

KHOURY COLLEGE MEANINGFUL MINORS

APPROVED ELECTIVE COURSES FOR COMPUTER SCIENCE

BOUVÉ COLLEGE OF HEALTH SCIENCES

HINF 5101 Introduction to Health Informatics and Health Information Systems

Introduces the history and current status of information systems in healthcare: information architectures, administrative and clinical applications, evidence-based medicine, information retrieval, decision support systems, security and confidentiality, bioinformatics, information system cycles, the electronic health record, key health information systems and standards, and medical devices.

HINF 5102 Data Management in Healthcare

Explores issues of data representation in healthcare systems, including patient and provider identification, audit trails, authentication, and reconciliation. Discusses underlying design of repositories for electronic health records (EHRs) and computerized provider order entry (CPOE) systems. Includes an overview of privacy issues, legislation, regulations, and accreditation standards unique to healthcare.

HINF 5300 Personal Health Interface Design and Development

Explores the design of innovative personal health human-computer interface technologies. Examples include assistive technologies that aid persons with disabilities, consumer wellness promotion applications, patient education and counseling systems, interfaces for reviewing personal health records, and elder care and social network systems that monitor health and support independent living. Offers students an opportunity to work in teams to build a prototype personal health interface system to solve a real problem. Topics include needs assessment and participatory research, iterative user interface design methods for health interface development, computational sensing of health states and behavior, software architectures for iteratively testing prototype personal health interface technologies, human-computer interaction issues related to personal health technology, and technology transfer requirements to support future validation studies of technology.

HINF 5102 Data Management in Healthcare

Explores issues of data representation in healthcare systems, including patient and provider identification, audit trails, authentication, and reconciliation. Discusses underlying design of repositories for electronic health records (EHRs) and computerized provider order entry (CPOE) systems. Includes an overview of privacy issues, legislation, regulations, and accreditation standards unique to healthcare.

HINF 5301 Personal Health Technologies: Field Deployment and System Evaluation

Explores the deployment and evaluation of innovative personal health technologies. In this project-based course, students work in teams to deploy and evaluate a prototype personal health technology that has been previously developed by students in HINF 5300. Offers students an opportunity to develop a research plan to measure the effectiveness, usability, and/or feasibility of the technology; recruit study participants; deploy the technology; and analyze the data collected. Also offers students an opportunity to learn about each of these steps and work toward producing a publishable-quality research paper on the technology and results of the efficacy study, as well as to prepare a grant application that extends the technology and research methodology. Additional topics include technology transfer and implications on health policy.

PHMD 3450 Research Methodology and Biostatistics

Offers an interactive course covering aspects of research designs used in experimental and observational studies, hypothesis testing, and an introduction to basic biostatistics. Offers students an opportunity to critically examine selected articles from the clinical literature and to analyze the framing of the research question and the methods used to insure the validity and generalizability of the study's findings. Clinical trials, observational studies, and problem sets illustrate principles of research design, conduct, and data analysis.

Northeastern University
**Khoury College of
Computer Sciences**

COLLEGE OF ARTS, MEDIA AND DESIGN

ARTD 2200 Interactive Narrative

Continues the study of narrative structures from ARTD 2100, emphasizing analysis and development of interactive and experimental new media applications. Offers students an opportunity to explore narrative issues in immersive multimedia and gaming, including dynamic characters and multiuser environments. Students work in teams to develop narrative continuity across multiple media, including alternate-reality games and other forms of multimedia experiences.

ARTD 2360 Photo Basics

Offers an introductory lecture/lab photography class. Explores the technical and theoretical concepts throughout the history of photography. The lab component of the course covers processing, editing, and output of images. Culminates in a final project designed to demonstrate both technical and conceptual knowledge of the medium.

ARTD 2370 Animation Basics

Offers an introductory studio course that explores the creative potential of animation. Exposes students to a variety of traditional animation processes and techniques through lectures, demonstrations, and hands-on assignments. Provides a historical survey of animation art through the twentieth century. Emphasizes using the computer to develop concepts creatively while learning the fundamental skills of constructing animated images and forms.

ARTD 2380 Video Basics

Offers an introductory exploration into the moving image as an art form. Covers the fundamental technical and aesthetic aspects of contemporary video production. Emphasizes personal, experimental works from an individual point of view. Analysis of projects is directed toward the development of a personal voice.

ARTG 2260 Programming Basics

Exposes students to basic programming design for user interfaces. Offers students an opportunity to become familiar with the logical elements of programming languages. Through lectures, hands-on in-class exercises, and modular projects, explores Web-based design and programming solutions for managing interaction and animation.

ARTG 2400 Interaction Design 1: Responsive

Applies information design principles to Web and mobile interface design. Explores user-centered interface and programming design strategies for the delivery of responsive data-driven websites. Discusses audience definition, content development, information structuring, and navigation. Emphasizes tools and strategies for design, such as site maps, wireframes, prototypes, usability testing, and iterative development. Offers students an opportunity to obtain meaningful interactive experiences through team-based projects.

ARTG 3250 Physical Computing

Explores the communication between the physical world and the interactive, computer-based interface. Examines the potential of reactive analog and digital devices embedded within the physical realm. Offers students an opportunity to use simple kit sensors and indicators designed to enable student teams to create interfaces triggered by gesture, bodily movement, physical forces, and other tangible actions. Concludes with discussions of more complex interactive devices, the relationship between physical computing and robotics, and possible future directions.

ARTG 3352 Interaction Design Basics

Introduces basic principles of interactive design, such as orientation, navigation, hierarchy, categorization, user expectation, usability, and responsiveness. Explores these concepts through the creation of Web-based user interfaces.

ARTG 3451 Information Design 1

Introduces basic concepts, methods, and procedures of information design with a focus on mapping information. Students investigate visual systems and information structures such as maps, graphs, charts, and diagrams. Emphasizes the creative process of organizing, visualizing, and communicating data by making complex information easier to understand and use.

ARTG 3700 Interaction Design 2: Mobile

Explores user-centered interface design for information exchanges using handheld and mobile devices. Studies the potentials for leveraging both the social and locative possibilities of mobile devices through research, discussions, and project assignments.

ARTG 4552 Information Design 2

Builds on concepts from ARTF 2223 and ARTG 3451. Offers students an opportunity to develop strategies for structuring and communicating complex information to increase understanding through dynamic states, which are controlled through the interaction of end users. Explores possibilities offered by interfaces that mediate between a person and information space through research, projects, readings, and discussions.

ARTG 5100 Information Design Studio 1—Principles

Explores the theories and practices of information design through studio projects. Investigates visual systems and information structures such as maps, timelines, charts, and diagrams. Emphasizes the creative process of organizing, visualizing, and communicating data by seeking to make complex information easier to understand and use.

ARTG 5110 Information Design History

Investigates the history of visualization practices across disciplines and in relation to technology developments. Critically examines seminal visualizations in social, cultural, and technological contexts by means of discussions and writing activities in a seminar format.

ARTG 5120 Information Design Research Methods

Examines qualitative and quantitative research methods pertinent to information communication systems. Through discussion and writing activities, offers students an opportunity to investigate varied inquiry toward the development of researchable questions, argument formation, and assessment methodologies.

COMM 2105 Social Networks

Explores the use of social network analysis theories and methods to understand the growing connectivity and complexity in the world around us on different scales, ranging from small groups to the World Wide Web. Offers students an opportunity to see the world in a new way: using a network perspective. Covers a wide range of topics and applications relating to social network analysis. Discusses how social networks concepts, theories, and visual-analytic methods are being used to map, measure, understand, and design a wide range of phenomena such as groups and organizations, friendships and romantic relationships, social networking sites (Facebook), recommender systems (Amazon), online games and virtual worlds (Second Life), and the World Wide Web.

GAME 4355 Game Scripting

Offers students an opportunity to understand the basic principles of game engines and how to control games and game engines through relatively simple scripting techniques. Examines several different game engines, including those where scripting is visual and those where scripting is textual. Studies critical concepts, including the game loop and triggering/collision events. Offers students an opportunity to propose scripts to add to games and to work in teams to devise these scripts (pair programming) and the associated presentations (proposal and completed work). Students choose game engines and scripts to implement based on critical analysis of existing games and on their own aspirations for being innovative game designers.

JRNL 3525 Online Journalism

Provides students with the opportunity to learn new media skills including Web site production, online packaging of news content, and digital photography. Analyzes the history, ethics, law, economics, and future of online journalism. Includes an in-depth look at Weblogs, traditional news Web sites, and alternative Webzines.

JRNL 3610 Digital Storytelling in Journalism

Offers students an opportunity to learn the fundamentals of digital journalism. Emphasizes hands-on instruction in multimedia skills. Topics may include blogging, photography, video and audio production, use of social media as a reporting tool, and mapping and data visualization. Guest speakers and a consideration of the future of news may also be part of the course. Requires students to produce a final project that consists of storytelling across a range of platforms—for example, a written article, a photo story, and a video.

JRNL 3615 Advanced Digital Storytelling

Continues JRNL 3610. Journalists now have access to more storytelling tools—blogs, smartphones, high-quality DSLRs, Facebook—than at any other time in our industry's history. Offers students an opportunity to learn advanced techniques in using video and audio production, social media, and crowdsourcing to create compelling, professional-grade multimedia stories.

JRNL 5214 The Online Newsroom Experience

Offers students an opportunity to report and write for publication, take photos, and edit news copy for the e-Bulletin, the online news site for the New England Newspaper and Press Association. The e-Bulletin, now a news Web site after a transition from a printed newspaper, reports news for journalists at about 800 newspapers in New England and their online operations. It is also a multimedia site, offering all the news-delivery methods of the modern newsroom— video, audio, still photos, and text. This course seeks to prepare students for co-op jobs and provide networking opportunities with New England journalists.

MSCR 2500 Digital Media Research

Examines the growing centrality of what has been variously labeled as the “social web,” “Web 2.0,” “participatory culture,” and “convergence culture.” Does so by situating blogs, social network sites, Wikis, image boards, and other types of participatory media in broader social, economic, and political contexts. Examines how the development of social media is infused with gendered, racial, cultural, and subcultural values. Offers students an opportunity to examine key dimensions of cultural life that make up our (online) selves—including friendship, privacy, labor, celebrity, power, gender, race, and activism—by conducting original research.

KHOURY COLLEGE OF COMPUTER AND INFORMATION SCIENCES

CS 1100 Computer Science and Its Applications

Introduces students to the field of computer science and the patterns of thinking that enable them to become intelligent users of software tools in a problem-solving setting. Examines several important software applications so that students may develop the skills necessary to use computers effectively in their own disciplines.

CS 1800 Discrete Structures

Introduces the mathematical structures and methods that form the foundation of computer science. Studies structures such as sets, tuples, sequences, lists, trees, and graphs. Discusses functions, relations, ordering, and equivalence relations. Examines inductive and recursive definitions of structures and functions. Discusses principles of proof such as truth tables, inductive proof, and basic logic. Also covers the counting techniques and arguments needed to estimate the size of sets, the growth of functions, and the space-time complexity of algorithms.

MUST 1220 Introduction to Music Technology

Provides students with instruction in the use of a computer for composing original music. Topics include MIDI sequencing, digital audio processing, and sound synthesis. Students use music hardware and software to complete a variety of projects.

MUST 3421 Digital Audio Processing

Comprises the theory and application of digital audio processing techniques. Includes multitrack digital recording, sampling and sample processing, and encoding audio for various delivery formats.

IS 1500 Introduction to Web Development

Introduces Web development and networks. Discusses HTML5, CSS, and client-side scripting with JavaScript and jQuery; embedding of media: images, video, and sound; the use of back-end data (either from databases or XML) to create dynamic Web sites; Web hosting, operating systems, and network infrastructure; and the automation of website construction using content management systems. Considers the construction of Web forms and the underlying protocols for information exchange: HTTP and HTTPS. Emphasizes the need for testing both correctness and usability. Offers a brief introduction to server-side scripting. Surveys the security problems faced by dynamic websites. Hands-on laboratory work is built into the course.

May be taken as a general elective by Khoury students but does not count as a CS or IS elective.

COLLEGE OF ENGINEERING

BIOE 2365 Bioengineering Measurement, Experimentation, and Statistics

Introduces the fundamentals of biomedical data acquisition and statistical analysis. Engineering statistics topics include descriptive statistics, probability distributions, hypothesis testing, analysis of variance, and experiment design. Applies these statistical topics by analyzing data obtained from laboratory exercises in BIOE 2366. Laboratory exercise topics include cell culture, mechanical testing, modeling medical imaging data, 3D printing, and bioprinting. Emphasizes using MATLAB software to analyze data on the computer.

EECE 2160 Embedded Design Enabling Robotics

Constitutes the lecture portion of an integrated lecture/lab. Presents the basics of the Unix operating system, high-level programming concepts, introductory digital design, wireless networking, and Simulink design.

EECE 2322 Fundamentals of Digital Design and Computer Organization

Covers the design and evaluation of control and data structures for digital systems. Uses hardware description languages to describe and design both behavioral and register-transfer-level architectures and control units. Topics covered include number systems, data representation, a review of combinational and sequential digital logic, finite state machines, arithmetic-logic unit (ALU) design, basic computer architecture, the concepts of memory and memory addressing, digital interfacing, timing, and synchronization. Assignments include designing and simulating digital hardware models using Verilog as well as some assembly language to expose the interface between hardware and software.

EECE 3324 Computer Architecture and Organization

Presents a range of topics that include assembly language programming, number systems, data representations, ALU design, arithmetic, the instruction set architecture, and the hardware/software interface. Offers students an opportunity to program using assembly language and to simulate execution. Covers the architecture of modern processors, including datapath/control design, caching, memory management, pipelining, and superscalar. Discusses metrics and benchmarking techniques used for evaluating performance.

EECE 4542 Advanced Engineering Algorithms

Covers classical and modern algorithms that efficiently solve hard electrical and computer engineering optimization problems. These problems arise in a wide range of disciplines—including computer-aided design, parallel computing, computer architecture, and compiler design—and are usually NP-complete, making it unlikely that optimal solutions can be found in a reasonable amount of time. Covers the fundamentals of algorithm analysis and complexity theory and then surveys a wide range of combinatorial optimization techniques, including exhaustive algorithms, greedy algorithms, integer and linear programming, branch and bound, simulated annealing, and genetic algorithms. Considers the efficient generation of optimal solutions, the development and evaluation of heuristics, and the computation of tight upper and lower bounds.

EECE 5639 Computer Vision

Introduces topics such as image formation, segmentation, feature extraction, matching, shape recovery, dynamic scene analysis, and object recognition. Computer vision brings together imaging devices, computers, and sophisticated algorithms to solve problems in industrial inspection, autonomous navigation, human-computer interfaces, medicine, image retrieval from databases, realistic computer graphics rendering, document analysis, and remote sensing. The goal of computer vision is to make useful decisions about real physical objects and scenes based on sensed images. Computer vision is an exciting but disorganized field that builds on very diverse disciplines such as image processing, statistics, pattern recognition, control theory, system identification, physics, geometry, computer graphics, and learning theory.

EECE 5642 Data Visualization

Introduces relevant topics and concepts in visualization, including computer graphics, visual data representation, physical and human vision models, numerical representation of knowledge and concept, animation techniques, pattern analysis, and computational methods. Topics include tools and techniques for practical visualization and elements of related fields, including computer graphics, human perception, computer vision, imaging science, multimedia, human-computer interaction, computational science, and information theory. Covers examples from a variety of scientific, medical, interactive multimedia, and artistic applications. Includes hands-on exercises and projects. Emphasizes modern engineering applications of computer vision, graphics, and pattern classification methodologies for data visualization.

EECE 5644 Introduction to Machine Learning and Pattern Recognition

Studies machine learning, the study and design of algorithms that enable computers/machines to learn from experience/data. Covers a range of algorithms, focusing on the underlying models between each approach. Emphasizes the foundations to prepare students for research in machine learning. Topics include Bayes decision theory, maximum likelihood parameter estimation, model selection, mixture density estimation, support vector machines, neural networks, probabilistic graphics models, and ensemble methods (boosting and bagging). Offers students an opportunity to learn where and how to apply machine learning algorithms and why they work.

IE 3412 Engineering Probability and Statistics

Presents probability theory axiomatically, with emphasis on sample space presentation of continuous and discrete random variables. Covers descriptive statistics, expected value of random variables, covariance and correlation, sampling distribution, and point and interval estimations. Introduces hypothesis testing including tests for means, variances, and proportions.

IE 4615 Expert Systems and Neural Networks

Covers the theory and applications of expert systems and neural networks in engineering. Topics include knowledge representation (semantic networks, frames, production rules, and logic systems), problem-solving methods (heuristic search algorithms, forward and backward chaining, constraint handling, truth, and maintenance), approximate reasoning methods (Bayesian, Dempster-Shafer, fuzzy logic, and certainty factors), and expert system shells. Reviews background material on important neural network architectures such as feed-forward neural networks, Kohonen's feature maps, radial basis function networks, and adaptive resonance theory networks. Discusses neural network applications in several areas including group technology; part family formation; manufacturing systems design, process, and machine tool monitoring and diagnosis; system identification and control; and product inspection.

ME 2315 Statistical and Economical Analyses in Engineering

Introduces engineering probability and statistics, as well as engineering economic analysis for project or design evaluation. Case studies are used to illustrate the integration of these areas in the design/system analysis process. Topics in engineering probability and statistics include descriptive statistics, expected value of random variables, and hypotheses testing. Introduces statistical process control and sampling methods as well as reliability methods for the analysis and improvement of system/design performance. Also covers fundamental concepts of time value of money and economic valuation of system designs. Effect of depreciation and taxes on comparing different alternatives are studied. Project management topics and optimization software applications are introduced. Provides students with evaluation tools for analyzing the design/manufacturing process.

COLLEGE OF SCIENCE

BIOL 2301 Genetics and Molecular Biology

Focuses on mechanisms of inheritance, gene-genome structure and function, and developmental genetics and evolution. Examples are drawn from the broad spectrum of plants, animals, fungi, bacteria, and viruses. Topics and analytical approaches include transmission genetics, molecular biology and gene regulation, DNA molecular methods, quantitative and population genetics, bioinformatics, genomics, and proteomics.

BIOL 3405 Neurobiology

Introduces the cellular and molecular functioning of the nervous system, the organization of neurons into circuits, the processing of information, and the generation of motor output.

BIOL 5587 Comparative Neurobiology

Presents a cellular approach to structure and function of the nervous system. Topics include neuronal anatomy, phylogeny of nervous systems, electrophysiology of membrane conductances, synaptic transmission, integration in nerve cells, neuronal networks, sensory systems, motor systems, sensory-motor integration, development and regeneration of neuronal connectivity, and fundamentals of neurotechnology for biomedics. Focuses on the development of these concepts from the primary research literature. A term project involves the design of a simple nervous system for a hypothetical animal.

BIOL 5603 Computational Neuroscience

Covers applications of computational methods to current problems in cellular and systems neuroscience. Draws examples from such biological domains as sensory encoding, motor control, cortical information processing, memory storage and retrieval, neuronal decision making, animal learning paradigms and cognitive architectures. Emphasizes neuronal computation, realistic network modeling, and associated analytical techniques.

BIOL 6200 Bioinformatics Programming [BY PERMISSION]

Focuses on the fundamental programming skills required in the bioinformatics industry. Perl is the main programming language used. Topics include string operations, file manipulation, regular expressions, object-oriented programming, data structures, testing, program design, and implementation. Includes substantial out-of-classroom assignments.

BIOL 6308 - Bioinformatics Computational Methods 1 [BY PERMISSION]

Offers the first semester of a two-semester sequence on the use of computers in bioinformatics research. Offers students an opportunity to work with current methods and computational algorithms used in contemporary sequence analysis. Teaches practical skills necessary to manage and mine the vast biological information being generated and housed in public databases. Emphasizes the use of Perl as the primary computer language and requires students to learn and understand basic computer logic and syntax, including an introduction to scalars, arrays, hashes, decision statements, loops, subroutines, references, and regular expressions. A focus on fundamental skills, including the command line interface found in the Linux operating system, is designed to prepare students for second-semester applications.

BIOL 6309 - Bioinformatics Computational Methods 2 [BY PERMISSION]

Designed to build upon the core topics covered in BIOL 6308, i.e., use of the computer as a tool for bioinformatics research. Builds upon the Perl language fundamentals covered during the first semester but requires students to apply these fundamentals to a semester-long project. The project includes protein family analysis, multiple sequence analysis, phylogeny, and protein structure analysis. Additionally, students have an opportunity to learn to build, load, connect, and query custom MySQL databases, parse command line flags, and build Perl objects.

CHEM 5638 Molecular Modeling

Introduces molecular modeling methods that are basic tools in the study of macromolecules. Is structured partly as a practical laboratory using a popular molecular modeling suite, and also aims to elucidate the underlying physical principles upon which molecular mechanics is based. These principles are presented in supplemental lectures or in laboratory workshops.

ENVR 2500 Biostatistics

Offers students an overview of traditional and modern statistical methods to analyze biological data using the free and open-source R programming environment. Describes core statistical approaches and discusses their suitability for understanding patterns that arise at different levels of biological organization, from cellular processes to whole ecosystems. Topics include basic probability and sampling theory, experimental design, Neyman-Pearson hypothesis testing, ANOVA/ANCOVA, regression and correlation, general and generalized linear models, model selection and information theory, multivariate statistics and ordination, hierarchical/mixed-effects models, and Monte Carlo randomization.

ENVR 3300 Geographic Information Systems

Introduces students to the use of a geographic information system (GIS). Explores the practical application of GIS to support geographic inquiry, analysis, and decision making. Topics include spatial data collection; data accuracy and uncertainty; cartographic principles and data visualization; geographic analysis; and legal, economic, and ethical issues associated with the use of a GIS. Investigates case studies from geology, environmental science, urban planning, architecture, social studies, and engineering. Offers students an opportunity to gain hands-on experience with a leading commercial GIS software package.

ENVR 3302 Introduction to Remote Sensing

Explores the fundamental concepts of remote sensing of the environment. Topics include digital imagery from spacecraft, conventional and high-altitude aerial photography, orthophotography production, and surface modeling systems. Offers hands-on experience with basic functions of industry standard image processing software.

ENVR 4563 Advanced Spatial Analysis

Provides an in-depth evaluation of theoretical, mathematical, and computational foundations of geographic information systems (GIS). Topics include spatial information theory, database theory, mathematical models of spatial objects, and GIS-based representation. Examines advanced concepts and techniques in raster-based GIS and high-level GIS modeling techniques.

LING 3450 Syntax

Introduces syntax, the theory of sentence structure. Explores how to do syntactic analysis using linguistic evidence and argumentation. Focuses primarily on English, with some discussion on the syntax of other languages. Other topics include syntactic universals and the relation between syntax and semantics.

LING 3452 Semantics

Focuses on meaning and how it is expressed in language—through words, sentence structure, intonation, stress patterns, and speech acts. Considers how content, logic, and speakers' and listeners' assumptions affect what sentences can mean and how linguistic meaning is determined by one's perceptual system or culture.

MATH 1260 Math Fundamentals for Games

Discusses linear algebra and vector geometry in two-, three-, and four-dimensional space. Examines length, dot product, and trigonometry. Introduces linear and affine transformations. Discusses complex numbers in two-space, cross product in three-space, and quaternions in four-space. Provides explicit formulas for rotations in three-space. Examines functions of one argument and treats exponentials and logarithms. Describes parametric curves in space. Discusses binomials, discrete probability, Bézier curves, and random numbers. Concludes with the concept of the derivative, the rules for computing derivatives, and the notion of a differential equation.

MATH 2250 Programming Skills for Mathematics

Introduces basic programming skills for applied mathematics. Also serves as preparation for co-op assignments. Topics include Excel macros, MATLAB programming, and the R statistical package. Every mathematics major or student in a mathematics combined major is required to take this course or an equivalent course in another department.

MATH 2280 Statistics and Software

Provides an introduction to basic statistical techniques and the reasoning behind each statistical procedure. Covers appropriate statistical data analysis methods for applications in health and social sciences. Also examines a statistical package such as SPSS or SAS to implement the data analysis on computer. Topics include descriptive statistics, elementary probability theory, parameter estimation, confidence intervals, hypothesis testing, nonparametric inference, and analysis of variance and regression with a minimum of mathematical derivations.

MATH 2285 Introduction to Multisample Statistics

Provides an introduction to statistical techniques, including multisample statistics and regression. Offers an opportunity to learn to choose appropriate statistical data analysis methods for applications in various scientific fields and to learn to use a statistical package to implement the data analysis. Topics include descriptive statistics, elementary probability theory, parameter estimation, confidence intervals, hypothesis testing, analysis of variance, and regression. May also include optimal design.

MATH 2331 Linear Algebra

Uses the Gauss-Jordan elimination algorithm to analyze and find bases for subspaces such as the image and kernel of a linear transformation. Covers the geometry of linear transformations: orthogonality, the Gram-Schmidt process, rotation matrices, and least squares fit. Examines diagonalization and similarity, and the spectral theorem and the singular value decomposition. Is primarily for math and science majors; applications are drawn from many technical fields. Computation is aided by the use of software such as Maple or MATLAB, and graphing calculators.

MATH 2341 Differential Equations and Linear Algebra for Engineering

Studies ordinary differential equations, their applications, and techniques for solving them including numerical methods (through computer labs using MS Excel and MATLAB), Laplace transforms, and linear algebra. Topics include linear and nonlinear first and second-order equations and applications include electrical and mechanical systems, forced oscillation, and resonance. Topics from linear algebra, such as matrices, row-reduction, vector spaces, and eigenvalues/eigenvectors, are developed and applied to systems of differential equations.

MATH 3081 Probability and Statistics

Focuses on probability theory. Topics include sample space; conditional probability and independence; discrete and continuous probability distributions for one and for several random variables; expectation; variance; special distributions including binomial, Poisson, and normal distributions; law of large numbers; and central limit theorem. Also introduces basic statistical theory including estimation of parameters, confidence intervals, and hypothesis testing.

MATH 3530 Numerical Analysis

Considers various problems including roots of nonlinear equations; simultaneous linear equations: direct and iterative methods of solution; eigenvalue problems; interpolation; and curve fitting. Emphasizes understanding issues rather than proving theorems or coming up with numerical recipes.

MATH 4535 Mathematical Topics in Computer Vision

Studies topics in computer vision and the mathematical approaches to them. These include but are not limited to detection of object boundaries in images, nonlinear diffusion, optimization, and curve evolution. Students are required to be able to program algorithms that the course develops.

MATH 4581 Statistics and Stochastic Processes

Continues topics introduced in MATH 3081. The first part of the course covers classical procedures of statistics including the t-test, linear regression, and the chi-square test. The second part provides an introduction to stochastic processes with emphasis on Markov chains, random walks, and Brownian motion, with applications to modeling and finance.

MATH 5104 Basics and Probability and Statistics

Introduces the ideas and the reasoning used in both finite and infinite probabilistic settings. Covers the concepts of sample space, event, and axioms. Studies discrete and continuous probability distributions for one or more random variables, conditional probability, Bayes's law, independence, and expectation and variance. Explores the use of moments, and the binomial, Poisson, and normal distributions. Examines the law of large numbers, the central limit theorem, and the use of probability in statistical inference including estimation of parameters, confidence interval, and hypotheses testing. Requires a substantial project that connects the material in this course to the secondary school classroom.

MATH 5105 Basics of Statistics and Stochastic Processes

Focuses on the classical procedures of statistics including the t-test, linear regression, and the chi-square test. Introduces stochastic processes, with an emphasis on Markov chains, random walks, and Brownian motion, with applications to modeling. Requires a substantial project that connects the material in this course to the secondary school classroom.

PHYS 1130 Computing, Data, and Science

Introduces how to deal with data and computation problems through the use of computer languages commonly used in the sciences. Focuses on manipulating data, but symbolic calculations are also covered. Intended for science majors during the first summer, when such a course can act as a foundation for later work.

PHYS/MATH 4606 Mathematical and Computational Methods for Physics

Covers advanced mathematical methods topics that are commonly used in the physical sciences, such as complex calculus, Fourier transforms, special functions, and the principles of variational calculus. Applies these methods to computational simulation and modeling exercises. Introduces basic computational techniques and numerical analysis, such as Newton's method, Monte Carlo integration, gradient descent, and least squares regression. Uses a simple programming language, such as MATLAB, for the exercises.

PSYC 2320 Statistics in Psychological Research

Offers an integrated lecture/lab one-semester course covering descriptive and inferential statistics with a focus on psychological applications. Includes a lab to provide hands-on experience with important concepts. Covers standard material in undergraduate statistics including distributions, central tendency, variability, z-scores, the normal distributions, correlation, regression, probability, hypothesis testing (using the z, t, F, and Chi-square statistics), and confidence intervals. This course should be taken before the end of the sophomore year.

PSYC 3452 Sensation and Perception

Discusses how our five senses work to aid us in perceiving states of the body and of the world, how our perceptions are modified by what we know and expect, and how sensation and perception develop (especially in infancy). Includes discussion of neural and anatomical bases of sensation and perception.

PSYC 3458 Biological Psychology

Focuses on the relation between brain function and human behavior. Examines how nerve cells function individually and work together both in small networks and in the nervous system; the structure of the nervous system; how our sense organs provide the nervous system with information about the outside world; how the brain controls movement;

COLLEGE OF SOCIAL SCIENCES AND HUMANITIES

ANTH 3418 Wired/Unwired: Cybercultures and Technopolitics

Explores the impacts of technology and new media on politics, society, and culture. Emphasizes the socioeconomic and political frameworks within which technologies are embedded as well as the role of technology and the Internet in contemporary political and cultural movements. Topics may include the political and cultural effects of the census, the radio, and the camera; the history of the Internet; virtual worlds and communities; online politics and activism; as well as blogging, gaming, and social networking.

CRIM 3700 Criminal Justice Statistics

Develops the basic foundation for which statistical properties are applied, with an emphasis on applications in criminal justice. Challenges students to understand both descriptive and inferential statistics including hypothesis testing. Develops the knowledge and understanding necessary to comprehend and interpret basic statistics in criminal justice research literature and reports. While an extensive mathematics background is not required, students should be familiar with basic algebra before taking this course.

and how psychological concepts from motivation to language and memory are represented in the brain.

PSYC 3464 Psychology of Language

Provides a basic introduction to psycholinguistics. Topics include the nature and structure of languages, processes involved in the production and comprehension of language, the biological bases of language, and aspects of language acquisition. Examines current theories of language processing and related experimental findings.

PSYC 3466 Cognition

Provides a basic introduction to human cognition. Topics include pattern recognition, attention, memory, categorization and concept formation, problem solving, and aspects of cognitive development. Examines current theories of cognitive processing and related experimental findings.

DSSH 6302 Information Design and Visual Analytics

Introduces the systematic use of visualization techniques for supporting the discovery of new information as well as the effective presentation of known facts. Based on principles from art, graphic design, perceptual psychology, and rhetoric, offers students an opportunity to learn how to successfully choose appropriate visual languages for representing various kinds of data to support insights relevant to the user's goals. Covers visual data mining techniques and algorithms for supporting the knowledge-discovery process; principles of visual perception and color theory for revealing patterns in data, semiotics, and the epistemology of visual representation; narrative strategies for communicating and presenting information and evidence; and the critical evaluation and critique of data visualizations.

ECON 1250 Game Theory in the Social Sciences

Introduces modern game theory. Games describe individuals' actions and offer tools for understanding and predicting how rational players will make choices, given their preferences, information, and available actions. The course considers games in which players know the payoffs and preferences but may have imperfect information about actions. Covers tools for predicting behavior, including iterative dominance, rationalizability, Nash equilibrium, backward induction, and subgame perfection. Introduces games of asymmetric information in which players do not know each others' payoffs and preferences. The tools are applied to a range of fields in economics (industrial organization, labor, public finance, insurance, auctions, bargaining, and macroeconomics); business (incentive design, organizational design, pricing, product-line decisions, marketing); political science; sociology; and law.

ECON 2350 Statistics

Discusses basic probability, descriptive statistics, estimation techniques, statistical hypotheses, sampling, analysis of variance, correlation, and regression analysis in the context of economics. Computer applications are an integral part of the course.

ECON 2560 Applied Econometrics

Examines research methods used by practicing economists. Discusses typical problems from applied areas of economics including choice of modeling framework, problems of data collection, review of estimation techniques, interpretation of results, and development of static and dynamic adaptive policy models. A research paper utilizing computer applications is an integral part of the course.

ECON 4653 Mathematics for Economics

Introduces basic tools of mathematics, matrix algebra, differential and integral calculus, and classical optimization, with special reference to economic applications. Computer applications are an integral part of the course.

ECON 5105 Math and Statistics for Economists

Offers an intensive study of the statistical methods and techniques and mathematical fundamentals necessary for quantitative economics. Statistical topics include descriptive statistics, probability theory, fundamentals of estimation and hypothesis testing, and regression and correlation analysis. Mathematical topics include linear algebra and differential and integral calculus. Computer applications are an integral part of the course.

ENGL 3340 Technologies of Text

Examines innovations that have reshaped how humans share information, e.g., the alphabet, the book, the printing press, the postal system, the computer. Focuses on debates over privacy, memory, intellectual property, and textual authority that have historically accompanied the rise of new media forms and genres. Offers students an opportunity to gain skills for working with texts using the rapidly changing tools of the present, e.g., geographic information systems, data mining, textual analysis.

INSH 2104 Statistics in the Social and Political World

Offers an introductory course in statistics for the social sciences. Topics include descriptive statistics, samples and populations, estimation, hypothesis testing of differences between groups, and measures of association among variables. Uses basic tools in SPSS to assist students in analyzing existing data sets relevant to the social sciences.

PHIL 1105 Science and Pseudoscience

Examines the distinction between science and pseudoscience, how scientific theories change over time, the limits of scientific explanation, and whether or not scientific practice is rational and objective. What makes a theory scientific? Does culture influence scientific reasoning? What separates Einstein's theory of relativity and astrological horoscopes? Covers a variety of topics in the history of science such as the Copernican revolution and the practice of psychoanalysis. Also covers contemporary issues regarding the scientific status of IQ tests, intelligent design theory, and others.

PHIL 1114 Risk, Reason and Evidence

Introduces the tools of inductive logic and probability while exploring their various philosophical and practical applications. What is the probability of a terrorist attack today given that there were none last week? What is the best bet to make at a roulette table? Is it rational to buy health insurance? What counts as good evidence for the existence of God? Examines evidence-based reasoning, the foundations of probability, the philosophical problem of induction, and how to make rational decisions when faced with risk and uncertainty.

PHIL 1115 Introduction to Logic

Introduces the logic of propositions and the syllogism. Examines principles of critical reasoning and fallacies. Offers practice in applying logical techniques to the creation and criticism of arguments.

PHIL 1145 Technology and Human Values

Studies philosophy of technology, as well as ethics and modern technology. Considers the relationship between technology and humanity, the social dimensions of technology, and ethical issues raised by emerging technologies. Discusses emerging technologies such as biotechnology, information technology, nanotechnology, and virtual reality.

PHIL 1215 Symbolic Logic

Focuses on the syntax and semantics of propositional logic and first-order quantification theory. Considers relations between these systems and natural language. Covers analysis of the notion of derivation within a system, the notion of logical consequence, and practice in analyzing logical structure in natural language sentences.

PHIL 2001 Ethics and Evolutionary Games

Surveys the basic ideas and principles from evolutionary game theory and how they can be applied to philosophical questions about ethical and social norms. Investigates how cooperation evolves and is maintained; where our sense of fairness comes from and how it affects the way we interact with others; why individuals are altruistic; and whether there is a rational basis for our most basic social norms. Basic ethical norms can involve cooperation, altruism, mutual aid, fairness, coordination, and communication. Evolution and game theory, the formal study of social interaction, have recently been applied to these areas in order to better understand how these norms can arise naturally.

PHIL 4510 Philosophy of Science

Focuses on the nature of scientific method, scientific theories, and scientific explanations. Examines the central question of why science is thought to provide the most reliable account of the nature of reality. Considers various theories about the nature and reliability of science.

PHIL 4515 Advanced Logic

Studies the major results in the metatheory of first-order logic. Examines consistency, completeness, and decidability. Discusses the general notion of an effectively computable process, Church's thesis, and the existence of unsolvable problems.

PHIL 4520 Philosophy of Logic

Examines philosophical problems and theories about the nature of logic.

POLS 2400 Quantitative Techniques

Teaches methods of quantitative analysis including descriptive statistics, hypothesis testing, cross-tabulation, regression, and multiple regression. Develops computer skills through use of the SPSS program. Practical applications of statistical techniques are emphasized by means of examples in political behavior, public policy analysis, public opinion, and others.

PPUA 5301 Introduction to Computational Statistics

Introduces the fundamental techniques of quantitative data analysis, ranging from foundational skills—such as data description and visualization, probability, and statistics—to the workhorse of data analysis and regression, to more advanced topics—such as machine learning and networks. Emphasizes real-world data and applications using the R statistical computing language. Analyzing and understanding complex data has become an essential component of numerous fields: business and economics, health and medicine, marketing, public policy, computer science, engineering, and many more. Offers students an opportunity to finish the course ready to apply a wide variety of analytic methods to data problems, present their results to nonexperts, and progress to more advanced course work delving into the many topics introduced here.

SOCL 2320 Statistical Analysis in Sociology

Introduces students to data collection, data description, and data analysis in sociology. Examines the application of the principles of measurement, probability, measures of centrality, tests of significance, and techniques of association and correlation to social science data. Statistical software is used to complete assignments. Required for sociology majors.

SOCL 3485 Environment, Technology, and Society

Explores the complex relationships among human society, technology, and the natural environment. Students are asked to write weekly journals as they develop an interdisciplinary approach to global environmental issues and integrate this approach with their own perspectives. Emphasizes how environmental problems can be solved by individual and group actions.

SOCL 4528 Computers and Society

Examines the impact of the computer revolution on the conditions of work and life in contemporary society including legal and theoretical issues. Discusses ethical and professional issues in computer use.

D'AMORE-MCKIM SCHOOL OF BUSINESS

ACCT 3403 Accounting Information Systems

Provides an understanding of accounting information systems, with an emphasis on the role of technology and risk analysis. Information is critical for the effective and efficient management of any organization.

Addresses concepts and applications relating to the design, analysis, and implementation of accounting systems. Examines the role of e-commerce and Internet-based technologies, including their implications for ethics and privacy, throughout the course.

ENTR 3410 Technology Strategy

Analyzes how to manage today's high-technology businesses. Complements strategy courses and functional electives. Seeks to provide particular value for those who want to work in high-technology sectors and for those who simply want to better understand how growth and wealth are created through technological innovation. Reviews the key theories and tools needed to understand how technological change creates new markets and prompts new business models; how technology-based firms can outcompete rivals in fast-growing markets characterized by high uncertainty; and how the evolution of technology in an industry affects the type of firm capabilities needed to succeed over time. The course is designed to be a combination of conceptual rigor and practical relevance.

ENTR 4501 Business Planning for Technology Ventures

Designed as a senior course for entrepreneurship majors. Covers the issues raised when creating a technology venture that goes through multiple rounds of financing in order to become a successful large company. Topics include managing growth, writing business plans, raising money, and formulating exit strategies. Focuses on projects to obtain venture financing from venture capitalists, angels, and corporate investors.

FINA 4608 Advanced Financial Strategy

Covers strategic financial decision making in dynamic and technology-driven organizations operating in domestic and international settings. Through case studies, discussions with senior financial executives, and student projects, students gain insight into capital investing and financing decisions in the new economy. An analytical paradigm linking business strategy, financial management, and valuation is utilized to explore financial decision making throughout the life cycle of companies, intended to optimize shareholder value creation. Topics include fundamental financial analysis, capital budgeting under conditions of high risk and uncertainty, startup financing, creative financing, mega-mergers, risk management, and valuation.

MISM 2301 Management Information Systems

Explores how a wide range of enterprises around the world use information and information technology to create better-managed, more innovative, and successful organizations. The twenty-first-century enterprise runs on information, and every part of the business has been transformed by the use of information technology. Today's business leaders, therefore, must have ready access to timely, accurate, and relevant information to manage effectively in the global economy.

MISM 3305 Information Resource Management

Examines how information technology is used to support the functional areas of business (finance, accounting, marketing, manufacturing, and human resource management) to achieve business results (creating new products and services, redesigning business operations, and altering relations with customers and suppliers to achieve competitive advantage). Offers students an opportunity to understand the business issues involved in investing in new technologies.

MISM 3403 Data Management in the Enterprise

Offers students an introduction to and overview of the methodological frameworks and tool sets for the design, development, and implementation of data-management solutions. Today, almost no aspect of business operates without a strong reliance on the flow of information. Even small enterprises track huge volumes of data, from sales transactions and supply chain activities to Web site traffic. Knowledge workers and managers at all levels within the organization require an understanding of data management, database design and operations, and associated decision-support and data-analysis tools and systems to complete even day-to-day tasks. Offers students an opportunity to work hands-on, applying these methods and tools to solve actual business problems.

MISM 3404 Data Communications

Introduces data communications concepts and terminology, network design and architecture, distributed information systems, and security within a business systems environment. The modern enterprise relies on being able to get information to where it is needed quickly, accurately, and securely. From the instantaneous global reach of the Internet, to mobile wireless devices, to multimedia communication, innovations in data communication have directly changed the way business is done today. Explores key emerging technologies such as Web services and Web 2.0, service-oriented architecture, wireless and mobile communication, and multimedia networking.

MKTG 3401 Marketing Research

Focuses on the marketing research process and the analysis of data using statistical software. Helps students develop an understanding of consumer attitudes and behavior processes as the basis of the design of marketing problems. Topics include problem definition, research design, sampling, attitude measurement, questionnaire design, data collection, and data analysis. Students are expected to work on group projects. The course requires no previous computer experience.

MKTG 3501 Marketing Analytics

Studies the importance of using an analytical approach to support marketing decision making in organizations and offers students an opportunity to learn how to implement such an approach in practice. Focuses on data science in marketing: identifying and acquiring the right data for addressing different marketing challenges, building skills necessary for conducting relevant quantitative analyses, and guiding how to use obtained insights to make better marketing decisions. Topics may include product innovation, market identification and segmentation, customer valuation, media attribution models, and assessment of digital and social media. Students are expected to apply statistical concepts and use relevant software packages for analyzing marketing datasets.

MKTG 4508 Digital Marketing

Examines the impact of technology on the marketing of goods and services. Focuses on the Internet and the World Wide Web. Investigates recent trends in e-business and identifies marketing strategies that work in this new environment. Introduces students to frameworks that help explain current issues in electronic marketing. Although the focus is on Internet marketing strategy, phenomena such as television home shopping and database marketing are also explored. Readings, cases, discussions, lectures, guest speakers, student reports, and exercises on the World Wide Web are all utilized.

MGSC 2301 Business Statistics

Offers students an opportunity to obtain the necessary skills to collect, summarize, analyze, and interpret business-related data. Covers descriptive statistics, sampling and sampling distributions, statistical inference, relationships between variables, formulating and testing hypotheses, and regression analysis in the context of business. Use of the SPSS statistical programming package is an integral part of the course.