IMPERIAL

Bayesian Model Identification of Predator and Prey Dynamics

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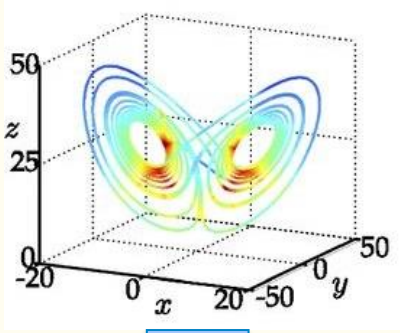
Learning Outcome – By the end, you should be able to…

- Identify and extract the relevant regressand (target) and regressor (label) in modelling times series data
  - Including the use of finite difference or other methods to approximate time derivatives
- Design a library of candidate functions for the problem
- Apply the principles of Bayesian Model Selection to different models of a given time-series data and select the one that best describes the data
  - Implement the Bayesian Model Selection algorithm in Python
- Test, validate, interpret and analyse the chosen model
  - Propagating the model with the learnt parameter values
- Tune hyperparameters suitably and justify the chosen values
- Extend the library of candidate functions to further improves the model
  - Justify the new terms used
- Quantify the uncertainty in the result

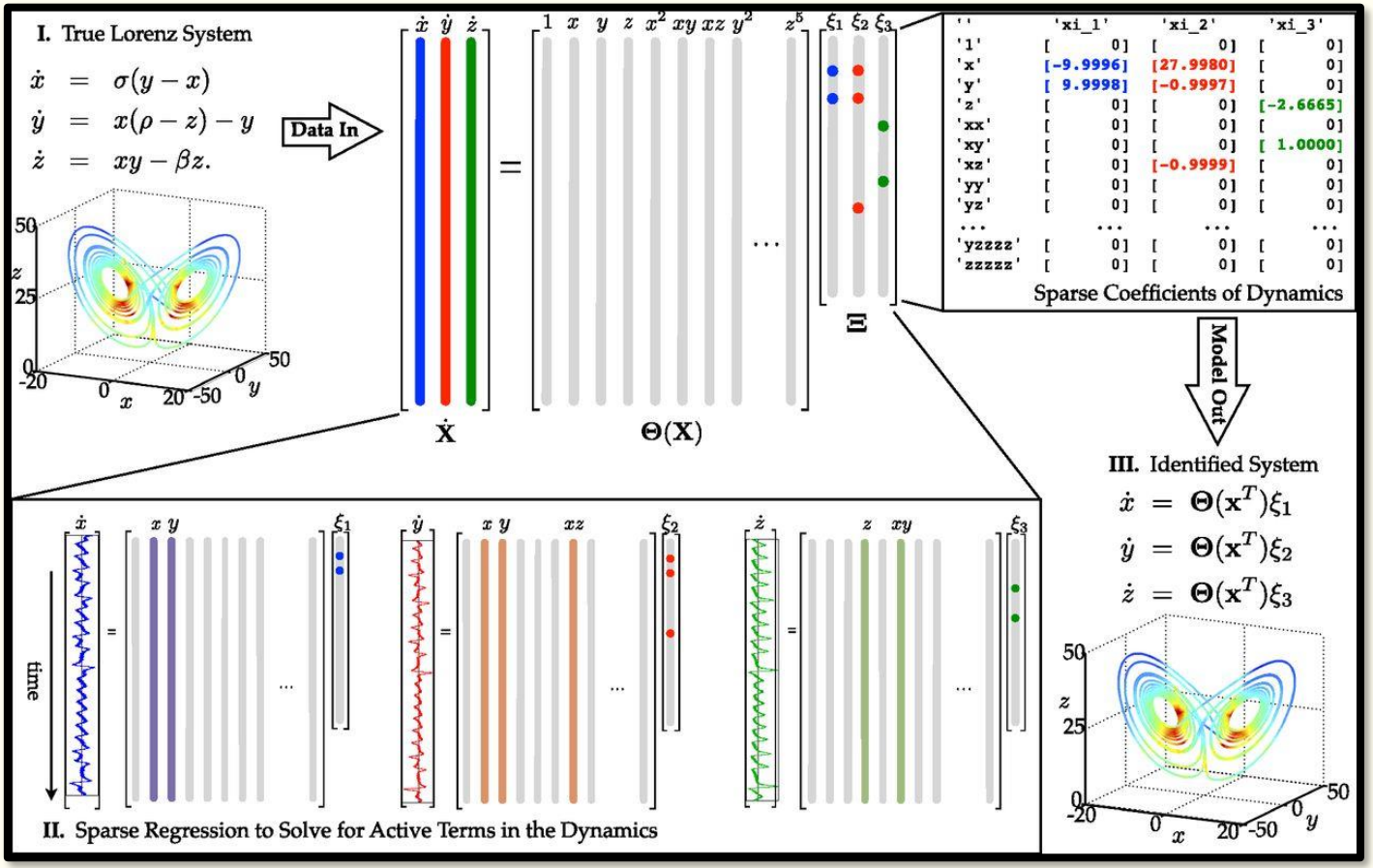
Model discovery from time-series data

Aim:



Learning

$$\dot{x} = \sigma(y - x)$$
$$\dot{y} = x(\rho - z) - y$$
$$\dot{z} = xy - \beta z.$$



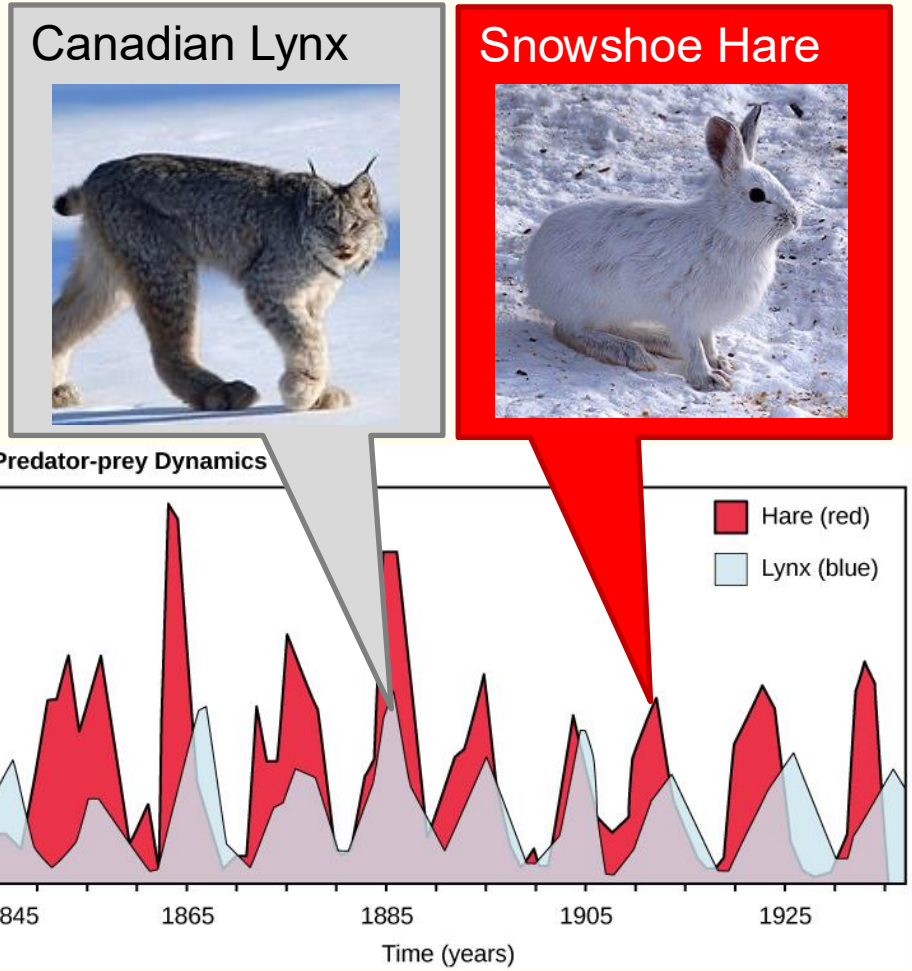
Taken from Brunton et al. (2016) PNAS

The data – Predator and Prey Dynamics

- Data: Lynx and Hare population in Canada
  - Projection based on pelts trades by the Hudson Bay Company
  - Annual data collected between 1845-1935
  - *Prior knowledge*: Lotka-Volterra equation is the simplest model to describe their population dynamics

$$\dot{u} = \alpha u - \beta uv$$
$$\dot{v} = -\delta v + \gamma uv$$

  - Real dataset might reveal a more complex and nuanced equation



Aim of project:

- Improve the eqn. from data
- Improve forecasting