International Symposium on Artificial Intelligence and Brain Science 2020

AI and Brain Science

To make intelligent machines by electronics,
we should not bother biological constraints.

There's a superb implementation of intelligence
in the brain, so why don't we learn from that.

AI in 20th century: program human expertise

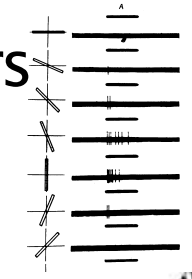
AI in 21st century: learn from big data

Brain-like implementation like *Deep Learning*
gives the best performance.

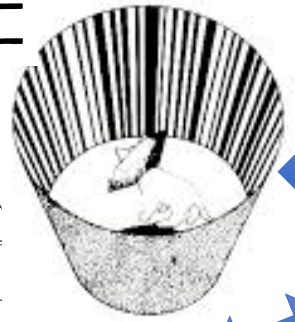
Coevolution in Pattern Recognition

Brain Science

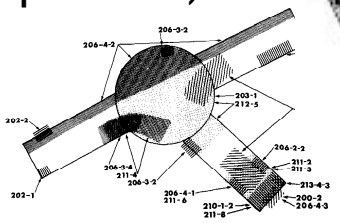
- Feature detectors
  (Hubel & Wiesel 1959)



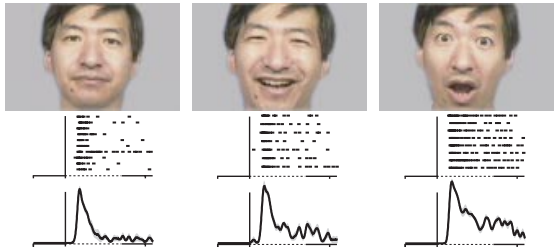
- Experience dependence
  (Blakemore & Cooper 1970)



- Place cell
  (O'Keefe 1976)

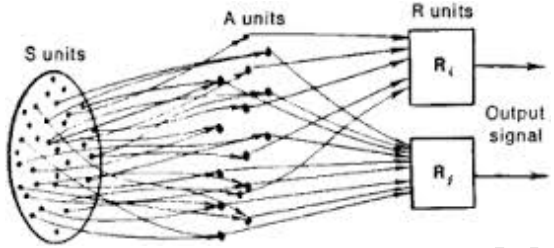


- Face cell (Bruce, Desimone, Gross 1981)

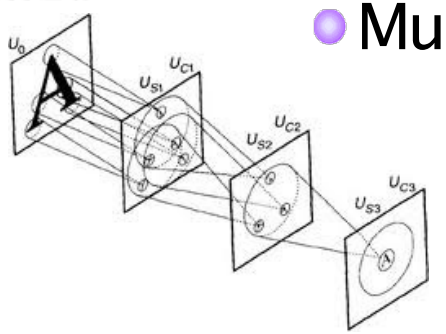


(Sugase et al. 1999)

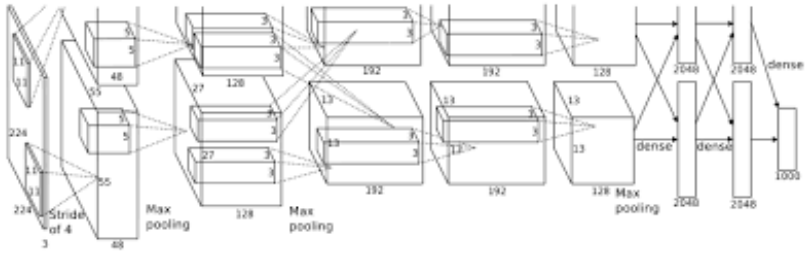
Artificial Intelligence



- Perceptron
  (Rosenblatt 1962)
- Multi-layer learning
  (Amari, 1967)



- Neocognitron
  (Fukushima 1980)
- ConvNet (Krizhevsky, Sutskever, Hinton, 2012)
- GoogleBrain (2012)



NEWS

2020-04-01 Dr.Hiroaki Gomi's group's study is featured in eLife Press Release

2020-01-06 Prof. Kenji Doya received JNNS Academic Award and APNNS Outstanding Achievement Award

Concept

- Recent advances in “deep learning” realized artificial intelligence (AI) that surpasses humans in certain tasks like visual object recognition and game playing.
- Today’s AI, however, still lacks the versatility and flexibility of human intelligence, which motivates AI researchers to learn brain’s working principles.
- Neuroscientists also need helps of AI in making sense of massive data from sequencing, imaging, and so forth.
- The aim of this symposium is to bring together researchers advancing the forefront of AI and neuroscience to identify next targets in creating brain-like intelligence and further advancing neuroscience.

Questions

1. What can we further learn from the brain for next-generation AI?

2. How AI can help bring neuroscience to the next stage?

3. How can fusion of AI and neuroscience affect our society?

Saturday October 10th

13:00 (UTC) Get Connected

13:15 (UTC) Greeting from Kenji Doya

13:30 (UTC) Keynote Lecture

Josh Tenenbaum : Building Machines That See, Think and Learn Like People

14:00 (UTC) Discussion on Session 1 Talks: **Deep Learning and Reinforcement Learning**

Chair: Jun Morimoto, Discussant: Shun-ichi Amari

Yann LeCun: Self-Supervised Learning
Yutaka Matsuo: World Model for Perception, Control and Language
Doina Precup: Fast Reinforcement Learning with Generalized Policy Updates
David Silver: Deep Reinforcement Learning from AlphaGo to AlphaStar
Masashi Sugiyama: Recent Advances in Robust Machine Learning

Saturday October 11th

13:00 (UTC) Discussion on Session 2 Talks: **World Model Learning and Inference**

Chair: Hiroaki Gomi, Discussant: Mitsuo Kawato

- Ila Fiete: Mixed Modular Codes and Remapping for Highly Generalizable Learning and Inference
- Karl Friston: Active Inference and Artificial Curiosity
- Yukie Nagai: Cognitive Development Based on Predictive Coding
- Maneesh Sahani: How Do Neural Systems Learn to Infer?
- Tadahiro Taniguchi: Symbol Emergence in Robotics: Pursuing Integrative Cognitive Architecture using Probabilistic Generative Models for Real-world Language Acquisition

14:00 (UTC) Discussion on Session 3 Talks: **Metacognition and Metalearning**

Chair: Masayuki Matsumoto, Discussant: Keiji Tanaka

- Matthew Botvinick: Object-oriented deep learning
- Ryota Kanai: Consciousness and Intelligence
- Angela Langdon: Model-based Reward Prediction: Algorithms for Learning to Represent a Task
- Hiroyuki Nakahara: Neural Computations for Making Decisions with Others' Rewards and Decisions
- Xiao-Jing Wang: Learning to Learn and the Brain

Monday October 12th

13:00 (UTC) Discussion on Session 4 Talks: **AI for Neuroscience and Neuromorphic Technologies**
Chair: Takatoshi Hikida, Discussant: Kunihiko Fukushima

James J. DiCarlo : Reverse Engineering Visual Intelligence

Yukiyasu Kamitani : The Free Energy Principle and Active Inference in Silico and in Vivo, Visual Sampling and 'World Model' Building

Rosalyn Moran : Cognitive Development Based on Predictive Coding

Terrence Sejnowski : Artificial Intelligence Meets Human Intelligence

Hidehiko Takahashi : Interface between AI and Psychiatry Research

14:00 (UTC) Discussion on Session 5 Talks: **Social Impact and Neuro-AI Ethics**
Chair: Masamichi Sakagami

Anne Churchland : Single-trial Neural Dynamics are Dominated by Richly Varied Movements

Kenji Doya : Toward the Society of AI Agents: What Should We Learn from the Brain and Human Society

Arisa Ema : Interpretative Flexibility' in AI and Neuroscience Research

Hiroaki Kitano : Nobel Turing Challenge : A Grand Challenge on AI for Scientific Discovery

Stuart Russell : Brains, Circuits, and Things

Day 1

Present

- First-principle RL with DNN can beat human wisdom
- Infants start with intuitive physics/psychology and hack awesome programs
- Animal OS + language App
- Successor coding allows zero-shot learning
- Weakly supervised learning

Future

- Unified theory of DL?
- Self-supervised learning for reconfigurable single model?
- AI to discover algorithms

Day 2

Present

- Free energy for curiosity
- Hypo/hyper prior for autism
- Grid-like code, distributed distributional code
- Joining multi-modal models
- Global workspace
- Rats/RNNs learn latent structures
- Other's value in rAI

Future

- Internal models in cerebellum, hippocampus and cortex
- Hierarchy by minimizing complexity?
- Metalearning without meta-agent?
- Metacognition agent or committee of agents?

Day 3

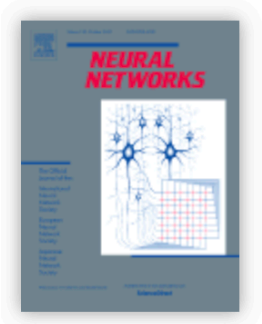
Present

- V1-based coding makes DNN more robust
- DNNs help decode images and thought disorders
- Free-energy principle explains neuromodulation
- Trained NNs to spike
- Cortical activity is full of uninstructed behaviors
- Systems biology is science for AI without cognitive bias
- Risks of AI and neurotech

Future

- Single, collaborative grand challenge for visual intelligence
- AI scientists need not ask the right question?
- Provably beneficial AI by inferring human preference
- Should AI agents learn from human society/brain?

Special Issue on Artificial Intelligence and Brain Science



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Neural Networks

The Official Journal of the International Neural Network Society, European Neural Network Society & Japanese Neural Network Society

Co-Editors-in-Chief: Kenji Doya, DeLiang Wang

> CiteScore: 10.0 ⓘ Impact Factor: 5.535 ⓘ

- www.journals.elsevier.com/neural-networks/

- Timeline
  - Manuscript submission due: January 10, 2021
  - First review completed: March 31, 2021
  - Revised manuscript due: May 31, 2021
  - Final decisions to authors: June 30, 2021
- Guest Editors:
  - Kenji Doya, Okinawa Institute of Science and Technology (ncus@oist.jp)
  - Karl Friston, University College London
  - Masashi Sugiyama, RIKEN AIP and The University of Tokyo IRCN
  - Josh Tenenbaum, Massachusetts Institute of Technology

Neuro 2022

Japanese Neuroscience/Neurochemistry/Neural Network Societies

June 30–July 3, 2022 in Okinawa Convention Center

Program

Saturday, October 10th
(Time in UTC)
13:00 Get connected
13:15 Greetings: Kenji Doya (OIST, AIBS)
13:30 **Keynote**
- Josh Tenenbaum (MIT)

14:00 **Session 1: Deep Learning and Reinforcement Learning**
Chair: Jun Morimoto (ATR, AIBS)
Discussant: Shunichi Amari (RIKEN CBS)
Speakers:
- Yann LeCun (NYU, Facebook)
- Yutaka Matsuo (U Tokyo, AIBS)
- Doina Precup (McGill U)
- David Silver (DeepMind)
- Masashi Sugiyama (RIKEN AIP, U Tokyo IRCN)

Sunday, October 11th
13:00 **Session 2: World Model Learning and Inference**
Chair: Hiroaki Gomi (NTT, AIBS)
Discussant: Mitsuo Kawato (ATR)
Speakers:
- Ila Fiete (MIT)
- Karl Friston (UCL)
- Yukie Nagai (U Tokyo IRCN)
- Maneesh Sahani (Gatsby Unit)
- Tadahiro Taniguchi (Ritsumeikan U, AIBS)

14:00 **Session 3: Metacognition and Metalearning**
Chair: Masayuki Matsumoto (Tsukuba U, AIBS)
Discussant: Keiji Tanaka (RIKEN CBS)
Speakers:
- Matthew Botvinick (DeepMind)
- Ryota Kanai (ARAYA)
- Angela Langdon (Princeton U)
- Hiroyuki Nakahara (RIKEN CBS, AIBS)
- Xiao-Jing Wang (NYU)

Monday, October 12th
13:00 **Session 4: AI for Neuroscience and Neuromorphic Technologies**
Chair: Takatoshi Hikida (Osaka U, AIBS)
Discussant: Kunihiko Fukushima (FLSI)
Speakers:
- Jim DiCarlo (MIT)
- Yukiyaku Kamitani (Kyoto U)
- Rosalyn Moran (King's College London)
- Terry Sejnowski (Salk Institute)
- Hidehiko Takahashi (Tokyo MDU, AIBS)

14:00 **Session 5: Social Impact and Neuro-AI Ethics**
Chair: Masamichi Sakagami (Tamagawa U, AIBS)
Speakers:
- Anne Churchland (UCLA)
- Kenji Doya (OIST, AIBS)
- Arisa Ema (U Tokyo IFI)
- Hiroaki Kitano (SONY CSL)
- Stuart Russell (UC Berkeley)

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- Masashi Sugiyama (RIKEN AIP, IRCN)
- Tadahiro Taniguchi (Ritsumeikan U, AIBS)
- Josh Tenenbaum (MIT)

- KAKENHI Project on Artificial Intelligence and Brain Science (AIBS)
- RIKEN Center for Advanced Intelligence Project (AIP)
- The University of Tokyo Institute for Future Initiatives (IFI)
- The University of Tokyo International Research Center for Neurointelligence (IRCN)

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