



Advanced Algorithms

Problem Set 7

Issued: Friday, June 14, 2019

Exercise 1: Maximum Flow as Zero Sum Game

Let $G = (V, E)$ be a graph with edge capacities $c : E \rightarrow \{1\}$ and let $s, t \in V$ be the source and sink respectively. We can formulate the maximum flow problem as zero sum game as follows. Let P be the (rather large) set of s - t paths. We define a path player \mathcal{P} which picks a path from P and an edge player \mathcal{E} which picks an edge from E . Let $e \in E$ and $p \in P$ be the choices of \mathcal{E} and \mathcal{P} . Then the payoff for \mathcal{E} is 1 if $e \in p$, else 0. Show that the value of this game is $\frac{1}{\gamma}$ where γ is the value of the maximum s - t flow.

Exercise 2: Maximum Flow with Multiplicative Weight Updates

Let $G = (V, E)$ be a graph with edge capacities $c : E \rightarrow \{1\}$ and let $s, t \in V$ be the source and sink respectively. Assume the value γ of the maximum s - t flow is given. Use MWU to efficiently compute a s - t flow f of total size γ , that has at most $(1+\varepsilon)$ flow per edge.