**Syllabus for CLP 7934 Class Number 22829**
**Neuroimaging Applications and Analyses With Lab**

Spring Semester 2019
Tuesdays 1:55 to 4:55 PM
HPNP Building
Room G-111

**Instructor**
Jared Tanner, Ph.D.
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**Appointments**: Schedule in person or via email

## GENERAL OVERVIEW AND PURPOSE

This 3-credit-hour course will be an applied and practical introduction to common tools for structural and functional analyses of human brain MRI. The course consists of limited topical and practical lectures and in-class lab time to help students become more comfortable with command line interfaces, HiPerGator, and comfortable with commonly used MRI tools, including FreeSurfer, FSL, and SPM/CONN (for fMRI analyses).

### COURSE OBJECTIVES

Successful completion of the course should allow students to 1) develop fundamental command line skills including basic scripting, 2) become acquainted with multiple software packages for structural and resting state MRI analysis, and 3) develop understanding of robust statistical analyses of MRI data.

**COURSE WEBSITE:** http://elearning.ufl.edu;
https://github.com/neured/MRI_Guide/wiki

**COURSE COMMUNICATIONS:** All general questions should be posted to discussion board on eLearning. Private questions should be sent via email, in person, or by phone.

## COURSE REQUIREMENTS

### HARDWARE

*A laptop is required and must be brought to class*. While the course will utilize HiPerGator for some analyses, if you want to run processing locally, macOS (MacBook Pro, MacBook Air, or MacBook [in that order of preference]) or Linux is strongly recommended. It is preferable if you have at least 30 GB of free storage for installation of imaging applications. A laptop running Windows 10 will also work with an installation of the Windows subsystem for Linux (https://docs.microsoft.com/en-us/windows/wsl/install-win10) and/or an installation of VirtualBox and appropriate Linux virtual machine (e.g., http://neuro.debian.net). Help with installation is available online or possibly via PHHP IT. You can also contact me for installation help but set-up for non-Apple machines should be done before the class starts. HiPerGator access will be provided for the semester.

I also recommend a large (64+ GB) external drive for data storage if you do not have much internal space on your laptop. An SSD or flash drive is preferable but a fast portable HDD will also work.

### COURSE OR TRAINING PREREQUISITES

It is expected you have at least rudimentary knowledge of the command line and Bash. There are many great tutorials and videos online to get started (e.g., https://ryanstutorials.net/linuxtutorial/; https://www.youtube.com/watch?v=oxuRxtrO2Ag).

For graduate students, CLP 7934 (Clinical and Cognitive Neuroscience Methods and Theory) is recommended but not required.

***Enrollment is limited to 15 students with preference given to graduate students. Undergraduate student enrollment will be capped at 5.***

**ADDITIONAL RESOURCES:** FreeSurfer tutorials: http://surfer.nmr.mgh.harvard.edu/fswiki/FsTutorial/Sept2015CourseSchedule

FSL tutorials: http://fsl.fmrib.ox.ac.uk/fslcourse/

CONN documentation and tutorials: https://sites.google.com/view/conn/

SPM documentation and tutorials: http://www.fil.ion.ucl.ac.uk/spm/doc/; http://www.fil.ion.ucl.ac.uk/spm/course/video/

**INSTRUCTIONAL METHODS:** The course consists of limited lecture with hands-on lab time. Students are encouraged to collaborate and use all reasonable resources (the internet, software listservs, etc.) to complete their work.

## COURSE MATERIALS

The syllabus and assigned readings are available on the course website. Readings will consist of articles or image processing guides selected by the course instructor. Make sure you have a working email address. If your email address changes or you miss the first day of class, it will be your responsibility to contact Dr. Tanner with your desired email address in order to receive notification about changes in course readings or topics. The content of the course includes assigned readings, lectures, and practicals. If available, lecture slides will be provided in advance.

## COURSE POLICIES

**ATTENDANCE POLICY:**

This class is a mixture of instruction and lab and attendance is *strongly encouraged*. Significant time in class will be spent working as a group. General requirements for class attendance and make-up assignments and other work in this course are consistent with university policies that can be found at: https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

**QUIZ AND EXAM POLICIES:**  There will be no exams or quizzes for this course. All grades come from assignments.

**MAKE-UP POLICY:** Assigned work might be made up under extenuating circumstances after discussion with the professor. If you have difficulty meeting a deadline please consult with me. Technology failures will not result in penalized work if the professor was contacted in a timely manner about such failures. Any requests for make-ups due to technical issues MUST be

accompanied by the ticket number received from the Help Desk or other service when the problem was reported to them.

**ASSIGNMENT POLICY:** Assigned homework will be due as indicated in the course schedule below. While it might be possible to obtain a passing grade with one missing assignment, missing more than one assignment will automatically result in a fail. Additionally, completing all assignments does not guarantee a passing grade. Please talk with Dr. Tanner in advance of the end of the semester if you have any concerns about your assignments or grade. Readings are recommended but not required.

**COURSE TECHNOLOGY:** Technical issues or questions can be addressed with me. Helpdesk or IT might also be able to help.

- http://helpdesk.ufl.edu

- (352) 392-HELP - select option 2

**ONLINE COURSE EVALUATION:** Students are expected to provide feedback on the quality of instruction in this course by completing online evaluations at https://evaluations.ufl.edu. Evaluations are typically open during the last two or three weeks of the semesters, but students will be given specific times when they are open. Summary results of these assessments are available to students at https://evaluations.ufl.edu/results.

## UF POLICIES

**UNIVERSITY POLICY ON ACCOMMODATING STUDENTS WITH DISABILITIES:** Students with disabilities requesting accommodations should first register with the Disability Resource Center (352-392-8565, www.dso.ufl.edu/drc ) by providing appropriate documentation.  Once registered, students will receive an accommodation letter, which must be presented to the instructor when requesting accommodation.  Students with disabilities should follow this procedure as early as possible in the semester.

**UNIVERSITY POLICY ON ACADEMIC CONDUCT:**  UF students are bound by The Honor Pledge, which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity by abiding by the Honor Code.  On all work submitted for credit by students at the University of Florida, the following pledge is either

required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment."  The Honor Code (http://www.dso.ufl.edu/sccr/process/student-conduct-honor-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions.  Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel.  If you have any questions or concerns, please consult with the instructor or TAs in this class.

**CLASS DEMEANOR:** All members of the class are expected to follow rules of common courtesy in all in-class interactions, email messages, and threaded discussions.

## GETTING HELP

Should you have any complaints with your experience in this course please visit http://www.distance.ufl.edu/student-complaints to submit a complaint.

Students may occasionally have personal issues that arise in the course of pursuing higher education or that may interfere with their academic performance. If you find yourself facing problems affecting your coursework, you are encouraged to talk with an instructor and to seek confidential assistance at the University of Florida Counseling Center, 352-392-1575, or Student Mental Health Services, 352-392-1171. Visit their web sites for more information: http://www.counsel.ufl.edu/ or http://www.health.ufl.edu/shcc/smhs/index.htm#urgent

The Student Health Care Center at Shands is a satellite clinic of the main Student Health Care Center located on Fletcher Drive on campus. Student Health at Shands offers a variety of clinical services, including primary care, women's health care, immunizations, mental health care, and pharmacy services. The clinic is located on the second floor of the Dental Tower in the Health Science Center. For more information, contact the clinic at 392-0627 or check out the web site at: www.health.ufl.edu/shcc

Crisis intervention is always available 24/7 from: Alachua County Crisis Center: (352) 264-6789.

BUT – Do not wait until you reach a crisis to come in and talk with me. I can help students through stressful situations impacting their academic performance. You are not alone so do not be afraid to ask for assistance.

## GRADING POLICIES

### METHODS BY WHICH STUDENTS WILL BE EVALUATED AND THEIR GRADE DETERMINED

The final grade will be determined according to the students' scores on the assignments (70%) and a final project (30%). **Note, graduate students have an additional required mid-term assignment**.

Assignments are practical applications and repetitions of work completed in class. They are assigned during the first class period of a new topic and are due before the start of class the following week. For example, if class is held T, assignments will be given on Tuesday with the due date the following Tuesday before class. In some cases, the assignment will cover more than one week and thus be due more than one week after assignment.

## GRADUATE STUDENTS ONLY

### MID-TERM ASSIGNMENT

The additional assignment should be one of the following

- Create a comprehensive step-by-step tutorial with screenshots for one MRI software tool where you cover installation, processing, troubleshooting, and quality control. This should not be just a copy of what's available online, although online tutorials might serve as a guide and foundation. If it's a tool where there are clear and substantial online guides, your instructions need to be substantively different. Make the guide clear enough that someone with little or no processing experience could follow it.

- 3 page review paper on one of the following: 1) imaging modality (i.e., type of scan) with utility for research or clinical applications (this could also be targeted towards a clinical population), or 2) applications and utility of one neuroimaging tool (e.g., FreeSurfer) with a discussion of some of the major results found using the tool. If there are not many results yet (i.e., it's a new tool), you could offer a discussion of potential applications of the tool. A discussion of its validity should also be included.

- Write a working (and bug-free) bash, Python, or other language script using multiple neuroimaging tools (we do not cover Python or other scripting languages but if you know a language and can demonstrate the script that will count). This ideally should be a script you could or would use with data. If you have data or an idea to process publicly available data this will be most useful. The script should include comments and white space as needed. The goal behind the length of the script is to automate or semi-automate the bulk or processing you might do for a project.

## FINAL PROJECT

The final project *must receive approval before starting*.

Perform a new analysis of existing MRI data (from your lab, a public dataset, or data Dr. Tanner has) written up in manuscript format (about 5 pages) including a brief introduction (1 page maximum – this could just be aims and hypotheses), methods, results, and a very brief discussion. You must include a script (or all the code) you used to perform your analyses (this allows for reproducibility and serves as part of your lab notebook).

## UNDERGRADUATE STUDENTS ONLY

### FINAL PROJECT

The final project **must receive approval before starting**.

CHOOSE ONE OF THE FOLLOWING

- Use publicly available, data provided by the instructor, or a mentor's data to perform an analysis using one of the tools covered in class. This assignment should be written up as a methods and results section of an original research article.

- 5 page review paper on one of the following: 1) imaging modality (i.e., type of scan) with utility for research or clinical applications (this could also be targeted towards a clinical population), or 2) applications and utility of one neuroimaging tool (e.g., FreeSurfer) with a discussion of some of the major results found using the tool. If there are not many results yet (i.e., it's a new tool), you could offer a discussion of potential

applications of the tool. A discussion of its validity should also be included.

- A comprehensive step-by-step tutorial with screenshots for one MRI software tool where you cover installation, processing, troubleshooting, and quality control. This should not be just a copy of what's available online, although online tutorials might serve as a guide and foundation. If it's a tool where there are clear and substantial online guides, your instructions need to be substantively different. Make the guide clear enough that someone with zero processing experience could follow it.

- Write a working (and bug-free) bash, python, or other language script (including comments) using multiple neuroimaging tools. This ideally should be a script you could or would use with data. If you have data or an idea to process publicly available data this will be most useful. The script must be a minimum of 250 lines, including comments and white space as needed. The goal behind the length of the script is to automate or semi-automate the bulk or processing you might do for a project.

## INFORMATION ON CURRENT UF GRADING POLICIES FOR ASSIGNING GRADE POINTS:

Grading policies are in line with standard UF policies as described here:
https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

## GRADING SCALE

*Grading Scale*:

93-100 = A

90-92 = A-

87-89 = B+

83-86 = B

80-82 = B-

77-79 = C+

73-76 = C

70-72 = C-

67-69 = D+

63-66 = D

60-62 = D-

<60 = E

*Late and Make-up Work*: Late work will be penalized 5% per late day unless 1) arrangements are made with me **prior** to the due date, or 2) there is a **documented** emergency. Be prepared to provide documentation of any emergencies that may arise (e.g., a doctor's note if you are out sick, a police report if you have a car accident). This policy will be strictly enforced.

## COURSE SCHEDULE

**CRITICAL DATES:** *The final paper/project is due **April 27 at 10:00 PM**.*

**A WEEKLY SCHEDULE OF TOPICS AND ASSIGNMENTS:**

| Week | Date | Topic | Assignment |
|------|------|-------|------------|
| 1 | Jan 8, 2019 | MRI intro and common clinical and research sequences with a dash of neuroanatomy<br><br>Intro to the command line | Write a 1 page summary (can be technical or for a lay audience) of a single type of neuroimaging modality. It does not have to be one covered in class. |
| 2 | Jan 15, 2019 | Intro to the command line, basic scripting, and HiPerGator | Write working Bash/HiPerGator submission script including the use of a for loop. It should perform multiple steps using multiple command line tools. |
| 3 | Jan 22, 2019 | FreeSurfer processing, and survey of FreeSurfer tools | Process a set of 3 brains using FreeSurfer |
| 4 | Jan 29, | FreeSurfer quality control | Process, assess, and reprocess one problematic brain |

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| 5 | Feb 5, 2019 | FreeSurfer analyses – exporting and QDEC | QDEC and stats assignment |
| 6 | INS – no class | | |
| 7 | Feb 19, 2019 | Survey of FSL structural tools (bet, flirt, fsleyes, fast, first, and more) | BET, FLIRT, FNIRT, FAST, and FIRST (fsl_anat) |
| 8 | Feb 26, 2019 | FSL tools continued | |
| 9 | Spring Break! | | **Project topic and outline due!**<br><br>**Graduate students only: Mid-term assignment due!** |
| 10 | Mar 12, 2019 | FSL continued and statistical analyses in FSL | FSL GLM assignment |
| 11 | Mar 19, 2019 | Resting state functional connectivity in SPM/CONN | |
| 12 | Mar 26, 2019 | rsfMRI continued | CONN assignment |
| 13 | Apr 2, 2019 | rsfMRI continued | |
| 14 | Apr 9, 2019 | Diffusion processing (DTIFIT, TBSS, Tracula) | Diffusion preprocessing assignment |
| 15 | Apr 16, | Diffusion processing continued | Diffusion analysis assignment |

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| 16 | Apr 23, 2019 | Diffusion processing continued and course wrap-up | **Project due by April 27 at 10:00 PM.** |

Disclaimer: This syllabus represents current plans and objectives. As we go through the semester, those plans may need to change to enhance learning opportunities of the class. Such changes, communicated clearly, are not unusual and should be expected.

Last update:  01/16/18