# Advanced Topics in Human Cognition: Matlab Programming for Behavioral Scientists

## Syllabus Spring 2015

### Instructor

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### Course Information

Course number: 01:830:402
Class time and location: Course will meet once a week. Wednesdays 8:40-11:40am
Credit  hours: 3
Prerequisite:  Psychology major

## Course Description

**What is Matlab?**
Matlab is a high-level programming language and mathematical software package for solving quantitative problems often encountered in experimental psychology.  Matlab  supports both the development of programs using basic program constructs, and functions that can be added  to the students own programs to design sophisticated experimental interfaces, statistical analysis, and graphic visualization of data.

**Why learn Matlab programming?**
As Psychology moves towards a technology based research field, programming is about as essential a skill as one can conceive of. Behavioral data collection is becoming automated and programming skills are needed to develop experimental interfaces, to analyze and visualize data, etc. Any student pursuing a graduate degree in psychology will find programming to be an essential skill

**Aims of this course**
The aims of this course are to introduce computer programming through the MATLAB software package. In this course students will learn to solve problems often encountered in experimental psychology, including designing experimental interfaces for presenting stimuli and solicit subject responses, record and organize data, read in and visualize experimental data, and basic statistical analysis.

This course requires and assumes no previous experience in computer programming. However, the course is programming intensive.

## Structure

The emphasis of this course will be on hands on lecture-lab format where students get both rigorous instruction and hands-on experience. Student-centered teaching is an effective format for a programming class because it allows students to do self-study under the guidance of the instructor, and to implement smaller structured projects from beginning to end (Zhang & Wang, 2010). Emphasis will be heavily placed on in-class programming.  During each class, a different topic in programming is introduced and discussed, followed by a programming lab where students complete exercises of a project that demonstrates the principles underlying the topic.

The course has two primary themes: to develop good programming habits and to gain hands-on experience by programming essential aspects of data collection and analysis, such as building experimental interfaces that span a range of research topics in cognitive psychology – from visual and auditory stimuli to surveys and interactive response formats.

The lab component requires students to use their new knowledge as a resource to solve problems and provides feedback from the instructor.  Students will practice and reflect on what they learned each week by writing short programs.

There will be assigned readings from the textbook, with lectures providing information on additional topics.

Lectures will be conducted in a computer lab equipped with computers with MATLAB.  There should usually be at least one machine available for student use. Therefore it is not necessary to bring a laptop to class. However, access to a computer is necessary for the completion of the course assignments. Importantly, students are recommended to store their program files on an external drive (flash drive), so that they will not be tied to a specific machine, or erased between lectures.

## Outcomes

At the end of the course students will have gained the technical skills, and should be confident about using MATLAB, to implement their own project work. The goal is for the student to be able to build their own experimental interface, apply them to their own data collection, analyze their data, and visualize the results.

# Course Materials

### Student access to Matlab outside the classroom

Students can access Matlab in the on campus public labs. Students can also point their browser at http://apps.rutgers.edu/ from their personal computer whether they are coming from anywhere on campus (including RUWireless) or from high speed network connections at home. To review basic documentation for Apps, click here. This outlines the steps for service activation as well as the login process which includes trusting the self-signed certificate, enabling Java, and mobile access. For more information, contact oirt @rutgers.edu.

### Textbook

There is no textbook assigned to this course. However, there are a number of good books available. I have used:

Marc Herniter "programming in Matlab"
http://books.google.com/books/about/Programming_in_MATLAB.html?id=KvRQAAAAMAAJ

Brian hunt, Ronald Lipsman & Jonathan Rosenberg "A guide to Matlab for beginners and experienced users"
http://www.amazon.com/Guide-MATLAB-Beginners-Experienced-Users/dp/0521615658

**Additional Readings**
Additional readings will be posted on Sakai.

**Exercises**
A lab manual containing the lab exercises and instructions for each programming activity will be poster on Sakai.

**Lecture Slides**
Partial lecture slides will be posted on Sakai. These slides will not include all of the materials presented during lectures. It is important that you are present for class and actively engaged in note taking and programming.

# Assessment

**Attendance**
Attendance in this course is mandatory. It is not possible to learn the material without attending lectures.

**Exams**
There will be 2 exams for this class including the final exam. The final exam is cumulative, covering the entire semester. Both exams will be given in-class on the scheduled day.
Exams will be in the format of the weekly assignments. You will be given a programming exercise where you will demonstrate your skills by writing a program to solve a stated problem. The exam might also include a brief essay question asking you to explain a central concept. Exam questions will come from both the lecture and the readings.
You must take both exams. There are NO make-up exams. If you miss a scheduled class/exam you will need to provide a valid/documented excuse (see section below for authenticating your excuse). Any other tests will be given in the finals week and will be in the essay format.

**Weekly Exercises**
Each week a topic introduced during the lecture portion of the class will be further explored during the lab portion. The manual on Sakai will outline each programming activity, and give step-by-step instructions on how to get started. Students will be responsible for finishing and submitting each programming exercise weekly.

**Project**
The programming project is a chance for the student to apply what they have learned to a topic of interest, for example their research project.  The final outcome of the project should be a working MATLAB program written by the student that implements this topic or experiment. More details will be available on Sakai.

**Extra Credit**
There are several different ways in which you can earn extra credit.
1)
You will have the opportunity to earn extra credit by writing an exercise that covers a topic from one of the lectures. For the exercise you must develop a problem to be solved and submit the code implementing the solution.
2)
You will have the opportunity to earn extra credit by programming the solution to a posted extra credit question on 3 of the weekly problem exercise sets.

Each extra credit will be worth 10 points and you can submit up to 3 extra credit opportunities for a total of 30 possible points. The assignments and due dates will be posted on Sakai.

# Grading

Your grade will be based on exams, a project, weekly exercises, attendance, and extra credit (if you choose).

| Activity | Maximum point value |
|---|:---:|
| Midterm exam | 75 |
| Final exam | 75 |
| Weekly projects (10 x 10points) | 100 |
| Take home project | 100 |
| Extra credit  (3 x 10 points) | 30 |
| Attendance (5 points each lecture) | 50 |
| Total possible points | 400 |

| Your grade | Points |
|---|:---:|
| A | 360 and up |
| B+ | 345-359 |
| B | 320-344 |
| C+ | 305-319 |
| C | 280-304 |
| D | 240-279 |
| F | below-239 |

# Schedule

Topics and chapters will be covered on the dates assigned in the schedule. Additional readings might be assigned. Please check Sakai for notices of additional readings.  Material not covered in the textbook or listed in the schedule might be covered in lectures.

**Lecture 1.     Introduction to Programming**
1.1.     Components of a computer
1.2.     Working with numbers
1.3.     Machine code
1.4.     Software hierarchy
1.5.     Programming Environment: MATLAB Windows
1.6.     A First Program
1.7.     Expressions, Constants
1.8.     Variables and assignment statement
1.9.     Arrays

**Lecture 2.     Graph Plots**
2.1.    Basic plotting
2.2.     Built in functions
2.3.     Load and save

2.4.  Get input
2.5.  Help function
2.6.  Subplot

**Lecture 3.    Loops and conditional statements**
3.1.  Logical expressions
3.2.   Conditional statements: If, Else, Elseif
3.3.   Repetition statements: While, For
3.4.  For statement
3.5.  Nested loops
3.6.  Switch case
3.7.  Strcmp

**Lecture 4.    Procedures and Functions**
4.1.   Arguments and return values
4.2.   M-files
4.3.   Formatted console input-output
4.4.  String handling
4.5.   Generating waveforms
4.6.   Sound replay, load and save

**Lecture 5.    Advanced plotting and text manipulation**
5.1.  Writing to a text file
5.2.  Reading from a text file
5.3.  Randomizing and sorting a list
5.4.  Searching a list
5.5.  Graphical use interface Part I

**Lecture 6.    GUI Interface**
6.1.   Attaching buttons to actions
6.2.   Getting Input
6.3.   Setting Output

**Lecture 7.    REVIEW**

**Lecture 8.    Working with keyboard input and RT**
8.1.   Taking input from keyboard
8.2.   Recording response time
8.3.   Randomizing trial sequences

**Lecture 9.    Building Separate Sections of an Experiment**
9.1.   Instructions
9.2.   Randomizing trial sequences
9.3.   Run Block
9.4.   Recording input
9.5.   "Waitfor" stimuli loading
9.6.   Programming a classic experiment from Psychology

**Lecture 10.    Visualizing results**

**Lecture 11.     Basic Data Analysis**

**Lecture 12.     Basic Data Analysis2**

**DETAILED SCEHDULE OF DATES WILL BE POSTED HERE AT THE BEGINNING OF THE SEMESTER**

| Date | Topic | Assignments |
|------|-------|-------------|
| | Introduction | Exercise set 1 + homework 1 |
| | Experiment part 1: subject input, randomization, simple stimulus presentation | Exercise set 2 |
| | Loading and presenting stimulus and saving subject inputs | Exercise set 3 |
| | Trial sequences | Exercise set 4 |
| | Presenting sound and more advanced stimuli | Exercise set 5 |
| | GUI | Exercise set 6 |
| | In class mid-term | |
| | Review | |
| | Building separate sections of experiments | Exercise set 7 |
| | Storing complex responses and manipulating data structures | Exercise set 8 |
| | Visualizing results | Exercise set 9 |
| | NO CLASS | |
| | Basic statistical analysis | Exercise set 10 |
| | Final exam | |

**Authentication of Absence**
To provide the documentation for a valid excused absence, you will need to get your note authenticated by the Dean of Students Office (this is to protect your medical confidentiality) by following the directions below:
On the Rutgers website
http://sasundergrad.rutgers.edu/academics/courses/registration-and-course-policies
under the heading in the left column:
Attendance and Cancellation of Classes
http://sasundergrad.rutgers.edu/academics/courses/registration-and-course-policies/attendance-and-cancellation-of-class
You will find the following policy:
"Students may obtain a note from the Office of the Dean of Students to authenticate an extended absence that is supported by appropriate documentation".
There is also a link to the Office of the Dean of Students by clicking on the highlighted text.

# Academic Honesty Policies
Cheating, plagiarism or any other violations of the university's policy on academic integrity will not be tolerated in this class.

Please visit this link to view the university's Academic Honesty Policies **Academic Honesty Policies**

## Students with Disabilities

Our community values diversity and seeks to promote meaningful access to educational opportunities for all students. If you believe that you need accommodations for a disability, please follow these procedures outlined at http://disabilityservices.rutgers.edu/request.html Since accommodations may require early planning and are not provided retroactively, please initiate this process as soon as possible.