1: cost = 19

The source node = 2

The path from 2 to 1: 1<-8<-2: cost = 10

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 = 6

The path from 2 to 6: 6<-4<-2: cost = 9

The path from 2 to 7: 7<-6<-4<-2: cost = 24

```
The path from 2 to 8: 8<-2: cost = 2
```

The source node = 3

The path from 3 to 1: 1<-4<-3: cost = 16

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 = 20

The path from 3 to 6: 6<-4<-3: cost = 13

The path from 3 to 7: 7<-6<-4<-3: cost = 30

The path from 3 to 8: 8<-3: cost = 9

The source node = 4

The path from 4 to 1: 1<-4: cost = 6

The path from 4 to 2: 2<-5<-4: cost = 21

The path from 4 to 3: 3<-6<-4: cost = 12

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 = 15

The path from 4 to 8: 8<-5<-4: cost = 21

The source node = 5

The path from 5 to 1: 1<-8<-5: cost = 16

The path from 5 to 2: 2<-5: cost = 5

The path from 5 to 3: 3<-2<-5: cost = 15

The path from 5 to 4: 4<-2<-5: cost = 13

The path from 5 to 5: 5<-5: cost = 0

The path from 5 to 6: 6<-4<-2<-5: cost = 24

The path from 5 to 7: 7<-6<-4<-2<-5: cost = 44

The path from 5 to 8: 8<-5: cost = 5

The source node = 6

The path from 6 to 1: 1<-6: cost = 6

The path from 6 to 2: 2<-3<-6: cost = 19

The path from 6 to 3: 3<-6: cost = 6

The path from 6 to 4: 4<-3<-6: cost = 17

The path from 6 to 5: 5<-8<-3<-6: cost = 38

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 = 21
```

The source node = 7

The path from 7 to 1: 1<-6<-7: cost = 12

The path from 7 to 2: 2<-3<-7: cost = 15

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 = 16

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 = 17

The source node = 8

The path from 8 to 1: 1 < -8: cost = 6

The path from 8 to 2: 2<-5<-8: cost = 9

The path from 8 to 3: 3<-1<-8: cost = 17

The path from 8 to 4: 4<-2<-5<-8: cost = 19

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 = 23

The path from 8 to 8: 8<-8: cost = 0