EC602 – Design by Software
Professor Jeffrey Carruthers

Meeting Times:
    A1 Tuesday, Thursday 8:00-10:00am
    A2 Tuesday, Thursday 4:00-6:00pm

Location: PHO-117

Course Description:

Software plays a central role in all aspects of electrical and computer engineering. This course will provide the foundation for effectively using software as a key part of a career as a professional electrical or computer engineer. Fundamentals of software development systems: system languages, high-level object-oriented languages, and computational languages. Data structures and algorithms in problem analysis and design. Strategies for designing software and designing with software. Software design and development: methodologies, principles and practice. Formalizing software: management, requirements, specifications, testing. Survey of software applications in ECE, including real-time systems, the web, networked systems, audio, graphics, and video systems, research and engineering analysis, consumer electronics and computing, instrumentation and measurement, design, modeling, prototyping, simulation, optimization and information analysis. Students can choose projects and assignments with application to/inspired by/drawn from a broad array of ECE fields including the traditional areas of electro-physics/photonics, computer engineering, and information and data science. Prerequisite: graduate standing or permission of instructor.

Course Goals:

The goal of the course is to provide a unified entry-level introduction to software for graduate students in electrical and computer engineering. This course will serve, together with EC 601 Product Design in ECE, to give new graduate students solid preparation for the rest of their studies and for careers in ECE.

The course will ensure that students are prepared to effectively employ software solutions in further graduate study.

Course Outcomes:

As an outcome of completing this course, students will:

1. Gain proficiency in object-oriented programming.
2. Gain proficiency in scientific computing language.
3. Gain proficiency in a scripting and prototyping language.
4. Learn how to choose appropriate hardware, software, and computer tools suitable for the problem.

5. Gain an understanding of the various functions and purposes of software in ECE products and processes.
6. Gain a deeper understanding of and fluency with key software tools in a career as a professional electrical or computer engineer.
7. Develop and improve their problem solving strategies.
8. Understand software development methods and how to select appropriate methods and tools for particular problems.
9. Learn when to use software in ECE designs
10. Learn about the wide array of software applications in ECE fields.

Course Topics:

The course will mix topics from three thread areas (A, B, and C) each week with the focus on problem solving and practice. This will allow the formal material from B (software design) to be learned in a real context C (applications) with particular tools and methods from A (fundamentals).

A. Fundamentals

   Computational programming using Python/Scipy and Matlab
   Object oriented programming using C++
   System programming in C
   Data structures, algorithms, and complexity.
   Problem solving strategies for designing software and designing with software

B. Software Design

   Formalizing software: management, requirements, specifications, testing
   Introduction to and evaluation of software development methodologies (waterfall, agile)
   Software development environments and tools

C. Applications

   Web and cloud computing, distributed systems
   Signal processing: audio, graphics, and video systems
   Research and engineering analysis
   Consumer electronics and computing
   Real-time systems and control
   Instrumentation and measurement
   Networking and communications
   Prototyping, modeling, simulation, analysis, optimization