UCLouvain

ÉCOLE POLYTECHNIQUE DE LOUVAIN

LGBIO2060: Modelling of biological systems

Practical sessions

Professor
P. Lefèvre

Teaching assistants
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Who are we ?

Clémence Vandamme – PhD student

PhD thesis on the gait pattern of Parkinson's patient with Pr. F. Crevecoeur

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Simon Vandergooten – PhD student

PhD thesis on the impact of microgravity on object manipulation with Pr. P. Lefèvre

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Office in Euler's building (A017 & A201) → Send email first !

Planning

- Week 2 – 6 : Bayesian inference
- Week 7 – 10 : Hidden dynamics (/!\ W7 : Practical session on Thursday)
- Week 11 – 12 : Optimal control
- Week 13 : Q&A
- Week 14 : Lesson with Pr. Lefèvre

→ Bring your laptop

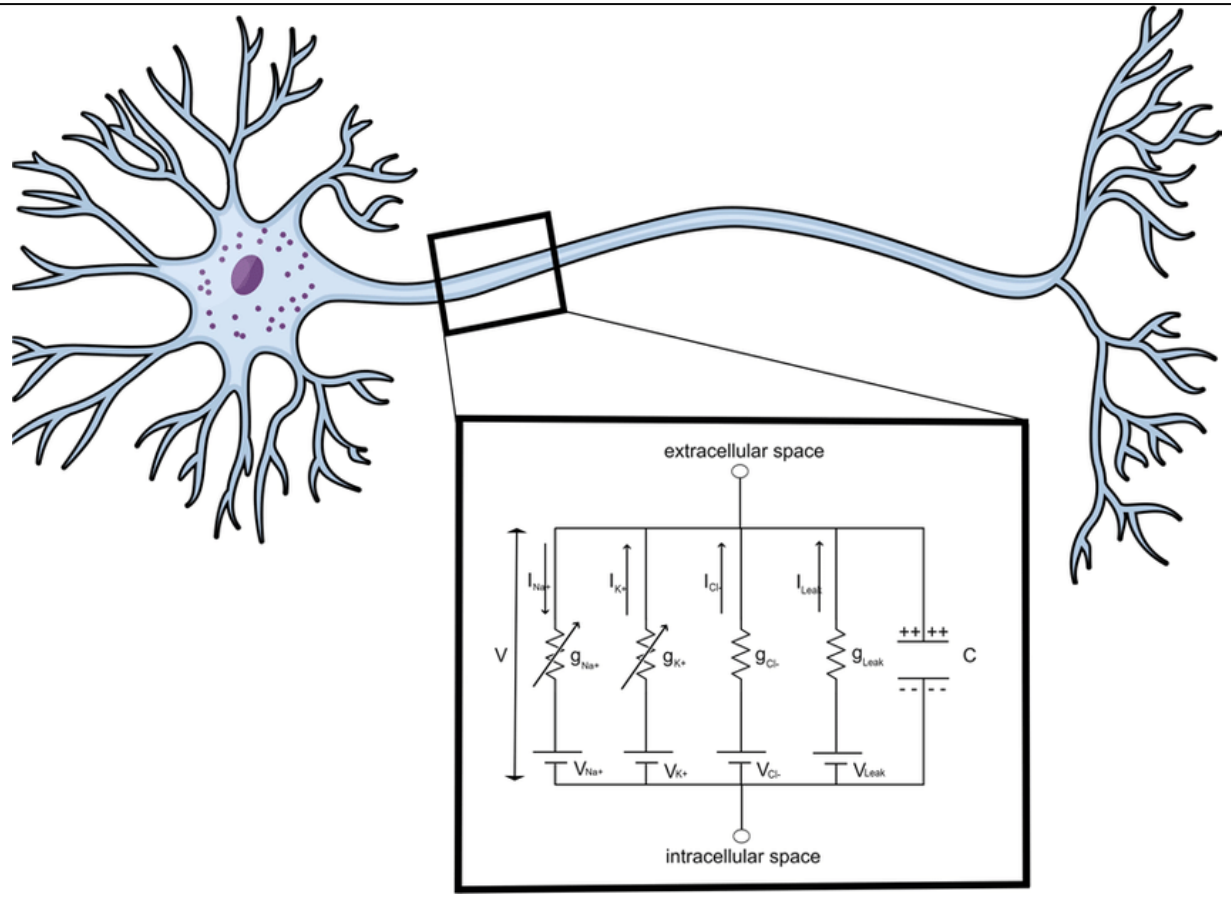
Evaluation

- 3 group projects (25%): coding exercises, articles reading, small report and discussion
  - 28th of October (W7)
  - 25th of November (W11)
  - 16th of December (W14)

- Part of written exam (25%)

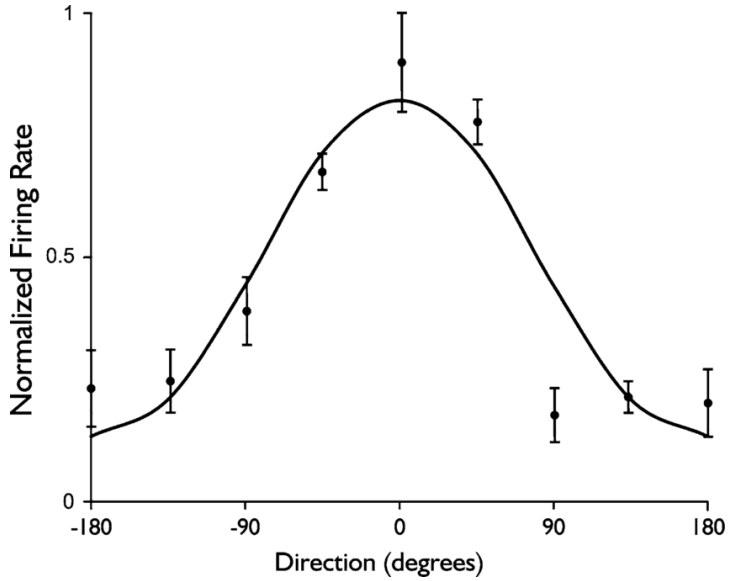
What are models ?

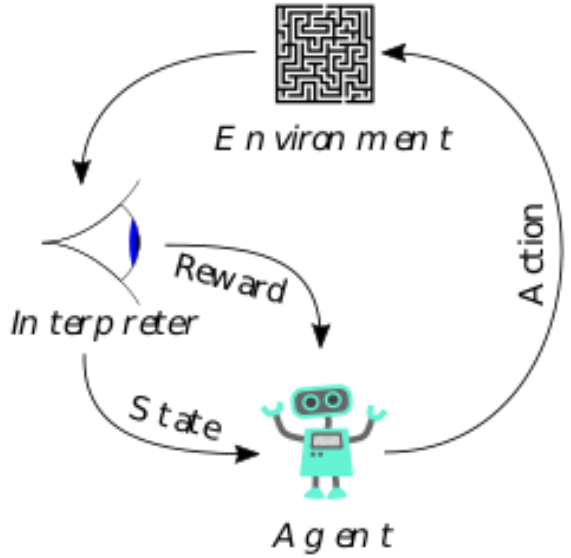
“Models are an abstraction of reality. Models are partial, imperfect descriptions of the universe, developed by science for our understanding of the universe that is otherwise too complex to grasp by the limits of the human mind”



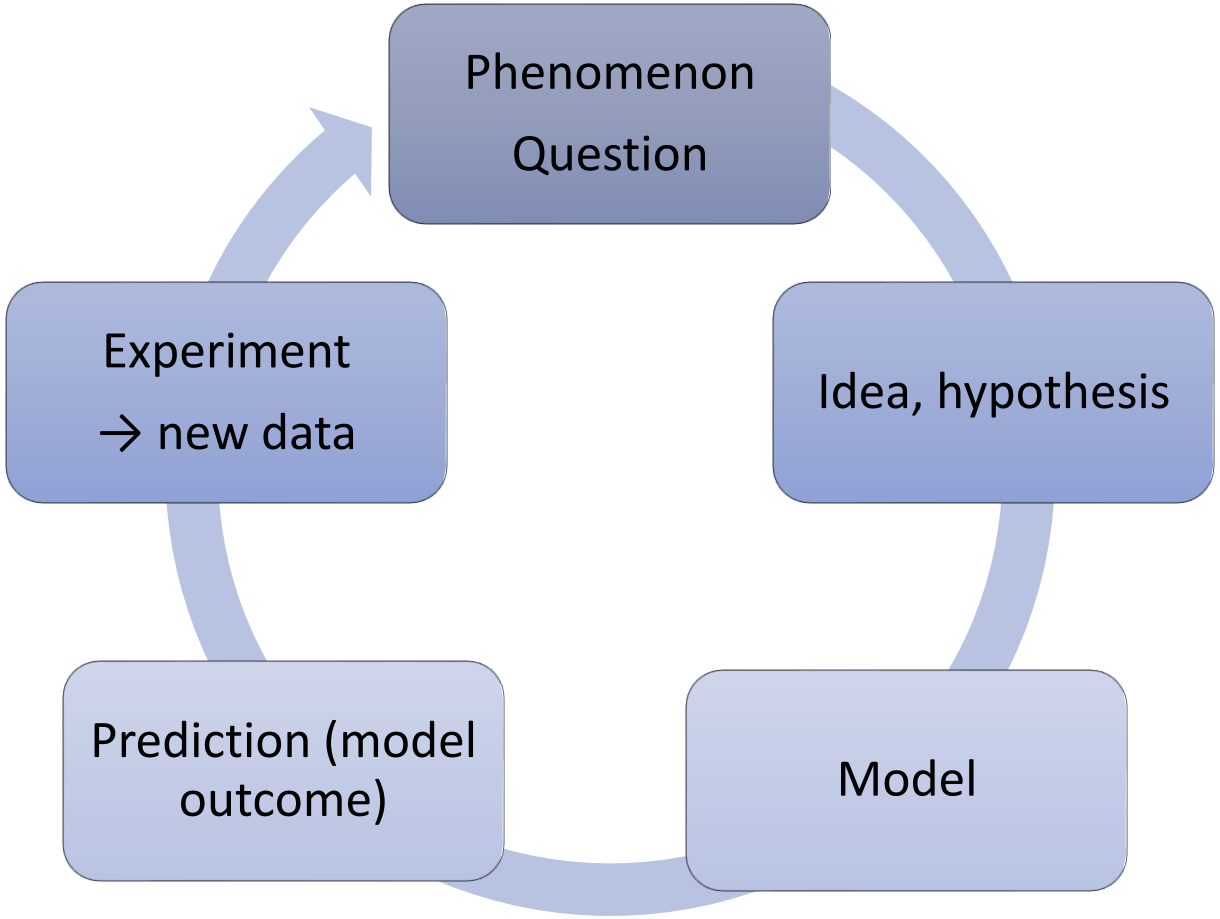
Why models are great ?

- Synthesize knowledge
- Identify hidden assumptions
- Bring mechanistics insights
- Retrieve latent information
- Design useful experiments
- Inspire new technologies/applications

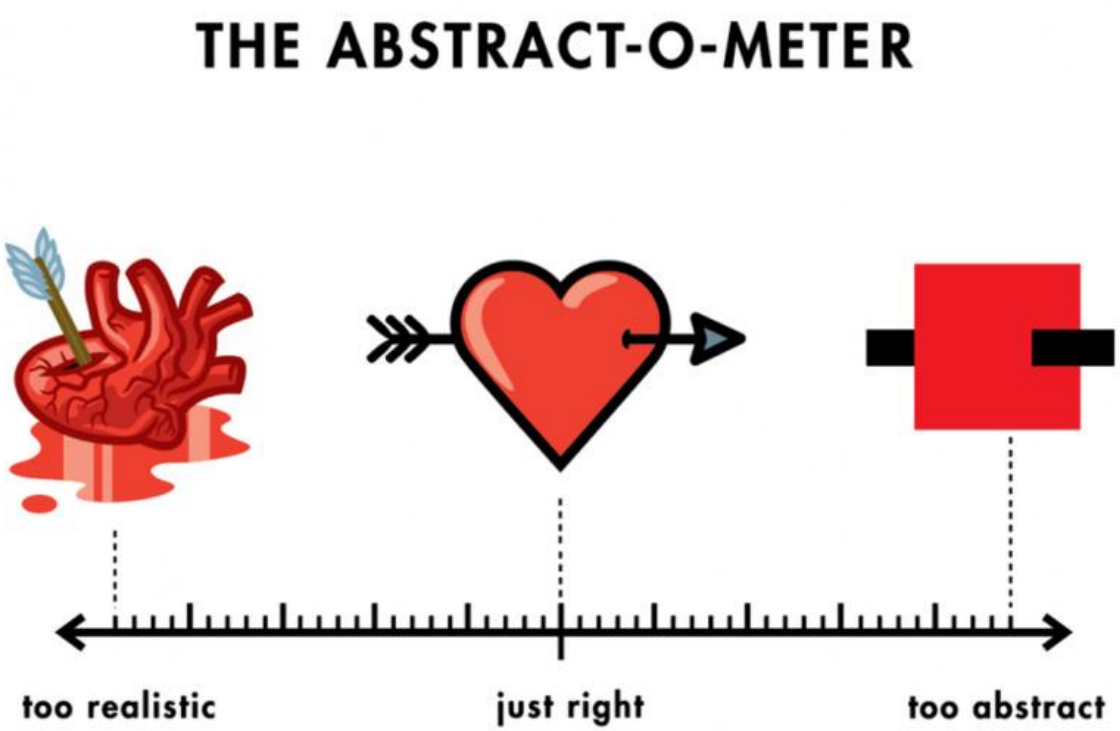




Models & experiments



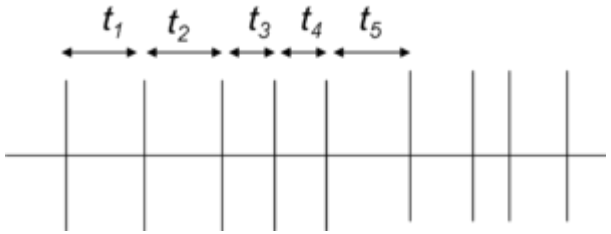
How to find the right level of abstraction ?



- As simple as possible
- As detailed as needed
  - ➢ Depends on your question, hypotheses and goals !

Different types of models answer different questions

1. “What” models
   - ✓ Description of the data
   - ✓ Generalization
   - ✓ Prediction
   - ✗ Meaning



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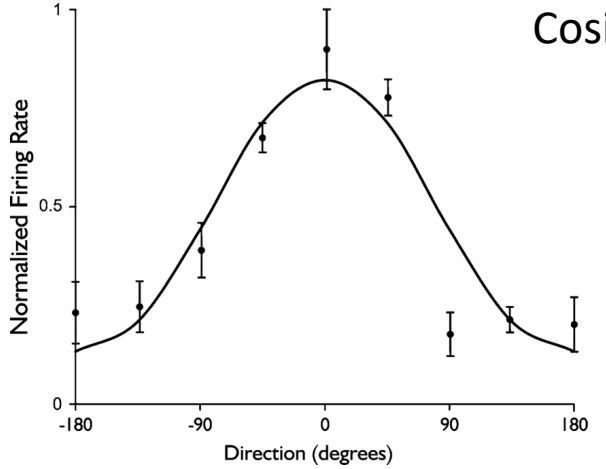
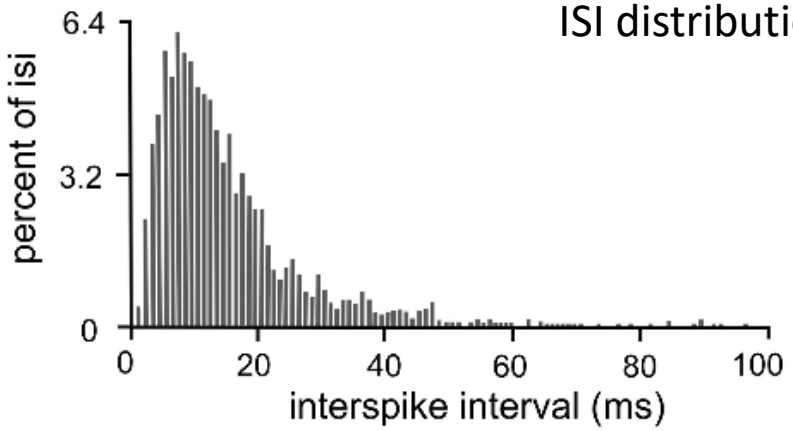
Cosine tuning



ISI distribution

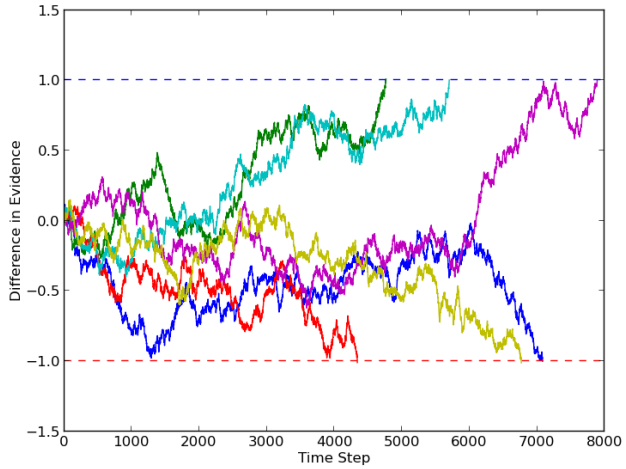


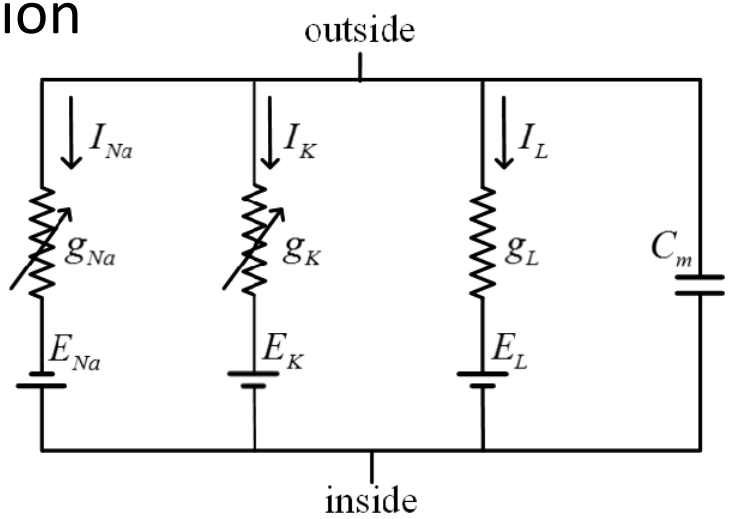
Different types of models answer different questions

2. “How” models

- How does the brain make the data ?
- Equation approximating the mechanism
- Identify hidden assumptions, latent variables
- Study the effect of an intervention
- Predictions
- Why is the brain doing so ?

Decision making



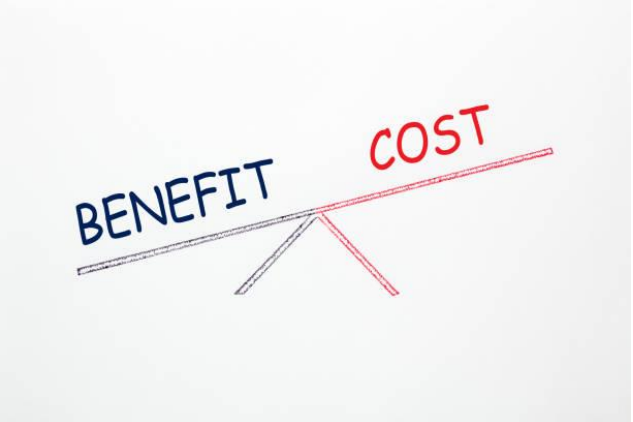


Spikes generation

Different types of models answer different questions

1. “Why” models
   - ✓ Why is the brain the way it is ?
   - ✓ Equation that comes from an optimizing problem
   - ✓ Provide a normative benchmark
   - ✓ Identify hidden assumptions, latent variables
   - ✓ Predictions
   - ✗ How the brain does that ?

Optimization process



What’s next ?

- First notebook: reminder of some statistics principles
- See on the github repository (link on moodle) and open “LGBIO2060-TP1” in Colab
- Don’t forget to save your work !