Traffic Routing Games -- Intro

Which route would you choose?
- The one with the lower delay of course!

Which route would you choose?
- Depends on what routes the other cars choose!
- This is a game.

What is the action space of each player?
- The path taken, i.e. (up, down)

What is a Strategy Profile?
- An assignment of route to each car
- But since, utility functions identical
  - just specify fraction that goes on each route.
  - Call this a “traffic assignment”

What is a Nash Equilibrium of this type of game?
- A traffic assignment such that no car has an incentive to switch paths.
- This is known as a “Wardrop Equilibrium”

For this game: the rates (½, ½) specify the Wardrop Equilibrium

In this game
- There are many “small” players
  - assume that each player has negligible effect on total traffic
- Payoff functions are the same
  - - Delay
Traffic Routing Games -- Intro

- For a traffic assignment to be a Wardrop Equilibrium
  - Traffic on used paths must encounter the same delay
  - Otherwise cars would switch paths
  - Any unused path must have a delay greater than the used paths

Example

- What is the Wardrop equilibrium?
  - \( \frac{1}{3}, \frac{1}{3} \)
- What is the delay the cars face?
  - 1.5

Example

- Is this the Wardrop equilibrium?
  - No
  - Cars can do better

Example

- Is this a Wardrop equilibrium?
  - No
  - Cars can do better
  - Red paths have a delay 5/3, green only 2/3
  - Cars want to switch to green

Example

- Is this a Wardrop equilibrium?
  - Yes...
  - The delay is 2.
  - One car switching to red path still finds a delay of 2.
Braess’s Paradox

- But this network had less delay in Wardrop Equilibrium!
- Delay: 1.5

- This network has an additional road
- Delay: 2
- If a social planner could re-route traffic we could achieve a delay of 1.5