

**LAB # 3:****GRAPH THEORY & PATH SEARCHES IN PYTHON****Objectives:**

- To familiarize students with the fundamentals of graph theory and path searches in Python

**Hardware/Software required:**

Hardware: Desktop/ Notebook Computer

Software Tool: Python 2.7/ 3.6.2

**Introduction:**

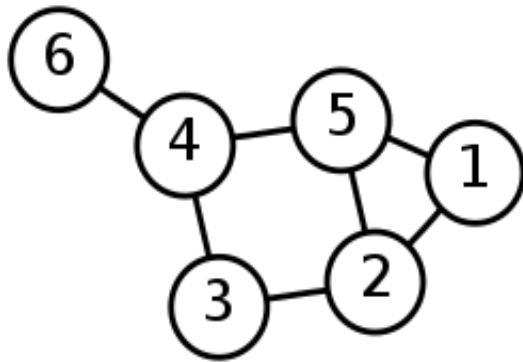
Graph theory is the fundamental concept in mathematics and it lays the foundation of many algorithms in the field of networking, artificial intelligence and image processing. Graph theory is the study of graphs, which are mathematical structures used to model pairwise relations between objects. A graph in this context is made up of vertices, nodes, or points which are connected by edges, arcs, or lines. A graph may be undirected, meaning that there is no distinction between the two vertices associated with each edge, or its edges may be directed from one vertex to another.

In Python, graphs can be easily implemented through key-value paired data structure i.e. dictionaries.

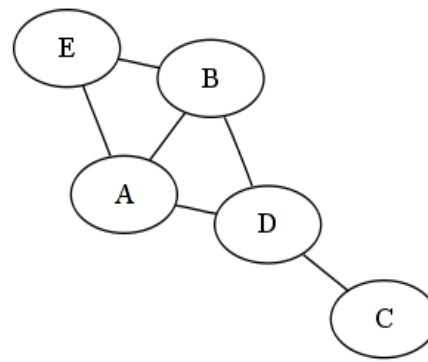
**Lab Tasks:**

1. Implement the undirected Graph 1 and 2 in Python. Show the connectivity as well as the degree of each node within these graphs.
2. Implement the directed Graph 3 and 4 in Python. Show the connectivity, indegree and outdegree of each node within these graphs.
3. Write a method to find any path between node 6 to node 1 in Graph 1.
4. Write a method to find any path between node E to node C in Graph 2.
5. Write a method to find any path between node 7 to node 9 in Graph 3.
6. Write a method to find any path between node A to node F in Graph 4.
7. Modify Question # 3 to show all possible paths between node 6 to node 1 in Graph 1.
8. Modify Question # 4 to show all possible paths between node E to node C in Graph 2.
9. Modify Question # 5 to show all possible paths between node 7 to node 9 in Graph 3.

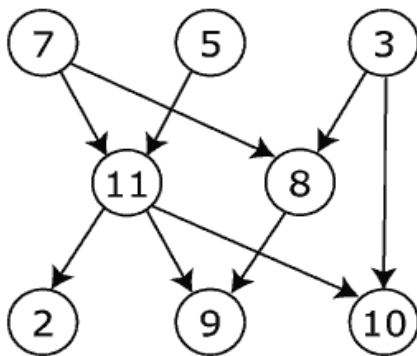
10. Modify Question # 6 to show all possible paths between node A to node F in Graph 1.



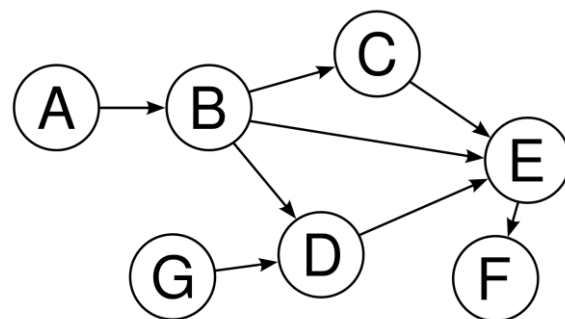
Graph 1



Graph 2



Graph 3



Graph 4

### Lab Evaluation:

**Q:** Suppose you have been given with a following 3x3 3-bit grayscale image. Your job is to decompose it into an undirected graph where each pixel within an image represents a node and adjacent nodes are connected to each other via 4-connectivity pattern. Show all possible paths between pixel 150 and pixel 165.

150	2	5
80	145	45
74	102	165

### Bonus Question:

**Q:** Decompose the above image into an undirected graph where each pixel represents a node and the edge cost between adjacent nodes is computed by taking the absolute difference.

Now segment the object between node 150 to node 165 by computing the shortest path.

**Hint: Use nested dictionaries to represent graph with edge costs**

**Conclusion:**

Write the conclusion about this lab

**NOTE:** A lab journal is expected to be submitted for this lab.