Shortest Path Algorithm (SPA)

This algorithm finds the shortest path between two nodes in a graph. The shortest path means the path with minimum number of nodes from node A to node B. Remember that the graph is undirected, meaning that the edge/link between A to B also represents B to A.

Algorithm Steps:

Step 1: Load matrix m

Step 2: Define two points s and t, such that s is starting point and t is ending point.

Step 3: Loop every row r in matrix m: $\{r = s, s+1, s+2, \dots, t\}$

c = In row r, find last column with value 1

Accumulate cell index Cell[r, c] in p to construct the path

If c is t Then exit loop.

End Loop

Output p as shortest path between nodes s and t.

Python Implementation of SPA

Please refer to SPA.py attached in this package.

Mis file description:

This file contains information about points and edges between the points. The first text appears as “p edge # #” which means number of points/nodes and edges in a graph. The following text appears as “e # #” which means there is an edge between number # and the number #. For example, the contents of the .mis file for first test case are “p edge 5 5” meaning that this graph contains 5 nodes and 5 edges. The following contents are “e 1 2”, “e 2 4” which means there are edges between nodes 1 and 2, and nodes 2 and 4.

Test Cases

To test the algorithm, following are different test cases of graphs with undirected/unweighted links between nodes. Here, we have to find the shortest path between two points (i.e. 1-8). The shortest path means smallest number of nodes between nodes s and t. The algorithm SPA should return path with minimum nodes between nodes s and t.

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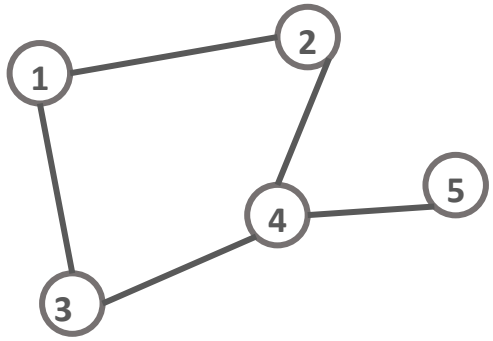
Test Case 1:



Following is the matrix representation for the edges between nodes:

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

Try following inputs (s and t) to SPA algorithm and the out should be as given:

(a) s=1 and t=5, mean shortest path needed between nodes 1-5.
Answer: [1,3], [3,4], [4,5] – Shortest path with 3 nodes

(b) s=3 and t=4, 3-4.
Answer: [3,4] – Shortest path with 1 node

(c) s=2 and t=5, 2-5.
Answer: [2,4], [4,5] – Shortest path with 2 nodes

(d) s=1 and t=4, 1-4.
Answer: [1,3], [3,4] – Shortest path with 2 nodes

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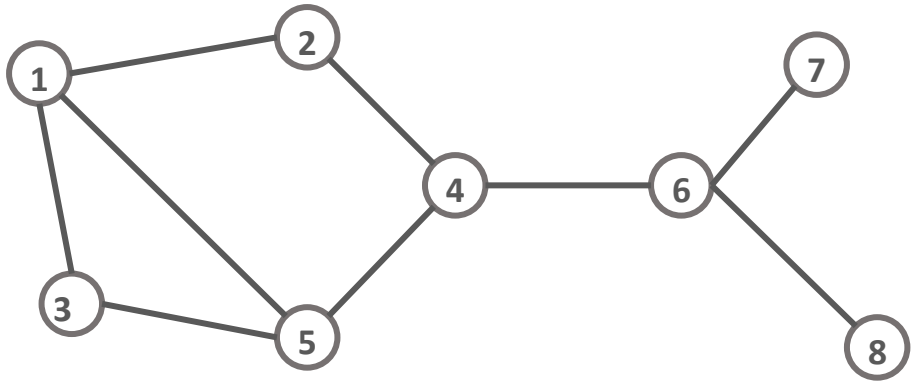
Test Case 2:



Following is the matrix representation for the edges between nodes:

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

Try following inputs (s and t) to SPA algorithm and the out should be as given:

(a) s=1 and t=8, mean shortest path needed between nodes 1-8.
Answer: [1,5], [5,4], [4,6], [6,8] – Shortest path with 4 nodes

(b) s=1 and t=7, 1-7.
Answer: [1,5], [5,4], [4,6], [6,7] – Shortest path with 4 node

(c) s=2 and t=5, 2-5.
Answer: [2,4], [4,5] – Shortest path with 2 nodes

(d) s=3 and t=6, 3-6.
Answer: [3,5], [5,4], [46] – Shortest path with 3 nodes

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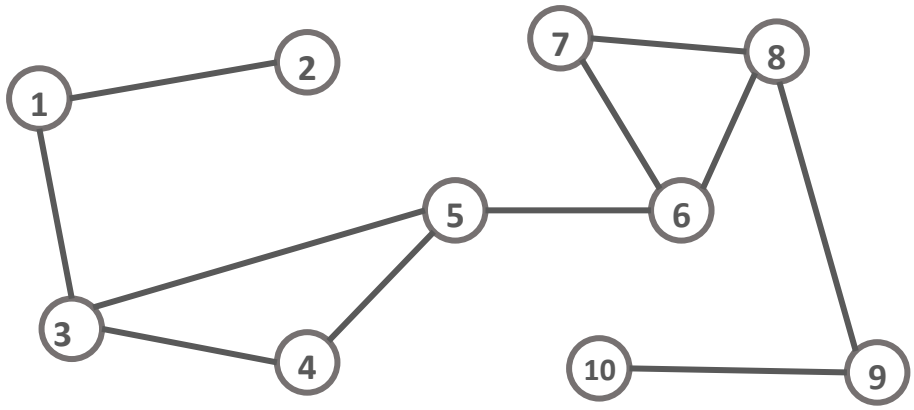
Test Case 3:



Following is the matrix representation for the edges between nodes:

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

Try following inputs (s and t) to SPA algorithm and the out should be as given:

(a) s=1 and t=10, mean shortest path needed between nodes 1-10.
Answer: [1,3], [3,5], [5,6], [6,8], [8,9], [9,10] – Shortest path with 6 nodes

(b) s=2 and t=6, 2-6.
Answer: [2,1], [1,3], [3,5], [5,6] – Shortest path with 4 node

(c) s=5 and t=9, 5-9.
Answer: [5,6], [6,8], [8,9] – Shortest path with 3 nodes

(d) s=8 and t=10, 8-10.
Answer: [8,9], [9,10] – Shortest path with 2 nodes

(e) s=3 and t=7, 3-7.
Answer: [3,5], [5,6], [6,7] – Shortest path with 3 nodes

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