Habib University

CS 102– Data Structures & Algorithm
Spring 2021

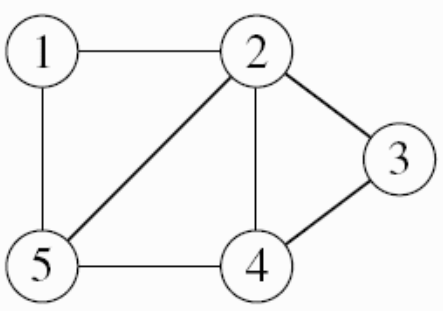
Lab# 10

Graph Applications

Objectives: In this lab, we will use graphs to solve some practical problems.

Exercise # 1

Given the following undirected graph, let's call it UG = (V, E)



Write a Python program to:

a) Build the adjacency list representation of the graph using appropriate helper functions.
b) Display the list of nodes/vertices in the graph.
c) Display the list of edges in the graph.
d) Print Adjacency Matrix representation of the above graph.
e) Print Adjacency List representation of the above graph.
f) Display the neighbors and degree of each node in the above graph.

Exercise # 2

Given the following directed graph, call it DG, whose sets of vertices and edges are given as follows:

Vertices = {1, 2, 3, 4}

(Directed) Edges = {(1, 2), (2, 4), (3, 1), (3, 2), (4, 3), (4, 4)}

Write a Python program to:

a) Create adjacency list of the given directed graph using appropriate helper functions.
b) Print the adjacency list representation of the above graph.
c) Display the out and in degrees of each node in DG.
d) Display the neighbors of each node in the above graph.
e) Print whether the sum of the in-degrees of all nodes, the sum of the out-degrees of all nodes and the total number of edges are all equal or not (i.e. True/False).

Exercise # 3

The following graph is an example from Rosen (2011). It shows the flights and distances between some of the major airports in the United States.

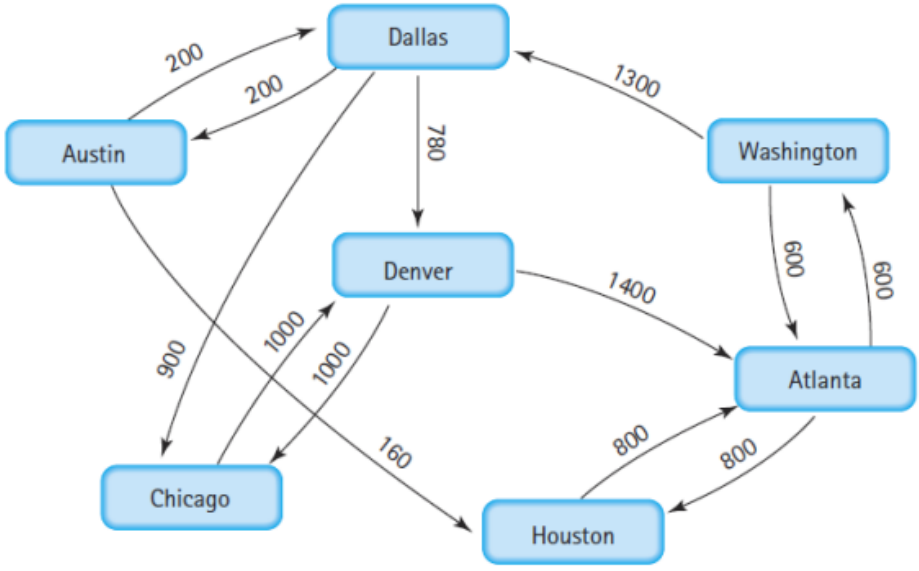


Figure 3.

a) Write a program to create adjacency list representation of the given directed and weighted graph using appropriate helper functions.
b) Write a function to find the airport that has maximum number of i) inbound ii) outbound flights?
c) Write a function that returns all pair of airports (A1, A2) having only one-way connection either from A1 to A2 or A2 to A1.
d) Write a function that returns the nearest airport from a given airport A.
e) Write a function that returns all airports that are connected from a given airport A with not more than one intermediate airport.