Annual Departmental Assessment Report

Department or Program: Earth Sciences
Academic Year of Report: 2018-19
Department Contact Person for Assessment: Dave Sutherland (dsuth@uoregon.edu)

Section 1: Learning Objectives Assessed for this Report

In the Department of Earth Sciences (ERTH), we have one major with four curricular tracks. For this annual assessment report, we are focusing on learning goals that cut across all four tracks, as outlined below.

Major: Earth Sciences

1. Students will learn all aspects of data science as it pertains to issues in Earth Sciences, from collecting data to data quality control and processing to analyzing real-world data sets for hazards assessment, management, or scientific research needs.
2. Students will learn computational and coding techniques using open-source software in order to build transferrable skills to use in their chosen field of research or career.

The following table outlines our completed and planned assessment activities moving forward.

Learning Objective (abbreviated)	AY 17-18	AY 18-19	AY 19-20	AY 20-21	AY 21-22	AY 22-23
LO1 – Students will learn all aspects of data science at it pertains to ERTH		X			Revisit	
LO2 – Students will learn computational and coding techniques		X			Revisit	
LO3 – Students will be proficient with the measurement, mapping, analytical and/or modeling tools	X			Revisit		
LO4 – Students will be able to develop and test hypotheses in a systematic way	X			Revisit		
LO5 – Students will use techniques from the traditional disciplines of ERTH	X			Revisit		
LO6 – Students will learn evolution and the fossil record			X			Revisit
LO7 – Students will explore the origin and history of the Earth			X			Revisit

Section 2: Assessment Activities

For each learning outcome, describe what information was collected, how it was analyzed and discussed, and the conclusions that were drawn from the analysis. In the narrative, reference all relevant means of collecting information about learning goals, including direct measures (e.g. assessment of student assignments), indirect measures (e.g. overall grade patterns in a particular course, student reflections on learning, SERU data), and qualitative information (e.g. faculty observations, student input). While the choice of which assessments are most meaningful is up to the department, a mix of direct and indirect measures is requested.

In academic years leading up to 2017-2018, our department recognized the need for increased skill development in the use of computational tools and open-source software among our undergraduate majors. In today's world, having practical experience with computer-based analytical tools, such as Python, R, HTML, etc. are critical to successfully obtaining a job and succeeding in an Earth Science related field (be it academia, government agency, industry, or non-profit).

Thus, in 2017-2018, we developed a new class, GEOL 410: Computational Tools in Earth Sciences, to directly address this gap in our curriculum. That class now has a real course number, GEOL 363, which is required for each track in the ERTH major. The class is now offered multiple times each academic year. The assessment activities described here evaluate how that class has evolved since 2017-18 and to measure whether it is serving our majors well.

To gather information for this assessment, we gathered together all class information for the 5 times this course has been offered since its inception (Winter 2018, Fall 2018, Winter 2019, Fall 2019, Winter 2020). The course has been taught by 2 instructors during this period. We discussed qualitatively how the instructors thought the class has evolved, how the students perform, what the students get out of the class, and what improvements they see moving forward. In addition, we collected all student assignments, grades, and evaluations from those courses. The assessment was accomplished by independent faculty member review (Sutherland) of the materials followed by group discussion. Before undertaking the assessment, faculty revisited the department's learning outcomes, as outlined above.

Assessment of Student Assignments: The hallmark of this course is the culminating final project, where students weave together the tools, code, and data science techniques they learned throughout the course and apply those to a chosen problem. This final project gives the students freedom to explore topics of interest, as well as creative space to practice their coding skills in a real-world environment. In examining the files containing the student projects, it is readily apparent that these students are going above and beyond 'problem sets' and applying their new knowledge to complex issues without a simple answer. Importantly, the instructors have provided the students with a final project rubric (see attached) that clearly outlines how they will be assessed, i.e., on code functionality, code clarity, interpretation of results, and the needed introduction and motivation to their chosen problem. Finally, students have to present their project, which takes gives them the full range of project development, execution, and delivery, that they will experience in real-world conditions.

Overall Grade Patterns: Students usually perform well in this class with the average grade being a B. However, they are students every term who do poorly (D/F grades). Mostly, these are students who fall behind on the week-to-week homework sets and quizzes. The final project is the centerpiece, but even acing that does not guarantee an 'A', as it is only worth 40% of the grade. This is good pedagogy, as it takes the place of the final exam and is in the right ballpark for that assessment of learning. Students have a chance to see where they're at throughout the term, given the way the class is structured (see an example syllabus attached). There is no clear trend in grades from the class inception to present. Note that this class is also small-ish, as it is capped at 16, which is the number of students who can fit in the ERTH computer lab.

Student Input (Student Evaluations): We examined student evaluations over the last few years to gather information on student input. Looking at the numerical scores for student evaluations shows that this class is a hit, with scores consistently above the department average and university average. These high scores can be attributed to both the small class size for a 300-level course, as well as the utility and need that students perceive in taking this course. These causes are demonstrated by several student comments highlighted below:

- Student in Fall 2018: "I have a feeling having such a small class size was a fluke, but having <10 students in this type of class was absolutely awesome. Really cultivates an environment where everyone feels welcomed and encouraged to ask questions or admit when they are completely lost. Having almost 30 students in MATLAB last term was a nightmare, in addition to the one day a week nonsense. In summary, I thought this 410 class was incredibly informative and the format of the class was great! Easily my favorite class I took this term"
- Student in Fall 2019: **"**The content of the course is not only interesting and relevant, it is applicable to a professional environment.**"**

- Student in Fall 2019: “The in class presentation and homework were really beneficial. Instructor also provided incentive to practice coding via online resources, to help students with proficiency.”

Section 3: Actions Taken Based on Assessment Analysis

For each learning goal assessed for each major, describe any actions taken as a result of assessment information, or plans to take action during the next academic year. Describe how the actions or action plans are meant to address the issues arrived at through the assessment activities in Section 2.

- This assessment exercise drove home how needed this curriculum change was in our department, in terms of updating our courses to be more computationally and skill focused. This class is now very popular and fills up immediately when offered each term. As a faculty, we are now discussing how to increase the enrollment in the course, potentially by offering it 3x/year (each term), up from 2x/year currently.
- After the discussion with the instructors, one issue came up about cultivating an inclusive classroom. Since the class is computer-based, many assignments and project details are done in the lab, yet for some students this poses a challenge. The department is looking into providing laptops (e.g., Chrome Books) for each student, which would allow them to finish assignments on their own schedule and provide flexibility for students with need.
- *Curriculum and Disciplinary Integration*: It is clear from the success of this class that we need to have a whole faculty discussion (e.g., at our fall retreat) in order to encourage integration of these techniques and computational skills into our upper level courses. Students should continue practicing what they learned in this course beyond this course, in order to drive home these learning outcomes (1 and 2) and provide more opportunities for skill development that they can use in real-world careers.

Section 4: Other Efforts to Improve the Student Educational Experience

Briefly describe other continuous improvement efforts that are not directly related to the learning goals above. In other words, what activity has the department engaged in to improve the student educational experience? This might include changes such as curriculum revisions, new advising approaches, revised or new co-curricular activities, etc. Describe the rationale for the change(s) and any outcomes resulting from the change(s).

Our major tracks underwent a comprehensive review and change over the last couple academic years. We have overhauled the requirements, learning outcomes, and advising structure (partly due to the creation of Tykeson Hall). We expect these changes to lead to both increased student engagement and learning, as well as increased number of ERTH majors in the coming years. Classes such as GEOL 363, which is assessed above, are at the center of this effort. Other efforts include working with the career center to educate both undergraduates and career counselors on what students can do with a degree in ERTH, tapping both into our alumni community and current faculty make-up.

Section 5: Plans for Next Year

Briefly describe tentative assessment plans for the next academic year. Which goals will be assessed and how? What actions will be taken as a result of this years’ analysis of assessment information? What other plans does the department have to improve the student educational experience? What are the budgetary implications of any proposed actions? How will those be addressed?

- Next year we plan to review our learning outcomes.
- We will present the assessment outcomes to faculty and use a faculty meeting to explore responses.

Beyond these general actions, we plan to assess learning outcomes centered on the Paleontology Track of the ERTH major in academic year 2020-21. Beyond the courses offered that serve this track, we also will ask if our current faculty makeup in paleontology are sufficient? That is, given the teaching needs for this track, do we need to hire in this area, specifically because two of our faculty have other commitments (Sam Hopkins is associated with the Clark Honors College and Edward Davis is half-time at the Museum) that take away from teaching in ERTH.

Syllabus, Fall 2019

Geology 363: Computational Tools for Earth Sciences

Professor: Valerie Sahakian
TA: Alexis Klimasewski
Time/Location: M/W 1000 – 1150h, Cascade 101 (Computer Lab)
Please send us correspondence through Canvas!

Other Information:

Books – on Canvas: Data Science from Scratch, Joel Grus (O'Reilly Publishing), Python Data Science Handbook (O'Reilly Publishing)
Books – In bookstore: Mastering Python Scientific Computing, Hemant Kumar Mehta (Packt Publishing) – NOT REQUIRED but recommended as a resource
Computer Lab Code: 399157 (DO NOT SHARE!)
Reminder: Always back up your work (to a thumb drive or your laptop)
My Office Hours: Tuesdays, 1000h – 1100h (Cascade 325D) or by appointment
Lexie's Office Hours: Thursdays, 1300h – 1500h (Cascade 324)

Introduction:

This class is designed to teach you the very basics of programming, using the programming language Python. As our world becomes more and more data rich, so does the field of Earth Sciences. The best way to handle all this data is with code, and the ability to design algorithms to synthesize large datasets and diverse data. In this class, you will learn what a computer program is, how a computer works, and be able to code your own solutions to common problems in Earth Sciences (or your homeworks for other classes!). Computers and code are tools, so this will help you learn how to use them.

Grading:

Homeworks: 20%

> **No late assignments accepted.** There will be approximately 1 per week. They will generally be handed out on Wednesday, and due the next Wednesday following. You may work together on homeworks, but what you turn in must be original work (it cannot be copied from another student's assignment, and it can also not be code or text copied from a website). Your algorithms may be very similar to other existing algorithms, but you must make a good faith effort to completely write and run this code from scratch, even if your algorithm resembles or is the same as another. Please see below for further information on Academic Misconduct.

Readings & Mini-essays: 10% (**5 essays**; more will be extra credit up to 10%)

> Each homework will be accompanied with an article, op-ed, essay, etc. on a topic relevant to this class. You must read ALL the readings, and write an essay for 5 of them (after these 5, the remaining are optional and extra credit up to 10% of the grade; but I highly recommend writing all of them).

For these essays, you must compose a 400 word minimum text providing a summary and argument-based opinion on whether you agree or disagree with the text's conclusions or findings. You are free to argue any position you want, but you must back that position with evidence-based arguments.

Quizzes: 10%

These will be randomly distributed throughout the quarter, generally one every week. They will cover topics covered in previous lectures, or the readings from the homeworks (so be sure to read all of them!). **Be prepared for a quiz for every class!** A good place to start is reviewing the previous classes materials before you come in each day.

Midterm: 20 %

Currently scheduled for Monday, February 11th.

Final Project: 40%

There will be no final exam. Instead, there will be a final project for you to demonstrate your command of the topics covered in this class. These will occur in the last week of classes. For this project, you must solve a problem with code. Select an interesting Earth Sciences problem or application. Find the relevant data and use some of the common Earth Science Python tools (discussed in class, or that you find online) to analyze the data or solve the problem. One of the homework assignments sometime around the midterm or thereafter will be to tell me what your project will be. I will provide a rubric for what is expected for the project as well.

About the final project, what you will need to do:

1. Provide the code (Jupyter notebook) and data for your project
2. Produce descriptive, clean-looking plots that are useful to demonstrate your findings
3. Prepare a write-up of your problem, your method, your results, and a discussion and conclusion of your findings (could be in markdown in the jupyter notebook if you like)
4. Give a 10 minute presentation on your project in the final week of class.
5. If the project was completed in a group, both group members must attend and both must present

Important Dates:

- Saturday, October 5th: *Last day to process a complete drop (all courses), no "W" recorded. Tuition refund: 90%.*
- Monday, October 7th: *Last day to add classes*
- **Wednesday, October 30th: Midterm**
- November 17th: *Last day to withdraw ("W" recorded)*
- **December 2nd and 4th: Final Presentations**

See https://registrar.uoregon.edu/calendars/academic?ts=201901 for more dates

Weekly Topics:

Week	Dates	Topics
1	Oct 2	Algorithms, Psuedocode, Control Structures
2	Oct 7, 9	More pseudeocode, Control structures, Looping, Python and the Jupyter Notebook
3	Oct 14, 16	Variables and Datatypes, Order of Operations
4	Oct 21, 23	Boolean Logic, More Notebooks, Basics of computer architecture
5	Oct 28, 30	Input/Output of data, Midterm
6	Nov 4, 6	Plotting
7	Nov 11, 13	3D plotting
8	Nov 18, 20	Maps and Map projections
9	Nov 25, 27	NetCDFs and geographic data, Data download
10	Dec 2, 4	Final presentations

Academic Misconduct

The University Student Conduct Code (available at conduct.uoregon.edu) defines academic misconduct. Students are prohibited from committing or attempting to commit any act that constitutes academic misconduct. By way of example, students should not give or receive (or attempt to give or receive) unauthorized help on assignments or examinations without express permission from the instructor. Students should properly acknowledge and document all sources of information (e.g. quotations, paraphrases, ideas) and use only the sources and resources authorized by the instructor. If there is any question about whether an act constitutes academic misconduct, it is the students' obligation to clarify the question with the instructor before committing or attempting to commit the act. Additional information about a common form of academic misconduct, plagiarism, is available at https://researchguides.uoregon.edu/citing-plagiarism.

Prohibited Discrimination and Harassment Reporting
Any student who has experienced sexual assault, relationship violence, sex or gender-based bullying, stalking, and/or sexual harassment may seek resources and help at safe.uoregon.edu. To get help by phone, a student can also call either the UO's 24-hour hotline at 541-346-SAFE [7244], or the non-confidential Title IX Coordinator/OICRC at 541-346-3123.

Students experiencing any other form of prohibited discrimination or harassment can find information and resources at investigations.uoregon.edu or contact the non-confidential Office of Investigations and Civil Rights Compliance at 541-346-3123 or the Dean of Students Office at 541-346-3216 for help. As UO policy has different reporting requirements based on the nature of the reported harassment or discrimination, additional information about reporting requirements for discrimination or harassment unrelated to sexual assault, relationship violence, sex or gender based bullying, stalking, and/or sexual harassment is available in the Employee Reponsibilities section of the Office of Investigations and Civil Rights Compliance website.

The instructor of this class, as a Student Directed-Employee, will direct students who disclose sexual harassment or sexual violence to resources that can help and will only report the information shared to the university administration when the student requests that the information be reported (unless someone is in imminent risk of serious harm or a minor). The instructor of this class is required to report all other forms of prohibited discrimination or harassment to the university administration.

Specific details about confidentiality of information and reporting obligations of employees can be found at investigations.uoregon.edu/employee-responsibilities.

Mandatory Reporting of Child Abuse
UO employees, including faculty, staff, and GEs, are mandatory reporters of child abuse. This statement is to advise you that your disclosure of information about child abuse to a UO employee may trigger the UO employee's duty to report that information to the designated authorities. Please refer to the following link for detailed information about mandatory reporting: Mandatory Reporting of Child Abuse and Neglect.

Final Project

Published | Edit

Final project - please find the rubric (updated to now include the presentation timing).

Please upload:

1. Your python notebook

2. If you used any, powerpoints you used for your presentation (to refresh my memory if I need it)

Points 260

Submitting a file upload

File Types ipynb, pptx, key, ppt, and pdf

Due	For	Available from	Until
Dec 6 at 10am	Everyone	-	-

Final project rubric

Criteria	Ratings		Pts
Write-up in notebook: Introduction A clear description of your problem/project, and the motivation for it. Why is your problem important to you or society	**10.0 pts Full Marks**	**0.0 pts No Marks**	10.0 pts
Write-up in notebook: Methods Describes your data. Describes your analyses, what algorithms/computations are you using in your code. Why have you chosen to go about your problem this way?	**15.0 pts Full Marks**	**0.0 pts No Marks**	15.0 pts
Write-up in notebook: Results What did you find from your analyses, with no interpretation	**10.0 pts Full Marks**	**0.0 pts No Marks**	10.0 pts
Write-up in notebook: Discussion An interpretation of your results, what do they mean? What could be some future directions for the work?	**10.0 pts Full Marks**	**0.0 pts No Marks**	10.0 pts
Write-up in notebook: Conclusion A summary of your findings, your main points, and your main interpretations	**5.0 pts Full Marks**	**0.0 pts No Marks**	5.0 pts
Code: Functionality Does it run?	**30.0 pts Full Marks**	**0.0 pts No Marks**	30.0 pts

Criteria	Ratings		Pts
Code: Clarity Is it clear and easy to follow?	**10.0 pts Full Marks**	**0.0 pts No Marks**	10.0 pts
Code: Variable names Are the variable names meaningful?	**10.0 pts Full Marks**	**0.0 pts No Marks**	10.0 pts
Code: Comments Are there helpful comments? Do you have markdown inside the notebook to describe the overall methodologies and sections of your code?	**30.0 pts Full Marks**	**0.0 pts No Marks**	30.0 pts
Plots Are they: a. Understandable? b. Labeling, colormap, and general presentation aesthetically pleasing? c. Do they convey the message that is intended and help make your point?	**50.0 pts Full Marks**	**0.0 pts No Marks**	50.0 pts
Presentation: Problem Statement Describe the problem you are trying to solve and why it is interesting or important to you (and/or others)	**20.0 pts Full Marks**	**0.0 pts No Marks**	20.0 pts
Presentation: Methodology Describe the data and/or method you will use to solve the problem. Why have you chosen to go about it this way?	**20.0 pts Full Marks**	**0.0 pts No Marks**	20.0 pts

Criteria	Ratings		Pts
Presentation: Results and Conclusions What did you find? What difficulties did you encounter? What are the future directions of this work?	**20.0 pts Full Marks**	**0.0 pts No Marks**	20.0 pts
Presentation: Timing and Oral Communication Did you fit it in the allotted 5 minute time? Was your oral communication clear?	**20.0 pts Full Marks**	**0.0 pts No Marks**	20.0 pts
			Total Points: 260.0