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
Instructor Webpage: www.cs.utah.edu/~dejohnso
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