AY2023 Admission Guide

Department of Information Physics and Computing

Graduate School of Information Science and Technology,
The University of Tokyo

Master’s Program
Doctoral Program

Contact [Department Administration Office]

7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8656
Department administration office (Department of Information Physics and Computing), Graduate School of Engineering / Information Science and Technology Administrative Group,
The University of Tokyo
office@office.keisu.t.u-tokyo.ac.jp

Visit: https://www.i.u-tokyo.ac.jp/edu/course/ipc/index_e.shtml

Note: This guide should be read together with the graduate school’s admission guide: “AY2023 Admission Guide: {Master's / Doctoral} Program, Graduate School of Information Science and Technology, The University of Tokyo.” The details of this guide may be changed. In that case, it will be posted on the Department’s admissions page.

This document is a translation from the official Japanese version. In the case of conflict, the Japanese version shall prevail and be conclusive.
I. Master’s Program

Due to the interdisciplinary nature of the Department of Information Physics and Computing, this department seeks applicants from a wide range of fields, both within and outside The University of Tokyo, with a fundamental understanding and knowledge of informatics, mathematics, physics, electrical or mechanical engineering. Examination subjects have been selected to allow for fair conditions to be met from a variety of departments outside the university. No priority is given to students from within the university. As described in Section C, examinees can choose other specialized subjects not administered within this department.

A. Preference Card

Download the “Preference Card for Master’s program” PDF form available at our website, fill in the form, and submit the card at the time of application. Up to nine Faculty Advisors can be selected as candidate advisors. At the bottom of the card, list Faculty Advisors whom you do not wish to be assigned to, if any. Depending on the examination results and the list of preferred/non-preferred Faculty Advisors, if you cannot be assigned to any Faculty Advisors, your application will be rejected. Submit the Preference Card together with the other application documents. Please note that students can pursue interdisciplinary studies about Information Physics and Computing no matter which Faculty Advisor you are assigned to, since laboratories in this department work closely together.

B. Reasons for Application

Submit a document describing the reasons for applying to the Department of Information Physics and Computing, with references if necessary, based on what you have learned
and experienced. The document should be written either in Japanese or English. The font size should be around 11 pt. The document should be on three A4-sized or letter-sized pages. Figures can be included. Please put your name on every sheet. Since the document is used for the document screening and evaluation, it should be well-thought out and of appropriate length and content.

C. Examination Schedule

(Document screening)

Document screening will be conducted based on the submitted documents. Please refer to the Admission Guide of the graduate school about the announcement of the screening result.

(Written and oral examinations)

Written and oral examinations will be conducted for examinees who have passed the Document screening. Enrolled students will be selected by using these results comprehensively.

1. Regular education subjects

For details, please refer to the Admission Guide of the graduate school.

2. Guidance for Online Examinations

<table>
<thead>
<tr>
<th>Date and Location</th>
<th>Time</th>
<th>Notes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 19, 2022 (Friday)</td>
<td>13:00 – 14:30</td>
<td>Guidance will be provided on how the online examinations will be conducted.</td>
</tr>
</tbody>
</table>

If you plan to take online examinations, please attend the Guidance for Online Examinations for the Department of “Information Physics and Computing.” Those who are absent from the guidance are not permitted to participate in online examinations. For information on the examinations for “Mathematical Informatics,” “Computer Science,” and “Information and Communication Engineering,” please refer to the Admission Guide.
3. Specialized subjects

For examinations on specialized subjects, students shall choose one subject among the following: “Information Physics and Computing,” “Mathematical Informatics,” “Computer Science,” and “Information and Communication Engineering.” Please note that dates, times, and locations differ depending on the subject.

<table>
<thead>
<tr>
<th>Specialized Subjects</th>
<th>Examination Dates, Times, and Locations</th>
<th>Scope of Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Physics and Computing</td>
<td>August 22, 2022 (Monday) 10:00 – 12:00 Onsite or Online</td>
<td>Students will be required to select and solve two among four problems: “signal processing,” “electronic circuits,” “control,” and “dynamics.” The total time for answering the problems is 100 minutes.</td>
</tr>
<tr>
<td>Mathematical Informatics</td>
<td>Please refer to the “Admission Guide” for the Department of Mathematical Informatics.</td>
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<tr>
<td>Computer Science</td>
<td>Please refer to the “Admission Guide” for the Department of Computer Science.</td>
<td></td>
</tr>
<tr>
<td>Information and Communication Engineering</td>
<td>Please refer to the “Admission Guide” for the Department of Information and Communication Engineering.</td>
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</table>

The log-in information for the “Website for Examinees (Master & Doctor)” will be sent to applicants who have passed the document screening. The details on the examination for “Information Physics and Computing” may be changed. In this case, it will be posted on the website for examinees. For information on the examinations for the Department of “Mathematical Informatics,” “Computer Science,” and “Information and Communication Engineering,” please refer to the Admission Guide for the Department in question. Those who are absent from the examinations of the specialized subjects are considered to have abstained from the entrance examination.

4. Oral Examination

The oral examination will be conducted between 9:00 a.m. and 6:00 p.m. on August 23 (Tuesday), 24 (Wednesday), 25 (Thursday), or 26 (Friday), 2022. Detailed schedules will
be posted or distributed during the examination period. The Oral Examination schedule for examinees who take written exam subjects other than “Information Physics and Computing” will be adjusted to avoid overlapping with examinations of the specialized subjects.

D. Notes of Caution

1. Persons who have not graduated from university by September 2022 and wish to enter the school in October are required to confirm their eligibility with the Department Team (the Department of Information Physics and Computing), Academic Affairs Group, Graduate School of Engineering / Information Science and Technology, The University of Tokyo.

2. For other detailed instructions, please keep checking the websites for examinees carefully.
II. Doctoral Program

A. Persons wishing to apply to the Doctoral Program should refer to the “AY2023 Admission Guide: Doctoral Program, Graduate School of Information Science and Technology,” and must contact the following Administration Office well in advance of submitting the application.

Contact:
Department of Information Physics and Computing, Graduate School of Information Science and Technology, The University of Tokyo
7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8656

Department of Information Physics and Computing Administration Office
+81 (0)3-5841-6889
office@office.keisu.t.u-tokyo.ac.jp

B. Preference Card

Download the “Preference Card for Doctoral Program” PDF form available at our website, fill in the form, and submit the card at the time of application. Applicants must identify a faculty member to serve as your thesis supervisor and contact the faculty member to arrange a face-to-face or online interview. In this interview, the applicants should describe their academic achievements, research experience, research abilities, and research plans. The interview must be completed between April 22 and May 31, 2022, for Summer Examinations or between October 13 and November 16, 2022, for Winter Examinations. Applicants may not be allowed to take the examinations if they fail to complete this procedure.

C. Outline of past research results and Research Plan for Doctoral Program
Submit the following documents together with the other application documents:

1. Describe the content and results of past research as well as the significance of the research in the field in question. The summary should be either in English or Japanese, on no more than four A4-sized or letter-sized pages.

2. Provide a specific research plan to be conducted after admission to the Doctoral Program and describe how this research will contribute to the field in question. Summary should be either in English or Japanese, on no more than two A4-sized or letter-sized pages.

3. Provide a list of research achievements on A4-sized or letter-sized pages. Achievements should be categorized into original articles, review articles, oral presentations, and others. If there are no research achievements, write “not applicable.”

Since the above documents will be used as the basis for the Oral Examinations and subject to scoring, they should be well-thought out and of appropriate length and content.

D. Examination Schedules

At the time of application, please select either the Summer Entrance Examination or the Winter Entrance Examination. Please note that the periods for acceptance of applications differ for the summer and winter examinations.
1. Summer Examinations

(Primary Examinations)

<table>
<thead>
<tr>
<th>Examination Dates and Locations</th>
<th>Examination Times</th>
<th>Examination Subjects</th>
<th>Notes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The afternoon of August 22, 2022 or the morning of August 23, 2022 Online</td>
<td>Detailed schedules will be posted at 10:00 on August 22.</td>
<td>Oral Examination I</td>
<td>Examinees will be required to answer questions related to the fundamentals of Information Physics and Computing and to the applicant’s research field.</td>
</tr>
<tr>
<td>August 24, 2022 Online</td>
<td>Detailed schedules will be posted at 17:00 on August 23.</td>
<td>Oral Examination II</td>
<td>Examinees will be required to answer questions on the results of their past research and research plan submitted beforehand.</td>
</tr>
</tbody>
</table>

The log-in information for the “Website for Examinees (Master & Doctor)” will be sent to applicants who have passed the document screening. Persons who have completed, or are expected to complete a Master’s Program of Graduate School of Information Science and Technology in The University of Tokyo will be exempt from Oral Examination I. Examinees who are rejected in Oral Examination I cannot take Oral Examination II. The results of Oral Examination I will be posted with the schedules of Oral Examination II.

No written English Examination will be administered. TOEFL scores will be used for evaluation of English ability. For details, refer to the Admission Guide of the graduate school. Persons who have completed or are expected to complete a Master’s program at the University of Tokyo will not be required to submit TOEFL scores.

(Secondary Examinations)

As a general rule, Secondary Examinations will be conducted between late January and mid-February, 2023. Applicants will be notified of a detailed schedule and locations later. Applicants should bring their Master’s thesis (or equivalent document). For persons wishing to start the school program in October 2022 or for persons already holding a master's degree at the time of application, the Secondary Examination will be conducted at the same time as Oral Examinations II.
2. Winter Examinations

As a general rule, the primary and secondary examinations will be conducted between late January and mid-February, 2023. Acceptance will be limited to a few students. Examination methods will be in accordance with those used for Summer Examinations. Applicants will be notified of detailed schedule and locations after applications have been received.

E. Notes of Caution

1. Persons wishing to start school in October 2022, but have not been conferred Master’s degree by September 2022, are required to confirm their eligibility with the Department Team (the Department of Information Physics and Computing), Academic Affairs Group, Graduate School of Engineering / Information Science and Technology, The University of Tokyo. They are also required to mark “Yes” in response to the question “Do you wish to enter the school in October 2022?” in the Preference card.

2. Persons wishing to be included in the “Special Selection for Professionals” MUST contact the Administration Office described above before submitting the application. Additional documents will be needed for the “Special Selection for Professionals.” They are also required to mark “Yes” in response to the question “Do you wish to apply based on the Special Selection for Professionals?” on the Preference card.

3. For other detailed instructions, please keep checking the websites for examinees carefully.
Faculty members and laboratories
Sound Media Informatics Lab. (Saruwatari and Koyama Lab.)  
http://www.sp.ipc.i.u-tokyo.ac.jp/

| Professor Hiroshi Saruwatari  
| Lecturer Shoichi Koyama |
| This laboratory mainly innovates in new signal processing and information processing systems, focusing our attention on understanding, processing, and controlling sound media (speech, music, etc.). For example, theories on new statistical modeling and machine-learning-based algorithms are of interest for solving optimization problems under acoustical generative models and physical constraints. Through our research, we extend human hearing systems, create new human-machine interface systems, and bring our innovative contribution to music creation. |

1) Auditory Communication Augmentation via Unsupervised Learning  
We realize versatile unsupervised source separation combining statistical estimation theories and low-rank modeling. Also, we address a new combination of deep learning and spatial acoustics, which can be applied to semi-supervised source separation. Thanks to these methods, new human-machine interfaces, auditory communication augmentation systems, and user-oriented music information systems can be developed.

2) Sound Field Analysis and Synthesis, and its Applications  
We tackle inverse problems related to acoustic fields, such as sound field imaging, analysis, source localization, and estimation of room acoustic parameters, as well as sound field control problems for synthesizing a desired sound space. We explore new methodologies based on wave theory using various approaches (signal processing, optimization, statistical modeling, machine learning, etc.) and develop new systems for telecommunication, virtual reality, etc.

3) Augmented Speech Communication Based on Machine Learning  
We investigate signal processing and machine learning theories for speech synthesis and conversion for human-human and human-machine communication. We interpret speech from the perspectives of physics and informatics and deal with accurate modeling of speech signals and speech information. We also develop speech-based virtual reality systems by using human-in-the-loop speech modeling that integrate humans into machine learning.

1) Department of Creative Informatics
Biomechanical system Lab. (Kawashima and Miyazaki Lab)  
http://www.bmc.ipc.u-tokyo.ac.jp/

<table>
<thead>
<tr>
<th>Professor</th>
<th>Kenji Kawashima</th>
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<tr>
<td>Lecturer</td>
<td>Tetsuro Miyazaki</td>
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We aim to develop novel medical systems, robotic systems, and human-machine systems useful for a healthy and long-lived society. Our original technique is to combine a measurement control technology based on distributed parameter models of fluid drive systems with a system design that utilizes actuator characteristics. We additionally integrate medical engineering and information science to develop highly smart and functional systems to implement them into our society.

(1) Surgical robots

We are researching robots that support minimally invasive surgery. We aim to improve system intelligence and function by autonomous control of specific operations using machine learning.

(2) Physical assistive systems

We realize motion assistive systems that estimate a wearer's motion from actuator-side control information without mounting sensors directly on the wearer's body by leveraging the advantages of directly driven soft actuators such as pneumatic artificial rubber muscles.

(3) Measurement and control of fluid systems

We propose applications to state estimation and prediction problems in fluid-driven medical systems by using morphological computation that utilizes non-linearly distributed state quantities of the fluid-driven systems.

(4) Status estimation from medical images

We develop a system that estimates the state of robots and the pathological conditions of organs for medical images using AI.
Inverse problems are problems to recover physical information through indirect measurements and mathematical reconstruction. Our laboratory develops basic and unified theories and measurement/actuating systems regarding inverse problems.

1. Development of direct reconstruction and measurement methods for inverse source/coefficients/boundary value/governing-equation problems: theories that express physical information in a closed form in terms of data are developed based on mathematical physics tools such as complex analysis, potential theories, and tensor analysis.

2. Application to non-invasive measurements, non-destructive inspection, disaster relief, and tissue engineering: novel measurements and mathematical methods are developed and applied to the diagnosis of epilepsy based on magnetoencephalography (MEG) and electroencephalography (EEG), imaging of electrical and mechanical properties inside the human body based on magnetic resonance imaging (MRI), non-destructive testing using electromagnetic field and ultrasonic waves, search for victims buried in rubble in earthquake disasters, and design of cellular alignment.

3. Construction of physical information systems based on midair acoustic fields designed via inverse-problem formulation: airborne acoustic fields with desired spatiotemporal structures are designed by solving inverse problems derived from physical models, to realize novel functions such as remote airflow control, non-contact acoustic measurement, and midair communication with spatial selectivity.
We realize a real-world informative environment that goes beyond conventional barriers by introducing new physical phenomena and physical structures into the system. In particular, we propose technologies from hardware to applied systems for sensing humans, environments, and their interactions, and for supporting humans through haptic and other human senses. Research topics include basic and universal discoveries based on novel ideas and the process of solving social problems and using them in practical technologies.

(1) Haptic Interface: A system that supports human life and behavior by stimulating the sense of touch simultaneously with audiovisual information. Clarify the relationship between the tactile sensation and the mind and emotions that support the base of human intelligence, and apply it to real systems.

(2) 2D Communication: Information and electricity transmission through a thin sheet using electromagnetic waves to realize wireless power supply and high-speed signal transmission without interfering with conventional wireless LAN.

(3) Use of human behavior: Based on the features of human behavior, we predict near-future motion and estimate haptic characteristics of the object in touch. This technology can be used for preventing falls and for sports.

(4) Other topics such as physical informatic devices, human-machine interfaces, non-contact measurement of haptic information, artificial robot skin, wearable computing, etc.

2) Department of Complexity Science and Engineering, Graduate School of Frontier Sciences
Control engineering is involved in the design of the behavior of systems and we conduct research related to a broad range of control theories and their applications. Research themes are divided into three categories; cybernetics, control system analysis & synthesis, and modeling/system identification/estimation/learning, which are explained below:

(1) Cybernetics: By employing a new fusion of system control theory with information theory/physics/optimization/system biology, we aim to establish theories of analysis and synthesis for large scale complex system/multi-agent system/networked system/networked AI/bio-system/quantum control system.

(2) Control System Analysis & Synthesis: We aim to develop advanced control theories including robust control, nonlinear control, hybrid control, learning control, etc.

(3) Modeling/System Identification/Estimation/Learning: We aim to establish theories for the modeling of dynamical systems, in particular system identification for uncertain modeling or modeling for large-scale complex systems.
**Neural Information Lab. (Amano Lab.)**
https://www.brain.ipc.i.u-tokyo.ac.jp/

<table>
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<tr>
<th>Professor Kaoru Amano</th>
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<tr>
<td>We are investigating the neural mechanisms underlying human sensory perception and cognition using non-invasive neuroimaging techniques such as magnetoencephalography (MEG), functional magnetic resonance imaging (fMRI). In particular, we are developing methods for non-invasive manipulation of brain information to elucidate the neural process that causally contributes to human perception and behavior. In recent years, we have been focusing on the functional roles of neural oscillations in information integration. We are also interested in how the individual differences in brain activity and perception are related to the individual differences in brain structure.</td>
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</table>

1. **Development and application of brain information control technology**

We are developing techniques for non-invasive manipulation of brain information based on transcranial electrical/magnetic stimulation and neurofeedback. Using these techniques, we investigate the changes in perception, cognition, and behavior associated with the changes in brain information.

2. **Neural oscillations as a clock for visual processing**

Neural oscillations such as alpha (8-13 Hz) and theta (4-8 Hz) oscillations are thought to work as a clock for information processing in the brain. For example, we have shown that an illusion called motion-induced spatial conflict, in which a figure that is actually moving smoothly is perceived to be moving while jittering at around 10 Hz, is tightly coupled with alpha oscillations. The results suggest that alpha oscillations might determine the timing of communication across different visual areas for integrating information. We will investigate this clock function by combining functional brain imaging such as electroencephalography (EEG) and magnetoencephalography (MEG) with non-invasive manipulative techniques.

3. **Functional roles of the white matter tracts**

Brain tissue called white matter is responsible for information transmission between brain regions. By investigating the relationship between the characteristics of white matter pathways measured by diffusion-weighted/quantitative MRI and perception, cognition, or behavior, we intend to clarify the function of information transmission in the brain.
Photonics plays a crucial role in the frontiers of innovative computing, imaging, and communications. Our research group is working in frontier research from three complementary perspectives. One is photonics-for-computing, where the aim is to develop novel architectures for computing, including decision making, in which we benefit from the unique physical attributes of photons. The second is computing-for-photonics, such as computational imaging, where novel algorithms and mathematical modeling significantly expand imaging functionalities. The third is to extend our information physics systems approach to new domains such as beyond 5G communications.

(1) AI Photonics – *Photonics for Computing*

This project physically resolves decision-making problems in dynamically changing uncertain environments by utilizing the unique nature of light. The topic includes the design of ultrafast decision-making using chaotic lasers and collective decision-making using entangled photons.

(2) Computational Imaging – *Computing for Photonics*

Computational imaging aims to provide novel imaging functionalities by unifying optics and computing. For example, we develop novel architectures for imaging through scattering media via insights into physical processes and state-of-the-art signal processing, including machine learning. *Computing-for-photonics* research plays critical roles in medical, astronomical, and security applications.

(3) Novel System Design Utilizing Natural Processes

Novel system architecture design is critical to deal with the growing demands for computing and communications. We are developing strictly delay-bounded information networks based on precision time-and-space synchronization technology, which is vital for real-time and reliable communications in the beyond 5G era.
Our goal is to establish a design methodology for high-quality computing in which advanced interactions between the physical world and the cyber world are realized. Here, high-quality includes performance, responsiveness, power consumption, reliability, and security. These qualities are in a trade-off relationship, and the system needs to be optimized according to its characteristics and requirements. We are researching the comprehensive system-level design methodology to optimize the entire system, including edge devices, such as sensors and robots, and servers, by coordinating device, circuit technology, architecture, and software.

(1) Cyber-physical systems: Cyber-physical systems connect everything in the physical world to the Internet, process enormous amounts of obtained data in the information or cyber world, and work on the physical world. We are conducting research to improve performance, responsiveness, power efficiency, reliability, and security of cyber-physical systems through advanced orchestration of widely distributed edge devices, networks, and servers by making use of characteristics of the target processing task.

(2) Ultra-low power computing: We are researching innovative computing that dramatically reduces power consumption by coordinating and cooperating devices, circuit technologies, architectures and system software across design layers. For this purpose, we are working on a coarse-grain reconfigurable architecture which makes good use of parallelism and/or locality in the target process and approximate computing which satisfies the accuracy required by the target processing task.

(3) Lightweight runtime environment and design optimization for robot systems: To realize a development platform that supports the cloud robotics era, we are researching a lightweight runtime environment for embedded devices, and a cooperative system design methodology that improves real-time performance and power efficiency. We are also working on development methodologies that utilize cloud-native technologies and virtual environments for robot applications in large-scale IoT environments.

(4) Comprehensive computing technology for IoT systems: For wide-area distributed IoT systems consisting of a next-generation communication network, we are researching resource-transparent parallel distributed platforms and highly autonomous communication middleware technology based on a functional paradigm. Furthermore, we are researching distributed machine learning infrastructures, especially an optimization method for processing allocation adapting to changes in resource and geographic information of IoT nodes, and a programming model for comprehensive representation of fairness and diversity in the AI model.
In the Information Somatics Lab, our work is built upon a foundation of psychology, cognitive science, and physics to understand the mechanisms of the human body from a systems perspective and to use the insights we gain to augment its innate sensory, physical, and intellectual capabilities.

(1) Jizai Technology: To enable free (jizai) control of their bodies, including any augmentations, both the user and system require awareness of the world and each other. We integrate biological (e.g., gaze, EMG) and environmental (e.g., vision, acoustic) sensing, intention interpretation and action prediction (e.g., using machine learning), and actuation (e.g., EMS, mechanisms) to achieve human augmentation.

(2) Human Augmentation Engineering: Employing VR, XR, robotic, wearable, wireless, and telexistence technologies, we augment human abilities to achieve novel forms of embodiment (e.g., superhuman, disembodied, transformed, cloned, fused) to address social issues such as hyperaging.

(3) Experience Transferral: We aim to provide experiential "supplements" which improve the quality of everyday life. These supplements are formed and administered by systems capable of recording, replaying, and transferring first-person audio-visual-haptic bodily and spatial experiences. We are working towards applying our work in the areas of entertainment computing, superhuman sports, and skill transferal.

(4) Experience Design: Building on a foundation of psychology and physiology, we design methods that make use of information technologies to enable the composition of arbitrary perceptual and emotional experiences by transforming a user's self perception as well as their perception of others.

(5) Wireless interaction: We explore wireless systems for smart interface between humans and machines. Technical areas of interest include, but are not limited to, microwaves, terahertz waves, and ultrasound. Based on core skills of analyzing and synthesizing distributed parameter systems, we apply those waves to transmit and receive signals and energies.
<table>
<thead>
<tr>
<th>Professor</th>
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<tr>
<td>Yuji Sekiya&lt;sup&gt;3)&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

In this laboratory, we research communication infrastructure technology and its architecture using software and virtualization, and methods for detection and countermeasures against cybersecurity threats using machine learning.

This laboratory cooperates with the Information Technology Center and Security Informatics Education and Research Center at the University of Tokyo. We aim to contribute to improving the system architecture using software technology and cybersecurity measures based on actual operations.

1) Virtualization and software technologies have been introduced as fundamental technologies for information communication systems (ICT) such as cloud computing and 5G. In recent years, flexibility and promptness are required on ICT systems. Therefore, virtualization and software technology are being introduced into, classically, hardware-based architectures. In this laboratory, we research software technologies for ICT systems and their new architecture.

2) Nowadays, cybersecurity is a big problem for ICT systems. Attackers steal confidential information and hijack systems through organized and sophisticated attacks. In this laboratory, we research methods to detect cyber threats using machine learning technologies with various types of datasets from communication infrastructure to social trends. This research improves the safety of ICT systems that support society’s infrastructures.

3) Security Informatics Education and Research Center
Our goal: Understanding and controlling sleep and consciousness through the integration of medicine and information science

Whole-brain & whole-cell analysis

Our laboratory has developed a whole-brain clearing and imaging method (CUBIC) which can make brain samples look transparent, such that all cells in the brain can be analyzed at a single-cell resolution, including the position of all cells. Aiming at understanding brain functions, we will develop analysis and visualization methods for large image data (14 terabytes per brain) obtained by CUBIC, and apply it to the study of sleep/wake rhythms.

Keywords: Cloud computing, Brain function analysis, Image analysis

Chemoinformatics-driven drug discovery

Chemoinformatics is becoming more and more widespread such as for drug discovery research, but it still requires development in many aspects, such as activity prediction and structure prediction. In our laboratory, we will develop algorithms to predict drug discovery and experimental reagent candidates by predicting compounds with specific activities, and apply it to the study of sleep/wake rhythms.

Keywords: Machine learning, Bayesian optimization, Drug screening

Development of sleep classification algorithm using biological data

Accurate sleep classification of humans is performed by measuring brain waves. Based on easily acquired time-series data such as breathing and arm movements, we have developed a simple and high-performance sleep classification algorithm using machine learning. By improving this algorithm, we will carry out a big data analysis of sleep and understand sleep/wake rhythm.

Keywords: Machine learning, Time series analysis, Biological data

4) Department of Systems Pharmacology, Graduate School of Medicine
| Associate Professor Takahiro Shinagawa | Our research is about low-layer (deep) system software located on the boundary between computer hardware (physical world) and software (information world). We primarily focus on core system software such as operating systems (OS) and virtual machine monitors (VMM) as well as system software in general, from middleware to distributed systems. From the perspectives of performance, functionality, security, reliability, manageability, and abstraction, we are conducting leading-edge research and development that contributes to the realization of next-generation system software based on new concepts. We use existing OSes such as Linux, Windows, macOS, iOS, and Android, and our original virtualization software called BitVisor developed in our laboratory. The target hardware is a variety of computer systems from large-scale systems such as servers, clouds, and data centers to small systems such as desktops, smartphones, and embedded devices such as IoT devices.

(1) Operating system: we are conducting research to improve the functionality and performance of existing OS kernels through modification. We also aim to research and develop our own OS for next-generation computers.

(2) Virtualization software: we have been conducting several kinds of research using “BitVisor,” made in Japan. By exploiting modern virtualization technology, we aim to realize new functionalities, such as security and system management, without depending on specific OSes.

(3) Secure computing: we aim to provide a secure computing environment as a whole by organically combining OS kernels, virtualization software, compilers, and applications. |

5) Information Technology Center
## Required Document (Department of Information Physics and Computing)

<table>
<thead>
<tr>
<th></th>
<th>Summer Examination</th>
<th>Winter Examination</th>
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</thead>
<tbody>
<tr>
<td>Documents to be Submitted</td>
<td>Who to Submit</td>
<td>Documents to be Submitted</td>
</tr>
<tr>
<td><strong>Master’s Course</strong></td>
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<tr>
<td>Preference Card (for Master’s Program)</td>
<td>All Applicants</td>
<td>Preference Card (for Doctoral Program)</td>
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<tr>
<td>Reason for Application (three A4-sized or letter-sized pages, either in English or Japanese)</td>
<td>All Applicants</td>
<td>N/A</td>
</tr>
<tr>
<td>TOEFL Score</td>
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