FlowUA – Flows Under Attack

A flow network is a directed graph in which each edge has a capacity limiting the amount of flow that can pass through it.
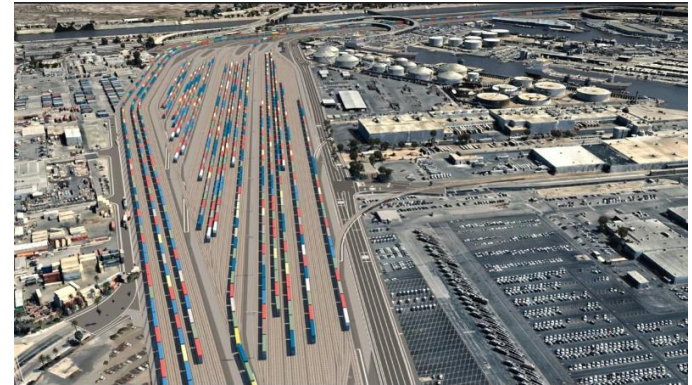
- flow into a vertex equals flow out of vertex
- *source* (outgoing) and *target* (incoming) vertices.

Problems
- maximum-flow problem
- Multi-commodity flow problem
- Minimum-cost flow problem
- …and more

Example application domains:

- packet routing in communication network
- fluids in pipes
- road or rail traffic systems
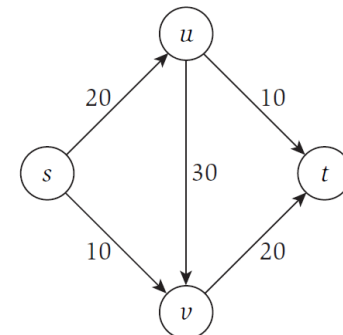- current in electrical circuit
- …& many more

Why is this old problem interesting?

- Investigate the system's behaviour/resistance under external influence and given dynamic/temporal changes
- Algorithmic game theory playground
  - strategy profile
  - equilibrium

FlowUA – Flows Under Attack

- ## Project focus:
  - Investigate the dynamic behaviour of a network
    - Realtime rerouting
    - Weaknesses within such systems

  - Experience with
    - Algorithm design
    - Optimization
      - Possible modifications/improvement

- ## Project information:
  - For Bachelor & Master (BA Inf, S&D, CS4DM & DE)
  - Knowledge requirements:
    - Programming
    - Algorithms & Data Structures
  - First meeting: next week
  - Regular meetings, final presentation, documentation
  - Advisor: Rosemary Utenwojo Adejoh, Andreas Jakoby.

"WE'RE EXPERIENCING HIGHER THAN NORMAL CALL VOLUMES. YOUR ESTIMATED WAIT TIME IS APPROXIMATELY..."

Algorithm Design J. Kleinberg and E.Tardos *Addison Wesley,* (*2006*)

FlowUA – Flows Under Attack

The max-flow problem and variants assume central authority where the algorithm directs the flow through the vertices and edges. In many applications of flow networks however, only some of the vertices of the network can be controlled.

Flow games are the game-theoretic setting of max-flow where vertices in the network are partitioned between two players, one corresponding to the network authority, whose goal is to maximize the flow, while the other player acts as the hostile environment.

- extension to multi-player games.
- investigate algorithmic game theory questions
    - strategies
    - profiles
    - equilibrium
- game variants of classical graph theory problems, for e.g., spanning-tree games, Turán numbers, game chromatic number of graphs, e.t.c.
- computational complexities of different game scenarios.