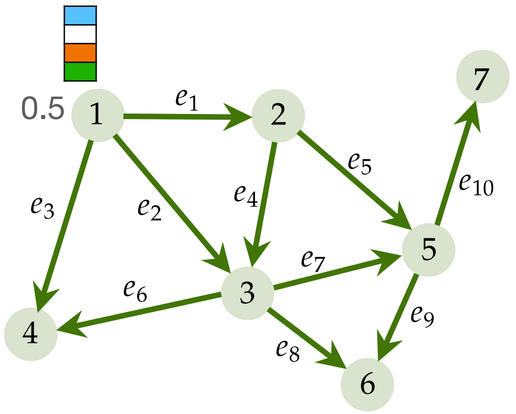
Functions on simplices

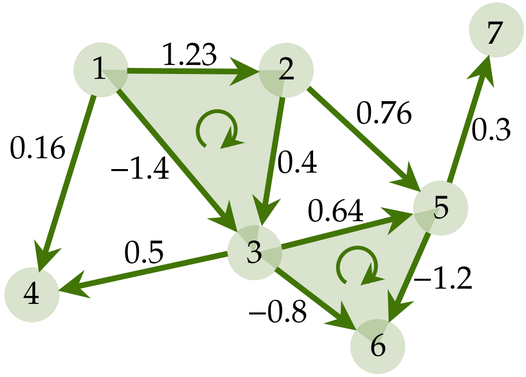
Signals on nodes, edges, triangles, …



Node function

$$f_0 : V \to \mathbb{R}$$

$$\mathbf{f}_0 = (f_0(1), \ldots, f_0(N_0))^\top$$



Edge function

$$f_1 : E \to \mathbb{R}$$

$$\mathbf{f}_1 = (f_1(e_1), \ldots, f_1(e_{N_1}))^\top$$

- Alternating property
- Magnitude and sign

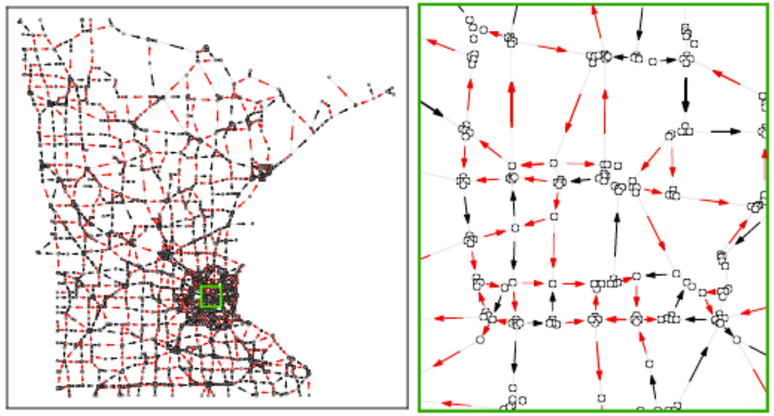
- Flow-type data (natural)
  - Physical world: traffic flow, water flow, information flow…
  - Forex: exchange rates
  - Game theory (Candogan et al. 2011)
  - Ranking data (Jiang et al. 2011)
  - Edge-based vector field discretisation (computer graphics)
  - …
- Representation learning
  - High-dim edge features

Triangle function

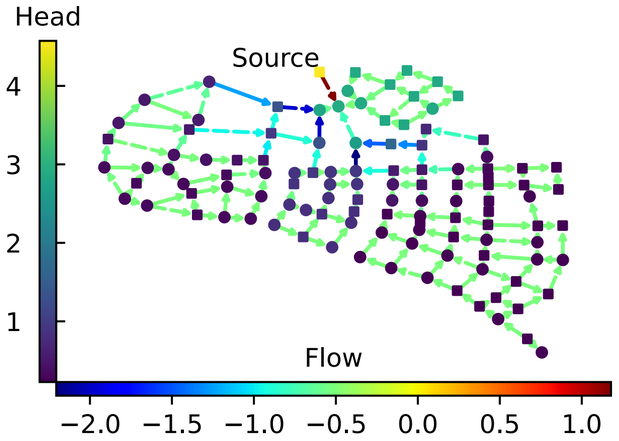
$$f_2 : T \to \mathbb{R}$$

0-, 1-, 2-cochains in topology

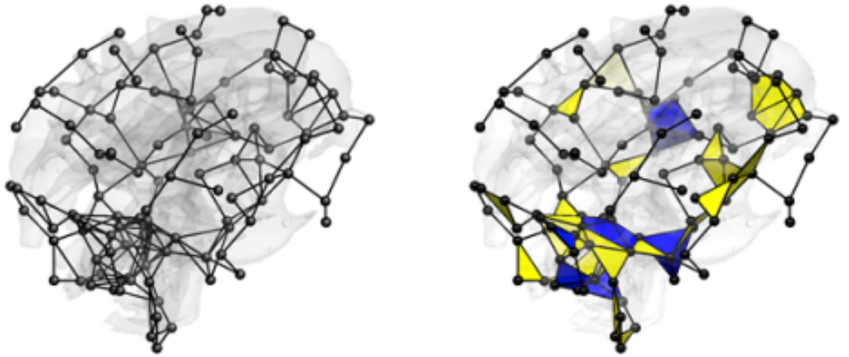
Simplicial complexes and Data in real world



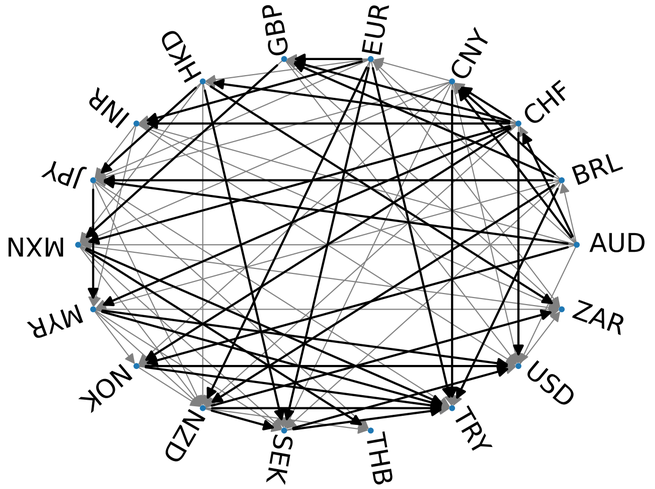
Traffic flows (Jia et al. 2019)



Water flows (Yang et al. 2023)



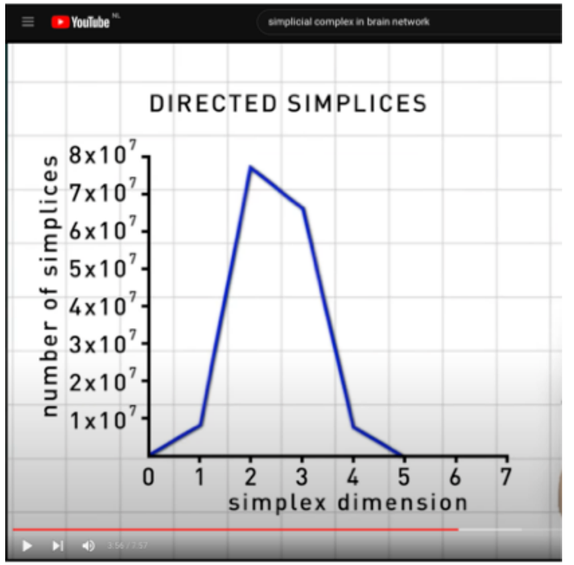
Neuroscience (Anand et al. 2023):
1. Firing of neurons
2. Activation of multiple brain regions



Foreign currency exchange (Jiang et al. 2011)

Others:
- Currents/Voltage in electric circuits/grid
- Game theory (Candogan et al. 2011)
- Ranking theory (Jiang et al. 2011)
- Information flows

…
- Discrete vector fields



Your Mind Is Eight-Dimensional - Your Brain as Math Part 3 | Infinite Series