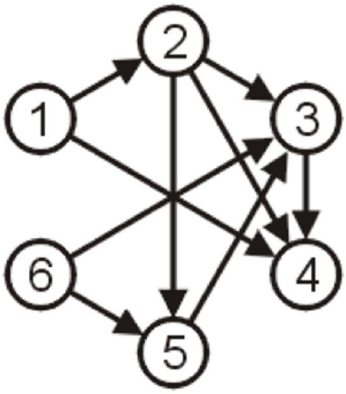
# COEN 244 Winter 2022 Project Specification

## Problem statement

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. In contrast, a graph where the edges are bidirectional is called an undirected graph. A graph can be formally define as *G=(N,E)* consisting of the set *N* of nodes and the set *E* of edges, which are ordered pairs of elements of *N*. It is further assumed in this project specification that any graph is finite with no directed or undirected cycles. An example is given below for directed graph.

$$V = \{1,2,3,4,5,6\}$$
$$E = \{(1,2),(1,4),(2,3),(2,4),(2,5),(3,4),(5,3),(6,3),(6,5)\}$$




A graph has many useful applications in the real world, such as scheduling of tasks; network topology; family tree; data compression; literature citation, social connections and so on.

This project requires you to develop an object-oriented application of a graph. Example applications can be social connection network, equipment connections, course sequences, family trees and so on. The graph application should achieve the following base **function:**

1. A graph can be empty with no vertex or edge.
2. A graph can be either a directed graph or an undirected graph.
3. A graph can be added in vertices and edges.
4. A vertex of a graph can contain values – in theory, the values can be of any type.
5. A graph can be displayed by listing all the possible paths, each linking vertices.
6. A graph can be queried by given a starting vertex, listing the path this vertex leads.
7. A graph can be queried by given an edge, if this edge exists in the graph
8. A graph can be queried if a value is contained by any of its vertex.

## Group Requirements

A group of maximum two members.

## Deliverables

There are 2 parts of deliverables of this project that needs to fulfill the above functional requirements.

Part 1: Programing Code in one Zip file in the form of **[group_member1_SID]-[group_member2_SID]-code.zip. [Totally 40 points]**

1. Design and program necessary C++ Classes with data members and member functions for above functions.
2. For each Class designed, provide default constructor, copy constructor, and constructor with arguments.
3. A Driver application to test the graph and demonstrate its functions.
4. Apply at least three of the following techniques (any 3): inheritance; polymorphism; operator overloading; template; exception handling.

Part 2: Report in one PDF File, following IEEE paper format. **[group_member1_SID]-[group_member2_SID]-report.pdf [Totally 10 points]**
https://www.ieee.org/conferences/publishing/templates.html

5. Design Description: (a) Provide a Class Diagram that describes, in detail, the classes you employ, and the relationships between them (following UML conventions); (b) Describe at least 2 non-trivial methods (member function) in your program; (c) describe your usages of 3 of techniques from inheritance, polymorphism, operator overloading, template and exception handling.

6. Testing Results: Utilize a black-box testing methodology of your program, with sufficient test cases, to support the hypothesis that your program is bug-free (does not crash in response to valid inputs), correct (generates the right output, in response to valid input) and reasonably robust (does not crash in response to – at least reasonable – invalid inputs). Necessary screenshots should be added. You can also consider providing a link to the video demo of your program.

## Important Dates

| Timeline | Task |
|---|---|
| Week 3 tutorial time | Send information to tutorial session TA your group information. Missing the submission has 1 point deduction. |
| Week 9 tutorial time | Demonstrate to tutorial session TA at least 5 out of 8 graph functions and two techniques implemented by running the driver application. Missing the demo to TA has 5 point deduction |
| Week 13 tutorial time | Demonstrate the whole application program to tutorial session TA by running the driver application. Missing the demo to TA has 5 points deduction. |

| | |
|---|---|
| The last lecture time | Randomly selected groups or volunteering groups will present the critical features of their design and programs at the last lecture time by sharing zoom screen. Bonus points up to 3 points will be awarded to each team member for the presentation. If selected but no presentation will result in 5 points deduction. |
| April 19, 11:59 | Final project program code and report should be submitted to the Moodle site for grading. |

# Appendix

Week 9 Tutorial Time Demo Checklist

Five out of eight graph functions:
[1] A graph can be empty with no vertex or edge.
[2] A graph can be either a directed graph or an undirected graph.
[3] A graph can be added in vertices and edges.
[4] A vertex of a graph can contain values – in theory, the values can be of any type.
[5] A graph can be displayed by listing all the possible paths, each linking vertices.
[6] A graph can be queried by given a starting vertex, listing the path this vertex leads.
[7] A graph can be queried by given an edge, if this edge exists in the graph
[8] A graph can be queried if a value is contained by any of its vertex.
[9] Show one C++ class defined with default constructor, copy constructor, and constructor with arguments.
[10] A Driver application to test the graph and demonstrate its functions.

Week 13 Tutorial Time Demo Checklist
The rest three graph functions:
[1] A graph can be empty with no vertex or edge.
[2] A graph can be either a directed graph or an undirected graph.
[3] A graph can be added in vertices and edges.
[4] A vertex of a graph can contain values – in theory, the values can be of any type.
[5] A graph can be displayed by listing all the possible paths, each linking vertices.
[6] A graph can be queried by given a starting vertex, listing the path this vertex leads.
[7] A graph can be queried by given an edge, if this edge exists in the graph
[8] A graph can be queried if a value is contained by any of its vertex.
[9] Demonstrate at least three of the following techniques (any 3): inheritance; polymorphism; operator overloading; template; exception handling.

Lecture Time Presentation Checklist
[1] Present with a Class Diagram that describes, in detail, the classes you develop, and the relationships between them (following UML conventions)
[2] Present at least 2 non-trivial methods (member function) in your classes developed;
[3] Present the usage of 3 kinds of techniques from inheritance, polymorphism, operator overloading, template and exception handling.