Prof. Dr. Knut Reinert,
Dr. Yaron Goldstein,
Sandro Andreotti

October 15, 2013

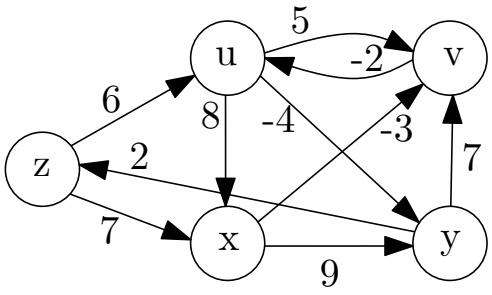
Algorithms

WS 2013/14

Exercises 1

1. **Bellman-Ford (Niveau I)**

   Use the Bellman-Ford algorithm (see lecture script) to determine the shortest path from source z to any other node in the graph.



2. **Bellman-Ford (Niveau II)**

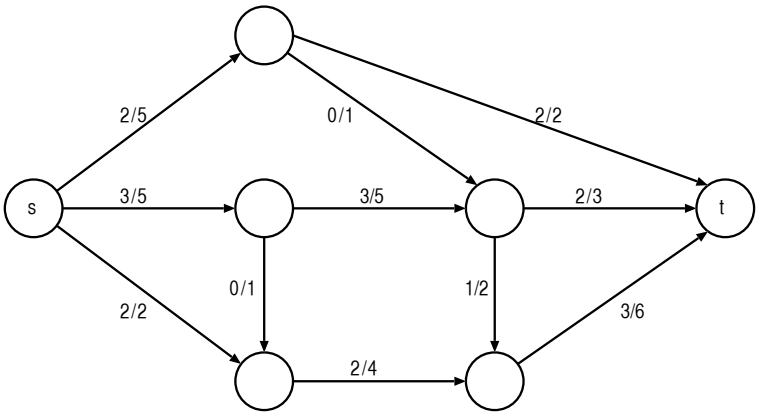
   Let $D = (V, A), n = |V|$ be a directed graph. Prove that D contains a circuit of negative length reachable from s if and only if $f_n(v) \neq f_{n-1}(v)$, for some $v \in V$, where $f_k(v) = \min\{l(P)|P \text{ is an } s - v \text{ walk traversing at most } k \text{ arcs}\}$

3. **Shortest paths in DAGs (Niveau I)**

   To detect the shortest path in a directed acyclic graph (DAG) allowing also for negative edge weights you could obviously apply the Bellman-Ford algorithm. Present a simpler and more efficient algorithm that exploits the acyclic property.

4. **Ford-Fulkerson (Niveau I)**

   (a) Use the Ford-Fulkerson algorithm to find a maximum flow in the network



   Start with the initial flow f. An edge label f/c means initial flow f and capacity c.

   (b) Find a minimum cut proving the maximality of the flow.