Graph Algorithms
Bellman-Ford

COP 3503
Fall 2021
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University of Central Florida
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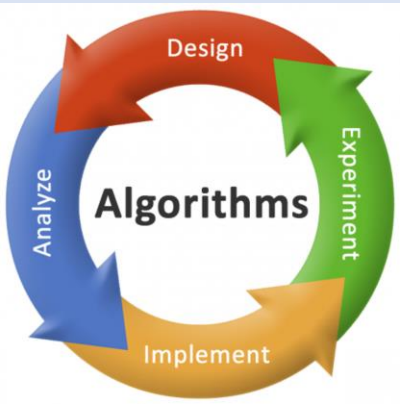
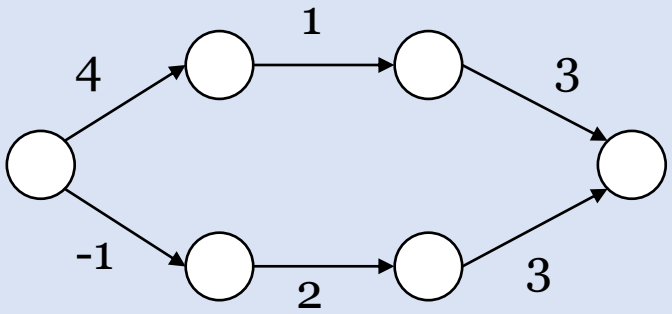


Single-Source Shortest Path

- The Problem Definition
  - Input: a directed weighted G(V,E) and a source vertex s
  - Output: The shortest path from s to destination vertex v
- Weight of a path

$$p = < v_0, v_1, v_2, \ldots v_k >$$

$$w(p) = \sum_{i=1}^{k} w(v_{i-1}, v_i)$$



- A shortest path has at most |V| vertices and at most |V| - 1 edges
- Some algorithms allow negative weight edges and others do not.

```
INITIALIZE-SINGLE-SOURCE(G, s)
1  for each vertex v ∈ G.V
2      v.d = ∞
3      v.π = NIL
4  s.d = 0
```

```
RELAX(u, v, w)
1  if v.d > u.d + w(u, v)
2      v.d = u.d + w(u, v)
3      v.π = u
```

```
BELLMAN-FORD(G, w, s)
1  INITIALIZE-SINGLE-SOURCE(G, s)
2  for i = 1 to |G.V| − 1
3      for each edge (u, v) ∈ G.E
4          RELAX(u, v, w)
5  for each edge (u, v) ∈ G.E
6      if v.d > u.d + w(u, v)
7          return FALSE
8  return TRUE
```