Lecture 5: Greedy Algorithms II

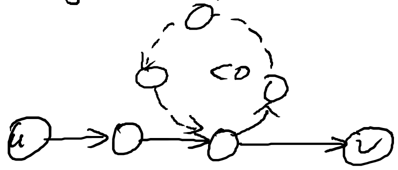
Outline:

- Bellman-Ford Algorithm (connection with Dijkstra, Prim)
- Summary

Recall : Negative weight cycles

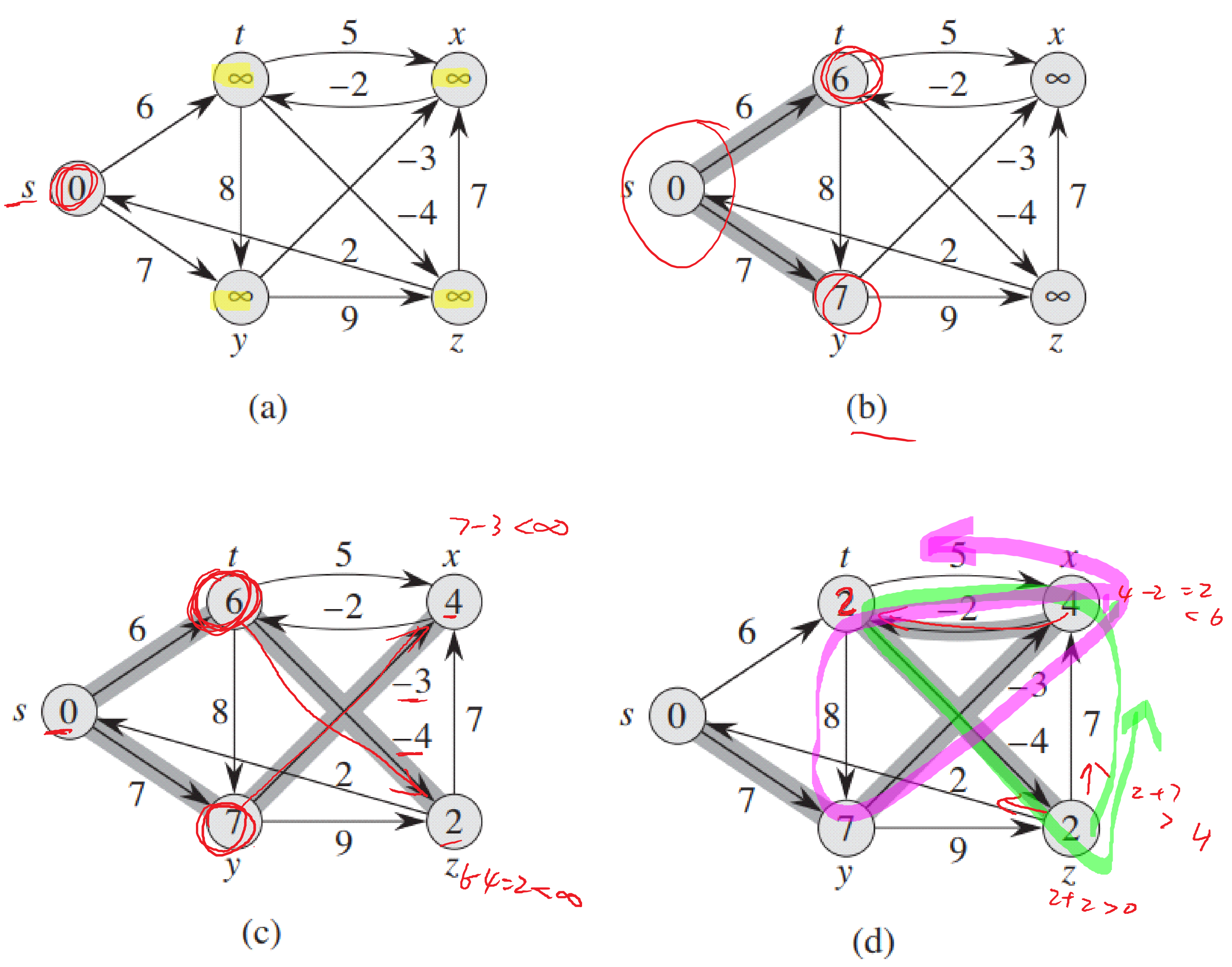
If a graph $G=(V, E)$ contains a negative-weight cycle, some shortest paths may not exist.

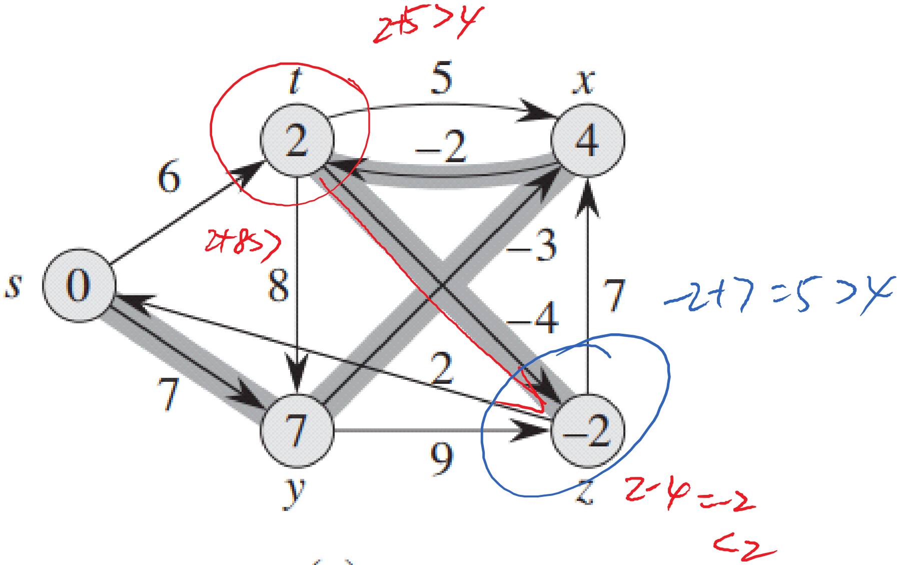
Example



Bellman-Ford algorithm : Find all shortest-path lengths from a source $s \in V$ to all $v \in V$ or determines that a negative-weight cycle exists.

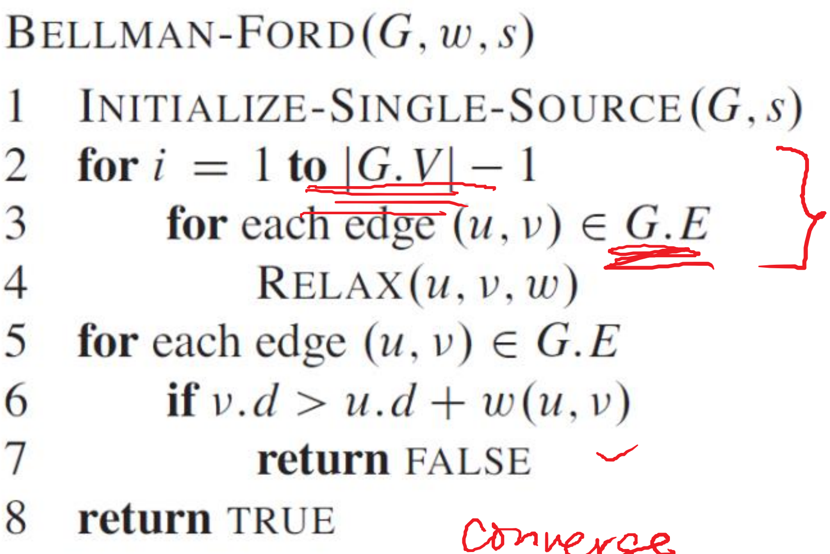
Bellman-Ford Algorithm Flowchart





(e)

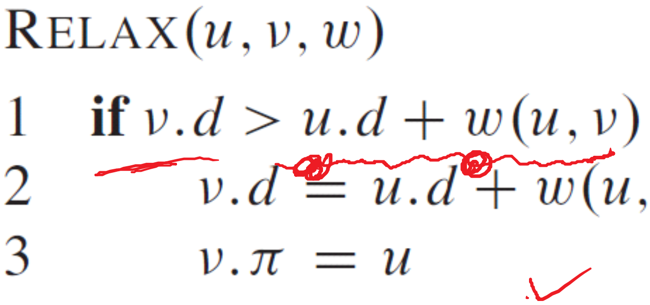
Pseudocode



```
BELLMAN-FORD($G, w, s$)
    INITIALIZE-SINGLE-SOURCE($G, s$)
    for $i = 1$ to $|G.V| - 1$
        for each edge $(u, v) \in G.E$
            RELAX($u, v, w$)
    for each edge $(u, v) \in G.E$
        if $v.d > u.d + w(u, v)$
            return FALSE
    return TRUE
```

$O(|V| \cdot |E|)$

converge



```
RELAX($u, v, w$)
    if $v.d > u.d + w(u, v)$
        $v.d = u.d + w(u, v)$
        $v.\pi = u$
```

Summary

Greedy algorithm

- Recall negative weights / cycles
- Bellman-Ford algorithm
- Pseudocode.