Shortest path has optimal substructure.

$$\delta(a, b) = \min(\delta(a, c) + w(c, b), \delta(a, d) + w(d, b))$$

Given a weighted, directed graph G = (V, E) and a source vertex s in V, find the min cost path from so to every vertex in V.

- Bellman-Ford
  - DP
  - General case, edge weights may be negative
- Djiikstra
  - Greedy
  - Edge weights must be non-negative

Relaxation: Given a vertex v, a vertex u, and an edge (u, v), we can relax v by

```
Relax(u, v)
    if v.d > u.d + w(u, v)
        v.d = u.d + w(u, v)
        v.pi = u
```

Proof by induction on relaxing the ith edge (v_{i-1}, v_i) on p

Let $w_I = \sum_1^i w(v_{i=1}, v_i)$. W_i is the shortest path weights $\delta(s, v_i)$ because of optimal substructure