CSE-2212: Design and Analysis of Algorithms-I Lab
Practice Lab 1– October 2, 2024

Experiment: Implementation of a Graph Class and Breadth-First Search (BFS) Algorithm with Java

Pre-reads: ArrayList/LinkedList, Queue, FileReader, Scanner

a) Create a Graph class where the constructor takes a filename as input and graph is initialized using input from the file and stored in adjacency list or matrix. Here's an example input for 5 vertices, 3 edges:

```
 5 3
 1 2
 2 5
 3 4
```

b) There should be functions to
   1. add vertex(n): Add n new vertices to the graph
   2. add edge(u,v): Add an edge to the graph
   3. get the number of vertices
   4. get adjacent vertices of a given vertex
   5. display the graph's adjacency list
   6. run BFS by taking a vertex as a parameter and returning the shortest path to all other vertices from that vertex. Also, print the order in which nodes are visited during the BFS traversal.

- **The main function should be in a class named Lab1.**
- **In main, create a graph object by passing "input.txt" as parameter to the constructor of Graph class.**
- **Call the BFS function of that graph object for a given node and display the shortest path to all vertices.**

Sample Test Cases for BFS:

Test Case 1: Simple Graph

```
3 2
1 2
2 3
```

Test Case 2: Disconnected Graph

```
5 3
1 2
3 4
```

Test Case 3: Cyclic Graph

```
5 3
1 2
2 3
3 1
```

Practice Problems :

https://www.hackerearth.com/practice/algorithms/graphs/breadth-first-search/practice-problems/

https://leetcode.com/problem-list/breadth-first-search/

https://matcomgrader.com/problem/9345/enigma/

from Beecrowd:

- "Connected Components": link
- "Knight Moves": link
- "Level Order Tree Traversal": link
- "Help Clotilde": link

From Kattis:

- "Cyanide Rivers": link
- "Grid": link

Codeforces:

easy level

- 329B
- 1176E

- 1037D
- 35C (multi-source)

medium level

- 1651D
- 1613E
- 173B

Difficult level

- 542E
- 29E
- 1407E