Communications and Transport Systems
Department of Science and Technology **Fall 2021**
Linköping University

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Design and Analysis of Algorithms Part 1 - Mathematical Tools and Network Problems homework 3, 1.12.2021

Problem 1 (BFS and DFS):

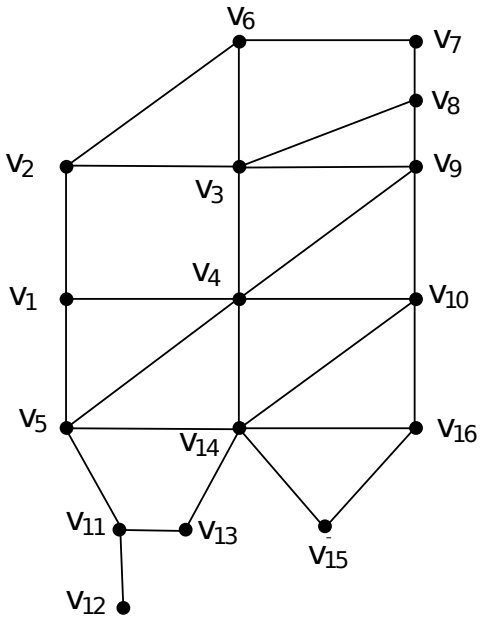

Abbildung 1: The graph G.

a) Apply BFS with start vertex v_1 to graph G from Figure 1.

b) Apply DFS with start vertex v_1 to graph G from Figure 1.

c) Give the adjacency list for G.

(Ad a) and b): If at any time there is more than one vertex to choose from, use the one with the smallest index.)

Problem 2 (BFS and DFS in trees):
Construct an algorithm that determines whether an arbitrary given graph G=(V,E) is a tree based on

(a) DFS

(b) BFS

Problem 3 (Trees and Leaves):

Show that (also during winter) each (undirected) tree has a leaf. (Hint: In an undirected tree a leaf is defined as a vertex of degree 1.)

(10 points)

Problem 4 (BFS):

Let $G = (V, E)$ be a graph and $s \in V$ a vertex; for an arbitrary vertex $x \in V$ let $d(s, x)$ denote the length of a shortest path from s to x. Let $e = \{u, v\} \in E$ be an edge.

a) Prove: $d(s, v) \leq d(s, u) + 1$.

b) Prove or disprove: $d(s, u) \leq d(s, v) + 1$.

c) Does $d(s, v) = d(s, u) + 1$ oder $d(s, u) = d(s, v) + 1$ always hold?