Biomedical Modeling & Simulation

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Some figures are from Eric Sobie, and Wikipedia.

Types of Modeling Techniques

- Describe how the system is changing over time using ordinary differential equation(s)
  - Analyze the properties of the system
  - Use ode solvers to simulate the system
- To model how things change both temporally and spatially, use Partial Differential Equations
  - Finite Element Models
- Random sampling simulations
  - Typically used in molecular dynamics
  - Define the energy of the system, search for random configurations to minimize the energy

Modeling ODEs from rate of change

- "(Cleaning the Great Lakes.) The Great Lakes are connected by a network of waterways, as roughly depicted in Figure 2.1. Assume the volume of each lake remains constant, and that water flows into the lake with volume V_k at rate r_k. Suppose pollution stops abruptly (i.e., no more pollution flows into the lakes) and develop a system of ODE that models the progression of pollution as it clears from the lakes."

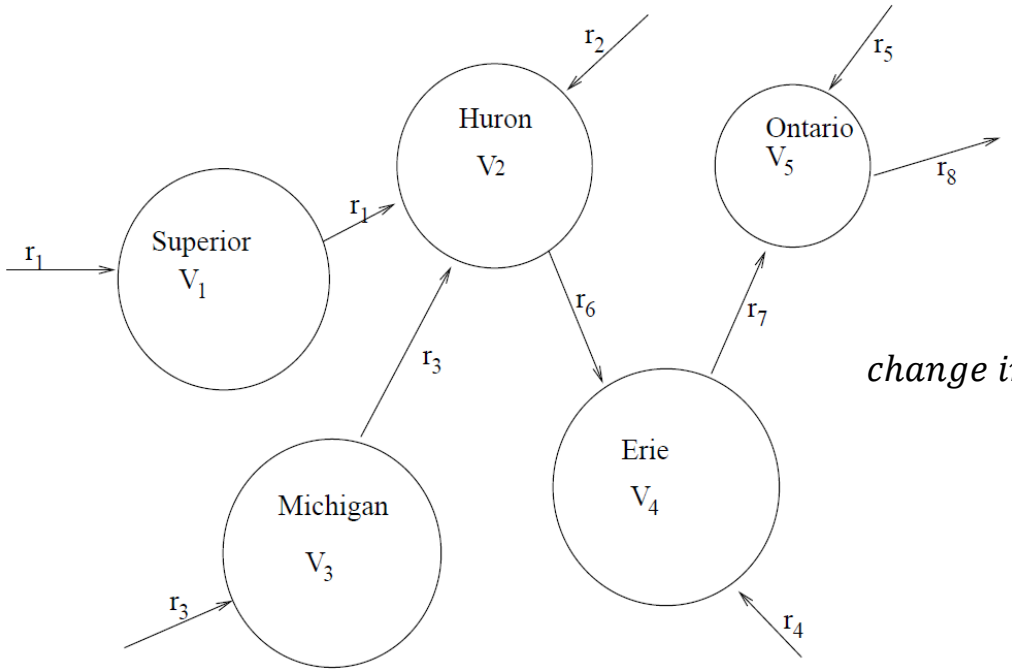

Figure 2.1: Great Lakes waterway network.

$$change\ in\ x = \frac{dx}{dt} = input\ rate\ - output\ rate$$

Example from: https://www.math.tamu.edu/~efendiev/math647_spring05/model_ode.pdf