

## Input and Output for O ( m + nK ) implementation of Dijkstra's algorithm (q<2)

Where  $q = \frac{nK}{m}$ .

### NOTE:

-1 value in Parent indicates that the corresponding node is source and doesn't have a Parent. Also, Parent for New-Dijkstra and Dijkstra may vary since there may be more than one shortest path.

### 1. V=5 E=10 k=3 q=1.5 (Sparse graph)

#### Input:

```
5 10
3
0 9 0 6 0
0 0 6 4 0
0 0 0 0 4
0 6 9 0 4
4 0 6 0 0
4 6 9
```

#### Output:

#### New-Dijkstra:

#### SSSP

Vertex	Distance from Source	Parent
0	0	-1
1	9	0
2	15	1
3	6	0
4	10	3

#### APSP

From 0:

Vertex	Distance from Source	Parent
0	0	-1
1	9	0
2	15	1
3	6	0
4	10	3

From 1:

Vertex	Distance from Source	Parent
0	12	4
1	0	-1
2	6	1
3	4	1
4	8	3

From 2:

Vertex	Distance from Source	Parent
0	8	4

1	17	0
2	0	-1
3	14	0
4	4	2

From 3:

Vertex	Distance from Source	Parent
0	8	4
1	6	3
2	9	3
3	0	-1
4	4	3

From 4:

Vertex	Distance from Source	Parent
0	4	4
1	13	0
2	6	4
3	10	0
4	0	-1

**Dijkstra:**

**SSSP**

Vertex	Distance from Source	Parent
0	0	-1
1	9	0
2	15	3
3	6	0
4	10	3

**APSP**

From 0:

Vertex	Distance from Source	Parent
0	0	-1
1	9	0
2	15	3
3	6	0
4	10	3

From 1:

Vertex	Distance from Source	Parent
0	12	4
1	0	-1
2	6	1
3	4	1
4	8	3

From 2:

Vertex	Distance from Source	Parent
0	8	4
1	17	0
2	0	-1
3	14	0
4	4	2

From 3:

Vertex	Distance from Source	Parent
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0	8	4
1	6	3
2	9	3
3	0	-1
4	4	3

From 4:

Vertex	Distance from Source	Parent
0	4	4
1	13	0
2	6	4
3	10	0
4	0	-1

**2.V=9 E=14 k=3 q=1.9 (Sparse graph)**

**Input:**

```

9 14
3
0 2 0 0 0 0 0 6 0
2 0 6 0 0 0 0 14 0
0 6 0 6 0 2 0 0 2
0 0 6 0 6 14 0 0 0
0 0 0 6 0 14 0 0 0
0 0 2 0 14 0 2 0 0
0 0 0 14 0 2 0 2 6
6 14 0 0 0 0 2 0 6
0 0 2 0 0 0 6 6 0
2 6 14

```

**Output:**

**New-Dijkstra:**

**SSSP**

Vertex	Distance from Source	Parent
0	0	-1
1	2	0
2	8	1
3	14	2
4	20	3
5	10	6
6	8	7
7	6	0
8	10	2

**APSP**

From 0:

Vertex	Distance from Source	Parent
0	0	-1
1	2	0
2	8	1

3	14	2
4	20	3
5	10	6
6	8	7
7	6	0
8	10	2

From 1:

Vertex	Distance from Source	Parent
0	2	1
1	0	-1
2	6	1
3	12	2
4	18	3
5	8	2
6	10	5
7	8	0
8	8	2

From 2:

Vertex	Distance from Source	Parent
0	8	1
1	6	2
2	0	-1
3	6	2
4	12	3
5	2	2
6	4	5
7	6	6
8	2	2

From 3:

Vertex	Distance from Source	Parent
0	14	1
1	12	2
2	6	3
3	0	-1
4	6	3
5	8	2
6	10	5
7	12	6
8	8	2

From 4:

Vertex	Distance from Source	Parent
0	20	1
1	18	2
2	12	3
3	6	4
4	0	-1
5	14	2
6	16	5
7	18	6
8	14	2

From 5:

Vertex	Distance from Source	Parent
0	10	1
1	8	2
2	2	5
3	8	2

4	14	3
5	0	-1
6	2	5
7	4	6
8	4	2

From 6:

Vertex	Distance from Source	Parent
0	8	7
1	10	0
2	4	5
3	10	2
4	16	3
5	2	6
6	0	-1
7	2	6
8	6	2

From 7:

Vertex	Distance from Source	Parent
0	6	7
1	8	0
2	6	5
3	12	2
4	18	3
5	4	6
6	2	7
7	0	-1
8	6	7

From 8:

Vertex	Distance from Source	Parent
0	10	1
1	8	2
2	2	8
3	8	2
4	14	3
5	4	2
6	6	5
7	6	8
8	0	-1

**Dijkstra:**

**SSSP**

Vertex	Distance from Source	Parent
0	0	-1
1	2	0
2	8	1
3	14	2
4	20	3
5	10	6
6	8	7
7	6	0
8	10	2

## APSP

From 0:

Vertex	Distance from Source	Parent
0	0	-1
1	2	0
2	8	1
3	14	2
4	20	3
5	10	6
6	8	7
7	6	0
8	10	2

From 1:

Vertex	Distance from Source	Parent
0	2	1
1	0	-1
2	6	1
3	12	2
4	18	3
5	8	2
6	10	7
7	8	0
8	8	2

From 2:

Vertex	Distance from Source	Parent
0	8	1
1	6	2
2	0	-1
3	6	2
4	12	3
5	2	2
6	4	5
7	6	6
8	2	2

From 3:

Vertex	Distance from Source	Parent
0	14	1
1	12	2
2	6	3
3	0	-1
4	6	3
5	8	2
6	10	5
7	12	6
8	8	2

From 4:

Vertex	Distance from Source	Parent
0	20	1
1	18	2
2	12	3
3	6	4
4	0	-1
5	14	4
6	16	5
7	18	6

8	14	2
From 5:		
Vertex	Distance from Source	Parent
0	10	7
1	8	2
2	2	5
3	8	2
4	14	5
5	0	-1
6	2	5
7	4	6
8	4	2

From 6:		
Vertex	Distance from Source	Parent
0	8	7
1	10	2
2	4	5
3	10	2
4	16	5
5	2	6
6	0	-1
7	2	6
8	6	6

From 7:		
Vertex	Distance from Source	Parent
0	6	7
1	8	0
2	6	5
3	12	2
4	18	5
5	4	6
6	2	7
7	0	-1
8	6	7

From 8:		
Vertex	Distance from Source	Parent
0	10	1
1	8	2
2	2	8
3	8	2
4	14	3
5	4	2
6	6	8
7	6	8
8	0	-1

**3.V=15 E=97 k=12 q=1.8 (Dense graph)**

**Input:**

```

15 97
12
0 2 7 3 6 7 7 12 4 0 11 11 0 11 5
2 0 3 10 5 8 4 2 8 5 2 10 6 6 1
7 3 0 9 10 5 0 3 3 7 10 9 5 0 5

```

```

3 10 9 0 1 12 8 5 4 6 10 9 2 4 4
6 5 10 1 0 2 6 6 10 4 2 0 4 8 11
7 8 5 12 2 0 5 6 12 9 2 11 5 11 11
7 4 0 8 6 5 0 2 3 2 4 8 8 10 4
12 2 3 5 6 6 2 0 5 5 12 12 0 8 12
4 8 3 4 10 12 3 5 0 10 10 0 5 8 9
0 5 7 6 4 9 2 5 10 0 5 4 4 0 12
11 2 10 10 2 2 4 12 10 5 0 10 11 2 10
11 10 9 9 0 11 8 12 0 4 10 0 5 10 6
0 6 5 2 4 5 8 0 5 4 11 5 0 11 5
11 6 0 4 8 11 10 8 8 0 2 10 11 0 6
5 1 5 4 11 11 4 12 9 12 10 6 5 6 0
1 2 3 4 5 6 7 8 9 10 11 12

```

**Output:**

**New-Dijkstra:**

**SSSP**

Vertex	Distance from Source	Parent
0	0	-1
1	2	0
2	5	1
3	3	0
4	4	3
5	6	4
6	6	7
7	4	1
8	4	0
9	7	1
10	4	1
11	9	14
12	5	3
13	6	10
14	3	1

**APSP**

From 0:

Vertex	Distance from Source	Parent
0	0	-1
1	2	0
2	5	1
3	3	0
4	4	3
5	6	4
6	6	7
7	4	1
8	4	0
9	7	1
10	4	1
11	9	14



12	5	3
13	6	10
14	3	1

From 1:

Vertex	Distance from Source	Parent
0	2	1
1	0	-1
2	3	1
3	5	4
4	4	10
5	4	10
6	4	7
7	2	1
8	6	2
9	5	1
10	2	1
11	7	14
12	6	14
13	4	10
14	1	1

From 2:

Vertex	Distance from Source	Parent
0	5	1
1	3	2
2	0	-1
3	7	12
4	7	10
5	5	2
6	5	7
7	3	2
8	3	2
9	7	6
10	5	1
11	9	2
12	5	2
13	7	10
14	4	1

From 3:

Vertex	Distance from Source	Parent
0	3	3
1	5	14
2	7	8
3	0	-1
4	1	3
5	3	4
6	7	9
7	5	3
8	4	3
9	5	4
10	3	4
11	7	12
12	2	3
13	4	3
14	4	3

From 4:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	4	3
1	4	10
2	7	1
3	1	4
4	0	-1
5	2	4
6	6	9
7	6	1
8	5	3
9	4	4
10	2	4
11	8	9
12	3	3
13	4	10
14	5	1

From 5:

Vertex Distance from Source Parent

0	6	1
1	4	10
2	5	5
3	3	4
4	2	5
5	0	-1
6	5	5
7	6	1
8	7	3
9	6	4
10	2	5
11	10	9
12	5	3
13	4	10
14	5	1

From 6:

Vertex Distance from Source Parent

0	6	1
1	4	7
2	5	7
3	7	4
4	6	10
5	5	6
6	0	-1
7	2	6
8	3	6
9	2	6
10	4	6
11	6	9
12	6	9
13	6	10
14	4	6

From 7:

Vertex Distance from Source Parent

0	4	1
1	2	7
2	3	7
3	5	7
4	6	3

5	6	10
6	2	7
7	0	-1
8	5	6
9	4	6
10	4	1
11	8	9
12	7	3
13	6	10
14	3	1

From 8:

Vertex	Distance from Source	Parent
0	4	8
1	6	0
2	3	8
3	4	8
4	5	3
5	7	4
6	3	8
7	5	6
8	0	-1
9	5	6
10	7	4
11	9	9
12	5	8
13	8	3
14	7	1

From 9:

Vertex	Distance from Source	Parent
0	7	1
1	5	9
2	7	7
3	5	4
4	4	9
5	6	4
6	2	9
7	4	6
8	5	6
9	0	-1
10	5	9
11	4	9
12	4	9
13	7	10
14	6	1

From 10:

Vertex	Distance from Source	Parent
0	4	1
1	2	10
2	5	1
3	3	4
4	2	10
5	2	10
6	4	10
7	4	1
8	7	6
9	5	10

10	0	-1
11	9	9
12	5	3
13	2	10
14	3	1

From 11:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	9	1
1	7	14
2	9	11
3	7	12
4	8	3
5	10	4
6	6	9
7	8	6
8	9	6
9	4	11
10	9	1
11	0	-1
12	5	11
13	10	11
14	6	11

From 12:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	5	3
1	6	14
2	5	12
3	2	12
4	3	3
5	5	4
6	6	9
7	7	3
8	5	12
9	4	12
10	5	4
11	5	12
12	0	-1
13	6	3
14	5	12

From 13:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	6	1
1	4	10
2	7	1
3	4	13
4	4	10
5	4	10
6	6	10
7	6	1
8	8	3
9	7	10
10	2	13
11	10	13
12	6	3
13	0	-1
14	5	1

From 14:

Vertex	Distance from Source	Parent
0	3	1
1	1	14
2	4	1
3	4	14
4	5	3
5	5	10
6	4	14
7	3	1
8	7	2
9	6	6
10	3	1
11	6	14
12	5	14
13	5	10
14	0	-1

**Dijkstra:**

**SSSP**

Vertex	Distance from Source	Parent
0	0	-1
1	2	0
2	5	1
3	3	0
4	4	3
5	6	10
6	6	1
7	4	1
8	4	0
9	7	1
10	4	1
11	9	14
12	5	3
13	6	10
14	3	1

**APSP**

From 0:

Vertex	Distance from Source	Parent
0	0	-1
1	2	0
2	5	1
3	3	0
4	4	3
5	6	10
6	6	1
7	4	1
8	4	0
9	7	1
10	4	1
11	9	14

12	5	3
13	6	10
14	3	1

From 1:

Vertex	Distance from Source	Parent
0	2	1
1	0	-1
2	3	1
3	5	14
4	4	10
5	4	10
6	4	1
7	2	1
8	6	0
9	5	1
10	2	1
11	7	14
12	6	1
13	4	10
14	1	1

From 2:

Vertex	Distance from Source	Parent
0	5	1
1	3	2
2	0	-1
3	7	8
4	7	10
5	5	2
6	5	7
7	3	2
8	3	2
9	7	2
10	5	1
11	9	2
12	5	2
13	7	10
14	4	1

From 3:

Vertex	Distance from Source	Parent
0	3	3
1	5	10
2	7	12
3	0	-1
4	1	3
5	3	4
6	7	4
7	5	3
8	4	3
9	5	4
10	3	4
11	7	12
12	2	3
13	4	3
14	4	3

From 4:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	4	3
1	4	10
2	7	5
3	1	4
4	0	-1
5	2	4
6	6	4
7	6	4
8	5	3
9	4	4
10	2	4
11	8	12
12	3	3
13	4	10
14	5	3

From 5:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	6	3
1	4	10
2	5	5
3	3	4
4	2	5
5	0	-1
6	5	5
7	6	5
8	7	3
9	6	4
10	2	5
11	10	12
12	5	5
13	4	10
14	5	1

From 6:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	6	1
1	4	6
2	5	7
3	7	7
4	6	6
5	5	6
6	0	-1
7	2	6
8	3	6
9	2	6
10	4	6
11	6	9
12	6	9
13	6	10
14	4	6

From 7:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	4	1
1	2	7
2	3	7
3	5	7
4	6	7

5	6	7
6	2	7
7	0	-1
8	5	7
9	4	6
10	4	1
11	8	9
12	7	3
13	6	10
14	3	1

From 8:

Vertex	Distance from Source	Parent
0	4	8
1	6	2
2	3	8
3	4	8
4	5	3
5	7	4
6	3	8
7	5	8
8	0	-1
9	5	6
10	7	6
11	9	9
12	5	8
13	8	8
14	7	6

From 9:

Vertex	Distance from Source	Parent
0	7	1
1	5	9
2	7	9
3	5	4
4	4	9
5	6	4
6	2	9
7	4	6
8	5	6
9	0	-1
10	5	9
11	4	9
12	4	9
13	7	10
14	6	6

From 10:

Vertex	Distance from Source	Parent
0	4	1
1	2	10
2	5	1
3	3	4
4	2	10
5	2	10
6	4	10
7	4	1
8	7	3
9	5	10



10	0	-1
11	9	14
12	5	3
13	2	10
14	3	1

From 11:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	9	1
1	7	14
2	9	11
3	7	12
4	8	9
5	10	12
6	6	9
7	8	6
8	9	6
9	4	11
10	9	9
11	0	-1
12	5	11
13	10	11
14	6	11

From 12:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	5	3
1	6	12
2	5	12
3	2	12
4	3	3
5	5	12
6	6	9
7	7	3
8	5	12
9	4	12
10	5	4
11	5	12
12	0	-1
13	6	3
14	5	12

From 13:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	6	1
1	4	10
2	7	1
3	4	13
4	4	10
5	4	10
6	6	10
7	6	1
8	8	13
9	7	10
10	2	13
11	10	13
12	6	3
13	0	-1
14	5	1

From 14:

Vertex Distance from Source Parent

0	3	1
1	1	14
2	4	1
3	4	14
4	5	10
5	5	10
6	4	14
7	3	1
8	7	0
9	6	1
10	3	1
11	6	14
12	5	14
13	5	10
14	0	-1

**4.V=20 E=183 k=14 q=1.5 (Dense graph)**

**Input:**

20 183

14

```
0 11 2 4 10 14 4 3 3 7 14 5 5 1 12 1 11 10 2 12
11 0 6 6 9 2 3 7 7 6 11 8 5 2 6 11 3 9 7 2
2 6 0 4 10 9 8 6 2 3 3 14 6 1 8 13 2 14 7 12
4 6 4 0 12 4 8 6 4 13 1 5 5 12 3 1 10 2 4 13
10 9 10 12 0 11 0 5 9 10 5 6 6 3 8 9 8 9 4 6
14 2 9 4 11 0 5 1 11 11 13 9 9 11 13 2 13 8 12 9
4 3 8 8 0 5 0 11 3 5 4 3 9 0 12 11 8 6 11 5
3 7 6 6 5 1 11 0 14 7 0 9 2 3 12 12 1 0 11 6
3 7 2 4 9 11 3 14 0 5 2 0 4 11 7 5 10 6 4 1
7 6 3 13 10 11 5 7 5 0 10 12 11 7 12 7 2 3 3 5
14 11 3 1 5 13 4 0 2 10 0 14 4 8 11 3 2 1 11 10
5 8 14 5 6 9 3 9 0 12 14 0 3 8 0 11 12 5 10 14
5 5 6 5 6 9 9 2 4 11 4 3 0 9 2 8 3 10 6 2
1 2 1 12 3 11 0 3 11 7 8 8 9 0 5 1 11 14 10 6
12 6 8 3 8 13 12 12 7 12 11 0 2 5 0 6 3 9 3 4
1 11 13 1 9 2 11 12 5 7 3 11 8 1 6 0 1 9 8 4
11 3 2 10 8 13 8 1 10 2 2 12 3 11 3 1 0 3 8 0
10 9 14 2 9 8 6 0 6 3 1 5 10 14 9 9 3 0 8 7
2 7 7 4 4 12 11 11 4 3 11 10 6 10 3 8 8 8 0 2
12 2 12 13 6 9 5 6 1 5 10 14 2 6 4 4 0 7 2 0
1 2 3 4 5 6 7 8 9 10 11 12 13 14
```

**Output:**

**New-Dijkstra:**

**SSSP**

Vertex Distance from Source Parent

0	0	-1
1	3	13
2	2	13
3	2	15
4	4	13
5	3	15
6	4	0
7	3	16
8	3	0
9	4	16
10	3	3
11	5	0
12	5	7
13	1	0
14	5	3
15	1	0
16	2	15
17	4	10
18	2	0
19	4	8

### APSP

From 0:

Vertex Distance from Source Parent

0	0	-1
1	3	13
2	2	13
3	2	15
4	4	13
5	3	15
6	4	0
7	3	16
8	3	0
9	4	16
10	3	3
11	5	0
12	5	7
13	1	0
14	5	3
15	1	0
16	2	15
17	4	10
18	2	0
19	4	8

From 1:

Vertex Distance from Source Parent

0	3	13
1	0	-1
2	3	13
3	4	15
4	5	13
5	2	1
6	3	1
7	3	5
8	3	19

9	5	16
10	5	3
11	6	6
12	4	19
13	2	1
14	6	12
15	3	13
16	3	1
17	6	10
18	4	19
19	2	1

From 2:

Vertex	Distance from Source	Parent
0	2	13
1	3	13
2	0	-1
3	3	15
4	4	13
5	4	7
6	5	8
7	3	16
8	2	2
9	3	2
10	3	2
11	7	0
12	5	19
13	1	2
14	5	16
15	2	13
16	2	2
17	4	10
18	4	0
19	3	8

From 3:

Vertex	Distance from Source	Parent
0	2	15
1	4	13
2	3	13
3	0	-1
4	5	13
5	3	15
6	5	10
7	3	16
8	3	10
9	4	16
10	1	3
11	5	3
12	5	7
13	2	15
14	3	3
15	1	3
16	2	15
17	2	10
18	4	0
19	4	8

From 4:

Vertex	Distance from Source	Parent
0	4	13
1	5	13
2	4	13
3	5	15
4	0	-1
5	6	7
6	8	1
7	5	4
8	6	2
9	7	16
10	5	4
11	6	4
12	6	4
13	3	4
14	7	18
15	4	13
16	5	15
17	6	10
18	4	4
19	6	18

From 5:

Vertex	Distance from Source	Parent
0	3	15
1	2	5
2	4	13
3	3	15
4	6	13
5	0	-1
6	5	1
7	1	5
8	5	19
9	4	16
10	4	3
11	6	12
12	3	7
13	3	15
14	5	12
15	2	5
16	2	7
17	5	10
18	5	0
19	4	1

From 6:

Vertex	Distance from Source	Parent
0	4	6
1	3	6
2	5	8
3	5	10
4	8	13
5	5	1
6	0	-1
7	6	5
8	3	6
9	5	6
10	4	6

11	3	6
12	6	19
13	5	0
14	8	12
15	5	0
16	6	15
17	5	10
18	6	19
19	4	8

From 7:

Vertex	Distance from Source	Parent
0	3	15
1	3	5
2	3	16
3	3	15
4	5	7
5	1	7
6	6	1
7	0	-1
8	5	19
9	3	16
10	3	16
11	5	12
12	2	7
13	3	15
14	4	12
15	2	16
16	1	7
17	4	10
18	5	0
19	4	12

From 8:

Vertex	Distance from Source	Parent
0	3	8
1	3	19
2	2	8
3	3	10
4	6	13
5	5	1
6	3	8
7	5	16
8	0	-1
9	5	2
10	2	8
11	6	12
12	3	19
13	3	2
14	5	12
15	4	13
16	4	2
17	3	10
18	3	19
19	1	8

From 9:

Vertex	Distance from Source	Parent
0	4	15

1	5	16
2	3	9
3	4	15
4	7	13
5	4	7
6	5	9
7	3	16
8	5	2
9	0	-1
10	4	17
11	8	12
12	5	7
13	4	15
14	5	16
15	3	16
16	2	9
17	3	9
18	3	9
19	5	18

From 10:

Vertex Distance from Source Parent

0	3	15
1	5	13
2	3	10
3	1	10
4	5	10
5	4	7
6	4	10
7	3	16
8	2	10
9	4	16
10	0	-1
11	6	3
12	4	10
13	3	15
14	4	3
15	2	3
16	2	10
17	1	10
18	5	0
19	3	8

From 11:

Vertex Distance from Source Parent

0	5	11
1	6	6
2	7	13
3	5	11
4	6	11
5	6	7
6	3	11
7	5	12
8	6	19
9	8	16
10	6	3
11	0	-1
12	3	11

13	6	0
14	5	12
15	6	0
16	6	7
17	5	11
18	7	19
19	5	12

From 12:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	5	15
1	4	19
2	5	16
3	5	15
4	6	12
5	3	7
6	6	8
7	2	12
8	3	19
9	5	16
10	4	12
11	3	12
12	0	-1
13	5	15
14	2	12
15	4	16
16	3	7
17	5	10
18	4	19
19	2	12

From 13:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	1	13
1	2	13
2	1	13
3	2	15
4	3	13
5	3	15
6	5	1
7	3	16
8	3	2
9	4	16
10	3	3
11	6	0
12	5	7
13	0	-1
14	5	3
15	1	13
16	2	15
17	4	10
18	3	0
19	4	8

From 14:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	5	15
1	6	19
2	5	16



3	3	14
4	7	18
5	5	7
6	8	8
7	4	16
8	5	19
9	5	16
10	4	3
11	5	12
12	2	14
13	5	15
14	0	-1
15	4	3
16	3	14
17	5	10
18	3	14
19	4	12

From 15:

Vertex Distance from Source Parent

0	1	15
1	3	13
2	2	13
3	1	15
4	4	13
5	2	15
6	5	0
7	2	16
8	4	10
9	3	16
10	2	3
11	6	0
12	4	7
13	1	15
14	4	3
15	0	-1
16	1	15
17	3	10
18	3	0
19	4	15

From 16:

Vertex Distance from Source Parent

0	2	15
1	3	16
2	2	16
3	2	15
4	5	13
5	2	7
6	6	1
7	1	16
8	4	2
9	2	16
10	2	16
11	6	12
12	3	7
13	2	15
14	3	16

15	1	16
16	0	-1
17	3	10
18	4	0
19	5	8

From 17:

Vertex Distance from Source Parent

0	4	15
1	6	13
2	4	10
3	2	10
4	6	10
5	5	7
6	5	10
7	4	16
8	3	10
9	3	17
10	1	17
11	5	17
12	5	10
13	4	15
14	5	3
15	3	3
16	3	10
17	0	-1
18	6	0
19	4	8

From 18:

Vertex Distance from Source Parent

0	2	18
1	4	19
2	4	13
3	4	15
4	4	18
5	5	15
6	6	8
7	5	16
8	3	19
9	3	18
10	5	3
11	7	12
12	4	19
13	3	0
14	3	18
15	3	0
16	4	15
17	6	10
18	0	-1
19	2	18

From 19:

Vertex Distance from Source Parent

0	4	18
1	2	19
2	3	8
3	4	10
4	6	18

5	4	1
6	4	8
7	4	12
8	1	19
9	5	18
10	3	8
11	5	12
12	2	19
13	4	2
14	4	12
15	4	19
16	5	7
17	4	10
18	2	19
19	0	-1

### Dijkstra:

#### SSSP

Vertex	Distance from Source	Parent
0	0	-1
1	3	13
2	2	0
3	2	15
4	4	13
5	3	15
6	4	0
7	3	0
8	3	0
9	4	16
10	3	3
11	5	0
12	5	0
13	1	0
14	5	18
15	1	0
16	2	15
17	4	3
18	2	0
19	4	18

#### APSP

From 0:

Vertex	Distance from Source	Parent
0	0	-1
1	3	13
2	2	0
3	2	15
4	4	13
5	3	15
6	4	0

7	3	0
8	3	0
9	4	16
10	3	3
11	5	0
12	5	0
13	1	0
14	5	18
15	1	0
16	2	15
17	4	3
18	2	0
19	4	18

From 1:

Vertex	Distance from Source	Parent
0	3	13
1	0	-1
2	3	13
3	4	15
4	5	13
5	2	1
6	3	1
7	3	5
8	3	19
9	5	16
10	5	16
11	6	6
12	4	19
13	2	1
14	6	1
15	3	13
16	3	1
17	6	16
18	4	19
19	2	1

From 2:

Vertex	Distance from Source	Parent
0	2	2
1	3	13
2	0	-1
3	3	15
4	4	13
5	4	15
6	5	8
7	3	16
8	2	2
9	3	2
10	3	2
11	7	0
12	5	16
13	1	2
14	5	16
15	2	13
16	2	2
17	4	10
18	4	0

19	3	8
----	---	---

From 3:

Vertex	Distance from Source	Parent
0	2	15
1	4	13
2	3	13
3	0	-1
4	5	13
5	3	15
6	5	10
7	3	16
8	3	10
9	4	16
10	1	3
11	5	3
12	5	3
13	2	15
14	3	3
15	1	3
16	2	15
17	2	3
18	4	3
19	4	8

From 4:

Vertex	Distance from Source	Parent
0	4	13
1	5	13
2	4	13
3	5	15
4	0	-1
5	6	15
6	8	0
7	5	4
8	6	2
9	7	18
10	5	4
11	6	4
12	6	4
13	3	4
14	7	18
15	4	13
16	5	15
17	6	10
18	4	4
19	6	4

From 5:

Vertex	Distance from Source	Parent
0	3	15
1	2	5
2	4	16
3	3	15
4	6	7
5	0	-1
6	5	5
7	1	5
8	5	19

9	4	16
10	4	16
11	6	12
12	3	7
13	3	15
14	5	16
15	2	5
16	2	7
17	5	16
18	5	0
19	4	1

From 6:

Vertex	Distance from Source	Parent
0	4	6
1	3	6
2	5	8
3	5	10
4	8	13
5	5	6
6	0	-1
7	6	5
8	3	6
9	5	6
10	4	6
11	3	6
12	6	11
13	5	1
14	8	19
15	5	0
16	6	1
17	5	10
18	6	19
19	4	8

From 7:

Vertex	Distance from Source	Parent
0	3	7
1	3	5
2	3	16
3	3	15
4	5	7
5	1	7
6	6	5
7	0	-1
8	5	10
9	3	16
10	3	16
11	5	12
12	2	7
13	3	7
14	4	16
15	2	16
16	1	7
17	4	16
18	5	0
19	4	12

From 8:

Vertex	Distance from Source	Parent
0	3	8
1	3	19
2	2	8
3	3	10
4	6	13
5	5	1
6	3	8
7	5	12
8	0	-1
9	5	8
10	2	8
11	6	12
12	3	19
13	3	2
14	5	19
15	4	13
16	4	10
17	3	10
18	3	19
19	1	8

From 9:

Vertex	Distance from Source	Parent
0	4	15
1	5	16
2	3	9
3	4	15
4	7	18
5	4	7
6	5	9
7	3	16
8	5	9
9	0	-1
10	4	16
11	8	17
12	5	16
13	4	15
14	5	16
15	3	16
16	2	9
17	3	9
18	3	9
19	5	9

From 10:

Vertex	Distance from Source	Parent
0	3	15
1	5	16
2	3	10
3	1	10
4	5	10
5	4	15
6	4	10
7	3	16
8	2	10
9	4	17
10	0	-1

11	6	17
12	4	10
13	3	15
14	4	3
15	2	3
16	2	10
17	1	10
18	5	3
19	3	8

From 11:

Vertex	Distance from Source	Parent
0	5	11
1	6	6
2	7	0
3	5	11
4	6	11
5	6	7
6	3	11
7	5	12
8	6	6
9	8	6
10	6	17
11	0	-1
12	3	11
13	6	0
14	5	12
15	6	3
16	6	12
17	5	11
18	7	19
19	5	12

From 12:

Vertex	Distance from Source	Parent
0	5	12
1	4	19
2	5	16
3	5	12
4	6	12
5	3	7
6	6	11
7	2	12
8	3	19
9	5	16
10	4	12
11	3	12
12	0	-1
13	5	7
14	2	12
15	4	16
16	3	12
17	5	10
18	4	19
19	2	12

From 13:

Vertex	Distance from Source	Parent
0	1	13



1	2	13
2	1	13
3	2	15
4	3	13
5	3	15
6	5	0
7	3	13
8	3	2
9	4	2
10	3	3
11	6	0
12	5	16
13	0	-1
14	5	13
15	1	13
16	2	15
17	4	3
18	3	0
19	4	1

From 14:

Vertex Distance from Source Parent

0	5	18
1	6	14
2	5	16
3	3	14
4	7	18
5	5	7
6	8	10
7	4	12
8	5	19
9	5	16
10	4	3
11	5	12
12	2	14
13	5	14
14	0	-1
15	4	16
16	3	14
17	5	3
18	3	14
19	4	14

From 15:

Vertex Distance from Source Parent

0	1	15
1	3	13
2	2	13
3	1	15
4	4	13
5	2	15
6	5	0
7	2	16
8	4	0
9	3	16
10	2	3
11	6	3
12	4	16

13	1	15
14	4	16
15	0	-1
16	1	15
17	3	3
18	3	0
19	4	15

From 16:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	2	15
1	3	16
2	2	16
3	2	15
4	5	13
5	2	7
6	6	10
7	1	16
8	4	10
9	2	16
10	2	16
11	6	12
12	3	16
13	2	15
14	3	16
15	1	16
16	0	-1
17	3	16
18	4	0
19	5	15

From 17:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	4	15
1	6	16
2	4	10
3	2	17
4	6	10
5	5	15
6	5	10
7	4	16
8	3	10
9	3	17
10	1	17
11	5	17
12	5	10
13	4	15
14	5	3
15	3	3
16	3	17
17	0	-1
18	6	3
19	4	8

From 18:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	2	18
1	4	19
2	4	0

3	4	18
4	4	18
5	5	15
6	6	0
7	5	0
8	3	19
9	3	18
10	5	8
11	7	0
12	4	19
13	3	0
14	3	18
15	3	0
16	4	15
17	6	9
18	0	-1
19	2	18

From 19:

Vertex Distance from Source Parent

0	4	8
1	2	19
2	3	8
3	4	10
4	6	19
5	4	1
6	4	8
7	4	12
8	1	19
9	5	19
10	3	8
11	5	12
12	2	19
13	4	1
14	4	19
15	4	19
16	5	12
17	4	10
18	2	19
19	0	-1

**5.V=25 E=274 k=9 q=0.8 (Dense graph)**

**Input:**

```

25
274
9
0 1 7 4 0 9 4 8 8 2 4 5 5 1 7 1 1 5 2 7 6 1 4 2 3
1 0 2 2 1 6 8 5 7 6 1 8 9 2 7 9 5 4 3 1 2 3 3 4 1
7 2 0 1 3 8 7 4 2 7 7 9 3 1 9 8 6 5 0 2 8 6 0 2 4
4 2 1 0 8 6 5 0 9 0 0 6 1 3 8 9 3 4 4 6 0 6 6 1 8
0 1 3 8 0 4 9 6 3 7 8 8 2 9 1 3 5 9 8 4 0 7 6 3 6
9 6 8 6 4 0 1 5 4 2 0 9 7 3 7 2 6 0 1 6 5 7 5 4 1
4 8 7 5 9 1 0 2 0 0 1 4 6 0 7 1 7 7 7 7 3 3 5 9 9

```

```

8 5 4 0 6 5 2 0 8 1 8 2 6 6 0 3 8 0 1 2 5 0 9 4 7
8 7 2 9 3 4 0 8 0 8 3 5 1 2 0 1 6 4 0 6 1 8 9 8 4
2 6 7 0 7 2 0 1 8 0 1 4 3 9 8 8 0 8 7 7 8 3 8 3 7
4 1 7 0 8 0 1 8 3 1 0 1 0 7 3 4 9 6 5 1 0 9 9 6 8
5 8 9 6 8 9 4 2 5 4 1 0 3 4 8 4 9 9 2 5 5 3 3 3 7
5 9 3 1 2 7 6 6 1 3 0 3 0 4 3 8 0 8 8 0 6 8 1 9 8
1 2 1 3 9 3 0 6 2 9 7 4 4 0 9 7 2 2 8 2 8 9 0 7 8
7 7 9 8 1 7 7 0 0 8 3 8 3 9 0 1 5 8 6 1 2 4 2 5 8
1 9 8 9 3 2 1 3 1 8 4 4 8 7 1 0 6 2 6 5 3 9 2 4 6
1 5 6 3 5 6 7 8 6 0 9 9 0 2 5 6 0 1 8 2 1 1 9 7 6
5 4 5 4 9 0 7 0 4 8 6 9 8 2 8 2 1 0 2 9 5 2 0 0 3
2 3 0 4 8 1 7 1 0 7 5 2 8 8 6 6 8 2 0 9 1 8 1 9 5
7 1 2 6 4 6 7 2 6 7 1 5 0 2 1 5 2 9 9 0 3 2 5 2 5
6 2 8 0 0 5 3 5 1 8 0 5 6 8 2 3 1 5 1 3 0 8 6 7 7
1 3 6 6 7 7 3 0 8 3 9 3 8 9 4 9 1 2 8 2 8 0 2 2 9
4 3 0 6 6 5 5 9 9 8 9 3 1 0 2 2 9 0 1 5 6 2 0 4 1
2 4 2 1 3 4 9 4 8 3 6 3 9 7 5 4 7 0 9 2 7 2 4 0 9
3 1 4 8 6 1 9 7 4 7 8 7 8 8 8 6 6 3 5 5 7 9 1 9 0
1 2 3 4 5 6 7 8 9

```

**Output:**

**New-Dijkstra:**

**SSSP**

Vertex	Distance from Source	Parent
0	0	-1
1	1	0
2	2	13
3	3	2
4	2	1
5	3	24
6	2	15
7	3	9
8	2	15
9	2	0
10	2	1
11	3	10
12	3	8
13	1	0
14	2	15
15	1	0
16	1	0
17	2	16
18	2	0
19	2	1
20	2	16
21	1	0
22	3	24
23	2	0
24	2	1

**APSP**

From 0:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	0	-1
1	1	0
2	2	13
3	3	2
4	2	1
5	3	24
6	2	15
7	3	9
8	2	15
9	2	0
10	2	1
11	3	10
12	3	8
13	1	0
14	2	15
15	1	0
16	1	0
17	2	16
18	2	0
19	2	1
20	2	16
21	1	0
22	3	24
23	2	0
24	2	1

From 1:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	1	1
1	0	-1
2	2	1
3	2	1
4	1	1
5	2	24
6	2	10
7	3	9
8	3	15
9	2	10
10	1	1
11	2	10
12	3	22
13	2	0
14	2	4
15	2	0
16	2	0
17	3	16
18	3	5
19	1	1
20	2	1
21	2	0
22	2	24
23	3	3
24	1	1

From 2:

Vertex	Distance	from Source	Parent
0	2		13
1	2		2
2	0		-1
3	1		2
4	3		1
5	4		24
6	4		15
7	4		19
8	2		2
9	4		10
10	3		1
11	4		10
12	2		3
13	1		2
14	3		19
15	3		0
16	3		0
17	3		13
18	4		22
19	2		2
20	3		8
21	3		0
22	3		12
23	2		3
24	3		1

From 3:

Vertex	Distance	from Source	Parent
0	3		13
1	2		3
2	1		3
3	0		-1
4	3		1
5	4		18
6	4		15
7	4		18
8	2		12
9	4		10
10	3		1
11	4		10
12	1		3
13	2		2
14	4		15
15	3		8
16	3		3
17	4		16
18	3		22
19	3		1
20	3		8
21	3		23
22	2		12
23	1		3
24	3		22

From 4:

Vertex	Distance	from Source	Parent
0	2		1

1	1	4
2	3	1
3	3	12
4	0	-1
5	3	24
6	3	10
7	4	9
8	3	15
9	3	10
10	2	1
11	3	10
12	2	4
13	3	0
14	1	4
15	2	14
16	3	0
17	4	16
18	4	5
19	2	1
20	3	1
21	3	0
22	3	24
23	3	4
24	2	1

From 5:

Vertex Distance from Source Parent

0	3	15
1	2	24
2	4	13
3	4	12
4	3	1
5	0	-1
6	1	5
7	2	18
8	3	15
9	2	5
10	2	6
11	3	10
12	3	22
13	3	5
14	3	15
15	2	6
16	3	20
17	3	18
18	1	5
19	3	10
20	2	18
21	4	0
22	2	18
23	4	5
24	1	5

From 6:

Vertex Distance from Source Parent

0	2	15
1	2	10
2	4	13

3	4	12
4	3	1
5	1	6
6	0	-1
7	2	6
8	2	15
9	2	10
10	1	6
11	2	10
12	3	8
13	3	0
14	2	15
15	1	6
16	3	0
17	3	15
18	2	5
19	2	10
20	3	18
21	3	0
22	3	18
23	4	19
24	2	5

From 7:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	3	9
1	3	10
2	4	19
3	4	12
4	4	1
5	2	18
6	2	7
7	0	-1
8	3	20
9	1	7
10	2	9
11	2	7
12	3	22
13	4	0
14	3	19
15	3	6
16	3	20
17	3	18
18	1	7
19	2	7
20	2	18
21	4	16
22	2	18
23	4	19
24	3	5

From 8:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	2	15
1	3	0
2	2	8
3	2	12
4	3	14



5	3	6
6	2	15
7	3	18
8	0	-1
9	4	10
10	3	6
11	4	10
12	1	8
13	2	8
14	2	15
15	1	8
16	2	20
17	3	16
18	2	20
19	3	14
20	1	8
21	3	0
22	2	12
23	3	3
24	3	22

From 9:

Vertex Distance from Source Parent

0	2	9
1	2	10
2	4	13
3	4	12
4	3	1
5	2	9
6	2	10
7	1	9
8	4	20
9	0	-1
10	1	9
11	2	10
12	3	9
13	3	0
14	3	19
15	3	6
16	3	0
17	4	16
18	2	7
19	2	10
20	3	18
21	3	0
22	3	18
23	3	9
24	3	1

From 10:

Vertex Distance from Source Parent

0	2	1
1	1	10
2	3	1
3	3	1
4	2	1
5	2	6
6	1	10

7	2	9
8	3	15
9	1	10
10	0	-1
11	1	10
12	4	22
13	3	0
14	2	19
15	2	6
16	3	0
17	4	16
18	3	5
19	1	10
20	3	1
21	3	0
22	3	24
23	3	19
24	2	1

From 11:

Vertex Distance from Source Parent

0	3	1
1	2	10
2	4	1
3	4	12
4	3	1
5	3	6
6	2	10
7	2	11
8	4	15
9	2	10
10	1	11
11	0	-1
12	3	11
13	4	0
14	3	19
15	3	6
16	4	0
17	4	18
18	2	11
19	2	10
20	3	18
21	3	11
22	3	18
23	3	11
24	3	1

From 12:

Vertex Distance from Source Parent

0	3	15
1	3	24
2	2	3
3	1	12
4	2	12
5	3	18
6	3	15
7	3	18
8	1	12

9	3	12
10	4	6
11	3	12
12	0	-1
13	3	2
14	3	15
15	2	8
16	3	20
17	4	16
18	2	22
19	4	14
20	2	8
21	3	22
22	1	12
23	2	3
24	2	22

From 13:

Vertex Distance from Source Parent

0	1	13
1	2	0
2	1	13
3	2	2
4	3	1
5	3	13
6	3	15
7	4	9
8	2	13
9	3	0
10	3	1
11	4	10
12	3	3
13	0	-1
14	3	15
15	2	0
16	2	0
17	2	13
18	3	0
19	2	13
20	3	16
21	2	0
22	4	24
23	3	3
24	3	1

From 14:

Vertex Distance from Source Parent

0	2	15
1	2	4
2	3	19
3	4	12
4	1	14
5	3	6
6	2	15
7	3	19
8	2	15
9	3	10
10	2	19

11	3	10
12	3	8
13	3	0
14	0	-1
15	1	14
16	3	0
17	3	15
18	3	20
19	1	14
20	2	14
21	3	0
22	2	14
23	3	19
24	3	1

From 15:

Vertex Distance from Source Parent

0	1	15
1	2	0
2	3	13
3	3	12
4	2	14
5	2	6
6	1	15
7	3	6
8	1	15
9	3	10
10	2	6
11	3	10
12	2	8
13	2	0
14	1	15
15	0	-1
16	2	0
17	2	15
18	3	5
19	2	14
20	2	8
21	2	0
22	2	15
23	3	0
24	3	1

From 16:

Vertex Distance from Source Parent

0	1	16
1	2	0
2	3	13
3	3	16
4	3	1
5	3	18
6	3	15
7	3	18
8	2	20
9	3	0
10	3	1
11	4	10
12	3	8

13	2	0
14	3	15
15	2	0
16	0	-1
17	1	16
18	2	20
19	2	16
20	1	16
21	1	16
22	3	18
23	3	0
24	3	1

From 17:

Vertex	Distance from Source	Parent
0	2	16
1	3	0
2	3	13
3	4	2
4	4	1
5	3	18
6	3	15
7	3	18
8	3	20
9	4	7
10	4	1
11	4	18
12	4	8
13	2	17
14	3	15
15	2	17
16	1	17
17	0	-1
18	2	17
19	3	16
20	2	16
21	2	16
22	3	18
23	4	0
24	3	17

From 18:

Vertex	Distance from Source	Parent
0	2	18
1	3	24
2	4	3
3	3	12
4	4	1
5	1	18
6	2	5
7	1	18
8	2	20
9	2	7
10	3	6
11	2	18
12	2	22
13	3	0
14	3	20

15	3	6
16	2	20
17	2	18
18	0	-1
19	3	7
20	1	18
21	3	16
22	1	18
23	4	3
24	2	5

From 19:

Vertex	Distance from Source	Parent
0	2	1
1	1	19
2	2	19
3	3	2
4	2	1
5	3	24
6	2	10
7	2	19
8	3	15
9	2	10
10	1	19
11	2	10
12	4	22
13	2	19
14	1	19
15	2	14
16	2	19
17	3	16
18	3	7
19	0	-1
20	3	16
21	2	19
22	3	24
23	2	19
24	2	1

From 20:

Vertex	Distance from Source	Parent
0	2	16
1	2	20
2	3	8
3	3	12
4	3	1
5	2	18
6	3	15
7	2	18
8	1	20
9	3	7
10	3	1
11	3	18
12	2	8
13	3	0
14	2	20
15	2	8
16	1	20

17	2	16
18	1	20
19	3	1
20	0	-1
21	2	16
22	2	18
23	4	3
24	3	5

From 21:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	1	21
1	2	0
2	3	13
3	3	23
4	3	1
5	4	24
6	3	15
7	4	18
8	3	15
9	3	0
10	3	1
11	3	21
12	3	22
13	2	0
14	3	15
15	2	0
16	1	21
17	2	16
18	3	20
19	2	21
20	2	16
21	0	-1
22	2	21
23	2	21
24	3	1

From 22:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	3	1
1	2	24
2	3	3
3	2	12
4	3	1
5	2	18
6	3	5
7	2	18
8	2	12
9	3	7
10	3	1
11	3	18
12	1	22
13	4	2
14	2	22
15	2	22
16	3	20
17	3	18
18	1	22

19	3	1
20	2	18
21	2	22
22	0	-1
23	3	3
24	1	22

From 23:

Vertex	Distance from Source	Parent
0	2	23
1	3	0
2	2	3
3	1	23
4	3	23
5	4	23
6	4	15
7	4	9
8	3	12
9	3	23
10	3	19
11	3	23
12	2	3
13	3	2
14	3	19
15	3	0
16	3	0
17	4	16
18	4	22
19	2	23
20	4	8
21	2	23
22	3	12
23	0	-1
24	4	22

From 24:

Vertex	Distance from Source	Parent
0	2	1
1	1	24
2	3	1
3	3	12
4	2	1
5	1	24
6	2	5
7	3	18
8	3	12
9	3	10
10	2	1
11	3	10
12	2	22
13	3	0
14	3	4
15	3	0
16	3	0
17	3	24
18	2	5
19	2	1
20	3	18



21	3	0
22	1	24
23	4	3
24	0	-1

**Dijkstra:**

**SSSP**

Vertex	Distance from Source	Parent
0	0	-1
1	1	0
2	2	13
3	3	1
4	2	1
5	3	15
6	2	15
7	3	18
8	2	15
9	2	0
10	2	1
11	3	10
12	3	8
13	1	0
14	2	15
15	1	0
16	1	0
17	2	16
18	2	0
19	2	1
20	2	16
21	1	0
22	3	21
23	2	0
24	2	1

**APSP**

From 0:

Vertex	Distance from Source	Parent
0	0	-1
1	1	0
2	2	13
3	3	1
4	2	1
5	3	15
6	2	15
7	3	18
8	2	15
9	2	0
10	2	1
11	3	10
12	3	8
13	1	0
14	2	15

15	1	0
16	1	0
17	2	16
18	2	0
19	2	1
20	2	16
21	1	0
22	3	21
23	2	0
24	2	1

From 1:

Vertex	Distance from Source	Parent
0	1	1
1	0	-1
2	2	1
3	2	1
4	1	1
5	2	24
6	2	10
7	3	19
8	3	20
9	2	10
10	1	1
11	2	10
12	3	4
13	2	1
14	2	19
15	2	0
16	2	0
17	3	16
18	3	1
19	1	1
20	2	1
21	2	0
22	2	24
23	3	19
24	1	1

From 2:

Vertex	Distance from Source	Parent
0	2	13
1	2	2
2	0	-1
3	1	2
4	3	2
5	4	13
6	4	15
7	4	2
8	2	2
9	4	0
10	3	19
11	4	10
12	2	3
13	1	2
14	3	19
15	3	8
16	3	13

17	3	13
18	4	0
19	2	2
20	3	8
21	3	0
22	3	12
23	2	2
24	3	1

From 3:

Vertex	Distance from Source	Parent
0	3	23
1	2	3
2	1	3
3	0	-1
4	3	12
5	4	24
6	4	15
7	4	18
8	2	12
9	4	23
10	3	1
11	4	23
12	1	3
13	2	2
14	4	12
15	3	8
16	3	3
17	4	3
18	3	22
19	3	23
20	3	8
21	3	23
22	2	12
23	1	3
24	3	22

From 4:

Vertex	Distance from Source	Parent
0	2	1
1	1	4
2	3	4
3	3	1
4	0	-1
5	3	24
6	3	15
7	4	19
8	3	4
9	3	10
10	2	1
11	3	10
12	2	4
13	3	1
14	1	4
15	2	14
16	3	0
17	4	15
18	4	1

19	2	14
20	3	14
21	3	0
22	3	14
23	3	4
24	2	1

From 5:

Vertex Distance from Source Parent

0	3	18
1	2	24
2	4	1
3	4	1
4	3	1
5	0	-1
6	1	5
7	2	18
8	3	20
9	2	5
10	2	6
11	3	18
12	3	22
13	3	5
14	3	15
15	2	5
16	3	20
17	3	18
18	1	5
19	3	10
20	2	18
21	4	6
22	2	24
23	4	5
24	1	5

From 6:

Vertex Distance from Source Parent

0	2	15
1	2	10
2	4	19
3	4	1
4	3	14
5	1	6
6	0	-1
7	2	6
8	2	15
9	2	10
10	1	6
11	2	10
12	3	8
13	3	0
14	2	15
15	1	6
16	3	0
17	3	15
18	2	5
19	2	10
20	3	6

21	3	6
22	3	15
23	4	19
24	2	5

From 7:

Vertex	Distance from Source	Parent
0	3	18
1	3	19
2	4	7
3	4	12
4	4	14
5	2	18
6	2	7
7	0	-1
8	3	20
9	1	7
10	2	9
11	2	7
12	3	22
13	4	19
14	3	19
15	3	7
16	3	20
17	3	18
18	1	7
19	2	7
20	2	18
21	4	9
22	2	18
23	4	7
24	3	22

From 8:

Vertex	Distance from Source	Parent
0	2	15
1	3	20
2	2	8
3	2	12
4	3	8
5	3	15
6	2	15
7	3	18
8	0	-1
9	4	12
10	3	8
11	4	12
12	1	8
13	2	8
14	2	15
15	1	8
16	2	20
17	3	15
18	2	20
19	3	14
20	1	8
21	3	16
22	2	12

23	3	3
24	3	22

From 9:

Vertex	Distance from Source	Parent
0	2	9
1	2	10
2	4	19
3	4	1
4	3	1
5	2	9
6	2	10
7	1	9
8	4	10
9	0	-1
10	1	9
11	2	10
12	3	9
13	3	0
14	3	19
15	3	6
16	3	0
17	4	18
18	2	7
19	2	10
20	3	18
21	3	9
22	3	18
23	3	9
24	3	5

From 10:

Vertex	Distance from Source	Parent
0	2	1
1	1	10
2	3	19
3	3	1
4	2	1
5	2	6
6	1	10
7	2	9
8	3	10
9	1	10
10	0	-1
11	1	10
12	4	11
13	3	19
14	2	19
15	2	6
16	3	19
17	4	15
18	3	11
19	1	10
20	3	1
21	3	19
22	3	24
23	3	19
24	2	1

From 11:

Vertex Distance from Source Parent

0	3	1
1	2	10
2	4	19
3	4	1
4	3	1
5	3	18
6	2	10
7	2	11
8	4	10
9	2	10
10	1	11
11	0	-1
12	3	11
13	4	11
14	3	19
15	3	6
16	4	19
17	4	18
18	2	11
19	2	10
20	3	18
21	3	11
22	3	11
23	3	11
24	3	1

From 12:

Vertex Distance from Source Parent

0	3	15
1	3	3
2	2	3
3	1	12
4	2	12
5	3	24
6	3	15
7	3	18
8	1	12
9	3	12
10	4	8
11	3	12
12	0	-1
13	3	8
14	3	12
15	2	8
16	3	20
17	4	18
18	2	22
19	4	23
20	2	8
21	3	22
22	1	12
23	2	3
24	2	22

From 13:

Vertex Distance from Source Parent

0	1	13
1	2	13
2	1	13
3	2	2
4	3	1
5	3	13
6	3	15
7	4	19
8	2	13
9	3	0
10	3	19
11	4	13
12	3	8
13	0	-1
14	3	19
15	2	0
16	2	13
17	2	13
18	3	0
19	2	13
20	3	16
21	2	0
22	4	21
23	3	2
24	3	1

From 14:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	2	15
1	2	19
2	3	19
3	4	1
4	1	14
5	3	15
6	2	15
7	3	19
8	2	15
9	3	10
10	2	19
11	3	10
12	3	14
13	3	19
14	0	-1
15	1	14
16	3	19
17	3	15
18	3	22
19	1	14
20	2	14
21	3	19
22	2	14
23	3	19
24	3	22

From 15:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	1	15
1	2	0



2	3	8
3	3	12
4	2	14
5	2	15
6	1	15
7	3	15
8	1	15
9	3	0
10	2	6
11	3	10
12	2	8
13	2	0
14	1	15
15	0	-1
16	2	0
17	2	15
18	3	0
19	2	14
20	2	8
21	2	0
22	2	15
23	3	0
24	3	22

From 16:

Vertex Distance from Source Parent

0	1	16
1	2	0
2	3	13
3	3	16
4	3	1
5	3	18
6	3	15
7	3	18
8	2	20
9	3	0
10	3	19
11	4	21
12	3	8
13	2	16
14	3	20
15	2	0
16	0	-1
17	1	16
18	2	20
19	2	16
20	1	16
21	1	16
22	3	21
23	3	21
24	3	1

From 17:

Vertex Distance from Source Parent

0	2	16
1	3	0
2	3	13
3	4	17

4	4	14
5	3	18
6	3	15
7	3	18
8	3	20
9	4	0
10	4	19
11	4	18
12	4	22
13	2	17
14	3	15
15	2	17
16	1	17
17	0	-1
18	2	17
19	3	16
20	2	16
21	2	17
22	3	18
23	4	21
24	3	17

From 18:

Vertex Distance from Source Parent

0	2	18
1	3	18
2	4	8
3	3	12
4	4	12
5	1	18
6	2	5
7	1	18
8	2	20
9	2	7
10	3	11
11	2	18
12	2	22
13	3	0
14	3	22
15	3	22
16	2	20
17	2	18
18	0	-1
19	3	7
20	1	18
21	3	22
22	1	18
23	4	0
24	2	22

From 19:

Vertex Distance from Source Parent

0	2	1
1	1	19
2	2	19
3	3	1
4	2	14
5	3	24

6	2	10
7	2	19
8	3	15
9	2	10
10	1	19
11	2	10
12	4	14
13	2	19
14	1	19
15	2	14
16	2	19
17	3	16
18	3	7
19	0	-1
20	3	19
21	2	19
22	3	14
23	2	19
24	2	1

From 20:

Vertex Distance from Source Parent

0	2	16
1	2	20
2	3	8
3	3	12
4	3	14
5	2	18
6	3	20
7	2	18
8	1	20
9	3	7
10	3	1
11	3	18
12	2	8
13	3	16
14	2	20
15	2	8
16	1	20
17	2	16
18	1	20
19	3	20
20	0	-1
21	2	16
22	2	18
23	4	21
24	3	22

From 21:

Vertex Distance from Source Parent

0	1	21
1	2	0
2	3	13
3	3	23
4	3	1
5	4	15
6	3	21
7	4	19

8	3	20
9	3	21
10	3	19
11	3	21
12	3	22
13	2	0
14	3	19
15	2	0
16	1	21
17	2	21
18	3	0
19	2	21
20	2	16
21	0	-1
22	2	21
23	2	21
24	3	22

From 22:

Vertex Distance from Source Parent

0	3	18
1	2	24
2	3	3
3	2	12
4	3	12
5	2	24
6	3	15
7	2	18
8	2	12
9	3	7
10	3	1
11	3	22
12	1	22
13	4	8
14	2	22
15	2	22
16	3	21
17	3	18
18	1	22
19	3	14
20	2	18
21	2	22
22	0	-1
23	3	3
24	1	22

From 23:

Vertex Distance from Source Parent

0	2	23
1	3	3
2	2	23
3	1	23
4	3	23
5	4	23
6	4	15
7	4	23
8	3	12
9	3	23

10	3	19
11	3	23
12	2	3
13	3	2
14	3	19
15	3	0
16	3	21
17	4	21
18	4	0
19	2	23
20	4	16
21	2	23
22	3	12
23	0	-1
24	4	22

From 24:

Vertex Distance from Source Parent

0	2	1
1	1	24
2	3	1
3	3	1
4	2	1
5	1	24
6	2	5
7	3	18
8	3	12
9	3	5
10	2	1
11	3	10
12	2	22
13	3	1
14	3	22
15	3	22
16	3	0
17	3	24
18	2	22
19	2	1
20	3	1
21	3	22
22	1	24
23	4	19
24	0	-1

**Input and Output for A faster algorithm if K is permitted to grow with problem size ( $q \geq 2$ )**

**1.V=5 E=10 k=8 q=4 (Sparse graph)**

**Input:**

```
5 10
8
0 9 0 5 0
0 0 1 2 0
0 0 0 0 4
0 3 9 0 2
7 0 6 0 0
1 2 3 4 5 6 7 9
```

**Output:**

**New-Dijkstra1:**

**SSSP**

Vertex	Distance from Source	Parent
0	0	-1
1	8	3
2	9	1
3	5	0
4	7	3

**APSP**

From 0:

Vertex	Distance from Source	Parent
0	0	-1
1	8	3
2	9	1
3	5	0
4	7	3

From 1:

Vertex	Distance from Source	Parent
0	11	4
1	0	-1
2	1	1
3	2	1
4	4	3

From 2:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	11	4
1	19	3
2	0	-1
3	16	0
4	4	2

From 3:

Vertex	Distance from Source	Parent
0	9	4
1	3	3
2	4	1
3	0	-1
4	2	3

From 4:

Vertex	Distance from Source	Parent
0	7	4
1	15	3
2	6	4
3	12	0
4	0	-1

### Dijkstra:

#### SSSP

Vertex	Distance from Source	Parent
0	0	-1
1	8	3
2	9	1
3	5	0
4	7	3

#### APSP

From 0:

Vertex	Distance from Source	Parent
0	0	-1
1	8	3
2	9	1
3	5	0
4	7	3

From 1:

Vertex	Distance from Source	Parent
0	11	4
1	0	-1
2	1	1
3	2	1
4	4	3

From 2:

Vertex	Distance from Source	Parent
0	11	4
1	19	3
2	0	-1
3	16	0
4	4	2

From 3:

Vertex	Distance from Source	Parent
0	9	4
1	3	3
2	4	1
3	0	-1
4	2	3

From 4:

Vertex	Distance from Source	Parent
0	7	4
1	15	3
2	6	4
3	12	0
4	0	-1

## 2. V=9 E=14 k=6 q=3.8 (Sparse graph)

**Input:**

```

9 14
6
0 4 0 0 0 0 0 8 0
4 0 8 0 0 0 0 11 0
0 8 0 7 0 4 0 0 2
0 0 7 0 4 4 0 0 0
0 0 0 4 0 10 0 0 0
0 0 4 0 10 0 2 0 0
0 0 0 4 0 2 0 1 6
8 11 0 0 0 0 1 0 7
0 0 2 0 0 0 6 7 0
1 2 4 6 7 8 10 11

```

**Output:**

**New-Dijkstra1:**

**SSSP**

Vertex	Distance from Source	Parent
0	0	-1
1	4	0
2	12	1
3	13	6
4	17	3
5	11	6
6	9	7
7	8	0
8	14	2

**APSP**

From 0:

Vertex	Distance from Source	Parent
0	0	-1
1	4	0



2	12	1
3	13	6
4	17	3
5	11	6
6	9	7
7	8	0
8	14	2

From 1:

Vertex	Distance from Source	Parent
0	4	1
1	0	-1
2	8	1
3	15	2
4	19	3
5	12	2
6	12	7
7	11	1
8	10	2

From 2:

Vertex	Distance from Source	Parent
0	12	1
1	8	2
2	0	-1
3	7	2
4	11	3
5	4	2
6	6	5
7	9	8
8	2	2

From 3:

Vertex	Distance from Source	Parent
0	15	7
1	15	2
2	7	3
3	0	-1
4	4	3
5	4	3
6	6	5
7	7	6
8	9	2

From 4:

Vertex	Distance from Source	Parent
0	19	7
1	19	2
2	11	3
3	4	4
4	0	-1
5	8	3
6	10	5
7	11	6
8	13	2

From 5:

Vertex	Distance from Source	Parent
0	11	7
1	12	2
2	4	5

3	6	6
4	10	5
5	0	-1
6	2	5
7	3	6
8	6	2

From 6:

Vertex	Distance from Source	Parent
0	9	7
1	12	7
2	6	5
3	4	6
4	8	3
5	2	6
6	0	-1
7	1	6
8	6	6

From 7:

Vertex	Distance from Source	Parent
0	8	7
1	11	7
2	9	8
3	5	6
4	9	3
5	3	6
6	1	7
7	0	-1
8	7	7

From 8:

Vertex	Distance from Source	Parent
0	14	1
1	10	2
2	2	8
3	9	2
4	13	3
5	6	2
6	6	8
7	7	8
8	0	-1

**Dijkstra:**

**SSSP**

Vertex	Distance from Source	Parent
0	0	-1
1	4	0
2	12	1
3	13	6
4	17	3
5	11	6
6	9	7
7	8	0
8	14	2

## APSP

From 0:

Vertex	Distance from Source	Parent
0	0	-1
1	4	0
2	12	1
3	13	6
4	17	3
5	11	6
6	9	7
7	8	0
8	14	2

From 1:

Vertex	Distance from Source	Parent
0	4	1
1	0	-1
2	8	1
3	15	2
4	19	3
5	12	2
6	12	7
7	11	1
8	10	2

From 2:

Vertex	Distance from Source	Parent
0	12	1
1	8	2
2	0	-1
3	7	2
4	11	3
5	4	2
6	6	5
7	7	6
8	2	2

From 3:

Vertex	Distance from Source	Parent
0	15	7
1	15	2
2	7	3
3	0	-1
4	4	3
5	4	3
6	6	5
7	7	6
8	9	2

From 4:

Vertex	Distance from Source	Parent
0	19	7
1	19	2
2	11	3
3	4	4
4	0	-1
5	8	3
6	10	5

7	11	6
8	13	2

From 5:

Vertex	Distance from Source	Parent
0	11	7
1	12	2
2	4	5
3	6	6
4	10	5
5	0	-1
6	2	5
7	3	6
8	6	2

From 6:

Vertex	Distance from Source	Parent
0	9	7
1	12	7
2	6	5
3	4	6
4	8	3
5	2	6
6	0	-1
7	1	6
8	6	6

From 7:

Vertex	Distance from Source	Parent
0	8	7
1	11	7
2	7	5
3	5	6
4	9	3
5	3	6
6	1	7
7	0	-1
8	7	7

From 8:

Vertex	Distance from Source	Parent
0	14	1
1	10	2
2	2	8
3	9	2
4	13	3
5	6	2
6	6	8
7	7	8
8	0	-1

### 3. V=15 E=104 k=63 q=9 (Dense graph)

#### Input:

```

15
104
63
0 41 67 34 0 69 24 78 58 62 64 5 45 81 27

```

```

41 0 61 91 93 42 27 36 91 4 2 53 92 82 21
67 61 0 16 18 93 47 26 71 38 69 12 67 94 35
34 91 16 0 94 3 11 22 33 73 64 41 11 53 68
0 93 18 94 0 47 44 62 57 37 59 23 41 29 78
69 42 93 3 47 0 16 35 90 42 88 6 40 42 64
24 27 47 11 44 16 0 48 46 5 90 29 70 50 6
78 36 26 22 62 35 48 0 1 93 48 29 23 84 54
58 91 71 33 57 90 46 1 0 56 40 66 76 31 8
62 4 38 73 37 42 5 93 56 0 44 39 26 23 37
64 2 69 64 59 88 90 48 40 44 0 38 18 82 29
5 53 12 41 23 6 29 29 66 39 38 0 41 33 15
45 92 67 11 41 40 70 23 76 26 18 41 0 39 58
81 82 94 53 29 42 50 84 31 23 82 33 39 0 4
27 21 35 68 78 64 6 54 8 37 29 15 58 4 0
1 2 3 4 5 6 8 11 12 15 16 18 21 22 23 24 26 27 29 31 33 34 35
36 37 38 39 40 41 42 44 45 46 47 48 50 53 54 56 57 58 59 61 62 64 66
67 68 69 70 71 73 76 78 81 82 84 88 90 91 92 93 94

```

## Output:

### New-Dijkstra1:

#### SSSP

Vertex	Distance from Source	Parent
0	0	-1
1	33	9
2	17	11
3	14	5
4	28	11
5	11	11
6	24	0
7	29	8
8	28	14
9	29	6
10	35	1
11	5	0
12	25	3
13	24	14
14	20	11

#### APSP

From 0:

Vertex	Distance from Source	Parent
0	0	-1
1	33	9
2	17	11
3	14	5
4	28	11
5	11	11
6	24	0
7	29	8
8	28	14

9	29	6
10	35	1
11	5	0
12	25	3
13	24	14
14	20	11

From 1:

Vertex	Distance from Source	Parent
0	33	6
1	0	-1
2	36	3
3	20	6
4	41	9
5	23	3
6	9	9
7	24	8
8	23	14
9	4	1
10	2	1
11	29	5
12	20	10
13	19	14
14	15	6

From 2:

Vertex	Distance from Source	Parent
0	17	11
1	36	9
2	0	-1
3	16	2
4	18	2
5	18	11
6	27	3
7	26	2
8	27	7
9	32	6
10	38	1
11	12	2
12	27	3
13	31	14
14	27	11

From 3:

Vertex	Distance from Source	Parent
0	14	11
1	20	9
2	16	3
3	0	-1
4	32	11
5	3	3
6	11	3
7	22	3
8	23	7
9	16	6
10	22	1
11	9	5
12	11	3
13	21	14

14	17	6
From 4:		
Vertex	Distance from Source	Parent
0	28	11
1	41	9
2	18	4
3	32	5
4	0	-1
5	29	11
6	39	14
7	42	8
8	41	14
9	37	4
10	43	1
11	23	4
12	41	4
13	29	4
14	33	13

From 5:		
Vertex	Distance from Source	Parent
0	11	11
1	23	9
2	18	11
3	3	5
4	29	11
5	0	-1
6	14	3
7	25	3
8	26	7
9	19	6
10	25	1
11	6	5
12	14	3
13	24	14
14	20	6

From 6:		
Vertex	Distance from Source	Parent
0	24	6
1	9	9
2	27	3
3	11	6
4	39	13
5	14	3
6	0	-1
7	15	8
8	14	14
9	5	6
10	11	1
11	20	5
12	22	3
13	10	14
14	6	6

From 7:		
Vertex	Distance from Source	Parent
0	29	11
1	24	9

2	26	7
3	22	7
4	42	13
5	25	3
6	15	14
7	0	-1
8	1	7
9	20	6
10	26	1
11	24	14
12	23	7
13	13	14
14	9	8

From 8:

Vertex	Distance from Source	Parent
0	28	11
1	23	9
2	27	7
3	23	7
4	41	13
5	26	3
6	14	14
7	1	8
8	0	-1
9	19	6
10	25	1
11	23	14
12	24	7
13	12	14
14	8	8

From 9:

Vertex	Distance from Source	Parent
0	29	6
1	4	9
2	32	3
3	16	6
4	37	9
5	19	3
6	5	9
7	20	8
8	19	14
9	0	-1
10	6	1
11	25	5
12	24	10
13	15	14
14	11	6

From 10:

Vertex	Distance from Source	Parent
0	35	6
1	2	10
2	38	3
3	22	6
4	43	9
5	25	3
6	11	9



7	26	8
8	25	14
9	6	1
10	0	-1
11	31	5
12	18	10
13	21	14
14	17	6

From 11:

Vertex	Distance from Source	Parent
0	5	11
1	29	9
2	12	11
3	9	5
4	23	11
5	6	11
6	20	3
7	24	8
8	23	14
9	25	6
10	31	1
11	0	-1
12	20	3
13	19	14
14	15	11

From 12:

Vertex	Distance from Source	Parent
0	25	11
1	20	10
2	27	3
3	11	12
4	41	12
5	14	3
6	22	3
7	23	12
8	24	7
9	24	1
10	18	12
11	20	5
12	0	-1
13	32	14
14	28	6

From 13:

Vertex	Distance from Source	Parent
0	24	11
1	19	9
2	31	11
3	21	6
4	29	13
5	24	3
6	10	14
7	13	8
8	12	14
9	15	6
10	21	1
11	19	14

12	32	3
13	0	-1
14	4	13

From 14:

Vertex	Distance from Source	Parent
0	20	11
1	15	9
2	27	11
3	17	6
4	33	13
5	20	3
6	6	14
7	9	8
8	8	14
9	11	6
10	17	1
11	15	14
12	28	3
13	4	14
14	0	-1

**Dijkstra:**

**SSSP**

Vertex	Distance from Source	Parent
0	0	-1
1	33	9
2	17	11
3	14	5
4	28	11
5	11	11
6	24	0
7	29	8
8	28	14
9	29	6
10	35	1
11	5	0
12	25	3
13	24	14
14	20	11

**APSP**

From 0:

Vertex	Distance from Source	Parent
0	0	-1
1	33	9
2	17	11
3	14	5
4	28	11
5	11	11
6	24	0
7	29	8
8	28	14

9	29	6
10	35	1
11	5	0
12	25	3
13	24	14
14	20	11

From 1:

Vertex	Distance from Source	Parent
0	33	6
1	0	-1
2	36	3
3	20	6
4	41	9
5	23	3
6	9	9
7	24	8
8	23	14
9	4	1
10	2	1
11	29	5
12	20	10
13	19	14
14	15	6

From 2:

Vertex	Distance from Source	Parent
0	17	11
1	36	9
2	0	-1
3	16	2
4	18	2
5	18	11
6	27	3
7	26	2
8	27	7
9	32	6
10	38	1
11	12	2
12	27	3
13	31	14
14	27	11

From 3:

Vertex	Distance from Source	Parent
0	14	11
1	20	9
2	16	3
3	0	-1
4	32	11
5	3	3
6	11	3
7	22	3
8	23	7
9	16	6
10	22	1
11	9	5
12	11	3
13	21	14

14	17	6
From 4:		
Vertex	Distance from Source	Parent
0	28	11
1	41	9
2	18	4
3	32	5
4	0	-1
5	29	11
6	39	14
7	42	8
8	41	14
9	37	4
10	43	1
11	23	4
12	41	4
13	29	4
14	33	13

From 5:		
Vertex	Distance from Source	Parent
0	11	11
1	23	9
2	18	11
3	3	5
4	29	11
5	0	-1
6	14	3
7	25	3
8	26	7
9	19	6
10	25	1
11	6	5
12	14	3
13	24	14
14	20	6

From 6:		
Vertex	Distance from Source	Parent
0	24	6
1	9	9
2	27	3
3	11	6
4	39	13
5	14	3
6	0	-1
7	15	8
8	14	14
9	5	6
10	11	1
11	20	5
12	22	3
13	10	14
14	6	6

From 7:		
Vertex	Distance from Source	Parent
0	29	11
1	24	9

2	26	7
3	22	7
4	42	13
5	25	3
6	15	14
7	0	-1
8	1	7
9	20	6
10	26	1
11	24	14
12	23	7
13	13	14
14	9	8

From 8:

Vertex	Distance from Source	Parent
0	28	11
1	23	9
2	27	7
3	23	7
4	41	13
5	26	3
6	14	14
7	1	8
8	0	-1
9	19	6
10	25	1
11	23	14
12	24	7
13	12	14
14	8	8

From 9:

Vertex	Distance from Source	Parent
0	29	6
1	4	9
2	32	3
3	16	6
4	37	9
5	19	3
6	5	9
7	20	8
8	19	14
9	0	-1
10	6	1
11	25	5
12	24	10
13	15	14
14	11	6

From 10:

Vertex	Distance from Source	Parent
0	35	6
1	2	10
2	38	3
3	22	6
4	43	9
5	25	3
6	11	9

7	26	8
8	25	14
9	6	1
10	0	-1
11	31	5
12	18	10
13	21	14
14	17	6

From 11:

Vertex	Distance from Source	Parent
0	5	11
1	29	9
2	12	11
3	9	5
4	23	11
5	6	11
6	20	3
7	24	8
8	23	14
9	25	6
10	31	1
11	0	-1
12	20	3
13	19	14
14	15	11

From 12:

Vertex	Distance from Source	Parent
0	25	11
1	20	10
2	27	3
3	11	12
4	41	12
5	14	3
6	22	3
7	23	12
8	24	7
9	24	1
10	18	12
11	20	5
12	0	-1
13	32	14
14	28	6

From 13:

Vertex	Distance from Source	Parent
0	24	11
1	19	9
2	31	11
3	21	6
4	29	13
5	24	3
6	10	14
7	13	8
8	12	14
9	15	6
10	21	1
11	19	14

12	32	3
13	0	-1
14	4	13

From 14:

Vertex	Distance from Source	Parent
0	20	11
1	15	9
2	27	11
3	17	6
4	33	13
5	20	3
6	6	14
7	9	8
8	8	14
9	11	6
10	17	1
11	15	14
12	28	3
13	4	14
14	0	-1

#### 4. V=20 E=187 k=80 q=8.5 (Dense graph)

Input:

```

20
187
80
0 41 67 34 0 69 24 78 58 62 64 5 45 81 27 61 91 95 42 27
41 0 36 91 4 2 53 92 82 21 16 18 95 47 26 71 38 69 12 67
67 36 0 97 35 94 3 11 22 33 73 64 41 11 53 68 47 44 62 57
34 91 97 0 37 59 23 41 29 78 16 35 90 42 88 6 40 42 64 48
0 4 35 37 0 46 5 90 29 70 50 6 1 93 48 29 23 84 54 56
69 2 94 59 46 0 40 66 76 31 8 44 39 26 23 37 38 18 82 29
24 53 3 23 5 40 0 41 33 15 39 58 4 30 77 6 73 86 21 45
78 92 11 41 90 66 41 0 24 72 70 29 77 73 97 12 86 90 61 36
58 82 22 29 29 76 33 24 0 55 67 55 74 31 52 50 50 41 24 66
62 21 33 78 70 31 15 72 55 0 30 7 91 7 37 57 87 53 83 45
64 16 73 16 50 8 39 70 67 30 0 9 9 58 21 88 22 46 6 30
5 18 64 35 6 44 58 29 55 7 9 0 13 68 0 91 62 55 10 59
45 95 41 90 1 39 4 77 74 91 9 13 0 24 37 48 83 95 41 2
81 47 11 42 93 26 30 73 31 7 58 68 24 0 50 91 36 74 20 96
27 26 53 88 48 23 77 97 52 37 21 0 37 50 0 21 48 97 68 84
61 71 68 6 29 37 6 12 50 57 88 91 48 91 21 0 81 34 53 97
91 38 47 40 23 38 73 86 50 87 22 62 83 36 48 81 0 18 38 0
95 69 44 42 84 18 86 90 41 53 46 55 95 74 97 34 18 0 88 27
42 12 62 64 54 82 21 61 24 83 6 10 41 20 68 53 38 88 0 67
27 67 57 48 56 29 45 36 66 45 30 59 2 96 84 97 0 27 67 0
1 2 3 4 5 6 7 8 9 10 11 12 13 15 16 18 20 21 22 23 24 26 27 29 30 31
33 34 35 36 37 38 39 40 41 42 44 45 46 47 48 50 52 53 54 55 56 57 58
59 61 62 64 66 67 68 69 70 71 72 73 74 76 77 78 81 82 83 84 86 87 88
90 91 92 93 94 95 96 97

```

Output:

## New-Dijkstra1:

### SSSP

Vertex	Distance from Source	Parent
0	0	-1
1	15	4
2	19	6
3	28	15
4	11	11
5	17	1
6	16	4
7	30	2
8	39	18
9	12	11
10	14	11
11	5	0
12	12	4
13	19	9
14	27	0
15	22	6
16	34	4
17	35	5
18	15	11
19	14	12

### APSP

From 0:

Vertex	Distance from Source	Parent
0	0	-1
1	15	4
2	19	6
3	28	15
4	11	11
5	17	1
6	16	4
7	30	2
8	39	18
9	12	11
10	14	11
11	5	0
12	12	4
13	19	9
14	27	0
15	22	6
16	34	4
17	35	5
18	15	11
19	14	12

From 1:

Vertex	Distance from Source	Parent
0	15	11
1	0	-1
2	12	6



3	21	15
4	4	1
5	2	1
6	9	12
7	23	2
8	33	4
9	17	11
10	10	5
11	10	4
12	5	4
13	23	2
14	25	5
15	15	6
16	27	4
17	20	5
18	12	1
19	7	12

From 2:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	19	11
1	12	4
2	0	-1
3	15	15
4	8	6
5	14	1
6	3	2
7	11	2
8	22	2
9	18	13
10	16	12
11	14	4
12	7	6
13	11	2
14	30	15
15	9	6
16	31	4
17	32	5
18	22	10
19	9	12

From 3:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	28	11
1	21	4
2	15	6
3	0	-1
4	17	12
5	23	1
6	12	15
7	18	15
8	29	3
9	27	6
10	16	3
11	23	4
12	16	6
13	26	2
14	27	15

15	6	3
16	38	10
17	40	15
18	22	10
19	18	12

From 4:

Vertex	Distance from Source	Parent
0	11	11
1	4	4
2	8	6
3	17	15
4	0	-1
5	6	1
6	5	4
7	19	2
8	29	4
9	13	11
10	10	12
11	6	4
12	1	4
13	19	2
14	29	5
15	11	6
16	23	4
17	24	5
18	16	10
19	3	12

From 5:

Vertex	Distance from Source	Parent
0	17	11
1	2	5
2	14	6
3	23	15
4	6	1
5	0	-1
6	11	12
7	25	2
8	35	4
9	19	11
10	8	5
11	12	4
12	7	4
13	25	2
14	23	5
15	17	6
16	29	4
17	18	5
18	14	10
19	9	12

From 6:

Vertex	Distance from Source	Parent
0	16	11
1	9	4
2	3	6
3	12	15
4	5	6

5	11	1
6	0	-1
7	14	2
8	25	2
9	15	6
10	13	12
11	11	4
12	4	6
13	14	2
14	27	15
15	6	6
16	28	4
17	29	5
18	19	10
19	6	12

From 7:

Vertex	Distance from Source	Parent
0	30	11
1	23	4
2	11	7
3	18	15
4	19	6
5	25	1
6	14	2
7	0	-1
8	24	7
9	29	13
10	27	12
11	25	4
12	18	6
13	22	2
14	33	15
15	12	7
16	42	4
17	43	5
18	33	10
19	20	12

From 8:

Vertex	Distance from Source	Parent
0	39	11
1	33	4
2	22	8
3	29	8
4	29	8
5	35	1
6	25	2
7	24	8
8	0	-1
9	38	13
10	30	18
11	34	18
12	29	6
13	31	8
14	51	10
15	31	6
16	50	8

17	41	8
18	24	8
19	31	12

From 9:

Vertex	Distance from Source	Parent
0	12	11
1	17	4
2	18	6
3	27	15
4	13	11
5	19	1
6	15	9
7	29	2
8	38	13
9	0	-1
10	16	11
11	7	9
12	14	4
13	7	9
14	37	10
15	21	6
16	36	4
17	37	5
18	17	11
19	16	12

From 10:

Vertex	Distance from Source	Parent
0	14	11
1	10	5
2	16	6
3	16	10
4	10	12
5	8	10
6	13	12
7	27	2
8	30	18
9	16	11
10	0	-1
11	9	10
12	9	10
13	23	9
14	21	10
15	19	6
16	22	10
17	26	5
18	6	10
19	11	12

From 11:

Vertex	Distance from Source	Parent
0	5	11
1	10	4
2	14	6
3	23	15
4	6	11
5	12	1
6	11	4

7	25	2
8	34	18
9	7	11
10	9	11
11	0	-1
12	7	4
13	14	9
14	30	10
15	17	6
16	29	4
17	30	5
18	10	11
19	9	12

From 12:

Vertex	Distance from Source	Parent
0	12	11
1	5	4
2	7	6
3	16	15
4	1	12
5	7	1
6	4	12
7	18	2
8	29	2
9	14	11
10	9	12
11	7	4
12	0	-1
13	18	2
14	30	5
15	10	6
16	24	4
17	25	5
18	15	10
19	2	12

From 13:

Vertex	Distance from Source	Parent
0	19	11
1	23	4
2	11	13
3	26	15
4	19	12
5	25	1
6	14	2
7	22	2
8	31	13
9	7	13
10	23	11
11	14	9
12	18	6
13	0	-1
14	41	15
15	20	6
16	36	13
17	43	5
18	20	13

19	20	12
From 14:		
Vertex	Distance from Source	Parent
0	27	14
1	25	5
2	30	6
3	27	15
4	29	1
5	23	14
6	27	15
7	33	15
8	51	18
9	37	11
10	21	14
11	30	10
12	30	4
13	41	2
14	0	-1
15	21	14
16	43	10
17	41	5
18	27	10
19	32	12

From 15:		
Vertex	Distance from Source	Parent
0	22	11
1	15	4
2	9	6
3	6	15
4	11	12
5	17	1
6	6	15
7	12	15
8	31	2
9	21	6
10	19	12
11	17	4
12	10	6
13	20	2
14	21	15
15	0	-1
16	34	4
17	34	15
18	25	10
19	12	12

From 16:		
Vertex	Distance from Source	Parent
0	34	11
1	27	4
2	31	6
3	38	10
4	23	16
5	29	1
6	28	4
7	42	2
8	50	16

9	36	11
10	22	16
11	29	4
12	24	4
13	36	16
14	43	10
15	34	6
16	0	-1
17	18	16
18	28	10
19	26	12

From 17:

Vertex	Distance from Source	Parent
0	35	11
1	20	5
2	32	6
3	40	15
4	24	1
5	18	17
6	29	12
7	43	2
8	41	17
9	37	11
10	26	5
11	30	4
12	25	4
13	43	2
14	41	5
15	34	17
16	18	17
17	0	-1
18	32	10
19	27	12

From 18:

Vertex	Distance from Source	Parent
0	15	11
1	12	18
2	22	6
3	22	10
4	16	11
5	14	10
6	19	12
7	33	2
8	24	18
9	17	11
10	6	18
11	10	18
12	15	10
13	20	18
14	27	10
15	25	6
16	28	10
17	32	5
18	0	-1
19	17	12

From 19:

Vertex	Distance from Source	Parent
0	14	11
1	7	4
2	9	6
3	18	15
4	3	12
5	9	1
6	6	12
7	20	2
8	31	2
9	16	11
10	11	12
11	9	4
12	2	19
13	20	2
14	32	5
15	12	6
16	26	4
17	27	5
18	17	10
19	0	-1

**Dijkstra:**

**SSSP**

Vertex	Distance from Source	Parent
0	0	-1
1	15	4
2	19	6
3	28	15
4	11	11
5	17	1
6	16	4
7	30	2
8	39	18
9	12	11
10	14	11
11	5	0
12	12	4
13	19	9
14	27	0
15	22	6
16	34	4
17	35	5
18	15	11
19	14	12

**APSP**

From 0:

Vertex	Distance from Source	Parent
0	0	-1
1	15	4
2	19	6



3	28	15
4	11	11
5	17	1
6	16	4
7	30	2
8	39	18
9	12	11
10	14	11
11	5	0
12	12	4
13	19	9
14	27	0
15	22	6
16	34	4
17	35	5
18	15	11
19	14	12

From 1:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	15	11
1	0	-1
2	12	6
3	21	15
4	4	1
5	2	1
6	9	4
7	23	2
8	33	4
9	17	11
10	10	5
11	10	4
12	5	4
13	23	2
14	25	5
15	15	6
16	27	4
17	20	5
18	12	1
19	7	12

From 2:

Vertex	Distance from Source	Parent
--------	----------------------	--------

0	19	11
1	12	4
2	0	-1
3	15	15
4	8	6
5	14	1
6	3	2
7	11	2
8	22	2
9	18	6
10	16	12
11	14	4
12	7	6
13	11	2
14	30	15

15	9	6
16	31	4
17	32	5
18	22	10
19	9	12

From 3:

Vertex	Distance from Source	Parent
0	28	11
1	21	4
2	15	6
3	0	-1
4	17	6
5	23	1
6	12	15
7	18	15
8	29	3
9	27	6
10	16	3
11	23	4
12	16	6
13	26	2
14	27	15
15	6	3
16	38	10
17	40	15
18	22	10
19	18	12

From 4:

Vertex	Distance from Source	Parent
0	11	11
1	4	4
2	8	6
3	17	15
4	0	-1
5	6	1
6	5	4
7	19	2
8	29	4
9	13	11
10	10	12
11	6	4
12	1	4
13	19	2
14	29	5
15	11	6
16	23	4
17	24	5
18	16	1
19	3	12

From 5:

Vertex	Distance from Source	Parent
0	17	11
1	2	5
2	14	6
3	23	15
4	6	1

5	0	-1
6	11	4
7	25	2
8	35	4
9	19	11
10	8	5
11	12	4
12	7	4
13	25	2
14	23	5
15	17	6
16	29	4
17	18	5
18	14	1
19	9	12

From 6:

Vertex	Distance from Source	Parent
0	16	11
1	9	4
2	3	6
3	12	15
4	5	6
5	11	1
6	0	-1
7	14	2
8	25	2
9	15	6
10	13	12
11	11	4
12	4	6
13	14	2
14	27	15
15	6	6
16	28	4
17	29	5
18	19	10
19	6	12

From 7:

Vertex	Distance from Source	Parent
0	30	11
1	23	4
2	11	7
3	18	15
4	19	6
5	25	1
6	14	2
7	0	-1
8	24	7
9	29	6
10	27	12
11	25	4
12	18	6
13	22	2
14	33	15
15	12	7
16	42	4

17	43	5
18	33	10
19	20	12

From 8:

Vertex	Distance	from Source	Parent
0	39		11
1	33		4
2	22		8
3	29		8
4	29		8
5	35		1
6	25		2
7	24		8
8	0		-1
9	38		13
10	30		18
11	34		18
12	29		6
13	31		8
14	51		10
15	31		6
16	50		8
17	41		8
18	24		8
19	31		12

From 9:

Vertex	Distance	from Source	Parent
0	12		11
1	17		4
2	18		13
3	27		15
4	13		11
5	19		1
6	15		9
7	29		2
8	38		13
9	0		-1
10	16		11
11	7		9
12	14		4
13	7		9
14	37		9
15	21		6
16	36		4
17	37		5
18	17		11
19	16		12

From 10:

Vertex	Distance	from Source	Parent
0	14		11
1	10		5
2	16		6
3	16		10
4	10		12
5	8		10
6	13		12

7	27	2
8	30	18
9	16	11
10	0	-1
11	9	10
12	9	10
13	23	9
14	21	10
15	19	6
16	22	10
17	26	5
18	6	10
19	11	12

From 11:

Vertex	Distance from Source	Parent
0	5	11
1	10	4
2	14	6
3	23	15
4	6	11
5	12	1
6	11	4
7	25	2
8	34	18
9	7	11
10	9	11
11	0	-1
12	7	4
13	14	9
14	30	10
15	17	6
16	29	4
17	30	5
18	10	11
19	9	12

From 12:

Vertex	Distance from Source	Parent
0	12	11
1	5	4
2	7	6
3	16	15
4	1	12
5	7	1
6	4	12
7	18	2
8	29	2
9	14	11
10	9	12
11	7	4
12	0	-1
13	18	2
14	30	5
15	10	6
16	24	4
17	25	5
18	15	10

19	2	12
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From 13:

Vertex	Distance from Source	Parent
0	19	11
1	23	4
2	11	13
3	26	15
4	19	6
5	25	1
6	14	2
7	22	2
8	31	13
9	7	13
10	23	11
11	14	9
12	18	6
13	0	-1
14	41	15
15	20	6
16	36	13
17	43	5
18	20	13
19	20	12

From 14:

Vertex	Distance from Source	Parent
0	27	14
1	25	5
2	30	6
3	27	15
4	29	1
5	23	14
6	27	15
7	33	15
8	51	18
9	37	14
10	21	14
11	30	10
12	30	10
13	41	2
14	0	-1
15	21	14
16	43	10
17	41	5
18	27	10
19	32	12

From 15:

Vertex	Distance from Source	Parent
0	22	11
1	15	4
2	9	6
3	6	15
4	11	6
5	17	1
6	6	15
7	12	15
8	31	2

9	21	6
10	19	12
11	17	4
12	10	6
13	20	2
14	21	15
15	0	-1
16	34	4
17	34	15
18	25	10
19	12	12

From 16:

Vertex	Distance from Source	Parent
0	34	11
1	27	4
2	31	6
3	38	10
4	23	16
5	29	1
6	28	4
7	42	2
8	50	16
9	36	11
10	22	16
11	29	4
12	24	4
13	36	16
14	43	10
15	34	6
16	0	-1
17	18	16
18	28	10
19	26	12

From 17:

Vertex	Distance from Source	Parent
0	35	11
1	20	5
2	32	6
3	40	15
4	24	1
5	18	17
6	29	4
7	43	2
8	41	17
9	37	11
10	26	5
11	30	4
12	25	4
13	43	2
14	41	5
15	34	17
16	18	17
17	0	-1
18	32	1
19	27	17

From 18:

Vertex	Distance from Source	Parent
0	15	11
1	12	18
2	22	6
3	22	10
4	16	11
5	14	10
6	19	12
7	33	2
8	24	18
9	17	11
10	6	18
11	10	18
12	15	10
13	20	18
14	27	10
15	25	6
16	28	10
17	32	5
18	0	-1
19	17	12

From 19:

Vertex	Distance from Source	Parent
0	14	11
1	7	4
2	9	6
3	18	15
4	3	12
5	9	1
6	6	12
7	20	2
8	31	2
9	16	11
10	11	12
11	9	4
12	2	19
13	20	2
14	32	5
15	12	6
16	26	4
17	27	19
18	17	10
19	0	-1

## 5. V=25 E=298 k=91 q=7.6 (Dense graph)

Input:

```

25
298
91
0 41 37 29 19 60 10 32 64 93 20 79 15 1 46 67 6 85 11 74 4 90 54 22
56

```



```

41 0 1 63 58 92 27 10 15 93 27 92 26 27 59 12 60 0 88 46 88 69 19 8
9
37 1 0 48 26 78 36 94 70 68 55 55 90 41 78 2 94 28 74 93 94 36 19 18
58
29 63 48 0 47 92 40 79 36 23 24 68 61 46 56 35 13 28 69 35 6 19 4 60
21
19 58 26 47 0 66 41 85 71 8 4 16 45 37 51 80 75 80 73 6 36 9 75 51
76
60 92 78 92 66 0 74 33 55 60 62 9 5 53 53 22 27 1 43 12 45 32 84 54
54
10 27 36 40 41 74 0 24 93 83 63 93 92 35 67 24 62 85 34 65 11 4 7 82
5
32 10 94 79 85 33 24 0 58 68 61 20 17 55 32 20 68 27 94 41 6 47 54
76 70
64 15 70 36 71 55 93 58 0 14 81 47 64 13 3 9 87 62 59 37 62 91 16 74
40
93 91 68 23 8 60 83 68 14 0 36 78 53 59 34 2 13 5 85 79 42 52 10 76
56
20 27 55 24 4 62 63 61 81 36 0 93 51 21 18 8 50 50 20 88 36 11 29 31
3
79 92 55 68 16 9 93 20 47 78 93 0 39 16 47 24 17 51 13 91 18 86 84
65 35
15 26 90 61 45 5 94 17 64 53 51 39 0 20 94 76 77 72 22 16 8 54 52 92
40
1 27 41 46 37 53 35 55 13 59 21 16 20 0 73 94 5 51 11 70 24 26 51 72
4
46 59 78 56 51 53 67 32 3 34 18 47 94 73 0 80 27 93 47 65 3 15 22 73
55
67 12 2 35 80 22 24 20 9 2 8 24 76 94 80 0 45 75 36 57 12 90 63 79
58
6 60 94 13 75 27 62 68 87 13 50 17 77 5 27 45 0 56 85 40 27 30 73 65
55
85 0 28 28 80 1 85 27 62 5 50 51 72 51 93 75 56 0 53 42 31 42 78 85
51
11 88 74 69 73 43 34 94 59 85 20 13 22 11 47 36 85 53 0 0 13 41 15
89 26
74 46 94 35 6 12 65 41 37 79 88 91 16 70 65 57 40 42 0 0 30 55 12 29
3
4 88 94 6 36 45 11 6 62 42 36 18 8 24 3 12 27 31 13 30 0 25 92 2 89
90 69 36 19 9 32 4 47 91 52 11 86 54 26 15 90 30 42 41 55 25 0 35 86
93
54 19 19 4 75 84 7 54 16 10 29 84 52 51 22 63 73 78 15 12 94 35 0 20
16
22 8 18 60 51 54 82 76 74 76 31 65 92 72 73 79 65 85 89 29 2 86 20 0
20
56 9 58 21 76 54 5 70 40 56 3 35 40 4 55 58 55 51 26 3 89 90 16 20 0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
27 28 29 30 31 32 33 34 35 36 37 39 40 41 42 43 45 46 47 48 50 51 52
53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75
76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94

```

**Output:**

**New-Dijkstra1:**

## SSSP

Vertex	Distance from Source	Parent
0	0	-1
1	14	23
2	15	1
3	10	20
4	12	10
5	17	12
6	10	24
7	10	20
8	10	14
9	18	15
10	8	24
11	17	13
12	12	20
13	1	0
14	7	20
15	16	10
16	6	0
17	18	5
18	11	0
19	8	24
20	4	0
21	14	6
22	14	3
23	6	20
24	5	13

## APSP

From 0:

Vertex	Distance from Source	Parent
0	0	-1
1	14	23
2	15	1
3	10	20
4	12	10
5	17	12
6	10	24
7	10	20
8	10	14
9	18	15
10	8	24
11	17	13
12	12	20
13	1	0
14	7	20
15	16	10
16	6	0
17	18	5
18	11	0
19	8	24
20	4	0
21	14	6

22	14	3
23	6	20
24	5	13

From 1:

Vertex	Distance from Source	Parent
0	14	20
1	0	-1
2	1	1
3	16	20
4	13	9
5	11	17
6	14	24
7	10	1
8	12	15
9	5	15
10	11	15
11	20	5
12	16	5
13	13	24
14	13	20
15	3	2
16	18	13
17	10	9
18	23	20
19	12	24
20	10	23
21	18	6
22	15	9
23	8	1
24	9	1

From 2:

Vertex	Distance from Source	Parent
0	15	13
1	1	2
2	0	-1
3	17	20
4	12	9
5	10	17
6	15	24
7	11	1
8	11	15
9	4	15
10	10	15
11	19	5
12	15	5
13	14	24
14	14	20
15	2	2
16	17	9
17	9	9
18	24	20
19	13	24
20	11	23
21	19	6
22	14	9
23	9	1

24	10	1
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From 3:

Vertex	Distance from Source	Parent
0	10	20
1	16	23
2	17	1
3	0	-1
4	22	19
5	19	12
6	11	22
7	12	20
8	12	14
9	14	22
10	18	24
11	24	20
12	14	20
13	11	0
14	9	20
15	16	9
16	13	3
17	19	9
18	19	20
19	16	22
20	6	3
21	15	6
22	4	3
23	8	20
24	15	13

From 4:

Vertex	Distance from Source	Parent
0	12	13
1	13	2
2	12	15
3	22	20
4	0	-1
5	14	17
6	12	24
7	22	20
8	19	15
9	8	4
10	4	4
11	16	4
12	19	5
13	11	24
14	19	20
15	10	9
16	16	13
17	13	9
18	22	13
19	6	4
20	16	0
21	9	4
22	18	9
23	18	20
24	7	10

From 5:

Vertex	Distance from Source	Parent
0	17	20
1	11	2
2	10	15
3	19	20
4	14	9
5	0	-1
6	20	24
7	19	20
8	17	15
9	6	17
10	16	15
11	9	5
12	5	5
13	18	0
14	16	20
15	8	9
16	19	9
17	1	5
18	22	11
19	12	5
20	13	12
21	23	4
22	16	9
23	15	20
24	15	19

From 6:

Vertex	Distance from Source	Parent
0	10	13
1	14	24
2	15	1
3	11	22
4	12	10
5	20	19
6	0	-1
7	17	20
8	17	14
9	17	22
10	8	24
11	25	13
12	19	20
13	9	24
14	14	20
15	16	10
16	14	13
17	21	5
18	20	13
19	8	24
20	11	6
21	4	6
22	7	6
23	13	20
24	5	6

From 7:

Vertex	Distance from Source	Parent
0	10	20

1	10	7
2	11	1
3	12	20
4	22	10
5	19	12
6	17	20
7	0	-1
8	12	14
9	15	15
10	18	24
11	20	7
12	14	20
13	11	0
14	9	20
15	13	2
16	16	13
17	20	5
18	19	20
19	18	24
20	6	7
21	21	6
22	16	3
23	8	20
24	15	13

From 8:

Vertex	Distance	from Source	Parent
0	10		20
1	12		2
2	11		15
3	12		20
4	19		9
5	17		17
6	17		20
7	12		20
8	0		-1
9	11		15
10	17		15
11	24		20
12	14		20
13	11		0
14	3		8
15	9		8
16	16		0
17	16		9
18	19		20
19	18		24
20	6		14
21	18		14
22	16		3
23	8		20
24	15		13

From 9:

Vertex	Distance	from Source	Parent
0	18		13
1	5		2
2	4		15

3	14	22
4	8	9
5	6	17
6	17	22
7	15	1
8	11	15
9	0	-1
10	10	15
11	15	5
12	11	5
13	17	24
14	14	8
15	2	9
16	13	9
17	5	9
18	25	22
19	14	4
20	14	15
21	17	4
22	10	9
23	13	1
24	13	10

From 10:

Vertex	Distance from Source	Parent
0	8	13
1	11	2
2	10	15
3	18	20
4	4	10
5	16	17
6	8	24
7	18	20
8	17	15
9	10	15
10	0	-1
11	20	4
12	20	20
13	7	24
14	15	20
15	8	10
16	12	13
17	15	9
18	18	13
19	6	24
20	12	0
21	11	10
22	15	6
23	14	20
24	3	10

From 11:

Vertex	Distance from Source	Parent
0	17	13
1	20	2
2	19	15
3	24	20
4	16	11

5	9	11
6	25	24
7	20	11
8	24	14
9	15	17
10	20	4
11	0	-1
12	14	5
13	16	11
14	21	20
15	17	9
16	17	11
17	10	5
18	13	11
19	21	5
20	18	11
21	25	4
22	25	9
23	20	20
24	20	13

From 12:

Vertex Distance from Source Parent

0	12	20
1	16	2
2	15	15
3	14	20
4	19	9
5	5	12
6	19	20
7	14	20
8	14	14
9	11	17
10	20	24
11	14	5
12	0	-1
13	13	0
14	11	20
15	13	9
16	18	13
17	6	5
18	21	20
19	16	12
20	8	12
21	23	6
22	18	3
23	10	20
24	17	13

From 13:

Vertex Distance from Source Parent

0	1	13
1	13	24
2	14	1
3	11	20
4	11	10
5	18	12
6	9	24



7	11	20
8	11	14
9	17	15
10	7	24
11	16	13
12	13	20
13	0	-1
14	8	20
15	15	10
16	5	13
17	19	5
18	11	13
19	7	24
20	5	0
21	13	6
22	15	3
23	7	20
24	4	13

From 14:

Vertex Distance from Source Parent

0	7	20
1	13	23
2	14	15
3	9	20
4	19	10
5	16	12
6	14	20
7	9	20
8	3	14
9	14	15
10	15	24
11	21	20
12	11	20
13	8	0
14	0	-1
15	12	8
16	13	0
17	17	5
18	16	20
19	15	24
20	3	14
21	15	14
22	13	3
23	5	20
24	12	13

From 15:

Vertex Distance from Source Parent

0	16	13
1	3	2
2	2	15
3	16	22
4	10	9
5	8	17
6	16	24
7	13	1
8	9	15

9	2	15
10	8	15
11	17	5
12	13	5
13	15	24
14	12	8
15	0	-1
16	15	9
17	7	9
18	25	20
19	14	24
20	12	15
21	19	10
22	12	9
23	11	1
24	11	10

From 16:

Vertex Distance from Source Parent

0	6	13
1	18	2
2	17	15
3	13	16
4	16	10
5	19	17
6	14	24
7	16	20
8	16	14
9	13	16
10	12	24
11	17	16
12	18	20
13	5	16
14	13	20
15	15	9
16	0	-1
17	18	9
18	16	13
19	12	24
20	10	0
21	18	6
22	17	3
23	12	20
24	9	13

From 17:

Vertex Distance from Source Parent

0	18	20
1	10	2
2	9	15
3	19	22
4	13	9
5	1	17
6	21	24
7	20	20
8	16	15
9	5	17
10	15	15

11	10	5
12	6	5
13	19	0
14	17	20
15	7	9
16	18	9
17	0	-1
18	23	11
19	13	5
20	14	12
21	22	4
22	15	9
23	16	20
24	16	19

From 18:

Vertex	Distance	from Source	Parent
--------	----------	-------------	--------

0	11	18
1	23	23
2	24	1
3	19	22
4	22	10
5	22	11
6	20	24
7	19	20
8	19	14
9	25	22
10	18	24
11	13	18
12	21	20
13	11	18
14	16	20
15	25	20
16	16	13
17	23	5
18	0	-1
19	18	24
20	13	18
21	24	6
22	15	18
23	15	20
24	15	13

From 19:

Vertex	Distance	from Source	Parent
--------	----------	-------------	--------

0	8	13
1	12	24
2	13	1
3	16	22
4	6	19
5	12	19
6	8	24
7	18	20
8	18	14
9	14	4
10	6	24
11	21	5
12	16	19

13	7	24
14	15	20
15	14	10
16	12	13
17	13	5
18	18	13
19	0	-1
20	12	0
21	12	6
22	12	19
23	14	20
24	3	19

From 20:

Vertex	Distance from Source	Parent
0	4	20
1	10	23
2	11	1
3	6	20
4	16	10
5	13	12
6	11	20
7	6	20
8	6	14
9	14	15
10	12	24
11	18	20
12	8	20
13	5	0
14	3	20
15	12	20
16	10	0
17	14	5
18	13	20
19	12	24
20	0	-1
21	15	6
22	10	3
23	2	20
24	9	13

From 21:

Vertex	Distance from Source	Parent
0	14	13
1	18	24
2	19	1
3	15	22
4	9	21
5	23	17
6	4	21
7	21	20
8	18	14
9	17	4
10	11	21
11	25	4
12	23	20
13	13	24
14	15	21

15	19	9
16	18	13
17	22	9
18	24	13
19	12	24
20	15	6
21	0	-1
22	11	6
23	17	20
24	9	6

From 22:

Vertex	Distance from Source	Parent
0	14	20
1	15	2
2	14	15
3	4	22
4	18	19
5	16	17
6	7	22
7	16	20
8	16	14
9	10	22
10	15	24
11	25	5
12	18	20
13	15	0
14	13	20
15	12	9
16	17	3
17	15	9
18	15	22
19	12	22
20	10	3
21	11	6
22	0	-1
23	12	20
24	12	6

From 23:

Vertex	Distance from Source	Parent
0	6	20
1	8	23
2	9	1
3	8	20
4	18	10
5	15	12
6	13	20
7	8	20
8	8	14
9	13	15
10	14	24
11	20	20
12	10	20
13	7	0
14	5	20
15	11	2
16	12	0

17	16	5
18	15	20
19	14	24
20	2	23
21	17	6
22	12	3
23	0	-1
24	11	13

From 24:

Vertex	Distance from Source	Parent
0	5	13
1	9	24
2	10	1
3	15	20
4	7	10
5	15	19
6	5	24
7	15	20
8	15	14
9	13	15
10	3	24
11	20	13
12	17	20
13	4	24
14	12	20
15	11	10
16	9	13
17	16	5
18	15	13
19	3	24
20	9	0
21	9	6
22	12	6
23	11	20
24	0	-1

## Dijkstra

### SSSP

Vertex	Distance from Source	Parent
0	0	-1
1	14	24
2	15	1
3	10	20
4	12	10
5	17	12
6	10	0
7	10	20
8	10	14
9	18	15
10	8	24
11	17	13
12	12	20
13	1	0

14	7	20
15	16	20
16	6	0
17	18	5
18	11	0
19	8	24
20	4	0
21	14	6
22	14	3
23	6	20
24	5	13

### APSP

From 0:

Vertex	Distance from Source	Parent
0	0	-1
1	14	24
2	15	1
3	10	20
4	12	10
5	17	12
6	10	0
7	10	20
8	10	14
9	18	15
10	8	24
11	17	13
12	12	20
13	1	0
14	7	20
15	16	20
16	6	0
17	18	5
18	11	0
19	8	24
20	4	0
21	14	6
22	14	3
23	6	20
24	5	13

From 1:

Vertex	Distance from Source	Parent
0	14	20
1	0	-1
2	1	1
3	16	20
4	13	9
5	11	17
6	14	24
7	10	1
8	12	15
9	5	15
10	11	15
11	20	5

12	16	5
13	13	24
14	13	20
15	3	2
16	18	9
17	10	9
18	23	20
19	12	24
20	10	23
21	18	6
22	15	9
23	8	1
24	9	1

From 2:

Vertex	Distance from Source	Parent
0	15	20
1	1	2
2	0	-1
3	17	20
4	12	9
5	10	17
6	15	24
7	11	1
8	11	15
9	4	15
10	10	15
11	19	5
12	15	5
13	14	24
14	14	20
15	2	2
16	17	9
17	9	9
18	24	20
19	13	24
20	11	23
21	19	6
22	14	9
23	9	1
24	10	1

From 3:

Vertex	Distance from Source	Parent
0	10	20
1	16	23
2	17	1
3	0	-1
4	22	9
5	19	12
6	11	22
7	12	20
8	12	14
9	14	22
10	18	24
11	24	20
12	14	20
13	11	0



14	9	20
15	16	9
16	13	3
17	19	9
18	19	22
19	16	22
20	6	3
21	15	6
22	4	3
23	8	20
24	15	13

From 4:

Vertex	Distance from Source	Parent
0	12	13
1	13	2
2	12	15
3	22	20
4	0	-1
5	14	17
6	12	24
7	22	20
8	19	15
9	8	4
10	4	4
11	16	4
12	19	5
13	11	24
14	19	20
15	10	9
16	16	13
17	13	9
18	22	13
19	6	4
20	16	0
21	9	4
22	18	19
23	18	20
24	7	10

From 5:

Vertex	Distance from Source	Parent
0	17	20
1	11	2
2	10	15
3	19	20
4	14	9
5	0	-1
6	20	24
7	19	20
8	17	15
9	6	17
10	16	15
11	9	5
12	5	5
13	18	0
14	16	20
15	8	9

16	19	9
17	1	5
18	22	11
19	12	5
20	13	12
21	23	4
22	16	9
23	15	20
24	15	19

From 6:

Vertex	Distance from Source	Parent
0	10	6
1	14	24
2	15	1
3	11	22
4	12	10
5	20	19
6	0	-1
7	17	20
8	17	14
9	17	22
10	8	24
11	25	13
12	19	20
13	9	24
14	14	20
15	16	10
16	14	13
17	21	5
18	20	13
19	8	24
20	11	6
21	4	6
22	7	6
23	13	20
24	5	6

From 7:

Vertex	Distance from Source	Parent
0	10	20
1	10	7
2	11	1
3	12	20
4	22	10
5	19	12
6	17	20
7	0	-1
8	12	14
9	15	15
10	18	24
11	20	7
12	14	20
13	11	0
14	9	20
15	13	2
16	16	0
17	20	9

18	19	20
19	18	24
20	6	7
21	21	6
22	16	3
23	8	20
24	15	13

From 8:

Vertex	Distance	from Source	Parent
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0	10	20
1	12	2
2	11	15
3	12	20
4	19	9
5	17	17
6	17	20
7	12	20
8	0	-1
9	11	15
10	17	15
11	24	20
12	14	20
13	11	0
14	3	8
15	9	8
16	16	0
17	16	9
18	19	20
19	18	24
20	6	14
21	18	14
22	16	8
23	8	20
24	15	13

From 9:

Vertex	Distance	from Source	Parent
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0	18	20
1	5	2
2	4	15
3	14	22
4	8	9
5	6	17
6	17	22
7	15	1
8	11	15
9	0	-1
10	10	15
11	15	5
12	11	5
13	17	24
14	14	8
15	2	9
16	13	9
17	5	9
18	25	22
19	14	4

20	14	15
21	17	4
22	10	9
23	13	1
24	13	10

From 10:

Vertex	Distance from Source	Parent
0	8	13
1	11	2
2	10	15
3	18	20
4	4	10
5	16	17
6	8	24
7	18	20
8	17	15
9	10	15
10	0	-1
11	20	4
12	20	20
13	7	24
14	15	20
15	8	10
16	12	13
17	15	9
18	18	13
19	6	24
20	12	0
21	11	10
22	15	6
23	14	20
24	3	10

From 11:

Vertex	Distance from Source	Parent
0	17	13
1	20	2
2	19	15
3	24	20
4	16	11
5	9	11
6	25	24
7	20	11
8	24	14
9	15	17
10	20	4
11	0	-1
12	14	5
13	16	11
14	21	20
15	17	9
16	17	11
17	10	5
18	13	11
19	21	5
20	18	11
21	25	4

22	25	9
23	20	20
24	20	13

From 12:

Vertex	Distance	from Source	Parent
0	12		20
1	16		2
2	15		15
3	14		20
4	19		9
5	5		12
6	19		20
7	14		20
8	14		14
9	11		17
10	20		24
11	14		5
12	0		-1
13	13		0
14	11		20
15	13		9
16	18		0
17	6		5
18	21		20
19	16		12
20	8		12
21	23		6
22	18		3
23	10		20
24	17		13

From 13:

Vertex	Distance	from Source	Parent
0	1		13
1	13		24
2	14		1
3	11		20
4	11		10
5	18		12
6	9		24
7	11		20
8	11		14
9	17		15
10	7		24
11	16		13
12	13		20
13	0		-1
14	8		20
15	15		10
16	5		13
17	19		5
18	11		13
19	7		24
20	5		0
21	13		6
22	15		3
23	7		20

24                    4                    13

From 14:

Vertex   Distance   from Source   Parent

0	7	20
1	13	23
2	14	15
3	9	20
4	19	10
5	16	12
6	14	20
7	9	20
8	3	14
9	14	15
10	15	24
11	21	20
12	11	20
13	8	0
14	0	-1
15	12	8
16	13	0
17	17	5
18	16	20
19	15	24
20	3	14
21	15	14
22	13	3
23	5	20
24	12	13

From 15:

Vertex   Distance   from Source   Parent

0	16	20
1	3	2
2	2	15
3	16	22
4	10	9
5	8	17
6	16	24
7	13	1
8	9	15
9	2	15
10	8	15
11	17	5
12	13	5
13	15	24
14	12	8
15	0	-1
16	15	9
17	7	9
18	25	20
19	14	24
20	12	15
21	19	10
22	12	9
23	11	1
24	11	10

From 16:

Vertex	Distance	from Source	Parent
0	6		16
1	18		24
2	17		15
3	13		16
4	16		10
5	19		17
6	14		24
7	16		20
8	16		14
9	13		16
10	12		24
11	17		16
12	18		20
13	5		16
14	13		20
15	15		9
16	0		-1
17	18		9
18	16		13
19	12		24
20	10		0
21	18		6
22	17		3
23	12		20
24	9		13

From 17:

Vertex	Distance	from Source	Parent
0	18		20
1	10		2
2	9		15
3	19		22
4	13		9
5	1		17
6	21		24
7	20		1
8	16		15
9	5		17
10	15		15
11	10		5
12	6		5
13	19		0
14	17		20
15	7		9
16	18		9
17	0		-1
18	23		11
19	13		5
20	14		12
21	22		4
22	15		9
23	16		20
24	16		19

From 18:

Vertex	Distance	from Source	Parent
0	11		18

1	23	23
2	24	1
3	19	20
4	22	10
5	22	11
6	20	24
7	19	20
8	19	14
9	25	22
10	18	24
11	13	18
12	21	20
13	11	18
14	16	20
15	25	20
16	16	13
17	23	5
18	0	-1
19	18	24
20	13	18
21	24	6
22	15	18
23	15	20
24	15	13

From 19:

Vertex	Distance from Source	Parent
0	8	13
1	12	24
2	13	1
3	16	22
4	6	19
5	12	19
6	8	24
7	18	20
8	18	14
9	14	4
10	6	24
11	21	5
12	16	19
13	7	24
14	15	20
15	14	10
16	12	13
17	13	5
18	18	13
19	0	-1
20	12	0
21	12	6
22	12	19
23	14	20
24	3	19

From 20:

Vertex	Distance from Source	Parent
0	4	20
1	10	23
2	11	1



3	6	20
4	16	10
5	13	12
6	11	20
7	6	20
8	6	14
9	14	15
10	12	24
11	18	20
12	8	20
13	5	0
14	3	20
15	12	20
16	10	0
17	14	5
18	13	20
19	12	24
20	0	-1
21	15	6
22	10	3
23	2	20
24	9	13

From 21:

Vertex	Distance from Source	Parent
0	14	6
1	18	24
2	19	1
3	15	22
4	9	21
5	23	17
6	4	21
7	21	20
8	18	14
9	17	4
10	11	21
11	25	4
12	23	20
13	13	24
14	15	21
15	19	10
16	18	13
17	22	9
18	24	13
19	12	24
20	15	6
21	0	-1
22	11	6
23	17	20
24	9	6

From 22:

Vertex	Distance from Source	Parent
0	14	20
1	15	2
2	14	15
3	4	22
4	18	9

5	16	17
6	7	22
7	16	20
8	16	22
9	10	22
10	15	24
11	25	5
12	18	20
13	15	0
14	13	20
15	12	9
16	17	3
17	15	9
18	15	22
19	12	22
20	10	3
21	11	6
22	0	-1
23	12	20
24	12	6

From 23:

Vertex Distance from Source Parent

0	6	20
1	8	23
2	9	1
3	8	20
4	18	10
5	15	12
6	13	20
7	8	20
8	8	14
9	13	15
10	14	24
11	20	20
12	10	20
13	7	0
14	5	20
15	11	2
16	12	0
17	16	5
18	15	20
19	14	24
20	2	23
21	17	6
22	12	3
23	0	-1
24	11	13

From 24:

Vertex Distance from Source Parent

0	5	13
1	9	24
2	10	1
3	15	20
4	7	10
5	15	19
6	5	24

7	15	20
8	15	14
9	13	15
10	3	24
11	20	13
12	17	20
13	4	24
14	12	20
15	11	10
16	9	13
17	16	5
18	15	13
19	3	24
20	9	0
21	9	6
22	12	6
23	11	20
24	0	-1