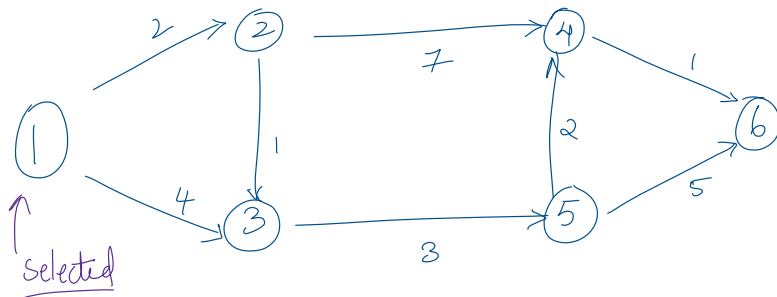


## 5. Dynamic and Greedy SSSP

Monday, March 1, 2021 12:08 PM

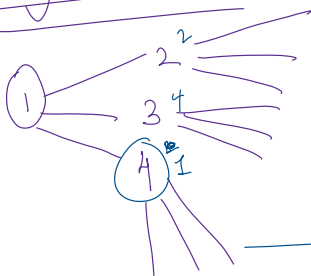
Dynamic	Greedy
<ul style="list-style-type: none"> <li>- Bellman-Ford</li> <li>- <math>O(V^3)</math></li> <li>- all possible solutions</li> <li>- directed weight</li> <li>- <del>no</del> negative weight</li> <li>- no cycles [detects cycles]</li> </ul>	<ul style="list-style-type: none"> <li>Dijkstra</li> <li><math>&lt; O(V^3)</math></li> <li>- optimal solution</li> <li>- directed + undirected</li> <li>- no -ve</li> <li>- no cycles</li> </ul>
	Worst: Best:



S.No	1	2	3	4	5	6	
1	0	2	4	∞	∞	∞	→ minimal value of weight → node 2
2	0	2	3	∞	7	∞	
3	0	2	3	∞	6	10	
4	0	2	3	8	6	10	
5	0	2	3	8	6	9	

dynamic, all possible solutions  
 $\Rightarrow$  takes more time  
 $\Rightarrow O(V^3)$

### Dijkstra's



\* priority heap  
 - picking minimal element  
 $- O(\log n)$

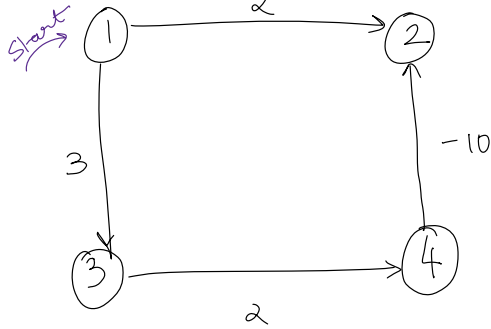
$$\begin{aligned}
 & \rightarrow O([V+E] \log V) \\
 & = O(V \log V + E \log V) \\
 & = O(E \log V) \quad [E \leq V^2]
 \end{aligned}$$

S.No	1	2
1	-	↖

$$= O(V \log V + E \log V)$$

$$= O(E \log V) \quad [E > V]$$

Dijkstra's

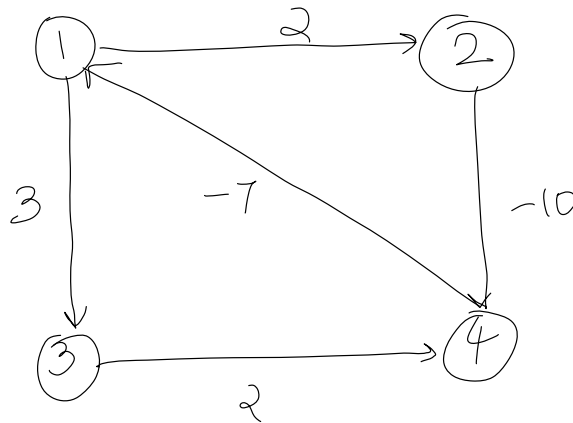


S.No	1	2	3	4
1	0	2	3	$\infty$
		reached		
2	0	2	3	5
		reached		
3	0	-5	3	5
		will not be taken into account		reached

if a node has minimal weight with 2 edges it cannot have minimal weight with 3 edges.

This can be avoided with Bellman-Ford.

How does Bellman-Ford identify negative cycles?

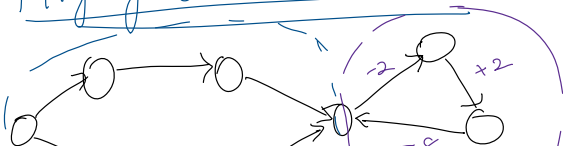


edges	1	2	3	4
k=1	0	2	3	$\infty$
k=2	0	2	3	-8
k=3	-15	2	3	-8
	0			

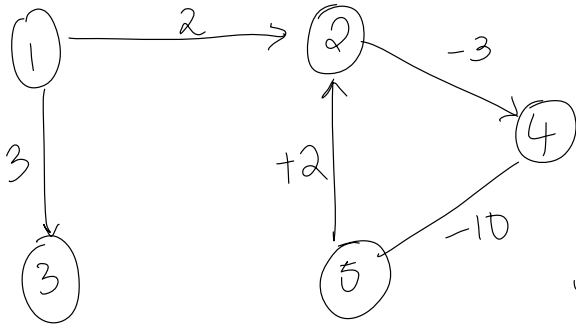
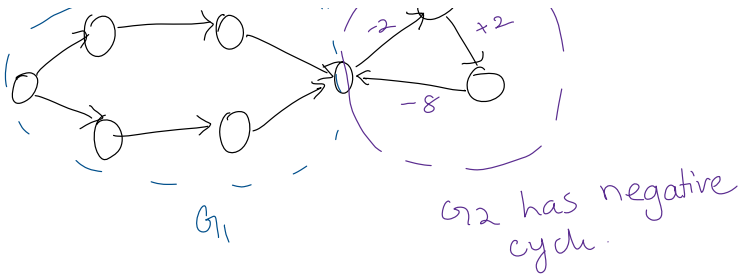
↑ n-1 edges only    ↑ to prevent cycle

if  $(d(v) < d(u) + \text{cost}(u, v))$   
nearest edge :  $d(u)$   
else:  
 $d(u) + \text{cost}(u, v)$

Highly Sensitive nodes



QUEUES



Bellman-Ford

	1	2	3	4	5
1	0	2	3	$\infty$	$\infty$
2	0	2	3	-1	$\infty$
3	0	2	3	-1	-11
4	0	-9	3	-1	-11