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**AY2024 Admission Guide**  
**Department of Mathematical Informatics**  
**Graduate School of Information Science and Technology**  
**The University of Tokyo**

Master's Program  
Doctoral Program

Contact

Department Team (Department of Mathematical Informatics),  
Academic Affairs Group, Graduate School of Engineering / Information Science and Technology,  
The University of Tokyo,  
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Visit

[https://www.i.u-tokyo.ac.jp/edu/entra/index\\_e.shtml](https://www.i.u-tokyo.ac.jp/edu/entra/index_e.shtml)  
to refer to the admission guide of the Graduate School of Information  
Science and Technology and the admission guide of each department.

In addition to this brochure, be sure to refer to the admission guide of the Graduate School of  
Information Science and Technology, the University of Tokyo.

## **(I) Master's Program**

### **1. Outline**

Selection will be conducted based on the “AY 2024 Admission Guide: Master's Program, Graduate School of Information Science and Technology, The University of Tokyo” (posted on [https://www.i.u-tokyo.ac.jp/edu/entra/entra\\_e.shtml](https://www.i.u-tokyo.ac.jp/edu/entra/entra_e.shtml)), and on this admission guide of the Department of Mathematical Informatics. All important items common to the graduate school, including requirements for eligibility and application procedures, are listed in the above common guide, so be sure to refer to that document. This admission guide supplements the above common guide with explanations regarding examination procedures that are specific to the Department of Mathematical Informatics.

Based on the interdisciplinary nature of the Department of Mathematical Informatics, this department invites applicants from a wide range of fields, both inside and outside the University of Tokyo, with a fundamental understanding and knowledge of mathematics, informatics, and physics. Examination subjects have been selected to ensure that applicants with diverse backgrounds can take examinations under fair conditions.

### **2. Declaring preferred faculty advisors, etc.**

Declare the following items in the designated fields in the Web application system.

- Preferred faculty advisors: Choose your first to sixth preferences from the pull-down menu in the field “Your Selection of Lab” on the application system. For the available faculty advisors and their research areas, consult the list in this Admission Guide. If you have any preferred choices in addition to the first six choices, fill (list) the information in the following Field 1 for Department-Specific Information.
- Field 1 for Department-Specific Information: As mentioned above, fill (list) the additional information on the preferred faculty advisors, if there are any in addition to the first six preferred choices.
- Field 2 for Department-Specific Information: Declare which language you hope to use in the oral examination, choosing from Japanese and English.

### **3. Examination Subjects**

#### **3.1. Document screening**

Document screening will be conducted based on the submitted documents. Regarding the notification of the screening results, refer to the admission guide of the Graduate School of Information Science and Technology.

Applicants are required to submit essays at the time of application, following “Document Screening Assignment (for Master's Program)” on page 10 of this guide.

#### **3.2. General education subjects**

We will conduct a mathematics examination. The examination will be conducted only for applicants who have passed the document screening. Refer to the admission guide of the Graduate School of Information Science and Technology for details.

#### **3.3. Foreign language (English)**

TOEFL scores will be used to evaluate applicants' English skills. For details, refer to “Guidelines for Submission of TOEFL Scores (for AY2024 Entrance Examinations)” which is provided on the

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webpage of the Graduate School of Information Science and Technology.

### 3.4. Specialized subjects and oral examination

The examinations will be conducted only for applicants who have passed the document screening and taken the written examinations of the general education subjects.

#### 1) Written Examination

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

| Specialized subjects                      | Examination Dates, Times, and Locations   | Scope of questions   |
|---|---|--|
| Mathematical Informatics                  | August 21, 2023<br>(Monday)<br>10:00 – 13:00<br>Faculty of<br>Engineering Bldg.<br>No. 6          | Applicants will be required to solve three out of five problems related to mathematical methods for solving problems, including: algebraic methods, analytic methods, geometric methods, discrete methods, stochastic methods, statistical methods, and algorithms, etc. |
| Information Physics and Computing         | Please refer to the “Admission Guide” of Department of Information Physics and Computing.         |  |
| Computer Science                          | Please refer to the “Admission Guide” of Department of Computer Science.                          |  |
| Information and Communication Engineering | Please refer to the “Admission Guide” of Department of Information and Communication Engineering. |  |

- Applicants will be notified of details for the examination location for “Mathematical Informatics” by August 16 (Wednesday), 2023.

- Written examinations may be replaced with online examinations in the following cases. Applicants who hope this replacement should apply for the replacement at the timing the case arises.

- I. Those who live outside Japan and are unable to travel to Japan due to restrictions on border control restrictions or other reasons.
- II. Those whose participation to onsite examinations are not adequate from some reasons including suffering from infectious diseases (those who have symptoms such as fever, cough, etc. For details, refer to the conditions for avoiding on-site examinations specified in the document “Examination Guideline for On-site Written Examination,” which will be delivered to each applicant.)

- For information on the examination locations for “Information Physics and Computing,” “Computer Science,” and “Information and Communication Engineering,” refer to the “Admission Guide” of each department.

#### 2) Oral examination

The oral examination will be held online between August 24 (Thursday) and August 25 (Friday), 2023, in principle. Examinees will be notified of the instructions of the oral examination by early August.

The oral examination will be conducted only for applicants who have taken the written examinations for both general education subjects and specialized subjects. Examinees will be notified regarding the detailed schedule of the oral examination by noon of August 16 (Wednesday), 2023.

#### **4. Important Notes**

4.1. Those who are absent from one of the exams (the general education subjects, the written examination on the specialized subjects, and the oral examination) will be considered to have withdrawn from the entrance examination.

4.2. During the written examinations, applicants can use only writing instruments (pencils or mechanical pencils; all must be black), pencil sharpeners, erasers, and a clock or watch (only with timekeeping function). No other instruments can be used.

4.3. Persons wishing to enter the school in October who have not graduated from university by September 2023 are required to confirm their eligibility with the Department Team (the Department of Mathematical Informatics), Academic Affairs Group, the Graduate School of Engineering / Information Science and Technology, the University of Tokyo.

4.4. For other notes, be sure to carefully read the “Department of Mathematical Informatics Information for applicants taking the Entrance Examinations Onsite,” which is included on page 8 of this Guide.

#### **5. Contact**

If you have any questions regarding this admission guide, contact the Department Team indicated on the cover.

## **(II) Doctoral Program [Summer and Winter Entrance Examinations]**

### **1. Outline**

Selection will be conducted based on the “AY 2024 Admission Guide: Doctoral Program, Graduate School of Information Science and Technology, The University of Tokyo” (posted on [https://www.i.u-tokyo.ac.jp/edu/entra/index\\_e.shtml](https://www.i.u-tokyo.ac.jp/edu/entra/index_e.shtml)), and on this admission guide of the Department of Mathematical Informatics. All important items common to the graduate school, including requirements for eligibility and application procedures, are listed in the above common guide, so be sure to refer to that document. This admission guide supplements the above common guide with explanations regarding examination procedures that are specific to the Department of Mathematical Informatics.

### **2. Contact before the Submission of the Applications**

Applicants are required to meet up with their preferred faculty advisor prior to the submission of the applications.

### **3. Declaring a preferred faculty advisor, etc.**

Declare the following items in the designated fields in the Web application system.

- Preferred faculty advisor: Indicate one in the field “Supervising Professor of your choice” on the application system.

- Field 1 for the Department-Specific Information: Declare which language you hope to use in the oral examination.

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## 4. Documents

Applicants are required to write reports on the following themes, and submit them with the application documents.

Theme:

- (1) Summarize your past research achievements and research plans for the Doctoral Program in a report in English or Japanese, comprising no more than ten A4-sized pages, including formulas, diagrams, etc. Applicants may use any format appropriate for this report.
- (2) Provide an English summary of the above report of about one A4-sized page.
- (3) Provide responses to the following questions regarding the content of the above report in English or Japanese, comprising no more than two A4-sized pages.
  - (a) What is the goal of your research?
  - (b) What are the specific content of this research and the methods used?
  - (c) What is the current status of this field of research, in Japan and overseas?
  - (d) What aspects of this research could be considered new in comparison to past researches in this field?
  - (e) How will the results of this research contribute to the field in question?

## 5. Primary Examinations

### 5.1. Foreign language (English)

- TOEFL scores will be used to evaluate applicants' English skills. For details, refer to "Guidelines for Submission of TOEFL Scores (for AY2024 Entrance Examinations)" which is provided on the webpage of the Graduate School of Information Science and Technology.
- For applicants who have completed or are expected to complete a Master's Program in the University of Tokyo, the submission is waived.

### 5.2. Written examination

- Applicants will take an examination on the specialized subject "Mathematical Informatics." Applicants will be required to answer essay-type questions that assess specialized academic skills and knowledge.
- In the Summer Entrance Examination, the written examination will be held online on August 22 (Tuesday), 2023, in principle. Applicants will be notified of the detailed schedule and the method of the examination by early August.
- In the Winter Entrance Examination, the written examination will be held online between January 30 (Tuesday) and February 2 (Friday), 2024, in principle. Applicants will be notified of the detailed schedule and the method of the examination.
- Applicants who have completed or are expected to complete a Master's Program of the University of Tokyo may be exempted from the specialized subject written examination. Applicants wishing to be exempted must contact the department via their preferred faculty advisor no later than June 8 (Thursday) in the case of the Summer Entrance Examination, and no later than November 21 (Tuesday) in the case of the Winter Entrance Examination.

### 5.3. Oral examination

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- Applicants will be required to answer questions on the research plan and other aspects of the submitted documents. Applicants should prepare presentation slides summarizing the descriptions on your past research achievements and future research plans for the Doctoral Program in the submitted documents.

- In the Summer Entrance Examination, the oral examination will be held online on August 23 (Wednesday), 2023, in principle. Applicants will be notified of the detailed schedule and the method of the examination by early August.

- In the Winter Entrance Examination, the oral examination will be held online between January 31 (Wednesday) and February 2 (Friday), 2024, in principle. Applicants will be notified regarding the detailed schedule and the method of the examination.

## 6. Secondary Examination

In the case of the Summer Entrance Examination, persons who have passed the Primary Examinations shall take the Secondary Examination between late January and mid-February, 2024. However, for applicants who wish to enter the graduate school in October and those who wish to enter in April but have obtained or are expected to obtain a master's or professional degree by September 30, 2023, the Secondary Examination will be conducted during the period of the Primary Examinations.

In the case of the Winter Entrance Examination, the Secondary Examination will be conducted on the same day as the Primary Examinations.

As the Secondary Examination, an oral examination will be conducted. Applicants should send their Master's theses (or equivalent materials), with a summary written in one or two A4-sized pages, to the office by e-mail before the examination date. Applicants will be notified of the schedule and the method of the oral examination.

## 7. Contact

If you have any questions regarding this admission guide, please contact the Department Team as indicated on the cover.

# (III) Doctoral Program - Special Selection for Professionals [Summer and Winter Entrance Examinations]

## 1. Outline

Selection will be conducted based on the “AY 2024 Admission Guide: Doctoral Program [ Special Selection for Professionals ], Graduate School of Information Science and Technology, The University of Tokyo” (posted on [https://www.i.u-tokyo.ac.jp/edu/entra/index\\_e.shtml](https://www.i.u-tokyo.ac.jp/edu/entra/index_e.shtml)) and on this admission guide of the Department of Mathematical Informatics. All important items common to the graduate school, including requirements for eligibility and application procedures, are listed in the above common guides, so please be sure to refer to those documents. This admission guide supplements the above common guides with explanations regarding examination procedures that are specific to the Department of Mathematical Informatics.

## 2. Contact before the Submission of the Applications

Applicants are required to contact meet up with their preferred faculty advisor prior to the submission

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of the applications.

### **3. Declaring a preferred faculty advisor, etc.**

Declare the following items in the designated fields in the WEB Application System.

- Preferred faculty advisor: Indicate one in the field “Supervising Professor of your choice” on the application system.
- Field 1 for the Department-Specific Information: Declare which language you hope to use in the oral examination.

### **4. Documents**

Applicants are required to prepare for the following five items regarding applicants' research and work achievements in a field related to Mathematical Informatics.

#### **(1) List of achievements**

Provide a list of academic papers, patents, products, and other examples of the applicant's achievements. In the case of collaborative achievements involving several persons, clearly indicate the part and the weight of the applicant's contributions.

#### **(2) Outline of main achievements**

Select three or fewer main achievements from the above list, and provide an outline of these achievements.

#### **(3) Research plan**

Provide a detailed description of the applicant's plan for research to be conducted in the Doctoral Program.

#### **(4) Materials related to main achievements**

These materials may include reprints (or copies) of academic papers, detailed descriptions of patents, or product pamphlets.

#### **(5) Recommendation letters**

Select two individuals with a clear understanding of the applicant's achievements, and ask them to provide separate evaluations of those achievements. Use the Word file “Recommendation letters (Doctoral Program [Special Selection for Professionals])” on the department webpage, and submit the file following the instructions on the department webpage and on the webpage of the Graduate School of Information Science and Technology.

Note: Items (2) and (3) should be combined in about ten A4-sized pages.

### **5. Selection Methods**

A few students will be selected based on research achievements and work achievements in fields related to Mathematical Informatics, and also on the examinations below.

#### **5.1. Foreign language (English)**

- TOEFL scores will be used to evaluate applicants' English skills. For details, refer to “Guidelines for Submission of TOEFL Scores (for AY2024 Entrance Examinations)” which is provided on the webpage of the Graduate School of Information Science and Technology.
- For applicants who have completed or are expected to complete a Master's Program in the University of Tokyo, the submission is waived.

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## 5.2. Written examination

- Applicants will take an examination on the specialized subject “Mathematical Informatics.” Applicants will be required to answer essay-type questions that assess specialized academic skills and knowledge.
- In the Summer Entrance Examination, the written examination will be held online on August 22 (Tuesday), 2023, in principle. Applicants will be notified of the detailed schedule and the method of the examination by early August.
- In the Winter Entrance Examination, the written examination will be held online between January 30 (Tuesday) and February 2 (Friday), 2024, in principle. Applicants will be notified of the detailed schedule and the method of the examination.
- Applicants who have completed or are expected to complete a Master's Program of the University of Tokyo may be exempted from the specialized subject written examination. Applicants wishing to be exempted must contact the department via their preferred faculty advisor no later than June 8 (Thursday) in the case of the Summer Entrance Examination, and no later than November 21 (Tuesday) in the case of the Winter Entrance Examination.

## 5.3. Oral examination

- Applicants will be required to answer questions on the research plan and other aspects of the submitted documents. Applicants should prepare presentation slides summarizing the descriptions on your past research achievements and future research plans for the Doctoral Program in the submitted documents.
- In the Summer Entrance Examination, the oral examination will be held online on August 23 (Wednesday), 2023, in principle. Applicants will be notified of the detailed schedule and the method of the examination by early August.
- In the Winter Entrance Examination, the oral examination will be held online between January 31 (Wednesday) and February 2 (Friday), 2024, in principle. Applicants will be notified regarding the detailed schedule and the method of the examination.
- Applicants should send their Master's theses (or equivalent materials) with their summaries written on one or two A4-sized pages to the office by e-mail before the examination date.

## 6. Contact

If you have any questions regarding this admission guide, please contact the Department Team as indicated on the cover.



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## **Department of Mathematical Informatics**

### **Information for applicants taking Entrance Examinations Onsite**

**(The written examinations of the specialized subjects “Mathematical Informatics”  
for Master’s Program)**

For applicants who take specialized subjects of other departments, see the relevant admission guide issued by the relevant department.

#### **1. Examination dates and times**

Please refer to the main body of this Guide.

#### **2. Examination locations**

University of Tokyo (7-3-1 Hongo, Bunkyo-ku, Tokyo)

Refer to the map on page 9.

By subway:

Marunouchi Line / Oedo Line: Get off at Hongo Sancho Station  
Chiyoda Line: Get off at Nezu Station  
Namboku Line: Get off at Todai Mae Station  
Mita Line: Get off at Kasuga Station

By Bus:

Take Toei Bus No. 43 or 51 to “Todai Seimon Mae” (Main Gate of The University of Tokyo),  
or Toei School Bus No. 1 or 7 to “Todai Konai” (Campus of The University of Tokyo).

Examinees should be in the designated examination room no later than 15 minutes before the start of the examination. In case of being late, the examinee should immediately contact an examination administrator.

#### **3. What to bring**

- (1) Paper-based Examination Admission Card (printed on A4-sized paper)
- (2) Be sure to bring black pencils (or mechanical pencil), erasers, pencil sharpeners (desktop types are not acceptable) if you are using black pencils, and a clock or watch (only with time-keeping function).

Caution: During the examination time, all mobile phones must be turned off and must not be worn.

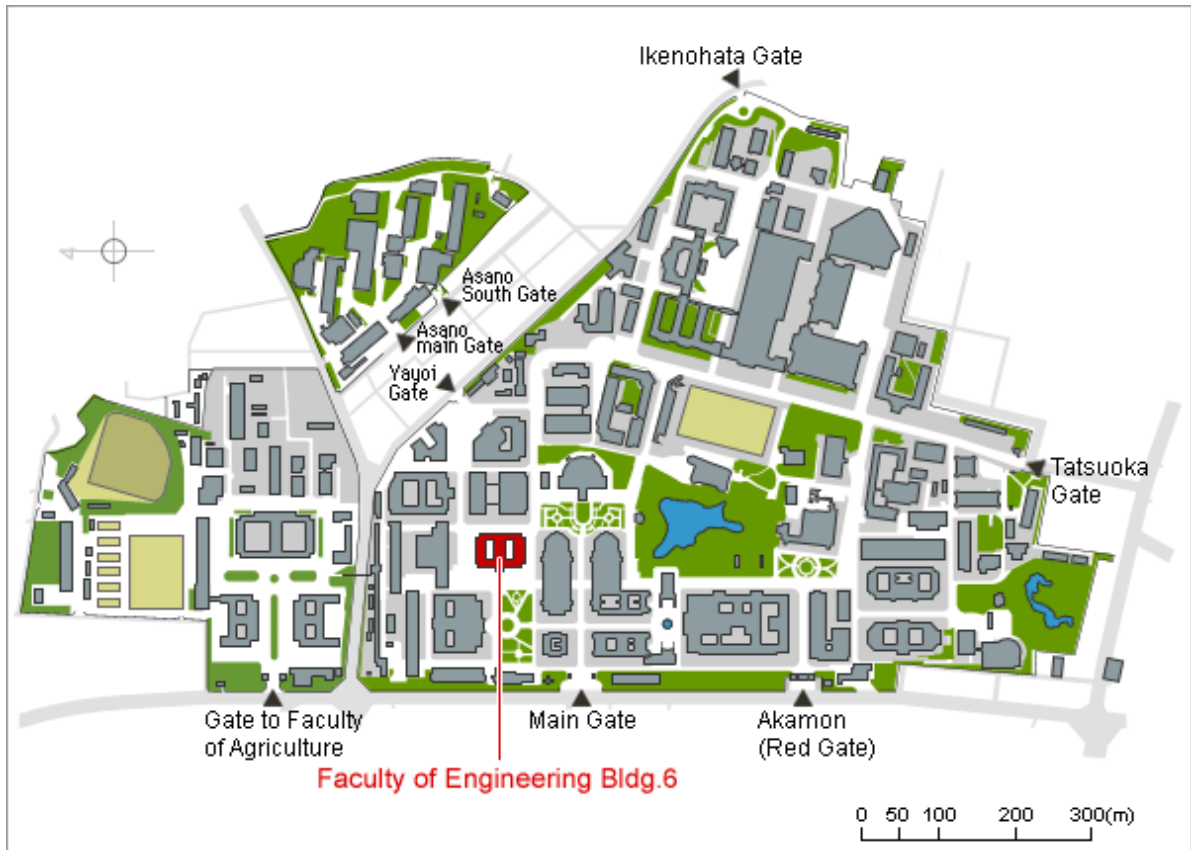
#### **4. Items to keep in mind during examinations**

- (1) Examinees will not be allowed to leave the examination room after the start of the examination, even after finishing writing answers or even when you abandon the examination.
- (2) Examinees will not be allowed, in principle, to leave their seats even temporarily. Call the proctor in case feeling sick or needing to go to the bathroom during the examination time.
- (3) Examination admission cards must be placed on the desks throughout the examination time.
- (4) Write your examinee’s number on all answer sheets. It is not allowed to write your name. Write your answer on each designated sheet. If there is not enough space, you may write on the back of the answer sheet.
- (5) Examinees are not allowed to take answer sheets and question booklets out of the examination room.

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## Department of Mathematical Informatics

### Map of Examination Location



By subway:

Marunouchi Line / Oedo Line: Get off at Hongo Sancho Station

Chiyoda Line: Get off at Nezu Station

Namboku Line: Get off at Todai Mae Station

Mita Line: Get off at Kasuga Station

Bus:

Take Toei Bus No. 43 or 51 to “Todai Seimon Mae” (Main Gate of The University of Tokyo), or Toei School Bus No. 1 or 7 to “Todai Konai” (Campus of The University of Tokyo).

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**[Document Screening Assignment (for Master's Program)]**

Submit essays on the following subjects at the time of application. Prepare your answers by using the template file found on the department webpage. Follow the instructions on the same page in writing your answers. Keep the guidelines about the length of answers, indicated in the parenthesis in each subject.

**Subject 1.** Explain your motivation for applying to our department, after presenting one concrete research topic. The description on the research topic should adequately include explanations on the following three elements: the research background of the topic, its recent progress, and your research idea and plan. (1.5 pages)

**Subject 2.** Select one important tool (e.g., theorem, formula, methodology, and algorithm) that is related to the research topic you presented in Subject 1. About this tool, explain the following aspects in a concrete and precise manner by clarifying the relation to your research topic. (1.5 pages)

- (1) Mathematical details
- (2) Significance in mathematical informatics
- (3) Example(s) of its application

Describe your answer to each of (1), (2), and (3) in a separate section.

Department of Mathematical Informatics

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

[https://www.i.u-tokyo.ac.jp/edu/course/mi/members\\_e.shtml](https://www.i.u-tokyo.ac.jp/edu/course/mi/members_e.shtml)

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|--|--|
| Tsuyoshi Takagi<br>(Professor)           | (1) Mathematical Cryptography: Theoretical analysis and efficient implementation of post-quantum cryptography in the era of quantum computers. (2) Applied Cryptography: Security evaluation of Bitcoin system or cryptographic protocols such as SSL/TLS.   |
| Kunihiko Sadakane<br>(Professor)         | (1) Algorithms and data structures: theory of algorithms for processing discrete data such as graphs and strings, theory of stream, external, and GPU algorithms, and theory of succinct data structures. (2) Applications of those theories to efficient big data processing such as genome information, geographic information, and secure computation.  |
| Takayasu Matsuo<br>(Professor)           | (1) Numerical algorithm: differential equation, function approximation, numerical linear algebra, tensor. (2) Theoretical numerical analysis: geometric numerical integration, discrete functional analysis, asymptotic behaviors of algorithms. (3) Applications: physical simulation, applications to optimization and deep learning.  |
| Fumiyasu Komaki<br>(Professor)           | (1) Theoretical statistics: inference theory, prediction theory, Bayesian theory, experimental design, model selection. (2) Statistical modeling: Bayesian networks, graphical models, point processes. (3) Information geometry: differential geometry of statistical inference.  |
| Akiko Takeda<br>(Professor)              | (1) Continuous optimization: development of efficient algorithms for solving nonconvex optimization problems, robust optimization problems, etc. (2) Applications of optimization methods to optimization problems in machine learning, energy system. (3) Operations Research.  |
| Kenji Yamanishi<br>(Professor)           | (1) Theory of machine learning: an information-theoretic or statistical approach to machine learning. (2) Data science: anomaly detection, change detection, network mining, latent dynamics. (3) Big data analysis: security, marketing, traffic risk analysis, medical data analysis, economic data analysis. (4) Symptomatics—Science of early warning signals of anomalies.  |
| Satoru Iwata<br>(Professor)              | (1) Discrete optimization: Design of efficient algorithms for optimization problems related to matroids and submodular functions. (2) Discrete mathematical engineering: Discrete optimization techniques in numerical linear algebra and dynamical systems analysis. (3) Global optimization: Design of efficient algorithms for solving nonconvex optimization problems with geometric backgrounds. (4) Chemo-informatics: Information processing methods for assisting research in chemistry. |
| Hiroshi Hirai ※<br>(Associate Professor) | (1) Discrete optimization: multicommodity flow, facility location, network design, etc. (2) Discrete mathematics: finite metric spaces, polyhedral combinatorics, graph theory, and their applications.  |

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| Ken'ichiro Tanaka<br>(Associate Professor)   | (1) Theoretical numerical analysis: numerical integration, function approximation, design and/or mathematical analysis of approximation formulas. (2) Numerical algorithm: accurate computation by variable transformation, fast and accurate computation of integral transforms and/or solutions of functional equations. (3) Design of approximation formulas by mathematical optimization: sampling by gradient methods in function spaces, acceleration of gradient methods. (4) Numerical methods in finance: option pricing, risk evaluation. |
| Takeru Matsuda<br>(Associate Professor)      | (1) Theoretical statistics: inference theory, Bayesian statistics, multivariate analysis, information geometry, etc. (2) Applied statistics: spatio-temporal modeling, hierarchical modeling, computational statistics, etc. (3) Brain data analysis.   |
| Taiji Suzuki<br>(Associate Professor)        | (1) Machine learning, statistical learning theory: theory of generalization error, deep learning, kernel method, regularization, stochastic optimization. (2) Mathematical statistics, statistical modeling: high dimensional sparse estimation, Bayesian statistics, information geometry.   |
| Shin-ichi Tanigawa<br>(Associate Professor)  | (1) Discrete and computational geometry: distance geometry, rigidity theory, matroids, graph embeddings. (2) Applications of discrete optimization techniques: graph algorithms, analysis of discrete engineering structures.   |
| Ayumi Igarashi<br>(Associate Professor)      | (1) Mechanism design. (2) Fair and efficient resource allocation and its applications. (3) Voting theory and its applications to participatory budgeting. (4) Cooperative game theory and its applications to social network analysis.  |
| Atsushi Takayasu<br>(Lecturer)               | (1) Design of Cryptographic Protocols: Designs of (post-quantum) public key encryption schemes, advanced public key encryption schemes, and their provable security. (2) Mathematical Analysis of Cryptography: Shortest vector problem, lattice basis reduction algorithms, analysis of cryptographic schemes with quantum algorithms and lattice basis reduction algorithms.  |
| Kazuhiro Sato<br>(Lecturer)                  | (1) Applications of optimization theory to control systems theory: Riemannian optimization, proximal algorithm, submodular optimization. (2) Applications of control systems theory to optimization theory: distributed optimization, accelerated gradient method, passivity. (3) Data-driven modeling for controlling systems: machine learning, optimization, numerical analysis.   |
| Takashi Kohno<br>(Professor)<br>[IIS]        | (1) Neuromorphic system: designing and construction of artificial system that mimics information processing scheme in nerve system and brain. (2) Modeling nerve system and brain: nonlinear model and bifurcation of neuronal cell, learning rule.   |
| Tetsuya J. Kobayashi<br>(Professor)<br>[IIS] | (1) Theory for biological systems: dynamical system, stochastic process, large deviation, thermodynamics, chemical reaction network. (2) Theory for biological information processing systems: searching, information coding, recognition, control, learning, and evolution. (3) Systems biology: bioinformatics, data analysis, and modeling of biological phenomena.  |

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| Yoshihiro Kanno<br>(Professor)<br>[MI]                     | (1) Continuous optimization and applied mechanics: convex optimization, complementarity, duality and their applications to structural optimization, contact mechanics, plasticity, etc. (2) Robust optimization and its applications: Optimization with uncertain data, robust optimization of structures, robustness evaluation of uncertain systems, etc.  |
| Tomonari Sei<br>(Professor)<br>[MI]                        | (1) Theoretical statistics: inference theory, directional statistics, algebraic statistics, information geometry, Bayesian statistics, copula theory. (2) Construction methods of general indices. (3) Statistical modeling with optimal transport map.  |
| Teppei Ogihara<br>(Associate Professor)<br>[MI]            | (1) Stochastic calculus and mathematical statistics: statistical analysis of stochastic processes (diffusion processes, jump diffusion processes, point processes, Malliavin calculus, maximum-likelihood-type estimation, asymptotic efficiency). (2) Statistical analysis of financial data: statistical inference of stock volatility and covariation, high-frequency financial data analysis, minimum variance portfolio.  |
| Ryohei Hisano<br>(Lecturer)<br>[MI]                        | (1) Learning on networks (temporal, heterogeneous information, knowledge graph). (2) Empirical research on social and economic networks (transaction patterns, detecting malicious nodes, systemic risk). (3) Reliability of information (news, financial reports). (4) Big data analysis (data science, complexity science): financial markets, block chain, marketing.   |
| Yasushi Kawase<br>(Project Associate Professor)<br>[RIISE] | (1) Discrete optimization: Design of algorithms for online optimization problems, robust optimization problems, etc. (2) Algorithmic game theory: Design and analysis of mechanisms in strategic behavior.   |
| Hikomichi Nagao<br>(Associate Professor)<br>[ERI]          | (1) Utilization of big data related to earthquakes: automatic detections of earthquakes based on machine learning, algorithm for hypocenter determinations, algorithm for earthquake and tsunami early warning. (2) Data assimilation: integration of large-scale numerical simulations and massive observation data, sequential Bayesian filters, four-dimensional variation method (fast automatic differentiation method), optimization of observational/experimental design, programming on parallel supercomputers. |
| Hiroshi Kori<br>(Professor)<br>[Frontier Science]          | (1) Nonlinear physics: nonlinear phenomena, synchronization, oscillations, complex systems, pattern formation, dynamical systems, stochastic processes, complex networks. (2) Theoretical biology: modeling of biological phenomena, biological oscillations, neuroscience, collaboration with experimentalists.   |
| Yuki Izumida<br>(Lecturer)<br>[Frontier Science]           | (1) Nonequilibrium physics: nonequilibrium thermodynamics and statistical mechanics, stochastic thermodynamics, nonequilibrium theory of life phenomena, fusion study of nonlinear dynamics and thermodynamics (dynamical modeling of engines, energy harvesting technologies). (2) Nonlinear physics: coupled oscillators, synchronization phenomena, bifurcation analysis, noise and stochastic resonance phenomena, complex systems, etc.   |

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| <p>Kengo Nakajima<br/>(Professor)<br/>[ITC]</p>                       | <p>(1) Parallel Numerical Algorithms: Parallel Linear Solvers (Iterative Methods, Preconditioning), Multigrid Methods. (2) High-Performance Computing (HPC): Parallel Programming Models, Problem Solving Environment (PSE). (3) Scientific Computing: Computational Mechanics, Finite Element Methods (FEM). (4) Large-Scale Data Processing: Adaptive Mesh Refinement (AMR), Visualization.</p>  |
| <p>Kantaro Fujiwara<br/>(Project Associate Professor)<br/>[IRCEN]</p> | <p>(1) Computational neuroscience: mathematical modeling of single neuron, neural network modeling, learning, and adaptation. (2) Data analysis in neural systems: theory for neural spike train analysis and its application, prediction, brain network analysis. (3) Biological information processing: pancreatic beta cell modeling, modeling for diabetes.</p>  |
| <p>Andrea Benucci<br/>(Professor)<br/>[RIKEN CBS]※</p>                | <p>(1) Computations in biological neural networks: encoding and decoding principles of sensory processing, sensory to decision transformations, linear and non-linear analyses of large-scale neuronal recordings. (2) Dynamical models of neural activity: deep recurrent neural networks (RNN), non-linear analysis of fitted RNN. (3) Predictive modeling and experiments: two-photon imaging, optogenetic perturbations of neural-network dynamics.</p>                      |
| <p>Taro Toyozumi<br/>(Professor)<br/>[RIKEN CBS]</p>                  | <p>(1) Computational neuroscience: Neural coding, Bayes theorem, Chaotic neural networks, Mean-field theory. (2) Learning theorem of the brain: Synaptic plasticity, Associative learning, Information-optimization, Signal processing, Critical period. (3) Neural data analysis: Delay embedding theorem, Modeling brain/body/environment interaction.</p>   |
| <p>L. Ian Schmitt<br/>(Associate Professor)<br/>[RIKEN CBS]</p>       | <p>(1) Analysis of Neural Dynamics and Behavior: neural spike isolation, state space modeling of neural activity, effective network connectivity estimation, behavioral psychophysics. (2) Biological Neural Network Computations: neural basis of short-term memory, attention, and probabilistic inference processes, multi-scale interactions of brain systems. (3) Neural recording and modulation: closed-loop electrophysiological/optogenetic technology development.</p> |

Faculty members marked with ※ are not accepting students for 2024.

[IIS] means members belonging to the Institute of Industrial Science. [MI] means members belonging to the Mathematics and Informatics Center. [RIISE] means members belonging to the Research Institute for an Inclusive Society through Engineering. [ERI] means members belonging to the Earthquake Research Institute. [Frontier Science] means members belonging to the Graduate School of Frontier Sciences. [ITC] means members belonging to the Information Technology Center. [IRCEN] means faculty members belonging to the International Research Center for Neurointelligence. [RIKEN CBS] means faculty members belonging to the RIKEN Center for Brain Science. For locations of offices of the faculty members, refer to their webpages.

This document is an unofficial translation from the official Japanese version.

## Department-specific Conditions on Submitted Documents

For other conditions on submitted documents common to all the departments, check the Admission Guide of the Graduate School.

### List of Department-Specific Documents

|  | Summer Entrance Examination  |                | Winter Entrance Examination  |                |
|--|--|----------------|--|----------------|
|  | Documents to be Submitted  | Who to Submit  | Documents to be Submitted  | Who to Submit  |
| Master's Program                                       | Document Screening Essays (Master's Program)   | All Applicants | /  |                |
| Doctoral Program                                       | (1)Research achievement & plans (written in Japanese or English, no more than 10 A4-sized pages)<br>(2)English summary of (1) (1 A4-sized page)<br>(3)Responses to questions (a)-(e) regarding (1) (written in Japanese or English, no more than 2 A4-sized pages) | All Applicants | (1)Research achievement & plans (written in Japanese or English, no more than 10 A4-sized pages)<br>(2)English summary of (1) (1 A4-sized page)<br>(3)Responses to questions (a)-(e) regarding (1) (written in Japanese or English, no more than 2 A4-sized pages) | All Applicants |
| Doctoral Program <Special Selection for Professionals> | (1)List of achievements<br>(2)Outline of main achievements<br>(3)Research plan<br>(4)Materials related to main achievements<br>(5)Recommendation letters (from 2 persons, in the specified form)<br>*(2)(3) should be combined on about 10 A4-sized pages.         | All Applicants | (1)List of achievements<br>(2)Outline of main achievements<br>(3)Research plan<br>(4)Materials related to main achievements<br>(5)Recommendation letters (from 2 persons, in the specified form)<br>*(2)(3) should be combined on about 10 A4-sized pages.         | All Applicants |

### Department-Specific Conditions on TOEFL Scores

|  | Summer Entrance Examination  | Winter Entrance Examination  |
|--|--|--|
| Master's Program                                       | All applicants must submit.  | /  |
| Doctoral Program                                       | All applicants must submit, except those who have completed (or are expected to complete) a Master's program at the University of Tokyo. | All applicants must submit, except those who have completed (or are expected to complete) a Master's program at the University of Tokyo. |
| Doctoral Program <Special Selection for Professionals> | All applicants must submit, except those who have completed (or are expected to complete) a Master's program at the University of Tokyo. | All applicants must submit, except those who have completed (or are expected to complete) a Master's program at the University of Tokyo. |

### Conditions for the Transfer to the Online Examinations

Written examinations may be replaced with online examinations in the following cases. Applicants who hope this replacement should apply for the replacement at the timing the case arises.

- I. Those who live outside Japan and are unable to travel to Japan due to border restrictions or other reasons.
- II. Those whose participation to onsite examinations are not adequate from some reasons including suffering from infectious diseases (those who have symptoms such as fever, cough, etc. For details, refer to the conditions for avoiding on-site



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examinations specified in the document “Examination Guideline for On-site Written Examination,” which will be delivered later to each applicant.)