L1: Jan. 19, 2017.

Housekeeping.

- Syllabus & introduction

- Index cards:

Name	/ Major(s)	/ Year

To you, what is a mathematical or computational model? (You may give examples?)   *Talk to your classmates!*

What skills do you expect to develop in MATH 365, and where/ how will you apply them? (Be as specific as you can.)   *Talk to your instructor!*

Which programming language(s) do you know, if any? Is there one you'd like to learn?

Today

- Review of computat'l science (Module 1.1)

- Modelling as a process (Module 1.2)

- (possible) System Dynamics Tutorial (Module 2.1)

Module 1.1: Computational Science.

Computational science :
- Mathematical modelling ←——
- Computer simulation
- Scientific visualization
- Data structures
- Networking
- Database design
- Symbolic manipulation

——→ - Numerical analysis

- HPC

Represents a paradigm shift in all of science — a new scientific revolution.
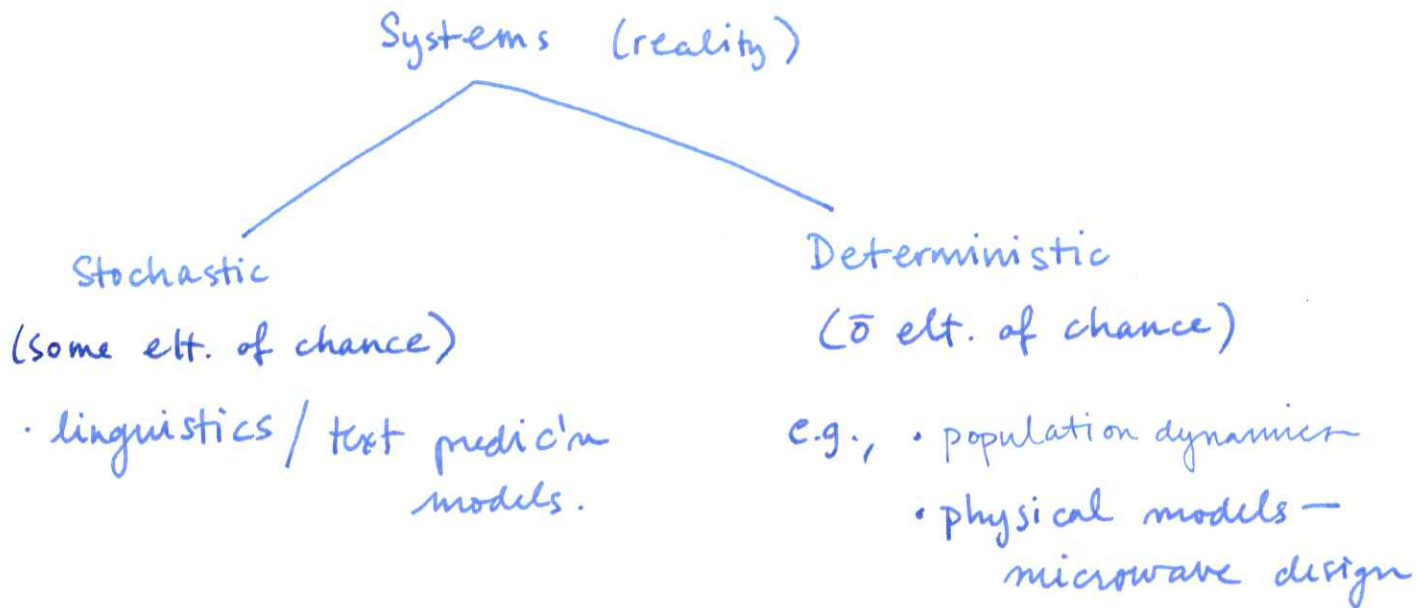
(Module 1.1 makes a good extended case for this designation — and corresponding references.)

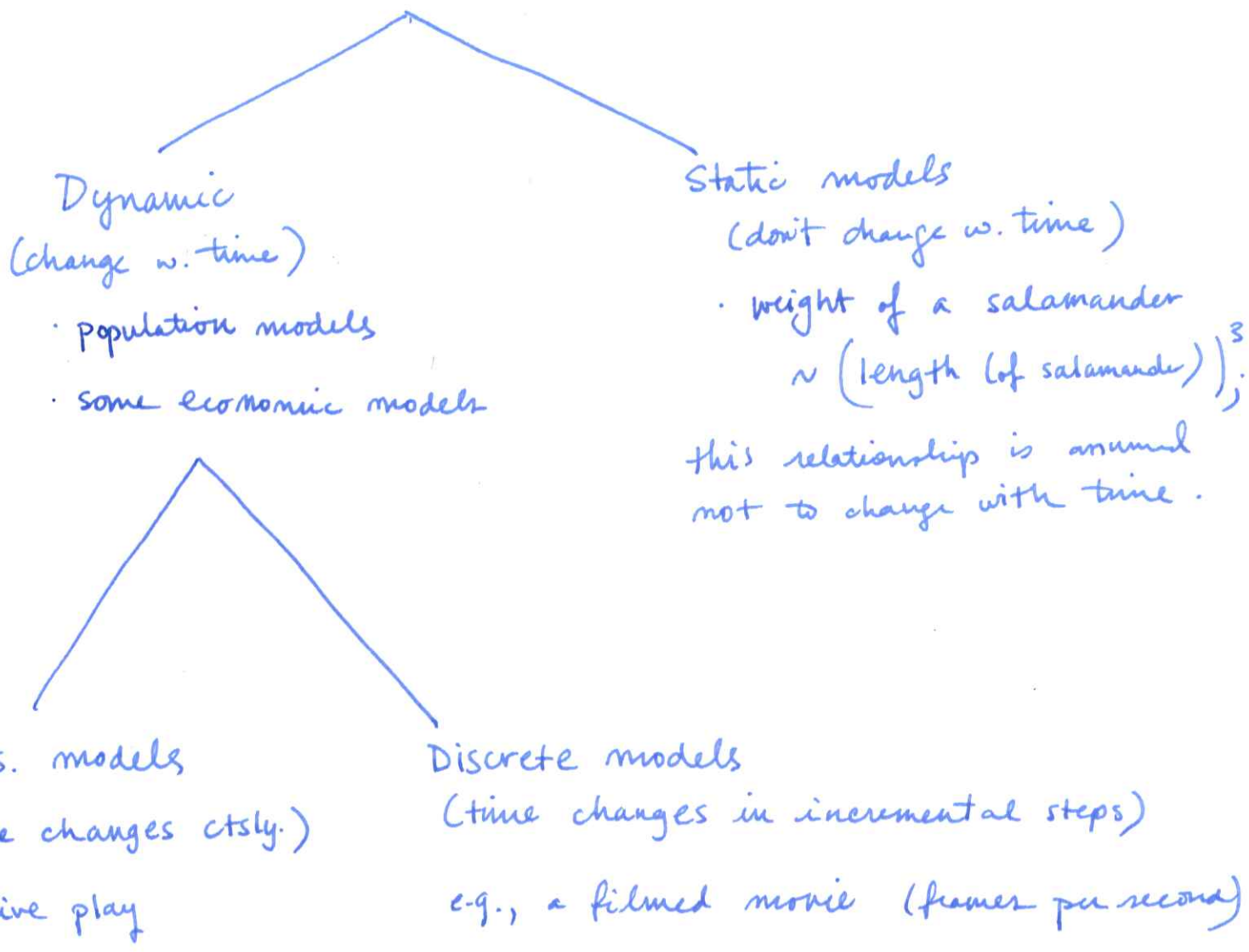Examples of computational science in action:

- Dynamic models of HIV in blood   (LANL / univ. of MN)

- Weather research + forecasting (NOAA, NCAR)
  (advanced hurricane prediction — a highly nonlinear, chaotic dynamical system)

- Ecological management — fish, bird, plant populations constitute a multiple-parameter system

- Computational linguistics — stochastic models of language use give rise to predictive models for text generation ("T9" program on mobile phones)

- Deterministic models for engineering + design — electromagnetics + high-power microwaves done here at MCLA (by yours, truly...)

- Electrical impulses in the heart; fluid flow in narrow vessels

- Influence of cranial geometry on presence of migraine aura

Modelling: The application of methods to analyze complex, real-world problems in order to predict what might happen under various conditions.

Idea: Replicate reality — but only the "important" parts! Then you can observe the effects of conditions that might not (yet) exist, in faster-than-real time.

Systems (reality)

Stochastic
(some elt. of chance)
· linguistics / text predic'n models.

Deterministic
($\bar{o}$ elt. of chance)
e.g., · population dynamics
· physical models — microwave design

Models

Dynamic
(change w. time)

· population models

· some economic models

Static models
(don't change w. time)

· weight of a salamander
  $\sim \left(\text{length (of salamander)} \right)^3$;

this relationship is assumed
not to change with time.

Cts. models
(time changes ctsly.)

eg. a live play

Discrete models
(time changes in incremental steps)

e.g., a filmed movie (frames per second)

Note: Distinction between models and systems
                              "   "
                        simulations   reality.