

CPSC 2150 – Algorithms and Data Structures II

Lab9: Graphs

Total - 40 Marks

Learning Outcomes

- Design and implement an appropriate data structure for a given graph.
- Develop C++ program based on the existing constraints.

Resources

- Chapter 13 of the text book

Your answers are evaluated based on the correctness, efficiency and simplicity.

Description

- **$G = \langle V, E \rangle$** is a graph with $|V|$ nodes and $|E|$ edges.
- **UDWG** : Undirected Weighted Graph
- **DWG** : Directed Weighted Graph
- **Sparse Graph** is a graph with only a few edges.
- **Dense Graph** is a graph in which the number of edges is close to the complete graph.

The distinction between sparse and dense graphs is rather vague, and depends on the context.

Provide an appropriate data structure and necessary methods to build a Graph class which enables you to complete the rest of this lab assignment. Your functions below should use the class(es) to create corresponding objects to fulfill the tasks. Make sure there is Graph printing method in class(es) to print the data structure on the console.

- [15 marks]** Write a function named **makeSparseUDWG** that given an integer **$n > 10$** , generates a sparse graph $G = \langle V, E \rangle$, where the number of nodes ($|V|$) is n , and the number of edges ($|E|$) is less than $2n$. The weights are random integer values between $[1, 100]$ inclusively. Use Adjacency-list to represent your graph. (**testGraph.cpp**)
- [15 marks]** Write a function named **makeDenseDWG** that given an integer **$n > 10$** , generates a dense graph $G = \langle V, E \rangle$, where the number of nodes ($|V|$) is n , and the number of edges ($|E|$) is more than $[(n-2)*n]/2$. The weights are random integer value between $[1, 100]$ inclusively. Use Adjacency-Matrix to represent your graph. (**testGraph.cpp**)
- [10 marks]** Write a function named **printGraph** that given an UDWG and a file name, prints the graph into a text file (eg. sparse25.txt), where the first line represents the number of nodes in the graph and for the rest of the lines, each line represents a weighted edge and includes node1, node2 and the weight, each separated by a space. The label of nodes must start from 0 to $n-1$. (**testGraph.cpp**)

Add a main function in testGraph.cpp to call all the above functions.

- [5 bonus marks]** How much space do you need to represent a graph in part (a) and (b) separately in terms of n ? (**answers.pdf**)

Submit to D2L

Make a **zip file** named **StudentNumber-lab9.zip** including all related files by the end of the lab time. For example, if your student number is 10023449, the submitted file must be named as **10023449-lab9.zip**.