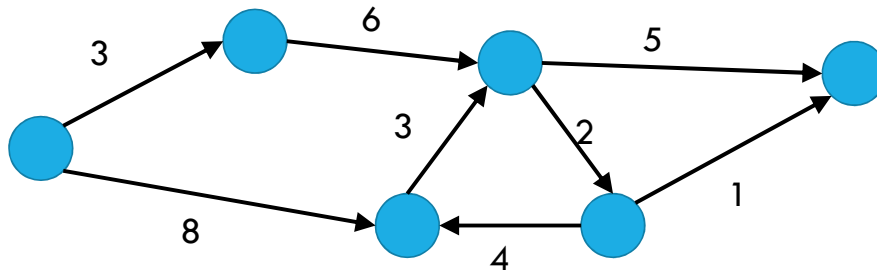


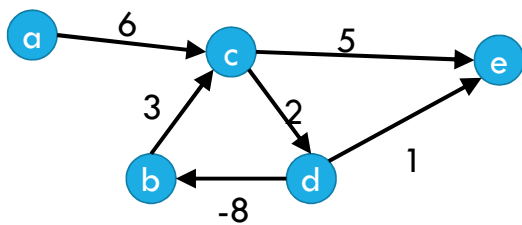
What about cycles?

$$\text{dist}(v) = \begin{cases} 0 & \text{if } v \text{ is the source} \\ \min_{u:(u,v) \in E} \{\text{dist}(u) + \text{weight}(u,v)\} & \text{otherwise} \end{cases}$$



Negative Edges

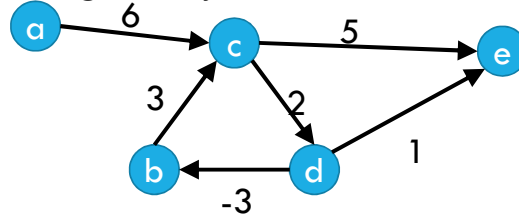
Negative Cycles



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



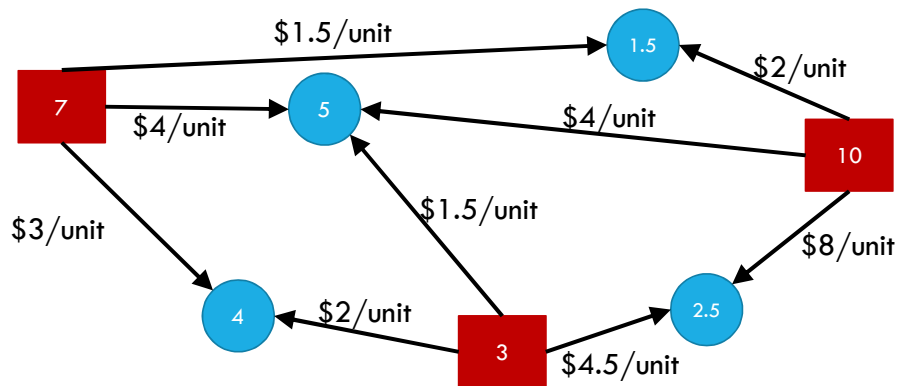
Dijkstra's might fail

But the shortest path IS defined.

There is an answer

Example Problem

You're laying down soil for a bunch of new gardens. You got a few big piles of soil delivered (more than enough to cover the gardens)



Linear constraints

[Pollev.com/robbie](https://pollev.com/robbie)

Can you write each of these requirements as linear constraint(s)?
Some of these are tricks...

x_i times x_j is at least 5

$5x_i$ is equal to 1

$x_i \leq 5$ OR $x_i \geq 7$

x_i is non-negative.

x_i is an integer.