

# CITS7211 Modelling Complex Systems

## Lecture 2: The modelling process

### Overview

We examine the process of building a model, from the initial problem description, through parameter refinement, assumptions and abstractions, inferring constants, implementations and verification and validation. We consider the variety of approaches that may be taken, and the model types available. We examine dimensional analysis as a means to select parameters and rules for a system. Finally, we work through an example based on traffic flow.

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#### Topics:

1. Approaches to complex systems: Leibnizian, Lockean, Kantian and Hegelian.
2. A Taxonomy of model types: Descriptive, physical, symbolic, procedural; black box/white box; and deductive/inductive.
3. The Process:
  - a. Problem definition; the goal should be a question rather than a model.
  - b. Observation: time, space, model type.
  - c. Selection of parameters: types, fuzzy parameters, dimensional analysis
  - d. Selection of rules: from theory, explicit assumptions, boundary case analysis.
  - e. Implementation/Simulation: calculation of constants
  - f. Validation/Verification: compare with existing models, introduce constraints, use well-defined measurable qualities, apply common sense.
4. Dimensional Analysis Example:
  - a. Fundamental Quantities and independent dimensions
  - b. Dimensionless groups
  - c. Lokta-Volterra predator-prey model.
5. Examples:
  - a. Traffic I (netlogo agent based model)
  - b. Traffic II (aggregate model)

#### Reading:

1. V. Vemuri, 1978, *Modeling of Complex Systems: An introduction*. Chapter 3 pp. 67-88
2. NetLogo 4.0.4 Models Library: Select one model of interest to you, and do a careful dimensional analysis of the parameters used. Do they make sense? Comments to <https://secure.csse.uwa.edu.au/run/help7211>

Tim French, 2009.