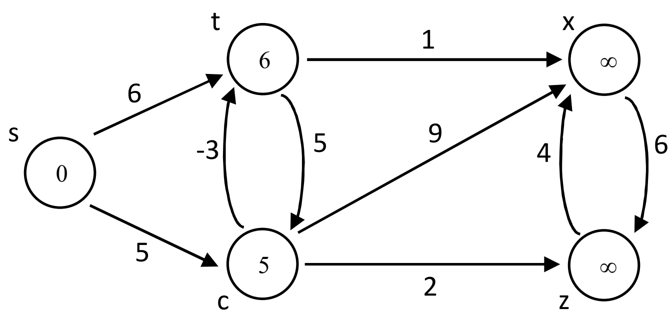
By considering the proof for Theorem 24.6, we can see that the proof builds on top of the loop invariant which is that: At the start of each iteration of the while loop of lines 4-8, d[v] = $\delta(s, v)$ for each vertex $v \in S$. But when the graph has negative edge-weights, this invariant does not hold anymore. For the proof, where it really falls apart is that it says $\delta(s, y) \leq \delta(s, u)$. If the graph contain only positive edge-weights, then this is absolutely true, but since we allow the graph to contain negative edge-weights, it's possible that $\delta(s, y) \geq \delta(s, u)$ if the path connecting y and u has negative edge-weights, and this would cause the followed proofs to be wrong. An example would be:



For this graph, after the first while loop, t and c would have their value being 6 and 5. And in this case, let t be the y in the proof, and let c be the u in the proof. If the graph contain only positive edge-weights, then $\delta(s, y) \leq \delta(s, u) \rightarrow \delta(s, t) \leq \delta(s, c)$ is right, and the proof would be fine. But sin there exists negative edge-weights, $\delta(s, c) = 3$, and $\delta(s, y) \geq \delta(s, u) \rightarrow \delta(s, t) \leq \delta(s, c)$, and this is where the proof falls apart and the invariant doesn't hold.