

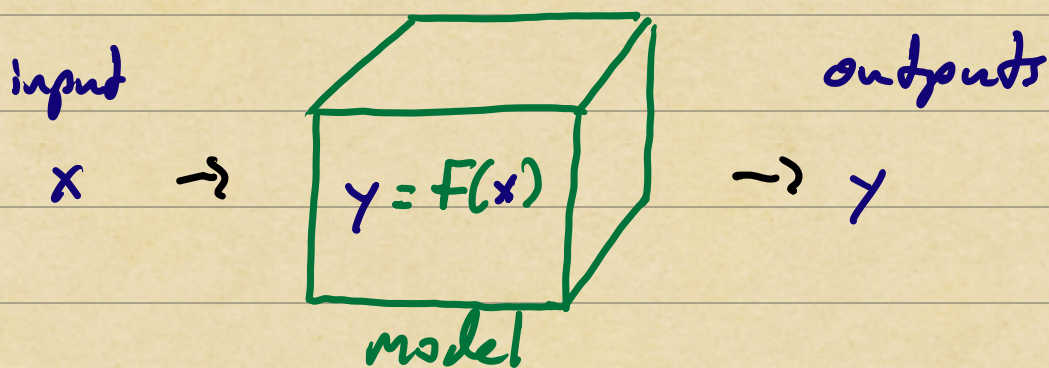
Intro to Data-Driven Modeling: Analysis

Spring 2026 Course Info

Linked via LMS

- Github - All course materials
- Piazza - Q&A, Discussion, Announce
- Gradescope - Release/View/submit HW

Course Aim: use data to develop mathematical models of complex phenomena.



Challenges: In "real-world" applications

Data: Too little / Too much data, noisy, corrupted, unlabeled

Model: Existence, Uniqueness, accuracy, insight, reliability

Mathematical Models

Math models form the "explanatory core" of quantitative scientific knowledge.

⇒ Newton's Laws

⇒ General Relativity

⇒ Quantum Mechanics

⋮

Questions: What makes a "good" model?

⇒ Explanatory Power

⇒ Predictive Accuracy

⇒ Capacity to Generalize

⇒ Computability/Solvability

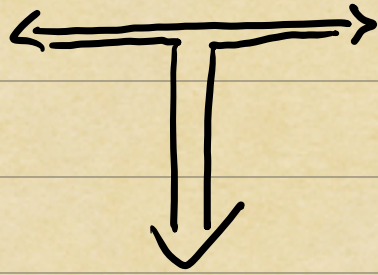
⇒ Interpretable/Actionable

Features are often in tension with each other!

⇒ Use mathematics to understand trade-offs.

Question: Where do models come from?

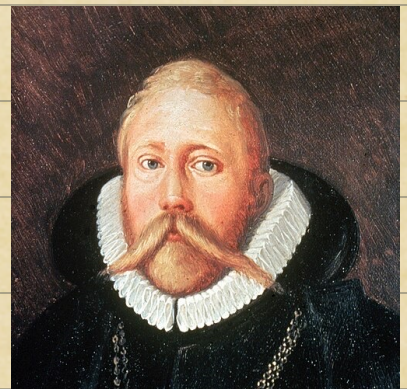
Rationalism
"logical reasoning"



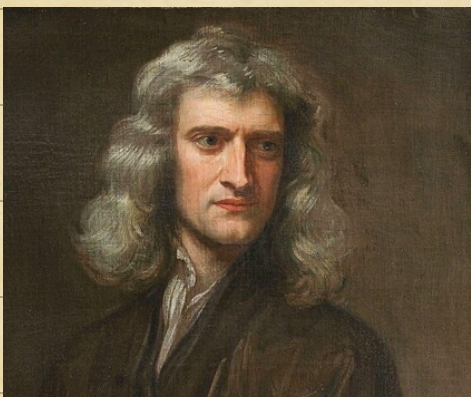
Empiricism
"real world observations"

Mathematical Models

Tycho Brahe collects data on planetary orbits



Johannes Kepler realizes the orbits are elliptical and proposes a new model.



Isaac Newton proposes a more fundamental model that "explains" Kepler's laws and much much more.

Question: So, what's new?

=> Computational Power/Resources

=> Quantity of available data