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Assignment 3

let s be the source vertex & t be the sink vertex. let ~~graph~~ graph $G = (V, E)$ be given

~~Ob~~ Primal

Objective : maximize $\sum_{v:(s,v)\in E} x_{sv}$

Decision variable : $x_{uv}\ \forall (u,v) \in E$ & $u, v \in V$

Constraints : 1) $x_{uv} \leq w_{uv}$ where w_{uv} is the weight of edge (u,v)

2) $\sum_{u} x_{uv} = \sum_{w} x_{vw}$

inflow = outflow

3) $x_{uv} \geq 0\ \forall (u,v) \in E$

For standard form, inequalities are replaced by equalities by introducing slack variables.

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Dual

~~Ia~~ Decision Variable : x_{uv} $\forall (u,v) \in E$
z_v $\forall v \in V$

Objective : minimize $\sum_{(u,v)\in E} \omega_{uv} \cdot d_{uv}$

where ω_{uv} is weight of edge (u,v)

Constraints : $x_{uv} - z_u + z_v \geq 0$
$\forall (u,v) \in E,\ u \neq s,\ v \neq t$

$d_{sv} + z_v \geq 1 \quad \forall (s,v) \in E$

$d_{ut} - z_u \geq 0 \quad \forall (u,t) \in E$

$d_{uv} \geq 0 \quad \forall (u,v) \in E$
$z_v \in \mathbb{R} \quad \forall v \in V$

The problem is converted to standard form by introducing slack variables to remove inequalities & writing
$z_v = z_v^+ - z_v^- \quad \forall v \in V$
s.t $z_v^+, z_v^- \geq 0$