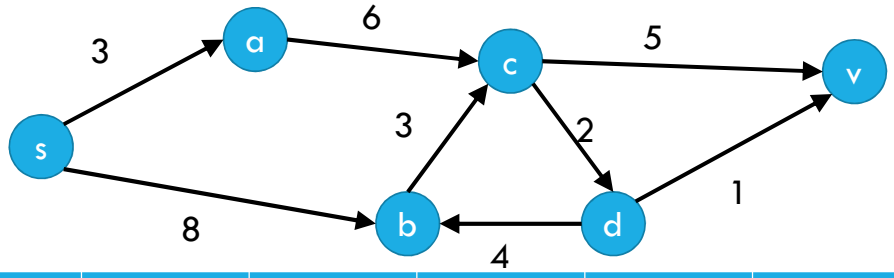
Sample calculation



Vertex\i	0	1	2	3	4	5
S	0	0	0	0	0	0
A	∞	3	3	3	3	3
B	∞	8	8	8	8	8
C	∞	∞	9	9	9	9
D	∞	∞	∞	11	11	11
V	∞	∞	∞	14	12	12

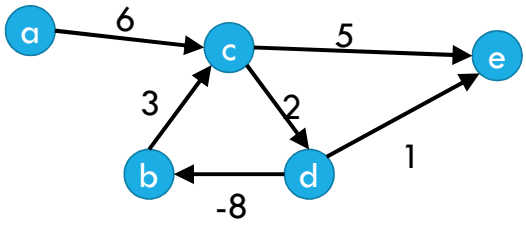
Pseudocode

```
Initialize source.dist[0]=0, u.dist[0]=∞ for others
for(i from 1 to ??)
   for(every vertex v) //what order?
      v.dist[i] = v.dist[i-1]
       for(each incoming edge (u,v))//hmmm
          if(u.dist[i-1]+weight(u,v)<v.dist[i])
             v.dist[i]=u.dist[i-1]+weight(u,v)
          endIf
       endFor
   endFor
endFor
```

$$dist(v,i) = \begin{cases} 0 & \text{if } i = 0 \text{ and } v \text{ is the source} \\ \infty & \text{if } i = 0 \text{ and } v \text{ is not the source} \\ \min\left\{ \min_{u:(u,v)\in E} \{dist(u,i-1) + w(u,v)\}, dist(v,i-1) \right\} \end{cases}$$

Negative Edges

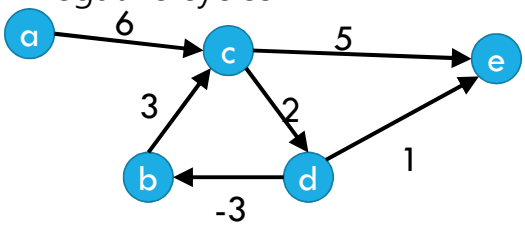
Negative Cycles



The fastest way from a to e (i.e. least-weight walk) isn't defined!

No valid answer ($-\infty$)

Negative edges, but only non-negative cycles



Dijkstra's might fail

But the shortest path IS defined.

There is an answer

What have we seen so far?

Stable Matchings

Graph Search
- BFS/DFS
- Graph modeling

Greedy Algorithms

Divide and Conquer

Dynamic Programming