# Tutorial-12

● Graded

**Student**

Abhinav Shripad

**Total Points**

2.75 / 3 pts

**Question 1**

## (no title)

2.75 / 3 pts

**+ 0.6 pts** Written "I do not know how to approach this problem"

✔ **+ 0.25 pts** Claiming that one can reduce the node capacity instance to an edge capacity instance.

✔ **+ 1.5 pts** Forming the correct edge capacity instance from a given node capacity instance.

✔ **+ 1 pt** Brief justification of the correctness of the reduction.

✔ **+ 0.25 pts** Brief justification of the running time being polynomial.

**– 0.25 pts** Not taken into account the node capacity of the sink.

✔ **– 0.25 pts** Not specified the source and sink nodes of the "blown up" graph.

**– 0.25 pts** Not specified that the size of the "blown up" graph is a constant times the size of the original graph.

**– 0.25 pts** Using Ford-Fulkerson (possibly pseudopolynomial time) instead of Edmonds-Karp (guaranteed to be polynomial time).

You should mention the use of the Edmonds-Karp algorithm.

**COL351: Analysis and Design of Algorithms**
**Tutorial 12**

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|---|---|
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| Entry number: 2022CS11596 | Group: 3 |

Consider a directed graph $G = (V, E)$ have node capacities.

Consider another graph $H = (V_1 \cup V_2, E_1)$ such that

$\forall\, v \in V$, $v_{in} \in V_1$ and $v_{out} \in V_2$

and capacity in $H$ of $c_{v_{in} v_{out}} = u_v$

$\forall\, (u, v) \in E$, $u_{out} \rightarrow v_{in} \in E_1$ with capacity $\infty$.

$H$ is a standard max ~~cut~~ flow problem in of polynomial size of $G$.

Observe that every valid flow in $H$ corresponds to a valid flow in $G$ of exact same value.

Solve max-flow in $G$. ~~It corresponds~~

$f_{v_{in} v_{out}}$ in $H$ corresponds $\delta^-(v)$ in $G$.

$\Rightarrow$ This ensures maxflow found in $H$ is correctly the max flow in $G$.

$$T.C. = O(\underbrace{(2n)}_{\text{vertices}}\underbrace{(m+n)^2}_{\text{edges}} + \underbrace{(m+n)}_{\text{time to convert}}) = \text{polytime algorithm.}$$