MANIPAL UNIVERSITY JAIPUR

(University under Section 2(f) of the UGC Act)

B.TECH. SECOND YEAR

(III SEM. CSE/IT/CCE)

ACADEMIC YEAR: 2020-2021

COURSE NAME: ENGINEERING MATHEMATICS III

COURSE CODE : MA 2101

LECTURE SERIES NO : UNIT-III (LECTURE NO. 14- 22)

CREDITS : 3

MODE OF DELIVERY : ONLINE (POWER POINT PRESENTATION)

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PROPOSED DATE OF DELIVERY: August 17, 2020

MANIPAL UNIVERSITY JAIPUR

VISION

Global Leadership in Higher Education and Human Development

MISSION

- Be the most preferred University for innovative and interdisciplinary learning
- Foster academic, research and professional excellence in all domains
- Transform young minds into competent professionals with good human values

VALUES

Integrity, Transparency, Quality,
Team Work, Execution with Passion, Humane Touch

SESSION OUTCOME

"TO UNDERSTAND THE CONCEPT OF TREES AND APPLY THE TREE ALGORITHMS TO ANALYZE THE SHORTEST PATH PROBLEMS"

ASSIGNMENT

QUIZ

MID TERM EXAMINATION –I & II

END TERM EXAMINATION

ASSESSMENT CRITERIA

PROGRAM OUTCOMES MAPPING WITH CO3

[PO1]

ENGINEERING KNOWLEDGE: APPLY THE KNOWLEDGE OF MATHEMATICS, SCIENCE, ENGINEERING FUNDAMENTALS, AND AN ENGINEERING SPECIALIZATION TO THE SOLUTION OF COMPLEX ENGINEERING PROBLEMS.

Representing Graphs

Definition: Let $G = (V, E)$ be an undirected graph with $|V| = n$. Suppose that the vertices and edges of G are listed in arbitrary order as $v_1, v_2, \ldots, v_n$ and $e_1, e_2, \ldots, e_m$, respectively.

The **Incidence matrix** of G with respect to this listing of the vertices and edges is the $n \times m$ zero-one matrix with 1 as its (i, j) entry when edge e_j is incident with v_i, and 0 otherwise.

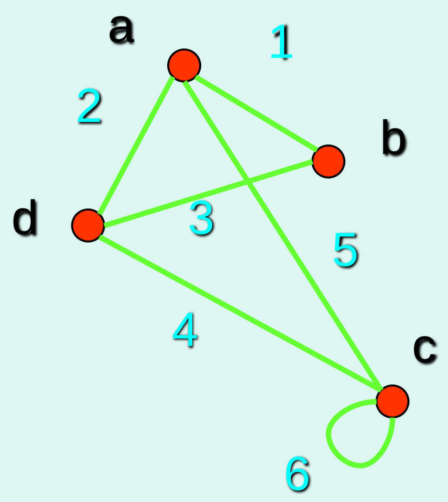
In other words, for an incidence matrix $M = [m_{ij}]$,

$m_{ij} = 1$ if edge e_j is incident with v_i

$m_{ij} = 0$ otherwise.

Representing Graphs

Example: What is the incidence matrix M for the following graph G based on the order of vertices a, b, c, d and edges 1, 2, 3, 4, 5, 6?



Solution:

$$M = \begin{bmatrix} 1 & 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 \\ 0 & 1 & 1 & 1 & 0 & 0 \end{bmatrix}$$

Note: Incidence matrices of undirected graphs contain two 1s per column for edges connecting two vertices and one 1 per column for loops.

Shortest Path

In an edge-weighted graph, the weight of an edge measures the cost of traveling that edge.

For example, in a graph representing a network of airports, the weights could represent: distance, cost or time.

Such a graph could be used to answer any of the following:

What is the fastest way to get from A to B?

Which route from A to B is the least expensive?

What is the shortest possible distance from A to B?

Each of these questions is an instance of the same problem:

The shortest path problem!

Shortest Path by Dijkstra's Algorithm

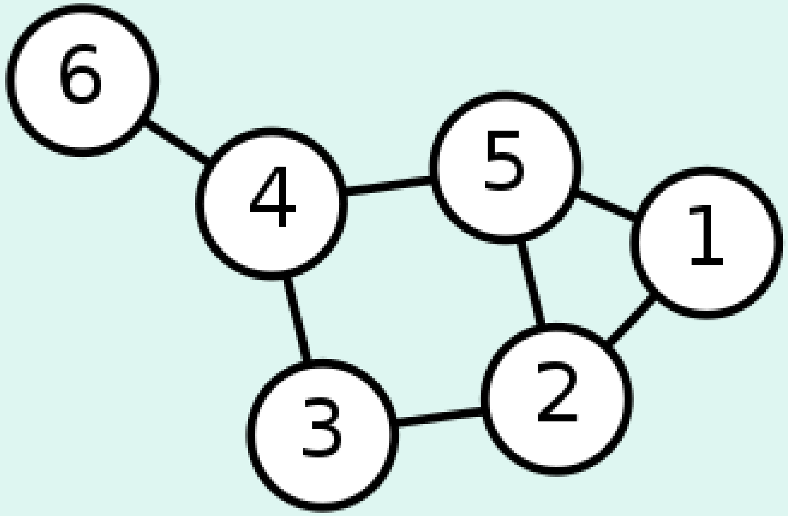
- Dijkstra's algorithm solves the single-source shortest path problem for a non-negative weights graph.

- It finds the shortest path from an initial vertex(say s) to all the other vertices.

- Works on both directed and undirected graphs. However, all edges must have nonnegative weights.

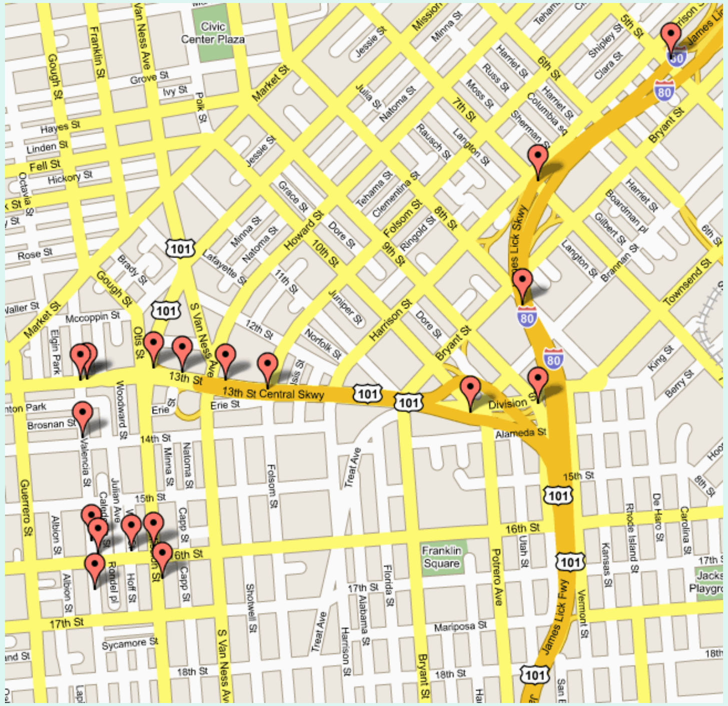
Dijkstra's Algorithm

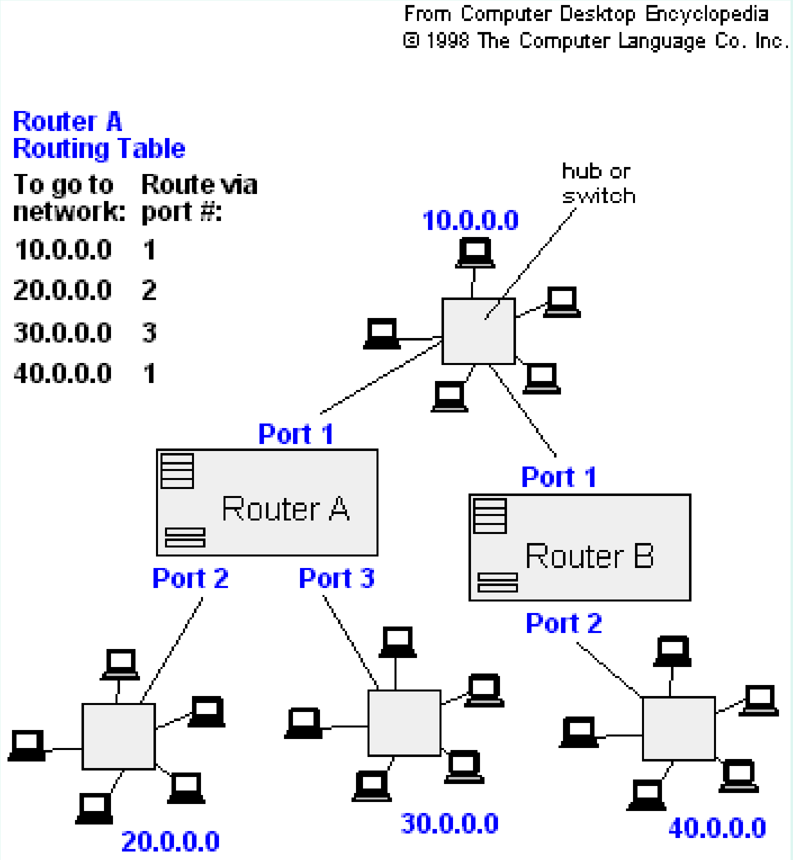
Single-Source Shortest Path Problem - The problem of finding shortest paths from a source vertex *v* to all other vertices in the graph.



Applications of Dijkstra's Algorithm

- Maps (Map Quest, Google Maps)
- Routing Systems





Dijkstra's Algorithm

Dijkstra's algorithm - is a solution to the single-source shortest path problem in graph theory.

Works on both directed and undirected graphs. However, all edges must have nonnegative weights.

Input: Weighted graph $G=\{E,V\}$ and source vertex $v \in V$, such that all edge weights are nonnegative

Output: Lengths of shortest paths (or the shortest paths themselves) from a given source vertex $v \in V$ to all other vertices.