Generic Technology Research Group

★Talk in English (or partially in English)

Poster NO.	Team/Unit	Leader	Research
1 ★	Imperfect Information Learning Team	Masashi Sugiyama	In the Imperfect Information Learning Team, for various machine learning tasks including supervised learning, unsupervised learning, and reinforcement learning, we develop novel algorithms that allow accurate learning from limited information. We also elucidate their theoretical properties and apply them to various real-world applications ranging from fundamental science to business.
2	Structured Learning Team	Yoshinobu Kawahara	When making predictions based on intelligent information processing such as machine learning, we usually have prior information about structures among variables in data. In our team, we study theories and algorithms for learning with such structural information. Moreover, we conduct applied researches by applying developed algorithms to a variety of scientific and engineering data.
3 ★	Tensor Learning Team	Qibin Zhao	We study various tensor-based machine learning technologies, e.g., tensor decomposition, multilinear latent variable model, tensor regression and classification, tensor networks, deep tensor learning, and Bayesian tensor learning, with aim to facilitate the learning from high-order structured data or large-scale latent space. Our goal is to develop innovative, scalable and efficient tensor learning algorithms supported by theoretical principles.
4 ★	Functional Analytic Learning Unit	Quang Minh Ha	The Functional Analytic Learning Unit focuses on functional analytic and geometrical methods in machine learning, in particular methods based on Riemannian geometry, matrix and operator theory, and vector-valued Reproducing Kernel Hilbert Spaces (RKHS). An important direction is the theoretical formulations and algorithms based on the geometry of positive definite operators, especially RKHS covariance operators.
5 ★	High-Dimensional Statistical Modeling Team	Makoto Yamada	We are focusing on developing machine learning algorithm for large p and small n problems such as biomarker discovery and toxicogenomics prediction. In particular, we are interested in nonlinear feature selection algorithms for such high-dimensional data, and proposing simple yet efficient algorithms. Ultimately, we want to build a machine learning framework to automatically find an important information from data.
6	Succinct Information Processing Unit	Yasuo Tabei	Data mining researchers/practitioners face the problem of processing and analyzing huge datasets for knowledge discoveries in various fields. Succinct data structure (SDS) is a space-efficient representation for data structures while supporting fast data operations on the representation. We research on basics of SDSs and their applications to artificial intelligence and knowledge discovery for scalable information processing.
7	Deep Learning Theory Team	Taiji Suzuki	Machine learning should deal with high dimensional and complicated data, and thus we are studying deep learning and structured sparse learning as methods to deal with such complicated data. Moreover, we are also developing efficient optimization algorithms for large and complicated machine learning problems based on such techniques as stochastic optimization.
8 ★	Computational Learning Theory Team	Kohei Hatano	We try to formulate and solve various problems in machine learning from a theoretical computer science perspective. Our goal is to clarify the limits of the player's strategies for various online decision problems under continuous/discrete constraints and to develop robust and efficient strategies based on theoretical analyses. Recently we are also investigating applications of online prediction techniques to commnication engineering.

9	Nonconvex Learning Theory Team	Takafumi Kanamori	We aim to develop machine learning algorithms using non-convex optimization problems and its theoretical foundations. We challenge to develop learning algorithm using non-convex optimization beyond the scope of convexity and to establish a theoretical foundation to analyze learning methods with non-convexity.
10	Causal Inference Team	Shohei Shimizu	Our group works on different topics related to causal inference. In particular, we develop theory, methods, algorithms, and software for estimating causal relations based on data that are obtained from sources other than randomized experiments, i.e., causal discovery.
11 ★	Approximate Bayesian Inference Team	Mohammad Emtiyaz Khan	Humans and animals have a natural ability to autonomously learn throughout their lives and quickly adapt to their surroundings, but AI systems lack such abilities. Our goal is to bridge such gaps between the learning of living-beings and computers. We are machine learning researchers with an expertise in areas such as approximate inference, Bayesian statistics, continuous optimization, information geometry, etc. We work on a variety of learning problems, especially those involving supervised, continual, active, federated, online, and reinforcement learning.
12	Continuous Optimization Team	Akiko Takeda	Our goal is to develop efficient algorithms for mathematical optimization problems. By formulating various real-world problems as optimization problems and solving them by efficient algorithms, we can find their reasonable solutions. Our work is motivated by optimization tasks with applications in operations research, machine learning, and control systems.
13	Mathematical Science Team	Kenichi Bannai	The Mathematical Science Team is a team consisting of a variety of pure mathematician disciplines such as Number theory, number theory geometry, algebraic geometry, partial differential equations, superstring theory, quantum many-body systems quantum many-body systems, differential geometry, topology, operator algebra, probability theory, statistics and theoretical physics with the aim of attacking mathematical problem arising in artificial intelligence and machine learning.
14	Mathematical Statistics Team	Hidetoshi Shimodaira	We develop methods of probabilistic inductive inference and explore methodologies for statistics and machine learning. We are working on statistical inference of growth mechanisms in complex networks and a multivariate method with graph embedding and deep learning to integrate multiple data types. In addition, we are working on the theory of representation learning from the perspective of additive compositionality of meaning in natural language processing, aiming at intelligence that can realize "thinking" beyond pattern recognition.
15 ★	Mathematical Analysis Team	Shin-ichi Ohta	Our main research field is geometry in a broad sense. Especially, optimal transport theory, gradient flows of convex functions, and information geometry have tight connections with machine learning as well as information theory. Upon mathematical strengths on these areas, we would theoretically contribute to the field of machine learning.
16	Topological Data Analysis Team	Yasuaki Hiraoka	Topological data analysis (TDA) provides a tool called the persistent homology that extracts multiscale topological features embedded in data. We study theory and algorithm on persistent homology based on representation theory, probability theory, machine learnings, and inverse problems. We also apply TDA into scientific and engineering problems such as materials science, life and medical science, meteorology, and economics.

Goal-Oriented Technology Research Group

★Talk in English (or partially in English)

Poster NO.	Team/Unit	Leader	Research
17	Cancer Translational Research Team	Ryuji Hamamoto	By using AI technology to analyze various data on cancer accumulated at the National Cancer Center, which is the largest scale in Japan, we aim to apply it to the elucidation of the molecular mechanism of cancer, diagnosis and treatment of cancer, and drug discovery. In particular, we are focusing on social implementation, and the endoscopic AI diagnostic support system we developed has already been approved as a medical device and are actually being used in clinical settings in Japan and Europe. We will continue to promote research for the benefit of patients.
18	Medical-risk Avoidance based on iPS Cells Team	Naonori Ueda	In cooperation with CiRA, by using AI and iPS cell technologies jointly, this team will research and develop technologies for predicting Altzheimer's disease risk which is becoming social urgent matter. Moreover, we will conduct research develop technologies to ensure the safety of iPS cells themselves.
19	Molecular Informatics Team	Koji Tsuda	We develop artificial intelligence methods that design functional biomolecules such as proteins and inorganic compounds such as metal, ceramic and nanoparticles.
20	Cognitive Behavioral Assistive Technology Team	Mihoko Otake	We develop conversational assistive AI based on Coimagination method, implement the AI to cognitive behavioral assistive systems, and evaluate the effects on human cognition and mind.
21	Disaster Resilience Science Team/Medical-risk Avoidance based on iPS Cells Team	Naonori Ueda	We aim to research and develop AI technologies that enable to reduce the natural disaster damage as much as possible, restore the social system once damaged efficiently and effectively, and resume social and economic activities promptly.
22	Robotics for Infrastructure Management Team	Takayuki Okatani	We are researching and developing autonomous AI/robots that can understand surrounding environments and communicate with humans through natural languages, aiming at solving a wide range of problems associated with infrastructure management.
23	Tourism Information Analytics Team	Satoshi Nakamura	Our research goal is to develop IoT-to-human technologies, which analyze, anonymize, and visualize big data obtained by IoT-based sensing and social media, and provide information in real time by language-centered human-comprehensive multimedia.
24	Machine Intelligence for Medical Engineering Team	Tatsuya Harada	Our goal is to invent intelligent systems assisting medical diagnosis and treatment by extracting useful features from medical information, and combining them with powerful computational resources and vast amount of data in the cyber space.
25	Data-Driven Biomedical Science Team	Ichiro Takeuchi	We study fundamental computational and mathematical techniques for data-driven scientific discovery, and demonstrate the effectiveness of these techniques in the field of biomedical science.

26	Computational Brain Dynamics Team	Okito Yamashita	We are developing big data analysis and dynamics modeling methods of human brain imaging data such as fMRI, MEG, EEG and NIRS in order to realize novel imaging-based diagnosis and therapy.
27	Information Integration for Neuroscience Team	Motoaki Kawanabe	Towards creation of a novel brain/mental health management framework, we are developing necessary key technologies such as brain state estimation methods by integrating everyday multi-sensor data with brain information, and robust EEG analysis techniques using fMRI data.
28	Statistical Genetics Team	Gen Tamiya	Our mission is to identify genetic and environmental factors underlying common and rare diseases via analysis of medical big data by AI technologies. By using identified factors, we aim to achieve highly accurate genomic risk prediction and to realize personalized medicine and prevention.
29	Pathology Informatics Team	Yoichiro Yamamoto	Our mission is to discover novel disease mechanisms, to find new therapies or to choose the best treatment for each patient through the combination of the state-of-the-art AI technologies and the medical big data including cell-level information. Comprehensive analysis of the medical information through collaborations with clinical doctors would contribute to cure current and future patients.
30	Natural Language Understanding Team	Kentaro Inui	We conduct research on fundamental technologies for understanding languages by computers by designing new tasks for automatic assessment of human language activities, such as reviewing argumentation and descriptive responses in pedagogical contexts. We aim to extend upon the frontier of language processing in both basic research and applied research while collaborating with the Language Information Access Technology Team and other teams in the Generic Technology Research Group.
31	Knowledge Acquisition Team	Yuji Matsumoto	We aim at text/figure analysis and knowledge extraction from scholarly documents and also at development of infrastructure for content-aware retrieval of scholarly documents through semi-automatic construction of expert domain knowledge bases, relation analysis of scientific documents, and summarization technologies.
32 ★	Language Information Access Technology Team	Satoshi Sekine	Due to the huge amount of information, we face serious difficulties to access necessary information. In order to solve the information access bottleneck problem, We will open the horizon of the basic technologies and will build the useful application systems based on the NLP technologies.
33 ★	Geoinformatics Unit	Naoto Yokoya	We aim at developing intelligent systems that understand and assess the state and changes of urban areas and natural environments from large-scale time-series geospatial data. We study fundamental technologies of geospatial data analysis that can deal with data incompleteness, limited training data, and multimodality. Our applied research includes disaster response, urban planning, and forest monitoring.
34	Music Information Intelligence Team	Masatoshi Hamanaka	We will develop a computational theory in which media operations are expressed as combinations of lattice operations. We will construct a system that accumulates media operation cases of media design experts and lets novices reuse them to produce content.
35	Sound Scene Understanding Team	Kazuyoshi Yoshii	We are working on audio-visual real-time scene understanding in the real world. The underlying technical foundations are audio information processing (e.g., speech enhancement and recognition), visual information processing (e.g., object detection and identification), and statistical machine learning for probabilistic inference. We aim to develop a system that can stably work in a real einvironment.

Artificial Intelligence in Society Research Group

★Talk in English (or partially in English)

Poster NO.	Team/Unit	Leader	Research
36	Artificial Intelligence Ethics and Society Team	Shoko Suzuki	There is an urgent need to develop an ethical foundation for continued coevolution with technology through coexistence and symbiosis with things and machines, while retaining an appropriate awe of technology. This team aims to develop a platform for a comprehensive ethics that will redefine human nature and make it possible for human beings and technology to continue to coevolve together.
37	AI Utilization in Society and Legal System Team	Hiroshi Nakagawa	We will examine AI ethics that will guide the function and deployment of AI. We mainly focus on privacy protection, explainability, accountability, trustworthiness, and AI agents. In addition to researching related AI technologies, we will examine and analyze the current status of legal and social systems, and consider what the future should be like. This year, we investigate (1)the way how we treat our personal data after our death and (2) what is AI in post-modanism such as actor network theory.
38	Science, Technology and Society Team	Osamu Sakura	Our research focuses on the public image of AI/robots in Japan and other East Asian countries. More specific targets are its historical transitions and its representations in fictional materials including sci-fi. Also planned is comparative research of the public images among East Asian, or Buddhist, countries. We are tackling to propose rather unique perspectives on human-AI relation from the East Asian viewpoint. About new technology (mainly artificial intelligince), we try to etract user requirements related to usage from the viewpoint of human and propose social acceptability of new technology.
39	Decentralized Big Data Team	Koiti Hasida	As a social infrastructure for the development and operation of artificial intelligence (AI), we are developing and implementing technologies that allow data subjects to safely and fully utilize private data containing personal information and trade secrets. As part of these efforts, we are also exploring document formats that allow easy and accurate composition and comprehension by humans, as well as AI to support creation, comprehension, and advanced use of those docuements.
40	Business and Economic Information Fusion Analysis Team	Takahiro Hoshino	This team will develop new data-fusion techniques for various types of datasets including governmental survey data, big-data and macro-level information, to improve accuracy of public statistical information, or to aid investment/managerial decision making. We also investigate new data acquisition methods in business and economic fields which utilize statistical machine learning methods.
41	AI Security and Privacy Team	Jun Sakuma	In order for artificial intelligence to play a prominent role in decision making of humans, it is necessary to guarantee that private or confidential information is not leaked through the process of decision making by AI. Our team aims to develop fundamental technologies of security and privacy that are necessary for proper use of AI in society.
42	AI Safety and Reliability Unit	Hiromi Arai	Along with the widespread use of artificial intelligence technologies, there are increasing demands for safety and reliability of artificial intelligence, including transparency, fairness, accountability, and privacy. We aim to develop fundamental technologies to enhance the safety and reliability of AI. We also conduct interdisciplinary researches on these topics in collaboration with various fields such as computer science, social sciences, and humanities.

Corporate Collaboration Center

★Talk in English (or partially in English)

Poster NO.	Collaboration Center	Leader	Research
43	RIKEN AIP-NEC Collaboration Center	Masashi Sugiyama	To realize a safe and secure society, we aim to establish fundamental technologies that enable the recognition of infrequent events such as disasters, accidents, and incidents that threaten this society, fundamental technologies that are useful for human decision-making when signs of an accident are detected, and fundamental technologies that support smooth and automatic negotiations between multiple AIs. We promote further acceleration of AI research and contribution to industry by conducting research and development in collaboration from the elucidation of the basic principles of AI to its application in the real world.
44	RIKEN AIP-TOSHIBA Collaboration Center	Masashi Sugiyama	We aim to achieve “Autonomous learning AI for innovative productivity” by bringing together our leading-edge AI technologies, plus know-how and data Toshiba has built up through years of experience as a leading industrial company in sectors ranging semiconductors to infrastructure. In carrying out research and development, Toshiba will develop a broad range of cutting-edge technologies and enhance the quality of its own AI researchers, toward offering solutions to society.
45	RIKEN AIP-FUJITSU Collaboration Center	Masashi Sugiyama	We are working on R&D to create “AI that predicts the unpredictable.” “AI that predicts the unpredictable” is AI that supports better decision-making for people based on appropriate future predictions, even in the face of environmental uncertainties. Toward this realization, we will advance research on Robust Machine Learning, Fusing Simulation and AI, and Structuring Large-Scale Knowledge.