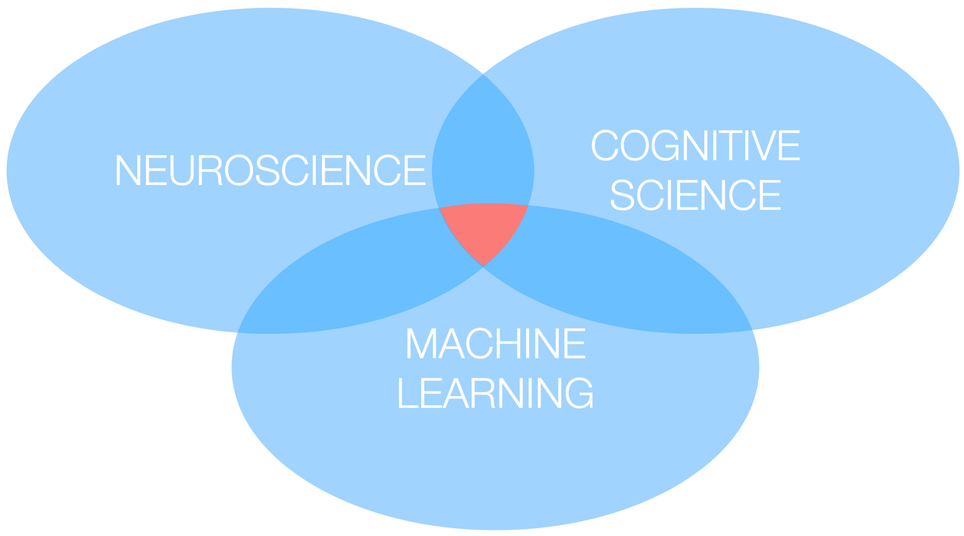
Wigner 121
Scientific Symposium

Wigner Research Centre for Physics
Institute for Particle and Nuclear Physics
Department of Computational Sciences
System Level Neuroscience Research Group

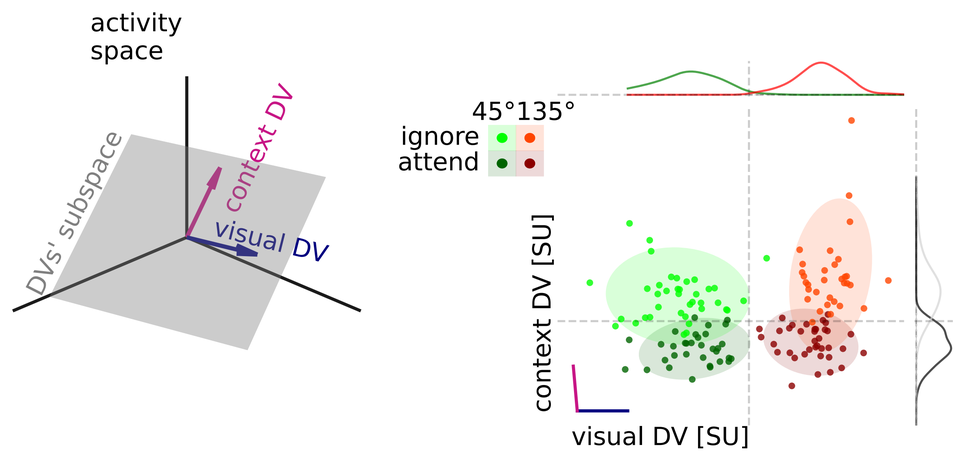
Gergő Orbán, Anna Székely, Balázs Meszéna, Ferenc Csikor, Márton Hajnal, Zsombor Ungvárszki

Group Introduction



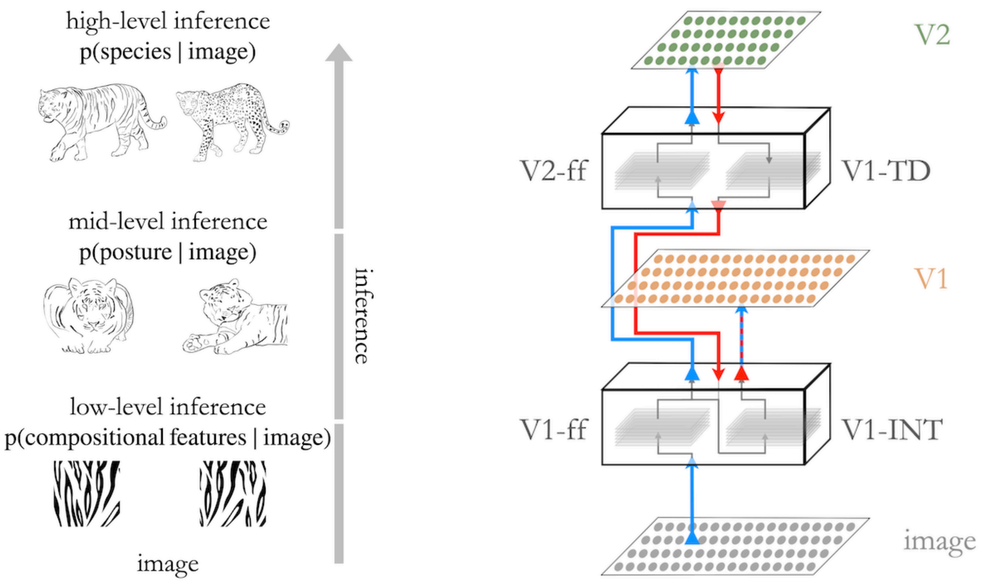
- Our research group conduct research in the interface of Machine Learning, Neuroscience and Cognitive Science
- Models of high-level computation aim at understanding the representation that humans use to learn about their environment.
- We also investigate how low-level computation happens in the visual area of the brain

Context dependent V1



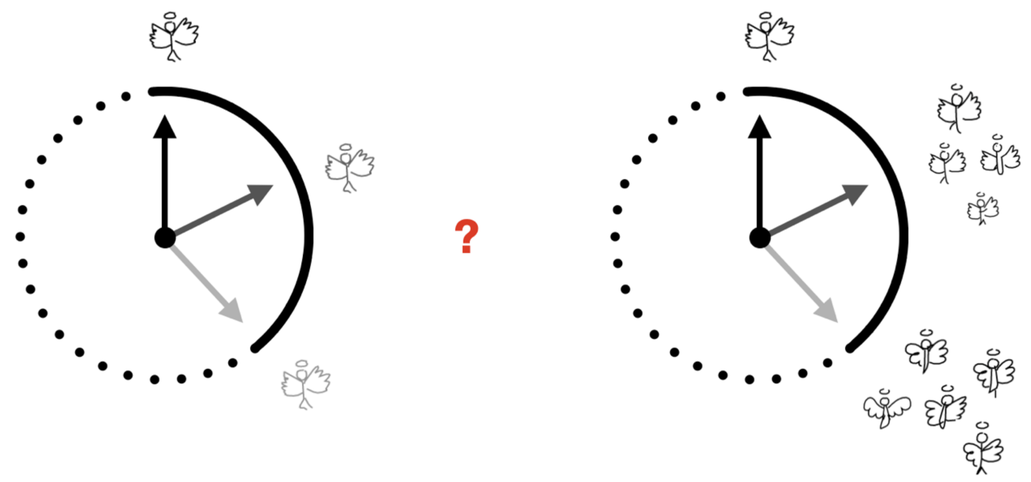
- Mice perform a context-dependent cross-modal decision task where the interpretation of identical audio-visual stimuli depends on task context
- Main collaborator: Peyman Golshani (UCLA)
- Experimental data: neurophysiological measurements in mice (from V1 and ACC)
- Publication: Hajnal et al., "Continuous multiplexed population representations of task context in the mouse primary visual cortex", 2023, *Nature Communications*

Modelling top-down interactions in biological vision



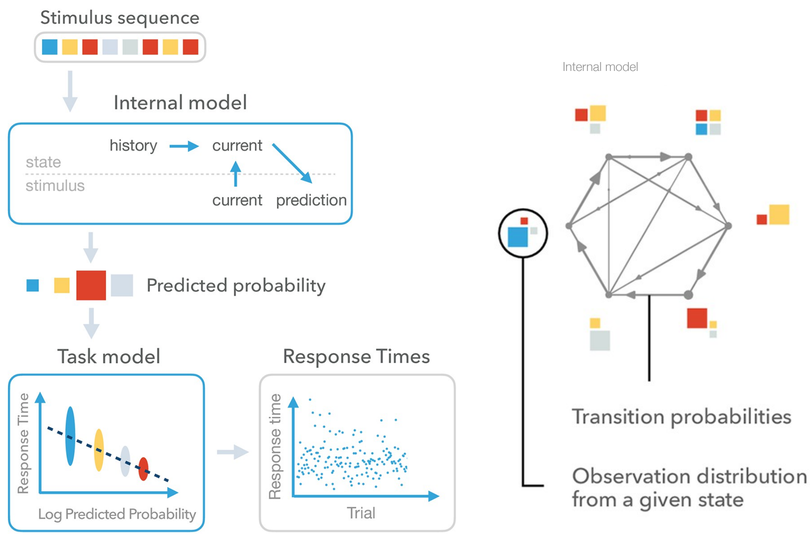
- We use deep generative models to model top-down interactions in the primate early visual system
- We compare properties of a hierarchical Variational Autoencoder to neurophysiological measurements in the V1 and V2 brain areas
- Publication: Ferenc Csikor, Balázs Meszéna, Bence Szabó, Gergő Orbán, "Top-down effects in an early visual cortex inspired hierarchical Variational Autoencoder", *SVRHM 2022 Workshop@ NeurIPS*

Models for optimal forgetting



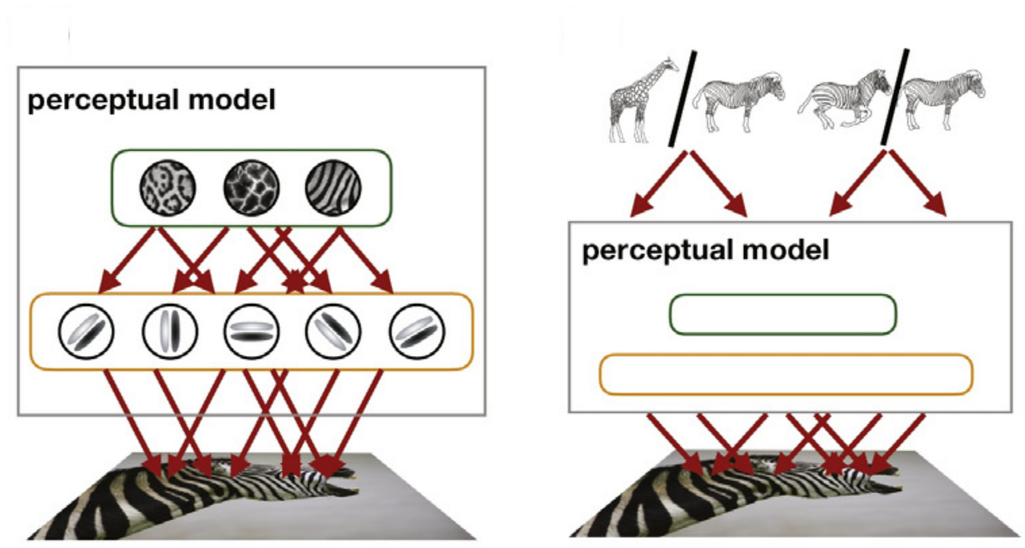
- We modelled forgetting in a $\beta - VAE$ setting and connceted to rate-distortion theory
- We tested our theoretical insights in three domains: recalling chess game configurations, sketch drawings and words
- Publication: David G Nagy, Balázs Török, Gergő Orbán, "Optimal forgetting: Semantic compression of episodic memories", *PLoS Comput Biol 16(10): e1008367*

Transfer Learning in Humans



- We inferred individual internal models of human participants based on response times measured on a visual sequence learning task
- We used a machine learning tool, called Cognitive Tomography to reconstruct individual internal latent models of the task from response times
- Main collaborator: Dezső Németh (Université Claude Bernard Lyon 1, CNRS, ELTE)
- Publication: Török B, Nagy DG, Kiss M, Janacsek K, Németh D, Orbán G (2022), "Tracking the contribution of inductive bias to individualised internal models", *PLoS Comput Biol 18(6): e1010182*

Effects of Attention in V1



- We studied the interactions between attentional and contextual top-signals in V1
- Experimental data: neurophysiological measurements in monkey (from V1 area)
- Main collaborator: Andreea Lazar (Max-Planck Institute for Neuroscience)
- Publication: Andreea Lazar, Liane Klein, Johanna Klon-Lipok, Mihály Bányai, Gergő Orbán, Wolf Singer, "Paying attention to natural scenes in area V1", 2023, *iScience*

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