COSYNE 2014

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WORKSHOPS

Snowbird, UT

Mar 3 - 4

COSYNE 2014 Workshops

Snowbird, UT
Mar 3-4, 2014

Organizers:
Tatyana Sharpee
Robert Froemke

COSYNE 2014 Workshops

March 3 & 4, 2014

Snowbird, Utah

Monday, March 3, 2014	**Organizer(s)**	**Location**
1. Computational psychiatry – Day 1	Q. Huys T. Maia	*Wasatch A*
2. Information sampling in behavioral optimization – Day 1	B. Averbeck R.C. Wilson M. R. Nassar	*Wasatch B*
3. Rogue states: Altered Dynamics of neural activity in brain disorders	C. O'Donnell T. Sejnowski	*Magpie A*
4. Scalable models for high dimensional neural data	I. M. Park E. Archer J. Pillow	*Superior A*
5. Homeostasis and self-regulation of developing circuits: From single neurons to networks	J. Gjorgjieva M. Hennig	*White Pine*
6. Theories of mammalian perception: Open and closed loop modes of brain-world interactions	E. Ahissar E. Assa	*Magpie B*
7. Noise correlations in the cortex: Quantification, origins, and functional significance	J. Fiser M. Lengyel A. Pouget	*Superior B*
8. Excitatory and inhibitory synaptic conductances: Functional roles and inference methods	M. Lankarany T. Toyoizumi	*Maybird*

Workshop Co-Chairs	**Email**	**Cell**
Robert Froemke, NYU	Robert.Froemke@med.nyu.edu	510-703-5702
Tatyana Sharpee, Salk	sharpee@salk.edu	858-610-7424

Maps of Snowbird are at the end of this booklet (page 38).

COSYNE 2014 Workshops

March 3 & 4, 2014

Snowbird, Utah

Tuesday, March 4, 2014	**Organizer(s)**	**Location**
1. Computational psychiatry – Day 2	Q. Huys T. Maia	*Wasatch A*
2. Information sampling in behavioral optimization – Day 2	B. Averbeck R.C. Wilson M. R. Nassar	*Wasatch B*
3. Discovering structure in neural data	E. Jonas S. Linderman R. Adams K. Körding	*Superior A*
4. Thalamocortical network mechanisms for cortical functioning	M. Sherman W. M. Usrey	*Superior B*
5. Canonical circuits, canonical computations	A. Disney K. Padmanabhan	*Magpie A*
6. From the actome to the ethome: Systems neuroscience of behavioral ecology	A. Faisal C. Rothkopf	*Magpie B*
7. Sequence generation and timing signals in neural circuits	K. Rajan C. D. Harvey D. W. Tank	*Maybird*
8. Multisensory computations in the cortex	J. Makin P. Sabes	*White Pine*

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Schedule

Each workshop group will meet in two sessions from ~8–11 am and from 4:30–7:30 pm.
Workshop summaries and schedules are available starting on page 3 of this booklet.

Transportation

Marriott Downtown to Snowbird: Free shuttle provided for registered attendees
(first shuttle leaves @ 4pm, last @ 5pm on Sunday, 2 Mar 2014).
Snowbird to Salt Lake City Airport:
Shuttle can also be arranged at Snowbird, or online at:
https://store.snowbird.com/ground_transport/

Further information about transportation to/from Snowbird is available at:
http://www.snowbird.com/about/accessibility.html
For further information on transportation or other logistics please contact Denise Soudan (denise.soudan@rochester.edu).

Lift tickets

Discounted workshop rates

Snowbird Chairlifts only: $62

Snowbird Tram & Chairlifts: $72

Pick up at the Cliff ticket window (level 1 of the Cliff Lodge next to the ski rental shop) or at the ticket window on the top level of the Snowbird Center (the plaza deck).

Meals included with registration

Breakfast (Day 1 and Day 2) - The Cliff Ballroom
Dinner (Day 2) - The Cliff Ballroom
Coffee breaks during morning and afternoon sessions

BURROUGHS WELLCOME FUND

1. Computational Psychiatry – Day 1

Monday, March 3, 2014

Organizers:
Quentin Huys, ETH Zurich
Tiago Maia

Computational techniques have become increasingly important to neuroscience. Over the past few years, researchers have started to fruitfully apply such techniques to mental health, with applications in clinical practice now coming into reach. The approaches are fascinatingly diverse, spanning many imaging modalities, multiple levels of characterization of brain function and a vast array of computational and machine learning techniques.

The workshop at Cosyne will bring together a large fraction of the key workers from across the spectrum of the field. Though nascent, computational psychiatry is a rapidly growing field and now is maybe the last opportunity for a reasonably comprehensive overview. Given the scope and breadth of questions and methods, such an overview is hard to fit into one day in a cohesive manner, and we have thus prepared a two-day workshop. It is important that this workshop should be held as part of Cosyne: it is one of the conferences with the most applicable broad technical skill sets for the problem at hand; the neuroscience of mental health is of genuine interest to the Cosyne community at large; and it is probably the main health sector to which insights gained in the Cosyne community can be applied. We hope to contribute to the consolidation of the field and the clarification of the key solvable questions by bringing together scientists using different techniques and working on different aspects of the same problem at this critical time of expansion.

The first day will focus particularly on reinforcement learning and decision-making approaches, while the second day will broaden the scope and encompass work ranging from explicit neural network models to large-scale models of social interactions in psychiatric populations.

Computational Psychiatry – Day 1

Wasatch A

Morning session Decision-making approaches

8:00–8:05 am	*Quentin Huys and Tiago Maia,* Welcome and overview
8:05–8:45 am	*Martin Paulus,* The utility of computational psychiatry
8:45–9:25 am	*Angela Yu,* Learning and decision-making in inhibitory control
9:25–9:40 am	Coffee break
9:40–10:20 am	*Quentin Huys.* Decision-theoretic psychiatry

Afternoon session Impulsivitty & Compulsivity

4:30–5:10 pm	*Tiago Maia,* Reinforcement learning in avoidance, habits, and tics
5:10–5:50 pm	*Nathaniel Daw.* Reinforcement learning and compulsion
5:50–6:10 pm	Coffee break
6:10–6:35 pm	*Frederike Petzchner.* Impulsive gambling
6:50–7:30 pm	*Valerie Voon.* Recent studies in impulsivity and compulsivity across disorders of addiction.

2. Information Sampling in Behavioral Optimization – Day 1

Monday, March 3, 2014

Organizers:

Bruno Averbeck,	National Institutes of Mental Health
Robert C. Wilson,	Princeton Neuroscience Institute
Matthew R. Nassar,	University of Pennsylvania

All learning depends on information - without information there is nothing to learn. But gathering information can be costly and the desire to learn can be opposed by the need for speed or the desire for immediate reward. In this workshop we will examine the role of information sampling in two well-known behavioral problems: the speed-accuracy tradeoff and the explore-exploit dilemma. We will hear from researchers studying these problems across a wide range of species, from monkeys and humans to rats and worms. We will look at information sampling algorithms that solve these problems optimally and the extent to which neural circuits and neuromodulators support these algorithms in the brain.

Our aim is to bring together a diverse set of participants, from the usual reinforcement learning and decision making crowd, to researchers interested in foraging and theorists interested in algorithms. In the spirit of exploration, most of the talks will be given by non-faculty members -- i.e. postdocs and graduate students. We believe that this focus on the first authors, rather than the last, will not only provide a welcome forum for new voices, but will also encourage fresh perspectives on these classic problems.

To highlight the similarity of the two behavioral problems, we will interleave talks on the explore-exploit dilemma with talks on the speed-accuracy tradeoff and several talks will combine both.

Information Sampling in Behavioral Optimization – Day 1

Wasatch B

Morning session

8:30–9:00 am	*Robert Wilson,* Human strategies for solving the exploration-exploitation dilemma
9:05–9:35 am	*Steven Flavell,* Serotonin and the neuropeptide PDF initiate and extend opposing behavioral states in *C. elegans*
9:55–10:25 am	*Shunan Zhang,* Forgetful Bayes and myopic planning: human exploration and exploitation in bandit problems
10:30–11:00 am	*Paul Schrater,* Optimal exploration driven by reward statistics

Afternoon session

4:30–5:00 pm	*Erie Boorman,* Frontal polar cortex and the evidence for changing future behavior
5:05–5:35 pm	*Andra Geana,* Reward, Risk and Ambiguity in Human Exploration - A Wheel of Fortune Task
5:55–6:25 pm	*Vincent Costa,* Neural and Dopaminergic Contributions to Novelty Driven Choice Behavior
6:30–7:00 pm	*Matt Nassar,* “Dissociating information value from information quantity

3. Rogue States: Altered Dynamics of Neural Circuit Activity in Brain Disorders

Monday, March 3, 2014

Organizers:
Cian O'Donnell and Terrence Sejnowski
Salk Institute for Biological Studies

Understanding and treating psychiatric and neurodevelopmental disorders such as schizophrenia, mood disorders, and autism is one of the central challenges for neuroscience research this century. Crucially, the devastating cognitive effects seen in these illnesses are likely the result of disruptions of neural circuit wiring and dynamics. Although these illnesses are heterogenous in origin, recent research has discovered several common circuit-level defects, including: imbalances in excitation-inhibition, changes in brain rhythms, and alterations in activity percolation. This workshop will bring together experimental and theoretical researchers that study brain disorders in both human patients and animal disease models to discuss several key questions:

1) How can such disparate diseases cause similar alterations in neural activity?

2) On the other hand, what are the main differences in circuit activity patterns between diseases?

3) Why would these alterations be detrimental for neural coding and cognitive function?

4) How can computational modeling of neural networks inform future experiments in the field?

Rogue States: Altered Dynamics of Neural Circuit Activity in Brain Disorders

Magpie A

Morning session

8:15–8:30 am	Introduction
8:30–9:00 am	*Wilson Truccolo,* Neural dynamics in human focal epilepsy
9:00–9:30 am	*Terrence Sejnowski,* Neural dynamics in models of human focal epilepsy
9:30–10:00 am	Coffee break
10:00–10:30 am	*Jessica Cardin,* Cell type-specific contributions to neural deficits in a general model of schizophrenia
10:30–11:00 am	*Tim Vogels,* Disease states in balanced network models: Schizophrenia as a network-level dysfunction

Afternoon session

4:30–5:00 pm	*Ofer Yizhar,* Advanced optogenetic approaches for probing cortical circuits
5:00–5:30 pm	*Carlos Portera-Cailliau,* Circuit-level dysfunction in the neocortex of Fragile X mice
5:30–6:00 pm Fragile-X	*Cian O'Donnell,* Low-dimensional cortical activity in
6:00–6:30 pm	Coffee break
6:30–7:00 pm	*Jim Cavanagh,* Synchrony in the subthalamic nucleus: adaptive and maladaptive patterns in health and disease
7:00–7:30 pm	*Karl Deisseroth,* Optical reconstruction of fully-assembled biological systems

4. Scalable Models for High-Dimensional Neural Data

Monday, March 3, 2014

Organizers:
Il Memming Park, Evan Archer, and Jonathan Pillow
University of Texas at Austin

Computational neuroscience will soon be inundated with data of an unprecedented size and quality. New techniques and projects such as the BRAIN Initiative spur an exponential increase in the number of simultaneously recorded neurons. But are we prepared to analyze such large data? In the era of “big data”, it’s tempting to think that ever-larger datasets will alone overcome scientific challenges. On the contrary, however, large and high-dimension data bring with it new hurdles for analysis. Increasing population sizes leave neural models with less data per parameter; meanwhile, many of the most popular tools in neuroscience scale poorly. This calls for a new kind of spike train analysis tools which are *scalable* to many (possibly hundreds to thousands) neurons. To prepare for coming flood of data, we invite experts on scalable neural modeling/analysis tools to shed light on the future of neural models.

- Which classes of models are scalable? How can we extend current models to be more scalable?

- Which models exploit the structure of population activity, such as low dimensionality and sparseness?

- What optimization techniques are efficient for large spike train datasets?

- How can we use Bayesian formalism to reduce the data required to fit models and estimate statistics?

- What can we learn from large-scale high-dimensional data?

- What kind of statistics will be powerful enough to verify/falsify population coding theories?

- What are the important questions we think will be answered by scalable models?

Scalable Models for High-Dimensional Neural Data

Superior A

Morning session

8:20–8:30 am	*Memming Park & Evan Archer,* Opening remarks
8:30–9:00 am	*Konrad Körding,* Big datasets of spike data: why it is coming and why it is useful
9:00–9:30 am	*Jeremy Freeman,* Distributed computing for large scale neuroscience
9:30–10:00 am	Coffee break
10:00–10:30 am	*Mark Churchland,* Tensor-based dimensionality reduction for data exploration
10:30–11:00 am	*John Cunningham,* Extracting low-dimensional dynamics

Afternoon session

4:30–5:00 pm	*Rob Kass,* Statistical considerations in making inferences about neural networks: the case of synchrony detection
5:00–5:30 pm	*Lars Büsing,* Dynamical component analysis of neural data
5:30–6:00 pm	Coffee break
6:00–6:30 pm	*Matteo Carandini,* Soloists and choristers in a cortical population
6:30–7:00 pm	*Memming Park,* Scaling up with Bayes
7:00–7:30 pm	*Surya Ganguli.* What are the right questions, and how many neurons do we need to answer them?

5. Homeostasis and Self-Regulation of Developing Circuits: From Single Neurons to Networks

Monday, March 3, 2014

Organizers:
Julijana Gjorgjieva, Harvard University
Matthias Hennig, University of Edinburgh

Abstracts are available at: http://homepages.inf.ed.ac.uk/mhennig/Cosyne2014/

This workshop will address **common mechanisms governing the activity-dependent organization and tuning of neural circuits** during development. It will focus on two main themes:

- the emergence of single neuron properties that influence neural computation

- the development and stability of network properties

Multiple forms of plasticity, including Hebbian and homeostatic rules, not only sculpt out and refine the connectivity of neural circuits, but also influence single neuron physiology and thus determine neural computations. This interplay of different activity-dependent mechanisms, together with genetic and molecular specification of neural properties, complicates the interpretation of experimental manipulations. Theoretical approaches, ranging from mechanistic models to conceptual frameworks, have played an important role in disentangling the contributions and roles of different mechanisms. Here we aim to **bring together scientists from experimental and theoretical communities** to expose recent progress and to discuss current open questions.

Homeostasis and Self-Regulation of Developing Circuits: From Single Neurons to Networks

White Pine

Morning session

8:00–8:10 am	Introduction
8:10–8:45 am	*Timothy O'Leary,* Neuronal variability, cell types, network homeostasis and pathological compensation from a single, biologically plausible ion channel expression model
8:45–9:20 am	*Alex Ward,* Establishing wiring specificity in the fly olfactory system
9:20–9:40 am	Coffee break
9:40–10:15 am	*Joel Tabak,* A universal pattern of activity in developing neural networks?
10:15–11:00 am	*Christian Lohmann,* Spontaneous activity wires developing circuits with subcellular precision

Afternoon session

4:30–5:05 pm	*J. Natahn Kutz,* A reaction-diffusion model of cholinergic retinal waves
5:05–5:40 pm	*Jianhua Cang,* Critical period plasticity and binocular matching in the mouse visual cortex
5:40–6:00 pm	Coffee break
6:00–6:35 pm	*Adrienne Fairhall¸* Structure of spontaneous activity in developing cortex
6:35–7:10 pm	*Mark Huebener,* How sensory deprivation and learning change neuronal responses in mouse visual cortex
7:10–7:30pm	General Discussion

6. Theories of Mammalian Perception: Open and Closed Loop Modes of Brain-World Interactions

Monday, March 3, 2014

Organizers:
Ehud Ahissar and Eldad Assa
Weizmann Institute of Science

Different hypotheses of the perceptual process will be presented and contrasted along the following axes of brain-world interactions:

- Open-loop versus closed loop processes ("open-loop" means that the external object triggers internal processes but its presence is not further required; "closed-loop" means that the perceptual process continuously depends on the presence of the object)

- Active versus passive processes ("active" means that the movements of the sensory organ are an integral component of perception; "passive" means that they are not)

- Conscious versus unconscious processes (are these categorically different processes?)

- Brain-world versus brain-brain processes (are these categorically different processes?)

Contrasting leading hypotheses across these basic axes is expected to be of interest to scientists who are attempting to understand neuronal mechanisms of perception via computational or experimental methods.

Theories of Mammalian Perception: Open and Closed Loop Modes of Brain-World Interactions

Magpie B

Morning session

8:00–8:30 am	*Saskia Haegens,* Mechanistic role of alpha oscillations in sensory processing
8:30–9:00 am	*Merav Ahissar.* Perception as an acquired skill
9:00–9:30 am	Coffee break
9:30–10:00 am	*Eli Nelken,* Objects of perception: the case of auditory objects.
10:00–10:30 am	*Atsushi Iriki.* Triadic niche-construction: Primate brain evolution through interactions among ecological, neural, and cognitive worlds.
10:30–11:00 am	Discussion

Afternoon session

4:30–5:00 pm	*Michele Rucci.* Active close-loop processing during visual fixation
5:00–5:30 pm	*Ehud Ahissar.* A close-loop hypothesis of perception
5:30–6:00 pm	Coffee break
6:00–6:30 pm	*Nava Rubin,* Perceptual attractors, conceptual attractors, and bi-stable stimuli
6:30–7:00 pm	*Eldad Assa,* Closed Loop Perception models: examples from the rat vibrissal system
7:00–7:30 pm	Discussion

7. Noise Correlations in the Cortex: Quantification, Origins, and Functional Significance

Monday, March 3, 2014

Organizers:

Jozsef Fiser, CEU

Mate Lengyel, Cambridge,

Alex Pouget, University of Geneva

With the recent transition of modern large-scale measuring methods, such as multi-electrode arrays and two-photon imaging, to the mainstream of system neuroscience, the problem of correlated neural activity gained a renewed significance. It is now clear that various types of correlations are abundant in the cortical neural signal and clarifying their role might be potentially transformative for our understanding about the nature of information processing in the cortex. Despite this, beyond the general agreement that there exist noise correlations in the cortex, there is mostly a heated debate in the community about the extent, magnitude, the cause of their emergence, and their functionality. There is a missing consensus about whether these correlations are minimal or large, same or different in anesthetized and awake animals, and if they are essential for understanding the operations carried out in the cortex. In this workshop, we will visit these questions and some proposed answers to them, and will argue that only few proposals in the field can provide a comprehensive treatment in the three domains of description (D), mechanism/dynamics (M) and function (F) of correlations in the cortex. Specifically, we will ask the following questions:

a) Do we have a clear agreement on the definition, measurement and description of various stimulus dependent and independent forms of noise correlations found in the cortex?

b) Are the proposed accounts (information-theoretical, dynamics-based, etc.) provide a satisfactory accounts of what and how should be computed by cortical neurons and also offer an adequate answer to how correlations factor into this computation?

In particular, we will contrast a probabilistic treatment of these issues with other alternatives to examine whether it provides the most coherent answers in all three of the domains above. To achieve this goal, we will invite both experimentalist and theorist of various philosophical background to present their work that will speak to questions in one or more of these domains sometimes contrasting each other's take on the issues. Hence the workshop will be of interest for both experimentalists using the latest methods of physiological recording from a large number of units in parallel and for theorists working on the correlational structure of neural activity.

At the end of the workshop, we will resolve all remaining issues with a now-traditional-event of wine-tasting.

Noise Correlations in the Cortex: Quantification, Origins, and Functional Significance

Superior B

Morning session

8.00–8.10 am	*Jozsef Fiser,* Introduction
8.10–8.40 am	*Adam Kohn,* Factors influencing neuronal correlations
8.40–9.10 am	*Matthias Bethge,* What can correlations tell about sensory populations coding?
9.10–9.40 am	*Robee Goris,* Partitioning neural covariability
9.40–9.55 am	Coffee break
9.55–10.25 am	*Mate Lengyel,* Sampling and correlations
10.25–10.55 am	*Peter Latham,* Good and bad correlations

Afternoon session

4:00–4.30 pm	*Bruce Cummings,* The structure of noise correlations is task dependent
4.30–5.00 pm	*Marlene Cohen,* Attention can flexibly increase or decrease spike count correlations
5.00–5.15 pm	Coffee break
5.15–5.45 pm	*Ralf Haefner,* The role of correlated variability in a hierarchical probabilistic inference framework
5.45–6.15 pm	*Alex Pouget,* The origin of differential correlations
6.15–6.45 pm	Discussion with wine-tasting

8. Excitatory and Inhibitory Synaptic Conductances: Functional Roles and Inference Methods

Monday, March 3, 2014

Organizers:
Milad Lankarany, Concordia Université
Taro Toyoizumi, RIKEN Brain Science Institute

Time-varying excitatory and inhibitory (E&I) synaptic conductances govern activity of neurons and considerably influence the information processing in the brain. Inferring these synaptic conductances elucidates several functional roles underlying neurons; including receptive field properties (Wehr and Zador 2003; Priebe and Ferster 2005), up/down transitions (Shu et al. 2003) and experience-dependent plasticity (Mitani et al. 2013). Therefore, inferring synaptic conductances from single trials of neural recordings has recently stimulated enormous interest in neuroscience. Trial-by-trial estimation of the E&I conductances provides much more information about E&I coordination than conventional techniques that characterize only trial averages. Covariation of E&I has recently been observed using novel experimental techniques in various systems (Okun and Lampl 2008; Tan et al. 2013) and has been shown to influence spiking responses of neurons (Cafaro and Rieke 2013). In parallel to such experimental techniques, advanced statistical techniques with wide applicability have been proposed for inferring E&I conductances from single trial of neural recordings (Bedard et al. 2012; Paninski et al. 2012; Berg and Ditlevsen 2013; Lankarany et al. 2013). Thus, effective collaborations combining advanced computational methods, novel experimental technologies, and computational modeling is the key to explore the E&I balance. The main objective of this workshop is to address the functional roles of E&I conductances and their inference based on single trials of neural recordings. We have the opportunity of hosting cutting edge scientists from both computational and experimental fields. This workshop discusses about the latest advances in this domain from experimental, methodological and modeling perspectives and, with higher hopes, aims at stimulating future theoretical and experimental collaborations to uncover novel computational functions achieved by E&I circuitry.

Excitatory and Inhibitory Synaptic Conductances: Functional Roles and Inference Methods

Maybird

Morning session

8:00–8:05 am	Welcome
8:05–8:45 am	*Brent Doiron,* Formation and maintenance of neuronal assemblies through synaptic plasticity"
8:45–9:25 am	*Andrew Tan,* A spontaneous state of weakly correlated synaptic excitation and inhibition in visual cortex
9:25–9:40 am	Coffee break
9:40–10:20 am	*Ilan Lampl,* Cortical E/I balance during tactile adaptation and ongoing activity
10:20–11:00am	*Milad Lankarany.* Trial by trial tracking of excitatory and inhibitory conductances: recursive Kalman filtering methods and case studies

Afternoon session

4:10–4:50 pm	*Christoph Schreiner.* Diversity in auditory cortex plasticity
4:50 –5:30pm	*Kevin Fox,* Experience dependent plasticity of Regular spiking and Intrinsic Bursting cells in cortical layer V
5:30–6:00pm	Coffee break
6:00–6:40pm	*Alfonso Renart.* Dynamics of excitation and Inhibition in recurrent networks
6:40–7:00 pm	Open discussion/debate on the methods & experiments

1. Computational Psychiatry – Day 2

Tuesday, March 4, 2014

Organizers
Quentin Huys, ETH Zurich
Tiago Maia

Computational techniques have become increasingly important to neuroscience. Over the past few years, researchers have started to fruitfully apply such techniques to mental health, with applications in clinical practice now coming into reach. The approaches are fascinatingly diverse, spanning many imaging modalities, multiple levels of characterization of brain function and a vast array of computational and machine learning techniques.

The workshop at Cosyne will bring together a large fraction of the key workers from across the spectrum of the field. Though nascent, computational psychiatry is a rapidly growing field and now is maybe the last opportunity for a reasonably comprehensive overview. Given the scope and breadth of questions and methods, such an overview is hard to fit into one day in a cohesive manner, and we have thus prepared a two-day workshop. It is important that this workshop should be held as part of Cosyne: it is one of the conferences with the most applicable broad technical skill sets for the problem at hand; the neuroscience of mental health is of genuine interest to the Cosyne community at large; and it is probably the main health sector to which insights gained in the Cosyne community can be applied. We hope to contribute to the consolidation of the field and the clarification of the key solvable questions by bringing together scientists using different techniques and working on different aspects of the same problem at this critical time of expansion.

The first day will focus particularly on reinforcement learning and decision-making approaches, while the second day will broaden the scope and encompass work ranging from explicit neural network models to large-scale models of social interactions in psychiatric populations.

Computational Psychiatry – Day 2

Wasatch A

Morning session	**Networks, aging, and placebo effects**
8:00–8:40 am	*John Murray,* Abnormal excitatory-inhibitory interplay at local and large scales associated with schizophrenia
8:40–9:25 am	*Rosalyn Moran,* Predictive coding and aging neurobiology
9:25–9:40 am	Coffee break
9:40–10:20 am	*Lauren Atlas,* Towards a quantitative model of placebo effect
Afternoon session	**Social & large scale approaches**
4:30–5:10 pm	*Ken Kishida,* Human in vivo dopamine release measurements - current findings and future implications
5:10–5:50 pm	*Brooks King-Casas,* Neural computations of social dominance in psychiatric illness
5:50–6:10 pm	Coffee break
6:10–6:50 pm	*Michael Moutoussis,* Psychiatric symptomatology and computational processes at the epidemiological scale
6:50–7:30 pm	*Michael Frank,* Model-based cognitive neuroscience approaches to computational psychiatry: clustering and classification

2. Information Sampling in Behavioral Optimization – Day 2

Tuesday, March 4, 2014

Organizers:

Bruno Averbeck,	National Institutes of Mental Health
Robert C. Wilson,	Princeton Neuroscience Institute
Matthew R. Nassar,	University of Pennsylvania

All learning depends on information - without information there is nothing to learn. But gathering information can be costly and the desire to learn can be opposed by the need for speed or the desire for immediate reward. In this workshop we will examine the role of information sampling in two well-known behavioral problems: the speed-accuracy tradeoff and the explore-exploit dilemma. We will hear from researchers studying these problems across a wide range of species, from monkeys and humans to rats and worms. We will look at information sampling algorithms that solve these problems optimally and the extent to which neural circuits and neuromodulators support these algorithms in the brain.

Our aim is to bring together a diverse set of participants, from the usual reinforcement learning and decision making crowd, to researchers interested in foraging and theorists interested in algorithms. In the spirit of exploration, most of the talks will be given by non-faculty members -- i.e. postdocs and graduate students. We believe that this focus on the first authors, rather than the last, will not only provide a welcome forum for new voices, but will also encourage fresh perspectives on these classic problems.

To highlight the similarity of the two behavioral problems, we will interleave talks on the explore-exploit dilemma with talks on the speed-accuracy tradeoff and several talks will combine both.

Information Sampling in Behavioral Optimization – Day 2

Wasatch B

Morning session

8:30–9:00 am	*Samarth Chandra*
9:05–9:35 am	*Marieke Jepma,* Noradrenergic modulation of exploration and learning in dynamic environments
9:55–10:25 am	*Christopher Fetsch,* Perceptual confidence from sequential sampling
10:30–11:00 am	*Kevin Miller,* Fitting the data as well as it can be fit: An analysis of rodent behavior on the two–armed bandit task

Afternoon session

4:30–5:00 pm	*Adam Calhoun,* A circuit for learning about environmental variability over long timescales
5:05–5:35 pm	*Jan Drugowitsch,* Behavioral variability induced by inference of limited precision
5:55–6:25 pm	*Laurence Hunt,* Comparing human and macaque information search strategies in decision making
6:30–7:00 pm	*Bruno Averbeck,* Normative perspectives on exploration, sampling and foraging

3. Discovering Structure in Neural Data

Tuesday, March 4, 2014

Organizers:

Eric Jonas,	University of California, San Francisco
Scott Linderman,	Harvard University
Ryan Adams,	Harvard University
Konrad Kording,	Northwestern University

www.neuralstructure.org

Neural systems exhibit complex, dynamical, highly structured responses at multiple scales. The rise of high-throughput neural data–electrophysiological, functional, connection-based, and optical–is placing greater demands on computational methods. In this workshop we discuss statistical and machine learning methods of identifying hidden structure in this data–patterns that are not obvious or apparent with more traditional approaches. Latent variable models, complex time series models, graph structure discovery methods, and others are all appropriate. Goals

1. Large-scale recordings, particularly in higher-order areas, challenge us to go beyond stimulus response properties of cells and start probing complex neural computations in a data-driven manner. For example, how can we discover state-dependent computations or unravel neural algorithms from data? How can the tools of machine learning and statistical inference link our top-down theoretical knowledge with bottom-up neural recordings?

2. Advances in neural recording methodologies are being made across many modalities. We have access to electrophysiological, fMRI, optical, connectomics, and MEG recordings, each of which provides insight at different spatiotemporal scales. How can our methods bridge these disparate recording modalities and connect latent patterns and functional interactions to anatomical measurements?

3. How do we scale our methods to massive datasets? This is not only a computational challenge for large-scale statistical inference, but also a modeling question. Is the inferred functional connectivity graph of a 10K neuron population meaningful, or should we instead be looking for lower-dimensional structure?

Discovering Structure in Neural Data

Superior A

Morning session

8:00–8:30 am	*Eric Jonas,* Discovering circuits in connectomics data
8:30–9:00 am	*Jonathan Pillow,* Inferring intracellular excitatory and inhibitory conductances from extracellular spike trains
9:00–9:30 am	*Uri Eden,* Estimating biophysical parameters of dynamical neural models from spike trains using a point process particle filter algorithm"
9:30–10:00 am	Coffee Break
10:00–10:30 am	*Zhe Chen,* A latent space approach to uncover neural representations of rodent hippocampal-cortical circuits
10:30–11:00 am	*Joshua Vogelstein,* Discovering structure in neural graphs

Afternoon session

4:30–5:00 pm	*Friedrich Sommer,* Decoding the animal's position from discovering structure in neural graphs
5:00–5:30 pm	*Danielle Bassett,* Probing brain network dynamics during learning
5:30–6:00 pm	Coffee Break
6:00–6:30 pm	*David Pfau,* Identifying neuron and inferring dynamics in whole-brain recordings from larval zebrafish
6:30–7:00 pm	*Maneesh Sahani,* Dynamical structure in neocortical population activity
7:00–7:30 pm	*Eric & Scott*, Discussion

4. Thalamocortical Network Mechanisms for Cortical Functioning

Tuesday, March 4, 2014

Organizers:

Murray Sherman, University of Chicago

W. Matrin Usrey, University of California, Davis

Until recently, thalamus has been neglected as a major player in cortical functioning, seen mainly as a bottleneck through which subcortical information flows to cortex, with no further role. However, we now appreciate that thalamus plays an ongoing role in cortical functioning, based on a number of new research findings. These include evidence that much of thalamus is critically involved in communication between cortical areas, is involved in attentional mechanisms, has much more complex connections with cortex in both directions than previously appreciated, and has complex circuitry organized to dynamically control flow of information to cortex and between cortical areas. We also are beginning to understand much more about the nature of the large feedback corticothalamic projection and its role in controlling information flow.

The purpose of this workshop is to bring together workers in the field of thalamocortical relationships to discuss new ideas about thalamocortical functioning. The speaker list includes both experimental and theoretical contributors, and the workshop is designed to encourage extensive discussion amongst the participants. We also hope to encourage those interested more generally in cortical functioning to attend. A main goal is to raise awareness among neuroscientists of the emerging notion that cortical functioning cannot be understood without taking into account thalamus and thalamocortical relationships. In addition to those interested generally in sensory processing, attention, circuit issues, etc., we specifically target the large number of neuroscientists, both experimental and theoretical, who self-identify as cortical specialists. Among this latter group, which is so dominant in contemporary neuroscience, is the implicit idea that all cortical processing is done by cortical circuits alone, with no special role for thalamus. We feel it is of great importance to emphasize the importance of thalamus in such functions.

Thalamocortical Network Mechanisms for Cortical Functioning

Superior B

Morning session

8:00–8:35 am	*Marty Usrey,* Dynamic properties of thalamocortical circuits for vision
8:35–9:10 am	*Judith Hirsch,* Neural circuits for visual processing in thalamus
9:10–9:45 am	*Martha Bickford,* How is the superior colliculus involved in thalamocortical networks?
9:45–10:00 am	Coffee Break
10:00–10:35 am	*Heather Read,* Thalamic pathway differences and cortical hierarchies for temporal coding of shape and rhythm in sound
10:35–11:10 am	*Catherine Carr,* Maps versus meters in sound localization

Afternoon session

4:00–4:35 pm	*Murray Sherman,* Thalamocortical processing and efference copies
4:35–5:10 pm	*Michael Schmid,* Signal processing in thalamo-cortical circuits during vision without V1
5:10–5:30 pm	Coffee Break
5:30–6:05 pm	*Vivien Casagrande,* Perceptual decision related activity in the lateral geniculate nucleus (LGN)
6:05–6:40 pm	*Larry Abbott,* Sequential task switching through modulated thalamocortical loops
6:40–7:00 pm	General Discussion

5. Canonical Circuits, Canonical Computations

Tuesday, March 4, 2014

Organizers:
Anita Disney, Salk Institute for Biological Studies
Krishnan Padmanabhan, Salk Institute for Biological Studies

That computations arise from the structure of the circuit has emerged as a maxim of neuroscience. The notion that these computations may be performed using anatomical modules–canonical circuits - that are repeated across species, brain areas, and modalities is appealing because such common circuits could offer signposts to guide generalization and translation of experimental findings. In practice, however, there have tended to be more exceptions than rules and the result has been a myriad of anatomical and physiological descriptors of neuronal circuits that have resisted attempts at “grand unification”. The canonical computation, a counterpoint rooted in the algorithmic approach to neuronal function, has been offered as a powerful alternative to the circuit-level approach to generalizing principles in neuroscience. But this framework too poses numerous challenges–not least among them the problem of translation of an algorithmic understanding of brain processes from the bench to the bedside. Understanding neuronal function requires discussion of universality principles at both the circuit and computation level–a dialogue this workshop will facilitate. We will bring together speakers who share a common interest in comparative neuroscience, but whose individual expertise span diverse levels of analysis (cell, circuit, system, species, evolution of species) and who employ different model systems and technical approaches (anatomical, in vivo, in vitro, in silico). In doing so, our aim is to foster links within our diverse participant pool, to start to provide a common language or framework for thinking about problems of generalization and translation, and perhaps to stimulate collaboration or common-themed approaches. We believe the target audience for this workshop will be neuroscientists looking for ways to bridge disciplines, seeking common themes which will allow them to explore neuronal circuits and computations in new and exciting ways. As the proposed speakers include experimental and theoretical researchers, often developing new methods with which to study universal principles, this workshop will also target researchers in one domain looking to dive into another domain (possibly through newly fostered collaborations) in search of canonical principles in neuronal function.

Canonical Circuits, Canonical Computations

Magpie A

Morning session

8:10–8:20 am	*Anita Disney,* Introduction
8:20–9:10 am	*Mitya Chklovskii,* Understanding the building blocks of neural computation: insights from connectomics and theory
9:10–9:30 am	Coffee break
9:30–10:20 am	*Jeffery Erlich,* Evolutionary conserved networks for orienting decisions
10:20–11:10 am	*I-Chun Lin,* The nature of cortical 'noise'

Afternoon session

4:15–4:55 pm	*Christoph Mathys,* Canonical microcircuits and predictive coding
4:55–5:35 pm	*Krishnan Padmanabhan,* Catalytic convertes, carbon monoxide, neuronal diversity, and evolution
5:35–5:50 pm	Coffee break
5:50–6:30 pm	*Odelia Scwartz,* Flexible gating of normalization via natural scene statistics
6:30–7:10 pm	*Robin Termblay, Bernando Rudy,* Specificity in interneuronal circuits
7:10 pm	Closing Remarks

6. From the Actome to the Ethome: Systems Neuroscience of Behavioral Ecology

Tuesday, March 4, 2014

Organizers:
Aldo Faisal, Imperial College
Constantin Rothkopf, Technical University Darmstadt

While we record the precision of an action potential with microsecond accuracy and characterize the impact of single amino acids on protein function, we often describe the behavior of a whole organism by eye or limit the quantification of actions to reaction times and fractions of correct classification responses. Experimental paradigms often use tasks that were introduced at a time when box-and-arrow models were a helpful way of describing cognitive processes. But advances in experimental methods have increased the availability, amount, and quality of behavioral data for both humans and animals. How can we use this data to derive insights about the underlying neuronal mechanisms? While solid progress on sensory coding has been made in considering the statistics of natural stimuli, we are still lacking similar progress with respect to natural behavior. Furthermore, considering extended sequential behavior forces us to consider how perception, decision making, motor control and learning are intertwined. On one side, there is a need for developing tools allowing to analyze complex sequential behavior in naturalistic tasks. On the other side, more fundamentally, it is important to find the proper models and paradigms to structure the questions that we can ask. Questions we want to address include:

- How should we build computational models that quantify natural behavior?

- How can we use these models to relate underlying behavioral mechanisms to neural data?

- How do classical behavioral paradigms constrain the conclusions the conclusions that can be drawn?

- How can we conceptualize task properties? By bringing together both experimentalists and theoreticians working on related questions we hope to engage in fruitful discussion on how to make progress on this emerging field.

Large scale current efforts are going after a full characterization of the connectivity and activity of the brain, but we are still lacking an understanding of the behavior, that the brain is generating. We therefore think that it is essential to work on better characterizing natural extended sequential behavior and connect this work to current investigations of the neural infrastructure and processes.

The workshop is aimed at bringing together experimentalists and theoreticians interested in measuring, describing, and understanding naturalistic extended sequential behavior.

From the Actome to the Ethome: Systems Neuroscience of Behavioral Ecology

Magpie B

Morning session (Chair: Aldo Faisal)

8:30–9:05am	*Constantin Rothkopf,* From natural stimuli to natural tasks and back
9:05–9:40am	*Andre Brown,* Syntax in C. elegans locomotion
9:40 –9:50am	Coffee break
9:50–10:25am	*Michael Platt,* Neuronal basis of competitive tactics in the primate prefrontal cortex
10:25–11:00am	*Francisco Valero-Cuevas,* We have barely enough neuromuscular degrees of freedom to meet the requirements of real-world tasks

Afternoon session (Chair: Constantin Rothkopf)

4:30–5:05 pm	*Paul Schrater,* Desire, fear, boredom–characterizing natural dynamics of goals via actions
5:05–5:40pm	*Terrence Sanger*
5:40–5:50pm	Coffee break
5:50–6:25pm	*Greg Stephens,* Sampling the movement phenospace: from posture to behavior in the free-wiggling of C. elegans
6:25–7:00 pm	*Aldo Faisal,* Action grammars of complex human tasks
7:00–7:30 pm	Discussion,"Computational systems neuroscience of behavior"

7. Sequence Generation and Timing Signals in Neural Circuits

Tuesday, March 4, 2014

Organizers:
Kanaka Rajan, Princeton University
Christopher D Harvey, Harvard University,
David W Tank, Princeton University

Even the simplest of tasks require the activation of a precise sequence of behavioral and perceptual actions over time. More complicated tasks involving delays and time estimation demand even more impressive capabilities for judging, remembering and incorporating complex temporal sequences into behavioral responses. Timing-based tasks form the basis for a number of studies in humans, primates, and other experimental animals, which have shown that behavioral or perceptual action sequences reflect a series of populations states within underlying neural circuits. Data from these studies have identified the neural correlates of several behaviors, from memory-based decision making to navigation, in different brain areas (for example, the posterior parietal cortex). While some experiments have suggested that ramping activity in groups of neurons is associated with delay intervals and reaction times, other reported activity-related correlates of timing in neural responses include co-active ensembles of neurons, cell assemblies, and stereotypical sequences or trajectories of neuronal assemblies or network states. These experimental observations have inspired network models that explain the emergence of biologically realistic assemblies or trajectories of activity states.

However several questions remain open.

1. How are temporally structured sequences and activation patterns generated and controlled?

2. How are time intervals estimated and encoded through these sequential patterns?

3. How do neural circuits reconcile the long time-scale activation patterns underlying timing tasks with their intrinsic dynamics operating across much faster (ms-level) time scales?

Answers to these questions, through experimental as well as theoretical approaches, will have enormous implications for our ability to understand any cognitive phenomenon or task requiring timing computations across different scales. It is critical to initiate this discussion now because of recent advances in experimental design, novel analysis methods for studying population responses and computational models - many of which have been made by our invited speakers.

Sequence Generation and Timing Signals in Neural Circuits

Maybird

Each participant has ~20 minutes to speak, followed by 5 for questions.

Morning session

8:05–8:15 am	*Kanaka Rajan,* Introduction and overview
8:15–8:40 am	*Michael Mauk,* Local reciprocal inhibition as a building block for temporal coding
8:40–9:05 am	*Michale Fee,* Emergence of a rhythmic neural sequence and its subsequent differentiation underlie vocal learning in a songbird
9:05–9:30 am	*Cengiz Pehlevan,* Flexible timekeeping in songbirds
9:30–10 am	Coffee break
10:00–10:25 am	*Eva Pastalkova,* Sequence generation and oscillations
10:25–10:50am	*Sandro Romani,* Network generated sequences of neuronal activation via short-term plastic synapses
10:50–11 am	Discussion

Afternoon session

4:35–5:00 pm	*Haim Sompolinsky,* Learning algorithms for spike time based computations
5:00–5:25 pm	*Howard Eichenbaum,* Hippocampus: Time cells and memory
5:25–5:50 pm	TBD
6:00–6:30 pm	Coffee break
6:30–6:55pm	*Joseph Paton,* A scalable population code for time in the striatum
6:55–7:20 pm	*Zach Mainen,* Neural mechanisms for action timing in the rat frontal cortex
7:20–7:30 pm	*Chris Harvey,* Summary, open questions and future directions

8. Multisensory Computations in the Cortex

Tuesday, March 4, 2014

Organizers:
Joseph Makin and Philip Sabes
University of California, San Francisco

In recent years there has been considerable attention from both experimentalists and theorists on the various multisensory computations that appear to make up the core function of primate parietal cortex. Operating on visual, auditory, somatosensory, and vestibular signals, these computations include cue combination, coordinate transformation, attention, and motor planning. Investigation into them has taken several forms: electrophysiology in parietal cortex and subcortical multisensory areas like superior colliculus; psychophysics; as well as theory, through computational models of neuronal populations and through normative models. Each of these approaches offers its own insights and its own sets of constraints on the nature of these operations and their implementation in cortical circuits. This heterogeneity of viewpoints offers an opportunity for new progress, but it has often been the case that the researchers in this field have borrowed what they want from other approaches without fully exploring the implications of those approaches. This workshop would bring together leading researchers from each of these perspectives in order to explore more deeply the implications of each approach for the others. The goal is to reach consensus on what is known about multisensory processing; what experiments need to be done to confirm or infirm theoretical work; and what experimental findings remain unexplained by computational models.

We are planning a somewhat innovative format for the workshop in order to foster productive discussion. We will ask the speakers to spend their ~20 min. making their best argument for their own view of multisensory processing (rather than standard presentation of results, although these will probably form part of the argument): what computational principles and physiological claims are (by their lights) established facts; what experiment(s) would be dispositive for their models; what they see as the open questions to be addressed in the next five years. We will include two discussion sessions. Panel members can bring whatever material they think supports their case, as long as it fits on one USB drive; during these discussions, panelists can show data/images from this material to support an argument.

Multisensory Computations in the Cortex

White Pine

Morning session

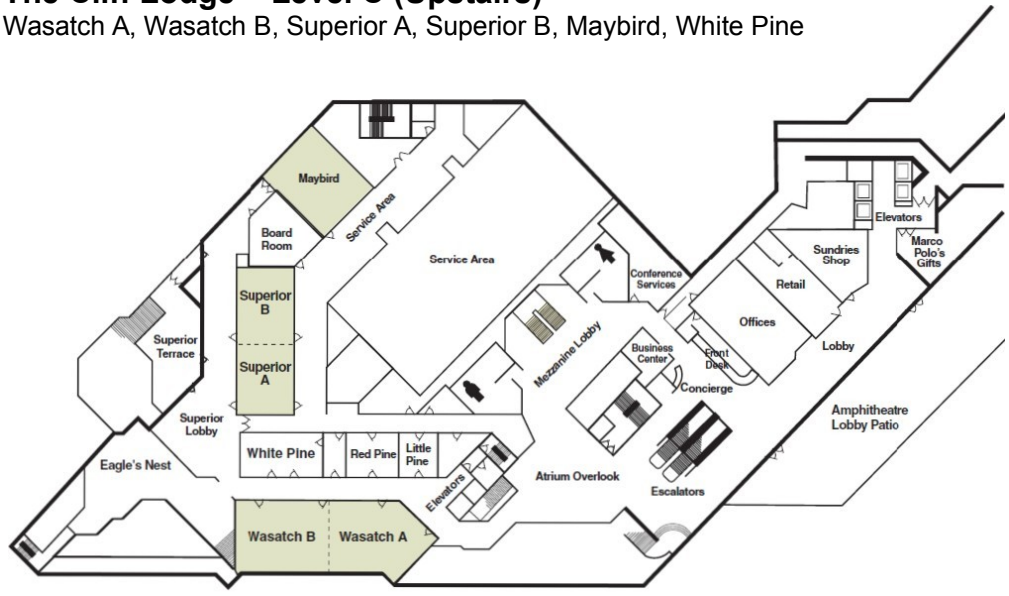
8:30–9:00 am	*Philip Sabes,* Introductory remarks: the challenge of understanding multisensory computation in functional neural circuits
9:00–9:30 am	*Dora Angelaki,* Multisensory calibration
9:30–9:55 am	Coffee break
9:55–10:25 am	*Alexander Gail,* Space-context integration in the frontoparietal sensorimotor network
10:25–11:00 am	*Robbie Jacobs,* Transfer of object category knowledge across visual and haptic domains: Experimental and computational studies

Afternoon session

4:30–5:00 pm	*Greg DeAngelis,* Divisive normalization as a model for multisensory integration by single neurons
5:00–5:30 pm	*Joseph Makin,* What is neural 'integration'?
5:30–5:55 pm	Coffee break
5:55–6:25 pm	*Jeff Beck,* Learning redundant representations.
6:25–6:55 pm	*Terry Stanford,* Beyond space and time: consideration of arbitrary associations between independent feature dimensions
6:55–7:30 pm	Panel discussion

The Cliff Lodge – Level C (Upstairs)

Wasatch A, Wasatch B, Superior A, Superior B, Maybird, White Pine



The Cliff Lodge – Level 8 (Downstairs)

Magpie A, Magpie B