Grand Finale!

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Vast array of stuff addressed by sims: from ion channels to attentional set-shifting.

Models are useful tools for theory building and testing.

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- Language: transformations, interacting orthographic, semantic, and phonological pathways

- Higher level cognition: activation-based processing, gating, top-down control, development of abstract PFC reps

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- Theta Oscillations: dynamics of network settling influences learning/memory

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- Models provide a unified framework, fit with neural data but take behavior seriously!

Scope of models: Your Final Projects!

- Memory and oscillations and sleep
- Face recognition in object pathway
- Ganong and McGurk effects
- Color perception, tactile detection
- Synesthesia Types
- Grid cells and place cells
- Hippocampus and drugs
- Schizophrenia and episodic/working memory
- Super memory
- Parkinson's, deep brain stimulation: oscillations, inhibitory control
- Context in attention model
- Arithmetic in deep networks
- Epilepsy and vagnus nerve stimulation
- Receptive fields in IT and object recogniton

Scope of models: Previous projects

Huntington's and learning
Tourrette's Syndrome model of tics
Musical interval learning
Demand avoidance and conflict in ACC/DA
Modeling addiction in the fruit fly
orbitofrontal scaling of rewards
Modeling Ikea Task!
Context in semantic memory
Mere exposure effect
Development and hierarchical rule learning
Antipsychotics and motor learning
Facial Spatial Neglect
Training primary visual cortex with mother's faces
Minimizing interference in hippocampus/neurogenesis
Learning context-sensitive grammar in BG-PFC
Aging and working memory in BG-PFC
Comparing models of speech perception
Framework for phonological vs phonetical judgments
Evolutionary algorithms in neural nets
Generalization in family trees
Neural model of inference
Cognitive dissonance and conflict

Learning reliability of landmark vs path-integration cues
Unified explanation of EEG responses to conflict and reinforcement
Simulating neural fatigue and memory interference
Word segmentation and object labeling
Bootstrapping object recognition with saccades and Hebb
Theta oscillations for repairing attractors during sleep
Role of V1-V4 interconnectivity in objrec and generalization
Dopaminergic effects on cognition in schizophrenia
Goal-directed behavior and outcome-specific revaluation in amygdala/OFC
Perceptual localization and attention

Remaining/Recurring Issues: Specific

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- Wiring.
- more physiological detail: glia, vessels, etc
- Missing brain areas, neurotransmitters (NE, 5HT).
- Scaling.
- Error signals.
- Higher order cognition
- Large-scale models: glue together models of hippo, cortex, PFC, basal ganglia.. how do these interact?

Remaining/Recurring Issues: General

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- Models are too simple.
  - detailed bio has to be considered within a larger functional (and necessarily simplified) framework.
  - often can compare detailed to simplified models: inhib interneurons vs FFFB; spike vs rate code
  - solve one problem at a time; test, refine add complexity

Remaining/Recurring Issues: General

- Models are too complex.
  - too complicated to explain verbally – but explanatory vs descriptive
  - principles that come out of models should transcend particular implementations
  - link across levels of modeling...

Remaining/Recurring Issues: General

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- Models can do anything.
  - parameters... but not so simple
  - generalization (test on untrained)
  - Constraints! many methods in cogneuro - models bring together
  - New predictions!

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- Models are reductionistic.
  - reconstructionism: ion channels and elec conductances in neurons, magnesium block for LTP ...
  - relevant for higher levels (self-organizing learning and V1), but whole new terminology becomes relevant (attractors, constraint satisfaction, distributed sparse, etc)

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Last Slide!

- Thanks
- Get involved in research
- Stop by any time
- Have a great break