WARSHALL-FLOYD'S ALL SOURCES SHORTEST PATH ALGORITHM

1 Uses BFS

2 Applies traigular ineqaulity exposing the vertices in linear fashion.
At the ned of each K iteration the plausible shortest paths are evident from that vertex.

Pre-Conditions:

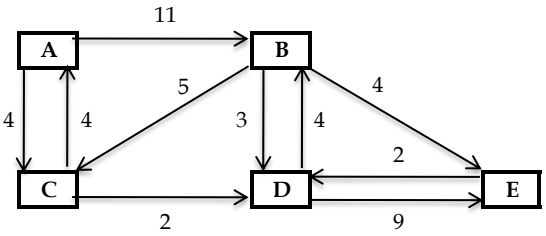
1 Edge cost should be non-negative.

2 Weighted directed graph

Required Data Structures:

1 A 2-D array, DIST[][] representing the distance of the vertex from any source vertex.

2 A 2-D array, NEXT[][] representing the vertex which will be reached next from the currrent vertex.



	A	B	C	D	E
A	0	11	4	NF	NF
B	NF	0	5	3	4
C	4	NF	0	2	NF
D	NF	4	NF	0	9
E	NF	NF	NF	2	0

Adjacency Matrix

NF := Infinity

Before start of algorithm

DIST[ ] [ ] := { NF }

NEXT[ ] [ ] := { NULL }

Vertices are numbered in increasing order.

Initial State

	1	2	3	4	5
1	0	11	4	NF	NF
2	NF	0	5	3	4
3	4	NF	0	2	NF
4	NF	4	NF	0	9
5	NF	NF	NF	2	0

DIST[ ][[ ]

	1	2	3	4	5
1	1	2	3	4	5
2	1	2	3	4	5
3	1	2	3	4	5
4	1	2	3	4	5
5	1	2	3	4	5

NEXT[ ][[ ]

Iteration : K = 1

K	I	J	D(I, J) > D(I,K) + D(K,J)	
1	1	1	0 > 0+0	False
1	1	2	11 > 0+11	False
1	1	3	4 > 0+4	False
1	1	4	NF > 0+NF	False
1	1	5	NF > 0+NF	False

	1	2	3	4	5
1	0	11	4	NF	NF
2	NF	0	5	3	4
3	4	NF	0	2	NF
4	NF	4	NF	0	9
5	NF	NF	NF	2	0

DIST[ ][[ ]

	1	2	3	4	5
1	1	2	3	4	5
2	1	2	3	4	5
3	1	2	3	4	5
4	1	2	3	4	5
5	1	2	3	4	5

NEXT[ ][[ ]

1	2	1	NF > NF+0	False
1	2	2	0 > NF+11	False
1	2	3	5 > NF+4	False
1	2	4	3 > NF+NF	False
1	2	5	4 > NF+NF	False

	1	2	3	4	5
1	0	11	4	NF	NF
2	NF	0	5	3	4
3	4	NF	0	2	NF
4	NF	4	NF	0	9
5	NF	NF	NF	2	0

DIST[ ][[ ]

	1	2	3	4	5
1	1	2	3	4	5
2	1	2	3	4	5
3	1	2	3	4	5
4	1	2	3	4	5
5	1	2	3	4	5

NEXT[ ][[ ]

1	3	1	4 > 4+0	False	
1	3	2	NF > 4+11	**True**	D(3,2) := 15
1	3	3	0 > 4+4	False	
1	3	4	2 > 4+NF	False	
1	3	5	NF > 4+NF	False	

	1	2	3	4	5
1	0	11	4	NF	NF
2	NF	0	5	3	4
3	4	15	0	2	NF
4	NF	4	NF	0	9
5	NF	NF	NF	2	0

DIST[ ][[ ]

	1	2	3	4	5
1	1	2	3	4	5
2	1	2	3	4	5
3	1	1	3	4	5
4	1	2	3	4	5
5	1	2	3	4	5

NEXT[ ][[ ]

1	4	1	NF > NF+0	False	
1	4	2	4 > NF+11	False	
1	4	3	NF > NF+4	False	
1	4	4	0 > NF+NF	False	
1	4	5	9 > NF+NF	False	

	1	2	3	4	5
1	0	11	4	NF	NF
2	NF	0	5	3	4
3	4	15	0	2	NF
4	NF	4	NF	0	9
5	NF	NF	NF	2	0

DIST[ ][[ ]

	1	2	3	4	5
1	1	2	3	4	5
2	1	2	3	4	5
3	1	1	3	4	5
4	1	2	3	4	5
5	1	2	3	4	5

NEXT[ ][[ ]

1	5	1	NF > NF+0	False	
1	5	2	NF > NF+11	False	
1	5	3	NF > NF+4	False	
1	5	4	NF > NF+NF	False	
1	5	5	NF > NF+NF	False	

	1	2	3	4	5
1	0	11	4	NF	NF
2	NF	0	5	3	4
3	4	15	0	2	NF
4	NF	4	NF	0	9
5	NF	NF	NF	2	0

DIST[ ][[ ]

	1	2	3	4	5
1	1	2	3	4	5
2	1	2	3	4	5
3	1	1	3	4	5
4	1	2	3	4	5
5	1	2	3	4	5

NEXT[ ][[ ]

Iteration : K = 2

2	1	1	0 > 11+NF	False	
2	1	2	11 > 11+0	False	
2	1	3	4 > 11+5	False	
2	1	4	NF > 11+3	**True**	D(1,4) := 14
2	1	5	NF > 11+4	**True**	D(1,5) := 15

	1	2	3	4	5
1	0	11	4	14	15
2	NF	0	5	3	4
3	4	15	0	2	NF
4	NF	4	NF	0	9
5	NF	NF	NF	2	0

DIST[ ][[ ]

	1	2	3	4	5
1	1	2	3	2	2
2	1	2	3	4	5
3	1	1	3	4	5
4	1	2	3	4	5
5	1	2	3	4	5

NEXT[ ][[ ]

2	2	1	NF >0+NF	False	
2	2	2	0 > 0+0	False	
2	2	3	5 > 0+5	False	
2	2	4	3 > 0+3	False	
2	2	5	4 > 0+4	False	

	1	2	3	4	5
1	0	11	4	14	15
2	NF	0	5	3	4
3	4	15	0	2	NF
4	NF	4	NF	0	9
5	NF	NF	NF	2	0

DIST[ ][[ ]

	1	2	3	4	5
1	1	2	3	2	2
2	1	2	3	4	5
3	1	1	3	4	5
4	1	2	3	4	5
5	1	2	3	4	5

NEXT[ ][[ ]

2	3	1	4 > 15+NF	False	
2	3	2	15 > 15+0	False	
2	3	3	0 > 15+5	False	
2	3	4	2 > 15+3	False	
2	3	5	NF > 15+4	**True**	D(3,5) := 19

	1	2	3	4	5
1	0	11	4	14	15
2	NF	0	5	3	4
3	4	15	0	2	19
4	NF	4	NF	0	9
5	NF	NF	NF	2	0

DIST[ ][[ ]

	1	2	3	4	5
1	1	2	3	2	2
2	1	2	3	4	5
3	1	1	3	4	2
4	1	2	3	4	5
5	1	2	3	4	5

NEXT[ ][[ ]

2	4	1	NF > 4+NF	False	
2	4	2	4 > 4+0	False	
2	4	3	NF > 4+5	**True**	D(4,3) := 9
2	4	4	0 > 4+3	False	
2	4	5	9 > 4+4	**True**	D(4,5) := 8

	1	2	3	4	5
1	0	11	4	14	15
2	NF	0	5	3	4
3	4	15	0	2	19
4	NF	4	9	0	8
5	NF	NF	NF	2	0

DIST[ ][[ ]

	1	2	3	4	5
1	1	2	3	2	2
2	1	2	3	4	5
3	1	1	3	4	2
4	1	2	2	4	2
5	1	2	3	4	5

NEXT[ ][[ ]

2	5	1	NF > NF+NF	False
2	5	2	NF > NF+0	False
2	5	3	NF > NF+5	False
2	5	4	2 > NF+3	False
2	5	5	0 > NF+4	False

	1	2	3	4	5
1	0	11	4	14	15
2	NF	0	5	3	4
3	4	15	0	2	19
4	NF	4	9	0	8
5	NF	NF	NF	2	0

DIST[ ][ ]

	1	2	3	4	5
1	1	2	3	2	2
2	1	2	3	4	5
3	1	1	3	4	2
4	1	2	2	4	2
5	1	2	3	4	5

NEXT[ ][ ]

Iteration : K = 3

3	1	1	0 > 4+4	False	
3	1	2	11 > 4+15	False	
3	1	3	4 > 4+0	False	
3	1	4	14 > 4+2	**True**	D(1,4) := 6
3	1	5	15 > 4+19	False	

	1	2	3	4	5
1	0	11	4	6	15
2	NF	0	5	3	4
3	4	15	0	2	19
4	NF	4	9	0	8
5	NF	NF	NF	2	0

DIST[ ][ ]

	1	2	3	4	5
1	1	2	3	3	2
2	1	2	3	4	5
3	1	1	3	4	2
4	1	2	2	4	2
5	1	2	3	4	5

NEXT[ ][ ]

3	2	1	NF > 5+4	**True**	D(2,1) := 9
3	2	2	0 > 5+15	False	
3	2	3	5 > 5+0	False	
3	2	4	3 > 5+2	False	
3	2	5	4 > 5+19	False	

	1	2	3	4	5
1	0	11	4	6	15
2	9	0	5	3	4
3	4	15	0	2	19
4	NF	4	9	0	8
5	NF	NF	NF	2	0

DIST[ ][ ]

	1	2	3	4	5
1	1	2	3	3	2
2	3	2	3	4	5
3	1	1	3	4	2
4	1	2	2	4	2
5	1	2	3	4	5

NEXT[ ][ ]

3	3	1	4 > 0 + 4	False
3	3	2	15 > 0+15	False
3	3	3	0 > 0+0	False
3	3	4	2 > 0+2	False
3	3	5	19 > 0+19	False

	1	2	3	4	5
1	0	11	4	6	15
2	9	0	5	3	4
3	4	15	0	2	19
4	NF	4	9	0	8
5	NF	NF	NF	2	0

DIST[ ][ ]

	1	2	3	4	5
1	1	2	3	3	2
2	3	2	3	4	5
3	1	1	3	4	2
4	1	2	2	4	2
5	1	2	3	4	5

NEXT[ ][ ]

3	4	1	NF > 9+4	**True**	D(4,1) := 13
3	4	2	4 > 9+15	False	
3	4	3	9 > 9+0	False	
3	4	4	0 > 9+2	False	
3	4	5	8 > 9+19	False	

	1	2	3	4	5
1	0	11	4	6	15
2	9	0	5	3	4
3	4	15	0	2	19
4	13	4	9	0	8
5	NF	NF	NF	2	0

DIST[ ][ ]

	1	2	3	4	5
1	1	2	3	3	2
2	3	2	3	4	5
3	1	1	3	4	2
4	3	2	2	4	2
5	1	2	3	4	5

NEXT[ ][ ]

3	5	1	NF > NF+4	False	
3	5	2	NF > NF+15	False	
3	5	3	NF > NF+0	False	
3	5	4	2 > NF+2	False	
3	5	5	0 > NF+19	False	

	1	2	3	4	5
1	0	11	4	6	15
2	9	0	5	3	4
3	4	15	0	2	19
4	13	4	9	0	8
5	NF	NF	NF	2	0

DIST[ ][ ]

	1	2	3	4	5
1	1	2	3	3	2
2	3	2	3	4	5
3	1	1	3	4	2
4	3	2	2	4	2
5	1	2	3	4	5

NEXT[ ][ ]

Iteration : K = 4

4	1	1	0 > 6+13	False	
4	1	2	11 > 6+4	**True**	D(1,2) := 10
4	1	3	4 > 6+9	False	
4	1	4	6 > 6+0	False	
4	1	5	15 > 6+8	**True**	D(1,5) := 14

	1	2	3	4	5
1	0	10	4	6	14
2	9	0	5	3	4
3	4	15	0	2	19
4	13	4	9	0	8
5	NF	NF	NF	2	0

DIST[ ][[ ]

	1	2	3	4	5
1	1	4	3	3	4
2	3	2	3	4	5
3	1	1	3	4	2
4	3	2	2	4	2
5	1	2	3	4	5

NEXT[ ][[ ]

4	2	1	9 > 3+13	False	
4	2	2	0 > 3+4	False	
4	2	3	5 > 3+9	False	
4	2	4	3 > 3+0	False	
4	2	5	4 > 3+8	False	

	1	2	3	4	5
1	0	10	4	6	14
2	9	0	5	3	4
3	4	15	0	2	19
4	13	4	9	0	8
5	NF	NF	NF	2	0

DIST[ ][[ ]

	1	2	3	4	5
1	1	4	3	3	4
2	3	2	3	4	5
3	1	1	3	4	2
4	3	2	2	4	2
5	1	2	3	4	5

NEXT[ ][[ ]

4	3	1	4 > 2+13	False	
4	3	2	15 > 2+4	**True**	D(3,2) : = 6
4	3	3	0 > 2+9	False	
4	3	4	2 > 2+0	False	
4	3	5	19 > 2+8	**True**	D(3,5) := 10

	1	2	3	4	5
1	0	10	4	6	14
2	9	0	5	3	4
3	4	6	0	2	10
4	13	4	9	0	8
5	NF	NF	NF	2	0

DIST[ ][[ ]

	1	2	3	4	5
1	1	4	3	3	4
2	3	2	3	4	5
3	1	4	3	4	4
4	3	2	2	4	2
5	1	2	3	4	5

NEXT[ ][[ ]

4	4	1	13 > 0+13	False	
4	4	2	4 > 0+4	False	
4	4	3	9 > 0+9	False	
4	4	4	0 > 0+0	False	
4	4	5	8 > 0+8	False	

	1	2	3	4	5
1	0	10	4	6	14
2	9	0	5	3	4
3	4	6	0	2	10
4	13	4	9	0	8
5	NF	NF	NF	2	0

DIST[ ][[ ]

	1	2	3	4	5
1	1	4	3	3	4
2	3	2	3	4	5
3	1	4	3	4	4
4	3	2	2	4	2
5	1	2	3	4	5

NEXT[ ][[ ]

4	5	1	NF > 2+13	**True**	D(5,1) := 15
4	5	2	NF > 2+4	**True**	D(5,2) := 6
4	5	3	NF > 2+9	**True**	D(5,3) := 11
4	5	4	2 > 2+0	False	
4	5	5	0 > 2+8	False	

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

DIST[ ][[ ]

	1	2	3	4	5
1	1	4	3	3	4
2	3	2	3	4	5
3	1	4	3	4	4
4	3	2	2	4	2
5	4	4	4	4	5

NEXT[ ][[ ]

Iteration : K = 5

5	1	1	0 > 14+15	False	
5	1	2	10 > 14+6	False	
5	1	3	4 > 14+11	False	
5	1	4	6 > 14+2	False	
5	1	5	14 > 14+0	False	

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

DIST[ ][[ ]

	1	2	3	4	5
1	1	4	3	3	4
2	3	2	3	4	5
3	1	4	3	4	4
4	3	2	2	4	2
5	4	4	4	4	5

NEXT[ ][[ ]

5	2	1	9 > 4+15	False	
5	2	2	0 > 4+6	False	
5	2	3	5 > 4+11	False	
5	2	4	3 > 4+2	False	
5	2	5	4 > 4+0	False	

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

DIST[ ][[ ]

	1	2	3	4	5
1	1	4	3	3	4
2	3	2	3	4	5
3	1	4	3	4	4
4	3	2	2	4	2
5	4	4	4	4	5

NEXT[ ][[ ]

5	3	1	4> 10+15	False
5	3	2	6 > 10+6	False
5	3	3	0 > 10+11	False
5	3	4	2 > 10+2	False
5	3	5	10 > 10+0	False

	1	2	3	4	5
1	**0**	**10**	4	**6**	**14**
2	**9**	**0**	5	3	4
3	4	**6**	**0**	2	**10**
4	**13**	4	**9**	**0**	**8**
5	**15**	**6**	**11**	2	**0**

DIST[ ][[ ]

	1	2	3	4	5
1	1	**4**	3	**3**	**4**
2	**3**	2	3	4	5
3	1	**4**	3	4	**4**
4	**3**	2	**2**	4	**2**
5	**4**	**4**	**4**	4	5

NEXT[ ][[ ]

5	4	1	13> 8+15	False
5	4	2	4 > 8+6	False
5	4	3	9 > 8+11	False
5	4	4	0 > 8+2	False
5	4	5	8 > 8+0	False

	1	2	3	4	5
1	**0**	**10**	4	**6**	**14**
2	**9**	**0**	5	3	4
3	4	**6**	**0**	2	**10**
4	**13**	4	**9**	**0**	**8**
5	**15**	**6**	**11**	2	**0**

DIST[ ][[ ]

	1	2	3	4	5
1	1	**4**	3	**3**	**4**
2	**3**	2	3	4	5
3	1	**4**	3	4	**4**
4	**3**	2	**2**	4	**2**
5	**4**	**4**	**4**	4	5

NEXT[ ][[ ]

5	5	1	15> 0+15	False
5	5	2	6 > 0+6	False
5	5	3	11 > 0+11	False
5	5	4	2 > 0+2	False
5	5	5	0 > 0+0	False

	1	2	3	4	5
1	**0**	**10**	4	**6**	**14**
2	**9**	**0**	5	3	4
3	4	**6**	**0**	2	**10**
4	**13**	4	**9**	**0**	**8**
5	**15**	**6**	**11**	2	**0**

DIST[ ][[ ]

	1	2	3	4	5
1	1	**4**	3	**3**	**4**
2	**3**	2	3	4	5
3	1	**4**	3	4	**4**
4	**3**	2	**2**	4	**2**
5	**4**	**4**	**4**	4	5

NEXT[ ][[ ]

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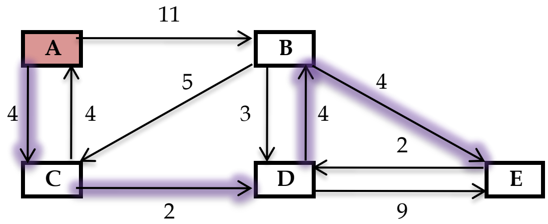

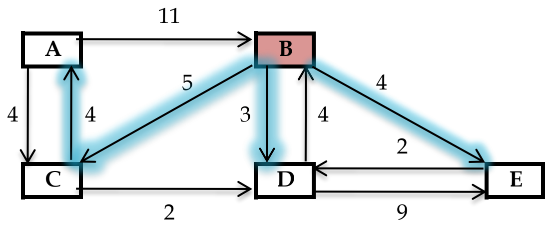

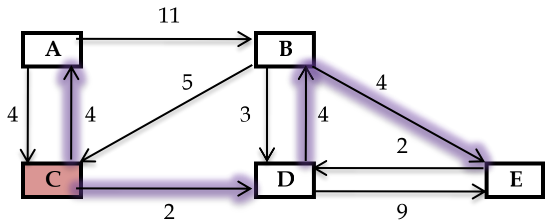

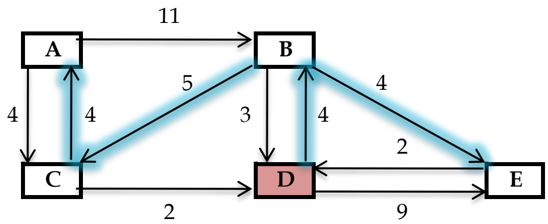

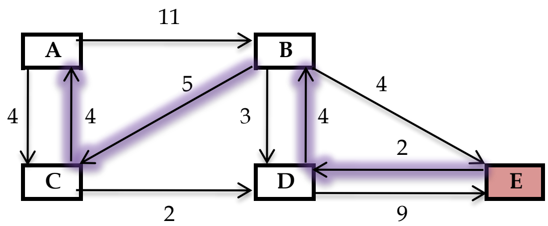

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