Virtual Brains, Minds and Machines Summer Course 2020

Tomaso Poggio
Course Director

Boris Katz
Course Director

Gabriel Kreiman
Course Director
Some relevant links and resources

Information about the summer course:
https://cbmm.mit.edu/summer-school/2020

Links to resources posted by the speakers:
https://cbmm.mit.edu/summer-school/2020/resources

Poster presentations:
https://cbmm.mit.edu/summer-school/2020/poster-sessions

CBMM Learning Hub:
https://cbmm.mit.edu/learning-hub

Ellen Hildreth
Coordinator for Education
Monday 10\textsuperscript{th}.  
\underline{Hilbert questions in AI}

Wednesday 12\textsuperscript{th}.  
\underline{What is the Relationship Between Biological Brains and AI?}

Friday 14\textsuperscript{th}.  
\underline{Is There Anything Special About Human Intelligence?}

Monday 17\textsuperscript{th}.  
\underline{AI and ethics}

Wednesday 19\textsuperscript{th}.  
\underline{The Path Towards General AI}
A brief history of AI and Neuroscience

-400
Intelligence is in the heart

1649
Dualism of mind and brain

1894
The single neuron doctrine

1900
The Wizard of Oz

1926
Listening to neuronal activity

1943
Artificial neuron model

1950
The Turing test

1962
Neural coding in cortex

1986
First connectome

1997
Deep Blue beats Kasparov

2005
Optogenetics

2012
Deep convolutional neural networks
“AI”. 1769: Great Chess Automaton
1894: New ideas on the fine anatomy of the nerve centres
AI. Early 1900s: Proliferation of fiction

1900: The Wizard of Oz

1927: Metropolis

By E. D. Adrian and Yngve Zotterman

(From the Physiological Laboratory, Cambridge.)
1943
The McCulloch-Pitts model of a neuron

AI and Neuroscience. 1943: Beginning of the dialogue
1956: Dartmouth Summer Research Project on Artificial Intelligence

Including
Claude Shannon, John McCarthy, Marvin Minsky, Ray Solomonoff, Nathaniel Rochester
Neuroscience. 1962: Neural code for vision

Hubel and Wiesel
Journal of Physiology, 1962

Text-fig. 4. Responses of a cell with a complex field to stimulation of the left
The summer vision project is an attempt to use our summer workers effectively in the construction of a significant part of a visual system. The particular task was chosen partly because it can be segmented into sub-problems which will allow individuals to work independently and yet participate in the construction of a system complex enough to be a real landmark in the development of "pattern recognition."
Neuroscience. 60s-90s. Systematic investigation of visual cortex

Hubel and Wiesel (1959) J. Physiol. 148: 574-591

Kuffler, S. (1953) J. Neurophys. 16: 37-68


Color, Curvature, Gratings, Hyperbolic gratings

3D curves, natural objects, fractals, paperclips, faces

Parietal Pathway

Temporal Pathway
Learning representations by back-propagating errors

David E. Rumelhart*, Geoffrey E. Hinton†
& Ronald J. Williams*

* Institute for Cognitive Science, C-015, University of California,
San Diego, La Jolla, California 92093, USA
† Department of Computer Science, Carnegie-Mellon University,
Pittsburgh, Philadelphia 15213, USA

Nature 1986: Backpropagation

Reinforcement Learning
An Introduction
second edition

Richard S. Sutton and Andrew G. Barto

MIT Press. 1998: Reinforcement Learning
AI. 1997. 2016. Machines beat humans in chess and Go

1997: Deep Blue beats Kasparov  
2016: Alpha Go beats Lee Sedol
Optogenetics: Turning specific neuronal circuits on and off

Boyden et al 2005
Neuroscience. 2014: Large-scale connectomics

Connectomics at scale: Unprecedented ability to scrutinize connectivity in the nervous system

Lichtman et al 2014
A brief history of AI and Neuroscience

- Intelligence is in the heart: -400
- Dualism of mind and brain: 1649
- The single neuron doctrine: 1894
- Listening to neuronal activity: 1926
- Artificial neuron model: 1943
- Neural coding in cortex: 1962
- First connectome: 1986
- Deep Blue beats Kasparov: 1997
- The Wizard of Oz: 1900
- The great chess automaton: 1769
Brains, Minds and Machines Summer Course. Towards the next generation of scholars in AI
It takes a village

Gut brain axis
Forensic psychology

Distribution of fields in BMM 2020

Top 60 fields
It takes a village
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<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Monday</th>
<th>Tuesday</th>
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<tr>
<td></td>
<td>1:15-2:15pm</td>
<td>Eugene Kreiman: Introduction to the summer course</td>
<td></td>
<td>Tutorial: Ethan Meyers: Using population decoding to understand neural content and coding</td>
<td>BREAK</td>
<td>Constantinos Daskalakis</td>
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<td>2:15-2:30pm</td>
<td>BREAK</td>
<td>破</td>
<td>Antonio Torralba: Computer Vision</td>
<td>BREAK</td>
<td>Nancy Kanwisher: Functional specificity of the human brain</td>
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<td>08/11/2020</td>
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<td>Virtual poster session</td>
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FAQ about the virtual summer course

How do I use zoom?

Are the talks going to be recorded?

Will you be issuing participation certificates?

Will there be any type of interaction?

Is there a slack channel?

What is the format for the poster sessions?

I registered for the virtual course, can I defer to take the residential course in 2021?

Are there any coding or experimental projects this year?

I have another question...