Tentative Syllabus
Object-Oriented Programming for Interactive Systems
or
Computing for Engineers

ME EN Special Topics 5960/6960-017

Course Instructor: Dr. David E. Johnson
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Office: WEB 2875, x5-1726

Meeting Time: MWF 9:40-10:30
Classroom: WEB L112

Textbook: TBA

Course Description: Many modern engineering systems incorporate computational elements, while other engineering systems needed to be validated through computational tools or through computer-aided data collection. This course is designed to provide a foundation in programming, software engineering, debugging, and using existing computational codes in the context of controlling physical equipment, gathering experimental data, and visualizing results. The course will be taught using the C++ programming language, which provides balance between access to physical devices and modern programming concepts. The course provides a level of programming proficiency to students planning on taking additional coursework with a programming emphasis or who might need custom computational applications in their research.

The course will use a mixture of short experimentation assignments (such as determining the result of certain programming constructs) and task-oriented programming assignments that demonstrate commonly used tools.

This is a combined 5xxx-6xxx level course. Students taking the 6xxx section will have small add-ons to homeworks and tests.

Proposed Schedule

Basic Programming
Week 1
- Compiled languages/Imperative programming/Linear flow
- Variables – typing
- Control Flow – looping/conditionals
  - Language Constructs Assignment

Week 2
- Functions
- Multiple files, header files
- Debugging
  - Debugging a problem Assignment

Object-Oriented programming
Week 3
- Classes
- Constructors
- Methods
    - Writing a vector class Assignment

Communications
Week 4
- Basic I/O
- Serial device I/O
- TCP/IP communication
    - Controlling a robot arm over serial port Assignment

GUI Toolkits
Week 5
- Event-based programming
- Qt basics
- GUI layout
    - Adding a GUI to robot control Assignment

Template programming
Week 6
- Basics of template programming/Using the STL for dynamic arrays
- Advanced STL structures
- Boost library
    - Using STL Assignment

Image Processing
Week 7
- Introduction to openCV image processing library
- Programming as a pipe/filter paradigm/Basic image tools
- Capturing images from a camera
    - Object Tracking Assignment

Inheritance
Week 8
- Inheritance
- Virtual functions
- Multiple inheritance
    - Inheritance Assignment

Simulation
Week 9
- Intro to 3D graphics
- Microsoft Robotics Studio or Open Dynamics Engine

Collision Detection basics
Simulation Assignment

Week 10
Simulation basics
More on 3D graphics
Generating quality images/videos
Graphics Assignment

Visualization
Week 11
Intro to VTK
Scalar fields
Isosurfacing
Visualization Assignment

Parallel Programming
Week 12
Threading
Data safety in threads
Threading architectures – vis loop, sim loop
Threading Assignment

Scripting Languages
Week 13
Python basics
Python class model
Using Python with other packages
Python Assignment