Introduction to Programming in Geographic Information Systems

<table>
<thead>
<tr>
<th>Section</th>
<th>Meeting time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEC 01</td>
<td>01</td>
<td>Web Based Course</td>
</tr>
<tr>
<td>LAB 01</td>
<td>01</td>
<td>Web Based Course</td>
</tr>
</tbody>
</table>

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Office: ES 338  
Telephone: 403 220 6398  
Email: dbender@ucalgary.ca

Official Course Description
Introduction to computer programming for customizing and automating a GIS. Topics include object-oriented programming techniques, advanced geoprocessing, scripting & automation using a programming language such as Python or Visual Basic.

Course Overview:
This course provides an introduction to programming and is intended for students with no previous programming experience. It focuses on fundamental programming skills using the Python programming language, with particular application to GIS-related tasks within the ArcGIS software environment. Approximately one-half of the course will be spent learning general and transferable programming skills, and the second half will cover GIS-specific applications, including basic scripting, batch processing and automation of repetitive tasks, and designing complex geoprocessing tasks.

This course assumes no prior knowledge of programming. However, students are expected to understand fundamental GIS concepts. Past experience with the ArcGIS Desktop application suite is essential. At least one advanced undergraduate-level course in GIS is recommended.

Online Meeting Schedule

<table>
<thead>
<tr>
<th>Section</th>
<th>Meeting Time</th>
<th>Meeting Dates</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEC 01</td>
<td>N/A</td>
<td>None – all asynchronous</td>
</tr>
<tr>
<td>LAB 01</td>
<td>N/A</td>
<td>None – all asynchronous</td>
</tr>
</tbody>
</table>

There are no required online meetings for this course. However, online meetings may be scheduled during the term to host question-and-answer sessions, facilitate class discussion, or assist with assignments. Attendance at these online sessions is not mandatory, and sessions will be recorded so that all students can access information provided in these meetings.

Course Objectives
Students will learn fundamental programming skills that are transferable to any object-oriented programming language and apply these skills to performing GIS-related tasks, such as geoprocessing or automation of repetitive tasks. Students will evaluate and design effective programming solutions to a variety of tasks relevant to GIS or geospatial software. Emphasis will be placed on analyzing problems and designing structured solutions, particularly using Python scripts and customized tools in ArcGIS Desktop.
applications. Programming concepts and coding skills will be presented from a fundamental/conceptual perspective and practiced in technically-oriented assignments.

**Course Learning Outcomes**
The Department of Geography is committed to student knowledge and skill development. The table below lists the key learning outcomes for this course, the program-learning outcomes to which they contribute, and the expected level of achievement.

<table>
<thead>
<tr>
<th>Course Learning Outcomes</th>
<th>PLO(s)</th>
<th>Level(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recognize and describe the differences between low- and high-level programming languages and distinguish between compiled and interpreted code.</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Describe data types and structures, decision structures and functions, and implement them in effective computer code to perform/automate GIS tasks.</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Explain the principles of object-oriented programming (OOP) and modularization of code and implement OOP techniques in effective code.</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Explain the value of the program development cycle for problem-solving and developing code solutions and implement the approach in assigned programming exercises.</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Apply effective programming techniques to problem-solve geoprocessing and map automation tasks in a GIS framework.</td>
<td>3,4,6</td>
<td>3</td>
</tr>
<tr>
<td>Demonstrate the ability to analyze coding problems and demonstrate active learning to develop original solutions using reference material and code examples.</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Create stand-alone solutions (e.g., ArcGIS script tools) that enhance or expand the built-in functionality of a GIS software system using OOP code.</td>
<td>3,4,6,7</td>
<td>2</td>
</tr>
</tbody>
</table>

*PLOs = Program Learning Outcomes: 1 = reflect and communicate diverse human-environment perspectives, 2 = identify and explain human-environment processes, 3 = implement sampling, data collection, analyses and communication methods, 4 = analyze spatial and temporal aspects of human-environment systems, 5 = employ knowledge, arguments, and methodologies for solving human-environment problems, 6 = evaluate geospatial data and manipulate it to create cartographic products, 7 = communicate geographic concepts using oral, written, graphic, and cartographic modes, and 8 = demonstrate literacy skills.

**Levels:** 1 = Introductory, 2 = Intermediate, and 3 = Advanced.

**Prerequisites**
3 units from Geography 357, 482. No previous experience with computer programming is required.

**Learning Resources**
One of the following texts is strongly recommended for this course:
- Zandenberg, Paul A. 2013. *Python Scripting for ArcGIS*. Esri Press, Redlands, CA. 368 pp. (This text is designed for those working with the older ArcMap and other ArcGIS Desktop software).
- Zandenberg, Paul A. 2020. *Python Scripting for ArcGIS Pro*. Esri Press, Redlands, CA. 420 pp. (This text is an updated version of the one above and designed for use with the newer ArcGIS Pro software.)

A discussion of these two textbook options will be presented in the first week of lectures, and students are encouraged to consider that information before purchasing a textbook.
Note: Readings from other sources may be assigned. Notifications of these will be posted on D2L. They will not require purchase.

Learning Technologies and Requirements
In order to successfully engage in their learning experiences at the University of Calgary, students taking online, remote and blended courses are required to have reliable access to the following technology.

• A computer with a supported operating system, as well as the latest security and malware updates
• A current and updates web browser
• Webcam (built in or external)
• Microphone and speaker (built in or external) or headset with microphone
• Broadband internet connection

Student Licences for ArcGIS Software
The exercises and assignments in this course will primarily use Esri’s ArcMap and/or ArcGIS Pro software, and students may obtain a licence to install ArcGIS Pro on their personal computers. ArcGIS software runs on the Windows operating system only, and system requirements for the software can be found on the software vendor’s website here: https://pro.arcgis.com/en/pro-app/get-started/arcgis-pro-system-requirements.htm.

For Apple Mac users, it may be possible to install the Windows operating system on a Mac computer using either Apple’s Boot Camp option or a commercial virtualization client, such as Parallels Desktop or VMware Fusion for Mac, although these options are supported by the University of Calgary, and students must obtain and install necessary software themselves (student discounts are often available to offset the cost of purchasing commercial virtualization software and a licence for the Windows operating system). Interested students are advised to contact their instructor for more information.

For students who are unable to run ArcMap or ArcGIS Pro on their home computers, shared access to a campus computer via a remote connection will be available. For remote access, students will require a Windows- or Mac-based computer and a reliable broadband connection. Details on how to schedule time on a shared computer using a remote desktop session will be provided at the beginning of the course.

Grading (Weighting)
Students will be evaluated in two areas: (1) their knowledge of the lecture materials and (2) weekly programming assignments. Two open-book, online term tests will be scheduled, and they will evaluate the students’ knowledge of the conceptual issues of programming and application development in GIS. Each test is expected to be completed in 50 minutes, and tests will be timed (limited to 75 minutes completion time). Weekly programming assignments will be assigned to evaluate the student’s application of knowledge and their programming skills (see D2L for schedule).

The distribution of marks will be:

Term test #1 (begins 26 Oct. @ 08:00, ends 27 Oct. @ 08:00) 15%
Term test #2 (begins 7 Dec. @ 08:00, ends 8 Dec. @ 08:00) 15%
Weekly programming assignments (10 @ 7% each): 70%

Note: students must pass each of the components above to pass the course overall.

There is no final exam scheduled for this course.

Late Assignments and Missed Evaluations
Late assignments will be assessed a penalty of 10% per calendar day or portion thereof past the assigned
deadline. If you anticipate that you will not meet a deadline for an assignment, contact your instructor or teaching assistant at least one business day before the deadline to discuss whether an extension can be granted. No extensions will be provided after the deadline.

It is mandatory that students complete the two term tests on the scheduled date and time. Missed term tests or assignments will automatically receive a grade of zero (0). If a student has missed a required component of the course, they must contact the instructor immediately to discuss whether accommodations can be made. If extenuating circumstances contributed to a missed component, accommodations might include options such as assigning an alternate evaluation component or waiving the component and reweighting of the overall course grade, at the instructor’s discretion (see the University Calendar – Academic Regulations section G.1.1 Course Assessments and Absences for procedures on missed term tests and assignments).

**Grading System**

<table>
<thead>
<tr>
<th>Score Range</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>96-100</td>
<td>A+</td>
</tr>
<tr>
<td>90-95</td>
<td>A</td>
</tr>
<tr>
<td>86-89</td>
<td>A-</td>
</tr>
<tr>
<td>81-85</td>
<td>B+</td>
</tr>
<tr>
<td>77-80</td>
<td>B</td>
</tr>
<tr>
<td>71-76</td>
<td>B-</td>
</tr>
<tr>
<td>65-70</td>
<td>C+</td>
</tr>
<tr>
<td>62-64</td>
<td>C</td>
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<tr>
<td>59-61</td>
<td>C-</td>
</tr>
<tr>
<td>55-58</td>
<td>D+</td>
</tr>
<tr>
<td>50-54</td>
<td>D</td>
</tr>
<tr>
<td>0-49</td>
<td>F</td>
</tr>
</tbody>
</table>

**Administrative Policies and Procedures**

This section describes the administrative policies and procedures that students are expected to follow for this course. If you have questions or concerns about these policies or procedures, please speak to your instructor immediately.

1. All materials presented in this course are examinable, including lecture materials, information presented orally by the instructor during lectures, assigned readings, online exercises, materials presented in the weekly assignments, etc.

2. You will be required to complete several assignments during this course. A due date and time will be posted for each assignment, and these deadlines are strict. If extenuating circumstances arise that will prevent you from completing an assignment by the deadline, you must request an extension from your lab Teaching Assistant at least one business day in advance of the deadline. Late submissions will be accepted at a penalty of 10% per day, or any portion thereof, past the deadline (e.g., 1 hour late = 10% penalty, 25 hours late = 20% penalty).

3. All assignments must be submitted to the course Desire2Learn (D2L) site following the instructions provided. Submissions that do not follow the instructions will be penalized or rejected entirely (e.g., email submissions will not be accepted).

4. **Plagiarism is a serious academic offence that will be vigilantly monitored and reported in this course.** Essentially, plagiarism can arise whenever a student submits material for evaluation that was not entirely their own work (e.g., copied from another student, “borrowed” from another source without proper citation, based on ideas that were not your own) and the source of that work was not appropriately acknowledged. All students in this course are required to review and become familiar with university policies and regulations regarding plagiarism and academic misconduct in the University Calendar.

For additional detailed course information posted by the instructor, visit the course Desire2Learn page online at [https://d2l.ucalgary.ca/d2l/home](https://d2l.ucalgary.ca/d2l/home).

**Supplementary Fees:**

No supplementary fee has been assessed for this course.
SUPPLEMENTAL INFORMATION

Principles of Conduct
The University Calendar includes a statement on the principles of conduct expected of all members of the university community (including students, faculty, administrators, any category of staff, practicum supervisors, and volunteers), whether on or off university property. This statement applies in all situations where members of the university community are acting in their university capacities. All members of the university community have a responsibility to familiarize themselves with the principles of conduct statement, which is available at: www.ucalgary.ca/pubs/calendar/current/k.html.

Plagiarism, Cheating, and Student Misconduct
The University of Calgary is committed to the highest standards of academic integrity and honesty. Students are expected to be familiar with these standards regarding academic honesty and to uphold the policies of the University in this respect.

Academic dishonesty is not an acceptable activity at the University of Calgary, and students are strongly advised to read the Student Misconduct section in the University Calendar at: www.ucalgary.ca/pubs/calendar/current/k-3.html. Often, students are unaware of what constitutes academic dishonesty or plagiarism. The most common are (1) presenting another student’s work as your own, (2) presenting an author’s work or ideas as your own without adequate citation, and (3) using work completed for another course. Such activities will not be tolerated in this course, and students suspected of academic misconduct will be dealt with according to the procedures outlined in the calendar at: https://ucalgary.ca/policies/files/policies/student-academic-misconduct-procedure.pdf

Instructor Intellectual Property

Freedom of Information and Protection of Privacy
Freedom of Information and Protection of Privacy (FOIP) legislation in Alberta disallows the practice of having students retrieve assignments from a public place, such as outside an instructor’s office, the department office, etc. Term assignments will be returned to students individually, during class or during the instructor’s office hours; if students are unable to pick up their assignments from the instructor, they must provide the instructor with a stamped, self-addressed envelope to be used for the return of the assignment.

Human Subjects:
Students will not participate as subjects or researchers on human subjects in this course.

Guidelines for Zoom Sessions
Zoom is a video conferencing program that will allow us to meet at specific times for a “live” video conference, so that we can have the opportunity to meet each other virtually and discuss relevant course topics as a learning community.

To help ensure Zoom sessions are private, do not share Zoom link or password with others, or on any social media platforms. Zoom links and passwords are only intended for students registered in the course. Zoom recordings and materials presented in Zoom, including any teaching materials, must not be shared, distributed or published with the instructor’s permission.

The use of video conferencing programs relies on participants to act ethically, honestly and with integrity; and in accordance with the principles of fairness, good faith and respect (as per the Code of Conduct).
When entering Zoom or other video conferencing sessions (such as MS Teams), you play a role in helping create an effective, safe and respectful learning environment. Please be mindful of how your behavior in these sessions may affect others. Participants are required to use names officially associated with their UCID (legal or preferred names listed in the Student Centre) when engaging in these activities. Instructors/moderators can remove those whose names do not appear on class rosters. Non-compliance may be investigated under relevant University of Calgary conduct policies (e.g. Student Non Academic Misconduct Policy). If participants have difficulties complying with this requirement, they should email the instructor of the class explaining why, so the instructor may consider whether to grant an exception, and on what terms. For more information on how to get the most out of your Zoom sessions visit: https://elearn.ucalgary.ca/guidelines-for-zoom/.

If you are unable to attend a Zoom session, please contact your instructor to arrange an alternative activity for the missed session (e.g., to review a recorded session). Please be prepared, as best as you are able, to join class in a quiet space that will allow you to be fully present and engaged in Zoom sessions. Students will be advised by their instructor when they are expected to turn on their webcam (for group work, presentations, etc.).

The instructor may record online Zoom class sessions for the purposes of supporting student learning in this class – such as making the recording available for review of the session or for students who miss a session. Students will be advised before the instructor initiates a recording of a Zoom session. These recordings will be used to support student learning only and will not be shared or used for any other purpose.

**Posting of Grades and Picking-up of Assignments**
Graded assignments will be returned by the instructor or teaching assistant personally during scheduled lecture or laboratory periods, unless they are made available electronically through the course D2L webpage. Grades and assignments will not be available at the Department of Geography’s main office.

**Academic Accommodations**
It is the student’s responsibility to request academic accommodations, according to the university policies and procedures listed in the University Calendar.

The student accommodation policy can be found at:
https://www.ucalgary.ca/policies/files/policies/student-accommodation-policy_0.pdf

Students needing an accommodation because of a disability or medical condition should communicate this need to Student Accessibility Services in accordance with the Procedure for Accommodations for Students with Disabilities: www.ucalgary.ca/policies/files/policies/student-accommodation-policy.pdf.

Students needing an accommodation based on a protected ground other than disability should communicate this need, preferably in writing to their instructor or the Department Head (email: david.goldblum@ucalgary.ca).

**Copyright Legislation**
All students are required to read the University of Calgary policy on Acceptable Use of Material Protected by Copyright https://www.ucalgary.ca/policies/files/policies/acceptable-use-of-material-protected-by-copyright-policy.pdf and requirements of the copyright act (https://laws-lois.justice.gc.ca/eng/acts/C-42/index.html) to ensure they are aware of the consequences of unauthorised sharing of course materials (including instructor notes, electronic versions of textbooks etc.). Students who use material protected by copyright in violation of this policy may be disciplines under the Non-Academic Misconduct Act.
Wellness and Mental Health Resources
The University of Calgary recognizes the pivotal role that student mental health plays in physical health, social connectedness, and academic success and aspires to create a caring and supportive campus community where individuals can freely talk about mental health and receive supports when needed. We encourage you to explore the mental health resources available throughout the university community, such as counselling, self-help resources, peer support, or skills-building available through the SU Wellness Centre (Room 370, MacEwan Student Centre, [https://www.ucalgary.ca/wellnesscentre/services/mental-health-services](https://www.ucalgary.ca/wellnesscentre/services/mental-health-services)) and the Campus Mental Health Strategy website ([http://www.ucalgary.ca/mentalhealth/](http://www.ucalgary.ca/mentalhealth/)).

Contact Information for Student and Faculty Representation
- Student Union VP Academic 403-220-3911, suvpaca@ucalgary.ca
- Students Union Representatives for the Faculty of Arts – 403-220-3913, arts1@su.ucalgary.ca, arts2@su.ucalgary.ca, arts3@su.ucalgary.ca, arts4@su.ucalgary.ca
- Student Ombuds Office information can be found at: [www.ucalgary.ca/ombuds/](http://www.ucalgary.ca/ombuds/)

Campus Safewalk
Campus Security, in partnership with the Students' Union, provides the Safewalk service, 24 hours a day, to any location on Campus, including the LRT station, parking lots, bus zones, and university residences. Contact Campus Security at 220-5333 or use a help phone, and Safewalkers or a Campus Security officer will accompany you to your campus destination.