URP4283 - Automation for Geospatial Modeling and Analysis

COURSE INFORMATION

- Course numbers: URP6271, URP4283
- Section numbers: 6271, 1052, 1701, 4283
- Number of credits: 3 credit hours
- Semester: Spring 2024

INSTRUCTOR

Changjie Chen, PhD,
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COURSE DESCRIPTION

This course covers methods and techniques for automating geospatial modeling and analysis for urban planning by using visual models, computer programming, and custom-built tools that utilize Geographic Information Systems (GIS) technology in the context of planning information systems.

Topical Outline:
- Overview of information technology for planning and the need for automation.
- GIS modeling using graphical modeling techniques (ModelBuilder in ArcGIS Pro).
- Use Jupyter Notebook as the Integrated Development Environment (IDE).
- Introduction to Python (with a focus on scripting).
- Visualize GIS information using ArcGIS API for Python.
- Introduction to NumPy, pandas, and matplotlib.
- GIS modeling using Python scripting (with ArcPy package).
- Working with maps, layers, tables.
- Esri GeoEnrichment and Places Service
- Insertion of GIS problem logic into the computer program.
- Bringing it all together: application design and development.

OFFICE HOURS

Every Tuesday: *2pm – 3pm*.

Students who want to come to the office hour must register to notify the instructor. https://doodle.com/bp/changjiechen/urp6271-office-hours. Zoom meetings can be scheduled if not able to join regular office hours in-person or due to calendar conflicts.

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- https://ufl.zoom.us/my/chj.chen

COURSE WEBSITE

Course content can be found https://chjch.github.io/gisautomation/. Assignment, exams, and final project are posted on the e-Learning website at https://elearning.ufl.edu/. Students are required to include a picture of themselves. To do so, go to your E-learning account, and add the picture to your profile.

COURSE EVALUATION

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at https://gatorevals.aa.ufl.edu/students/. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via https://ufl.bluera.com/ufl/. Summaries of course evaluation results are available to students at https://gatorevals.aa.ufl.edu/public-results/.

TEXTBOOK (OPTIONAL)

Student enrolled in this course are required to obtain the following textbook: **Zandbergen, P. (2020).** *Python scripting for ArcGIS Pro*. **Redlands, California 9781589484993: ESRI Press.**

The text is a guide for experienced users of ArcGIS Pro to get started with Python scripting without needing previous programming experience. Experience with other scripting or programming languages is helpful but not required.

COURSE COMMUNICATIONS

Communication with the instructor will be done through the email system offered by e-Learning. Any emails received outside the e-Learning system will not receive a response in a timely fashion. Help with homework and project assignments will also be provided via email or through online communication as applicable. For online communication, you can use a computer microphone and speakers or telephone. The use of a headset is recommended for the best sound quality.

INSTRUCTIONAL METHODS

Lectures will be recorded via Zoom and posted on the course website on e-Learning. Students are free to watch the lectures according to their own availability.

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COMPUTER REQUIREMENT

Student enrolled in this course are required to obtain a computer and the following software:

- <u>Hardware</u> - It is highly recommended that student who enrolled in this class has access to a 64-bit computer that can run ESRI's ArcGIS Pro.
  See requirements at: http://pro.arcgis.com/en/pro-app/get-started/arcgis-pro-system-requirements.htm

- <u>Software</u> - The following software applications are required.
  1. ArcGIS Pro.

- <u>Note</u> **-** If you are a Mac user or you find your computer does not match the recommended configuration above, consider using **UFApps** as an alternative (not preferred though). For details, see '**Appendix A: Software Setup**' at the end of this document for obtaining and installing the software and how to use UFApps.

ADDITIONAL RESOURCE

<u>Web Resources</u>
- Learning ArcGIS Python Scripting (Linked-in Learning)
- ArcPy Documentation
- Python 3.6 Documentation: The Python Tutorial (official Python documentation)
- Learn Python the Hard Way (online Book with hands-on exercises)
- Scientific Computing Tools for Python
- Jupyter Notebook Documentation

<u>UF Libraries and Labs</u>
- Library homepage: http://www.uflib.ufl.edu
- Architecture & Fine Arts Library: http://www.uflib.ufl.edu/afa/
- Course Reserves: https://ares.uflib.ufl.edu/ares/
- Library Tools and Mobile Apps (smart phones, RSS feeds, etc.): http://www.uflib.ufl.edu/tools
- Architecture CIRCA computer lab): https://labs.at.ufl.edu/computer-labs/architecture/

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PREREQUISITE KNOWLEDGE AND SKILLS

The course requires prior basic knowledge of GIS which students will need to have previously acquired by taking any of the introductory GIS courses offered by the URP or other departments at University of Florida, or elsewhere. Previous programming experience is preferred but not required. At present, the course will teach ModelBuilder and Python to develop custom GIS applications using ArcGIS. Basic working knowledge of desktop ArcGIS is required.

PURPOSE OF COURSE

The purpose of the course is to give students a basic understanding of the concepts and techniques for solving planning problems more efficiently through automation and customization of Planning Information Systems. The course will focus on planning applications development using computer programming and GIS technology. Students will be exposed to fundamental concepts of programming including typical programming operations such as logical expressions, conditional processing, repetitive actions, and table and file manipulations.

The integration of programming with the use of GIS software for problem solving will be emphasized throughout the course. Students will learn how to automate common manual GIS operations and develop custom GIS tools. User-program interaction will include basic elements of event programming.

Students will practice the acquired knowledge through computer programming assignments that include homework and a final project which focuses on the development of a complete application program.

COURSE GOALS AND/OR OBJECTIVES

At the conclusion of this course, students should be able to:
- Basic knowledge of Python programming language as well as some widely used site packages, such as ArcPy, pandas, NumPy, arcgis (ArcGIS API for Python).
- Create interactive Jupyter Notebooks as a tool for both developing and presenting codes and results of GIS analysis.
- Automate and customize GIS to solve planning problems.
- Develop planning applications using computer programming and GIS technology.
- Perform typical programming operations such as logical expressions, conditional processing, repetitive actions, and table and file manipulations.

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HOW THIS COURSE RELATES TO THE STUDENT LEARNING OUTCOMES IN THE DEPARTMENT OF URBAN AND REGIONAL PLANNING

This course is in line with the department's educational goal for students to apply knowledge to perform specific tasks required in the practice of planning. In addition, as a course in an area of specialization, it adds significantly to the basic knowledge, skills, and values of planning. Automation for Geospatial Modeling and Analysis addresses all of the objectives of the Information Technologies for Planning (ITP) specialization:

- Provide graduate planning students with the basic and advanced skills necessary to excel as a practicing planner that uses advanced information systems and technologies. This course is intended to teach skills in spatial analysis and urban modeling through automation in the context of planning information systems.
- Teach students to think critically about the use and function of advanced technologies within the planning profession and academy. Course assignments and project emphasizes the application of critical thinking skills to foster deep learning and facilitate "real-world" problem solving.
- Students are taught the techniques, methods, and concepts that are the foundation upon which they will excel in careers that advance planning analysis as a modern field of research and as a means of advancing their individual professional goals. Students level of comprehension and ability to apply methods are reflected in the required coursework produced by the students.

TEACHING PHILOSOPHY

It is important for Urban and Regional Planning students to develop critical thinking, problem solving, and data analysis skills to allow them to evaluate problems and propose solutions in the "real-world" arena they will soon be entering. In my class we use a combination of lecture and hands-on demonstrations to illustrate how the students can begin to apply the technology concepts and skills to examining the built environment. Project-based learning through individual or group assignments is another major component of the teaching philosophy. These tasks challenge the students apply critical thinking skills to solve tangible planning problems using real-world data and scenarios. The skills acquired through the assignments build upon each other and all come together in a project that incorporates constraints one might encounter as a professional in the planning field. In the project, students are required to apply the concepts they have learned using various assignments, exercises, and software tools. Students are reviewed based on the ability to effectively communicate their ideas through oral and graphic presentation as well as creative application of technical skills using various applications covered in the course.

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COURSE POLICIES:

ATTENDANCE POLICY

<u>Web/Online Sections:</u> Students need to make use of the various tools in e-Learning system to develop a learning community. The discussion board is an area where students can communicate with the instructor and classmates regarding a variety of topics.

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies. Consult relevant graduate or undergraduate catalog respectively at:

- http://gradcatalog.ufl.edu/content.php?catoid=11&navoid=2486#attendance
- https://catalog.ufl.edu/ugrad/current/regulations/info/attendance.aspx

MAKE-UP POLICY

Student's with a valid reason will be allowed to present or submit assignments late. In such cases prior arrangement should be made with the instructor. See 'Late Submissions' under Grading Policies below. Otherwise students must present on the appointed time and must submit the assignments at the appointed time or a grade deduction will be enforced.

UF POLICIES:

UNIVERSITY POLICY ON ACCOMMODATING STUDENTS WITH DISABILITIES

Students requesting accommodation for disabilities must first register with the UF Disability Resource Center (https://disability.ufl.edu/students/get-started/). The UF Disability Resource Center will provide documentation to the student who must then provide this documentation to the instructor when requesting accommodation. You must submit this documentation prior to submitting assignments or taking the quizzes or exams. Accommodations are not retroactive; therefore, students should contact the office as soon as possible in the term for which they are seeking accommodations.

UNIVERSITY POLICY ON ACADEMIC MISCONDUCT

Academic honesty and integrity are fundamental values of the University community. Students should be sure that they understand the UF Student Honor Code at https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/.

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NETIQUETTE - COMMUNICATION COURTESY

All members of the class are expected to follow rules of common courtesy in all email messages, threaded discussions and chats. Please see http://teach.ufl.edu/wp-content/uploads/2012/08/NetiquetteGuideforOnlineCourses.pdf

GETTING HELP:

For technical difficulties** with e-Learning please contact the UF Help Desk at:

- helpdesk@ufl.edu
- (352) 392-4357 - select option 2
- https://elearning.ufl.edu/

** Any requests for make-ups due to technical issues MUST be accompanied by the ticket number received from LSS when the problem was reported to them. The ticket number will document the time and date of the problem. You MUST e-mail your instructor within 24 hours of the technical difficulty if you wish to request a make-up.

Other resources are available at http://www.distance.ufl.edu/getting-help for:
- Counseling and Wellness resources
- Disability resources
- Resources for handling student concerns and complaints
- Library Help Desk support

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

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GRADING POLICIES:

University of Florida Grading Scale

Letter Grade	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	E	WF	I	NG	S/U
Range	>93	90-92	87-89	83-86	80-82	77-79	73-76	70-72	67-69	63-66	60-62	<60				
Grade Point	4.0	3.67	3.33	3.0	2.67	2.33	2.0	1.67	1.33	1.0	.67	0	0	0	0	0

Non-Punitive Grades (not counted in GPA)

W	Withdrew
U	Unsatisfactory
H	Deferred
N	No grade reported

Failing Grades (counted in GPA)

E	Failure
WF	Withdrew failing
NG	No grade reported
I	Incomplete

Assignments are designed to build student's knowledge and understanding of various aspect of automation and its application to problem solving. Masterful understanding of the concepts throughout the course of the semester will contribute to the student's success in this course. Tentatively, there will be six assignments, each given a calculated weight corresponding to the magnitude and difficulty of work required. It is very likely that more assignments will be added. If so, the weights will be adjusted accordingly.

The Project will focus on developing a complete GIS model and tool that addresses an analytical problem. The project makes use of most of the knowledge and skills taught in class and will be accomplished during several weeks.

The assignments and the project will be graded in a scale of 0 to 100 and will be weighted as follows (tentatively):

- Assignment 1: 8%
- Assignment 2: 8%
- Assignment 3: 8%
- Assignment 4: 10%
- Assignment 5: 8%
- Assignment 6: 8%
- Mid-term exam: 20%
- Final project: 30%

Late Submissions: For assignments/project submitted late there will be a 7-point deduction for each day late for the first week following the due date. The assignment will not be accepted after 7 days late and a grade of 0(zero) will be issued. Exceptions could be made for extraordinary circumstances consistent with university policies (See Make-Up Policy under Course Policies above).

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COURSE SCHEDULE:

MODULE	DATE (Tentative)	TOPIC	ASSIGNMENTS	
			Assigned	Due
Module 1	1/15	Introduction to ModelBuilder	Homework 1	
Module 2	1/22	Introduction to Python and Python Notebook	Homework 2	Homework 1
Module 3	1/29	Python Function and Flow Control	Homework 3	Homework 2
Module 4	2/5	Introduction to ArcPy and GIS Data Visualization	Homework 4	Homework3
Module 5	2/12	Introduction to the Scientific Python Ecosystem		Homework 4
Module 6	2/19	Data Visualization in Python	Homework 5	
Module 7	2/26	Raster Data Analysis	Homework 6	Homework 5
Module 8	3/5	Building Custom Tools (mid-term exam)		Homework 6
Project	3/12	Project Work - Part 1: Develop Model	Project: Part 1	
Project	3/26	Project Work - Part 2: Python Script	Project: Part 2	Project: Part 1
Project	4/2	Project Work - Part 2: Python Script		
Project	4/9	Project Work - Part 2: Python Script		
Project	4/16	Project Work - Part 3: Develop Tool	Prepare Presentation	Project: Part 2
Project	4/23	Project Presentation		Project Presentation
Project	4/24	Final Materials Due		

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APPENDIX A: SOFTWARE SETUP

Before the first day of this course (1/15/2025), all students are responsible for having the following software setup appropriately if decided to install them locally on your own computer. If you chose to use UFApps (not preferred), you must familiarize yourself with the process of accessing these software applications. Please see the end of this appendix for using ArcGIS Pro on UFApps. The bottom line is that you must be able to access ArcGIS Pro and Jupyter Notebook one way or another.

This course will utilize a variety of technologies and multimedia. To complete the activities in this course and to access course content, you are required to install and properly setup the software for this class following the instructions below:

ARCGIS PRO

ArcGIS Pro may be installed on a personally owned computer if it is for educational purposes only. ArcGIS Pro can be installed on the same computer that ArcGIS 10.x is installed on. Follow the steps below to install the ArcGIS Pro:

1. Go to http://ufl.maps.arcgis.com. Click Sign In › choose University of Florida › enter GatorLink Credentials.
   This will automatically give you an access of ArcGIS online with the "user" role. Once successfully logged in, you must let the instructor know about your *ArcGIS Pro username* (NOT your GatorLink ID). We will elevate the "user" role to the "student" role to unlock more ArcGIS online features.
   How to find my ArcGIS Pro username: After logged in, click your first name at the right-up corner of your screen, you can find your username below "My Profile".

2. **Skip this step** if you are inside the UF network. Otherwise (e.g., working from home), download and install the UF VPN app at https://connect.ufl.edu/it/wiki/pages/glvpn.aspx. After installation, initiate UF VPN and establish the connection.

3. Download "**ArcGISPro_303_184244.exe**" and install ArcGIS Pro from https://software.geoplan.ufl.edu/downloads/ArcGIS_Pro/agp3.0/

4. After installation completed, open ArcGIS Pro and follow the instruction at https://www.geoplan.ufl.edu/software/esri-login-instructions/ to finish activating ArcGIS Pro on your computer.

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UFAPPS

NOTE: This is only an alternative solution to Mac users or the Windows users whose computer does not meet the recommended configuration. The best way to learn the content in this course is by installing the software on your machine.

UFApps leverages a number of cutting-edge technologies to provide UF students and faculty access to Windows based software applications from any computing device–laptops, tablets, desktops, and smartphones–from any location, at any time.

If this is your first time using UFApps, go to https://info.apps.ufl.edu/frequently-asked-questions/first-time-use/ for an instruction on how to use it.

To access UFApps simply go to https://apps.ufl.edu/ and log on with your GatorLink.
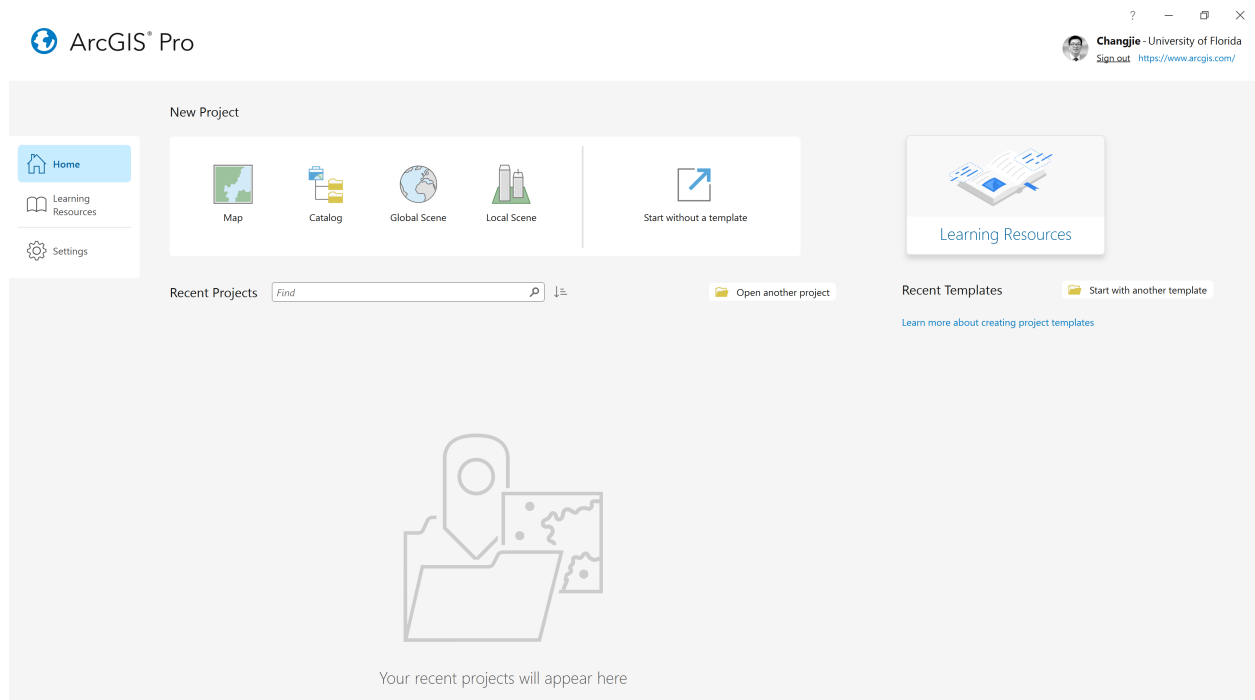
Go to the APPS tab, the two software applications of interest are ArcGIS Pro and ArcGIS Pro Python, as shown in the following image.
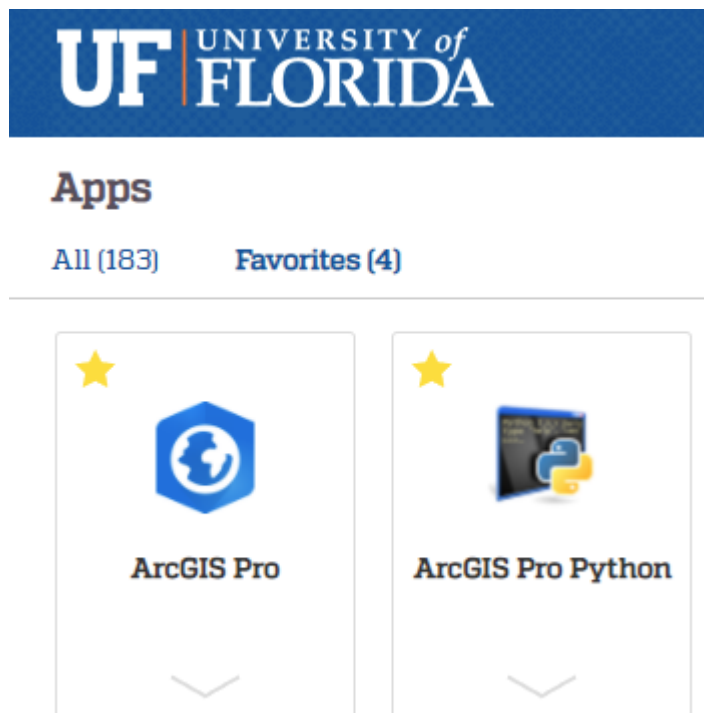
Open these software applications to test whether they work or not. See images on the next page for an image of successfully running of the two applications.

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ArcGIS Pro

Python Command Prompt (Start Menu -> All apps -> ArcGIS)