

# Dijkstra Algorithm

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SUSTech

# Dijkstra's algorithm 1

## *Dijkstra's algorithm*

- net topology, link costs known to all nodes
  - accomplished via “link state broadcast”
  - all nodes have same info
- computes least cost paths from one node (‘source’) to all other nodes
  - gives *forwarding table* for that node
- iterative: after k iterations, know least cost path to k dest.’s

## *notation:*

- $c(x,y)$ : link cost from node x to y;  $= \infty$  if not direct neighbors
- $D(v)$ : current value of cost of path from source to dest. v
- $p(v)$ : predecessor node along path from source to v
- $N'$ : set of nodes whose least cost path definitively known

# Dijkstra's algorithm 2

1 **Initialization:**

2  $N' = \{u\}$

3 for all nodes  $v$

4 if  $v$  adjacent to  $u$

5 then  $D(v) = c(u,v)$

6 else  $D(v) = \infty$

7

8 **Loop**

9 find  $w$  not in  $N'$  such that  $D(w)$  is a minimum

10 add  $w$  to  $N'$

11 update  $D(v)$  for all  $v$  adjacent to  $w$  and not in  $N'$  :

12  **$D(v) = \min( D(v), D(w) + c(w,v) )$**

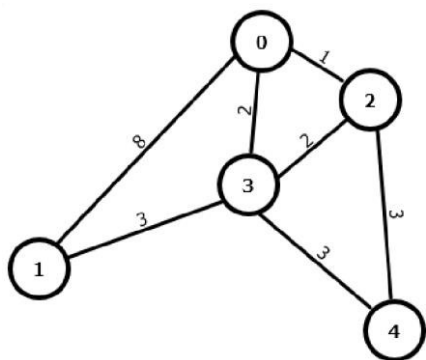
13 /\* new cost to  $v$  is either old cost to  $v$  or known

14 shortest path cost to  $w$  plus cost from  $w$  to  $v$  \*/

15 **until all nodes in  $N'$**



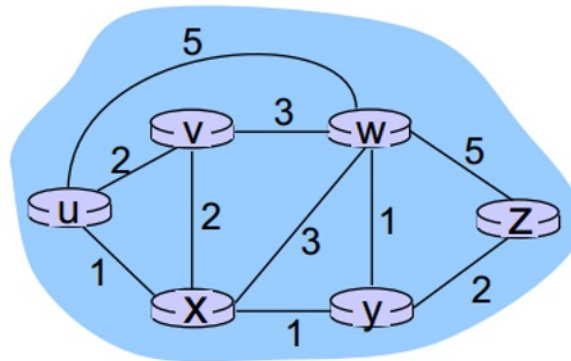
# Demo 1



步骤	dist[1]	dist[2]	dist[3]	dist[4]	已找到的集合
第 1 步	8	1	2	$+\infty$	{2}
第 2 步	8	×	2	4	{2, 3}
第 3 步	5	×	×	4	{2, 3, 4}
第 4 步	5	×	×	×	{2, 3, 4, 1}
第 5 步	×	×	×	×	{2, 3, 4, 1}

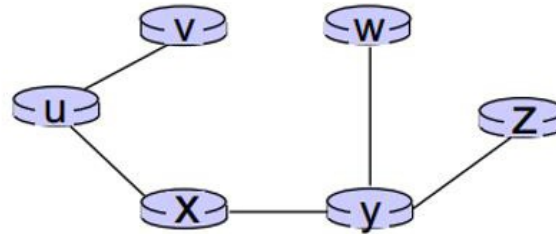
# Demo 2

Step	N'	D(v),p(v)	D(w),p(w)	D(x),p(x)	D(y),p(y)	D(z),p(z)
0	u	2,u	5,u	1,u	$\infty$	$\infty$
1	ux	2,u	4,x		2,x	$\infty$
2	uxy	2,u	3,y			4,y
3	uxyv		3,y			4,y
4	uxyvw					4,y
5	uxyvwz					



# Forwarding table

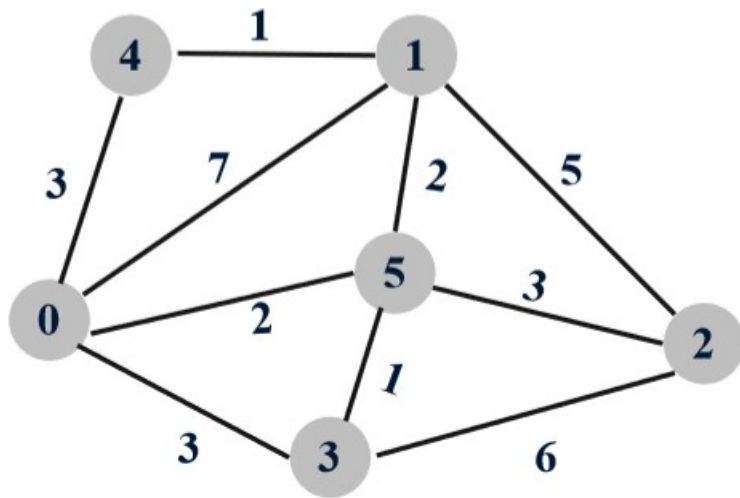
resulting shortest-path tree from u:



resulting forwarding table in u:

destination	link
v	(u,v)
x	(u,x)
y	(u,x)
w	(u,x)
z	(u,x)

# assignment



- Implement the Dijkstra algorithm, return the shortest distance and path from the source to each node, and print out the forwarding table of the route starting from the source.
- The program must return the above three results and print out the output with different inputs.
  - Tip: fill in the missing part of the code template to implement the Dijkstra algorithm
- Submit the code report and source code. The report should include algorithm introduction, screenshots and analysis of results, and summary.