ARTS-4960 - CRN 78693 - Inflatables
Igor Vamos
This class will study and create inflatable sculpture as public art. We will examine the history of inflatables, with special attention paid to how they have been part of political movements that imagine radical social futures, and how those contrast with the commercial applications that are common today. Throughout the class, we will explore, design and build inflated structures which may include video and sound elements.

ARTS-4961/6961 – CRN 78694 - Deep Listening and Creativity
Tomie Hahn
Prerequisite: any Arts 2000-level and above, or by permission of professor.
Imagine life from a bug's view. Does this vantage point, perhaps poised on a car antenna or leaf, encourage you to consider life and existence differently? This class explores what creativity is through practicing the art of shifting one's point of view. We will examine creativity through interdisciplinary works, and techniques and through practices rooted in the spirit of Deep Listening. Experiential exercises in class will provide opportunities to explore many perspectives and encourage discussion.

ARTS-6962 – CRN 78697 - Graduate Studio Critique
Robert Nideffer
Focus on studio production, method, and process. Students are expected to help foster an environment in which serious and sophisticated peer critique can take place.

ARTS-6963 (meets with ARTS-4080) – CRN 78698 - Art, Community and Technology
Branda Miller
Through direct experience in the community, this course explores the complex roles and relationships of art, education, and technology. Students will develop a plan to work with a media arts center, community organization, or school; final teams will produce real-world arts and education projects that ultimately will be realized as significant additions to their professional portfolio. The projects can include a range from traditional arts practice to creative writing, creative IT models, to community art and activism.

ARTS-6966 – CRN 78260 - Performance Technologies
Curtis Bahn
This graduate seminar will explore the potentials of performance technologies at Rensselaer. Through student, staff and faculty presentations relating to RPI facilities, personal research, creative applications of new technological tools, and artistic projects, we will share and workshop skills to develop new approaches to interactive performance,
audio engineering, electronics and new media. Open to all Graduate students. Upper level undergraduates doing thesis work may enroll with the permission of the instructor.

CHEM 2960 – CRN 78616 – Introduction to Forensic Chemistry: Picasso to PCBs
Forensic chemistry covers multiple aspects of the interaction of chemical science and the law. The use of chemistry, especially applied analytical chemistry and biochemistry, to support the solving of crimes, investigation of art fraud, finding the source of pollution in the environment, deception in the food industry, the role of DNA analysis in forensics, and more will be presented in a lecture/demonstration format. The course will focus on modern chemical methods for investigation and comparison of evidence, using real case studies and expert guest lecturers. The course is suitable for majors and non-majors. Prerequisite: CHEM-2250.

CIVL 6961-01 CRN 78797 Structural Reliability
Instructor, Franklin Lombardo, M R 8:30-9:50 AM
To provide a treatment of the application of probabilistic methods in civil engineering analysis and design; to develop concepts of reliability theory as applied to CE systems; to develop an understanding of the theoretical bases for modern probability-based limit states design codes including Load and Resistance Factor Design; to provide an introduction to related topics in system reliability, simulation, fragility analysis, and performance-based design. The emphasis of the course will be on structural engineering applications. Prerequisites: one course in probability and statistics (preferably with engineering applications)
3 credit hours.

CIVL 4962/6962 – CRN 78280/78281 – Design for Constructability
Instructor: Ryan McClure
Design of systems to consider foundations, structures and constructability; foundation alternatives; structural design to simplify erection; prefabrication, modulation of structures; material handling on a construction site; crane selection and placement; temporary works.
3 credit hours. Prerequisites: CIVL 2630 and CIVL 2670.
Monday/Thursday: 4:00-5:50 PM

COGS-4961/6962 – CRN 78499/78500 - Engr Human-Level Art Cogs Sys
Selmer Bringsjord
This course is designed to teach students methods for imbuing artificial agents and robots with genuinely cognitive abilities, by focusing on cognitive modeling and reasoning techniques designed for really smart agents. In particular, students will be introduced to a
set of hypothetical “WowBots”: \textit{R3Bot, MacGyverBot, BrilliantBoardroomBot, Go\textdaggerquote{del}Bot}, and so on. Students will learn the theory behind each of these bots and computationally model the analogical, deductive, and other types of reasoning required to make these bots real, drawing primarily on RAIR Lab research, resources, tools, and services. An exam and homework assignments will be assigned to ensure student understanding, but the course will largely be project-based.

**COGS 4962/6963 – CRN 77941/77942 - Learning & Adv Game AI**

Si

Digital game is one of the most fast developing fields. To make a game fun to play, the design of the game levels and/or the AI driven opponents needs to be intelligent and adaptive to the players’ strategies and skills. This course will cover basic and advanced topics in Artificial Intelligence and Learning. The course will also introduce psychological theories and studies about the players’ experience in games.

**COGS 4968 – CRN 78343 - Language Endowed Intelligents**

Nirenberg

This course will concentrate on the knowledge-based modeling of intelligent agents, with a special emphasis on semantically-oriented language processing. Theoretical and conceptual discussions will be balanced by practical work within the implemented OntoAgent cognitive architecture. A tutoring application in the domain of clinical medical will serve a springboard for discussing the modeling of decision-making, the various aspects of natural-language processing, and the art of knowledge engineering.

**COGS 6961 – CRN 75632 - Research Problems in Cognitive Science**

Selmer Bringsjord

This is a seminar-based course primarily for graduate students in Cognitive Science. Students learn about a wide variety of topics related to cognitive science through reading articles, attending lectures by guest speakers, and participating in group discussions. The specific topics that are covered vary widely from semester to semester. Students also participate in a roundtable discussion at the end of the semester in which they synthesize the material to identify new research opportunities.

**COGS 6964/PSYC 4966 – CRN 76776/76778 - Modern Economic Mechanics**

Yang

Current economics, such as neoclassical economics, are heavily rooted in classic Newtonian mechanics, successfully borrowing a great deal of modeling tools from it. Its models are mostly based on directly observable phenomenon. This course introduces a new approach that integrates cognitive science and economics by applying modern theoretical physics from modeling perspectives. The design of the course is self-contained, and no pre-required courses. Required textbook: Modern Principles of Economic Mechanics, Vol. I, by Yingrui Yang (available at RPI bookstore and Amazon.com.)

**COGS-6960 – CRN 78777 - Recent papers from "topiCS"**

Wayne Gray

This seminar will read and discuss papers from three recent issues of the journal, "Topics
in Cognitive Science.” For each of the three topics, we will start with the Topic Editors introduction and commentaries (if any). We will then proceed to sample papers from that topic.

A. Research on Mathematical Practice and Cognition (topiCS 2013, vol. 5, issue 2)
B. Computational Models of Natural Language (topiCS 2013, vol. 5, issue 3)
C. Utility Maximization and Bounds on Human Information Processing (topiCS 2014, vol. 6, issue 2)

COMM-4961 – CRN 78646 - Reality TV
June Deery
This course considers the sociopolitical and ethical dimensions of reality television, one of the most significant developments in recent popular culture. An analysis of a variety of reality formats allows students to understand the evolution, economics and, above all, the cultural and political significance of modern media. Topics include: the representation of gender, class, race, sexual orientation; celebrity; scandal; body identity; advertising and commercialization; audience interaction and multiplatform use; surveillance; nationalism; globalization; mediation and reality.

COMM 2960 – CRN 78868 – Media Futures
Rebecca Rouse
Media Futures invites students to explore the relationship between historical media forms, cutting-edge contemporary technologies, and imagined future technologies. Examples include Renaissance and Baroque illusions and automata, 17th century panoramas, Victorian theatrical ghost illusions, contemporary experimental cinema, mixed reality, and social media. Assignments include a video project, podcast interview, and comparative media research paper.

COMM-4963 – CRN 77951 - Intro to Game Production
Michael Lynch
This is a class about how real videogames get built at real game studios. We cannot hope to fully replicate this experience, but in this course you will be building a non-trivial video game, for an actual "client" who works at one of the area's videogame studios.

COMM-4964 – CRN 78658 - Internet Programming
Michael Lynch
This course introduces non-programmers to several of the core technologies of the WWW, including Hypertext Markup Language (HTML), Cascading Style Sheets (CS), the Document
Object Model, JavaScript and PHP. A top level presentation of the architecture will be presented along with a non-technical discussion of key internet protocols. Students will learn to use HTML and CSS to create a functioning web site, later adding JavaScript functionality. The PHP server environment will be briefly examined.

**COMM-4966 – CRN 77952 - Video Game Level Design**
Lee Sheldon  
Prerequisite: Introduction to Game Design  
Students will build levels for video games with middleware tools still to be determined (articy:draft and Game Maker or Play Maker). The end product of the class will be two complete, playable games: one by individual students, the other a class collaboration. They will learn all of the skills necessary to design levels of a game and create transitions between them, including constructing maps and terrain; identifying landmarks; and implementing story, puzzles, quests and events.

**COMM-4960/COMM-6961 – CRN 78779/78652 - Agile Prototype Development**
Roger Grice  
In this course, we will design and develop prototypes for interactive interfaces using agile methodology. We will gather and analyze user requirements and produce initial prototypes that respond to those requirements. Will develop and refine prototypes using iterative testing as a development tool. Classes will consist of sessions that discuss prototype development and agile development methods and classes in which we will implement and present prototype designs.

**CSCI-6964 - CRN 78763 - Open Problems in Graph Theory**
Mark Goldberg  
The objective of this course is to study the background of several open problems in Graph Theory. The sources of the problems are Web-accessible lists, such as "Open Problems - Graph Theory and Combinatorics" maintained by Douglas B. West (http://www.math.uiuc.edu/~west/openp/) and "Unsolved Problems" maintained by Stephen Locke (http://math.fau.edu/locke/Unsolved.htm). Every student will study a specific open problem, to be selected with the help of the instructor. Every student will give two presentations: short and long. The short one is expected to contain a formulation of the problem and its background. The long presentation is expected to contain an explanation of a (known) result towards the proof of the conjecture. Prerequisite: a course in Graph Theory.

**CSCI-4961 - CRN 77240 - Cognitive Modeling I**
Schoelles See PSYC-4510; COGS-4210/6965

**CSCI-4962/CSCI-6270 - CRN 75568/# - Computational Vision**
Charles Stewart
This course is an introduction to the field of computer vision from a computational perspective. We will study a wide variety of mathematical, statistical, algorithmic, machine learning and software techniques and how they apply to the problems of feature extraction, image registration and mosaic construction, 3D reconstruction (how the Kinect works), motion estimation, tracking, and various forms of object recognition. Requirements will be a mixture of homework assignments, programming projects and a final paper. It is possible that communication intensive credit can be obtained for this course. Prerequisites include CSCI 2300 and MATH 2100 or the equivalent.

CSCI-4963 - CRN 77241 - RCOS
David Goldschmidt & Mukkai Krishnamoorthy
This 0-credit non-graded course offering is an administrative means to obtaining a full roster of students participating in RCOS. RCOS (Rensselaer Center for Open Source) is an eclectic group of undergraduate students that embark on individual and team-based open source projects, primarily software, but also open hardware projects. Many new projects are introduced each semester, though many ongoing and higher-profile projects are undertaken, as well. Students are required to work on and contribute to open source projects, maintain a blog, and present to the group twice per semester. Students may earn 3 or 4 independent credit hours, a limited stipend, or do RCOS for the experience only. Prerequisites include CSCI-1200 and a 2000-level course in CSCI, ECSE, ITWS (or permission of the instructors).

CSCI-4964/6965 - CRN 77243/77268 - Approximation Algorithms
Elliot Anshelevich
Algorithms with provable guarantees on the quality of their solutions are a powerful way of dealing with intractable problems. This course is an advanced course in approximation algorithms; it will cover fundamental techniques for designing approximation algorithms as well as more specialized topics. Possible topics include: semi-definite and linear programming, inapproximability and the PCP theorem, iterated rounding, metrics and cuts, primal-dual methods, online algorithms, and the unique games conjecture. We will look at algorithms in a variety of settings; some of these may include social networks, graph partitioning, network design and routing, traveling salesman problems, and many applications in communication networks. Prerequisites: CSCI 2300, but CSCI 4020 or equivalent is highly recommended.

CSCI-4965/6962 - CRN 77293/77728 - Knowledge Discovery and Information Extraction
Heng Ji

CSCI-4966/6967 - CRN 78313/78772 - Foundations of Data Science
Petros Drineas
Modern scientific, engineering, and business applications are increasingly dependent on data, yet traditional data analysis technologies were not designed for the complexity of the modern world. Data Science has emerged as a new, exciting, and fast-paced discipline that explores novel statistical, algorithmic, and implementation challenges that emerge in processing, storing, and extracting knowledge from Big Data. In this course, we will cover foundational aspects of data science, building upon popular models of Big Data using matrices (and tensors) and graphs (and hypergraphs). Numerous matrix and graph algorithms have been developed to analyze such data, taking into account the time complexity and inherent structure of data matrices and graphs. We will discuss popular approaches for data analysis tasks such as dimensionality reduction, clustering, classification, as well as a number of exciting special topics such as streaming algorithms, recommendation systems, ranking algorithms, etc. The course will combine theoretical foundations with implementation and evaluation of data analysis algorithms on real data.

Prerequisites: CSCI 4020 or equivalent; basic probability theory; basic linear algebra; experience in MatLab programming or similar language (e.g., Python).

CSCI-4967/6963 - CRN 76816/77242 - Data and Society
Fran Berman
The ubiquitous availability of digital information has transformed the world as we know it. This has created a paradigm shift from information-poor to information-rich, and impacts virtually every part of society. This course is a data topics course that provides an overview of the ways in which society is leveraging and responding to social, organizational, policy, and technical opportunities and challenges of a digitally-enabled world. Course topics and readings will sample a broad spectrum of areas of a data-enabled society and are described below. The prerequisite is Data Science (CSCI/ERTH/ITWS 4350/6350) or permission from the instructor.

CSCI-4968 75569 MODERN BINARY EXPLOITATION
4 credits
prereq: CSCI-2500 or ECSE-2660 or permission of instructor
instructor: Yener

Cybersecurity is one of the fastest growing fields in computer science, though its study is rarely covered in academia due to its rapid pace of development and its technical specificity. Modern Binary Exploitation will focus on teaching practical offensive security skills in binary exploitation and reverse engineering. Through a combination of interactive lectures, hands on labs, and guest speakers from industry, the course will offer students a rare opportunity to explore some of the most technically involved and fascinating subjects in the rapidly evolving field of security.

The course will start off by covering basic x86 reverse engineering, vulnerability analysis, and classical forms of Linux-based userland binary exploitation. It will then transition into protections found on modern systems (Canaries, DEP, ASLR, RELRO, Fortify Source, etc)
and the techniques used to defeat them. Time permitting, the course will also cover other subjects in exploitation including kernel-land and Windows based exploitation.

CSCI-4975/6961 - CRN 78497/78498 - Engineering Human-Level Art Cognitive Systems
Selmer Bringsjord See COGS-4961/6962

CSCI-4976 - CRN 78598 - Web Science Systems Development
Richard Plotka See ITWS-4500

CSCI-4977/6971 - CRN 78667/78668 - Intelligent Virtual Agents
Mei Si See COGS-4640/6640

ECON-4961 – CRN 78638 - Econ of Financial Inst & Markets
Robert Jones
This course focuses on the economic analysis of non-money financial markets and of financial institutions that operate in those markets. Markets considered include bond, stock, and derivative markets, as well as asset securitization. The institutional focus is primarily on non-banks, and includes investment companies, insurance companies, and pension funds. The course investigates the rationale for and the economic consequences of financial markets and institutions.
Prerequisite: ECON 1200

77965 ECSE 4965/01 Applied Parallel Computing for Engineers

Instructor: W. Randolph Franklin
A computer engineering course. Engineering techniques for parallel processing. Providing the knowledge and hands-on experience in developing applications software for processors on inexpensive widely-available computers with massively parallel computing resources. Multithread shared memory programming with OpenMP on multicore Intel processors. NVIDIA GPU multicore programming with CUDA and Thrust, for general purpose parallel computing using linux.

This course is aimed at seniors and grad students who wish to obtain knowledge and hands-on experience in developing parallel applications software on affordable, widely
available, machines. This course will minimally overlap other RPI parallel programming courses, so that students can profitably take all.

NVIDIA GPUs are both inexpensive (useful gaming cards cost only a few hundred dollars), and ubiquitous (a majority of modern desktops and laptops have NVIDIA GPUs). Nevertheless, these techniques scale up -- number 2 on the top 500 list has 18,688 NVIDIA GPUs.

Effectively programming these processors also require in-depth knowledge about parallel programming principles, as well as the parallelism models, communication models, and resource limitations of these processors.

Students will learn tools such as OpenMP, CUDA, and Thrust via extensive programming work. Students do not need any special computer, since they can use ssh to remotely access the professor's machine with 128GB of memory, dual 8-core Xeons, and an Nvidia Tesla K20Xm compute processing unit with 2688 CUDA cores and Quadro K5000 GPU with 1536 cores.

Prereq: ECSE-2660 CANOS or equivalent, knowledge of C++.

**CRN 78818 ECSE-6961-01 Light Emitting Diodes.**

The topics to be covered in this course are: History of light-emitting diodes; Radiative and non-radiative recombination; Theory of radiative recombination; LED basics: Electrical properties; LED basics: Optical properties; Junction and carrier temperature; High internal efficiency LED designs; Design of current flow; High extraction efficiency structures; Reflectors; Packaging; Visible-spectrum LEDs; Ultraviolet LEDs; Spontaneous emission from resonant cavities; Resonant cavity light-emitting diodes; Human eye sensitivity and photometric qualities; Color vision and planckian sources; Color mixing and rendering; White-light sources based on LEDs; White light sources based on wavelength converters; Optical communication; Communication LEDs; LED modulation characteristics.

Taught by Prof. Huang

**ECSE 4962/6962 Radar Imaging**

Synthetic-aperture radar (SAR) is a form of radar used to create images of remote sensing applications and surfaces of both the Earth and other planets. The motion of the SAR
antenna over a target region provides finer spatial resolution than is possible with conventional beam-scanning radars.

A SAR image is created by transmitting successive pulses of radio waves and recording the received echo of each pulse. Signal processing of the recorded echoes combines the recordings from multiple locations of the moving antenna and forms the synthetic antenna aperture, allowing the creation of a high resolution image.

**Course Outline**

This course will cover the fundamental aspects of radar systems and radar signal processing, inverse scattering, synthetic aperture imaging concepts and synthetic aperture radar image formation algorithms. The course will survey a wide range of radar imaging concepts, and image formation methods:

**Prerequisites**

ESCE-2410 Signals and Systems or equivalent; ECSE 2100 Fields and Waves I; ESCE-2500 Engineering Probability or equivalent.

**Text**


**Instructor**

Prof. Birsen Yazici

CRN 78818 ECSE-6961-01 Light Emitting Diodes.

The topics to be covered in this course are: History of light-emitting diodes; Radiative and non-radiative recombination; Theory of radiative recombination; LED basics: Electrical properties; LED basics: Optical properties; Junction and carrier temperature; High internal efficiency LED designs; Design of current flow; High extraction efficiency structures; Reflectors; Packaging; Visible-spectrum LEDs; Ultraviolet LEDs; Spontaneous emission from resonant cavities; Resonant cavity light-emitting diodes; Human eye sensitivity and photometric qualities; Color vision and planckian sources; Color mixing and rendering; White-light sources based on LEDs; White light sources based on wavelength converters; Optical communication;
Communication LEDs; LED modulation characteristics.

Taught by Prof. Huang

ITWS-6961/ITWS 4960 – CRN 78760/78761 - Data and Society
The ubiquitous availability of digital information has transformed the world as we know it. This has created a paradigm shift from information-poor to information-rich, and impacts virtually every part of society. This course is a data topics course that provides an overview of the ways in which society is leveraging and responding to social, organizational, policy, and technical opportunities and challenges of a digitally-enabled world. Course topics and readings will sample a broad spectrum of areas of a data-enabled society and are described below. The prerequisite is Data Science (CSCI/ERTH/ITWS 4350/ 6350) or permission from the instructor.
Cross listed with CSCI 6963/CSCI 4967
3/4 c32 total students across all sections
Friday – 9:00 – 11:50
Instr. – Berman

ITWS-696X/ITWS 496X3 Data Analytics
Data and Information analytics extends analysis by using insight from analyses to recommend action or to guide and communicate decision-making. Thus, analytics is not so much concerned with individual analyses or analysis steps, but with an entire methodology. The world at-large is confronted with increasingly larger and complex sets of structured/unstructured information; from sensors, instruments, and generated by computer simulations; data is "hidden" in websites, application servers, social networks and on mobile devices. In commerce and industry, analytics-driven enterprises are becoming mainstream. Yet, there is a shortfall in the key education skills needed to meet the growing needs. Key topics include: statistical computing theory, multivariate
analysis, and application of computer science concepts such as data mining and machine learning and change detection by uncovering unexpected patterns in data.

3/4 credits
Instr. – Fox

ITWS-6963 – CRN 78244 - IT Software Development
This course teaches students about the roles and infrastructure of IT departments in modern organizations, IT software engineering technologies and methodologies for software development life cycle through hands-on experience.

3 credits
Instr. – Liu
100 total students across all sections
Tuesday/Friday – 12:00 – 13:20

ITWS 4961 – CRN 78764 - Parallel Programming
Techniques and methods for parallel programming: models of parallel machines and programs, efficiency and complexity of parallel algorithms. Paradigms of parallel programming and corresponding extensions to sequential programming languages. Overview of parallel languages and coordination languages and models; programming on networks of workstations. Basic parallel algorithms: elementary computation, matrix multiplication, sorting; sample scientific application.

Prerequisites/Corequisites: Prerequisites: CSCI 2300 and CSCI 2500.
Cross listed with CSCI 4320/6360 and ITWS 696X (also needs to be added as note)

4 credits
Instr. – Carothers
100 total students across all sections
Tuesday/Friday – 12:00 – 13:20

ITWS-6961 – CRN 78765 - Parallel Computing
A survey of fundamental issues in design of efficient programs for parallel computers. The topics discussed include models of parallel machines and programs, efficiency of parallel algorithms, programming styles for shared memory, message passing, data parallelism, and using MPI in scientific parallel programs. Parallel programming project required.

Prerequisites/Corequisites: Prerequisite: CSCI 4210 or equivalent.
Cross listed with CSCI 6360/4320 and ITWS 496X

3 credits
Instr. – Carothers

78319 – MANE-2960 (1 credit hour) Mechatronics Hardware and Software
A laboratory introduction to programming with MATLAB and Simulink with hardware implementation on Arduino. This course will cover the fundamental theory and
programming tools for common sensors and actuators: gyroscopes, accelerometers, rotary encoders, analog sensors, DC Motors, PWM and motor drivers. Includes the basic supporting theory: discretization, sampling, integration, differentiation and filtering. All the material covered is in a hands on, application specific and relevant way. Every concept has a real, observable effect on the actual system: students will be required to purchase a MinSeg - a Miniature Segway kit which will be used for the weekly labs. Weekly 1 hour lectures will introduce basic topics. Labs reinforce these topics and are performed at home with hardware kits. Each lab is designed to be 1-2 hours. MinSeg (www.minseg.com) kits contain all the hardware listed and required. A Windows computer is required with Matlab/Simulink.

78604 – MANE-2961 (2 credit hours) Art, Science, and Practice of Innovation

Students would learn: a) select “tools” for innovation, and how to choose the appropriate tool for an idea or problem b) systematic “process” for innovation to develop an innovative idea from concept to a minimum workable prototype using 3-D printing equipment c) iterate on fine tuning innovative idea, learning from each “iteration” using a ideate-build-learn cycle and d) quick overview of “Additive Manufacturing” or 3-D printing methods. At the end of the course, students would be ready to enroll in the 3rd course of MANE.Innovation Spine, which is to develop their prototype into a full fledged product or offering to have discussions with industry or investors. Students/mentors/RPI would own the Intellectual Property of the ideas.

Prerequisites: Sophomore, Junior, or Senior status.

78607 – MANE-4960 (3 credit hours)

Analysis and Design of Thermal-Fluid Systems

This course extends basic concepts of thermodynamics, fluid mechanics, and heat transfer to a wide variety of thermal and fluid system components such as heat exchangers, pumps,
fans, and piping networks. Design and analysis techniques including are developed for applications in refrigeration and air conditioning, air handling, and energy conversion systems.

Prerequisite: MANE-4010 Thermal and Fluids Engineering II.

78608 – MANE-4961 (3 credit hours) Introduction to Radiation Transport Methods

The broad goal of this course is to introduce students to basic methods that are used for simulating radiation transport processes, encountered in nuclear engineering. Radiation transport computation plays important roles in the design of new reactors, evaluation of radiation dose in medical physics, and the understanding of radiation interactions with materials. This introductory course will present the foundations of deterministic and Monte Carlo numerical methods that are widely used in the modeling and simulation of nuclear reactor design, radiation dosimetry, and radiation shielding. Some theoretical properties of the underlying transport and diffusion equations will also be developed, but only if they relate directly to computational methods. Emphasis will be placed on the three fundamental aspects of computation methods: (i) discretization methods for the transport and diffusion equations; (ii) iterative methods for solving the system of discretized equations; and (iii) Monte Carlo methods for solving general fixed-source and eigenvalue problems. A practical goal of the course is to provide students with a working knowledge of computational methods for deterministic and Monte Carlo simulations of 1-D transport problems. Students who wish to pursue this topic for more realistic (multidimensional) problems will receive the necessary background in this course.

78612 / 77266 – MANE-4962 / MANE-6961 (3 credit hours)

Bio-Fluid Mechanics

This course introduces the fundamental circulatory bio-fluid mechanics, blood rheology, and governing laws of physiological blood flows. The course involves theoretical and numerical modeling of simple study cases and research in clinical applications. The main topics will cover: fundamentals of fluid mechanics and physical principles of circulation; blood rheology -- properties of flowing blood; blood flow in vessels, veins, and coronary
arteries; microcirculation; models of biofluids; computational biofluid mechanics; and fluid in the lung.

Prerequisites: background of fundamental fluid dynamics and partial differential equations.

78613 – MANE-4963 (3 credit hours) Introduction to Computational Fluid Dynamics

This course will provide an understanding of the computational methods and analysis techniques used to solve problems in Fluid Dynamics. It will also provide real-world, hands-on experience in solving complex flow problems in Aerospace and Aeronautical Engineering. The course will progress along two parallel tracks. In one track, students will learn about computational methods, in particular, the finite volume method, used to solve fluid dynamics problems. They will write a finite volume code in a simple programming language (Python/Matlab), use it solve benchmark problems, and learn to analyze the stability and convergence their algorithms. In the second track, they will use an established computational fluid dynamics package to solve problems that are motivated by complex Aerospace and Aeronautical problems. Here they will learn the importance of representing geometry, meshing fluid volumes, and selecting important problem parameters like appropriate models for turbulence.

Prerequisites: MATH-2010 Multivariate Calculus and Matrix Algebra, MANE-4070 Aerodynamics I, and MATH 4800 Numerical Computing.

78683 – MANE-6960 (3 credit hours) Nano- to Macro-Scale Heat Conduction

The course focuses on physical understanding of heat conduction across all scales and particularly when sample dimensions approach the fundamental lengths-scales of the charge and energy carriers. The lectures emphasize the parallel treatments of photons, electrons, phonons, and molecules as energy carriers. Topics include energy levels, statistical behavior and internal energy, energy transport in the forms of waves and particles, scattering and heat generation processes, Boltzmann equation and derivation of classical laws, analytical solutions for heat conduction at macroscale, deviation from classical laws at nanoscale and their appropriate descriptions.
77524 – MANE-6963  (3 credit hours)  Multidisciplinary Design Optimization

Motivated by multidisciplinary design problems arising in aerospace applications, this course provides an introduction to the theory and algorithms underlying numerical optimization. Course topics include: first- and second-order optimality conditions for constrained and unconstrained problems; single-variable optimization and line searches; gradient-based optimization; methods for evaluating derivatives; gradient-free optimization methods; function fitting and regression; MDO architectures; optimization under uncertainty, and; partial-differential-equation-constrained optimization. Students are expected to have taken undergraduate courses in multi-variable calculus and linear algebra. In addition, problem sets require the use of Matlab, so students must be comfortable programming in this language.

Prerequisites: MATH-2010 Multivariate Calculus and Matrix Algebra, or equivalent; any introductory programming course.

78615 – MANE-6964  (3 credit hours)  Additive Manufacturing

Additive Manufacturing technologies are a direct result of the layer-based, additive material build processes developed since the early 1980s. As compared to traditional prototyping and manufacturing methods and approaches, these technologies allow designers, engineers, manufacturers, architects, artists and other professionals in a variety of industries to quickly produce part and assembly prototypes, net-shape and near-net-shape production parts, tooling, master patterns, and workholding devices based on CAD models or reverse-engineered artifacts. The purpose of this course is to teach you about these technologies, some of the science and engineering behind them, and how they can be used in practice through a series of lectures, hands-on activities (both individual and group-based), equipment demonstrations, and facility tours.
MGMT 6964/01 CRN 78846  FIXED INCOME

This course develops the concepts and tools that will provide a deep understanding of the forces driving the valuation, risk and return of fixed income securities. Fixed income securities were once associated with securities having deterministic streams of "fixed" income payments, such as coupons on US Treasury debt. However, nowadays most fixed income instruments have income streams that are, in fact, random and which depend on the level of interest rates and/or the health of the underlying assets or the economy. The study of the world of fixed-income securities now includes such instruments as floaters, inverse floaters, forwards, futures, options, caps/floors, callable bonds, interest rate swaps, credit default swaps, pass throughs, collateralized debt obligations, mortgage-backed securities and treasury inflation protected securities. The size and importance of these markets makes the pricing, hedging and overall risk management of fixed-income securities and their derivatives invaluable to traders, risk managers, regulators or anyone interested in the functioning of the modern financial system.

The course will introduce students to a set of analytical tools and real-world examples to highlight the valuation, the risks and the management of fixed income securities. After taking the course, you will be empowered with the most important tools necessary to tackle the proper analysis of a wide class of fixed income securities, assess their risk and to value them.

MATH-6790 – CRN 78543 - Geometric Methods for Data Processing

Course Description
Processing and analyzing data in 3D and higher are crucial topics in many fields such as computer vision, 3D modeling, medical image analysis etc. Topics of this course includes fundamental concepts of differential manifolds, computation of basic geometric quantities, numerical methods for solving PDEs on Riemannian manifolds and applications to data analysis.

Prerequisites: Multivariable calculus, Numerical linear algebra, Numerical differential equations.
Credit Hours: 4
Course Time: Spring 2015, Monday & Thursday, 10:00 - 11:50 AM
Instructor: Rongjie Lai
MATH-6490 – CRN 78542 – Stochastic Differential Equations for Physics and Microbiology

Course Description
We will introduce and study mathematical frameworks for analyzing complex systems in physics and microbiology where some interactions are modeled statistically. Techniques from stochastic differential equations and other stochastic process theory will be developed and illustrated in applications such as molecular dynamics, intracellular transport, swimming microorganisms, and neuroscience.

Prerequisites: Familiarity with probability theory and differential equations at an undergraduate level.

Credit Hours: 4
Course Time: Spring 2015, Tuesday and Friday, 2:00 - 3:50 PM
Instructor: Peter Kramer

MATH-6590 – CRN 78541 - Introduction to Mathematical Physics

Course Description
The goal will be to provide mathematics students with a background in physics from a mathematician's perspective. The course will explain classical mechanics, electromagnetic theory, and quantum mechanics. Mathematical topics may include the spectral theory of unbounded self-adjoint operators, hyperbolic systems of equations, and the theory of group representations.

Prerequisites: MATH-2010, MATH-2400, MATH-411 and basic analysis.

Credit Hours: 4
Course Time: Spring 2015, Tuesday and Friday, 10:00 - 11:50 AM
Instructor: David Isaacson
Friday – 9:00 – 11:50

MTLE 4962-01 CRN 78618 MATERIALS & SUSTAINABILITY

This course is an introduction to the economic, environmental and social impact (i.e. sustainability) of materials. Topics will focus on materials used in renewable energy technologies and the built environment with emphasis on potential climate change impact.

Material sustainability metrics will be introduced to students through life cycle analysis (LCA) software and other evaluation tools in a project-based format. The course will also touch on sustainable development of new materials for the applications above.

Prerequisites: ENGR1600 or ENGR2530.
MTLE 6961; MGMT 4966/6975  CRN 78317; 78593/78594  Energy, Environment and Economy

3 credit graduate course cross-listed with MGMT and MTLE.

The main energy sources, including fossil fuels, nuclear energy and renewable energy sources will be reviewed. The underlying science and technology of renewable energy solutions will be presented in the context of their advantages and limitations with respect to technological, social, environmental and economic considerations. Interdisciplinary teams of students will develop multifaceted analysis of a specific energy issue addressing needs of a potential customer, such as industry, service entity or local and state governments. The team research and activities will lead to a report and a proposal on further development of their ideas.

PHIL-2962 – CRN 78253 - Anarchism: Ethical Society
Bill Puka

We examine our psychology of submission to illegitimate authority, its dehumanizing effects, and the prospect for greater individual and social self-determination— in practice as well as theory. Posing anarchism as radical democracy allows its themes to be further explored in "Democracy: Outlook & Life-Way. Anarchism is the quaint notion that people shouldn’t be pushed around. Nor should they be plugged into a Matrix of compliance by authoritarian socialization and political indoctrination.

Bill Puka

A readings-seminar course designed to extract “living wisdom” from the “wisdom literature.” Greater emphasis will be placed on finding a “spiritual” path to purposeful living than on deities or their worship. The transcending worth of faith-in-ideals will be contrasted with supernatural beliefs. Key concepts such as overcoming ego, taking ultimate perspectives on life, striving for unconditional love, compassion and appreciation will be highlighted along with meaning in life concerns and peace of mind. The main teachings the Abrahamic religions (Judeo-Christianity and Islam) will be contrasted with the core teachings of Hindu-buddhism and Taoism. The level of evil and injustice promulgated by scriptural writers will contrasted with the unwittingly elevated secular humanism that peeked through in scripture, alongside a potential for religious democracy, not cosmic autocracy, mined by some sects.
Where usually genes alone have been the initial focus of human evolution, cognition and culture, we will be start with considerations of bodily form and activity and expanded evolutionary theory perspectives. The topics we cover will include primates, hunter-gathers, theories of groups, cultural evolution, modern societies, and speculations about the uptake and consequences of modern technologies, especially how they may intersect with face-to-face social life, which has been constrained by time and space throughout human evolution. Prerequisites: Biology 1010 or equivalent or PHIL 2400 Philosophy of Biology or permission of the instructor.

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Human higher order mental processes involve a number of cognitive capacities, such as reasoning, decision making, and game theoretic interactions. Traditionally, each of these capacities is studied independently. This course provides an integrated approach from formal as well as empirical perspectives, and it introduces a set of new modeling methods, such as fiber bundle method and gauge theoretic modeling. The design of the course is self-contained, and no pre-required courses.

Positive psychology calls for as much focus on strength as on weakness, as much interest in building the best things in life as in repairing the worst, and as much attention to fulfilling the lives of healthy people as to healing the wounds of the distressed. The concern of psychology with human problems is understandable. It will not and should not be abandoned. Positive psychologists are “merely” saying that the psychology of the past sixty years is incomplete. But as simple as this proposal sounds, it demands a sea change in perspective. Psychologists interested in promoting human potential need to start with different assumptions and to pose different questions from their peers who assume a disease model. This course will concern itself with the basics of positive psychology.

The success if digital games has inspired an entire industry focused on using explicit rewards to motivate people. The trend towards accountability in education and elsewhere is built on the assumption that explicit rewards control behavior. This course provides a
rigorous examination of the use of explicit external rewards and the consequences neglect of intrinsic rewards in real world situations.

**PSYC-4962 – CRN 78778 - Educational & Therapeutic Computer Games**  
Larry Reid  
The course is a seminar designed to introduce the cognitive and psychological science germane to computer-assisted game-like programs for improving education and psychotherapy. Much of the background for computer-assisted game-like programs is associated with what has been called the brain plasticity movement; consequently that will be a topic for the course. Students will choose a problem to be solved and think about how to design a computer-assisted game-like program to solve the problem. Viable designs might even be instituted by way of teams of students.

**STSH/S-2960 – CRN 78739 - Science Fiction & Social Criticism**  
Langdon Winner  
This course explores significant strands of modern social theory and criticism as reflected in science fiction films from the 1920s to the present. A good amount of reading and writing is required along with focused discussion about central themes in the movies.

**STSH 2961 (Meets with STSS 2300) – CRN 78781 - Environment and Society**  
Costelloe-Kuehn  
Prerequisite: STSH 1110/STSS 1110 or permission of instructor.  
Society and the natural environment are crucially linked in a number of ways. Environmental problems such as pollution and natural resource depletion are not only problems for society, affecting the way we live our lives; they are also problems of society—the result of patterns of social organization and social practices. In this course, we will explore these society/environment interactions at various levels, from the local to the global, using the concepts and insights of environmental sociology. Environmental sociologists aim to understand the social origins of environmental problems and propose workable solutions to them. By showing how social interaction, institutions, and beliefs shape human behavior, environmental sociology provides a useful complement to the natural sciences in the analysis of the environmental problems faced today.

**STSS-4960 – CRN 78743 - STS Research Methods (Survey)**  
Michael Mascarenhas  
This course is designed to introduce students to research methods used in the human and social sciences. The course will advance a framework, a process, and compositional approaches to help students become proficient in research design, practice, and writing. The course will examine three sociological methods: quantitative, qualitative, and mixed methods. The course will also examine selected ethical and political issues associated with the role of research methods in the production of knowledge and expertise.

**STSS-4961/6961 (Meets with PHIL-4962) – CRN 78745/78746 - Evolution, Cognition, Culture**  
Linnda Caporael  
Prerequisites: Biology 1010 or equivalent or PHIL 2400 Philosophy of Biology or
permission of the instructor.
What does evolutionary theory add to our understanding of human behavior, cognition, organization, and society? This course presents new perspectives in the philosophy of biology, particularly as they relate to humans, levels of selection, epigenetics and cultural evolutionary theories. The course will focus on new directions of expanded evolutionary theory as applied to humans as well as the relationship between biology and society.

**STSS 4962 (Meets with ECON 4250) – CRN 78200 - Economics, Tech & Sustainability**
Faye Duchin
Prerequisites: ECON 1200 or permission of instructor.
This course explores the relationships between the economy and the material world. It identifies the most critical challenges to sustainable economic development on local to global scales and ways of addressing them. The course examines options surrounding material and energy flows, technological alternatives, livelihoods, consumption behavior, public policy, civil society institutions and social movements as avenues for meeting the major challenges to sustainability.

**STSS-4963/6967 – CRN 78748/78756 - Sciences of Sustainability**
Mike Fortun
How did scientists come to understand the earth as a planetary system -- perhaps even a living one? This course explores how the contemporary sciences of sustainability --ecology, agronomy, biogeochemistry, climatology, epidemiology, and related sciences – developed new concepts, technological infrastructures, and national and international institutions aimed at understanding the earth as a whole – and its limits. Topics may include the Gaia hypothesis; post-WWII ecological sciences; the emergence of environmentalism; the growth and decay of public health institutions; ideas of complexity and self-organization; and agriculture and biotechnology. Students will develop their own research projects describing the history or contemporary state of a particular science of sustainability.

**STSS-4964 – CRN 78749 - Sustainability Careers**
Costelloe-Kuehn
Advancing environmental sustainability will depend on many kinds of expertise. In this course, students will explore the evolving terrain of green jobs, and diverse sustainability-oriented career pathways they could pursue that leverage the expertise they have developed through their undergraduate studies. This course provide students the opportunity to conduct sustained research that examines where sustainability-oriented work is being done, and how people with varied expertise are making a contribution.

**STSS 6960 (Meets with STSS-4370) – CRN 78750 - Environment Politics and Policy**
Steve Breyman
A highly interactive introduction to environmental politics and policy in the United States.
Major themes include the background and context of environmental politics and policy, the policy-making process, environmental issues selected and reported on by students, the varieties of environmentalism, and environmental ethics.

**STSS-6962 – CRN 78752 - Postcolonial STS**
Michael Mascarenhas
During the last decade there have been several calls to integrate postcolonial perspectives in STS. One the one hand, some scholars argue that postcolonial theory and insight have failed to explicitly explain the transactions, translations, and transformations of science and technology as they travel over the uneven terrain that colonialism as worked. On the other hand, other scholars have suggested that Western epistemologies do not have the resources to enable them to recognize their own location in the *postcolonial condition*, and argue for a politics and epistemology of location, position, and situation, where partiality and feminist standpoints, and not universality, is the pre-condition for knowledge making. This course will examine postcolonial science studies in creative, conceptual evocative, and empirical grounded ways.

**STSS-6963 – CRN 78753 - Contemporary Issues**
Ned Woodhouse
Designed to help PhD students think conceptually about potential reconstruction of social processes shaping technoscience and its utilization. Topics will depend partly on student interests, but probably will include weaponry, the built environment, consumerism, workplace automation, toxics, the biomedical juggernaut, 3D printing, and artificial intelligence. The main writing assignment will be a rough draft of a potentially publishable article. Fulfills the requirement for the Policy Seminar.

**STSS-6964 – CRN 78754 - History & Ethnography**
Nancy Campbell
“History and Ethnography” (STSS 6961) is a graduate theory and methods seminar that outfits students to undertake original empirical and interpretive work in the interdisciplinary field of Science and Technology Studies (STS). It is geared to graduate students who want to combine historical and ethnographic approaches in their understanding of the cultures of science, medicine, and technology. There are substantial fieldwork and archival components to the course.

**STSS-6966 – CRN 78755 - Professional Development Seminar**
Caporael
The STS Proseminar course works with students in their development of professional practices, methods and activities in Science and Technology Studies. Topics are structured for students just beginning their STS studies, and progressing through their program including their dissertations, and their job search, and may cover library research, choosing
digital tools, writing for journals, conferences, and grants; and overviews of research methods and epistemologies.

6971 Professional Development Workshop-MS

The Professional Development Workshop-MS is designed to develop the professional skills that are needed to be a successful contributor in a business setting for students in each of Lally’s five Masters of Science programs. The PDW will follow a framework of Leadership, Followership and Membership in a professional community. Workshop sessions will be conducted by either the instructor or by the Assistant Director of the Lally School’s Office of Graduate Career Services and Professional Development. Guest speakers as well as Program-specific activities are included to ensure students are receiving not only a common set of material across all of the Masters’ programs but also exposure to professional development experiences that may be unique to specific career paths and industry environments determined by the specific MS program in which the student is enrolled.