開講科目名	Course	時間割コード	授業の目標、概要／Course Objectives/ Overview
連続情報論	Analytical Methods in Mathematical Informatics	4820-1004	Data assimilation (DA) is a computational technique that integrates numerical simulation models and observational data based on Bayesian statistics. DA has developed mainly in meteorology and oceanography, and it is the foundation of modern weather forecasting now.In this lecture, we learn a couple of basic DA techniques, such as Kalman filter, ensemble Kalman filter, particle filter, and four-dimensional variational method. Then we learn how they are applied in practical problems in various fields. We also experience the DA techniques through their actual programming.
非線形現象論	Topics on Nonlinear Phenomena	4820-1005	We learn the basics of dynamical systems that describe nonlinear phenomena. In particular, we learn the idea of time-scale separation, and deepen our understanding of approximation/reduction theory for time-evolution equations based on it.
数理構造論	Mathematical Structures in Informatics	4820-1008	The first half of the course introduces various topics in computational social choice, including fair allocation of resources and voting. The second half covers discrete structures that aid in designing efficient algorithms for optimization.
数理情報学特別講義II	Special Lectures in Mathematical Informatics II	4820-1015	Since the late 1990s, network analysis has become a prominent subject for researchers in complex systems, statistics, and machine learning. While these three disciplines share specific conceptual frameworks, some techniques remain unique to each field, making it challenging for students to fully grasp the vast landscape of network analysis. This course is designed to offer an inclusive overview of network analysis and its diverse applications.
複雑数理システム論	Advanced Topics on Complex Systems	4820-1018	本講義では、複雑システムの数理構造を理解するための基礎として、特に非線形力学系理論、非線形時系列解析理論、複雑系数理モデル理論などを取りあげ、それらの基礎知識を解説する。さらに、複雑システムの具体例として、脳・神経系などを取り上げ、それらの具体的な解析例を紹介しながら、実在複雑システムに対する数理工学的アプローチの有効性を論じる。
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.
情報論的学習理論	Information-Theoretic Learning Theory	4820-1026	Machine learning is a technology for discovering novel knowledge from a large amount of data. This lecture shows an information-theorertic approach to machine learning, specifically on the basis of the minimum description length (MDL) principle.This approach gives a unifying view of design and analyasis of machine learning algorithms. The lecture also includes a wide range of machine learning applications, including medicine, traffic, marketing, SNS, etc.
科学技術計算 I	Technical and Scientific Computing I	4820-1027	OpenMPは指示行を挿入するだけで手軽に「マルチスレッド並列化（multi-threading）」ができるため，マルチコアプロセッサ内の並列化に広く使用されている。本講義ではOpenMPによる並列化に関する講義・実習を実施する。本講義では対象アプリケーション（有限体積法（finite-volume method, FVM）によってポアソン方程式）をOpenMPによってマルチコアプロセッサ上で並列化するのに必要な計算手法，アルゴリズム，プログラミング手法の講義，実習の他，並列前処理手法の最新の研究に関する講義も実施する。プログラミング実習にはスーパーコンピュータシステム（Wisteria/BDEC-01(Odyssey)）を使用する。OpenMP is the most widely-used way for parallelization on each compute node with multiple cores because multi-threading can be done easily by just inserting directives. In this class, lectures and exercises for parallelization by multi-threading of the target application (Poisson's equation solver by FVM (finite-volume method)) on multicore processors using OpenMP are provided, which covers numerical algorithms, and programming methods. Moreover, lectures on recent research topics on parallel preconditioning methods will be also provided. The Supercomputer System (Wisteria/BDEC-01(Odyssey)) is available for hands-on exercises.
科学技術計算 II	Technical and Scientific Computing II	4820-1028	並列計算プログラミング技法に関する講義、実習を実施する。並列計算に広く使用されているMPI（Message Passing Interface）, OpenMPを使用したプログラミングを中心に扱う。様々な計算機における最適化技術についても併せて講義，実習を実施する。プログラミング実習には東大情報基盤センターのWisteria/BDEC-01(Odyssey)を使用する。ターゲットとするアプリケーションは有限要素法による一次元及び三次元定常熱伝導解析プログラムであり，背景となる基礎的な理論から，実用的なプログラムの作成法まで，連立一次方程式解法などの周辺技術も含めて講義を実施する。Lectures and hands-on exercises on parallel programming methods for large-scale scientific computing will be provided. This class focuses of programming using MPI (Message Passing Interface) and OpenMP, which is widely used method for "de facto standard" of parallel programming. Lectures on optimization methods on various types of architectures are also given. Wisteria/BDEC-01(Odyssey) at ITC is available for hands-on exercises. Target applications are 1D/3D codes for steady-state heat transfer by finite-element method (FEM). This class covers wide range of topics related to FEM, such as fundamental mathematical theory, programming method, and solving large-scale linear equation.
現代暗号理論	Contemporary Cryptography	4820-1031	公開鍵暗号の構成法と安全性評価を中心に学習する。1. 暗号理論の基本的事項2. 整数の基本的アルゴリズムや公開鍵暗号の原理3. 暗号アルゴリズムの高速実装技法4. 公開鍵暗号の安全性評価方法5. 量子計算機に対して安全な公開鍵暗号
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
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，研究発表の仕方，聴講・質疑応答の練習を行う.
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，研究発表の仕方，聴講・質疑応答の練習を行う.
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。

開講科目名	Course	時間割コード	授業の目標、概要／Course Objectives/ Overview
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，研究発表の仕方，聴講・質疑応答の練習を行う．
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，研究発表の仕方，聴講・質疑応答の練習を行う．
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，研究発表の仕方，聴講・質疑応答の練習を行う．
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	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	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．