

Algorithmic Game Theory

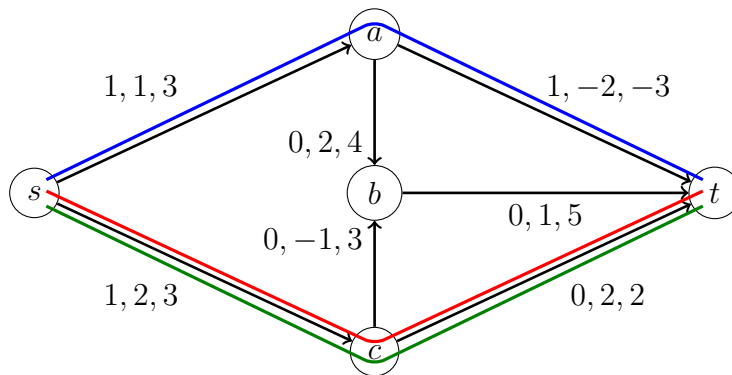
Summer Term 2026

Tutorial Session - Week 1

Exercise 1:

Consider the following symmetric network congestion game with players blue, red and green and their corresponding beginning strategies.

- a) Formalize the network congestion game depicted below. For this purpose, specify the tuple $\Gamma = (N, R, (\Sigma_i)_{i \in N}, (d_r)_{r \in R})$. It suffices to state the delay function of a single resource/edge.
- b) Find a pure Nash equilibrium by stating a sequence of best response improvement steps.



Exercise 2:

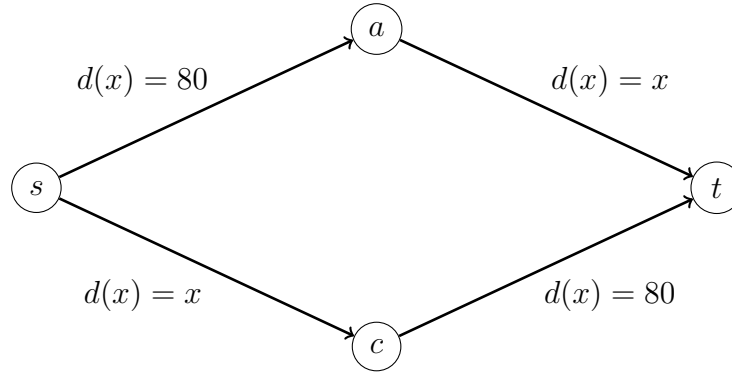
The following game is known as the Pollution Game. There are n players in this game and each player represents a country. For simplicity, we assume that each country has the following two choices: Either it agrees to set industry standards such that its pollution is controlled, or not. Each country that does not agree to control pollution adds 1 to the cost of all countries, including itself. Agreeing to control pollution adds cost 3 to the country itself but does not affect the cost of other countries.

Formulate this game as a congestion game. Does your model fall under one of the subtypes of congestion games seen in the lecture?

State a pure Nash equilibrium. Does the equilibrium state minimize the social cost? If not, what state does?

Exercise 3:

- a) Consider the following symmetric network congestion game with 100 players. State a pure Nash equilibrium S and calculate the social cost $\sum_{i \in \mathcal{N}} c_i(S)$.



- b) Now consider the network congestion game, with one additional edge with 0 delay. Again state a pure Nash equilibrium S and calculate its social cost.

