Data Structure and Algorithm

Laboratory Activity No. 10

Intro to Graphs

|  |  |
| --- | --- |
| *Submitted by:* | *Instructor:* |
| Nerio, Hannah Grace A. | Engr. Maria Rizette H. Sayo |

October 11, 2025

# Objectives

Introduction

A graph is a visual representation of a collection of things where some object pairs are linked together. Vertices are the points used to depict the interconnected items, while edges are the connections between them. In this course, we go into great detail on the many words and functions related to graphs.

An undirected graph, or simply a graph, is a set of points with lines connecting some of the points. The points are called nodes or vertices, and the lines are called edges.

A graph can be easily presented using the python dictionary data types. We represent the vertices as the keys of the dictionary and the connection between the vertices also called edges as the values in the dictionary.

A diagram of a triangle with green dots

AI-generated content may be incorrect.

Figure 1. Sample graph with vertices and edges

This laboratory activity aims to implement the principles and techniques in:

* To introduce the Non-linear data structure – Graphs
* To discuss the importance of Graphs in programming

# Methods

* 1. Discuss the following terms related to graphs:
     1. Undirected graph
     2. Directed graph
     3. Nodes
     4. Vertex
     5. Degree
     6. Indegree
     7. Outdegree
     8. Path
     9. Cycle
     10. Simple Cycle

# Results

**1.Undirected Graph**

- An undirected graph is a type of graph where edges have no direction. The edges simply connect two vertices without indicating any direction, meaning if vertex A is connected to vertex B, then vertex B is also connected to vertex A. This symmetry is characteristic of undirected graphs.

A diagram of a graph

AI-generated content may be incorrect.

Figure 1: **Und**irected Graph

**2. Directed Graph**

- A directed graph, or digraph, is a graph in which edges have a direction. Each edge is represented as an ordered pair of vertices, indicating a one-way relationship from one vertex to another. This directionality is crucial in representing asymmetric relationships.

A diagram of a graph

AI-generated content may be incorrect.

Figure 2:Directed Graph

**3. Nodes**

- In graph theory, nodes (also known as vertices) are the fundamental units or points in a graph. They represent entities such as individuals in a social network or intersections in a transportation system.

A diagram of a diagram

AI-generated content may be incorrect.

Figure 3:Nodes

**4. Vertex**

- A vertex is a single point in a graph where edges meet. It is a fundamental component of a graph, representing an entity or a position within a network.

A diagram of a network with Ice hockey rink in the background

AI-generated content may be incorrect.

Figure 4:Vertex

**5. Degree**

- The degree of a vertex is the number of edges incident to it. In an undirected graph, this is simply the count of edges connected to the vertex. In a directed graph, the degree is divided into indegree and outdegree.

A diagram of a network with Ice hockey rink in the background

AI-generated content may be incorrect.

Figure 5:Degree

**6. Indegree**

- Indegree refers to the number of incoming edges to a vertex in a directed graph. It indicates how many edges point towards that vertex.

A diagram of a number and a number

AI-generated content may be incorrect.

Figure 6:Indegree

**7. Outdegree**

- Outdegree is the number of outgoing edges from a vertex in a directed graph. It shows how many edges originate from that vertex.

A diagram of a number and a number

AI-generated content may be incorrect.

Figure 7:Outdegree

**8. Path**

- A path in a graph is a sequence of vertices connected by edges. It represents a route from one vertex to another, without revisiting any vertex.

A diagram of a network

AI-generated content may be incorrect.

Figure 8:Path

**9. Cycle**

- A cycle is a path that starts and ends at the same vertex, with all other vertices being distinct. It forms a closed loop within the graph.

A diagram of a network

AI-generated content may be incorrect.

Figure 9:Cycle

**10. Simple Cycle**

- A simple cycle is a cycle that does not repeat any vertices or edges, except for the starting and ending vertex. It is the most basic form of a cycle in a graph.

A diagram of a network

AI-generated content may be incorrect.

Figure 10:SimpleCycle

# Conclusion

This laboratory activity offered an in-depth introduction to graphs, a fundamental type of non-linear data structure used to model relationships between interconnected entities. During the exercise, we examined key concepts including undirected and directed graphs, vertices (or nodes), degrees, indegrees, outdegrees, paths, cycles, and simple cycles. Gaining a clear understanding of these elements is essential for addressing complex problems in areas such as network design, social media analysis, computer science, and beyond.

Graphs serve as the foundation for numerous algorithms and practical applications, including shortest path calculations, routing, network connectivity, and web page ranking. Implementing graphs using Python dictionaries demonstrated an efficient approach for representing and manipulating these structures in computational tasks. This activity not only reinforced theoretical knowledge but also enhanced our practical skills, providing a strong basis for applying graph concepts to real-world programming challenges and algorithmic solutions.

**References**

[1] Co Arthur O., “University of Caloocan City Computer Engineering Department Honor Code,” UCC-CpE Departmental Policies, 2020.

[2] Google Colab, “Directed Graph Java Download.” Available: https://colab.research.google.com/drive/1AyHQFYocOQThWljclrAUUKFHx927T0Om. [Accessed: Oct. 11, 2025].

[3] Google Colab, “Graphs.ipynb.” Available: https://colab.research.google.com/github/caam37830/book/blob/master/05\_graphs/graphs.ipynb. [Accessed: Oct. 11, 2025].

[4] Google Sites, “Brain Connectivity Toolbox - List of Measures.” Available: https://sites.google.com/site/bctnet/list-of-measures. [Accessed: Oct. 11, 2025].

[5] Google Sites, “Advanced Python Programming - Vocabulary & Definitions.” Available: https://sites.google.com/site/advancedpythonprogramming/graphs-graph-algorithms/vocabulary-definitions. [Accessed: Oct. 11, 2025].

[6] Google Sites, “ASNR 2022 - Problems 9.” Available: https://sites.google.com/view/asnr-2022/home/9-centrality-measures/problems-9. [Accessed: Oct. 11, 2025].

[7] bp.blogspot.com, “Undirected+Graph.JPG.” Available: https://2.bp.blogspot.com/-pVtG77iUsiM/Us2ME0qYKfI/AAAAAAAAB6Q/mg0mDWr42YA/s1600/Undirected+Graph.JPG. [Accessed: Oct. 11, 2025].

[8] bp.blogspot.com, “Directed+Graph.JPG.” Available: https://th.bing.com/th/id/R.c711582fc454e214d2e3f362b16e0f83?rik=R6SICMlg8qE1cQ&riu=http%3a%2f%2f2.bp.blogspot.com%2f-u1vvXiQJJuo%2fUs2MBDSsDfI%2fAAAAAAAAB5M%2fUWM7k3P0E1o%2fs1600%2fDirected%2bGraph.JPG&ehk=imn%2b90bL80J3bv3u1D8JTOK8YxKRqDfwlhgngq%2fQGX0%3d&risl=&pid=ImgRaw&r=0. [Accessed: Oct. 11, 2025].

[9] helloacm.com, “star-graph-300x297.jpg.” Available: https://helloacm.com/wp-content/uploads/2021/03/star-graph-300x297.jpg. [Accessed: Oct. 11, 2025].

[10] geeksforgeeks.org, “iougsd.jpg.” Available: https://media.geeksforgeeks.org/wp-content/uploads/20200710023854/iougsd.jpg. [Accessed: Oct. 11, 2025].

[11] kindpng.com, “graphe-rename-line-art-hd-png-download.png.” Available: https://www.kindpng.com/picc/m/239-2394325\_graphe-rename-line-art-hd-png-download.png. [Accessed: Oct. 11, 2025].

[12] innoskrit.in, “7-2.png.” Available: https://learn.innoskrit.in/content/images/2023/12/7-2.png. [Accessed: Oct. 11, 2025].

[13] includehelp.com, “strictly-binary-tree.jpg.” Available: https://www.includehelp.com/data-structure-tutorial/images/strictly-binary-tree.jpg. [Accessed: Oct. 11, 2025].