開講科目名	Course Title	時間割コード	授業の目標、概要／Course Objectives and Overview
確率統計情報論	Stochastic Methods in Mathematical Informatics	4820-1001	ベイズ統計学の理論的な話題について扱う．／This course covers theoretical topics in Bayesian statistics.
現代情報理論	Modern Information Theory	4820-1003	Information theory is an important concept with applications in various fields of mathematical informatics. In this lecture, we will take one of the main applications, cryptography, as an example to show how the concepts of information theory can be used.
離散情報論	Discrete Methods in Mathematical Informatics	4820-1007	最適化と計算科学を支える数学的概念として重要な離散構造を扱うとともに、それらを利用したアルゴリズムの設計と解析に関する基本的な手法を論じる。特に、大規模データを扱うためのアルゴリズムとデータ構造として，簡潔データ構造を講義する。We study discrete mathematical structures, which play important rolesin optimization and computer science,and also fundamental issues in design and analysis of algorithmsand data structures that make use of these structures.In particular, we deal with algorithms and data structuresfor manipulating big data such as succinct data structures.
応用数理学	Applied Mathematical Programming	4820-1009	応用数理に関する話題を扱う。
数理情報学特別講義III（オンライン学習理論）	Special Lectures in Mathematical Informatics III	4820-1016	This course provides a systematic study of the theoretical foundationsof online learning. Online learning addresses sequential decision-makingproblems in which data arrives one instance at a time, with nodistributional assumptions on the data. Even in worst-case (adversarial)environments, algorithms can be designed whose cumulative performance iscompetitive with the best fixed strategy chosen in hindsight.The course covers major topics including Online Convex Optimization (OCO),Prediction with Expert Advice, Follow the Regularized Leader (FTRL),Online Mirror Descent (OMD), Adversarial Multi-Armed Bandits, andLearning in Games. For each topic, we discuss algorithm design principles,regret analysis techniques, and the geometric principle of choosing theright regularizer, with detailed proofs.By the end of the course, students will be able to:- Precisely formulate online learning problems and explain the concept of regret- Derive and analyze various algorithms within the unified FTRL/OMD framework- Understand and apply the principle of matching the regularizer to the problem geometry- Extend the framework to bandit settings and understand connections to game theory
線形数理要論	Advanced Core in Linear Algebra	4820-1022	数理情報学全般の基礎となる道具としての線形代数を身につける．特に，数理計画法，制御理論，信号処理，確率過程，多変量解析において有用な知見を整理して習得する．（This course delivers lectures on advanced linear algebra, which serves as a fundamental tool in various areas of mathematical informatics. Emphasis is put on those concepts and techniques that are useful in mathematical programming, control theory, stochastic process, signal processing, and multivariate statistical analysis).
解析数理要論	Advanced Core in Analysis	4820-1023	数理情報学全般の基礎となる道具としての解析学、とくに、関数解析の基礎について講義する。問題演習も併せて行う。An introduction of functional analysis as a fundamental tool of mathematical informatics is provided.
確率数理要論	Advanced Core in Probability	4820-1024	測度論的確率論・確率過程論の基礎を理解する。/ The goal of the course is to understand the basics of measure-theoretic probability and stochastic processes.
算法設計要論	Advanced Core in Algorithm Design	4820-1025	基本的なアルゴリズム設計技法を、様々な問題例を通して解説する。/ The goal of the course is to understand the basic techniques for designing efficient algorithms.
脳科学特論I	Special Topics in Brain Science I	4820-1033	The Brain Science Training Program is a 2 semester-long (October through June) lecture series that consists of 24 lectures each taught by different RIKEN CBS team/unit leaders, 2 journal club presentations, and 2 oral exams at the end of each semester. This program is suitable for those with a strong interest in becoming a neuroscientist. It is primarily designed for early-stage graduate students, but applications will be accepted from senior-graduate and undergraduate students as well. Neuroscience employs a wide range of disciplines from molecular biology to mathematics to ethology. Brain Science Training Program takes full advantage of the great diversity of CBS's research and provides a systematic overview of neuroscience. It is our sincere hope that through this program we will be able to play a part in fostering the next generation of neuroscientists. By the end of the program, students:1. Have a good grasp of the broad field of neuroscience2. Can connect concepts and methods in different subfields of neuroscience3. Are informed about scientific practices and a wide variety of training/career paths to become aneuroscientist4. Are more confident in scientific communication in English5. Have peers as well as mentors who share the same passion for neuroscience
脳科学特論II	Special Topics in Brain Science II	4820-1034	The Brain Science Training Program is a 2 semester-long (October through June) lecture series that consists of 24 lectures each taught by different RIKEN CBS team/unit leaders, 2 journal club presentations, and 2 oral exams at the end of each semester. This program is suitable for those with a strong interest in becoming a neuroscientist. It is primarily designed for early-stage graduate students, but applications will be accepted from senior-graduate and undergraduate students as well. Neuroscience employs a wide range of disciplines from molecular biology to mathematics to ethology. Brain Science Training Program takes full advantage of the great diversity of CBS's research and provides a systematic overview of neuroscience. It is our sincere hope that through this program we will be able to play a part in fostering the next generation of neuroscientists. By the end of the program, students:1. Have a good grasp of the broad field of neuroscience2. Can connect concepts and methods in different subfields of neuroscience3. Are informed about scientific practices and a wide variety of training/career paths to become aneuroscientist4. Are more confident in scientific communication in English5. Have peers as well as mentors who share the same passion for neuroscience
ニューロインテリジェンス入門	Introduction to Neurointelligence	4820-1035	Recent progress in artificial intelligence (AI) has been remarkable and produced results comparable to those of human experts in various applications like Games, Shogi and Go. Historically neuroscience played key roles in such progress of AI, but nowadays there is a wide gap in neuroscience and artificial intelligence. To deeply understand neuroscience, it is important to take the idea of the AI such as reinforcement learning, which is one of the central learning algorithms in AI. On the other hand, to create future AI such as truly neuro-inspired AI, it is important to learn latest discoveries in neuroscience. The interaction of neuroscience and AI should lead to the new field Neurointelligence: the interface of human intelligence and artificial intelligence. In this lecture series, introduction of neurointelligence is given by each researcher working on neurointelligence from a wide range of fields covering computational neuroscience, AI as well as experimental neuroscience.
数理情報学輪講I	Colloquium on Mathematical Informatics I	4820-2001	各人の研究，または各人の研究テーマに関連した論文を題材にとり，発表および聴講・質疑応答を行う．／Students present their own research or papers related to their research topics, listen to others' presentations, and discuss through questions and answers.
数理情報学輪講II	Colloquium on Mathematical Informatics II	4820-2002	各人の研究，または各人の研究テーマに関連した論文を題材にとり，発表および聴講・質疑応答を行う．／Students present their own research or papers related to their research topics, listen to others' presentations, and discuss through questions and answers.
数理情報学講究	Seminar in Mathematical Informatics	4820-2003	統計学に関係する教員及び院生による統計学セミナー。様々な研究科において統計学とその応用に関心を持っている教員及び院生が自由に参加できる。普段は自分の分野とは異なるとの理由であまり聞く機会のない色々な話題も登場するので、新しい発想、未知の理論分野や応用分野を勉強できる。
数理情報学博士輪講I	Advanced Colloquium on Mathematical Informatics I	4820-2006	各人の研究，または各人の研究テーマに関連した論文を題材にとり，発表および聴講・質疑応答を行う．／Students present their own research or papers related to their research topics, listen to others' presentations, and discuss through questions and answers.
数理情報学博士輪講II	Advanced Colloquium on Mathematical Informatics II	4820-2007	各人の研究，または各人の研究テーマに関連した論文を題材にとり，発表および聴講・質疑応答を行う．／Students present their own research or papers related to their research topics, listen to others' presentations, and discuss through questions and answers.
数理情報学博士輪講III	Advanced Colloquium on Mathematical Informatics III	4820-2008	各人の研究，または各人の研究テーマに関連した論文を題材にとり，発表および聴講・質疑応答を行う．／Students present their own research or papers related to their research topics, listen to others' presentations, and discuss through questions and answers.
数理情報学修士特別研究I	Research Project on Mathematical Informatics I	4820-3001	各研究室において修士論文の執筆に向けた研究を行う．議論や実験・調査等を通じて専門的なスキルを身に着けるとともに研究遂行に必要な論理的思考能力や論文執筆能力を身に着ける．
数理情報学修士特別研究II	Research Project on Mathematical Informatics II	4820-3002	各研究室において修士論文の執筆に向けた研究を行う．議論や実験・調査等を通じて専門的なスキルを身に着けるとともに研究遂行に必要な論理的思考能力や論文執筆能力を身に着ける．
数理情報学博士特別研究I	Advanced Research Project on Mathematical Informatics I	4820-3003	各研究室において博士論文の執筆に向けた研究を行う．議論や実験・調査等を通じて専門的なスキルを身に着けるとともに研究遂行に必要な論理的思考能力や論文執筆能力を身に着ける．
数理情報学博士特別研究II	Advanced Research Project on Mathematical Informatics II	4820-3004	各研究室において博士論文の執筆に向けた研究を行う．議論や実験・調査等を通じて専門的なスキルを身に着けるとともに研究遂行に必要な論理的思考能力や論文執筆能力を身に着ける．
数理情報学博士特別研究III	Advanced Research Project on Mathematical Informatics III	4820-3005	各研究室において博士論文の執筆に向けた研究を行う．議論や実験・調査等を通じて専門的なスキルを身に着けるとともに研究遂行に必要な論理的思考能力や論文執筆能力を身に着ける．