Course title : **CSE2001**

Course title : **Data Structures and Algorithms**

Module : **6**

Topic : **2**

Shortest-path algorithms

Objectives

This session will give the knowledge about

- Dijkstra’s algorithm

Introduction to Dijkstra’s algorithm

Dijkstra's Algorithm allows you to calculate the shortest path between one node (you pick which one) and every other node in the graph.

Here’s how the algorithm is implemented:

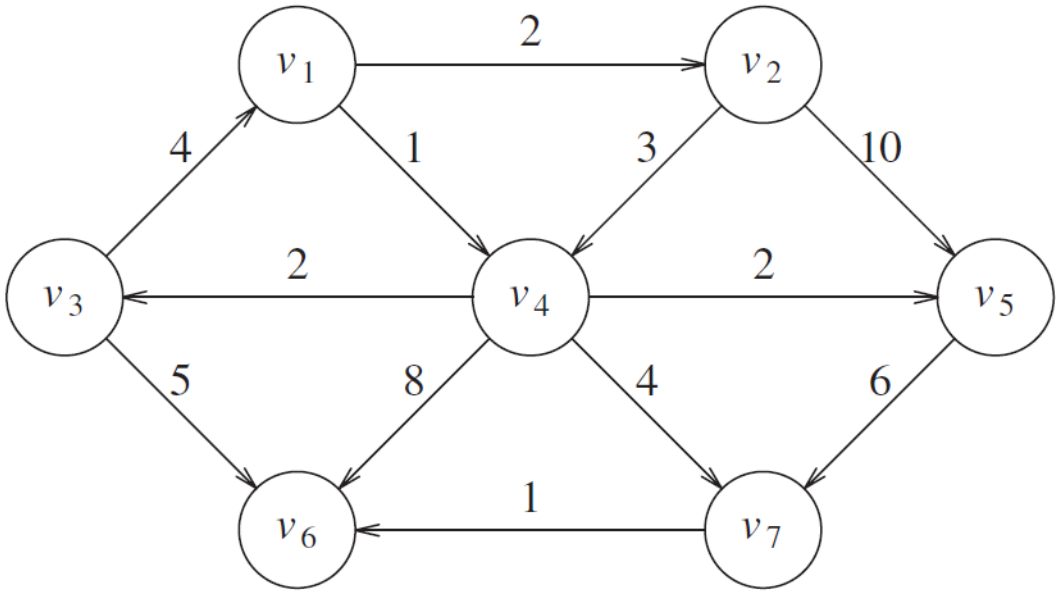
1. Mark all nodes as unvisited.
2. Mark the selected **initial** node with a current distance of **0** and the rest with **infinity**.
3. Set the **initial** node as **current** node.
4. For the **current** node, consider all of its **unvisited** neighbors and calculate their distances by adding the current distance of **current** node to the weight of the edge connecting **neighbor** node and **current** node.

Introduction to Dijkstra's algorithm

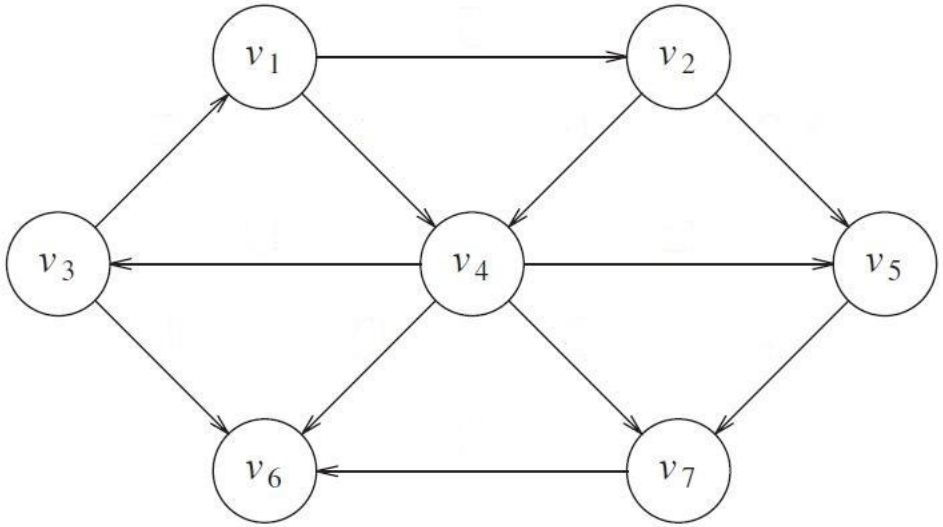
5. Compare the newly calculated distance to the current distance assigned to the **neighboring** node and set is as the **new** current distance of **neighboring** node.
6. When done considering all of the **unvisited** neighbors of the **current** node, mark the **current** node as **visited**.
7. If the **destination** node has been marked **visited** then stop. The algorithm has finished.
8. Otherwise, select the **unvisited** node that is marked with the **smallest** distance, set it as the new **current node**, and go back to **step 4**.

Introduction to Dijkstra's algorithm

Find the Shortest path from the following directed Graph



Dijkstra's algorithm Problem



Initial directed Graph

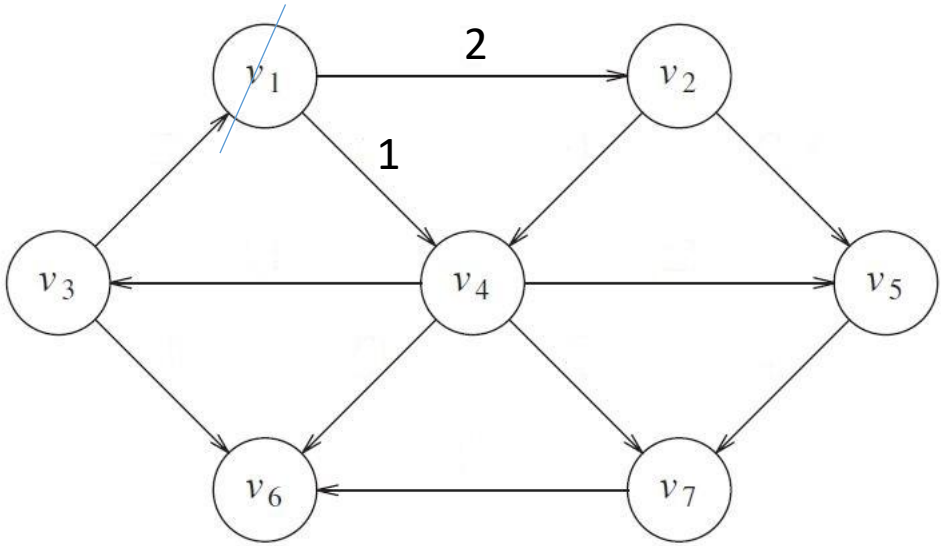
v	*known*	d_v	p_v
v_1	F	0	0
v_2	F	∞	0
v_3	F	∞	0
v_4	F	∞	0
v_5	F	∞	0
v_6	F	∞	0
v_7	F	∞	0

Initial path table

Dijkstra's algorithm Problem

Step1: v1 is known

Directed Graph



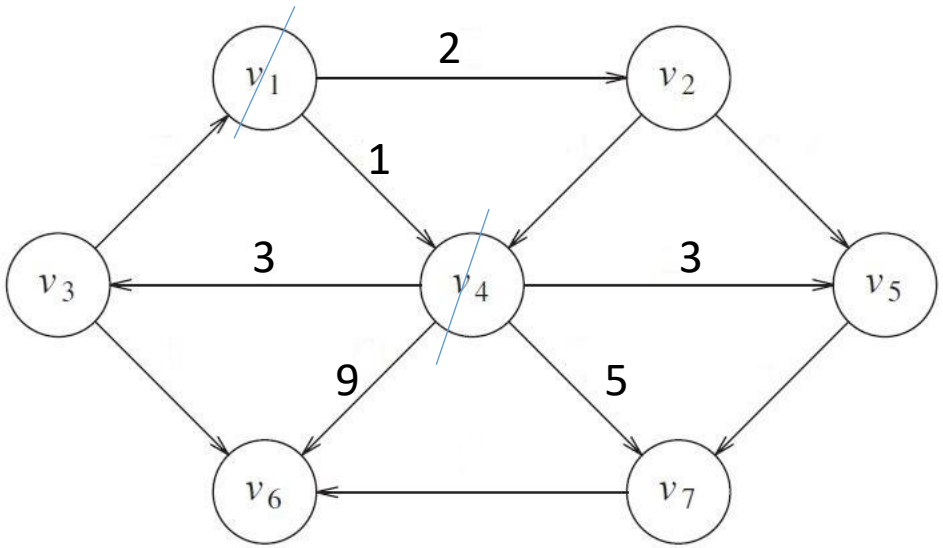
Path table

v	*known*	d_v	p_v
v_1	T	0	0
v_2	F	2	v_1
v_3	F	∞	0
v_4	F	1	v_1
v_5	F	∞	0
v_6	F	∞	0
v_7	F	∞	0

Dijkstra's algorithm Problem

Step2: v4 is declared known

Directed Graph



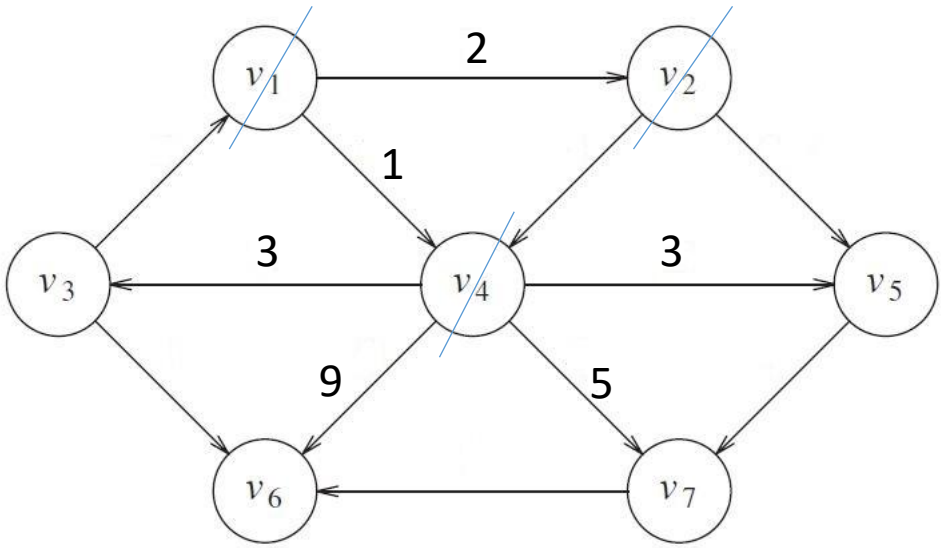
Path table

v	*known*	d_v	p_v
v_1	T	0	0
v_2	F	2	v_1
v_3	F	3	v_4
v_4	T	1	v_1
v_5	F	3	v_4
v_6	F	9	v_4
v_7	F	5	v_4

Dijkstra's algorithm Problem

Step3: v2 is declared known

Directed Graph



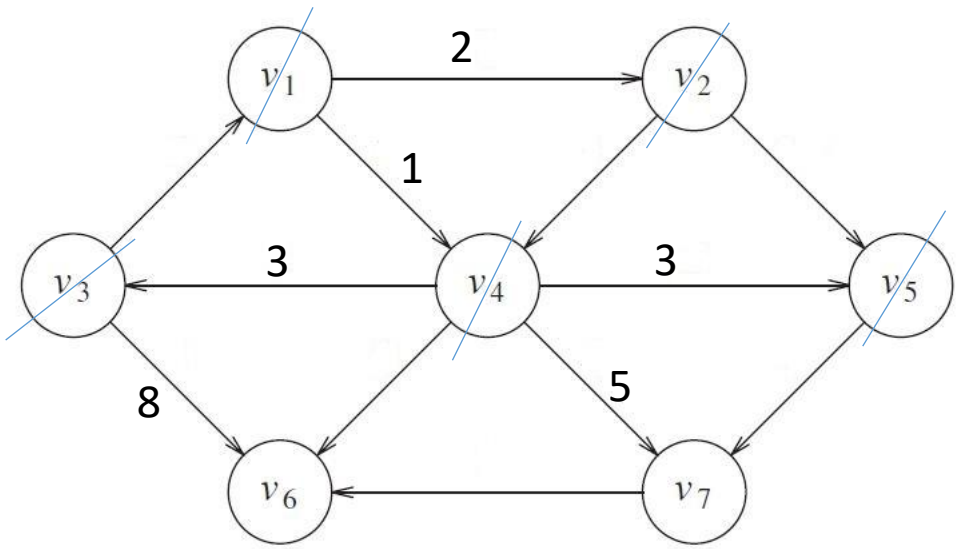
Path table

v	*known*	d_v	p_v
v_1	T	0	0
v_2	T	2	v_1
v_3	F	3	v_4
v_4	T	1	v_1
v_5	F	3	v_4
v_6	F	9	v_4
v_7	F	5	v_4

Dijkstra's algorithm Problem

Step4: v5 and then v3 are declared known

Directed Graph



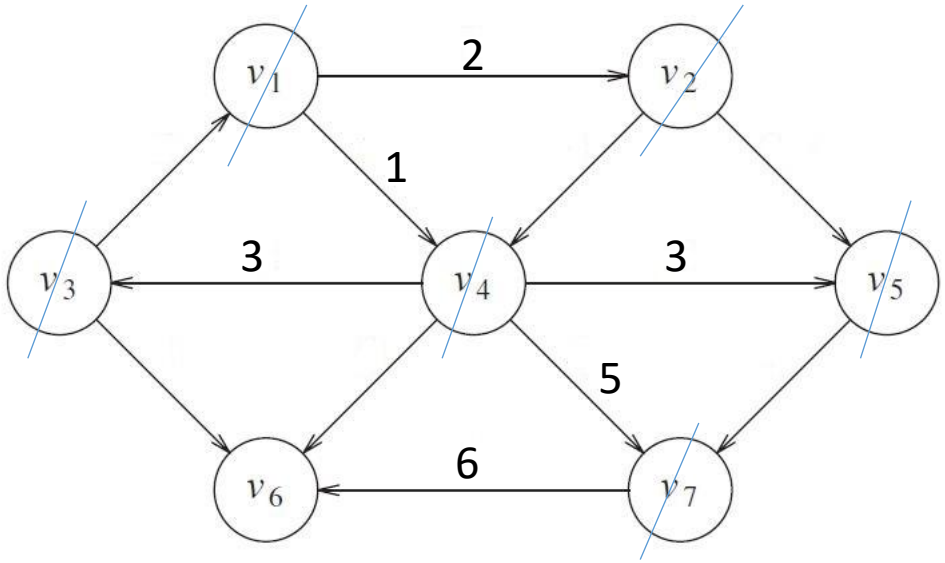
Path table

v	*known*	d_v	p_v
v_1	T	0	0
v_2	T	2	v_1
v_3	T	3	v_4
v_4	T	1	v_1
v_5	T	3	v_4
v_6	F	8	v_3
v_7	F	5	v_4

Dijkstra's algorithm Problem

Step5: v7 is declared known

Directed Graph



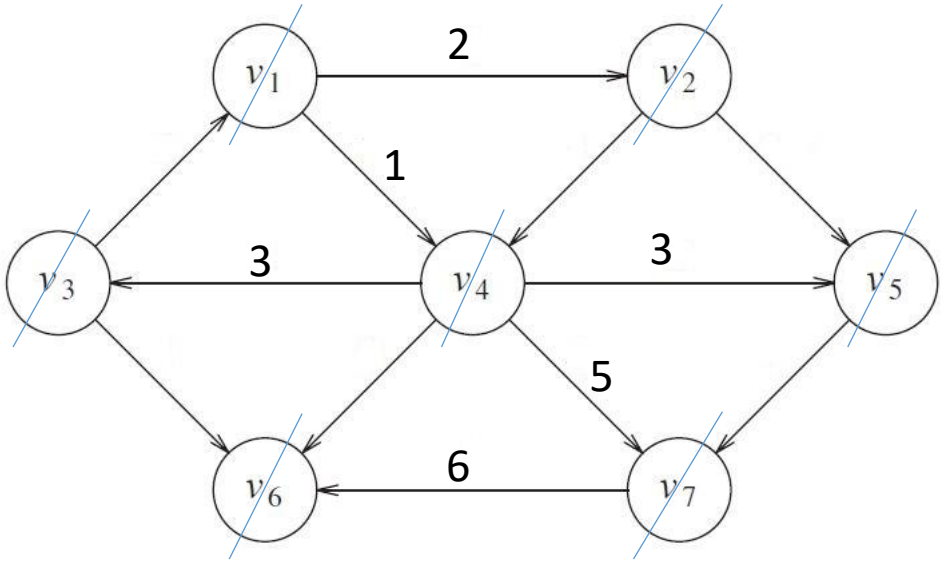
Path table

v	*known*	d_v	p_v
v_1	T	0	0
v_2	T	2	v_1
v_3	T	3	v_4
v_4	T	1	v_1
v_5	T	3	v_4
v_6	F	6	v_7
v_7	T	5	v_4

Dijkstra's algorithm Problem

Step6: v6 is declared known and algorithm terminates

Directed Graph



Path table

v	*known*	d_v	p_v
v_1	T	0	0
v_2	T	2	v_1
v_3	T	3	v_4
v_4	T	1	v_1
v_5	T	3	v_4
v_6	T	6	v_7
v_7	T	5	v_4

Dijkstra's algorithm Problem

Result: Distance pairs

(v1,v2) = 2

(v4,v3) = 3

(v1,v4) = 1

(v4,v5) = 3

(v7,v6) = 6

(v4,v7) = 5

Total cost in Shortest path is = 20

v	*known*	d_v	p_v
v_1	T	0	0
v_2	T	2	v_1
v_3	T	3	v_4
v_4	T	1	v_1
v_5	T	3	v_4
v_6	T	6	v_7
v_7	T	5	v_4

Reference Links

- https://www.educative.io/edpresso/what-is-dijkstras-algorithm?affiliate_id=5082902844932096&utm_source=google&utm_medium=cpc&utm_campaign=platform2&utm_content=ad-1-dynamic&gclid=Cj0KCQjwgLLoBRDyARIsACRAZe4Q0tIv7xXB8R_RSD5n9jgiKhXxA5OnETC7_kspXg03j-pnZz-_JjsaAg-qEALw_wcB

- https://en.wikipedia.org/wiki/Dijkstra%27s_algorithm

Practice Problems