Orientation for the Third Whole Brain Architecture Hackathon

— Wake up, Hippocampus!
Incorporating Hippocampal Models
toward AGI Prototypes —

- Date: September 16th, 17th, and 18th, 2017
- Venue: Tokyo, Japan
- End of Registration: August 8th



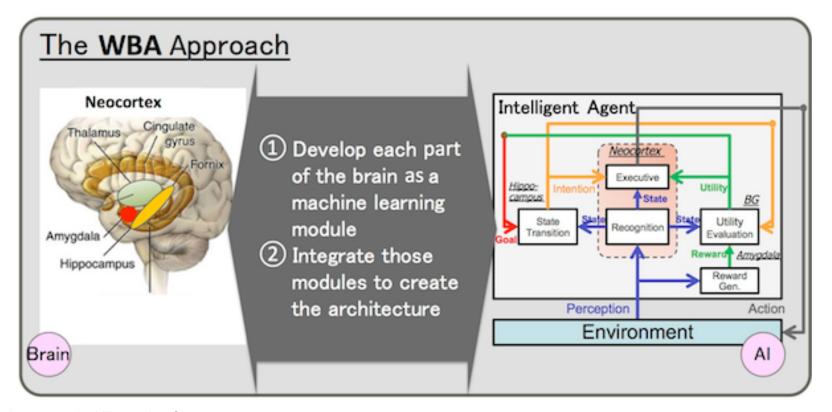
Hackathon: Incorporate Hippocampus into WBA



- What is the Whole Brain Architecture Approach?
- Connectomic Architecture to AGI
- Hackathon Summary, Guidance
- Software used in the Hackathon
- Criteria for Evaluation
- Example Maze Task
- Example Hippocampus Computational Model
- What will be ready by the next Orientation

What is the Whole Brain Architecture Approach?

'to create a human-like artificial general intelligence (AGI) by learning from the architecture of the entire brain.'



An anatomical illustration from Sobotta's Human Anatomy (1908)

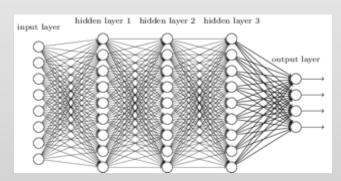




Whole Brain Architecture

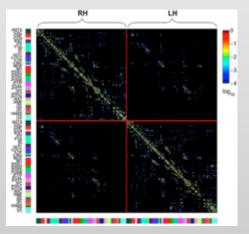
= Machine Learning + Cognitive Architecture

DL Research as the model of Neocortex



Nielsen M. (2015) Neural Nerworks and Deep Learning CC BY 3.0

Connectome as referential architecture



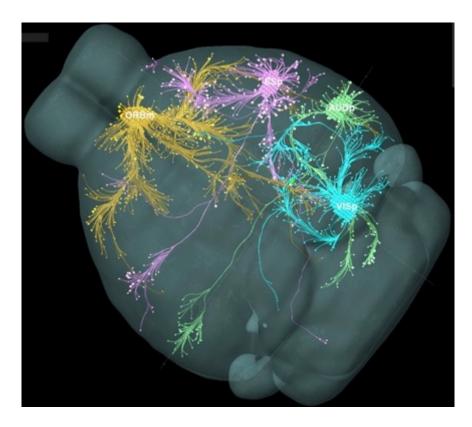
Hagmann P et al., (2008) PLoS Biology Vol. 6, e159, CC-BY



What is the Connectome?



- Biologically clarified wiring diagram in the brain
 - Connectomics: science related to connectome

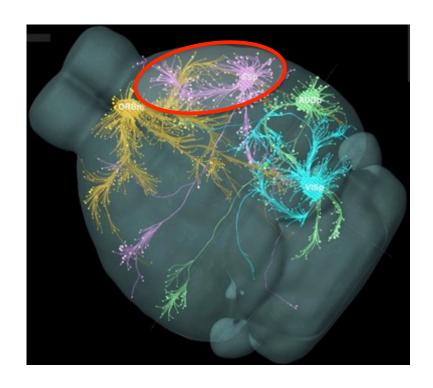


Allen Institute for Brain Science www.alleninstitute.org/



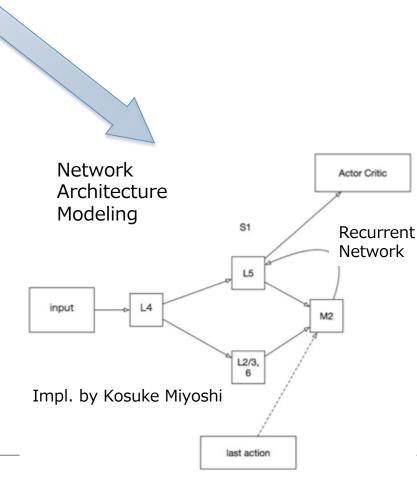
From Connectomic Architecture to AI





The Whole Brain Connectome Architecture (WBCA)

to develop brain-inspired AI by integrating ML modules on static architecture based on connectomic information





Why Connectome?



Connectome Constraint: Limiting the combination of ML modules corresponding brain organs with Connectome

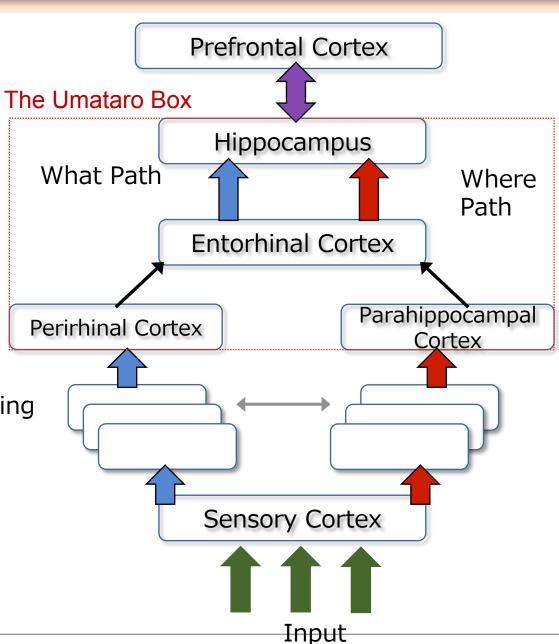
- 1) Preventing divergence in development
- 2) Guaranteed AGI
- A fast track to AGI



Brain-inspired Cognitive Architecture



- 2 Pathways
 - What is it?
 - Where is it?
- Sensory-Motor Info.
 - Action Generation
 - Interaction with Env.
- Hippocampus
 - Episodic Memory
 - Space Cognition
- Prefrontal Cortex
 - Decision Making, Planning





Toward AGI



- The following functions may have been realized in particular systems, but not in an integrated system:
 - Classification
 Self-localization
 - Interaction with Environment Episodic Memory
 - Space Cognition
 One-shot Learning
 - Decision Making
 Planning
 Action Generation
- In this Hackathon, brain-inspired cognitive architecture as a prototype AGI system is to be developed by incorporating the Hippocampus.



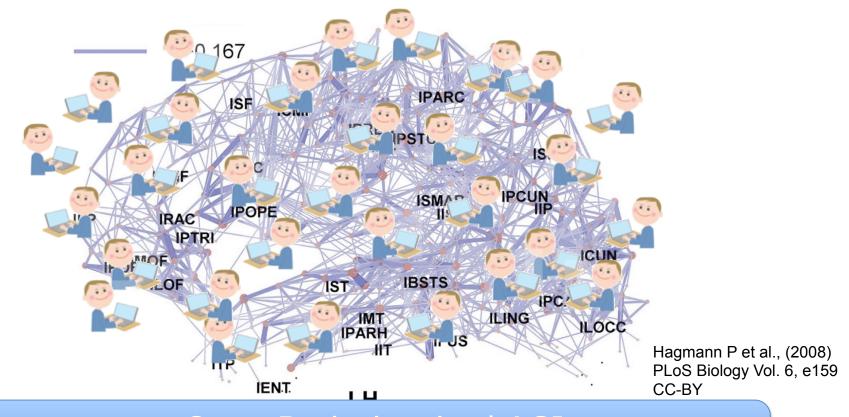
Co-Creation on Connectome Architecture &



Making shared AGI

Utilization of Neuroscience

Non-deferred integration



Open Brain-inspired AGI Integrated Development Platform



The Third WBA Hackathon: Summary



- Date: September 16th, 17th, and 18th, 2017
- Venue: φ-Café
 Kadokawa Hongo Bldg. 6F, 5-24-5 Hongo, Bunkyo-ku, Tokyo, Japan
- End of Registration: August 8th
- Registration Form
 - https://goo.gl/forms/PqAPINoIn53nyCG92
- Fee
 - Free
 - Participants may incur travel and lodging expenses.
 - Students meeting certain conditions will be eligible for financial aids with regard to travel and lodging expenses.



Timeline till Hackathon



- 6/24: the First Orientation
- 7/22 : the Second Orientation
 - Sample Demo.
 - Explanation of Regulations
- 8/8 : Registration Due
- 8/10 : Acceptance notice
- 8/18 : Sample code release
- 8/19 : Sample code orientation + Participant presentation
- 9/16~18: Hackathon!
 - From 10AM



Lodging



Optional Local Lodging at a Hotel

■ Dates: 9/15, 16, 17

■ Venue: <u>SAKURA HOTEL JIMBOCHO</u>

■ Cost: about 4,300JPY/Night

■ Please let us know about your choice from the registration

form.

■ Up to 20 persons





Extra Info.



Computational Environment

■ Bring Your Own Device

Publishing your code

We asks you to publish your code developed for the Hackathon for the open development of WBA.

- WBAI Contributor Agreement
- Apache License (Version 2.0)
- To be published on Github

Financial aids for students

Students meeting the following conditions will be eligible for financial aids with regard to travel and lodging expenses up to JPY65,000/person.

- You should fully participate in the hackathon at Φ Cafe on September 16th, 17th, and 18th.
- Your work at the hackathon with a Readme file should be published on GitHub.



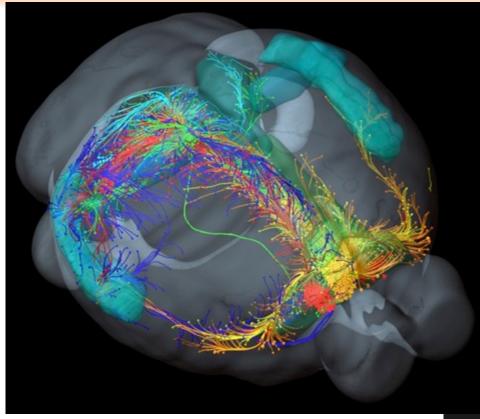
Software to be provided



- WBCA (Whole Brain Connectomic Architecture)
- BiCAmon (Brain Inspired Cognitive Architecture Monitor)
- BriCA (Brain Inspired Cognitive Architecture)
- Unity/LIS (Life in Silico)

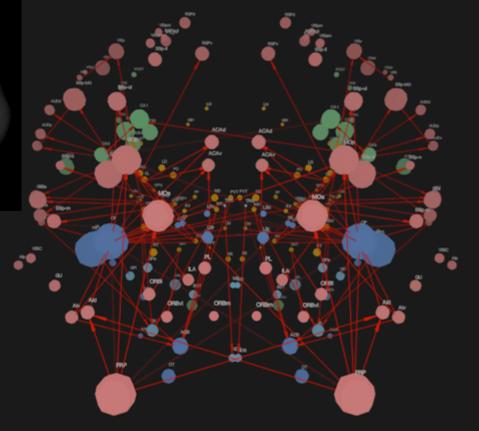
Whole Brain Connectome Architecture (WBCA)





Allen Mouse Brain Connectivity Atlas http://connectivity.brain-map.org/

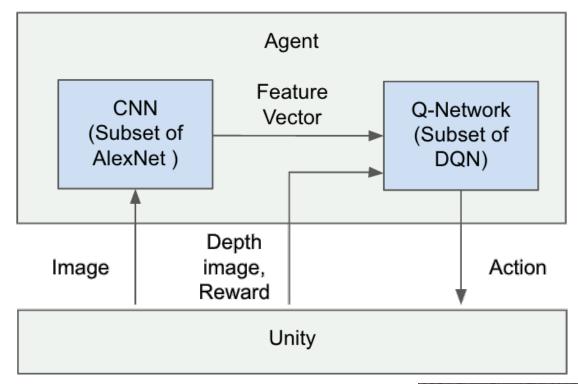
Displayed with BiCAmon





LIS (Life in Silico)









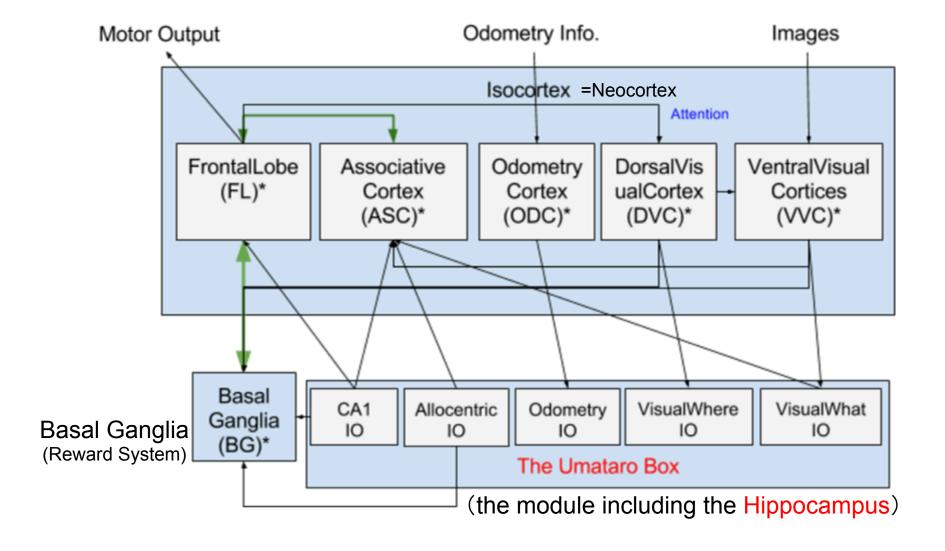
Features of the Hackathon



- WBAI will provide you with Neocortex, Basal Ganglia, and Hippocampus Modules (the last one being empty).
- Module connectivity is presented based on connectome.
- Participants try to make the agent to solve tasks (to be explained below) by implementing the Hippocampus module.
- If you can make a single AI system to realize many cognitive functions, it will advance the development of AGI.

Connectivity around the Hippocampus







Evaluation Criteria



- Developed systems will be reviewed by juries in terms of the following criteria:
 - Neuroscientific reality
 - Realization of various cognitive functions on hippocampus
 - Neuro-connectivity between hippocampus and other brain areas
 - Correspondence with neuronal activities of hippocampus and other brain areas
 - Engineering utility
 - Originality
 - Systems utilizing the software provided by WBAI, such as BriCA, WBCA, BiCAmon will get extra points.
- The winner will be awarded with cash prize.



Evaluation Tasks



- Tasks constructed in an Environment Simulator are used to evaluate the developed systems.
- The following task styles are used.
 In both styles, generality of the system is valued.
- Provided Tasks
 - Competition of solving tasks provided by WBAI
- Free Tasks
 - Competition of solving tasks set by participants

Example Task



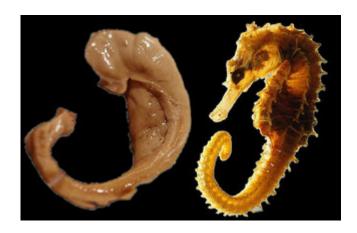
- Linear (One-Dimensional) Maze Task
- The wall and floor of the linear maze have patterns and there are reward spots marked by colors.
- The mouse starts from the end and obtains reward if it waits for two seconds at a reward spot.
 - Learning with the place cells in the Hippocampus and projection paths in the cortex (Masaaki S et al., eNeuro 2017)
- Relearning by setting reward in another spot.
 - How does relearning proceed with the activities of related cells?

How does the hippocampus relate with other brain areas as learning proceeds?



Major Function of the Hippocampus

- Episodic Memory
- Space Cognition, Navigation



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Example Hippocampus Modeling



Robot Navigation

- Huajin Tang, Weiwei Huang, Aditya Narayanamoorthy, Rui Yan
 Cognitive memory and mapping in a brain-like system for robotic navigation, Neural Networks 87 (2017): 27-37.
- OpenRatSlam.org: Self-Location/Navigation

Place cells

 András Lőrincz & Gábor Szirtes
 Here and now: How time segments may become events in the hippocampus, Neural Networks 22 (2009) 738–747



What will be ready by the next Orientation



- Manual for the Hippocampus
 - ■Summary
 - **■**Overall Functions
 - ■Parts (DG, CA1, CA3, ...) and their functions
- Related Papers
- ■Task Set (Maze Task, etc.)