Python For Geoscience Research

Professor: Daniel Trugman (dtrugman@jsg.utexas.edu). UT Offices: JGB 4.220C, ROC 2.116E
TA: Claire Williams (cmw3@utexas.edu).

Professor Office Hours: Th 11am-12:15pm, F 12:30pm-1:45pm (Zoom)
TA Office Hours: Tu 12pm-1pm (Zoom)
Meetings: In-person lectures: Tu/Th 9:30-10:45 in JGB 3.222

Course Textbook: No textbook required. This course was originally developed by Dr. Gail Christeson, inspired by content from these books: 1) Introducing Python, Bill Lubanovic; 2) Python for Data Analysis, Wes McKinney; 3) Python Data Science Handbook, Jake VanderPlas; 4) Introduction to Machine Learning with Python, Andreas Müller and Sarah Guido. I’ve put my own spin on the course materials and added a few bells and whistles, but major kudos to Gail for getting the foundation for this course in nice working order.

Course Overview: This course will cover the basics of Python programming and common Python libraries for application to scientific research. All students need access to a computer with Anaconda Python 3 installed starting with Lecture 2. Students attending the in-person lectures are required to bring a laptop to each class starting with the 2nd class day. By the end of this course students should be able to use Python on their own datasets to carry out analyses and produce figures. The course is divided into four sections: Python Fundamentals, Scientific Python, Data Visualizations, and Introduction to Machine Learning.

Class Format: All sections will use a combined Canvas site, will have the same due dates, and will have access to all the same materials. This year, we are back to in-person lectures! (Fingers crossed). Each class will begin with a short lecture notebook (~30 minutes) meant to convey the key concepts we are working on that day. After the lecture there are ‘in-class’ exercises for students to work on, with both instructors (professor and TA) roving the classroom to provide assistance. Students are encouraged to interact with each other and discuss the in-class coding problems. Longer coding problems are assigned as homework, with collaboration again encouraged. Despite the collaborative environment, all work turned in must be your own!
Assignments: Most lectures will include an In-class Assignment, which will be due Fridays at midnight. There will also be 8 Homework Assignments, which will be due Sundays at midnight. Draft versions of the final projects are due Sunday Nov. 21, with the final version due at midnight, Monday, Dec. 6. Homework 9 will be a peer review exercise of the projects. All due dates for Assignments will be posted on Canvas.

Late Work and Homework Corrections: Late in-class and homework assignments will lose 10 points if turned in within 1 week after due date, and 20 points otherwise. No late assignments will be accepted after Nov 29. Students can turn in corrections to homework (not in-class) assignments and receive half-credit (e.g., a student who gets a grade of 70 and makes corrections can increase their grade to as high as 85). No corrections will be accepted after Nov 29.

Final Project: There are 2 options for students to choose from for the final project. 1) Carry out an analysis of a dataset of interest – this can be your own research data or a publicly available dataset. 2) Convert existing code into Python. Only choose the second option if you have significant/useful code to convert and can incorporate figures. For example, Matlab code or Excel spreadsheets that compute models and displays results; Fortran code that manipulates data and you currently have to use another method to display figures of the results. The final project should be presented in 2 ways: an electronic pdf presentation (from PowerPoint, Keynote, Google Slides, etc), and a Jupyter Notebook .html file. The electronic presentations will undergo peer review, and the top ones will be selected for presentation to the class.

Course Grades:
- In-Class Jupyter Notebooks 40%
- Homework Exercises 40%
- Final Project 20%

A standard plus/minus system will be used to calculate final grades:
- 94.0+ A
- 90.0 - <94.0 A-
- 87.0 - <90.0 B+
- 84.0 - <87.0 B
- 80.0 - <84.0 B-
- 77.0 - <80.0 C+
- 74.0 - <77.0 C
- 70.0 - <74.0 C-
- 67.0 - <70.0 D+
- 64.0 - <67.0 D
- 60.0 - <64.0 D-
- 0 - <60.0 F

Undergraduate students taking the class pass/fail require a D- (60.0+) to pass. Graduate students taking the class credit/no credit require a C (74.0+) to receive credit.

Policy on Academic Integrity: Students who violate University rules on academic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from the University. Since such dishonesty harms the individual, all students, and the integrity of the University, policies on academic dishonesty will be strictly enforced. For further information, please visit the Student Conduct and Academic Integrity website at: http://deanofstudents.utexas.edu/conduct. One specific way that students can commit academic dishonesty is ‘Submitting computer programs written by another person’. Feel free to collaborate with other students on ideas of how to approach the homework questions, but make sure that your submitted work is your own!
Course Schedule: All changes to this schedule will be posted on Canvas.

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Lecture</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aug 26</td>
<td>1</td>
<td>Introduction to Class and Python</td>
</tr>
<tr>
<td>2</td>
<td>Aug 31</td>
<td>2</td>
<td>Variable Types and Mathematical Operators</td>
</tr>
<tr>
<td></td>
<td>Sep 02</td>
<td>3</td>
<td>Lists</td>
</tr>
<tr>
<td>3</td>
<td>Sep 07</td>
<td>4</td>
<td>Comparison and Logical Operators</td>
</tr>
<tr>
<td></td>
<td>Sep 09</td>
<td>5</td>
<td>Loops</td>
</tr>
<tr>
<td>4</td>
<td>Sep 14</td>
<td>6</td>
<td>Functions, Namespaces</td>
</tr>
<tr>
<td></td>
<td>Sep 16</td>
<td>7</td>
<td>Modules, Dictionaries</td>
</tr>
<tr>
<td>5</td>
<td>Sep 21</td>
<td>8</td>
<td>Strings</td>
</tr>
<tr>
<td></td>
<td>Sep 23</td>
<td>9</td>
<td>Matplotlib 1</td>
</tr>
<tr>
<td>6</td>
<td>Sep 28</td>
<td>10</td>
<td>Numpy 1</td>
</tr>
<tr>
<td></td>
<td>Sep 30</td>
<td>11</td>
<td>Numpy 2</td>
</tr>
<tr>
<td>7</td>
<td>Oct 05</td>
<td>12</td>
<td>Advanced Loops</td>
</tr>
<tr>
<td></td>
<td>Oct 07</td>
<td>13</td>
<td>Matplotlib 2</td>
</tr>
<tr>
<td>8</td>
<td>Oct 12</td>
<td>14</td>
<td>Pandas 1</td>
</tr>
<tr>
<td></td>
<td>Oct 14</td>
<td>15</td>
<td>Pandas 2</td>
</tr>
<tr>
<td>9</td>
<td>Oct 19</td>
<td>16</td>
<td>Pandas 3</td>
</tr>
<tr>
<td></td>
<td>Oct 21</td>
<td>17</td>
<td>Advanced File I/O</td>
</tr>
<tr>
<td>10</td>
<td>Oct 26</td>
<td>18</td>
<td>SciPy Functions</td>
</tr>
<tr>
<td></td>
<td>Sep 21</td>
<td>11</td>
<td>Cartopy and Choropleth Maps</td>
</tr>
<tr>
<td>11</td>
<td>Nov 02</td>
<td>20</td>
<td>Folium Maps</td>
</tr>
<tr>
<td></td>
<td>Nov 04</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Nov 09</td>
<td>22</td>
<td>Plotly Maps, Animations, and Plots</td>
</tr>
<tr>
<td></td>
<td>Nov 11</td>
<td>23</td>
<td>Supervised Machine Learning 1</td>
</tr>
<tr>
<td>13</td>
<td>Nov 16</td>
<td>24</td>
<td>Supervised Machine Learning 2</td>
</tr>
<tr>
<td></td>
<td>Nov 18</td>
<td>25</td>
<td>Unsupervised Machine Learning</td>
</tr>
<tr>
<td>14</td>
<td>Nov 23</td>
<td>26</td>
<td>Titanic: Machine Learning From Disaster</td>
</tr>
<tr>
<td>15</td>
<td>Nov 30</td>
<td></td>
<td>No Class</td>
</tr>
<tr>
<td>16</td>
<td>Dec 2</td>
<td></td>
<td>Top Student Presentations, Selected By Peers</td>
</tr>
</tbody>
</table>

Key deadlines:
- In-class Assignments for the week are due Fridays at Midnight.
- Homework Assignments (HW1 to HW8) are due Sundays at Midnight.
- Draft version of final projects (for peer review): Sunday, November 21 (midnight).
- Homework 9, Peer Review: Sunday, November 28 (midnight).
- Final version of final projects: Sunday, Dec 6 (midnight).
University Policies

**Academic Integrity:** Each student in the course is expected to abide by the University of Texas Honor Code: “As a student of The University of Texas at Austin, I shall abide by the core values of the University and uphold academic integrity.” Plagiarism is taken very seriously at UT. Therefore, if you use words or ideas that are not your own (or that you have used in previous class), you must cite your sources. Otherwise you will be guilty of plagiarism and subject to academic disciplinary action, including failure of the course. You are responsible for understanding UT’s Academic Honesty and the University Honor Code which can be found at the following web address: [http://deanofstudents.utexas.edu/sjs/acint_student.php](http://deanofstudents.utexas.edu/sjs/acint_student.php)

**Sharing of Course Materials is Prohibited:** No materials used in this class, including, but not limited to, lecture hand-outs, videos, assessments (quizzes, exams, papers, projects, homework assignments), in-class materials, review sheets, and additional problem sets, may be shared online or with anyone outside of the class unless you have my explicit, written permission. Unauthorized sharing of materials promotes cheating. It is a violation of the University’s Student Honor Code and an act of academic dishonesty. I am well aware of the sites used for sharing materials, and any materials found online that are associated with you, or any suspected unauthorized sharing of materials, will be reported to Student Conduct and Academic Integrity in the Office of the Dean of Students. These reports can result in sanctions, including failure in the course.

**Class Recordings:** Class recordings are reserved only for students in this class for educational purposes and are protected under FERPA. The recordings should not be shared outside the class in any form. Violation of this restriction by a student could lead to Student Misconduct proceedings.

**Q Drop Policy:** If you want to drop a class after the 12th class day, you’ll need to execute a Q drop before the Q-drop deadline, which typically occurs near the middle of the semester. Under Texas law, you are only allowed six Q drops while you are in college at any public Texas institution. For more information, see: [http://www.utexas.edu/ugs/csacc/academic/adddrop/qdrop](http://www.utexas.edu/ugs/csacc/academic/adddrop/qdrop)

**Classroom Safety and COVID-19**
Unfortunately, COVID-19 doesn’t appear to be going away any time soon. To get through this semester safely, we need to take individual responsibility to mitigate to potential for outbreaks in our classroom and our community. To help preserve our in person learning environment, the university recommends:

- Adhere to university mask guidance.
- **Vaccinations are widely available**, free and not billed to health insurance. The vaccine will help protect against the transmission of the virus to others and reduce serious symptoms in those who are vaccinated.
- **Proactive Community Testing** remains an important part of the university’s efforts to protect our community. Tests are fast and free.

Please visit [protect.utexas.edu](http://protect.utexas.edu) for more information. We are requested to maintain a fixed seating chart to facilitate contact tracing, so please try to keep a consistent seat choice throughout semester. Each time you come to class, scan the QR code on your seat. Thank you!
Student Rights & Responsibilities

- You have a right to a learning environment that supports mental and physical wellness.
- You have a right to respect.
- You have a right to be assessed and graded fairly.
- You have a right to freedom of opinion and expression.
- You have a right to privacy and confidentiality.
- You have a right to meaningful and equal participation, and to self-organize groups to improve your learning environment.
- You have a right to learn in an environment that is welcoming to all people. No student shall be isolated, excluded or diminished in any way.

With these rights come responsibilities:

- You are responsible for taking care of yourself, managing your time, and communicating with the teaching team and with others if things start to feel out of control or overwhelming.
- You are responsible for acting in a way that is worthy of respect and always respectful of others.
- Your experience with this course is directly related to the quality of the energy that you bring to it, and your energy shapes the quality of your peers’ experiences.
- You are responsible for creating an inclusive environment and for speaking up when someone is excluded.
- You are responsible for holding yourself accountable to these standards, holding each other to these standards, and holding the teaching team accountable as well.

Personal Pronoun Use (She / He / They / Ze / Etc)

Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender, gender variance, and nationalities. Class rosters are provided to the instructor with the student’s legal name, unless they have added a “preferred name” with the Gender and Sexuality Center (http://diversity.utexas.edu/genderandsexuality/publications-and-resources/). I will gladly honor your request to address you by a name that is different from what appears on the official roster, and by the gender pronouns you use (she/he/they/ze, etc). Please advise me of any changes early in the semester so that I may make appropriate updates to my records.

University Resources for Students

Services for Students with Disabilities

This class respects and welcomes students of all backgrounds, identities, and abilities. If there are circumstances that make our learning environment and activities difficult, if you have medical information that you need to share with me, or if you need specific arrangements in case the building needs to be evacuated, please let me know. I am committed to creating an effective learning environment for all students, but I can only do so if you discuss your needs with me as early as possible. I promise to maintain the confidentiality of these discussions. Any student with a documented disability who requires academic accommodations should contact Services for Students with Disabilities at 471-6259 (voice) or 512-410-6644 (Video Phone) as soon as possible to request
A letter outlining authorized accommodations. For more information, visit http://ddce.utexas.edu/disability/about/.

Counseling and Mental Health Center
Do your best to maintain a healthy lifestyle this semester by eating well, exercising, avoiding drugs and alcohol, getting enough sleep and taking some time to relax. This will help you achieve your goals and cope with stress.

All of us benefit from support during times of struggle. You are not alone. There are many helpful resources available on campus and an important part of the college experience is learning how to ask for help. Asking for support sooner rather than later is often helpful.

If you or anyone you know experiences any academic stress, difficult life events, or feelings like anxiety or depression, we strongly encourage you to seek support. http://www.cmhc.utexas.edu/individualcounseling.html

The Sanger Learning Center
Did you know that more than one-third of UT undergraduate students use the Sanger Learning Center each year to improve their academic performance? All students are welcome to take advantage of Sanger Center’s classes and workshops, private learning specialist appointments, peer academic coaching, and tutoring for more than 70 courses in 15 different subject areas. For more information, please visit http://www.utexas.edu/ugs/slc or call 512-471-3614 (JES A332).

Undergraduate Writing Center: http://uwc.utexas.edu/

Libraries: http://www.lib.utexas.edu/

ITS: http://www.utexas.edu/its/

Student Emergency Services: http://deanofstudents.utexas.edu/emergency/

BeVocal is a university-wide initiative to promote the idea that individual Longhorns have the power to prevent high-risk behavior and harm. At UT Austin all Longhorns have the power to intervene and reduce harm. To learn more about BeVocal and how you can help to build a culture of care on campus, go to: wellnessnetwork.utexas.edu/BeVocal.

Important Safety Information:
If you have concerns about the safety or behavior of fellow students, TAs or Professors, call BCAL (the Behavior Concerns Advice Line): 512-232-5050. Your call can be anonymous. If something doesn’t feel right – it probably isn’t. Trust your instincts and share your concerns.

The following recommendations regarding emergency evacuation from the Office of Campus Safety and Security, 512-471-5767, http://www.utexas.edu/safety/

Occupants of buildings on The University of Texas at Austin campus are required to evacuate buildings when a fire alarm is activated. Alarm activation or announcement requires exiting and assembling outside.

- Familiarize yourself with all exit doors of each classroom and building you may occupy. Remember that the nearest exit door may not be the one you used when entering the building.
- Students requiring assistance in evacuation shall inform their instructor in writing during the first week of class.
- In the event of an evacuation, follow the instruction of faculty or class instructors. Do not re-enter
a building unless given instructions by the following: Austin Fire Department, The University of Texas at Austin Police Department, or Fire Prevention Services office.

- Link to information regarding emergency evacuation routes and emergency procedures can be found at: www.utexas.edu/emergency

**Title IX Reporting**
Title IX is a federal law that protects against sex and gender-based discrimination, sexual harassment, sexual assault, sexual misconduct, dating/domestic violence and stalking at federally funded educational institutions. UT Austin is committed to fostering a learning and working environment free from discrimination in all its forms. When sexual misconduct occurs in our community, the university can:

1. Intervene to prevent harmful behavior from continuing or escalating.
2. Provide support and remedies to students and employees who have experienced harm or have become involved in a Title IX investigation.
3. Investigate and discipline violations of the university’s relevant policies.

Beginning January 1, 2020, Texas Senate Bill 212 requires all employees of Texas universities, including faculty, report any information to the Title IX Office regarding sexual harassment, sexual assault, dating violence and stalking that is disclosed to them. Texas law requires that all employees who witness or receive any information of this type (including, but not limited to, writing assignments, class discussions, or one-on-one conversations) must be reported. **I am a Responsible Employee and must report any Title IX related incidents** that are disclosed in writing, discussion, or one-on-one. Before talking with me, or with any faculty or staff member about a Title IX related incident, be sure to ask whether they are a responsible employee. If you would like to speak with someone who can provide support or remedies without making an official report to the university, please email advocate@austin.utexas.edu. For more information about reporting options and resources, visit http://www.titleix.utexas.edu/, contact the Title IX Office via email at titleix@austin.utexas.edu, or call 512-471-0419.

Although graduate teaching and research assistants are not subject to Texas Senate Bill 212, they are still mandatory reporters under Federal Title IX laws and are required to report a wide range of behaviors we refer to as sexual misconduct, including the types of sexual misconduct covered under Texas Senate Bill 212. The Title IX office has developed supportive ways to respond to a survivor and compiled campus resources to support survivors.