UNIVERSITY OF CALOOCAN CITY
COMPUTER ENGINEERING DEPARTMENT

Data Structure and Algorithm

Laboratory Activity No. 10

Intro to Graphs

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I. 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.

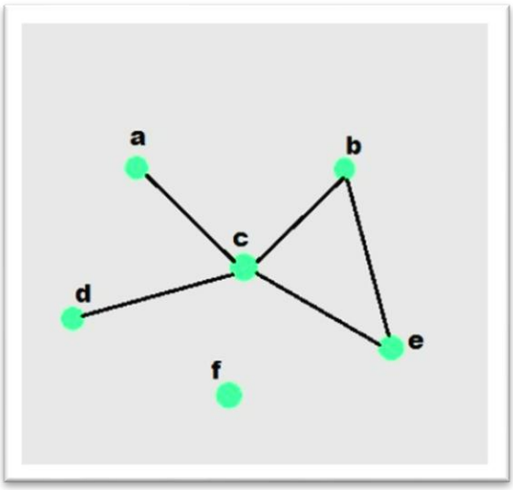

Figure 1. Sample graph with vertices and edges

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

II. Methods

A. 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

III. Results

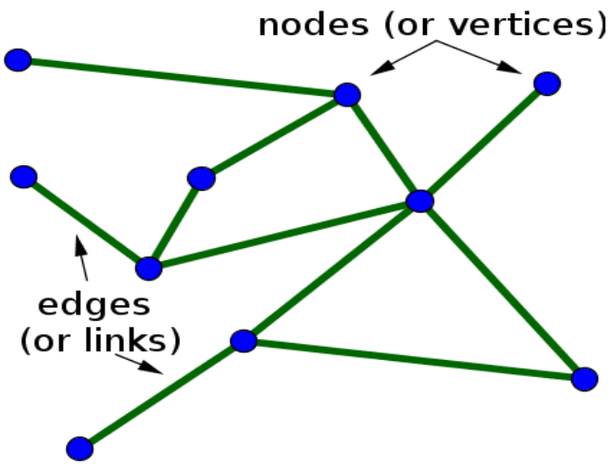

Figure 1 Undirected Graph source: https://mathinsight.org/image/small_undirected_network_labeled

An undirected graph is graph, i.e., a set of objects (called vertices or nodes) that are connected together, where all the edges are bidirectional. An undirected graph is sometimes called an undirected network. In contrast, a graph where the edges point in a direction is called a directed graph.

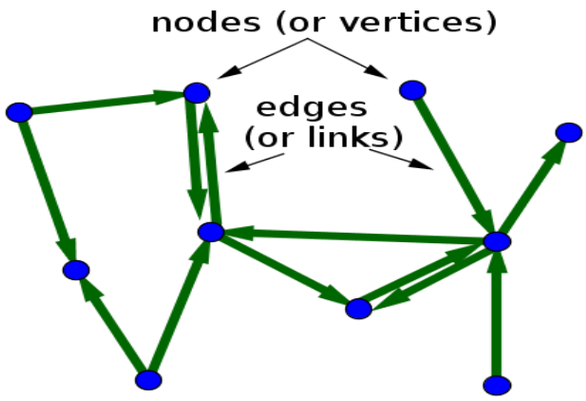

Figure 2 Directed Graph source: https://mathinsight.org/image/small_directed_network_labeled

A directed graph is graph, i.e., a set of objects (called vertices or nodes) that are connected together, where all the edges are directed from one vertex to another. A directed graph is sometimes called a digraph or a directed network. In contrast, a graph where the edges are bidirectional is called an undirected graph.

Vertices are the fundamental units of the graph. Sometimes, vertices are also known as vertices or nodes. Every node/vertex can be labeled or unlabelled.

Indegree of a vertex is defined as the number of incoming edges incident on a vertex in a directed graph.

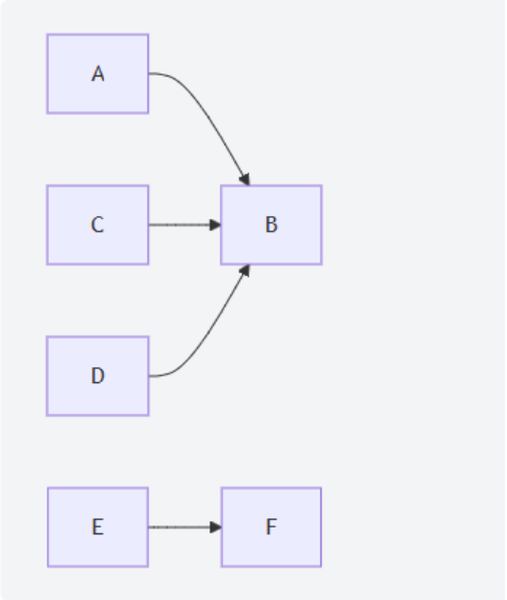

Figure 3 Indegree source: https://www.numberanalytics.com/blog/ultimate-guide-indegree-graph-theory

Example in this graph, node B has an indegree of 3, as there are three edges pointing to it ($A \rightarrow B$, $C \rightarrow B$, and $D \rightarrow B$).

Outdegree of a vertex is defined as the number of outgoing edges from a vertex in a directed graph.

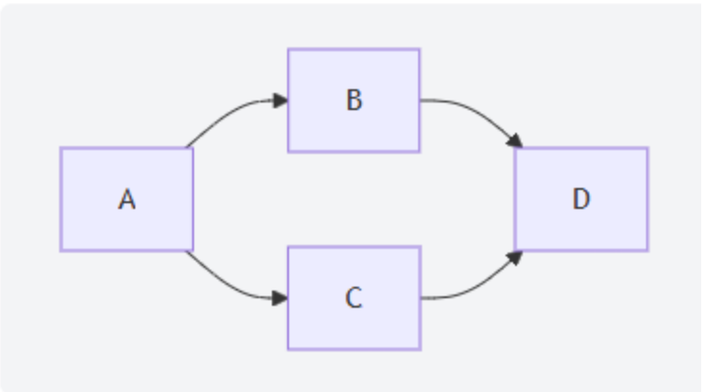

Figure 4 Outdegree source: https://www.numberanalytics.com/blog/ultimate-guide-outdegree-graph-theory

Example in this directed graph, the outdegree of vertex A is 2 because there are two edges emanating from it, pointing to vertices B and C. Similarly, the outdegree of B is 1, and the outdegree of C is 1.

A path is a trail in which neither vertices nor edges are repeated. In other words, when traversing a graph along a path, each vertex and each edge is visited exactly once. Since a path is also a trail, it is inherently an open walk unless stated otherwise. Another definition of a path is a walk with no repeated vertices. This automatically implies that no edges are repeated, making it unnecessary to explicitly mention edge repetition in the definition.

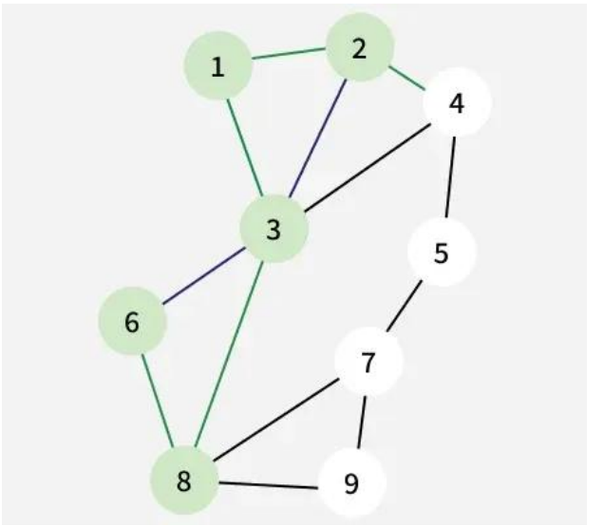

Figure 5 Path source: https://media.geeksforgeeks.org/wp-content/uploads/20250225100502126809/graph-4.webp

Example Here 6->8->3->1->2->4 is a Path

A cycle in graph is a closed path, meaning that it starts and ends at the same vertex while ensuring that no other vertices or edges are repeated. In other words, a cycle is formed by traversing a graph such that: No vertex is repeated, except for the starting and ending vertex, which must be the same and No edge is repeated.

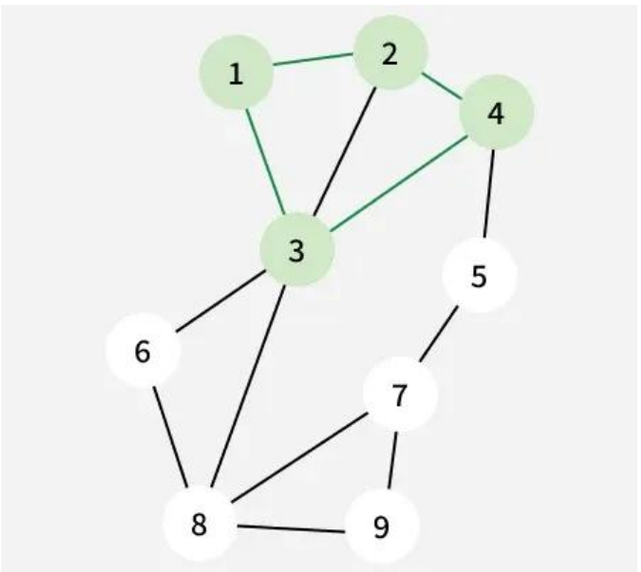

Figure 6 Cycle source: https://media.geeksforgeeks.org/wp-content/uploads/20250225100502420291/graph-2.webp

Example Here 1->2->4->3->1 is a cycle.

A simple cycle is a cycle in a Graph with no repeated vertices (except for the beginning and ending vertex). Basically, if a cycle can't be broken down to two or more cycles, then it is a simple cycle.

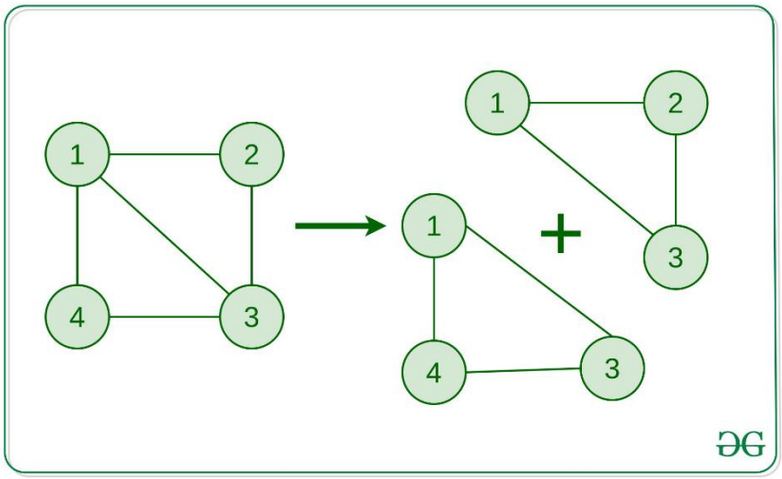

Figure 7 Simple Cycle source: https://media.geeksforgeeks.org/wp-content/uploads/20200710023232/dkhjd.jpg

The graph in the above picture explains how the cycle 1 -> 2 -> 3 -> 4 -> 1 isn't a simple cycle because, it can be broken into 2 simple cycles 1 -> 3 -> 4 -> 1 and 1 -> 2 -> 3 -> 1.

IV. Conclusion

In this laboratory activity, we learned about graphs, a non-linear data structure used to show connections between objects. We explored both undirected and directed graphs, where the direction of edges either doesn't matter or points from one vertex to another. We discussed key terms such as nodes or vertices (the points), and edges (the lines connecting them). We also learned about degree, indegree (number of incoming edges), and outdegree (number of outgoing edges), which describe how connected a node is. In addition, we studied paths, which are sequences of connected nodes with no repeats, and cycles, which are paths that start and end at the same node. A simple cycle is a cycle that cannot be broken into smaller ones. Using Python dictionaries to represent graphs helped us understand how these concepts are applied in programming.

References

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