Computational Neuroscience: Vision

Course Introduction
+ Linear Systems
Model Types
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• Descriptive (what?)
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  - eg: tuning curves, receptive field, LNP
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• Mechanistic (how?)
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  • eg: compartmental models, Hodgkin-Huxley
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• Interpretive/Explanatory (why?)
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  • eg: tuning curves, receptive field, LNP

• Mechanistic (how?)
  • eg: compartmental models, Hodgkin-Huxley

• Interpretive/Explanatory (why?)
  • eg: efficient coding, optimal estimation/decision, wiring length, metabolic cost, etc
Interaction with Experiments
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• Fit existing data
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• Make predictions...
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  - for other neurons, under other conditions
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  - of mechanisms not yet understood (e.g., HH)
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  - of behavior
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  - of behavior
  - in other animals/species
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  - that can be tested with new experiments
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• Develop new experiments...
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• Develop new experiments...
  - to refine model
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• Develop new experiments...
  - to refine model
  - to differentiate models
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  - of behavior
  - in other animals/species
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- Develop new experiments...
  - to refine model
  - to differentiate models
  - with optimized stimuli
Simple is good
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• Curse of dimensionality
Simple is good

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• Occam’s Razor
Simple is good

• Curse of dimensionality

• Occam’s Razor

• Linearity...
Linear Systems
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• Extremely well understood
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- Extremely well understood
- Excellent design/characterization toolbox
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- An idealization (they do not exist!)
Linear Systems

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- Excellent design/characterization toolbox
- An idealization (they do not exist!)
- But are still useful:
  - conceptualization of fundamental issues
  - provide baseline performance (often remarkably good)
  - starting point for more complex model
Quick overview of
Linear Systems Theory

(on the board)