UC San Diego
JACOBS SCHOOL OF ENGINEERING
Electrical and Computer Engineering

NEW 2017-18 Courses

Undergraduate courses:

- ECE 180: Programming for Data Analysis
  - A hands-on course designed to teach students Python and its usage in Data Science applications. Topics include:
    - Understand Python object-oriented and functional programming styles
    - Learn key scientific computing packages
    - Apply key Python data structures and algorithms effectively
    - Enhance productivity with Python development workflows
    - Develop deployable codes using modern package management and source control
  - Prerequisite: ECE 15

- ECE 188: LabVIEW Programming: Design and Applications
  - An interactive LabVIEW programming course designed to teach students how to design and develop LabVIEW applications. The course will prepare students for the NI Certified LabVIEW Associate Developer (CLAD) exam as well as provide hands-on engineering through team oriented LabVIEW projects!
  - Prerequisite: ECE 15

- ECE 188: Software Systems

Graduate courses on Machine Learning and Data Science:

- ECE 289: Special Topics in ECE: Big Network Data
  - People, societies, biological micro-organisms and man-made devices connect to each other and form all kinds of complex networks. Thanks to technological advancements, an ocean of data has become available describing these connections. How do we analyze these "Big Network Data" and construct relevant engineering models?
  - Network science is a new discipline that addresses this question, investigating the topology and dynamics of complex networks arising from massive data collection, and aims at explaining and predicting the emerging trends and features of real systems. These systems are modeled as a statistical ensemble of interacting components, capable of exhibiting emerging complexity as a network property.

  - The course focuses on both rigorous foundations as well as on getting practical hands-on experience in analyzing real-world network data leading to learning and prediction in a variety of domains, including social, economic, medical, and engineering domains.
  - Specific topics include network structure (percolation graphs, paths, diameter, chemical distance, small worlds); processes on network (interacting particle systems, community detection, segregation, contagion), statistical methods: (sampling, bayesian inference, learning, and intervention); constrained optimization (network formation and evolution).

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- ECE 289: Special Topics in ECE: Optimization and Acceleration of Deep Learning on Various Hardware Platforms
  - This course focuses on a holistic end-to-end methodology for optimizing the physical performance metrics of Deep Learning on hardware platforms, e.g., real-time performance, energy, memory, and power. The hardware platforms include CPU-CPU, CPU-GPU, and CPU-FPGA architectures. We start by discussing the hardware characteristics and the effect of the architecture on the DL performance. We will cover platform-specific algorithm and data transformation that contribute to significant improvement in deep learning performance.

- ECE 289: Special Topics in ECE: Parallel Processing in Data Science.

Graduate courses on ISRC:

- ECE 276A: Sensing & Estimation in Robotics.
  - This course covers the mathematical fundamentals of Bayesian filtering and their application to sensing and estimation in mobile robotics. Topics include maximum likelihood estimation (MLE), expectation maximization (EM), Gaussian and particle filters, simultaneous

- localization and mapping (SLAM), visual features and optical flow, and hidden Markov models (HMM).
- Prerequisites: equivalent of ECE101, 153, 171, 174

- ECE 276B: Planning & Learning in Robotics.
  - This course covers optimal control and reinforcement learning fundamentals and their application to planning and decision making in mobile robotics. Topics include Markov decision processes (MDP), Pontryagin's Maximum Principle, linear quadratic regulation (LQR), deterministic planning (A^* and RRT^*), value and policy iteration, Q-learning, and policy gradient methods
  - Prerequisite: ECE276A

- ECE 276C: Advances in Robotics Manipulation.
  - Robot Manipulation involves the use of robot effectors (like arms, trunks, hands, etc.) to operate in real environments. It ranges from low-level control (such as how a robot should move its joints to move its gripper towards an object), to high-level decision making (such as whether the robot should make the move in the first place). Many useful algorithms that have been developed in the areas of control theory, artificial intelligence, and now machine learning are being used in unison to achieve tasks. This class is set up in a way to explore reinforcement learning as a means to solve challenging robot manipulation problems. Part 1 will cover topics pertinent to robot manipulation and will rapidly focus on examining new algorithms for achieving more complex robot motions and behaviors. Part 2 will involve a substantial project component involving developing a new machine learning algorithm to solve some open challenges in robot manipulation.
  - Prerequisite: ECE 276A

Graduate courses on Signal and Image Processing:

- ECE 207: Computational Evolutionary Biology
  - Syllabus: A hands-on course where students learn to apply a set of computational techniques to a real biological question, namely evolutionary biology (e.g., the study of tree-of-life). The course involves building biological tools in assignments and projects and we focus on scalability to big genomic data. Techniques taught include dynamic programming, continuous time Markov models, hidden Markov models, statistical inference of phylogenies, sequence alignment, uncertainty (e.g., bootstrapping), heterogeneity (e.g., phylogenetic mixture models). Programming skills required.

- ECE 285: Special Topic in SIP/ISRC: Video and Image Restoration
  - Introduction to inverse problems in image/video restoration contexts: denoising, deblurring, super-resolution, tomography, compressed sensing. Fundamentals of linear/local filtering: maximum likelihood, spatial averaging, heat equation, low-pass and Wiener filtering. Basic of non-linear filtering: signal adaptation, maximum a posteriori, wavelets and sparsity, non-locality, patches. Towards advanced filtering: dictionary learning, convex and non-convex optimization, parameter selection.

- ECE 285: Special Topic in SIP/ISRC: Fundamentals of Image and Video Compression
    - This course provides theoretical background to image and video compression. Topics cover basic coding tools such as entropy coding, transform and quantisation as well as advanced coding methods: motion estimation and compensation, error resilient coding and scalable coding. Also students will learn how these coding tools are related with the popular image and video compression like JPEG, JPEG2000, SPIHT and HEVC.

- ECE 285: Special Topic in SIP/ISRC: Real-time Image and Video Compression
    - This course introduces image and video coding methods for real-time processing. Topics cover parallel image compression on GPU, integer transform and quantisation, fast motion estimation, fast prediction, multiplication-free arithmetic coding. Especially, students will learn practical GPU programming for parallel compression on the real GPU system.
    - Prerequisite: Matlab and C/C++ programming skill, ECE285 (Fall quarter).

Graduate courses on Computer Engineering:

- ECE 268: Security of Hardware Embedded System
    - The course gives an overview of areas of security and protection of modern hardware, embedded systems, and IoTs. Covers essential cryptographic methodologies and blocks required for building a secure system. Topics include low overhead security, physical and side-channel attacks, physical security primitives, physical security and proofs of presence, hardware-based secure program execution, scalable implementation of secure functions, emerging technologies, and rising threats. Recommended preparation: Programming in a standard programming language. Undergraduate level knowledge of the IC design flow and digital designs.

Graduate courses on Mathematics for MS Comp Exam:

- ECE 278: Math Topics for MS Comp Exam