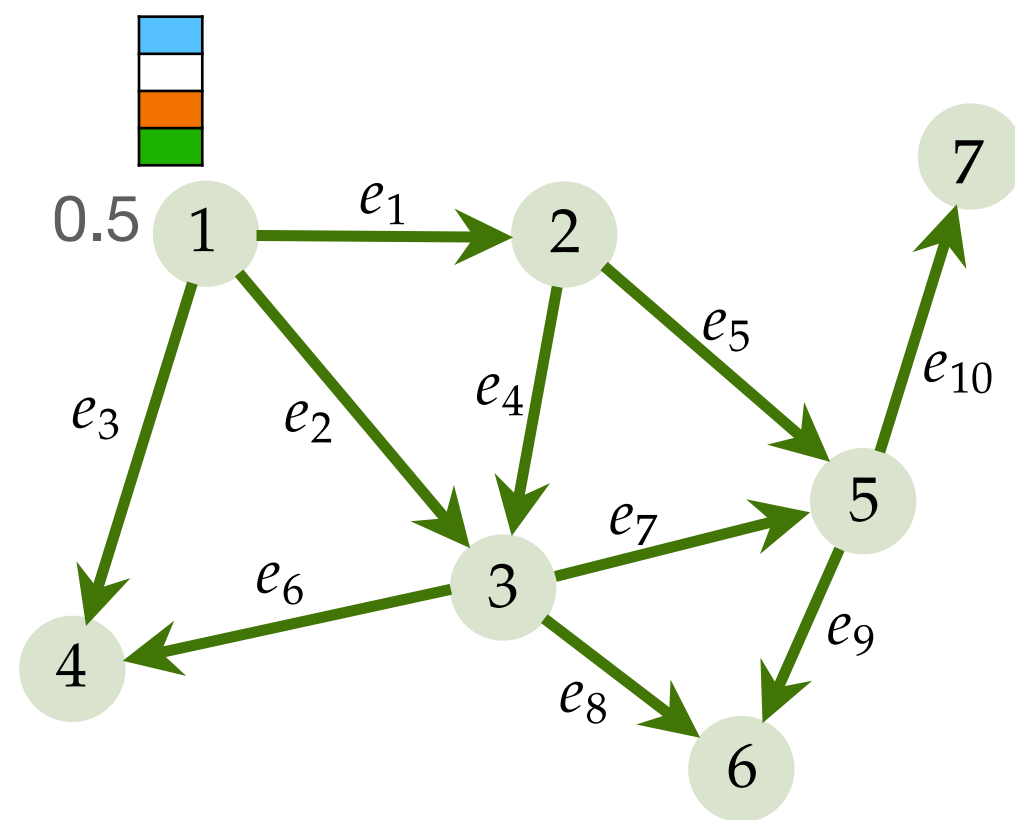# Functions on simplices
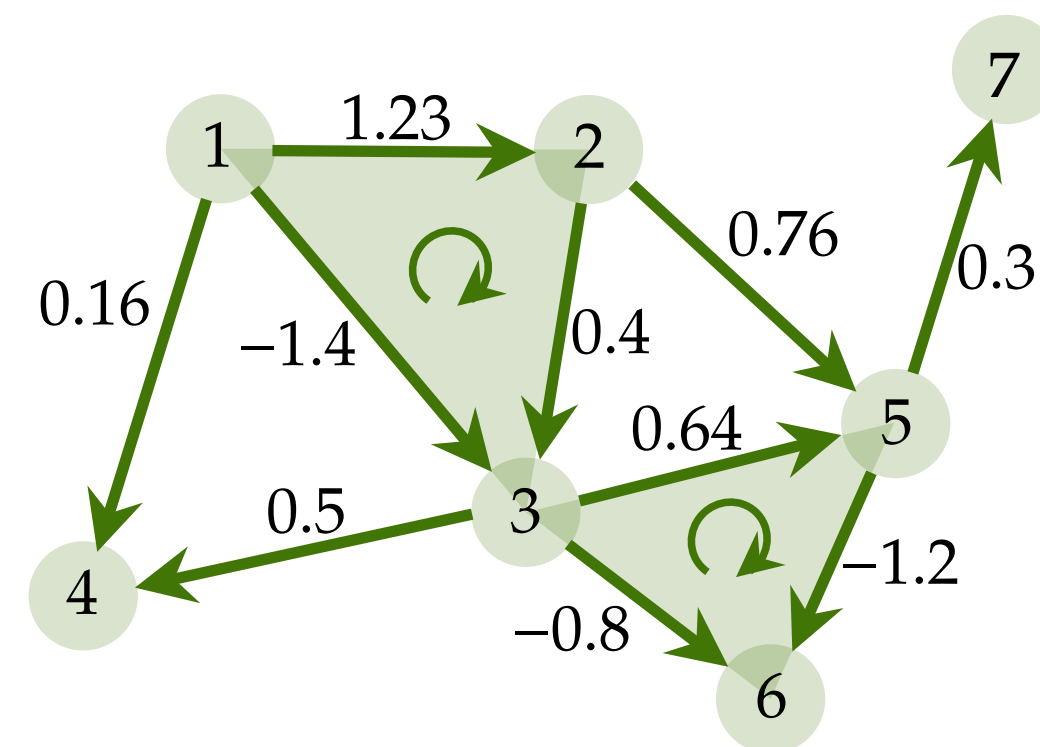## Signals on nodes, edges, triangles, …

Node function
$$f_0 : V \to \mathbb{R}$$
$$\mathbf{f}_0 = (f_0(1), \dots, f_0(N_0))^\top$$

Edge function
$$f_1 : E \to \mathbb{R}$$
$$\mathbf{f}_1 = (f_1(e_1), \dots, f_1(e_{N_1}))^\top$$

- 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
$$f_2 : T \to \mathbb{R}$$
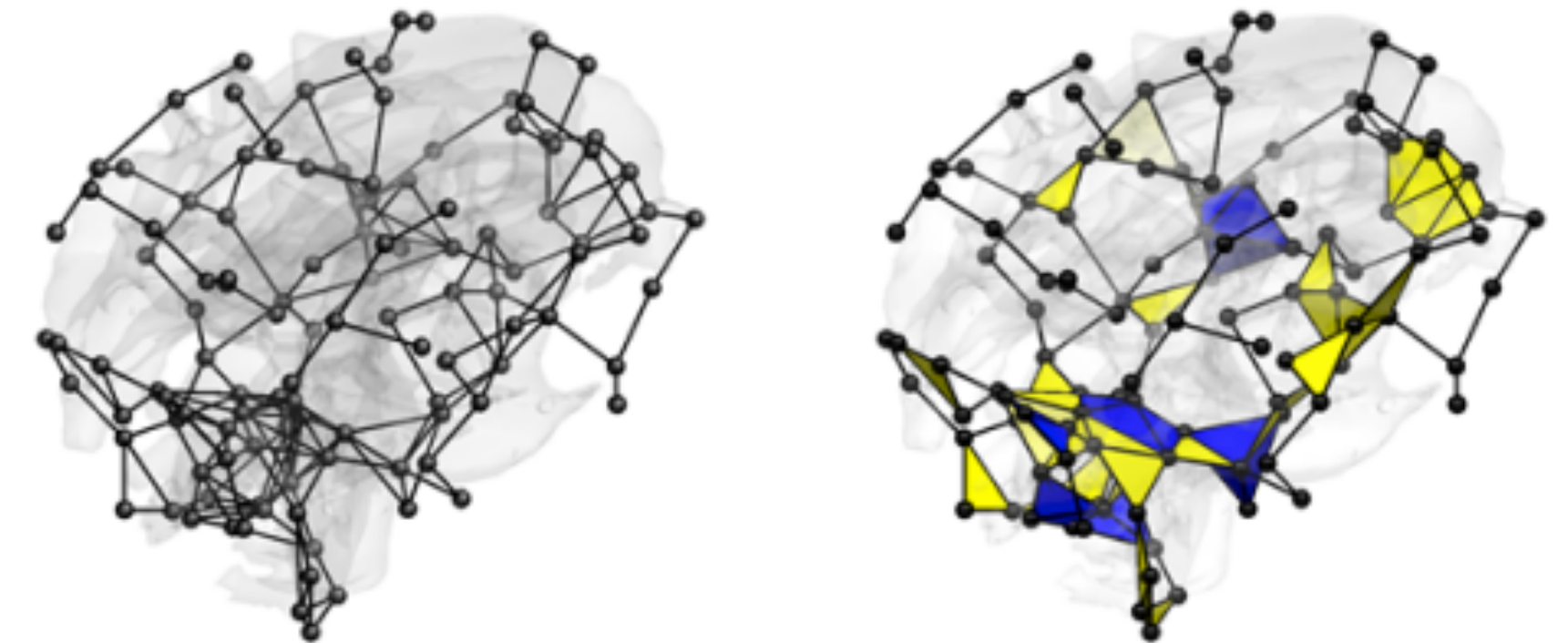
0-, 1-, 2-cochains in topology

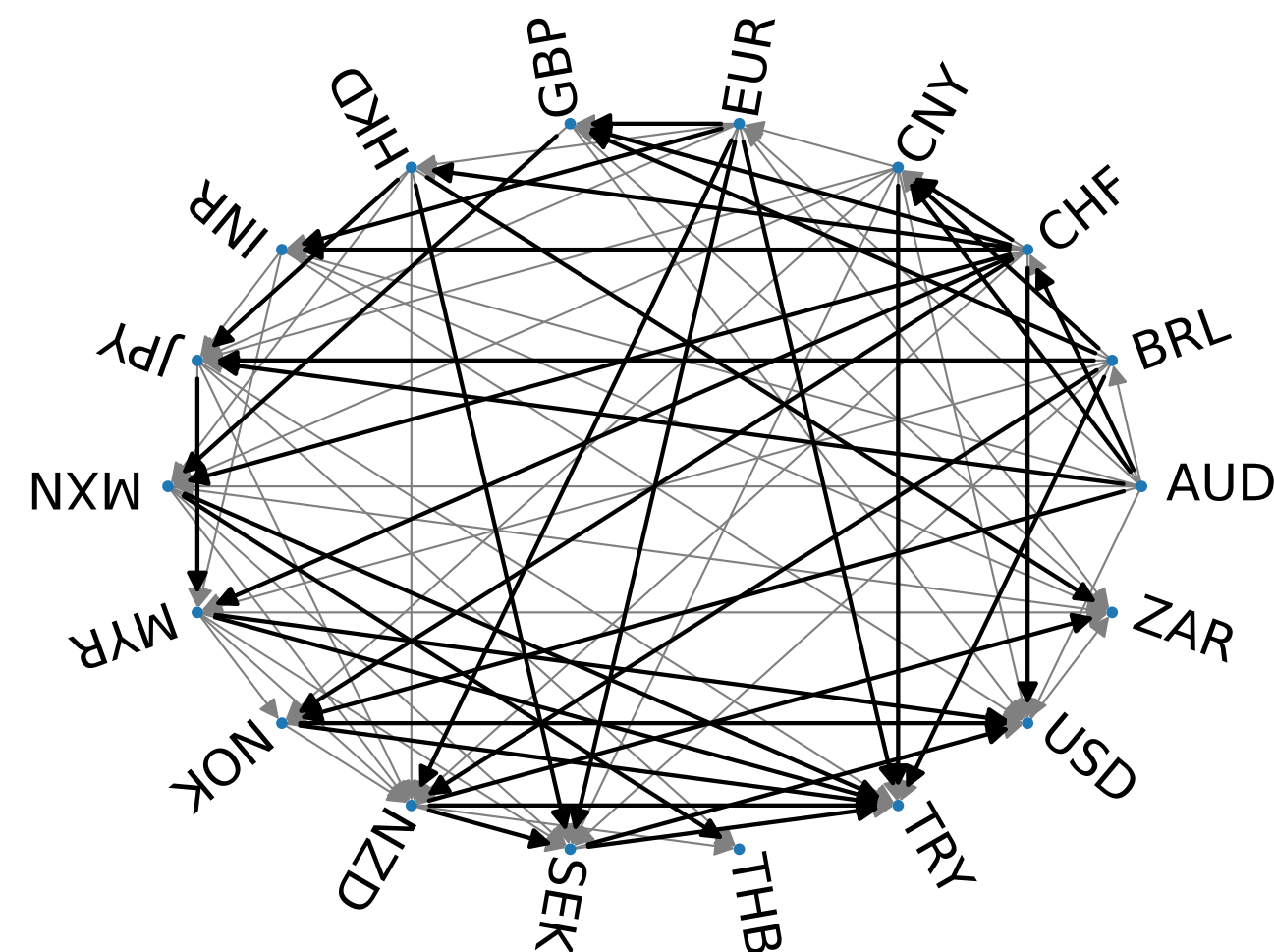# Simplicial complexes and Data in real world
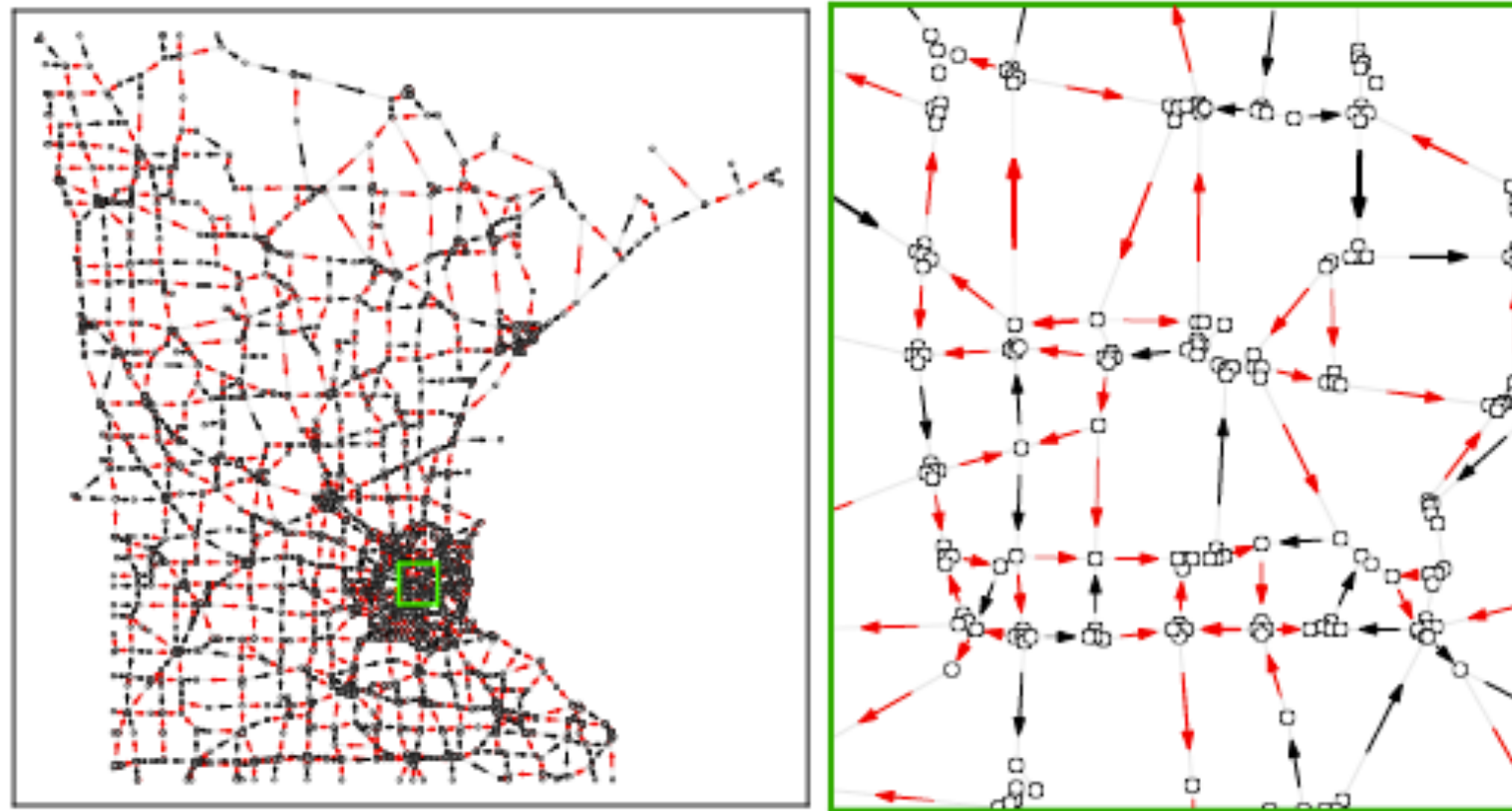
Traffic flows (Jia et al. 2019)
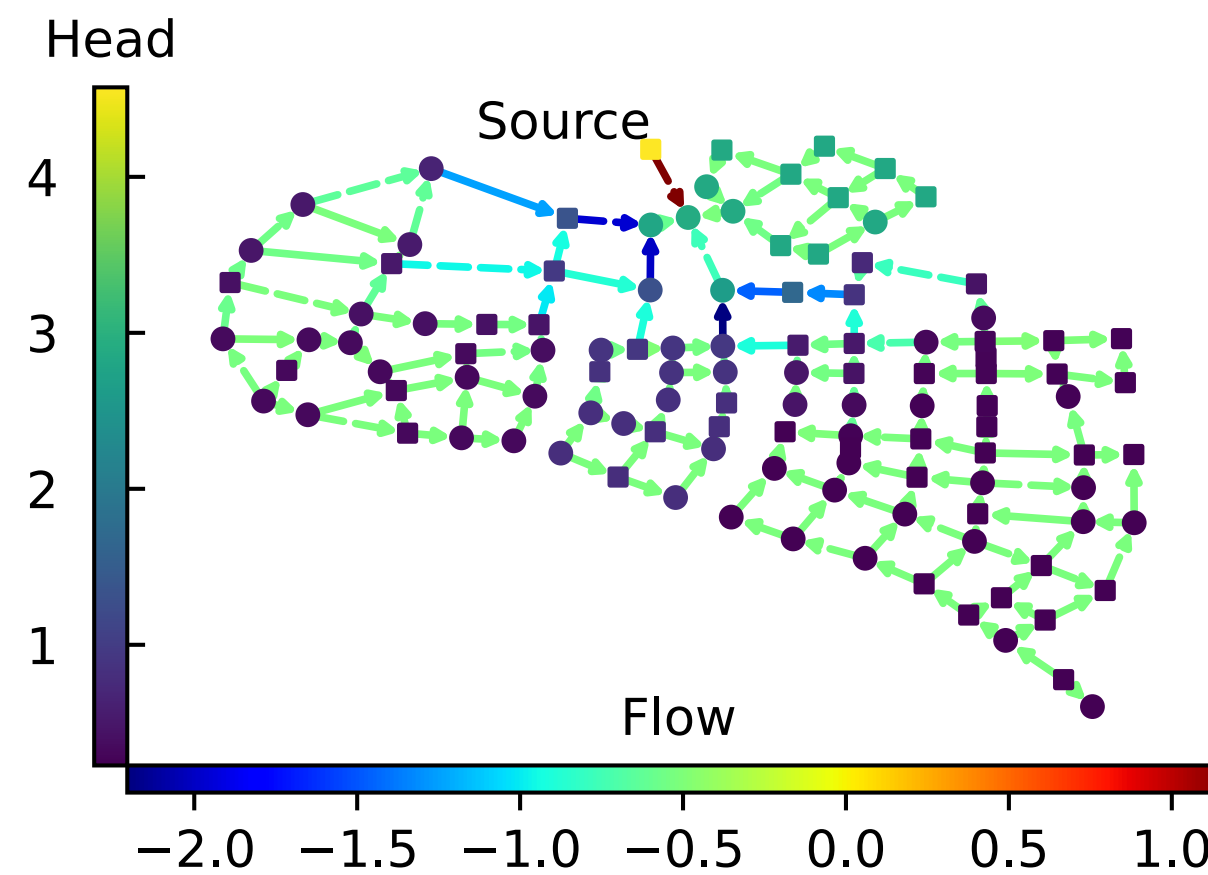
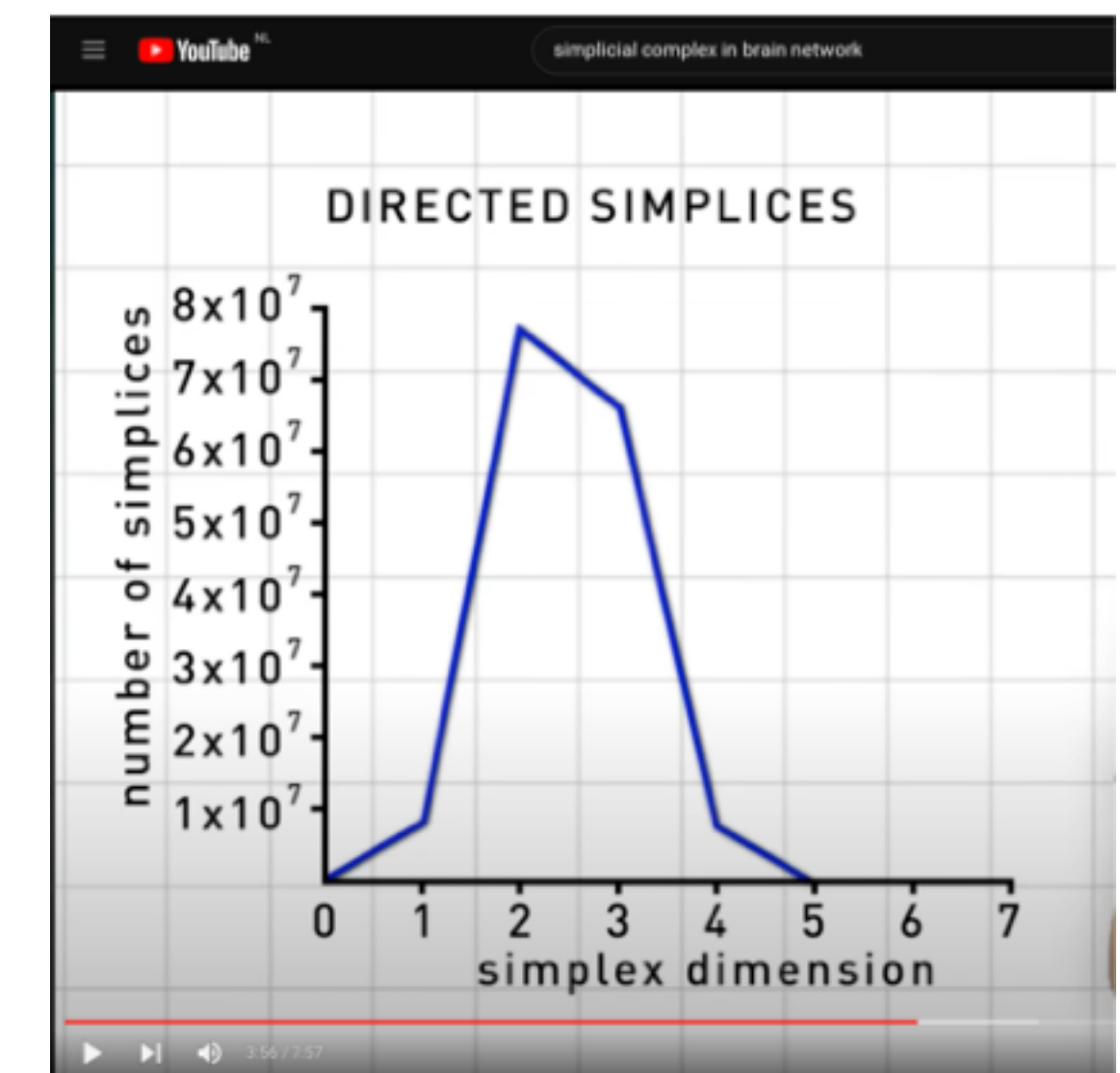
Water flows (Yang et al. 2023)

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

4