

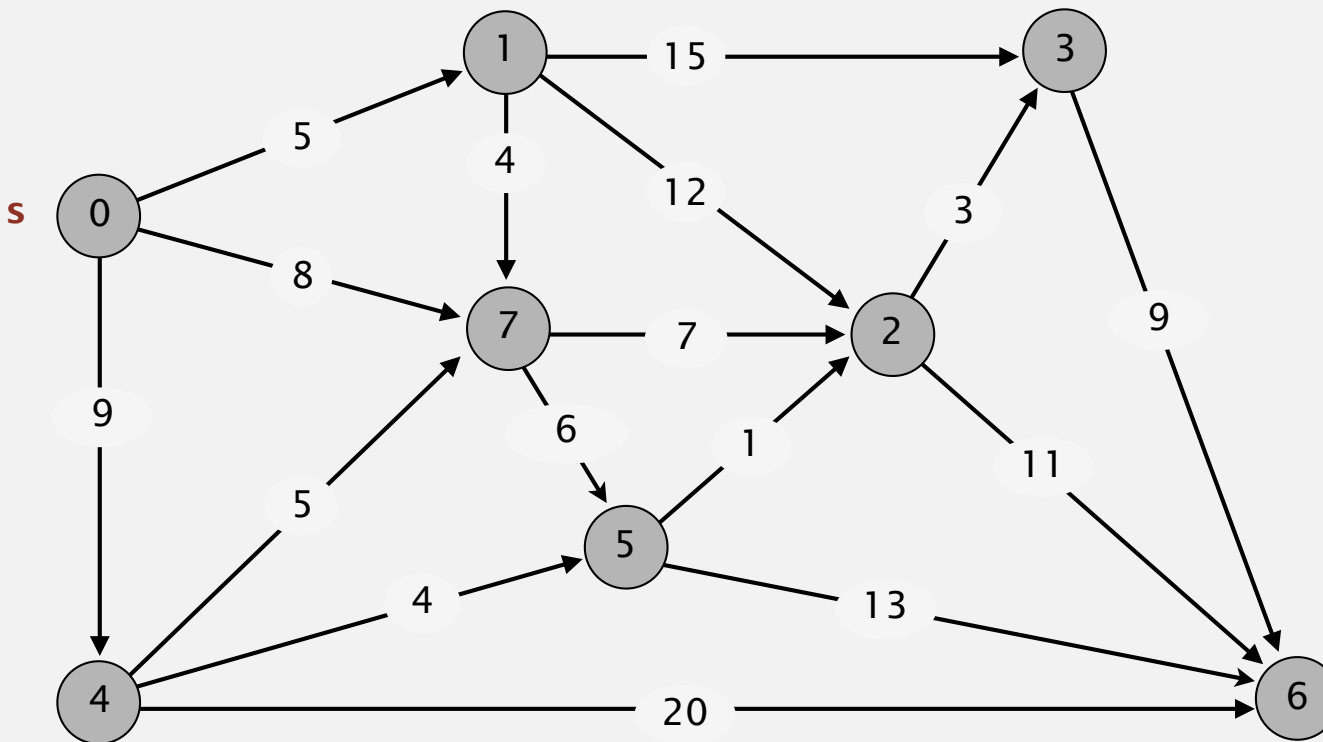


<http://algs4.cs.princeton.edu>

ACYCLIC SHORTEST PATHS

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.

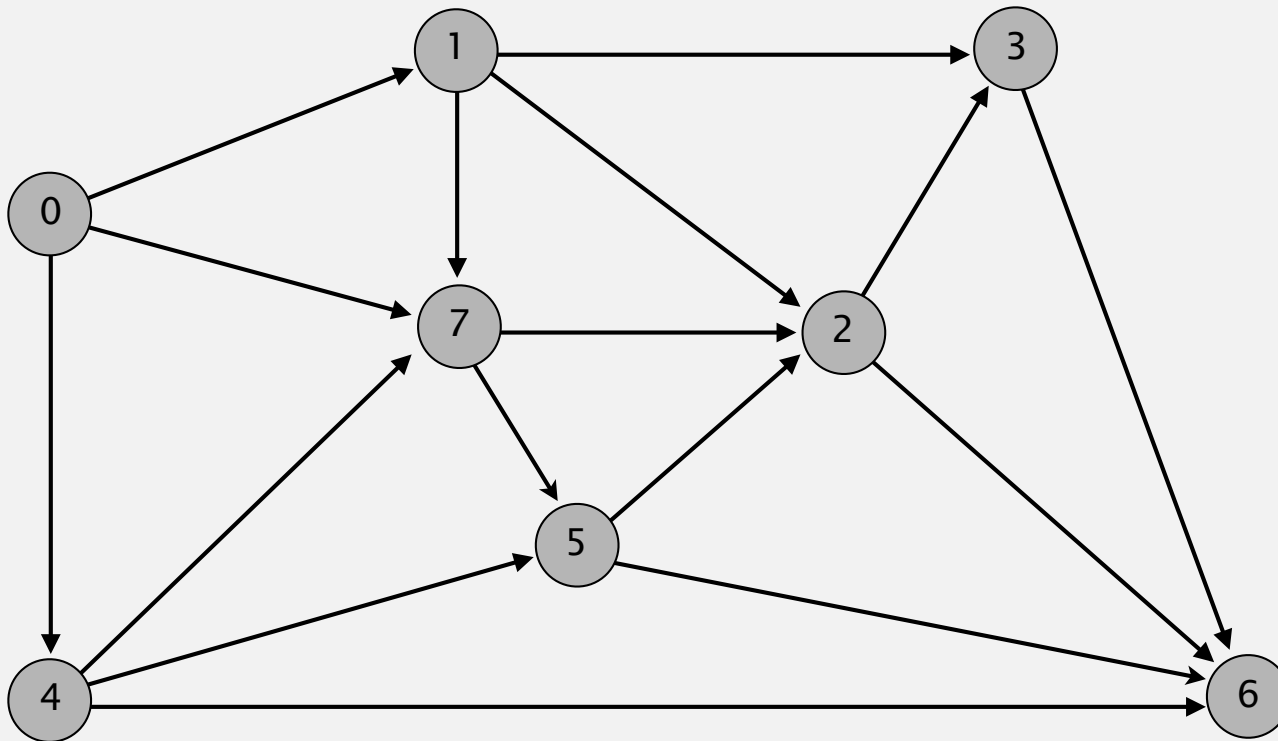


an edge-weighted DAG

0→1	5.0
0→4	9.0
0→7	8.0
1→2	12.0
1→3	15.0
1→7	4.0
2→3	3.0
2→6	11.0
3→6	9.0
4→5	4.0
4→6	20.0
4→7	5.0
5→2	1.0
5→6	13.0
7→5	6.0
7→2	7.0

Acyclic shortest paths demo

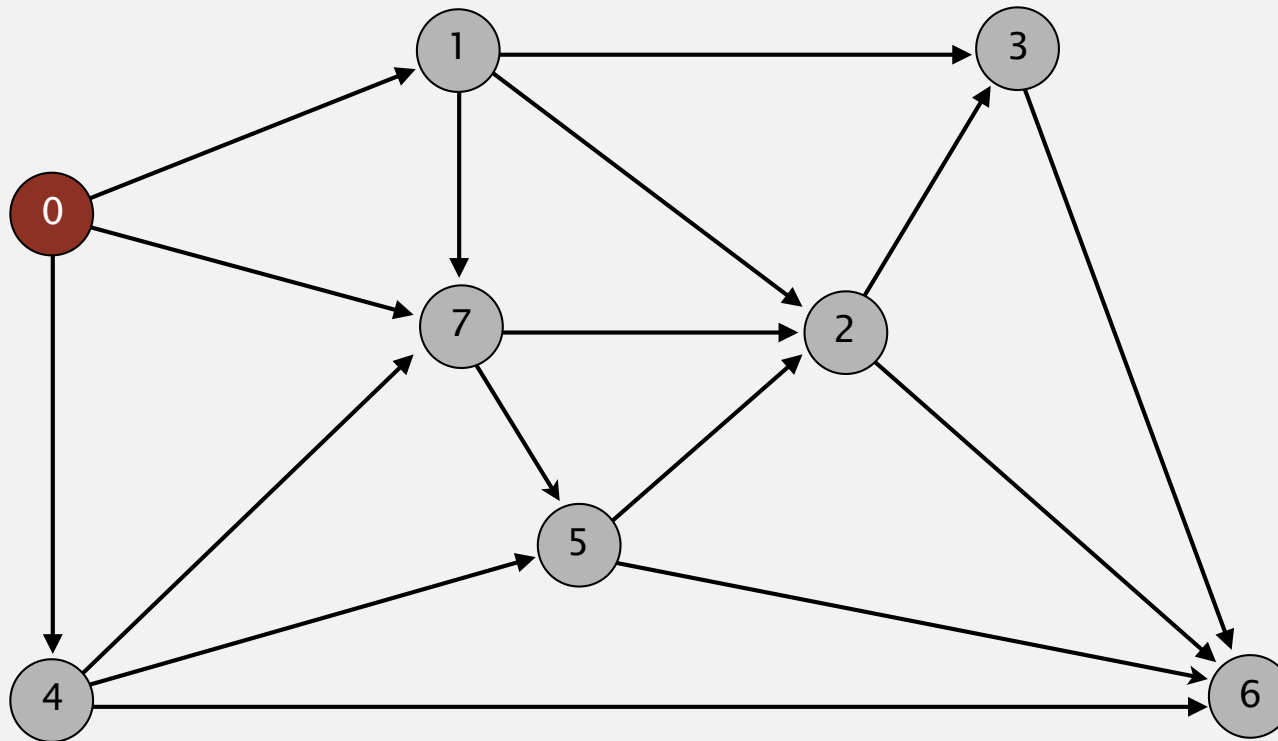
- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



topological order: 0 1 4 7 5 2 3 6

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



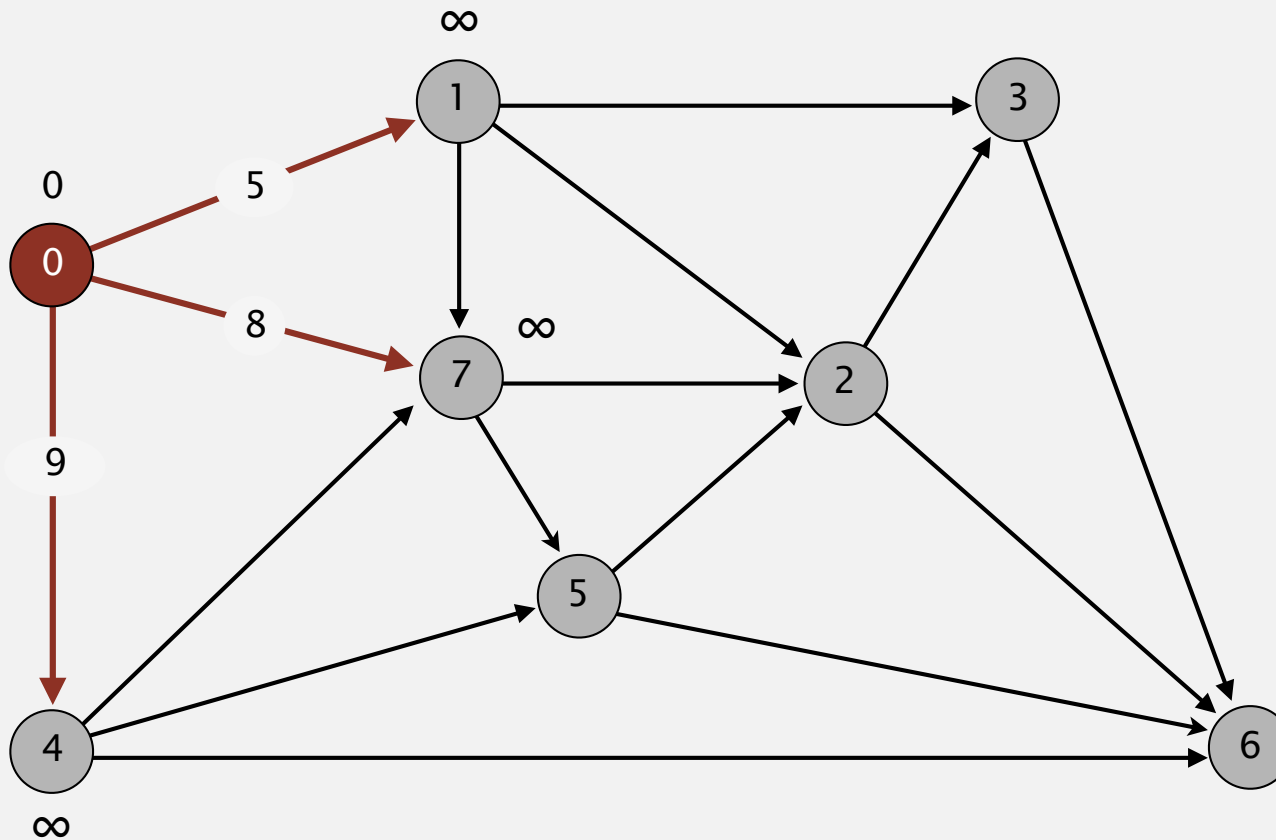
choose vertex 0

↓
0 1 4 7 5 2 3 6

v	distTo[]	edgeTo[]
→ 0	0.0	-
1		
2		
3		
4		
5		
6		
7		

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



↓

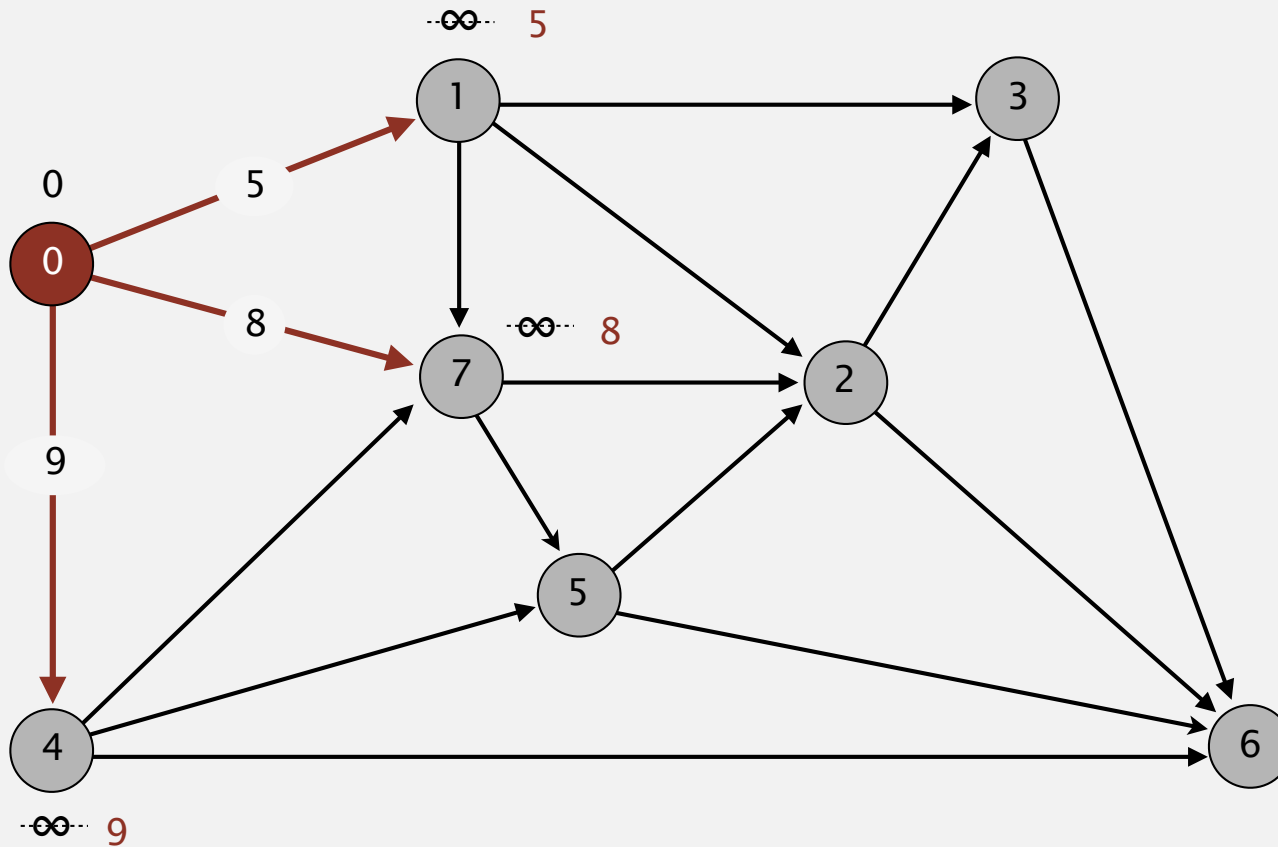
0 1 4 7 5 2 3 6

v	distTo[]	edgeTo[]
→ 0	0.0	-
1		
2		
3		
4		
5		
6		
7		

relax all edges pointing from 0

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



relax all edges pointing from 0

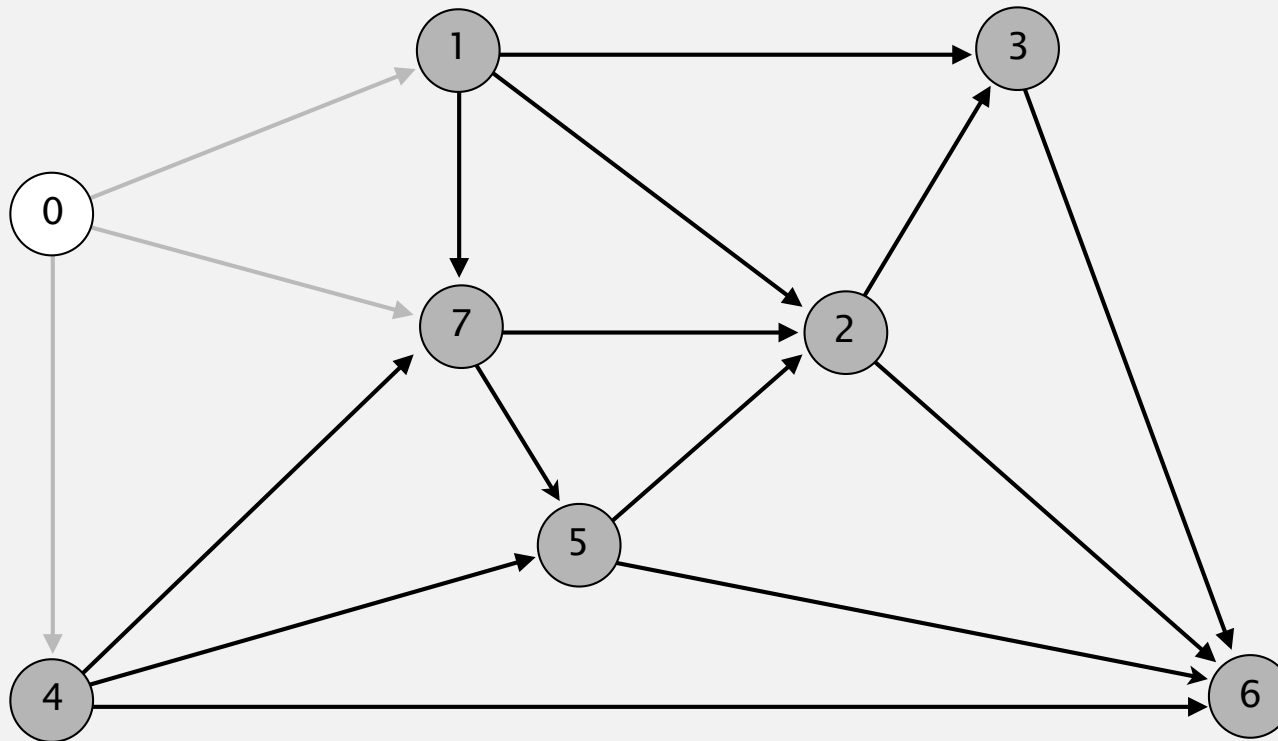
↓

0 1 4 7 5 2 3 6

v	distTo[]	edgeTo[]
→ 0	0.0	-
1	5.0	0→1
2		
3		
4	9.0	0→4
5		
6		
7	8.0	0→7

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



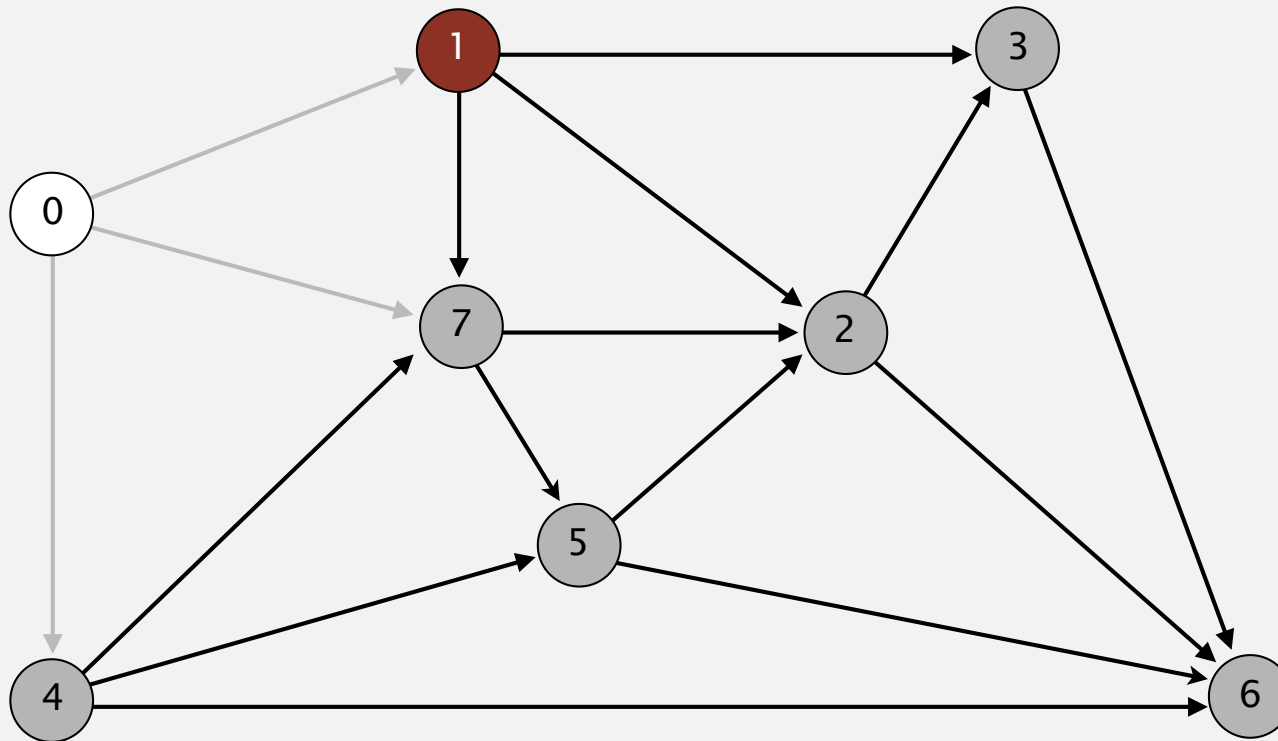
↓

0 1 4 7 5 2 3 6

v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2		
3		
4	9.0	0→4
5		
6		
7	8.0	0→7

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.

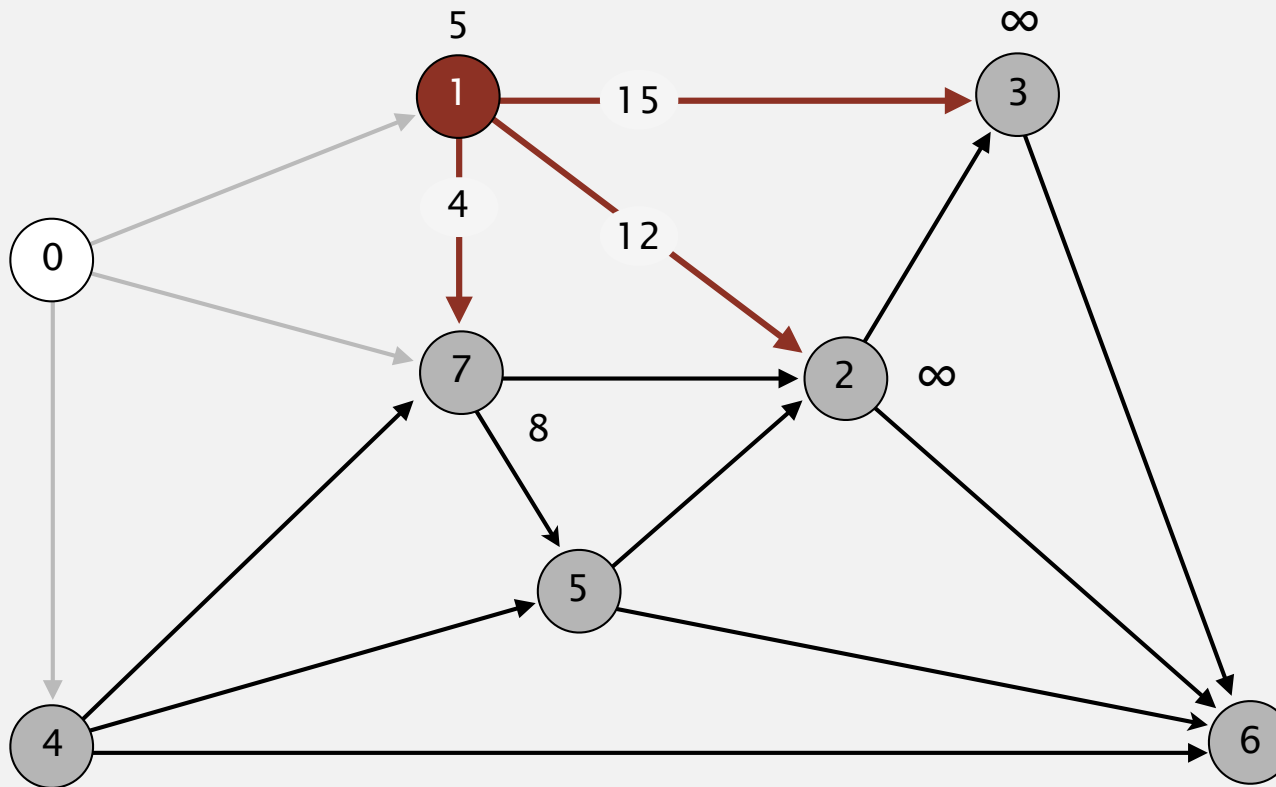


choose vertex 1

	↓						
0	1	4	7	5	2	3	6
v	distTo[]	edgeTo[]					
0	0.0	-					
→ 1	5.0	0→1					
2							
3							
4	9.0	0→4					
5							
6							
7	8.0	0→7					

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.

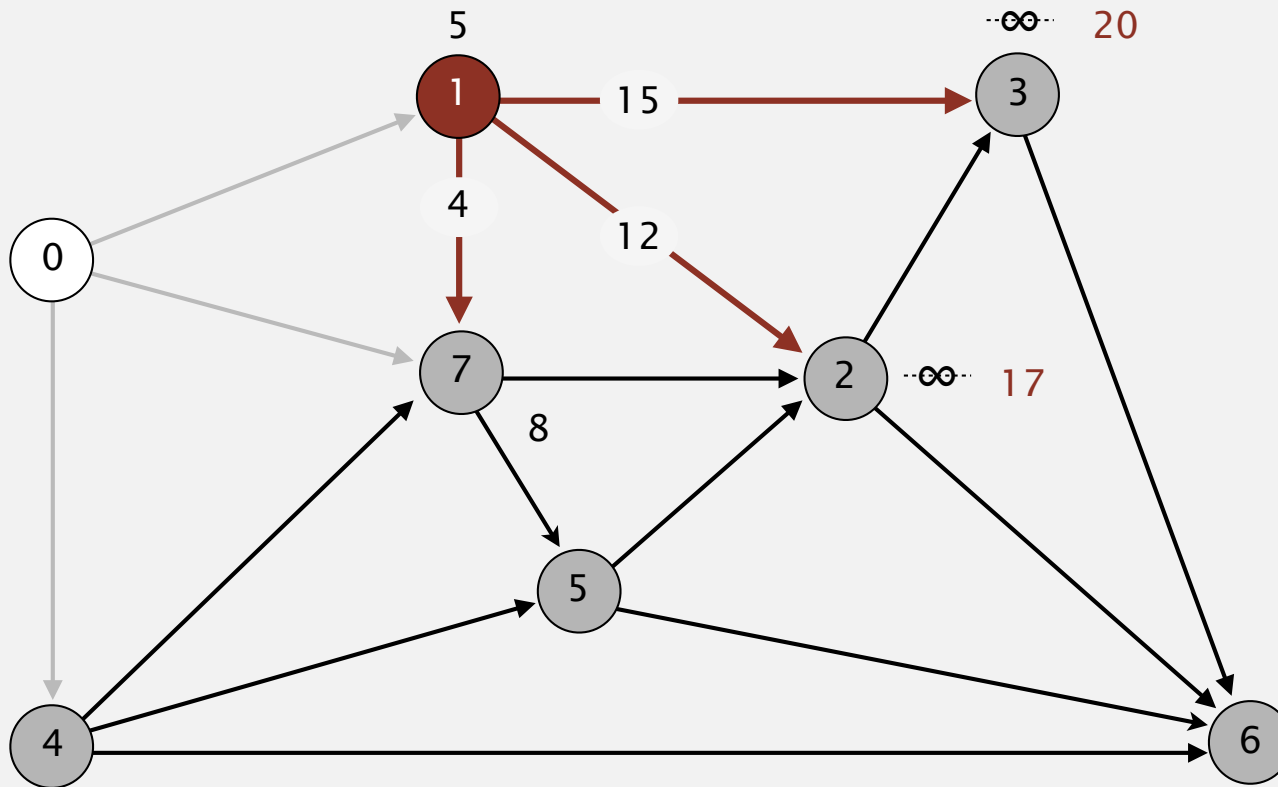


v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2		
3		
4	9.0	0→4
5		
6		
7	8.0	0→7

relax all edges pointing from 1

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.

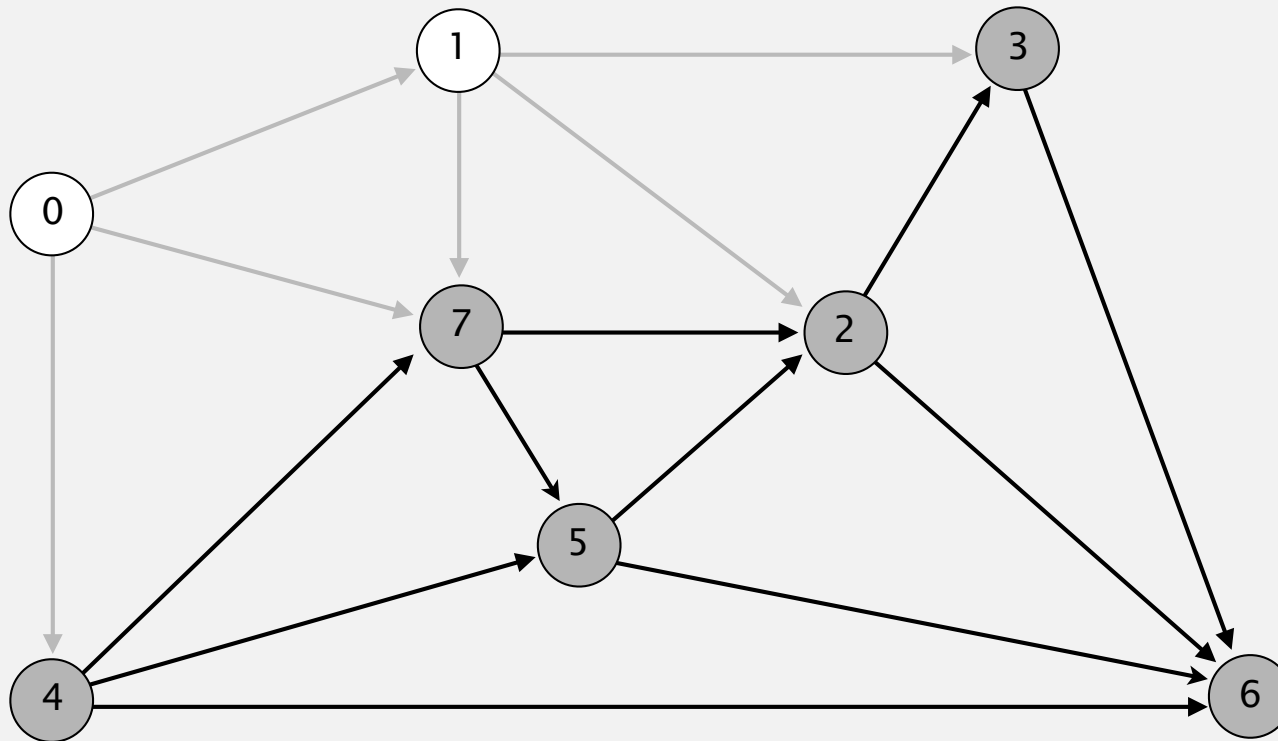


v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2	17.0	1→2
3	20.0	1→3
4	9.0	0→4
5	∞	
6	∞	
7	8.0 ✓	0→7

relax all edges pointing from 1

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



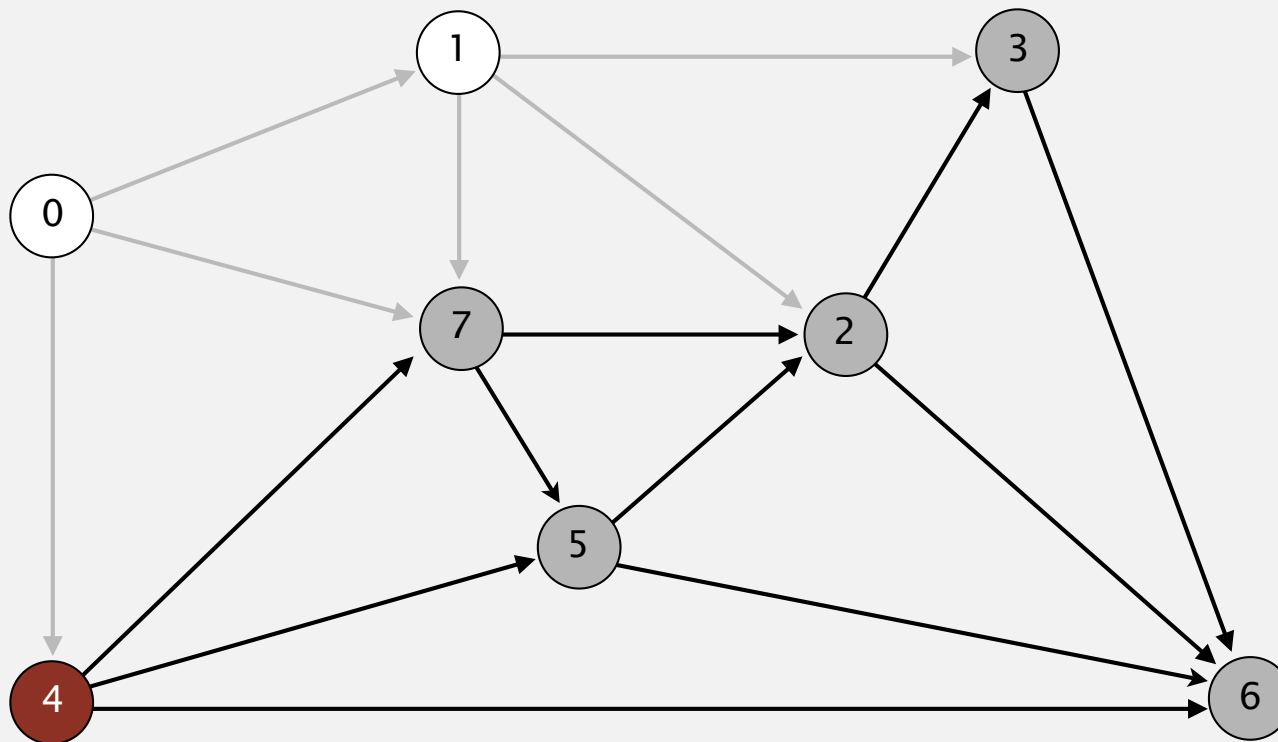
↓

0 1 4 7 5 2 3 6

v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2	17.0	1→2
3	20.0	1→3
4	9.0	0→4
5		
6		
7	8.0	0→7

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



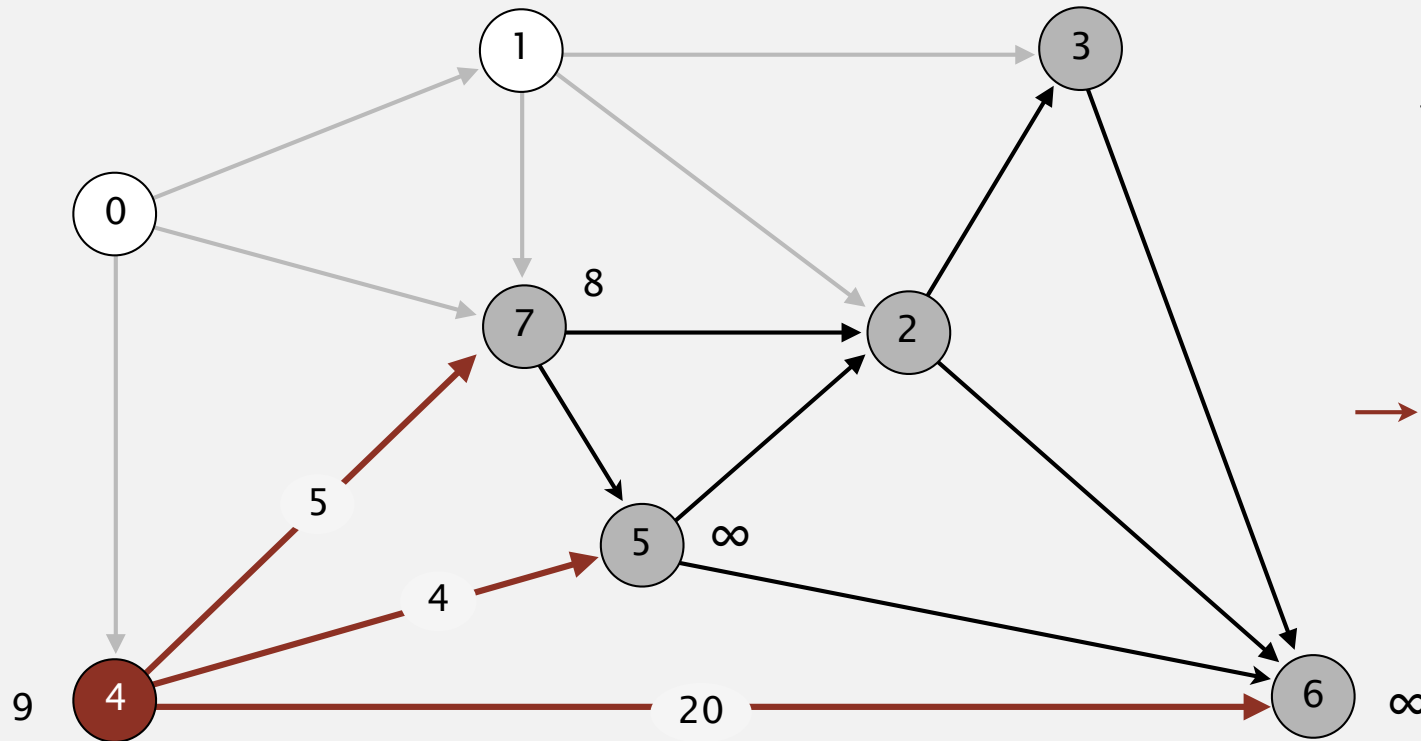
	0	1	4	7	5	2	3	6
			↓					
v	distTo[]	edgeTo[]						
0	0.0	-						
1	5.0	0→1						
2	17.0	1→2						
3	20.0	1→3						
→ 4	9.0	0→4						
5								
6								
7	8.0	0→7						

select vertex 4

(Dijkstra would have selected vertex 7)

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.

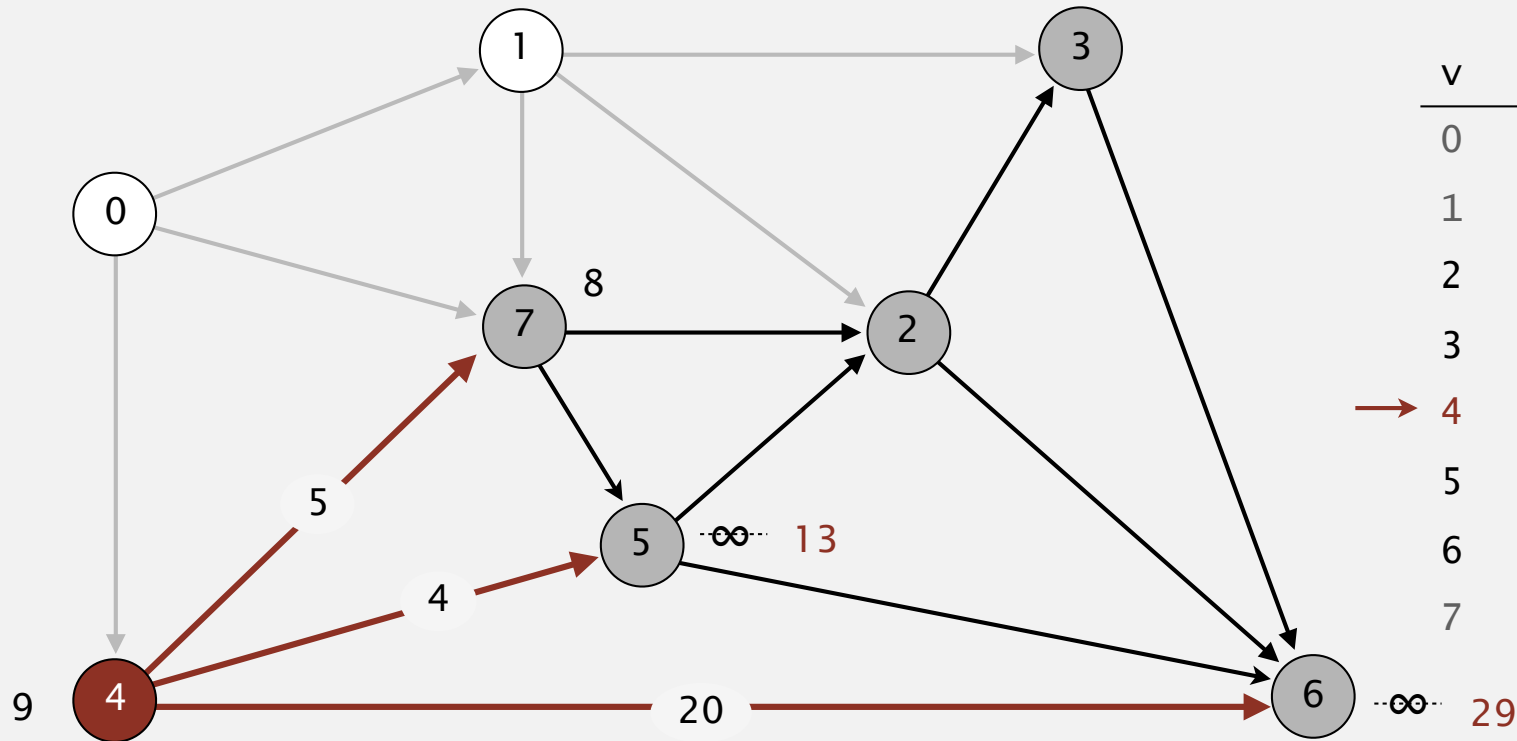


v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2	17.0	1→2
3	20.0	1→3
4	9.0	0→4
5	∞	
6	∞	
7	8.0	0→7

relax all edges pointing from 4

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.

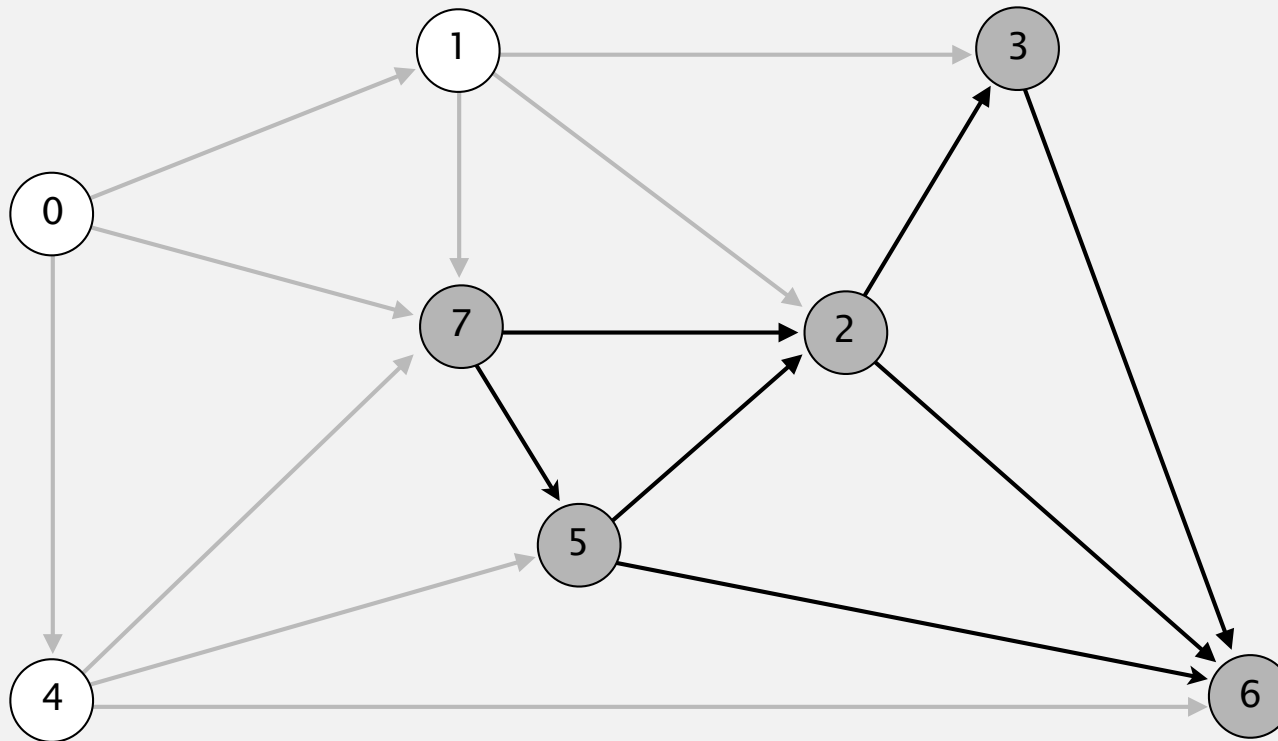


v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2	17.0	1→2
3	20.0	1→3
4	9.0	0→4
5	13.0	4→5
6	29.0	4→6
7	8.0 ✓	0→7

relax all edges pointing from 4

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



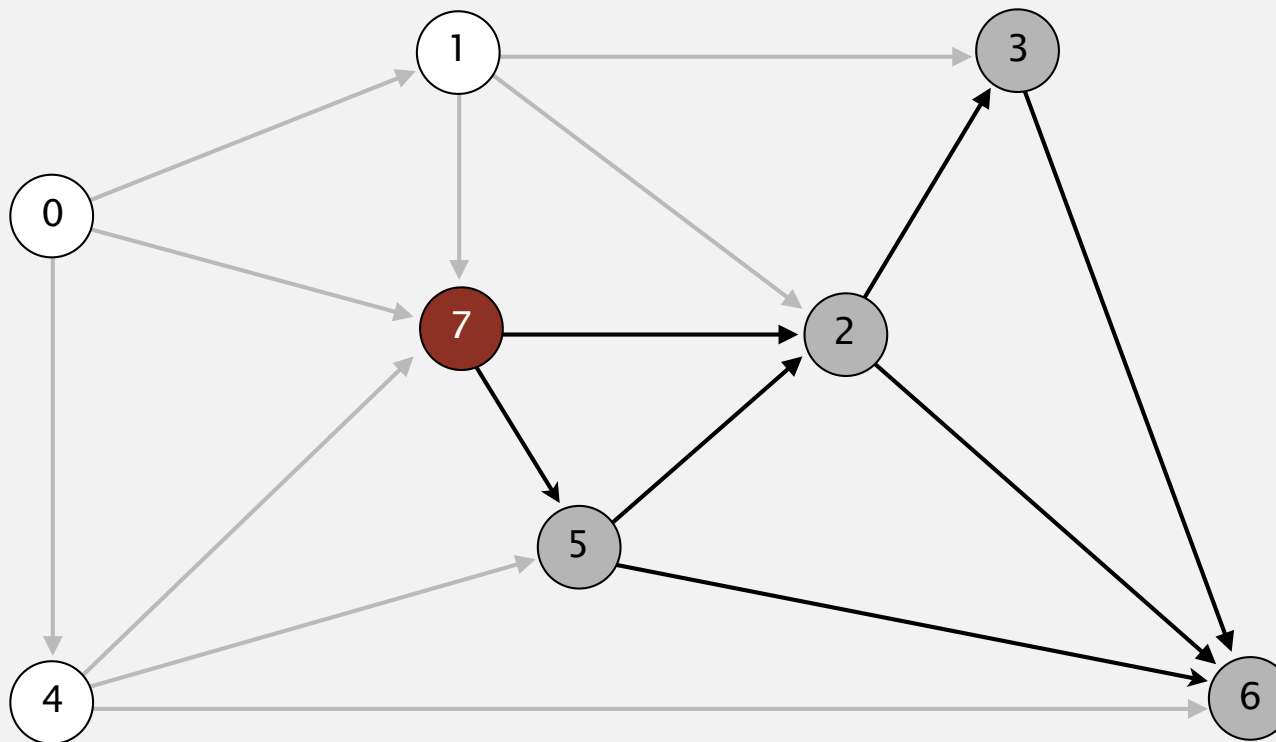
↓

0 1 4 7 5 2 3 6

v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2	17.0	1→2
3	20.0	1→3
4	9.0	0→4
5	13.0	4→5
6	29.0	4→6
7	8.0	0→7

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



↓

0 1 4 7 5 2 3 6

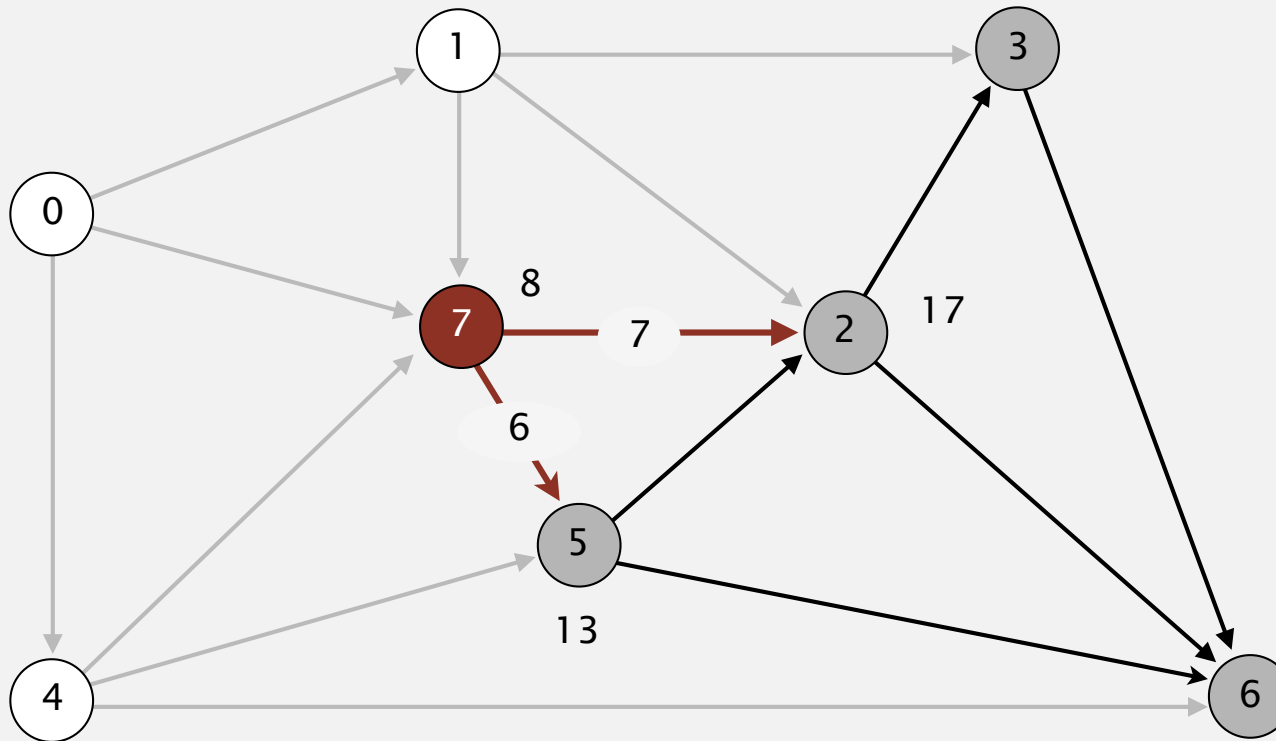
v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2	17.0	1→2
3	20.0	1→3
4	9.0	0→4
5	13.0	4→5
6	29.0	4→6
7	8.0	0→7

→

choose vertex 7

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



↓

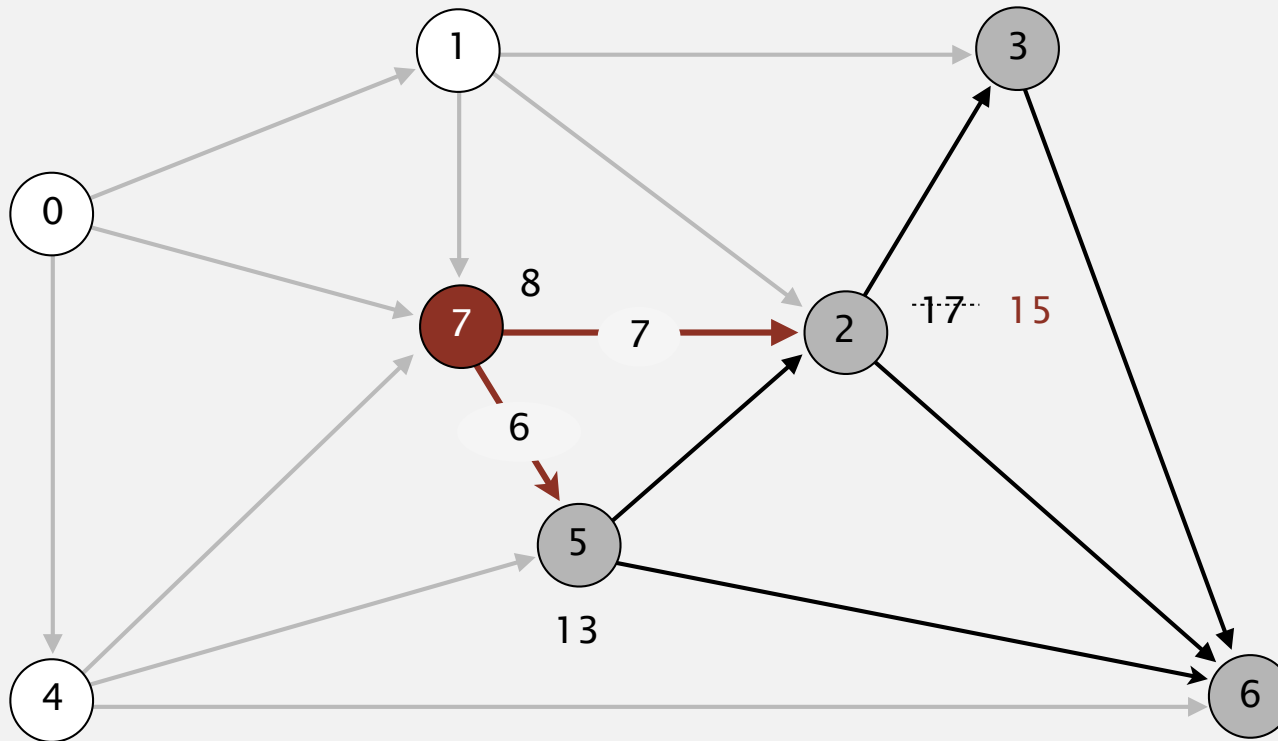
0 1 4 7 5 2 3 6

v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2	17.0	1→2
3	20.0	1→3
4	9.0	0→4
5	13.0	4→5
6	29.0	4→6
7	8.0	0→7

relax all edges pointing from 7

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



↓

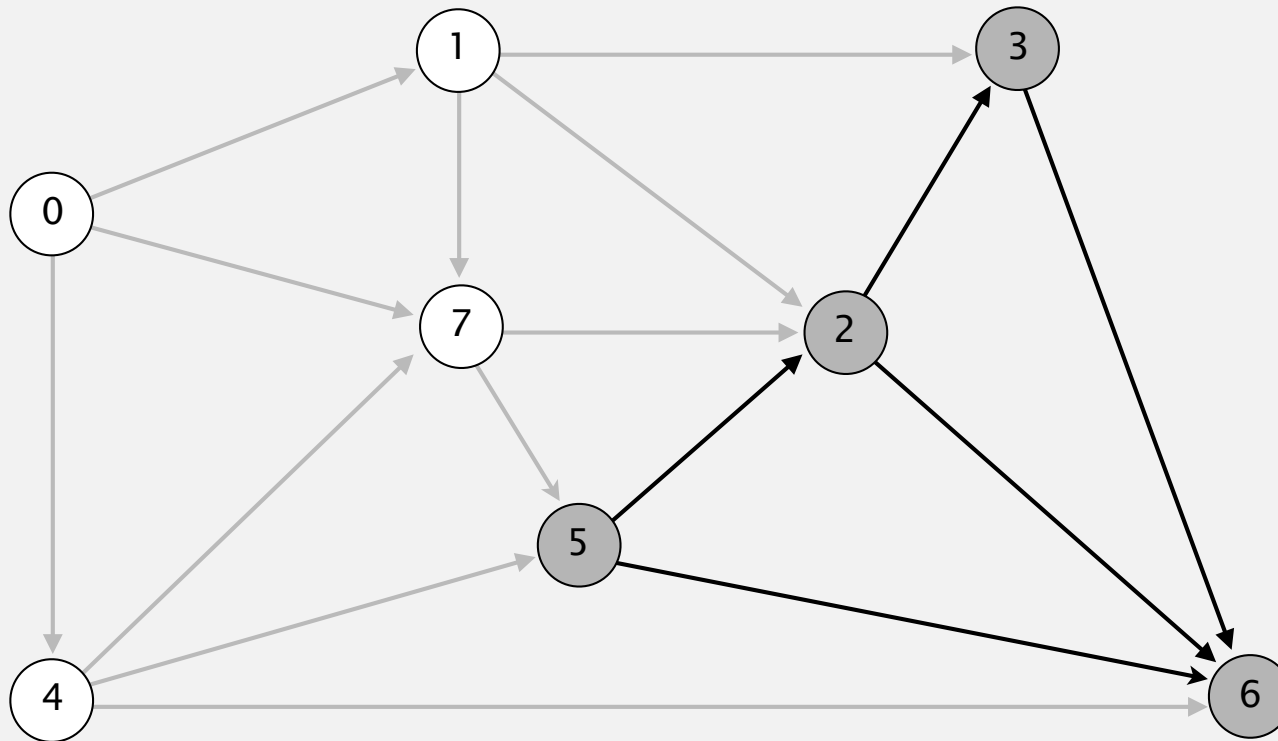
0 1 4 7 5 2 3 6

v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2	15.0	7→2
3	20.0	1→3
4	9.0	0→4
5	13.0 ✓	4→5
6	29.0	4→6
7	8.0	0→7

relax all edges pointing from 7

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



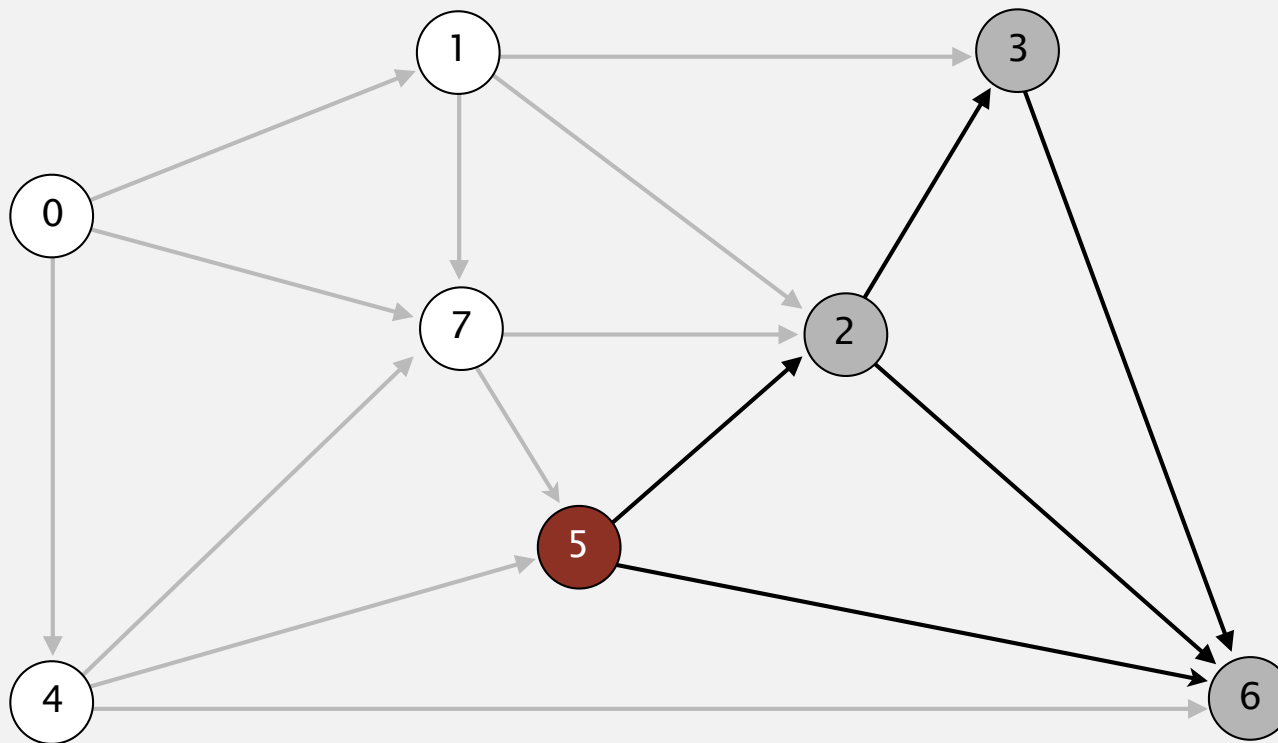
↓

0 1 4 7 5 2 3 6

v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2	15.0	7→2
3	20.0	1→3
4	9.0	0→4
5	13.0	4→5
6	29.0	4→6
7	8.0	0→7

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



↓

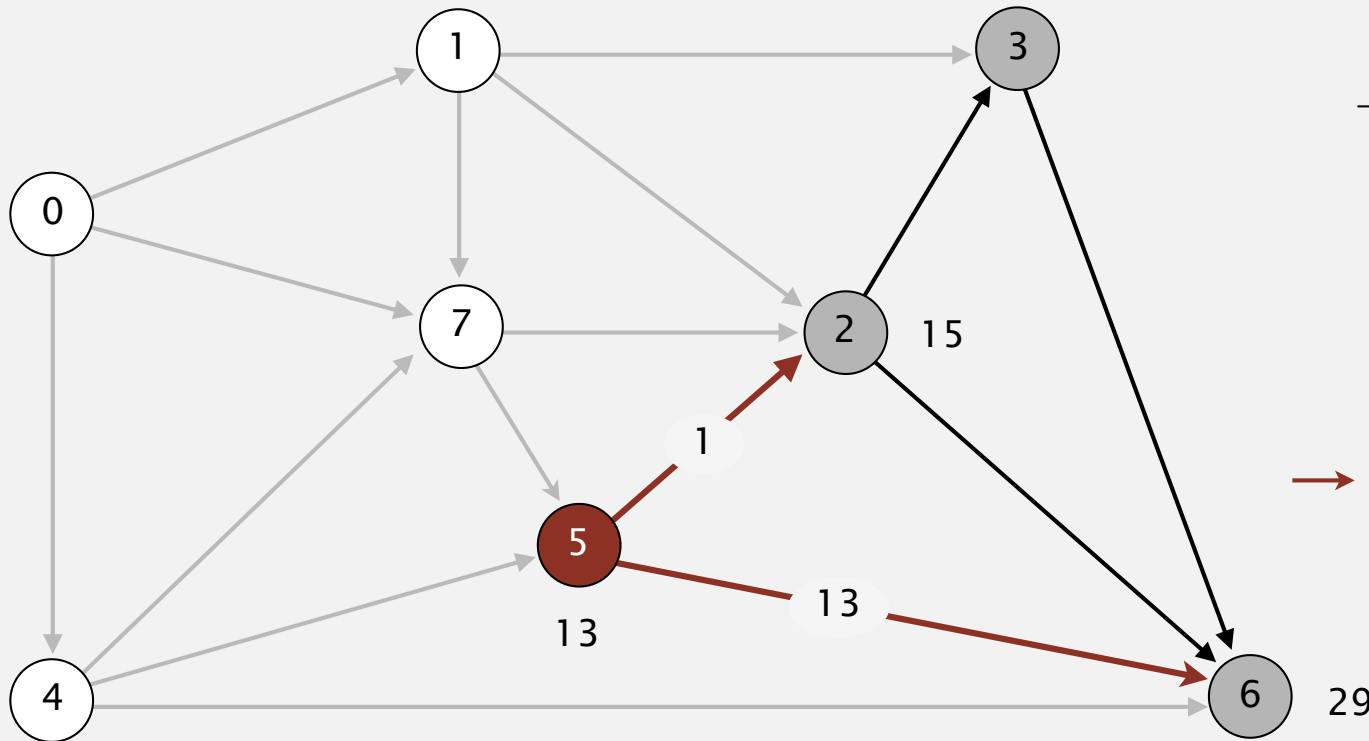
0 1 4 7 **5** 2 3 6

v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2	15.0	7→2
3	20.0	1→3
4	9.0	0→4
5	13.0	4→5
6	29.0	4→6
7	8.0	0→7

select vertex 5

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.

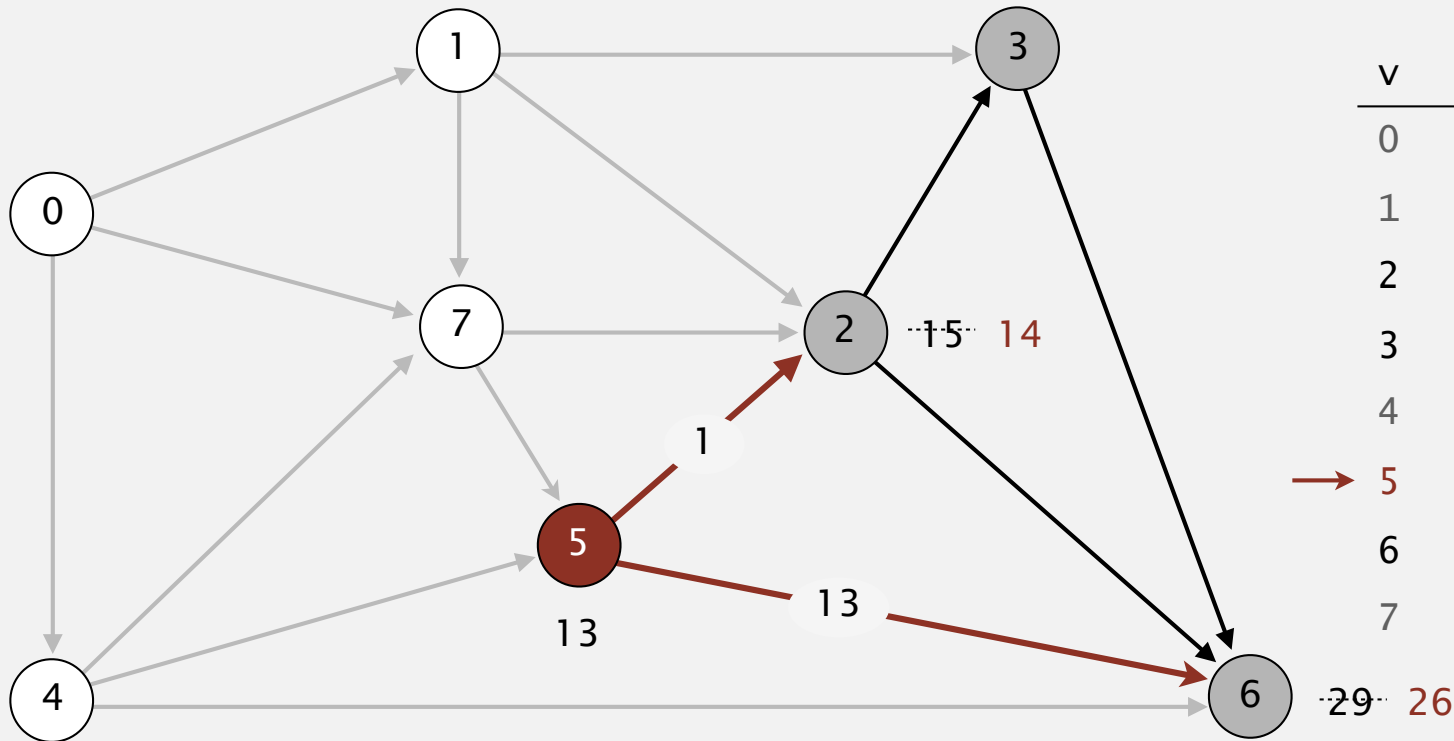


v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2	15.0	7→2
3	20.0	1→3
4	9.0	0→4
5	13.0	4→5
6	29.0	4→6
7	8.0	0→7

relax all edges pointing from 5

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



↓

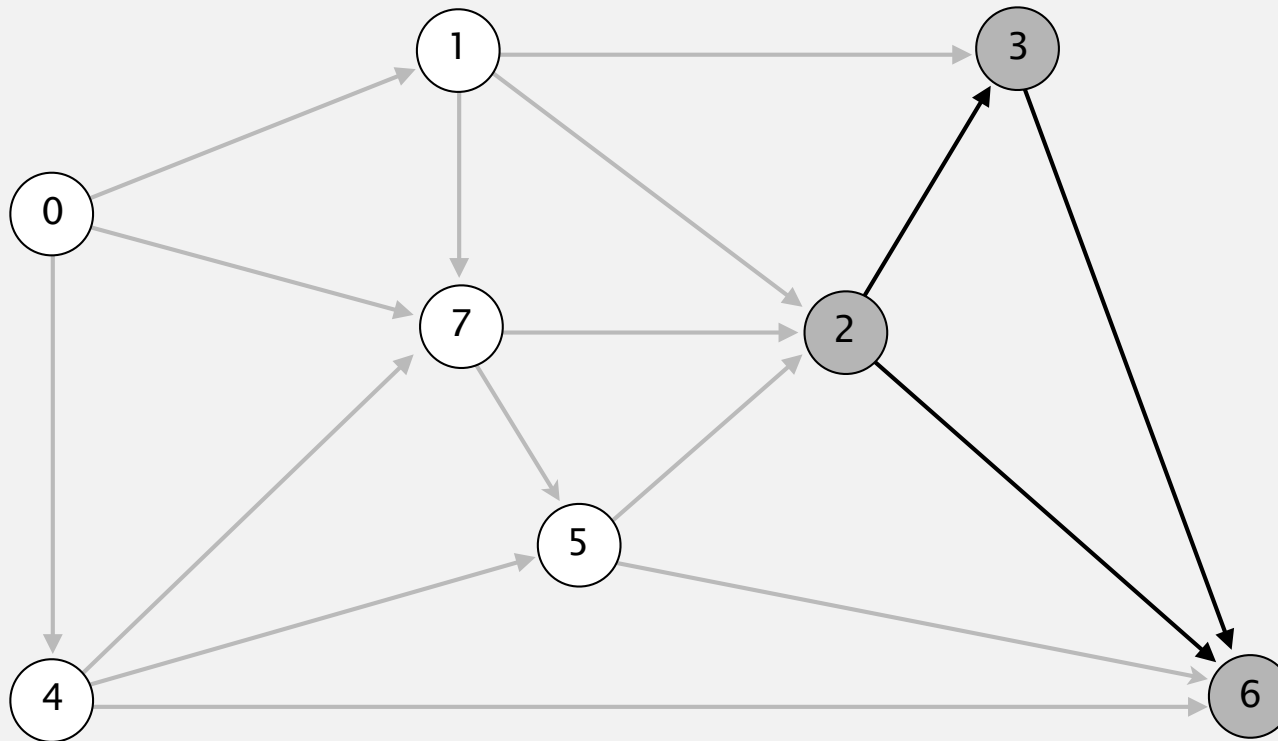
0 1 4 7 5 2 3 6

v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2	14.0	5→2
3	20.0	1→3
4	9.0	0→4
→ 5	13.0	4→5
6	26.0	5→6
7	8.0	0→7

relax all edges pointing from 5

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



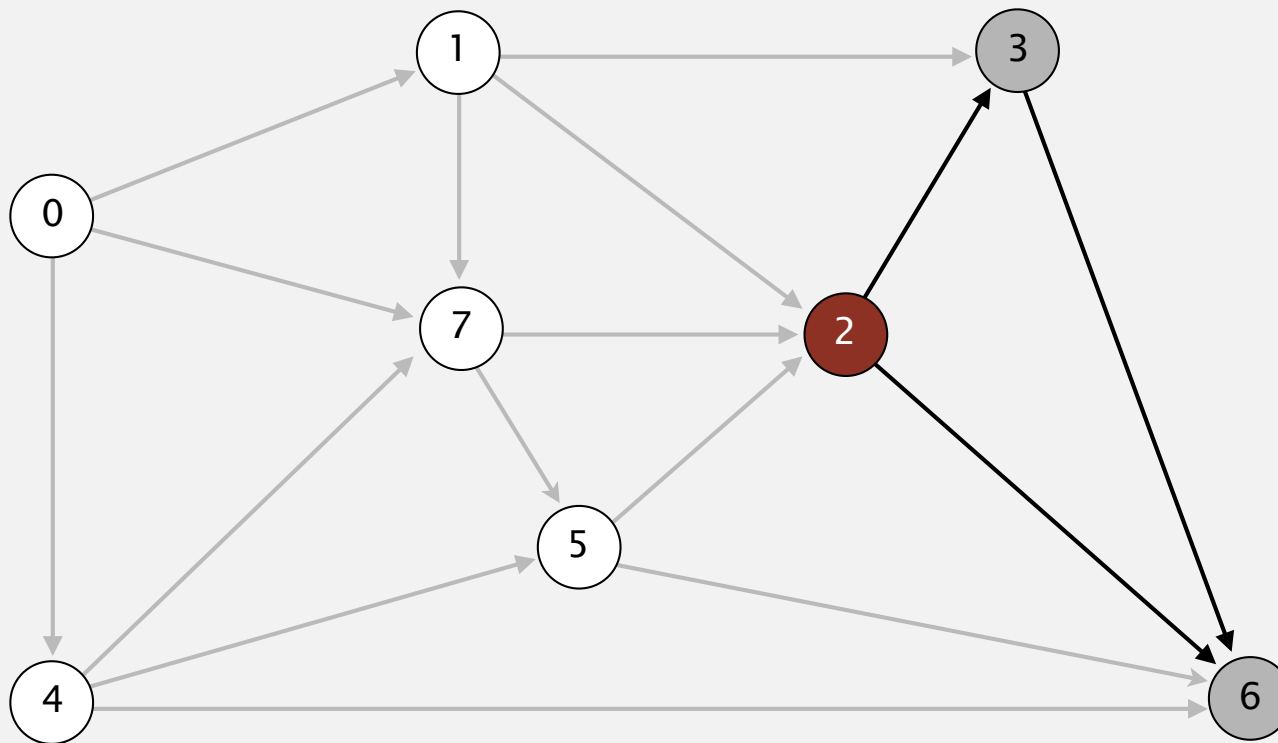
↓

0 1 4 7 5 **2** 3 6

v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2	14.0	5→2
3	20.0	1→3
4	9.0	0→4
5	13.0	4→5
6	26.0	5→6
7	8.0	0→7

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



select vertex 2

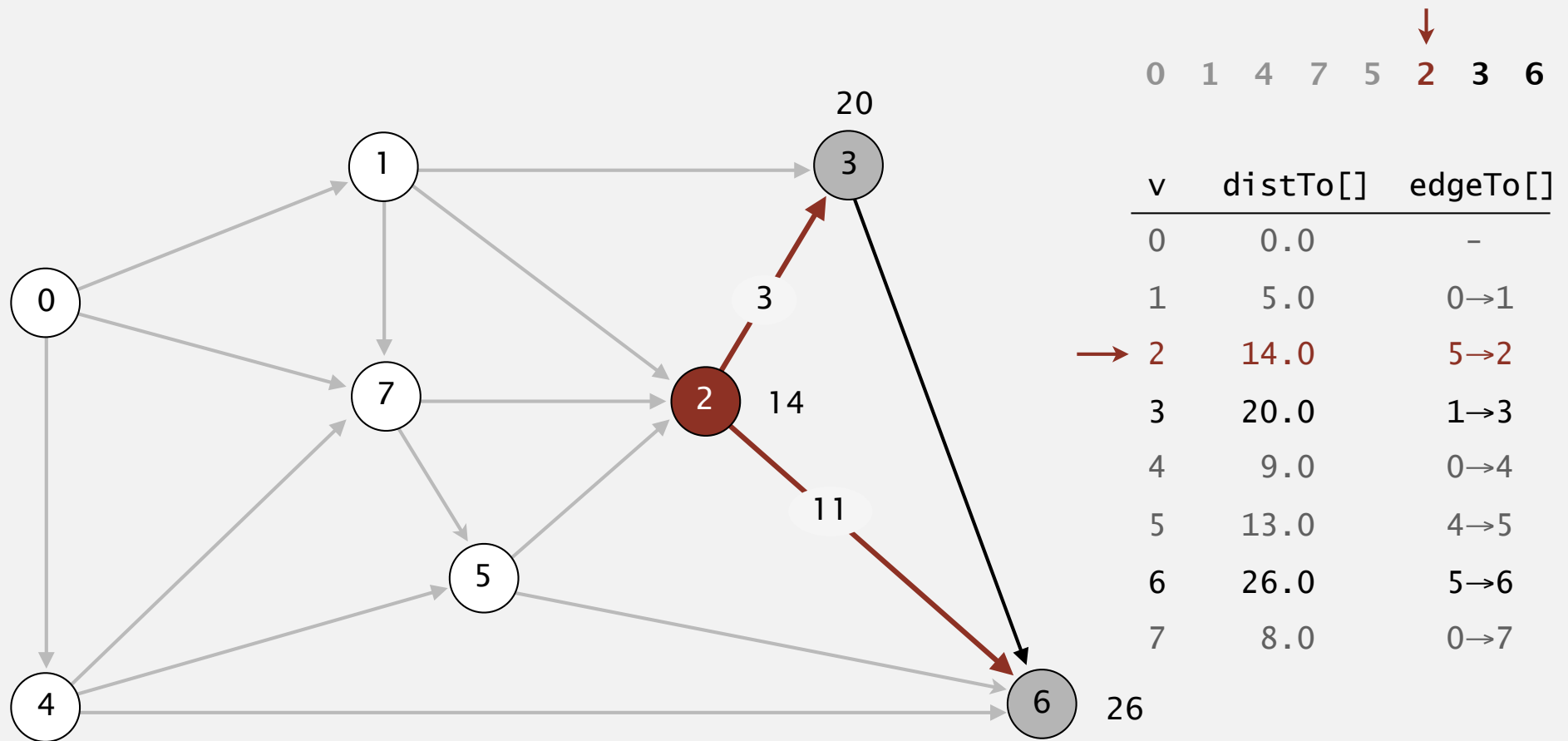
↓

0 1 4 7 5 **2** 3 6

v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2	14.0	5→2
3	20.0	1→3
4	9.0	0→4
5	13.0	4→5
6	26.0	5→6
7	8.0	0→7

Acyclic shortest paths demo

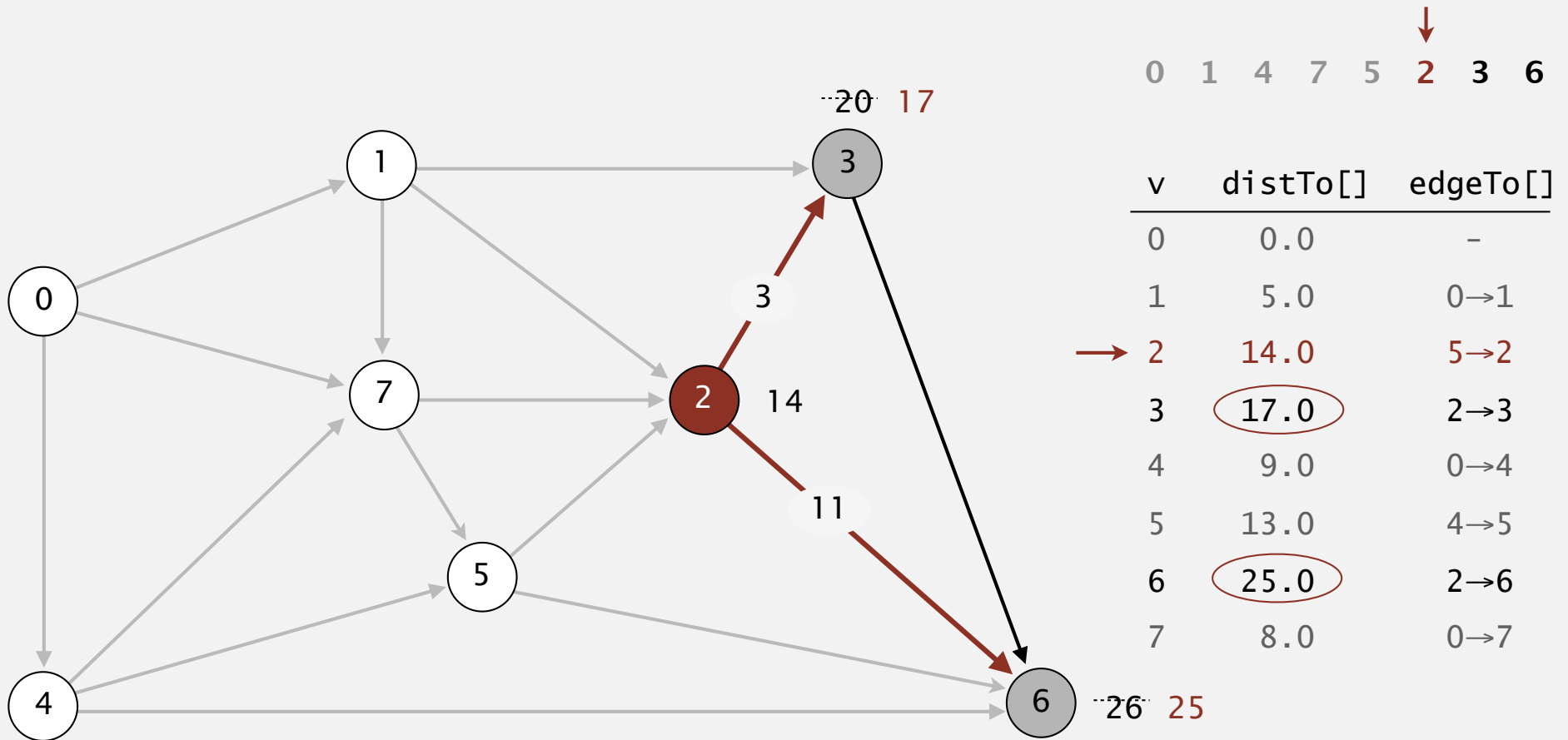
- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



relax all edges pointing from 2

Acyclic shortest paths demo

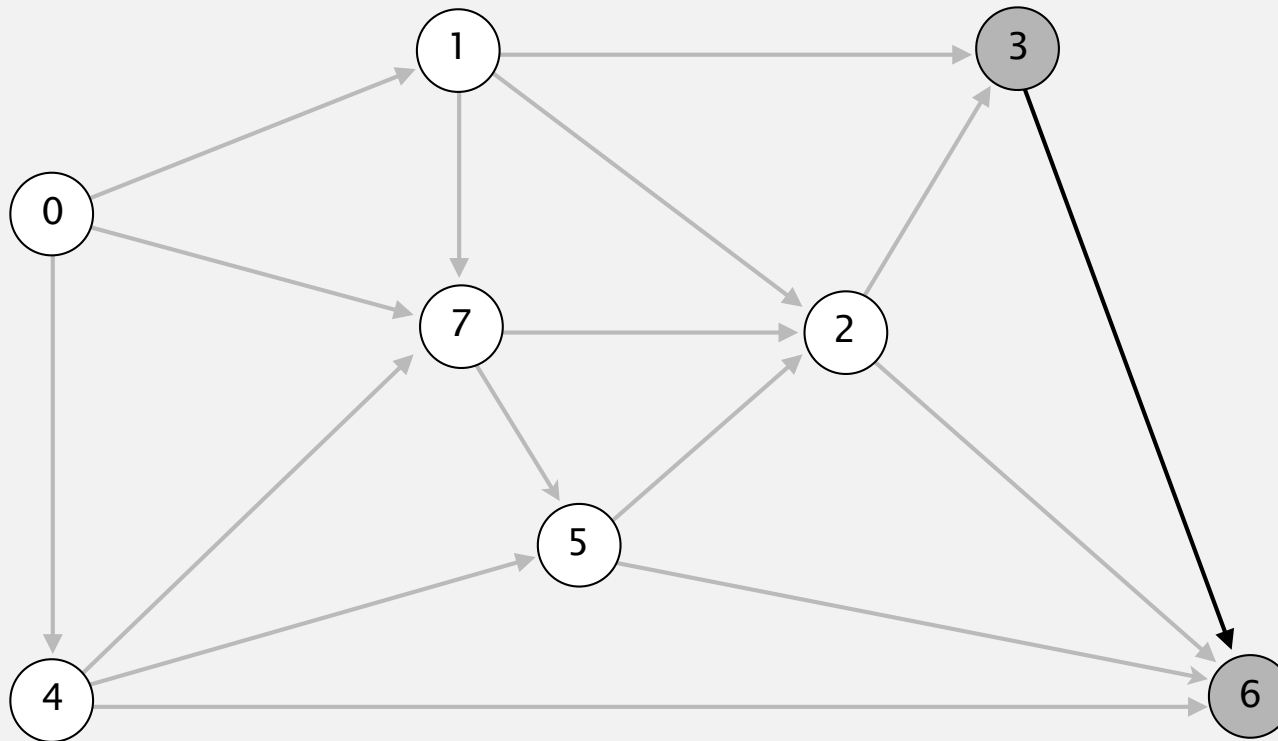
- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



relax all edges pointing from 2

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



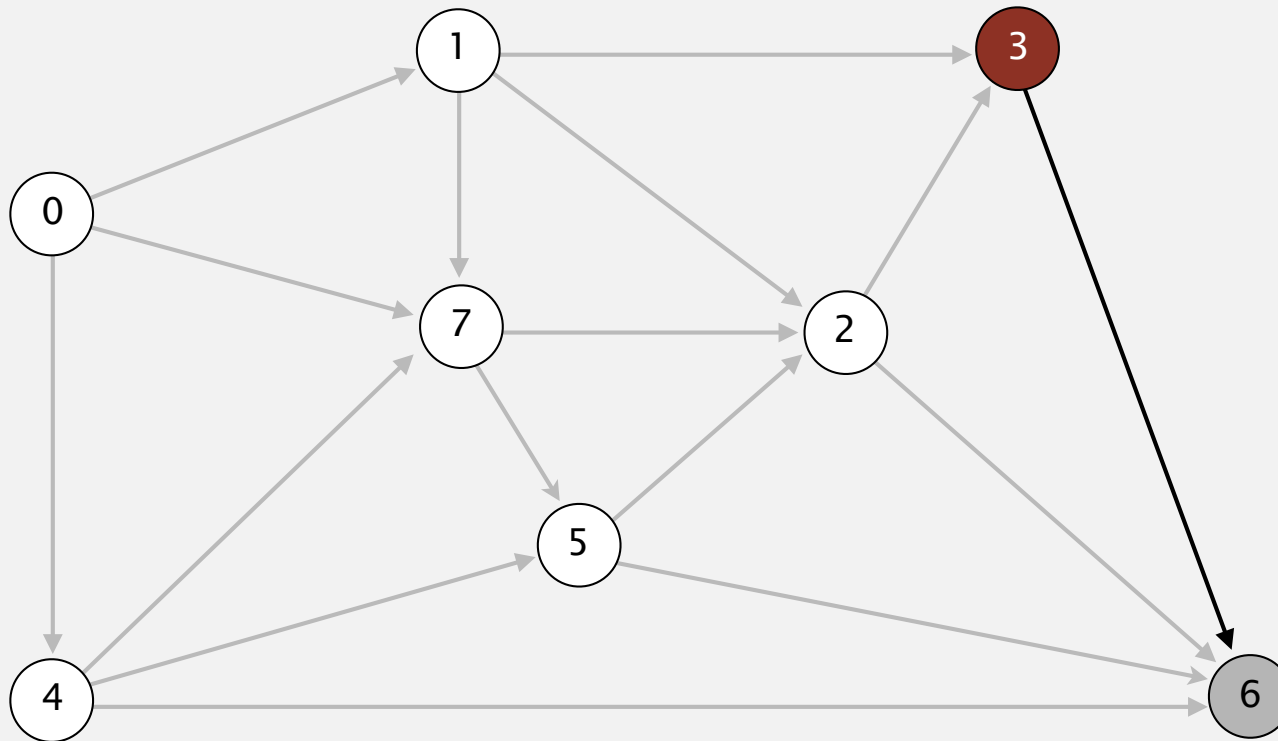
↓

0 1 4 7 5 2 3 6

v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2	14.0	5→2
3	17.0	2→3
4	9.0	0→4
5	13.0	4→5
6	25.0	2→6
7	8.0	0→7

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.

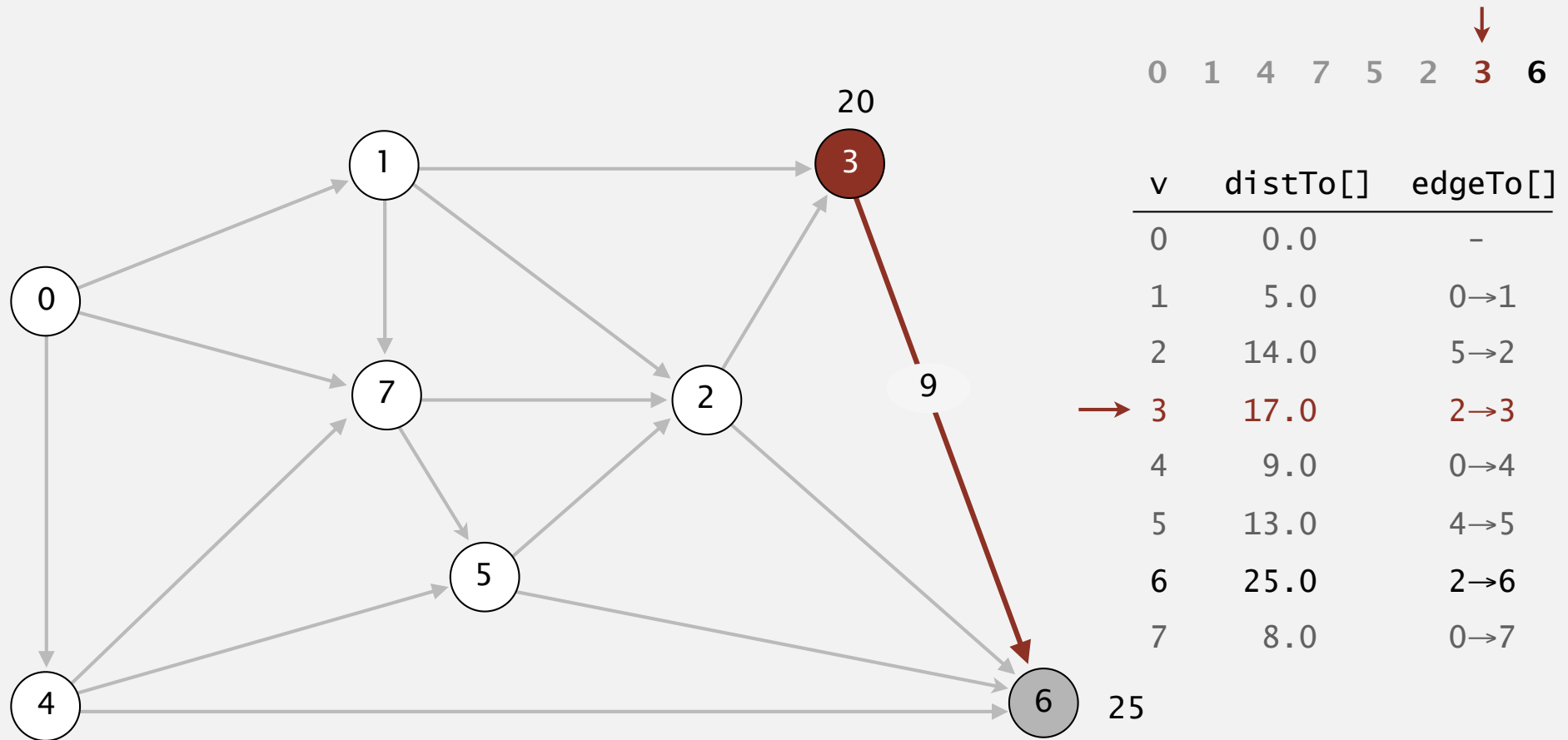


select vertex 3

	0	1	4	7	5	2	3	6
							↓	
v	distTo[]	edgeTo[]						
0	0.0	-						
1	5.0	0→1						
2	14.0	5→2						
3	17.0	2→3						
4	9.0	0→4						
5	13.0	4→5						
6	25.0	2→6						
7	8.0	0→7						

Acyclic shortest paths demo

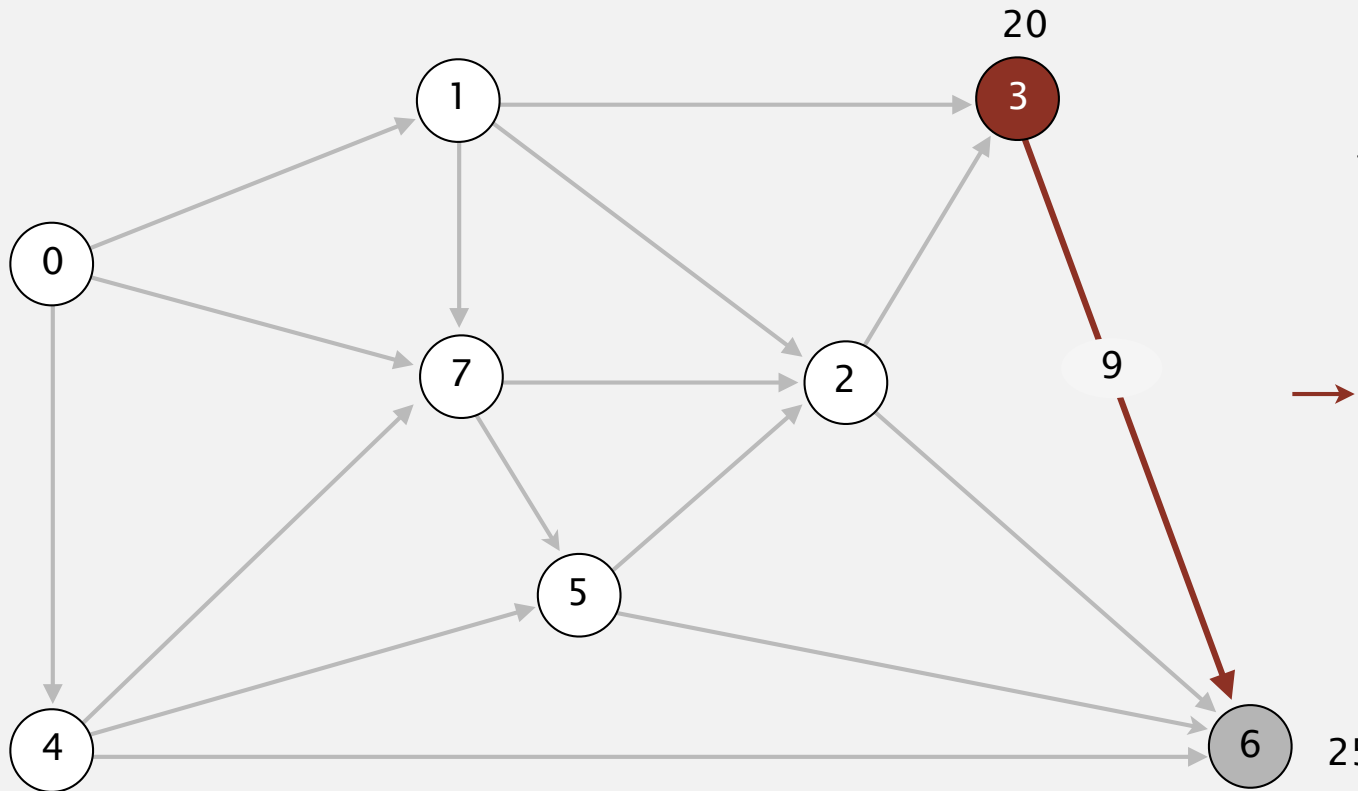
- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



relax all edges pointing from 3

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.

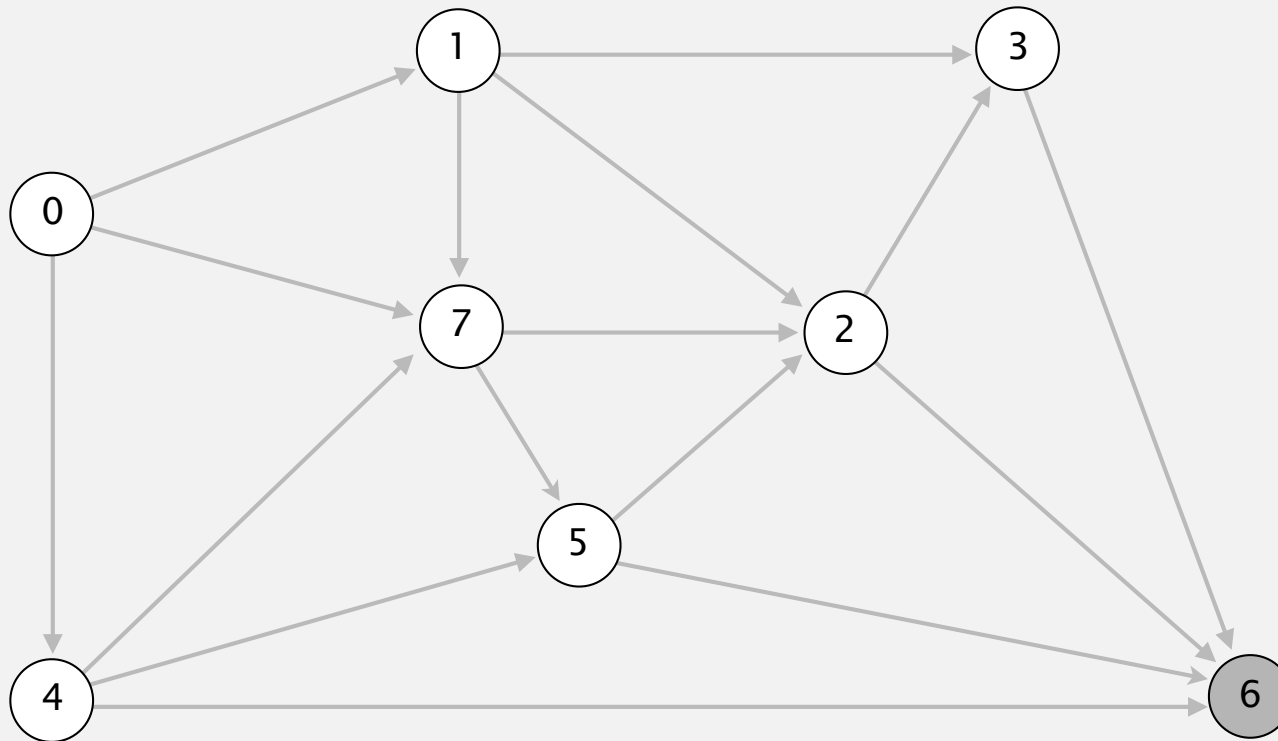


v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2	14.0	5→2
3	17.0	2→3
4	9.0	0→4
5	13.0	4→5
6	25.0 ✓	2→6
7	8.0	0→7

relax all edges pointing from 3

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



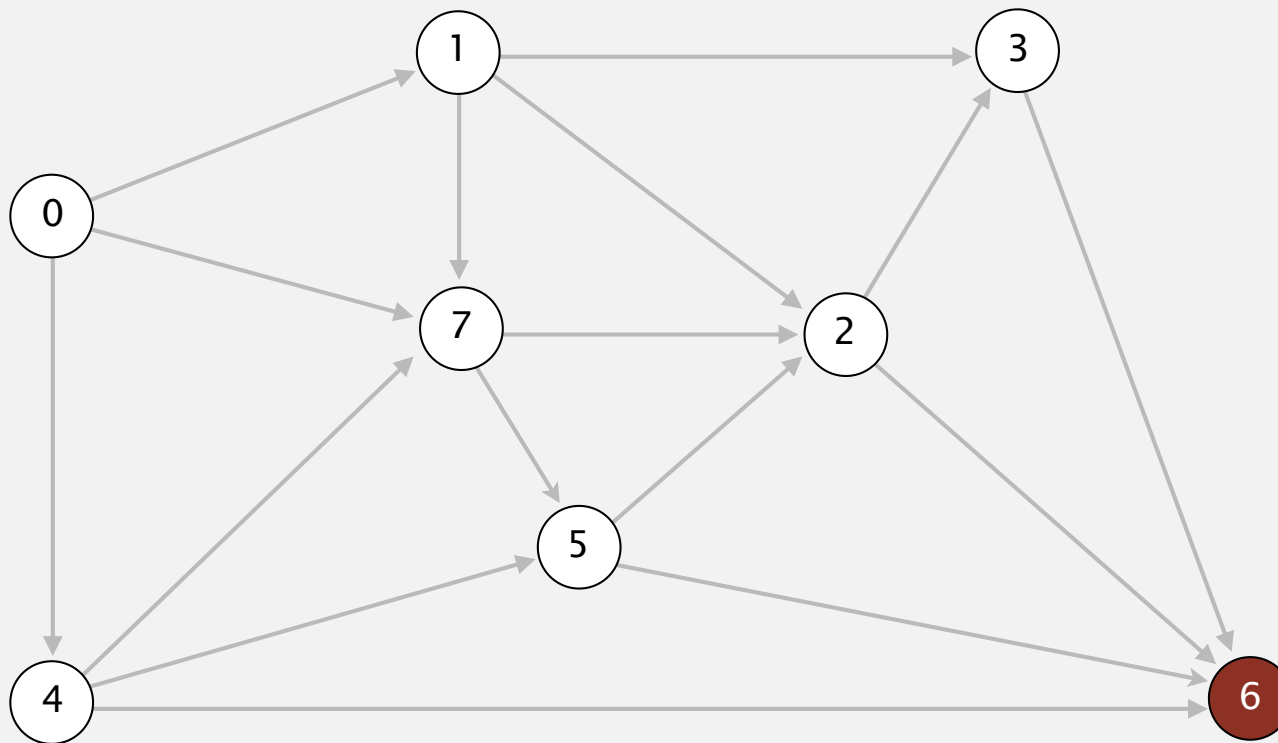
↓

0 1 4 7 5 2 3 **6**

v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2	14.0	5→2
3	17.0	2→3
4	9.0	0→4
5	13.0	4→5
6	25.0	2→6
7	8.0	0→7

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.

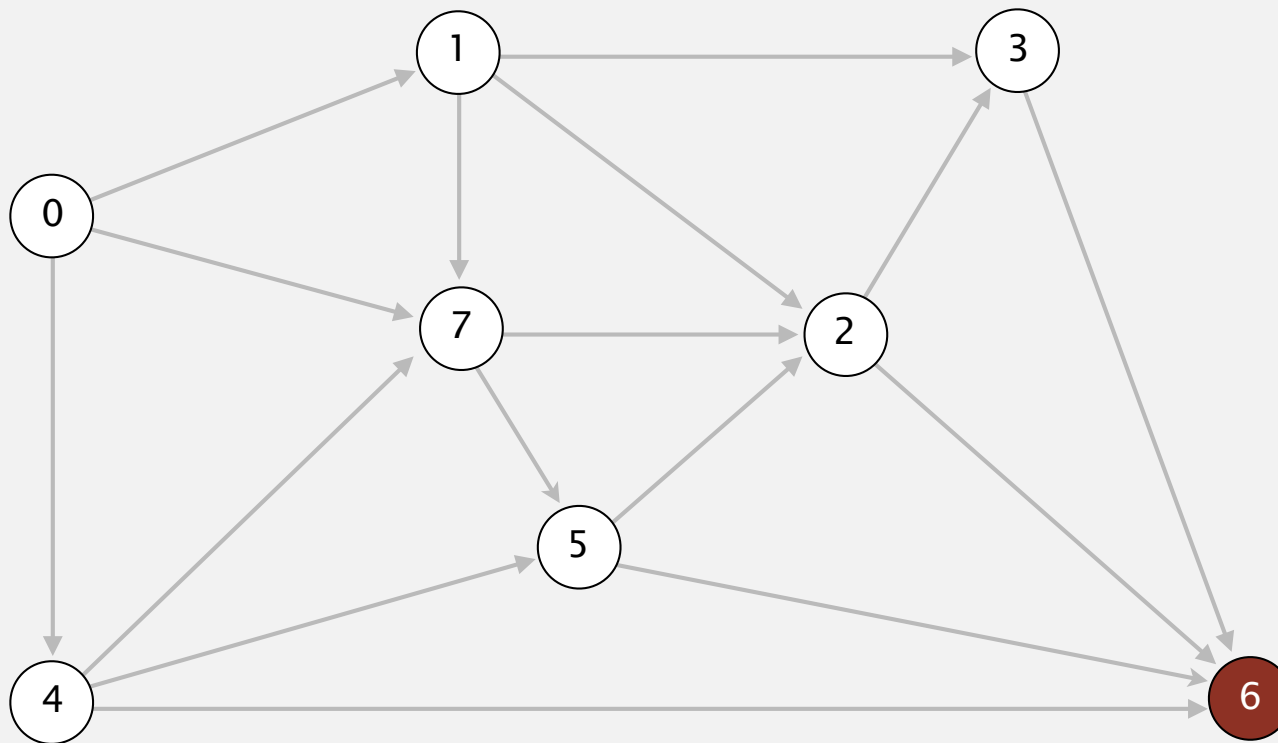


	0	1	4	7	5	2	3	6
								↓
v	distTo[]	edgeTo[]						
0	0.0	-						
1	5.0	0→1						
2	14.0	5→2						
3	17.0	2→3						
4	9.0	0→4						
5	13.0	4→5						
→ 6	25.0	2→6						
7	8.0	0→7						

select vertex 6

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



↓

0 1 4 7 5 2 3 **6**

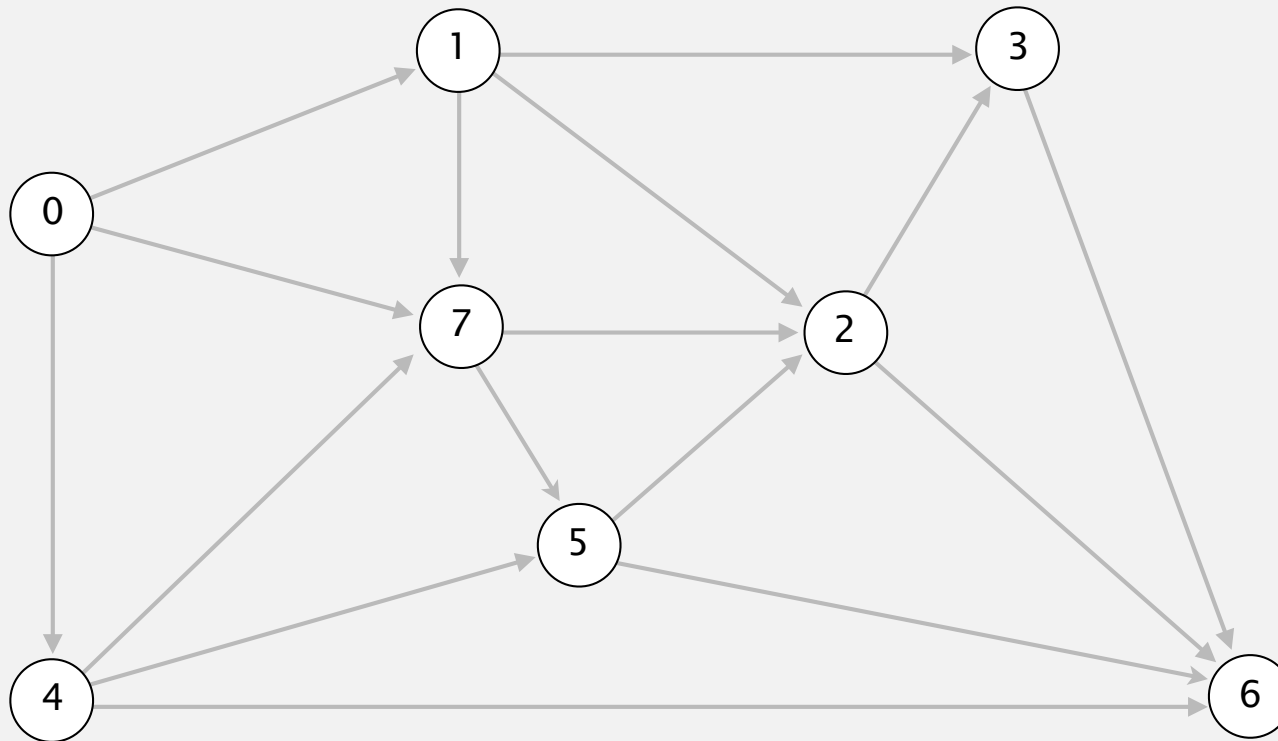
v	distTo[]	edgeTo[]
0	0.0	-
1	5.0	0→1
2	14.0	5→2
3	17.0	2→3
4	9.0	0→4
5	13.0	4→5
6	25.0	2→6
7	8.0	0→7

→

relax all edges pointing from 6

Acyclic shortest paths demo

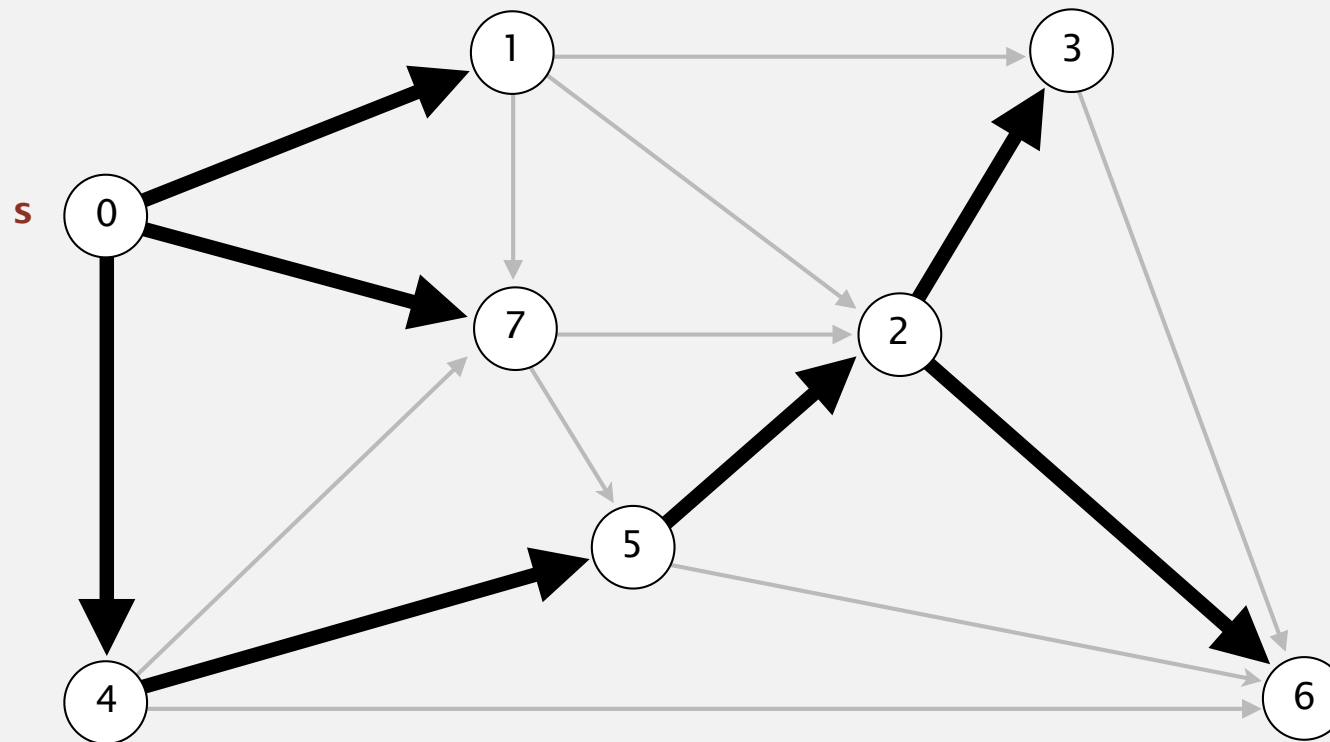
- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



	0	1	4	7	5	2	3	6
v	distTo[]		edgeTo[]					
0	0.0	-						
1	5.0	0→1						
2	14.0	5→2						
3	17.0	2→3						
4	9.0	0→4						
5	13.0	4→5						
6	25.0	2→6						
7	8.0	0→7						

Acyclic shortest paths demo

- Consider vertices in topological order.
- Relax all edges pointing from that vertex.



	0	1	4	7	5	2	3	6
v	distTo[]		edgeTo[]					
0	0.0	-						
1	5.0	0→1						
2	14.0	5→2						
3	17.0	2→3						
4	9.0	0→4						
5	13.0	4→5						
6	25.0	2→6						
7	8.0	0→7						

shortest-paths tree from vertex s