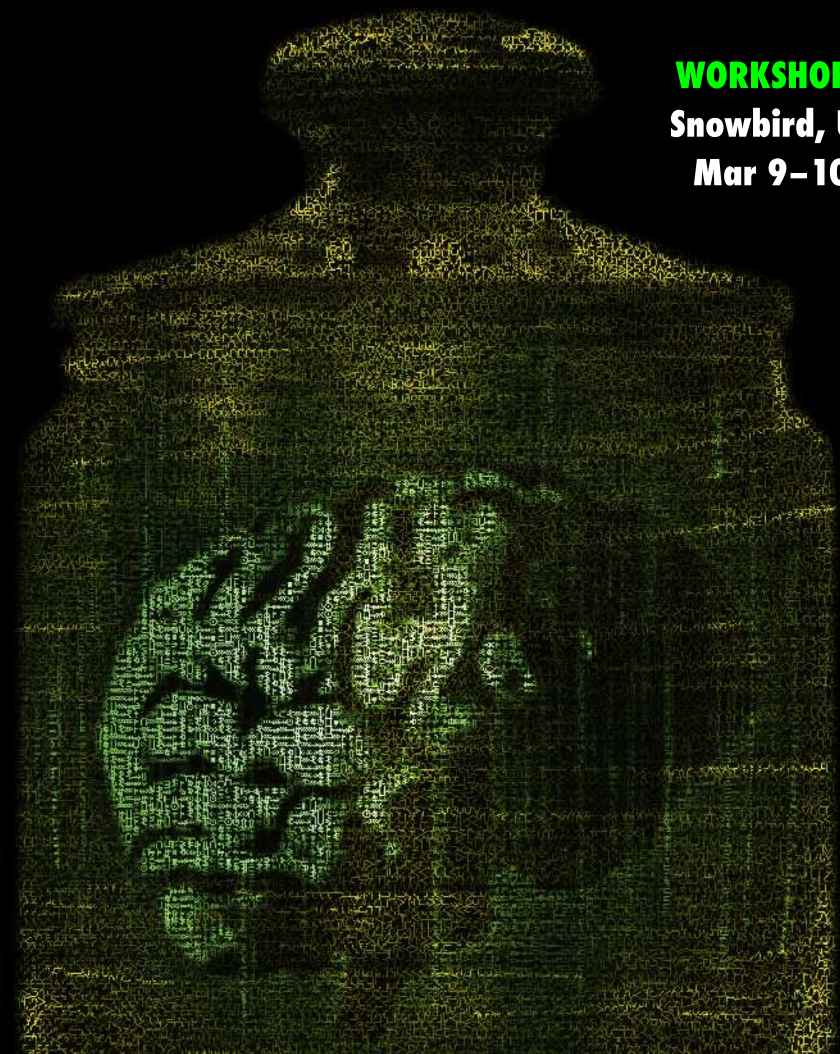
COSYNE 2015

cosyne.org



WORKSHOPS

Snowbird, UT

Mar 9–10

COSYNE 2015 Workshops

Snowbird, UT
Mar 9–10, 2015

Organizers:
Claudia Clopath
Robert Froemke

COSYNE 2015 Workshops

March 9–10, 2015

Snowbird, Utah

Monday, March 9, 2015	Organizer(s)	Location
1. Cortical circuits in action – Day 1	M McGinley D Schneider	*Wasatch*
2. Grid cells: A decade of unraveling the mechanisms and function of a cognitive cortical code – Day 1	D Derdikman I Fiete	*Golden Cliff*
3. Perturbations in perceptual behavior: Emerging evidence for rate and dynamic codes in sparse and dense populations of cortical neurons	G Doron C Deister M Histed	*Maybird*
4. Cascaded computations – Novel approaches to study information processing in complex nervous systems	R Goris R Kiani	*Superior A*
5. Functional stability in a dynamic connectome	Y Loewenstein G Mongillo	*Magpie B*
6. Random walk models across decision-making domains	M Shvartsman A Shenhav RC Wilson	*White Pine*
7. Computational mechanisms of object recognition in the ventral visual pathway	R Rajimehr N Kriegeskorte	*Superior B*
8. How the brain makes prediction: Relevance of time and spontaneous activity	BJ He L Melloni	*Magpie A*

Workshop Co-Chairs	Email
Robert Froemke, NYU	Robert.Froemke@med.nyu.edu
Claudia Clopath, Imperial College	c.clopath@imperial.ac.uk

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

COSYNE 2015 Workshops

March 9–10, 2015

Snowbird, Utah

Tuesday, March 10, 2015	Organizer(s)	Location
1. Cortical circuits in action – Day 2	M McGinley D Schneider	*Wasatch*
2. Grid cells: A decade of unraveling the mechanisms and function of a cognitive cortical code – Day 2	D Derdikman I Fiete	*Golden Cliff*
3. What on Earth is the orbitofrontal cortex doing up there? A cortical-subcortical approach	P Rudebeck G Schoenbaum	*Superior A*
4. Memory in action: The role(s) of the hippocampus in decisions for reward	AM Bornstein GE Wimmer	*Superior B*
5. What can sleep tell us about memory consolidation?	S Mednick M Bazhenov	*Magpie B*
6. Tools and approaches for ground-truth neuroscience	A Marblestone A Singer	*Magpie A*
7. Evidence for and against synaptic clustering and its role in neuronal functions	P Poirazi A Papoutsi C Melachrinos	*White Pine*
8. What can brain perturbation teach us about brain function?	A Afraz	*Maybird*

Workshop Co-Chairs	Email
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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

Hilton City Center to Snowbird: Free shuttle provided for registered attendees
(first shuttle leaves @ 4pm, last @ 5pm on Sunday, 8 Mar 2015).

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/maps/

For further information on transportation or other logistics please contact Denise Acton (denise.acton@rochester.edu).

Discounted workshop rates

Snowbird walk up rate: $80

Equipment rental coupons available at the registration desk: 30% off

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).

Spa facility discount for Cosyne guests: $12.50/day

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

1. Cortical circuits in action – Day 1

Monday, March 9, 2015

Organizers:

Matthew McGinley, David Schneider

Recent work in mouse neocortex has identified profound changes in sensory processing that occur between periods of action versus inaction and periods of arousal versus quiescence. These findings indicate that the function of sensory systems is strongly dependent on internal and behavioral states. However, the rules governing the state dependence of cortical circuits across sensory systems and species are far from resolved. For example, when mice transition from rest to running, sensory responses in visual cortex are enhanced whereas responses in auditory cortex are suppressed. Moreover, the proposed drivers of state-dependent changes in sensory cortex are many – encompassing efferent copies of motor-related signals, changes in neuromodulatory tone, and other subcortical influences – and may vary from one sensory modality and species to the next.

Resolving the synaptic, circuit and network mechanisms by which sensory processing is shaped by internal and behavioral state is extremely timely. To this end, this workshop will focus on five interrelated questions: (1) How does sensory processing change as a function of state? (2) What are the neural circuits that mediate state-dependent changes in sensory processing? (3) Are the heterogeneous changes observed across sensory systems and states accounted for by common synaptic and circuit mechanisms? (4) How do we best measure and quantify behavior and internal state? (5) How do we determine the important links between state effects on neurophysiology and perception and behavior?

To address these questions, we will bring together neuroscientists who study multiple sensory systems in a variety of behavioral contexts with the goal of reaching a deeper understanding of state-dependent changes in the cortex and their fundamental governing principles and mechanisms. This workshop will be of interest to experimentalists and theorists alike, including those with interests in animal behavior, sensory and motor processing, neuromodulation, state dependence, and excitatory and inhibitory circuit function in rodent cortex and beyond.

Cortical circuits in action – Day 1

Wasatch

Morning session	**Sensing while moving**
8.00–8.05a	*Matt McGinley,* Welcome and introduction
8.05–8.40a	*Cris Niell,* Brain-wide circuits mediating effects of locomotion and task engagement on visual processing
8.40–9.15a	*Matteo Carandini,* Influences of locomotion and navigation on mouse visual cortex
9.15–9.35a	Coffee break
9.35–10.10a	*Gaby Maimon,* Dynamic gating of fly vision
10.10–10.45a	*Larry Abbott,* Modeling stimulus detection in electric fish
10.45–11.00a	Discussion

Afternoon session	**Arousal and attention in the active brain**
4.30–4.35p	*David Schneider,* Introduction
4.35–5.10p	*Harvey Swadlow,* Alert and non-alert awake brain states: Effects on visual thalamocortical processing
5.10–5.45p	*Peyman Golshani,* Attention and brain-state dependent membrane potential dynamics in visual cortex
5.45–6.05p	Coffee break
6.05–6.40p	*Li Zhang,* Synaptic excitation and inhibition underlying auditory cortical processing in behaving mice
6.40–7.15p	*David McCormick,* Rapid changes in waking state explain response and behavioral variability
7.15–7.30p	Discussion

2. Grid cells: A decade of unraveling the mechanisms and function of a cognitive cortical code – Day 1

Monday, March 9, 2015

Organizers:

Dori Derdikman, Ila Fiete

Sensory and motor systems are extensively studied by quantitative psychologists and systems and computational neuroscientists. They are steadily giving up their secrets to science, though of course much remains to be done. The representations and mechanisms used by high-level cognitive brain regions, though of great interest, have proved much harder to probe and analyze. Some of the most notable exceptions are neurons that play a part in spatial representation, including head-direction, place, and grid cells. Spatial location is merely a 2-dimensional variable, and orientation another 1-dimensional variable; since these low-dimensional variables can be easily controlled or at least measured, deciphering the spatial cognitive code in may some respects be an arguably more tractable problem than related problems in vision. The ten years (and a Nobel prize) since the discovery of grid cells have seen much progress in understanding some of the mechanisms and principles behind the grid cell code. We are suggesting to convene a second Cosyne workshop to bring together experimentalists and theoretists working on the spatial cognition system to discuss the cortical circuits that underlie these striking responses and attempt to decipher their function. On the first day, we will discuss the various fascinating discoveries and models of grid cell activity and its relationship to other neural systems, with the aim of synthesizing what we have learned so far. On the second day, we will focus on pressing open questions, untested theoretical predictions, and new approaches in experiment and theory that will continue to lead us forward.

Grid cells: A decade of unraveling the mechanisms and function of a cognitive cortical code – Day 1

Golden Cliff

Morning session	Moderator: Michael Brecht
8.30–8.45a	*Marianne Fyhn,* Grid cells, perineuronal nets and cortical plasticity
8.45–9.00a	Discussion
9.00–9.15a	*Jim Knierim,* Entorhinal inputs and hippocampal outputs
9.15–9.30a	Discussion
9.30–10.00a	Coffee break
10.00–10.15a	*Praveen Pilly,* Self-organized spatial coding in the entorhinal-hippocampal system
10.15–10.30a	Discussion
10.30–10.45a	*Stefan Leutgeb,* What information do grid cells provide to the hippocampus?
10.45–11.00a	Discussion
Afternoon session	Moderator: Marianne Fyhn
4.30–4.45p	*Kate Jeffery,* Grid cell clues to how rats encode 3D space
4.45–5.00p	Discussion
5.00–5.15p	*Neil Burgess,* Grid cell firing: influences of environment & self-motion, and use for large-scale navigation
5.15–5.30p	Discussion
5.30–5.45p	*Francesca Caccuci,* Developing spatial maps
5.45–6.00p	Discussion
6.00–6.30p	Coffee Break
6.30–6.45p	*Yoram Burak,* Dynamics and neural coding: what principles may determine the number of cells in each module?
6.45–7.00p	Discussion
7.00–7.15p	*Nachum Ulanovsky,* Towards a neurobiology of natural navigation
7.15–7.30p	Discussion

3. Perturbations in perceptual behavior: Emerging evidence for rate and dynamic codes in sparse and dense populations of cortical neurons

Monday, March 9, 2015

Organizers:

Guy Doron, Chris Deister, Mark Histed

Neural processing of information occurs in multiple stages. This hierarchical organization forms the foundation of dominant theories on brain function. At the same time, it poses one of the central challenges for achieving systems-level understanding in neuroscience. How exactly does one go about studying information processing in complex, hierarchically organized nervous systems? Recent experimental and theoretical advances have opened up multiple new avenues to tackle this problem. Our workshop will provide a forum for discussing these advances and exploring their theoretical and conceptual implications. Specifically, we will focus on the following overarching questions:

– As the number of cascaded computations discovered in different neural systems and organisms increases, it is time to ask which types of cascaded computations might be canonical computational motifs?

– Recent studies have emphasized the functional importance of feedback and lateral connections, departing from the feedforward tradition of cascaded computations. Do these recent advances challenge or modify prevalent viewpoints about normative aspects of cascaded models?

– How are cascaded computations implemented in diverse neural circuits? As we gain more detailed understanding about the anatomy and function of feedforward, feedback, and lateral connections, as well as insight into the circuitry associated with different classes of neurons, it is time to explore the implications of these advances for models of canonical circuit and information flow.

Our workshop gathers leading scientists, whose work encompasses several sub-fields of systems neuroscience (visual, vestibular, and tactile systems), model organisms (primates, rodents, and insects), and experimental and theoretical approaches. The talks and ensuing group discussions will open the way for the development of a unifying theory of cascaded processing in complex nervous systems.

Perturbations in perceptual behavior: Emerging evidence for rate and dynamic codes in sparse and dense populations of cortical neurons

Maybird

Morning session

8.00–8.10a	Introductory remarks
8.10–8.30a	*Michael Long,* Using focal cooling to localize behaviorally relevant circuitry
8.30–8.40a	Discussion
8.40–8.55a	*Mark Histed,* Transformations of external input by a cortical network
8.55–9.05a	Discussion
9.05–9.20a	*Guy Doron,* Spiking patterns & cortical neuron detectability
9.20–9.30a	Discussion
9.30–10.00a	Coffee break
10.00–10.20a	*Dmitry Rinberg,* What the mouse glomerulus tells the mouse brain
10.20–10.30a	Discussion
10.30–10.50a	*Cornelius Schwarz,* Perception and neuronal coding in the rodent whisker–related tactile system
10.50–11.00a	Discussion

Afternoon session

4.10–4.30p	*Shawn Olsen*
4.30–4.40p	Discussion
4.40–5.00p	*Gwyneth Card,* A spike-timing mechanism for action selection in Drosophila
5.00–5.10p	Discussion
5.10–5.30p	*Karel Svoboda,* Computation in a thalamocortical circuit
5.30–5.40p	Discussion
5.40–6.00p	Coffee break
6.00–6.20p	*Dan O'Connor,* Circuit analysis of choice–related activity in mouse somatosensory cortex.
6.20–6.30p	Discussion
6.30–6.50p	*Brent Doiron,* The neural mechanics of attention mediated suppression of noise correlations
6.50–7.00p	Discussion
7.00–7.15p	*Chris Deister,* Correlated and Decorrelated States of Representation in Sensory Cortex
7.15–7.20p	Discussion
7.20–7.30p	Concluding remarks and panel discussion

4. Cascaded computations – novel approaches to study information processing in complex nervous systems

Monday, March 9, 2015

Organizers:
Robbe Goris, Roozbeh Kiani,

Neural processing of information occurs in multiple stages. This hierarchical organization forms the foundation of dominant theories on brain function. At the same time, it poses one of the central challenges for achieving systems-level understanding in neuroscience. How exactly does one go about studying information processing in complex, hierarchically organized nervous systems? Recent experimental and theoretical advances have opened up multiple new avenues to tackle this problem. Our workshop will provide a forum for discussing these advances and exploring their theoretical and conceptual implications. Specifically, we will focus on the following overarching questions:

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Cascaded computations – novel approaches to study information processing in complex nervous systems

Superior A

Morning session

8.00–8.10a	*Roozbeh Kiani,* Introduction
8.10–8.40a	*Ken Miller,* The stabilized supralinear network: a cascadeable canonical circuit motif
8.40–9.10a	*Nicholas Priebe,* The emergence of response selectivity in primary visual cortex
9.10–9.40a	*Corey Ziemba,* Uncovering early visual transformations with targeted naturalistic stimuli
9.40–10.00a	Coffee break
10.00–10.30a	*Damon Clark,* Tuning the nonlinearity in insect motion detection
10.30–11.00a	*Adam Kohn,* Adaptation disrupts motion integration in the primate dorsal stream

Afternoon session

4.10–4.40p	*Dora Angelaki,* Suboptimal decoding of two cortical populations predicts the behavioral consequences of their selective inactivation
4.40–5.10p	*Ralf Haefner,* The source of sensory & decision-related activity in area MT
5.10–5.40p	*Jakob Macke,* Dissecting choice-probabilities in V2 neurons using serial dependence
5.40–6.00p	Coffee break
6.00–6.30p	*Robbe Goris,* Cascaded representation of decision formation and choice commitment in parietal cortex
6.30–7.00p	*Randy Bruno,* The Neocortical Circuit Is Two Circuits
7.00–7.30p	Open discussion

5. Functional stability in a dynamic connectome

Monday, March 9, 2015

Organizers:

Yonatan Loewenstein, Gianluigi Mongillo

It is widely believed that the pattern and strengths of the connections between neurons determine the network response properties to external inputs, and that synaptic re-organization underlies the acquisition of new memories and skills. If the re-organization of the synaptic architecture underlies learning then, naively, the corresponding networks should be structurally stable in the absence of learning. Chronic imaging studies have demonstrated, however, substantial volatility of the cortical architecture (at the micro-circuit level) even in the absence of any explicit learning. In addition, in vitro studies have reported significant network reconfiguration, even when the neural activity is blocked. Taken together, these results suggest that some of the substantial volatility of the connectome is not the result of the acquisition of new memories.

The last decade has seen revolutionary technical advances in our ability to measure synaptic structures in the living brain over long time periods (weeks or months). With improved optical reporters of synaptic and neuronal activity, it is becoming possible to functionally characterize neuronal populations in the superficial layers of the neocortex with single-cell resolution over the same time scales. Together, these techniques will soon allow us to accurately quantify network volatility and changes in its patterns of activity. Modeling will, in time, provide a suitable understanding of the relationships between structural volatility and functional stability, both at the mechanistic and at the computational level. Existing theories and models, on the other hand, have been developed in the absence of these data. Are they compatible with them, or are they in need of substantial amendments?

This workshop will bring together experimentalists and theoreticians with the goal of discussing the computational implications of synaptic volatility and, in particular, of understanding how functionality is maintained in the face of this volatility.

Functional stability in a dynamic connectome

Magpie B

Morning session

8.00–8.20a	*Yonatan Loewenstein,* The volatile brain – a challenge to the synaptic trace theory of memory?
8.20–8.55a	*Anthony Holtmaat,* Modes of structural plasticity in somatosensory cortex in vivo
8.55–9.30a	*Gianluigi Mongillo,* The poverty of excitatory plasticity
9.30–9.50a	Coffee Break
9.50–10.25a	*Vincenzo De Paola,* In vivo imaging of the synaptic life cycle in healthy and diseased cortical circuits
10.25–11.00a	*Mitya Chklovskii,* A biological neuron as an online algorithm for matrix factorization

Afternoon session

4.30–5.05p	*Srini Turaga,* Machine learning tools for reconstructing the structure of neural circuits
5.05–5.40p	*Karen Zito,* Heterosynaptic plasticity on local dendritic segments of hippocampal CA1 neurons
5.40–6.00p	Coffee Break
6.00–6.35p	*Matthias Kaschube,* How stable are representations of complex sounds in mouse auditory cortex?
6.35–7.10p	*Fred Wolf,* Driven by salt and pepper – drift and uncertainty in V1
7.10–7.30p	Discussion

6. Random walk models across decision making domains

Monday, March 9, 2015

http://mshvartsman.github.io/cosyne2015-randomwalks/

Organizers:

Amitai Shenhav, Michael Shvartsman, Robert Wilson

Random walk models are an emerging standard theory of the dynamics of decision-making in humans and animals. While the specific theoretical perspectives differ, the central idea of a random walk in decision space has been remarkably successful over the past 50 years in recovering reaction time and error distributions in humans, matching patterns in neural firing in animals and imaging data in humans, and even serving as the core of larger-scale models of multi-step neural computation.

This workshop will bring together a group of talks all sharing the perspective of thresholded random walks as elegant and parsimonious models of decision-making, but cutting across theoretical perspectives, species, and task domains. We will have speakers working in Bayesian frameworks and a variety of dynamical systems settings; speakers working on behavioral paradigms in humans, eye movements and pupillometry, EEG and fMRI, as well as animal work in rats and monkeys in addition to pure theory. Our aim is to prompt discussion and emerging insights from research communities that may not commonly interact but nonetheless share a key theoretical and methodological link.

Random walk models across decision making domains

White Pine

Morning session

8.20–8.30a	*Amitai Shenhav,* Opening Remarks
8.30–9.00a	*Tim Hanks,* Neural circuit analysis during an accumulation of evidence decision task.
9.00–9.30a	*Shunan Zhang,* TBA
9.30–10.00a	Coffee Break
10.00–10.30a	*Samuel Feng,* Jump and multistage diffusion models for decision making.
10.30–11.00a	*James Cavanagh,* Dynamic Thresholds in Decision Making.
11.00–11.30a	*Alex Huk,* Neural correlates of evidence accumulation in area LIP: more than just expensive psychophysics.

Afternoon session

4.00–4.30p	*Michael Shvartsman,* Covert changes of mind: spillover lexical frequency effects in a sequential sampling model of reading.
4.30–5.00p	*Sebastian Gluth,* Filling decision variables with life: the case of memory-based preferential choice.
5.00–5.30p	Coffee Break
5.30–6.00p	*Adele Diederich,* Sequential sampling model for multiattribute choice alternatives with random attention time and processing order.
6.00–6.30p	*Laurence Hunt,* Bridging microscopic and macroscopic choice dynamics in prefrontal cortex.
6.30–7.00p	*Robert C. Wilson,* The directed-random tradeoff in explore-exploit decision making.
7.00–7.10p	*Organizers,* Closing Remarks

7. Computational mechanisms of object recognition in the ventral visual pathway

Monday, March 9, 2015

Organizers:

Reza Rajimehr, Niko Kriegeskorte

A fundamental, yet unresolved, question in neuroscience is how visual objects are processed in the brain. In order to have a comprehensive understanding of such process, three questions must be addressed: 1) how visual objects and their features are represented at each stage of the ventral stream, 2) how representations are transformed from stage to stage, and 3) how feedforward and recurrent computations contribute to object recognition.

Extending the rigor of computational neuroscience from early visual areas to high-level visual object representations has been challenging. In contrast to other brain functions such as visual motion perception and certain aspects of perceptual decision making, the neuroscience of object recognition has had to proceed without either normative theory (defining the optimal way of solving the problem) or even computational models that meet basic performance requirements (computer vision systems that rival biological vision on real-world tasks). Although normative theory still appears out of reach, recent progress in computer vision with deep convolutional neural networks provides a new set of tools for building models that take on the complexities of natural images and can perform basic object recognition tasks. Recent studies suggest that deep models predict brain representations of novel stimuli at unprecedented levels. However, the current computational models do not explain the stages of transformation, the role of recurrent processing, or the spatial organization of the ventral stream in detail.

This workshop will showcase the pieces of the computational puzzle of the ventral stream. The studies presented used cell recordings and/or functional imaging, and introduced novel computational models and data analysis techniques to reveal how the ventral stream 'represents' at each stage and 'computes' across stages and time. In the discussion, we hope to begin to put the pieces together.

Computational mechanisms of object recognition in the ventral visual pathway

Superior B

Morning session

8.00–8.10a	*Reza Rajimehr & Niko Kriegeskorte,* Introduction
8.10–8.40a	*Winrich Freiwald,* Is IT a thing? Perspectives on the functional organizations of inferotemporal cortex
8.40–9.10a	*Reza Rajimehr,* Data-driven approaches reveal the functional organization of IT cortex in humans and monkeys
9.10–9.30a	Coffee break
9.30–10.00a	*Talia Konkle,* A common representational structure across high-level visual cortex
10.00–10.30	*Jack Gallant,* Representation of visual information across the cortical hierarchy
10.30–11.00a	*Kendrick Kay,* Modeling top-down influences on representation in word- and face-selective cortex

Afternoon session

4.30–5.00p	*Niko Kriegeskorte,* Deep supervised neural net visual representation resembles inferior temporal cortex
5.00–5.30p	*Jim DiCarlo,* Performance optimized hierarchical models predict responses of high level ventral visual stream neurons
5.30–6.00p	Coffee break
6.00–6.30p	*Thomas Carlson,* Encoding and decoding object categories in IT
6.30–7.00p	*Gabriel Kreiman,* Neural signals underlying visual pattern completion
7.00–7.30p	General Discussion

8. How the brain makes prediction: relevance of time and spontaneous activity

Monday, March 9, 2015

Organizers:

Biyu J. He, Lucia Melloni

Adaptive behavior requires planning ahead. A fundamental goal of the brain and the nervous system is thus to predict the environment that the organism lives in and to act based on these predictions. Key to understanding predictive computations in the brain is the investigation of spontaneous brain activity, not only because spontaneous brain activity reflects the functional architecture of the brain, but also because it contains rich information likely used in predictive computations. Recent evidence suggests that different time constants observed in spontaneous brain activity may represent the statistics of the environment on multiple time scales and as such reflect learned predictions. Thus, it appears timely and relevant to get a better grasp on the brain's representation of time, the multiplicity of time scales of neural activity, as well as their relation to predictive computations and behavior. This workshop brings together experimentalists and theorists who have worked on these topics, and covers a range of studies in different model systems and at different levels of observation – from single neurons and microcircuits in animals to whole-brain dynamics in humans. It should therefore be of relevance to anyone interested in understanding the ongoing dynamics and predictive computations of the brain.

How the brain makes prediction: relevance of time and spontaneous activity

Magpie A

Morning session

8.30–9.00a	*Adam Kohn,* Neuronal adaptation effects in the context of predictive coding
9.00–9.30a	*Michael Berry,* Predictive computations in the retina
9.30–10.00a	Coffee break
10.00–10.30a	*Rishidev Chaudhuri,* A large-scale circuit mechanism for hierarchical dynamical processing in the primate cortex
10.30–11.00a	*Charlie Schroeder,* Neuronal oscillations as substrates for temporal prediction

Afternoon session

4.30–5.00p	*Jozsef Fiser,* How spontaneous activity and time are used in the cortex for probabilistic perception
5.00–5.30p	*Biyu Jade He,* The initial-state dependence of cortical activity trajectory and perception
5.30–6.00p	Coffee break
6.00–6.30p	*Chris Summerfield,* Rhythmic gain control during perceptual decision-making
6.30–7.00p	*Lucia Melloni,* Learning the statistics of the environment: priors, predictions errors and the brain
7.00–7.30p	General discussion

1. Cortical circuits in action – Day 2

Tuesday, March 10, 2015

Organizers

Matthew McGinley, David Schneider

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Cortical circuits in action – Day 2

Wasatch

Morning session	**Circuit interactions across states and behaviors**
8.00–8.05a	*Matt McGinley,* Introduction
8.05–8.35a	*Gabrielle Gutierrez,* Understanding state-dependent neuromodulation in small circuits
8.35–9.05a	*Robbe Goris,* A computational framework to dissect the effects of attentional state on population activity in macaque visual cortex
9.05–9.20a	Coffee break
9.20–9.50a	*Renata Batista-Brito,* Still aroused: distinct contributions of locomotion and arousal to cortical activity patterns and visual encoding
9.50–10.20a	*Kishore Kuchibhotla,* Inhibition controls rapid context-dependent switching in auditory cortex during behavior
10.20–10.50a	*Anders Nelson,* Synaptic and circuit mechanisms governing corollary discharge in auditory cortex
10.50–11.00a	Discussion
Afternoon session	**Modulating neural circuits during behavior**
4.30–4.35p	*David Schneider,* Introduction
4.35–5.10p	*Randy Bruno,* Reward-related activity in primary somatosensory cortex
5.10–5.45p	*Anita Disney,* Signals in the noise? Measuring neuromodulators in cortical circuits
5.45–6.05p	Coffee break
6.05–6.40p	*Daniel Polley,* Subcortical antecedents for modulation of cortical circuits by internal state
6.40–7.15p	*Zach Mainen,* Serotonin and its modulation of olfactory cortical circuits
7.15–7.30p	Discussion and closing comments

2. Grid cells: A decade of unraveling the mechanisms and function of a cognitive cortical code – Day 2

Tuesday, March 10, 2015

Organizers:

Dori Derdikman, Ila Fiete

Sensory and motor systems are extensively studied by quantitative psychologists and systems and computational neuroscientists. They are steadily giving up their secrets to science, though of course much remains to be done. The representations and mechanisms used by high-level cognitive brain regions, though of great interest, have proved much harder to probe and analyze. Some of the most notable exceptions are neurons that play a part in spatial representation, including head-direction, place, and grid cells. Spatial location is merely a 2-dimensional variable, and orientation another 1-dimensional variable; since these low-dimensional variables can be easily controlled or at least measured, deciphering the spatial cognitive code in may some respects be an arguably more tractable problem than related problems in vision. The ten years (and a Nobel prize) since the discovery of grid cells have seen much progress in understanding some of the mechanisms and principles behind the grid cell code. We are suggesting to convene a second Cosyne workshop to bring together experimentalists and theoretists working on the spatial cognition system to discuss the cortical circuits that underlie these striking responses and attempt to decipher their function. On the first day, we will discuss the various fascinating discoveries and models of grid cell activity and its relationship to other neural systems, with the aim of synthesizing what we have learned so far. On the second day, we will focus on pressing open questions, untested theoretical predictions, and new approaches in experiment and theory that will continue to lead us forward.

Grid cells: A decade of unraveling the mechanisms and function of a cognitive cortical code – Day 2

Golden Cliff

Morning session	Moderator: Kate Jeffery
8.30–8.45a	*Michael Brecht,* A grid cell grid
8.45–9.00a	Discussion
9.00–9.15a	*Ila Fiete,* A feasible detailed probe of the grid cell microcircuit
9.15–9.30a	Discussion
9.30–10.00a	Coffee Break
10.00–10.15a	*Caswell Barry,* Global maps vs. local maps. What are grids good for?
10.15–10.30a	Discussion
10.30–10.45a	*Allen Cheung,* Uncertainty, bounded spaces and grid codes
10.45–11.00a	Discussion

Afternoon session	Moderator: Jim Knierim
4.30–4.45p	*Lisa Giocomo,* Grid error correction by environmental boundaries
4.45–5.00p	Discussion
5.00–5.15p	*Dori Derdikman,* Deciphering the grid cell network
5.15–5.30p	Discussion
5.40–6.00p	Coffee break
6.00–6.15p	*Jill Leutgeb,* Context coding in the medial entorhinal cortex
6.15–6.30p	Discussion
6.30–6.45p	*Andreas Herz,* Nested population vectors in spatial navigation: Predictions for future experiments
6.45–7.00p	Discussion
7.00–7.30p	Closing remarks

3. What on Earth is the orbitofrontal cortex doing up there? A cortical-subcortical approach

Tuesday, March 10, 2015

Organizers:

Peter Rudebeck, Geoffrey Schoenbaum

The orbitofrontal cortex (OFC) has gone from a prefrontal backwater to one of the more intensively studied cortical areas. At present, Pubmed is averaging over 50 experimental and theoretical papers per month that include mention of the term 'orbitofrontal'. It is implicated in nearly every behavior and behavioral function in some way, and increasingly in nearly every neuropsychiatric disorder. With this high level of interest however has come increasing confusion and controversy over what computations OFC performs and how it does these. Response inhibition, cognitive flexibility, Pavlovian outcome expectancies, credit assignment, model-based behavior, a cognitive state space, and even regret - what does it all mean?

The workshop will combine theoretical and experimental approaches that address these hypotheses across levels of investigation, from local circuits to the brain systems. Our workshop will expose new results and insights and consider how they inform our view of OFC function. To get the most inclusive view of OFC function, we will bring together a diverse set of researchers working across numerous species, using different techniques, and approaches, both theoretical and experimental and who hold alternative viewpoints. This workshop will be an excellent forum for researchers interested in the brain mechanisms of motivation, reward, and decision-making in general, and the contribution of the OFC in particular to get the latest perspective and discuss new ideas. Talks will be 20 minutes in length. 10 minutes will then be set aside for questions and discussion. At the end of the workshop, we will reserve time for additional discussion of how the most recent data mesh with extant theoretical models of OFC. What explanations of OFC function do they potentially allow us to rule out and which deserve more study.

What on Earth is the orbitofrontal cortex doing up there? A cortical-subcortical approach

Superior A

Morning session	Moderator: Peter Rudebeck
8.00–8.05a	*Peter Rudebeck & Geoff Schoenbaum ,* Introduction
8.05–8.25a	*Geoff Schoenbaum,* The good, the bad, and the ugly: neural coding of upshifted, downshifted and blocked cues in the OFC.
8.25–8.35a	Discussion
8.35–8.55a	*Patricia Janak,* A dominant role for the OFC in decision-making
8.55–9.05a	Discussion
9.05–9.30a	Coffee Break
9.30–9.50a	*Matthew Shapiro,* Reward history, reversal learning, and coding interactions between the OFC and the hippocampus.
9.50–10.00a	Discussion
10.00–10.20a	*Hannah Clarke,* OFC-subcortical connectivity and emotional decision-making
10.20–10.30a	Discussion

Afternoon session	Moderator: Geoff Schoenbaum
4.30–4.50p	*Peter Rudebeck,* Inhibitory control, specific outcomes, or contingency learning: which theory best accounts for OFC function?
4.50–5.00p	Discussion
5.00–5.20p	*Jon Wallis,* Decoding orbitofrontal value information at multiple scales
5.20 - 5.30p	Discussion
5.30–6.00p	Coffee break
6.00–6.20p	*Tim Behrens,* Models, inferences and credit assignment in OFC
6.20–6.30p	Discussion
6.30–6.50p	*Nico Schuck,* State space representations in human orbitofrontal cortex
6.50– 7.00p	Discussion
7.00–7.30p	Final discussion

4. Memory in action: The role(s) of the hippocampus in decisions for reward

Tuesday, March 10, 2015

http://aaron.bornstein.org/cosyne2015/

Organizers:

Aaron M. Bornstein, G. Elliott Wimmer

The hippocampus has long been understood to play a critical role in flexible relational learning, episodic memory, and navigation. More recently, a growing body of work implicates the hippocampus in value-based decision making. However, a dichotomy exists between research performed in different organisms and from distinct theoretical traditions. For instance, results in rodent models support an active role for the hippocampus in evaluating potential next-step actions and outcomes. Meanwhile, human research has mainly emphasized the role of the hippocampus in forming representations that may then support later decisions. Other divisions concern the nature of spatial versus more general relational processing, various algorithms for active sampling in support of decisions, and whether the hippocampus plays a part in tasks that require short-term memory or well-learned outcomes. These divergences are in part due to different experimental methods, but they also reveal fundamental gaps in the theory. Computational treatments exist that offer normative justifications for each of these roles, but to date few efforts have been made to unify these observations.

This workshop brings together for the first time many of the researchers behind the primary work to discuss the emerging computational frameworks that describe the role - or roles - of the hippocampus in decision making. Participants will work to understand what might be the core computations performed by the hippocampus to guide reward-based decision making and goal-directed behavior.

Memory in action: The role(s) of the hippocampus in decisions for reward

Superior B

Morning session

8.00–8.30a	*Nathaniel Daw,* Separable effects of individual episodes in reinforcement learning: models, data, and aspirations
8.30–9.00a	*Jai Yu,* Anterior cingulate cortex-hippocampal interactionsduring goal-driven behavior
9.00–9.30a	*Jane Wang,* Hippocampal-cortical network dynamics of information-seeking decisions during exploratory learning
9.30–9.45a	Coffee break
9.45–10.15a	*David Foster,* TBA
10.15–10.30a	*Kevin Miller,* A causal role for hippocampus in model-based planning in the rat."
10.30–11.00a	Panel discussion (Daw, Yu, Wang, Foster, Miller)

Afternoon session

4.30–5.00p	*Daphna Shohamy,* How relational memory mechanisms in the hippocampus support decisions
5.00–5.30p	*Genela Morris,* The role of dopamine in setting the coordinates of the cognitive map
5.30–6.00p	*Helen Barron,* Building new neural representations using the hippocampus
6.00–6.15p	Coffee break
6.15–6.45p	*Matthijs van der Meer,* Motivational state and the content of hippocampal sequences
6.45–7.00p	*Kimberly Stachenfeld,* Design principles of the hippocampal cognitive map
7.00–7.30p	Panel discussion (Shohamy, Morris, Barron, van der Meer, Stachenfeld)

5. What can sleep tell us about memory consolidation?

Tuesday, March 10, 2015

Organizers:

Sara Mednick, Maxim Bazhenov

Memory depends on three general processes: encoding, consolidation and retrieval. Although the vast majority of research has been devoted to understanding encoding and retrieval, recent novel approaches have been developed in both human and animal research to probe mechanisms of consolidation. A story is emerging in which important functions of consolidation occur during sleep and that specific features of sleep appear critical for successful retrieval across a range of memory domains, tasks, and species. These insights are now providing the basis for building computational models of the cellular and network mechanisms underlying consolidation processes.

One important finding is that the neural activity associated with encoding has been shown to reactivate during sleep. This memory replay is associated with characteristic neuronal oscillations (sleep spindles, sleep slow oscillation) that may help to understand the neural mechanisms underlying memory consolidation. Current studies have mainly focused on the rat hippocampus and memory tasks dependent on this structure. Evidence still remains sparse for the role of replay in other structures, memory domains, and species, especially concerning the specific interactions between thalamic, hippocampal and cortical networks. At the same time, recent technological developments (such as source localization with high density EEG, intercranial recordings in humans, optogenetics) allow active interaction with brain structures, thus opening a new research avenue focused on controlling and enhancing consolidation processes.

In this workshop we will discuss new findings from animal, human and computational works that explain fundamental mechanisms of sleep rhythm generation and how sleep rhythms contribute to memory consolidation. The goal of this workshop is to bring together experimental and computational neuroscientists to discuss fundamental principles of the network dynamics of the brain that are involved in the processes of memory and learning.

What can sleep tell us about memory consolidation?

Magpie B

Morning session	**Animal models**
8.00–8.05a	*Maxim Bazhenov,* Welcome and Introduction
8.05–8.35a	*Sara Aton,* Understanding the contribution of sleep to visual system plasticity
8.35–9.05a	*Igor Timofeev,* Sleep slow oscillation induces long–term synaptic potentiation and mediates memory formation.
9.05–9.30a	Coffee Break
9.30–10.00a	*Maxim Bazhenov,* Synaptic plasticity by sleep slow oscillations
10.00–10.30a	*Matt Wilson,* Reward signaling and hippocampal memory reactivation
10.30–11.00a	*Jean-Marc Fellous,* Reactivation of the dopaminergic system in the rodent
Afternoon session	
4.30–4.35p	*Sara Mednick,* Introduction
4.35–5.05p	*Anna Schapiro,* The consolidation of semantic memory: Empirical and neural network modeling investigations
5.05–5.35p	*Sara Mednick,* The role of REM sleep in learning and rescuing damaged memories.
5.35–6.00p	Coffee Break
6.00–6.30p	*Erin Wamsley,* Sleep Spindle Deficits and Memory Consolidation in Schizophrenia
6.30–7.00p	*Eric Halgren,* Sleep spindles and K-complexes: Local and global variants could provide substrates for specificity and integration during memory consolidation

6. Tools and approaches for ground-truth neuroscience

Tuesday, March 10, 2015

Organizers:

Adam Marblestone, Annabelle Singer

There has been much recent excitement about the potential for tools that might enable scalable mapping of brain circuits at the anatomical level (i.e., connectomics), the molecular level (e.g., transcriptomics, proteomics), the activity level (i.e., dynomics), and the behavior level (i.e., high-throughput behavior). However, new fundamental mechanisms of neural function are being discovered all the time, including dendritic computation, glial computation, the glymphatic system, retrograde neurotransmission and many others. This raises a question that sits at the junction between “big neuroscience” projects and discovery-oriented research: how should one design brain mapping technologies that can scalably acquire knowledge about classical mechanisms that we know are important, while taking in stride the continual uncovering of new mechanisms? Some of the principles for designing such technologies include comprehensiveness (for example, the ability to achieve high resolution while spanning large spatial scales) and integrativeness (for example, the ability to combine many different types of measurements on the exact same sample). Novel methods that can begin to address these challenges include technologies for recording from entire intact organisms, molecular multiplexing strategies that allow hundreds of distinct molecular markers to be read out simultaneously via microscopy, versatile approaches to super-resolution microscopy that enable large volumes to be mapped quickly at nanoscopic resolution, new methods of sample preparation that preserve “ground truth” biological structures, and the automation of in-vivo neuroscience to allow quantitative, unbiased observation of the living, behaving brain in action. To better understand the emerging possibilities, this workshop will bring together scientists at the frontiers of discovering new fundamental mechanisms in the brain, and tool developers committed to enabling “ground-truth” approaches to brain mapping. Targeted participants include experimentalists interested in novel tools and computationalists interested in analysis of emerging, comprehensive neural datasets.

Tools and approaches for ground-truth neuroscience

Magpie A

Morning session

8.00 – 8.20a	Welcome and Introduction
8.20 – 9.00a	*Viviana Gradinaru,* Visualizing the Activity and Anatomy of Brain Circuits: Optogenetic Sensors and Tissue Clearing Approaches
9.00 – 9.40a	*Fei Chen & Paul Tillberg,* Expansion microscopy
9.40 – 10.00a	Coffee Break
10.00–10.40a	*Jai-Yoon Sul,* University of Pennsylvania
10.40–11.00a	Discussion

Afternoon session

4.35–5.10p	*Bobby Kasthuri,* Towards a saturated decryption of brain structure
5.10–5.45p	*Marc Gershow,* Decoding Drosophila photo-taxis and odor-taxis using natural and optogenetic stimuli
5.45–6.00p	Coffee Break
6.00–6.35p	*Tyler Brown,* Cell Type-Specific Vascular Optogenetic Stimulation Allows Bi-Directional Control of Cerebral Vascular Responses.
6.35–7.10p	*Albert Lee,* Intracellular recording in behaving animals
7.10p–7.30p	Discussion

7. Evidence for and against synaptic clustering and its role in neuronal functions

Tuesday, March 10, 2015

Organizers:

Panayiota Poirazi, Athanasia Papoutsi, Constantinos Melachrinos

This workshop will present and assess existing, often controversial, evidence regarding the following open questions: Do dendrites of various cell types receive spatially structured synaptic input (e.g. clustering of synapses) and under what conditions does this happen? How does/can this spatial profile influence neuronal output and the functions subserved by these neurons at the cellular, network and behavioral levels? Computational modeling studies predict that the spatial arrangement of synapses within active dendrites is very important for neuronal output, since co-activation of neighboring synapses (clustered input) allows for complex dendritic computations that may be relevant to behavior. Such clustering of synaptic contacts has recently been documented in several neuron types, as a result of development or learning. On the other hand, studies in sensory cortices have failed to find such clustered organization of synapses in dendrites, casting doubt on the synaptic clustering hypothesis. This interdisciplinary workshop brings together leading experimentalists and theoreticians with proven expertise on the subject to discuss this controversial issue, and propose ways to move forward. We place particular emphasis on allowing young and highly promising scientists to present their findings and take into account gender balance. Our aim is to bring together a diverse set of participants, at multiple stages of their career, from the molecular and electrophysiology experimentalists to behavioral and computational researchers interested in the clustering hypothesis, thus allowing for an invigorating and effective discussion. Since technological advances over the last few years place the suggested topic at the forefront of neuroscience research and the number of relevant publications is rapidly increasing, we expect that a large portion of the neuroscience community will be interested in attending.

Evidence for and against synaptic clustering and its role in neuronal functions

White Pine

Morning session

9.00–9.40a	*Christian Lohmann,* A plasticity mechanism for clustering developing synapses in vivo
9.40–10.20a	*Shaul Druckmann,* Nonuniform synaptic distributions in hippocampal neurons
10.20–11.00a	*Bartlett Mel,* Multiple factors contributing to optimal dendrite size in a one-shot learning task
11.00–11.30a	Coffee break
11.30–12.10a	*Judit Makara,* Cooperative function of clustered synaptic inputs
12.10–12.50a	*Monika Jadi,* Different stokes for different folks: Inhibition of dendritic spikes by distal and proximal GABAergic synapses

Afternoon session

4.30–5.10p	*Yi Zuo,* Spatial control of spine formation during motor–skill learning
5.10–5.50p	*William DeBello,* Input clustering in the normal and learned circuits of barn owls
5.50–6.10p	Coffee break
6.10–6.50p	*Roberto Araya,* Role of spines in synaptic integration and plasticity: clustered vs. distributed connectivity
6.50–7.30p	*Robert Legenstein,* Synaptic clustering through branch-specific plasticity

8. What can brain perturbation teach us about brain function?

Tuesday, March 10, 2015

Organizer:

Arash Afraz

There exist two classes of methodological approaches to understanding brain function: correlational methods (single unit recording, two-photon imaging, field potentials, EEG, etc) that are based on passive listening to neural activity and causal methods (microstimulation, drug microinjection, cooling, optogenetics, etc) that involve perturbation of neural activity. Currently, most studies in systems neuroscience use correlational methods to evaluate competing hypotheses and inform computational models. In the absence of a conceptual framework that formalizes the added value of the data obtained by causal interventions, it is unclear whether they can contribute more than “confirmatory” evidence for what has already been discovered by correlational methods.

The goal of this workshop is to discuss what can be learned from causal interventions, beyond confirmation of correlational findings. The selected group of speakers will discuss the limitations and benefits of causal methods, and aspects of brain function revealed by interventional physiology that cannot be studied by only listening to neural activity. The workshop will elaborate on the advantages of causal methods for bridging the gap between neural activity and behavior, and teasing apart components of neural circuits. We will discuss why computational neuroscientists should consider "perturbation experiments" in neural models, as well as how computational modeling can inform interventional physiology in developing better perturbation experiments.

The workshop will be of interest to a broad audience including people with a general interest in the relationship between neural activity and behavior, neuroscientists interested in new technologies for brain perturbation and theoretical neuroscientists interested in incorporating neural data in computational models.

What can brain perturbation teach us about brain function?

Maybird

Morning session

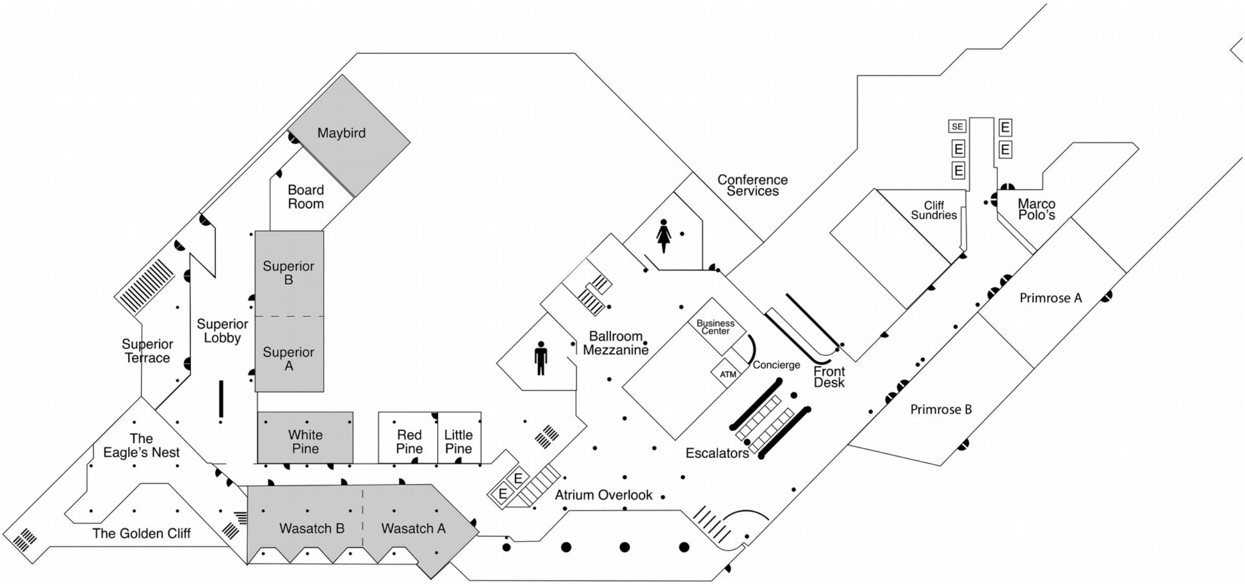
8.00–8.15a	*Arash Afraz,* Opening remarks
8.15–8.45a	*Anne Churchland,* Changes in multisensory decisions during elevation or suppression of neurons in rodent posterior parietal cortex
8.45–9.15a	*Karel Svoboda*, Why perturbations are critical for neuroscience
9.15–10.00a	Coffee break
10.00–10.30a	*Rick Born,* Reversible inactivation of monkey cortex with cooling: spikes, correlations and behavior
10.30–11.00a	*Chris Fetsch,* Manipulating signal and noise in visual area MT: implications for a unified theory of choice, reaction time, and confidence

Afternoon session

4.30–5.00p	*Tirin Moore,* ‘Reality Checking’ Neural Correlates of Perceptual and Cognitive Functions
5.00–5.30p	*Mehrdad Jazayeri,* Causal mapping of where and when and ... what else?
5.30–6.00p	Coffee break
6.00–6.30p	*Arash Afraz,* The causal role of face–selective neurons in face perception, evidence from electrical microstimulation, drug microinjection and optogenetics.
6.30–7.00p	*Dan Yamins,* Using Computational Models of Vision to Guide Real-Time Perturbation Experiments
7.00–7.30p	Discussion panel

The Cliff Lodge – Level C (Upstairs)

Wasatch (A+B), Superior A, Superior B, Maybird, White Pine



The Cliff Lodge – Level B (Downstairs)

Golden Cliff, Magpie A, Magpie B