MEEM 4990/5990: Getting Data in the Lab

Course Syllabus

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Summary

This course is designed to help you understand data acquisition and instrument control, especially in the context of experimental, laboratory environments. The course will also introduce LabVIEW, a programming language commonly used in industry, academia and government laboratories for running laboratory experiments and industrial processes.

Class format, meeting time, etc.

The class meets Tuesday and Thursday at 8:00 in MEEM 406. Class will be a mixture of lecture and laboratory time, where the laboratory time will provide students an opportunity to work with software and hardware with the instructor and with other students. Students are encouraged to bring a laptop computer with LabVIEW installed (see "Materials") to every class period.

My office is MEEM 210. Office hours will Tuesday and Thursday from 9:30 – 11:00.

4990 vs. 5990

All students registered this semester are graduate students. If you registered for the 4990 section, we will move you to the 5990 section.

Software and Materials (Homework for the first day)

Each student should have access to a computer with National Instruments LabVIEW installed. In the worst case, this computer will be a computer laboratory machine. Ideally, students can bring their own laptop to class. Students may install the LabVIEW on their machines by going to

http://downloads.it.mtu.edu

Please install, at a minimum, the following components: LabVIEW, NI-DAQ and NI-VISA.

Students may also wish to use machines in research laboratories either instead of, or in addition to their personal machines. LabVIEW runs on Windows, Mac, and Linux. The instructor will be using a Windows version, but students are free to use any version they see fit. That said, LabVIEW for Windows is the most feature-full version, particularly when it comes to support for hardware. With apologies to Obi-wan Kenobi, "If you choose to face LabVIEW for Linux, you will do it alone. I cannot interfere."

Additionally, students will need to install the git revision control software on their machines. This is a free, open source RCS which can be downloaded from

https://git-scm.com/downloads

and downloading the version appropriate to your machine. Additionally, you will need to create an account at www.github.com. Preferably, use the same username as your MTU username, but this is not required. Once your account is created, please send me an e-mail with your full name and your github account username.

The course requires a National Instruments myDAQ available at www.studica.com (currently $179). Alternative National Instruments multifunction DAQ devices may be acceptable with approval from the instructor (and the owner of the device!). The devices will not be used until the fifth week of the class to allow time for the devices to be ordered.

In addition to the myDAQ, students may find it necessary to acquire other materials for their projects such as transducers, etc. It is expected that these materials will be available in the students through their project advisor's laboratory as the projects are expected to support the laboratory research.

Assignments and grading

Grades will be assigned on the following basis:

- Homework: 10%
- Biweekly quizzes: 30%
- Interim project: 20%
- Final project: 40%

Homework will typically consist of programming assignments in LabVIEW designed to exercise the material covered in the lectures. Homework will be due biweekly and will be graded for completeness only. You are free to work in groups to complete the assignments. *However, you are required to do your own work and turn in your own assignment.* Unless otherwise noted, assignments shall be due by the beginning of class (8:00 am) on the due date. For electronically submitted assignments, timeliness will be judged by the timestamp of the submission. Paper assignments will be collected in-class. No late assignments will be accepted.

Quizzes will be given in class, typically every other Thursday. Upcoming quizzes will be announced in the preceding class. They will primarily cover material from the preceding two weeks, but anything from the class to that point may be covered. For each student, the single lowest-scoring quiz will be dropped when tabulating the final grade. If you are going to miss a class, please make notify me at least one week in advance and I will *try* to accommodate you.

The interim project and final project will be larger assignments designed to exercise the skills taught in class. The projects will be designed by the student following certain guidelines and should complement the graduate student's research or laboratory work.

Outline (subject to minor changes)

1. Introduction and Best Practices
2. LabVIEW I

2.1. Introduction
2.2. Case statements and loops
2.3. Charts and Graphs
2.4. Modular Programming, SubVIs, Unit Test
2.5. Error Handling
2.6. Saving Data 1
2.7. Saving Data 2, and Logging Data

3. Data Acquisition
   3.1. Intro, Transducers, Actuators, DAQ types
   3.2. Signal conditioning, ADC parameters, Nyquist, Antitalias filters
   3.3. Choosing DAQ Hardware
   3.4. Wiring, Grounding, Noise, Argh!
   3.5. The process
   3.6. Analog Input 1
   3.7. Analog Input 2, Triggering and External Clocking
   3.8. Analog Output
   3.9. Digital I/O
   3.10. Counter Timers, Encoders, using complex timing.
4. LabVIEW II
   4.1. Analysis
   4.2. Design Patterns
   4.3. Design Patterns 2
   4.4. Calling External Software
5. Instrument Control
   5.1. Choosing Instruments
   5.2. Protocols, Drivers, Standards, IDN, CAN
   5.3. Message-based protocols.
   5.4. Synchronizing Instruments and DAQ