A guide to “Tutorial Workshop: The Free Energy Principle of the Brain”

(supported by National Institutes of Natural Sciences)

[Contents]

[Event overview]

Date： 2019/8/31(Sat) 9:00 ~ 9/1(Sun)14:00 (Registration desk opens at 31st AM 8:30)

Venue： National Institute for Physiological Sciences of National Institutes of Natural Sciences

Conference room (lectures) and Seminar room (coffee break, etc.)

Web site： http://www.nips.ac.jp/~myoshi/nins_tutorial2019/indexe.html

Registration fee: free

Organizers: Hideaki Shimazaki（Graduate School of Informatics, Kyoto University）and Masatoshi Yoshida (NIPS)

The workshop is composed of lectures on the free energy principle and hands-on tutorials using python prgrams that the lecturers will pvoide. We expect to run the code on the Google Colab. Please bring your laptop. Please also make account of the Google Colab, and check if it works on your laptop.

Following the tutorial workshop (8/31-9/1), we will have NIPS Workshop 2019 From theories of the brain to the body and world on 9/1-2.A registration separate from this tutorial workshp is required for the participation (the deadline has past).

[Version history]

ver. 0.91: 2019/8/21 created English version.

ver. 1.00: 2019/8/23 Final version available. (added flow charts)

[How to get to the venue]

1) To arrive at Higashi-Okazaki station (Meitetsu-railway);

●From Tokyo

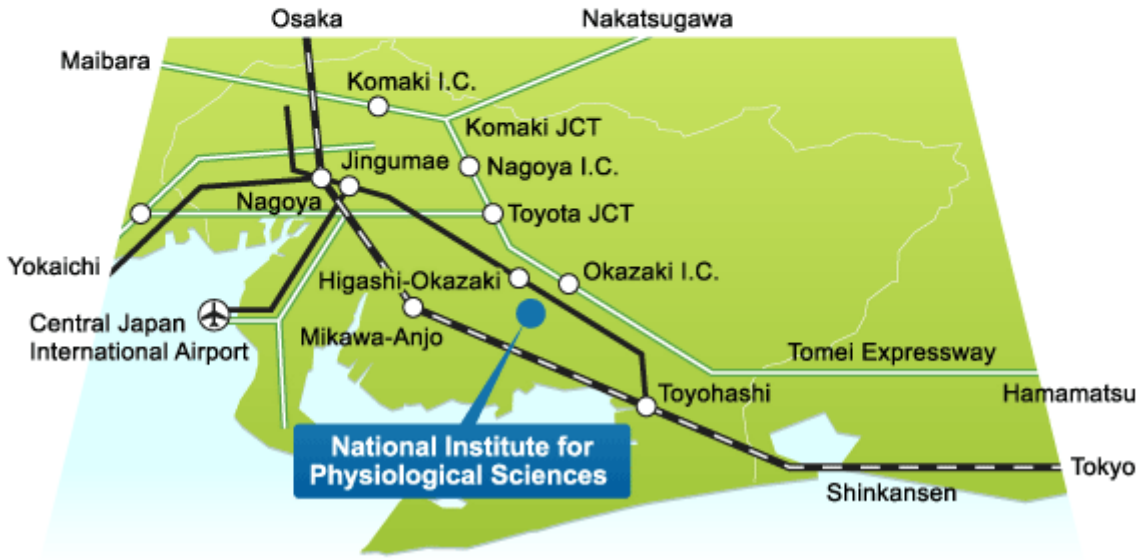
Change the train to Meitetsu at Toyohashi Station and get off at Higashi-Okazaki Station (about 20min between Toyohashi and Higashi-Okazaki). Do not forget to get to the express train, not the local train.

●From Osaka

Change the train to Meitetsu at Meitetsu-Nagoya Station and get off at Higashi-Okazaki Station (about 30min. between Meitetsu-Nagoya and Higashi-Okazaki). Do not forget to get to the express train, not the local train.

●From Central Japan International Airport

By train: take the Meitetsu Airport limited express bound for Toyohashi and get off at Higashi- Okazaki Station. (65 min, 1210 yen)



2) From Higashi-Okazaki to the venue (National Institute for Physiological Sciences, green on the map below)

- By walk

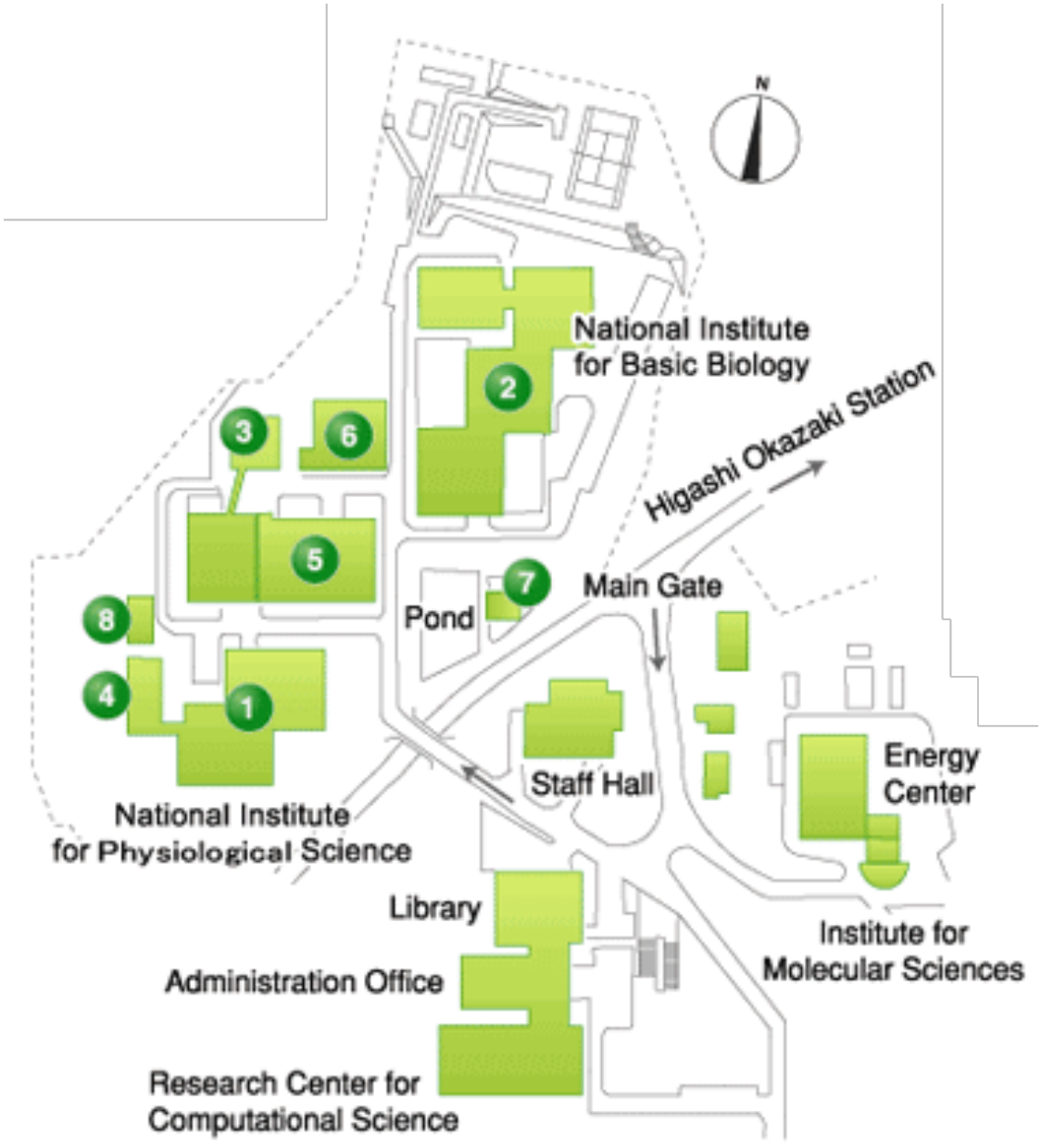
  It is a 10-minutes walk from Higashi-Okazaki Station. Follow the magenta line on the map.

- By taxi

  Taxi is available in front of the South Exit. It costs around 650 yen.

[Campus map]

- Enter from the Main Gate.
- Go to the building #1. The venue is on the first floor. Change your shoes at the entrance.
- The entrance is locked except for the registration time. If you wish to go out from the building, go to the registration desk to borrow the key.
- The registration desk is on the first floor, in front of the seminar room.
- The lectures and tutorials will be done at the conference room.
- Coffee break at the seminar room.



[To the participants]

Registration:

- Registration will open at 8:30 on Aug 31 (Sat) in front of the Seminar Room at the first floor of the Research Building of NIPS.
- We DO NOT provide the printed program (this PDF). Please print out this PDF by yourself if you need the printed version.
- There is no cloak in the building. We will provide the place to store baggage. Please leave your baggage there, but use it on your own responsibility. Do not leave valuable things.

Accommodations:

- The administration office will contact those who will stay at Mishima Lodge. Please refer to the email on how to receive/return the keys and the payment information. Application to the Mishima Lodge has closed.
- Please book hotels by yourself those who do not stay at the Mishima Lodge. Please check the list and map of the major hotels nearby the NIPS at the NIPS website: http://www.nips.ac.jp/accommo/index.html.

About the Lectures and Tutorials:

- Lectures and tutorials will be performed in English.
- Three tutors will support the lectures and tutorials. Please consult with them if you have any questions.
- We will issue the guest wifi account that is valid during the tutorial workshop. On the first day, please receive the paper with the user name and password.
- Lectures and tutorials will be held in the conference room.
- We will provide snacks for coffee breaks at the seminar room, next to the main room. Please help yourself for having snacks at any time.
- The institute cafeteria is closed because this event is held on Saturday and Sunday. We will bring light meal for lunch at the seminar room (coffee break room).

After the lectures and tutorials:

- Following the closing of the tutorial workshop on the second day (9/1) at 14:00, we start the NIPS workshop from 15:00. To rearrange the desks, we ask you to leave the room. Please register the NIPS workshop during this period. We cordially ask for your understanding.

[Time table]

Day 1: Aug 31 (Sat) Conference room at 1F, NIPS

Registration open: 8:30

9:00-9:10	Opening by Masatoshi Yoshida (NIPS)
9:10-10:00	Lecture #1: Overview of free energy principle by Chris Buckley (University of Sussex)
10:30-12:00	Lecture #2: Mathmatical foundations by Chris Buckley (University of Sussex)
12:00-13:00	Preparation for Hands-on tutorial #1 (+ Lunch)
13:00-15:30	Hands-on tutorial #1 (Individuals with simplest model) by Alec Tschantz (University of Sussex)
16:00-17:00	Lecture #3: Expected free energy (discrete version) by Chris Buckley (University of Sussex)
17:00-19:30	Lecture #4: Introduction to Python toolbox by Alec Tschantz (University of Sussex)

Day 2: Sep 1(Sun) Conference room at 1F, NIPS

9:00-12:30	Hands-on tutorial #2 (in groups, projects about Expected free energy) (+ Lunch) by Alec Tschantz (University of Sussex)
12:30-13:30	Presentation about the projects (by participants in six groups)
13:30-13:55	Wrap-up lecture by Chris Buckley (University of Sussex)
13:55-14:00	Closing by Hideaki Shimazaki (Kyoto University)

[Overview of Lectures and Tutorials (tentative)]

- Lecture #1: Overview of free energy principle
  - Overall lecture on the Free Energy Principle. The lecturer will show the significance of the theory before we delve into the mathematical details. We recommend you to read the Ref.1 (Friston 2010).
- Lecture #2: Mathematical foundations
  - The lecturer will introduce Bayesian estimation, variational Bayes, and explain the free energy principle based on the continuous-time, generalized coordinates.
- Hands-on tutorial #1
  - Participants perform programing individually.
  - This hands-on tutorial will cover the basics of the free energy principle. The example will be similar to the simulation used in the Ref. 2 (Bogacz 2017) and Ref. 3 (Buckley et al 2017).
- Lecture #3: Expected free energy (discrete version)
  - The lecturer will explain the model of perception, action, and learning based on the discrete-time formulation of the expected free energy, which was introduce in Ref.4 (Friston et al 2015).
- Lecture #4: Introduction to Python toolbox
  - In the hands-on tutorial #2 (next session), the participants will perform programming using the python toolbox that the lecturers created. In this lecture, the lecturers will explain the basic structure and settings of this toolbox. Using this toolbox, participants simulate agents that select action in the known environment. The environment is a grid world often used in the reinforcement learning paradigm. The action of an agent is selected by expected free energy at discrete-time steps.
- Hands-on tutorial #2 (in groups, projects about Expected free energy)
  - Using the toolbox explained in the Lecture #4, the participants will investigate action selections in more complex environment, and learning of the new environment. Participants will perform the tasks as a group of 5 people (in total 6 groups). We will notify the assignment to groups beforehand.
- Presentation about the projects
  - Participants will report the results of Hands-on tutorial #2. Each group has 10 minutes of presentation, including question time.
- 13:30-13:55 Wrap-up lecture
  - We will make a wrap-up of the tutorials.

(See the next page for the references)

[Preparation before the tutorial]

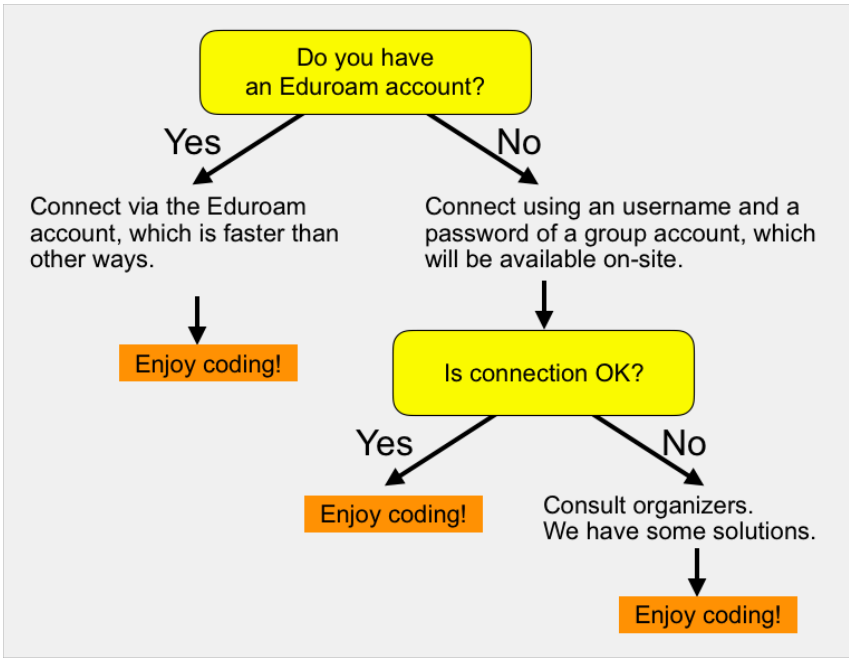
References (recommended by the lecturer)：

1. Friston K. (2010) The free-energy principle: a unified brain theory? Nat Rev Neurosci. 11(2):127-38. doi: 10.1038/nrn2787. PDF is available from: https://www.researchgate.net/publication/41001209_Friston_KJ_The_free-energy_principle_a_unified_brain_theory_Nat_Rev_Neurosci_11_127-138
2. Bogacz R. (2017) A tutorial on the free-energy framework for modelling perception and learning. J Math Psychol. 76(Pt B):198-211. doi: 10.1016/j.jmp.2015.11.003. PDF is available at: https://doi.org/10.1016/j.jmp.2015.11.003
3. Buckley CL. et. al. (2017) The free energy principle for action and perception: A mathematical review. Journal of Mathematical Psychology, Volume 81, Pages 55-79. PDF is available at: https://doi.org/10.1016/j.jmp.2017.09.004
4. Friston K et. al. (2015) Active inference and epistemic value. Cogn Neurosci. 6(4):187-214. doi: 10.1080/17588928.2015.1020053. PDF is available at: https://www.researchgate.net/publication/272520403_Active_inference_and_epistemic_value

For Japanese-speaking people, following two papers will be helpful:

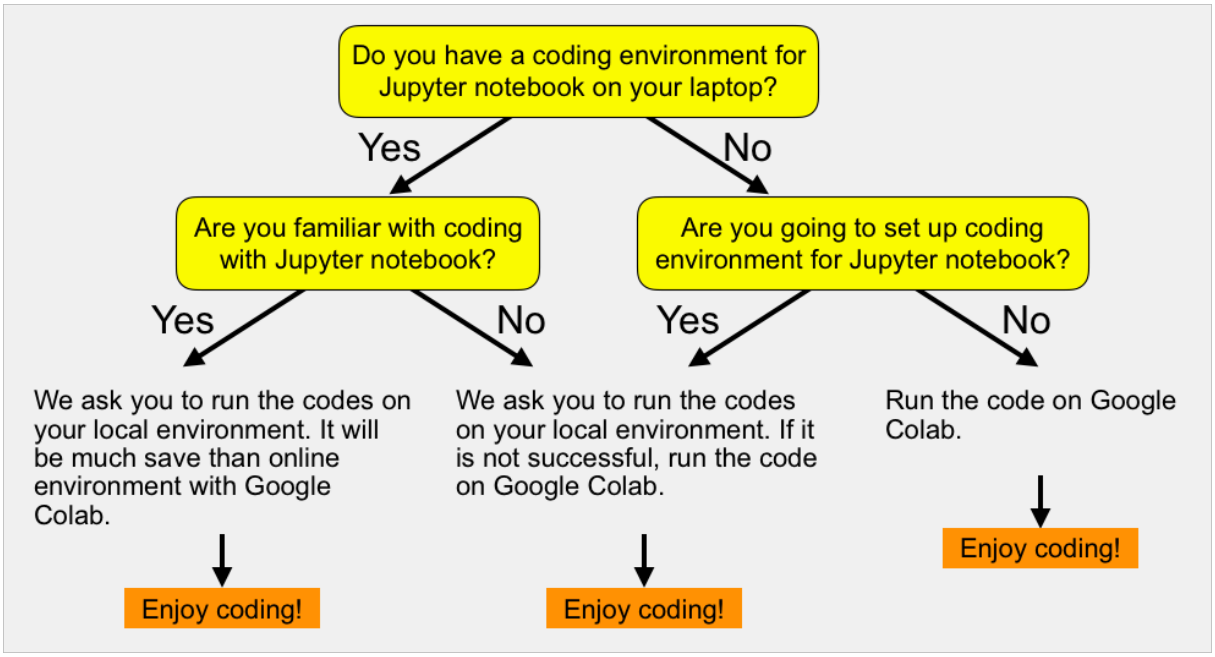
5. 神経回路学会誌 25 巻 3 号 特集「自由エネルギー原理入門」 https://www.jstage.jst.go.jp/browse/jnns/25/3/_contents/-char/ja
6. 吉田正俊 (2019)「自由エネルギー原理の基礎徹底解説」(吉田の個人ブログ上の資料) http://pooneil.sakura.ne.jp/EFE_secALL0517.pdf

Wifi connection:



Preparation for hands-on tutorials:

- Please bring your laptop.
- We will do programing using Jupyter notebook written in Python3 on Google Colab (Colaboratory). Please make an account for Google Colab https://colab.research.google.com/, and verify that it works using the tutorial at https://colab.research.google.com/notebooks/welcome.ipynb
- Troubles may happen on the tutorial sessions as 30 people simultaneously connect to WiFi. If you are already the user of Python, and have developing environment on your laptop, it would be recommended to use the local environment to code the program, instead of the Google Colab. Python codes we will use is Jupyter notebook (*.ipynb) written in Python3. The required libraries are just numpy, matplotlib, seaborn. No libraries of machine learning (scikit-learn, TensorFlows) will be required.
- If you are not familiar with Google Colab and Python, it is recommended to prepare using the materials on the web. We can recommend you to run the preparation part of “Introduction to deep learning” by the Preferred Networks, on Google Colab, although we do not need deep learning in this tutorial.
- If you have not constructed local environment of Python, and wish to do so, then we recommend to use miniconda. For Mac users, it is easy to construct the environment by using Docker.
- Follow the instructions below.



(Masatoshi Yoshida is responsible for this tutorial guide)