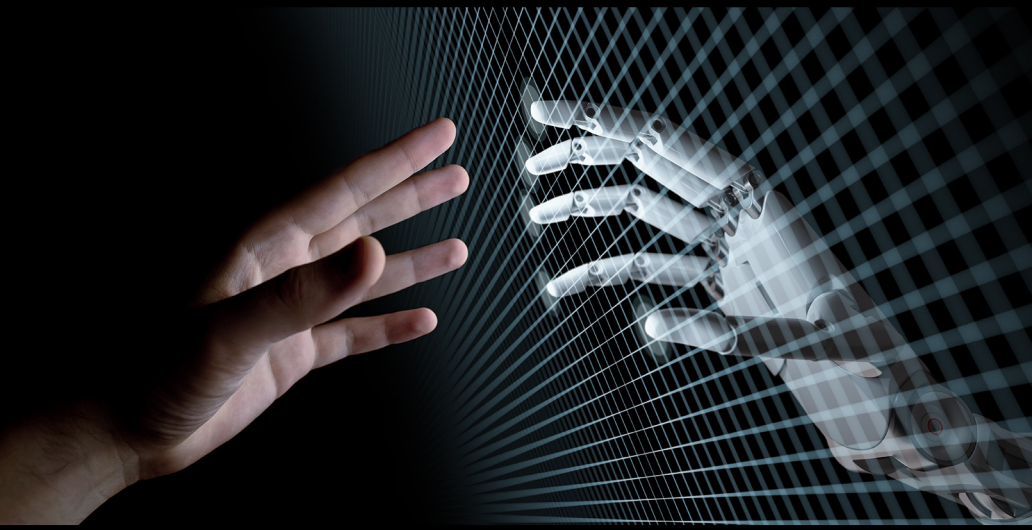
Abstracts of papers presented
at the 2020 *virtual* meeting on

# FROM NEUROSCIENCE TO ARTIFICIALLY INTELLIGENT SYSTEMS (NAISys)

November 9–November 12, 2020



Cold Spring Harbor Laboratory
MEETINGS & COURSES PROGRAM

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Presenter affiliation: Harvard Medical School, Boston, Massachusetts.

**Multi-area recurrent neural network model of decision-making** View Poster 116
Christopher M. Langdon, Tatiana Engel.
Presenter affiliation: Cold Spring Harbor Laboratory, Cold Spring Harbor, New York.

**Computer vision and feedback alignment methods** View Poster 117
Julien Launay, Iacopo Poli, Florent Krzakala.
Presenter affiliation: LightOn, Paris, France; École Normale Supérieure, Paris, France.

**Integration of human-like covert-overt attention with probabilistic convolutional neural nets** View Poster 118
Alexander Lavin.
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**Orientation and color tuning of gamma range activity in human visual cortex** View Poster 120
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**Influence of various temporal recoding on Pavlovian eyeblink conditioning in the cerebellum** View Poster 121
Sang-Yoon Kim, Woochang Lim.
Presenter affiliation: Institute for Computational Neuroscience, Daegu, South Korea.

**Cognitive influences on fixational eye movements (FEM) during visual discrimination** View Poster 122
Yen-Chu Lin, Michele Rucci, Jonathan D. Victor.
Presenter affiliation: Weill Cornell Medical College, New York City, New York.

# INFLUENCE OF VARIOUS TEMPORAL RECODING ON PAVLOVIAN EYEBLINK CONDITIONING IN THE CEREBELLUM

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We consider the Pavlovian eyeblink conditioning (EBC) via repeated presentation of paired conditioned stimulus (tone) and unconditioned stimulus (airpuff). The influence of various temporal recoding of granule cells on the EBC is investigated in a cerebellar network where the connection probability $p_c$ from Golgi to granule cells is changed. In an optimal case of $p_c^*$ (=0.029), individual granule cells show various well- and ill-matched firing patterns relative to the unconditioned stimulus. Then, these variously-recoded signals are fed into the Purkinje cells (PCs) through parallel-fibers (PFs), and the instructor climbing-fiber (CF) signals from the inferior olive depress them effectively. In the case of well-matched PF-PC synapses, their synaptic weights are strongly depressed through strong long-term depression (LTD). On the other hand, practically no LTD occurs for the ill-matched PF-PC synapses. This type of "effective" depression at the PF-PC synapses coordinates firings of PCs effectively, which then make effective inhibitory coordination on cerebellar nucleus neuron [which elicits conditioned response (CR; eyeblink)]. When the learning trial passes a threshold, acquisition of CR begins. In this case, the timing degree $T_d$ of CR becomes good due to presence of the ill-matched firing group which plays a role of protection barrier for the timing. With further increase in the trial, strength $S$ of CR (corresponding to the amplitude of eyelid closure) increases due to strong LTD in the well-matched firing group, while its timing degree $T_d$ decreases. In this way, the well- and the ill-matched firing groups play their own roles for the strength and the timing of CR, respectively. Thus, with increasing the learning trial, the (overall) learning efficiency degree $L_e$ (taking into consideration both timing and strength of CR) for the CR is increased, and eventually it becomes saturated. By changing $p_c$ from $p_c^*$, we also investigate the influence of various temporal recoding on the EBC. It is thus found that, the more various in temporal recoding, the more effective in learning for the Pavlovian EBC.