WHAT YOU WILL LEARN

GIS PROGRAMMING FUNDAMENTALS (WITH PYTHON)

Dr. Tateosian
Center for Geospatial Analytics
North Carolina State University


OK-KUN


SWITZERLAND
FRANCE
GREATER GERMANY
Milano
Verona
Mantua
Bologna
Florence
ITALY
Rome
DEPORTATIONS FROM ITALY 1943–1944
MILES
Assembly Plants
Deportations
German Ally
German-Occupied

What do we hope to teach

1. The foundations of programming and Python syntax

2. Python access to ArcGIS.

3. Combine data processing and analysis to create a meaningful tool with an easy interface that eliminates tedious manual processing.

Course learning outcomes

Students will be able to…

- interpret basic Python syntax (indentation, context highlighting)
- write Python scripts in an integrated development environment (PythonWin)
- use Python to construct code using core data structures (strings, lists, …)
- call ArcGIS tools with Python (arcpy.buffer…)
- handle contingencies within Python (if, else…)
- construct basic batch processing Python code (looping)
- read/modify data files with Python
- create a graphical user interface
- do more…

Course project examples

Course project example

Data preparation for Generating NOAA Acoustic Trawl Survey Fish Species Biomass Estimates - Shannon Dolan

Input: NOAA acoustic trawl navigational and cluster csv tables.

Output: Cleaned daytime data for specific species, a map of the data, and an HTML page to show the result.

Recreational Aviation Navigation - Aaron Jones

Input: Departure and destination airports, operational range, planned altitude for the flight.

Output Flight map and HTML page including flight map plan and recommended stops.

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Updates and reading

ArcMap to ArcGIS Pro & Python 2 to Python 3

- Noticeable differences
  1. mapping in ArcGIS
     Python 2: arcpy.mapping....
     Python 3: arcpy.mp....
  2. Script tools look different.
  3. Printing
     Python 2: print "hello"
     Python 3: print("hello")

- Prioritizing semantic differences
  - Some videos // slides may contain old-style print statements

Textbook readings

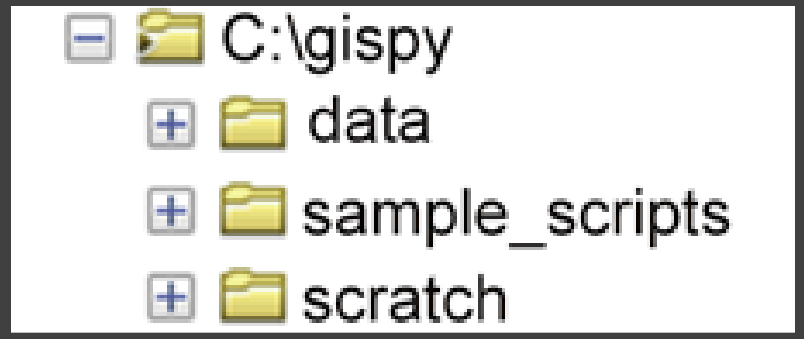
1. Selected readings from an updated (Python 3) version of Tateosian, Laura. Python For ArcGIS. Cham, Switzerland: Springer, 2015.

   - These reading will be provided as PDF documents linked to the course Moodle page.
   - The electronic version of this textbook available through the library is Python 2 and uses ArcMap, so please refer to the chapters linked in Moodle instead, unless otherwise notified.
   - Caution: If you read ahead, you might outpace me as I work to update the chapters this semester.

2. Selected readings from: Zandbergen, Paul A. Python Scripting for ArcGIS Pro. Redlands, CA, USA: Esri Press, 2020.

Data and sample scripts

- Download the data and sample scripts from http://go.ncsu.edu/gispy

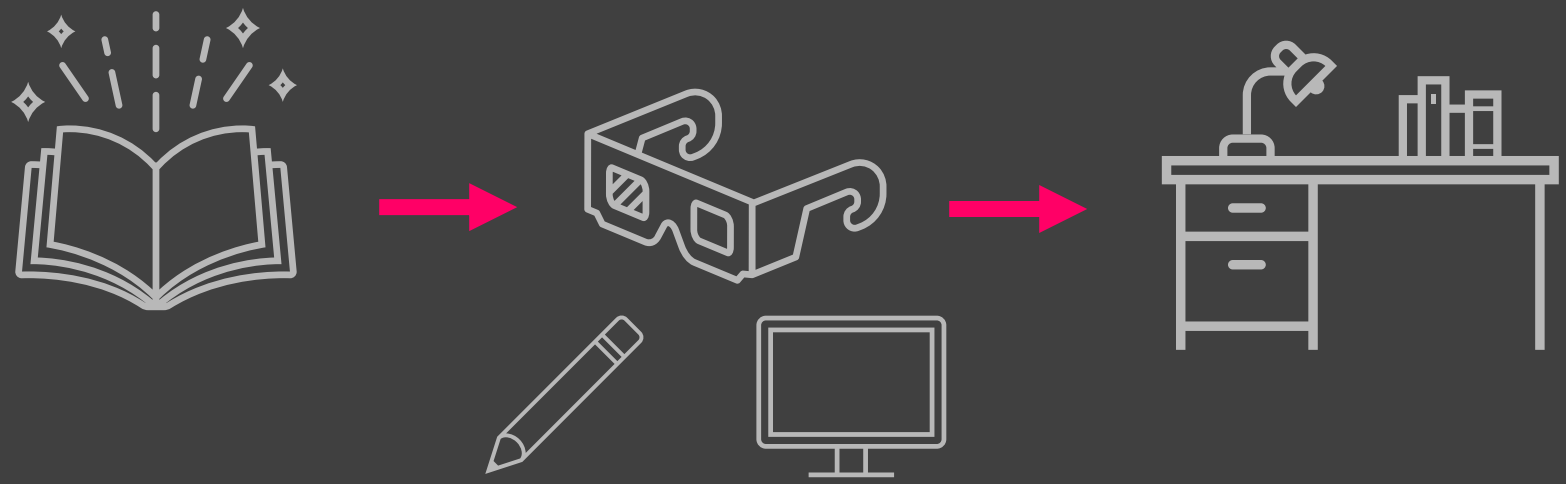


GRADING AND EXPECTATIONS

What to expect

“Although the lectures provided a nice introduction to the material, I definitely learned to code best by reading the textbook and working through assignments (I think this is just the nature of coding).”

--Anonymous student on course eval.



Put more in, expect more

GIS Cartographer Salaries

Job Title	Salary
Maps.com **GIS Cartographer salaries** - 1 **salaries** reported	$44,270/yr
Jeppesen **Cartographer/GIS salaries** - 1 **salaries** reported	$73,383/yr
DATA SOLUTIONS & TECHNOLOGY **Cartographer/GIS** Technician I **salaries** - 1 **salaries** reported	$51,826/yr

GIS Developer Salary

	Annual Salary
Top Earners	$147,000
75th Percentile	$124,500
Average	$110,411
25th Percentile	**$95,000**

Grading Overview

- Homework (25%)
- Mid-term Exam (25%)
- 4 timed quizzes (20%)
- Final project (20%)
- Participation (10%)

Homework (25%)

- Python scripts (10 pts each)
- Moodle exercises (~20 pts each)
- Other (tutorials, polls,...)

Mid-term exam (25%)

- Closed book, paper, 2 hour
- Proctored

  DE students need to make a reservation through the NCSU Testing Services

Quizzes (20%)

- Timed
- Open book
- Online (not proctored)

Participation (10%)

- Hands-on activities
- Participation in help sessions
- Lecture questions

Final project (20%)

Apply what you learn to a geospatial challenge of your choice

Final Project Instructions

Stage 1: Preliminary project proposal (~week 10)

Feedback

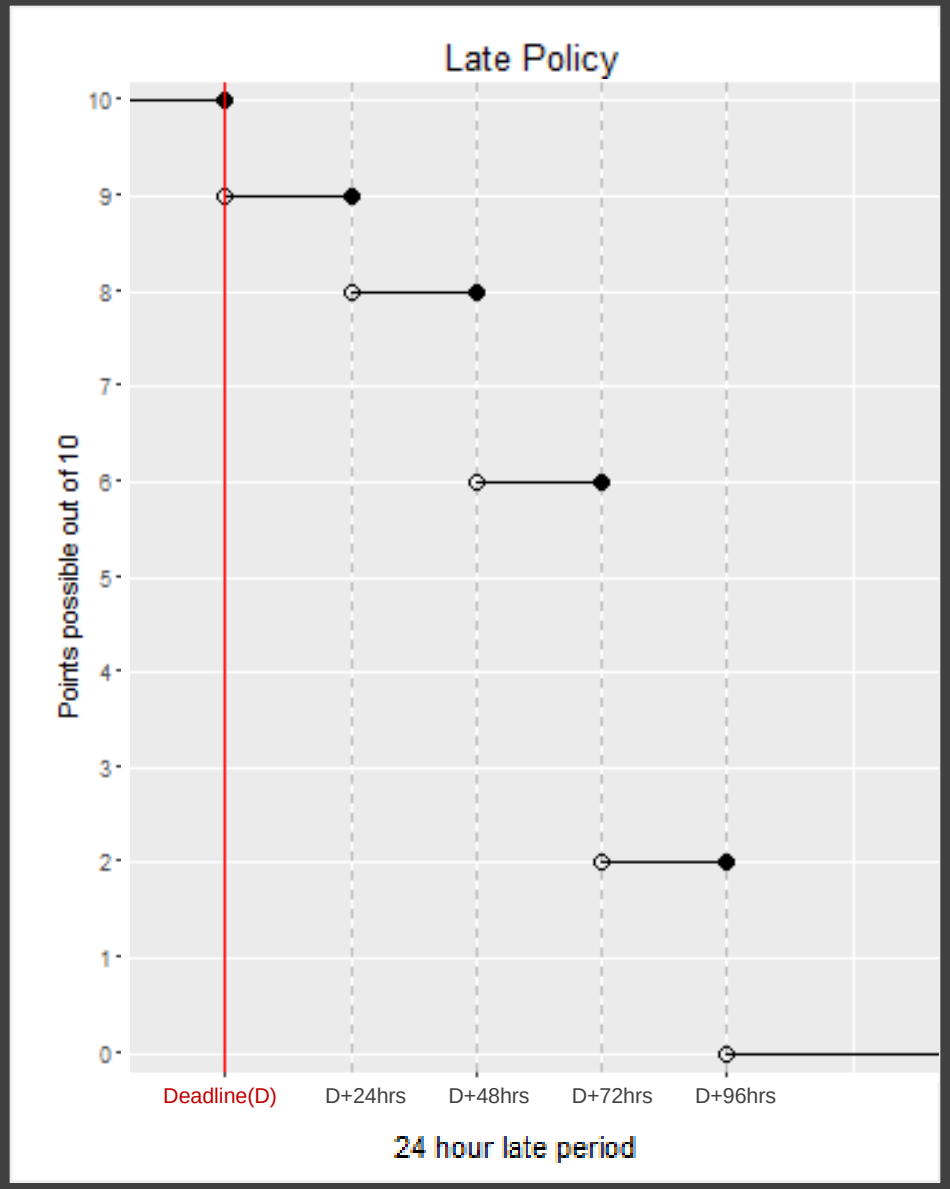
Stage 2: Project progress (~week 13)

Feedback

Stage 3: Final project submission (1st day of finals week)

Late homework

penalty $=10*2^{(r-1)}\%$
where *r* is the number of 24-hour periods late.



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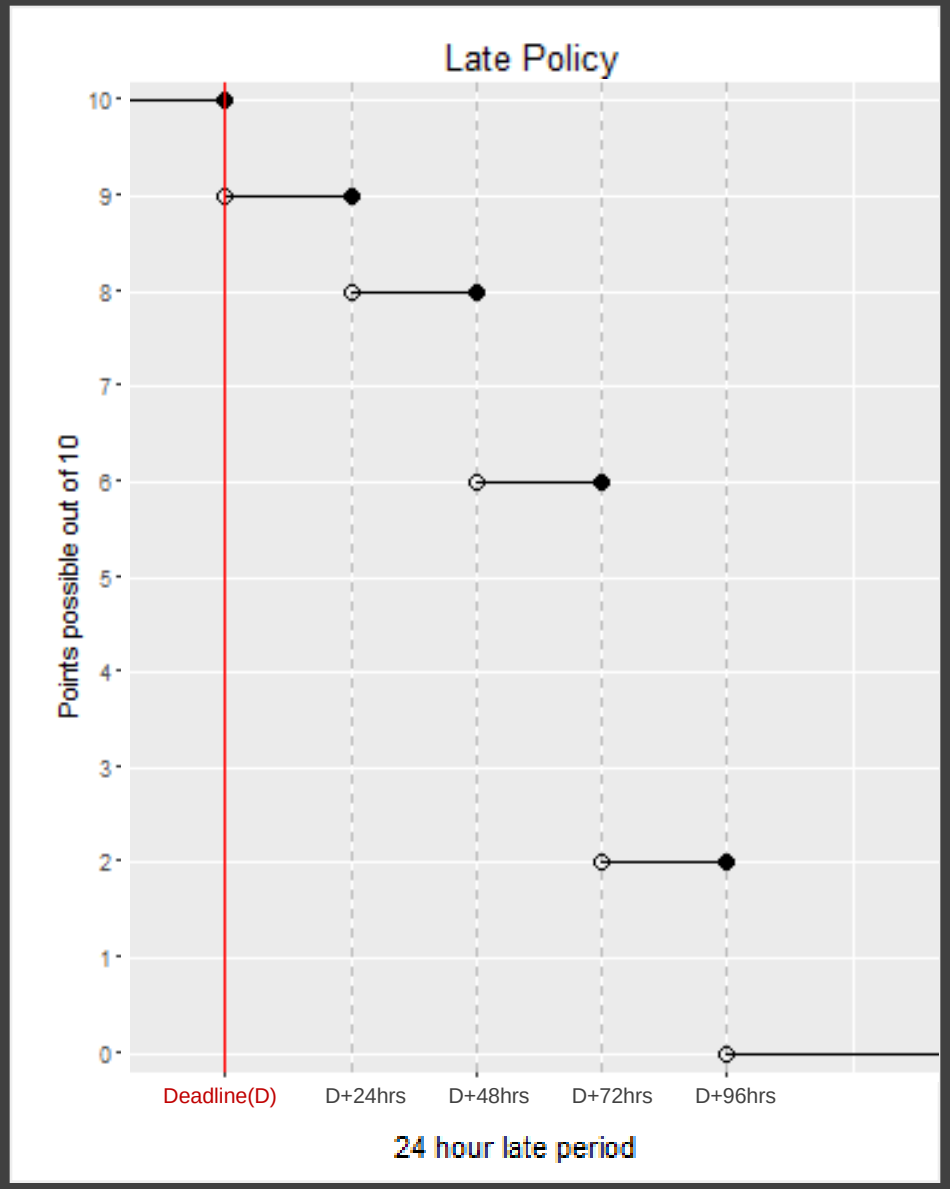
“Lateness” applies to each homework item separately.



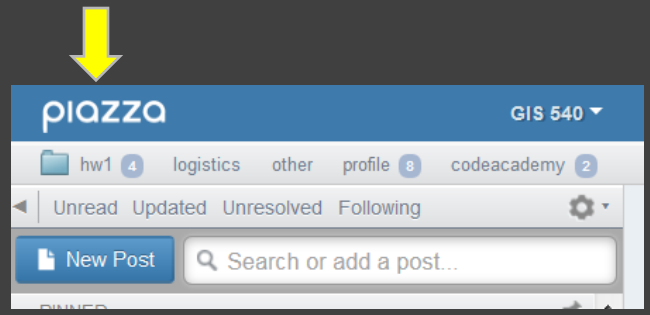
Academic integrity

- Material challenging -> utilize teaching staff help. Otherwise, **homework assignments must be completed alone**.
- University policy is strict. Read the NCSU policy overview and Sections 8 and 9 of the Code of Student Conduct linked to the syllabus.
- Building fundamental skills in this class. Group work not allowed unless specified.
- Study groups can discuss code from in-class exercises, slides, and assigned reading, but not from homework.
- Not allowed:
  - Copying.
  - Talking someone through the solution.
- If you need more help go to office hours, Skype with TAs, or use private posts on the message board.
- Otherwise, the work you submit for homework must be entirely your own.

GETTING HELP

Message board (Piazza)

- Post Type: question or note
- Post To: public or private (to instructors)
- Select folder(s)
- Filtering and searching



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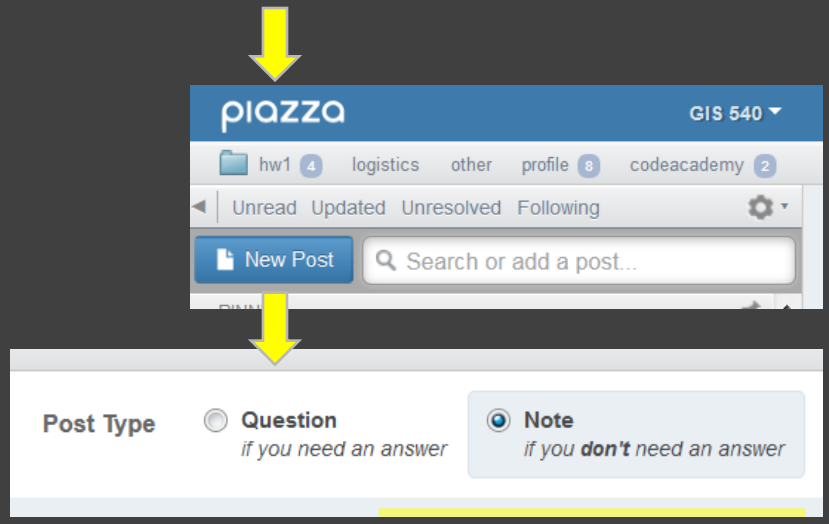

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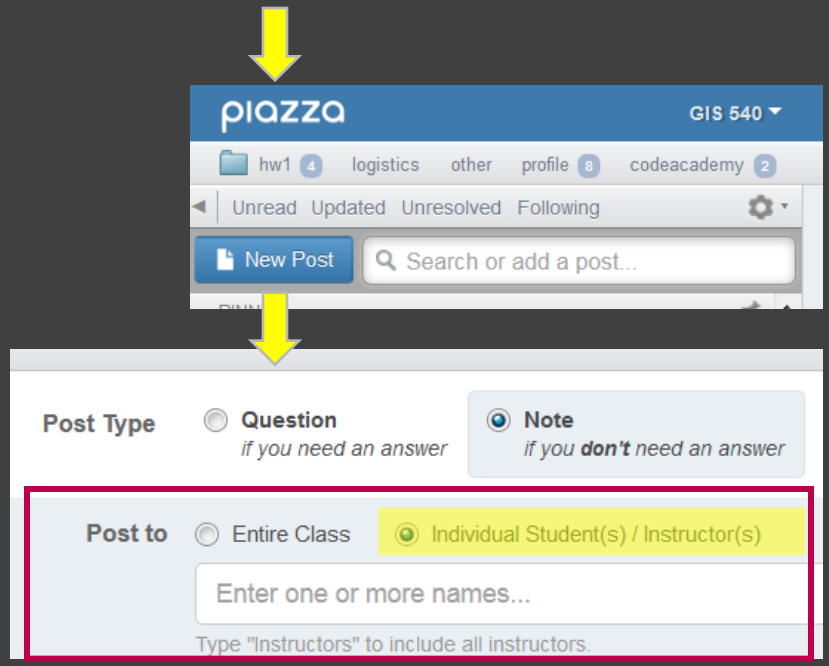

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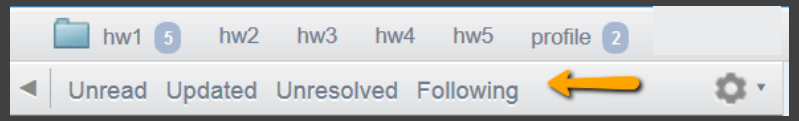

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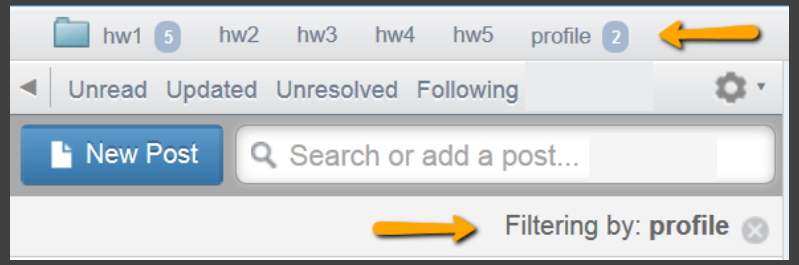

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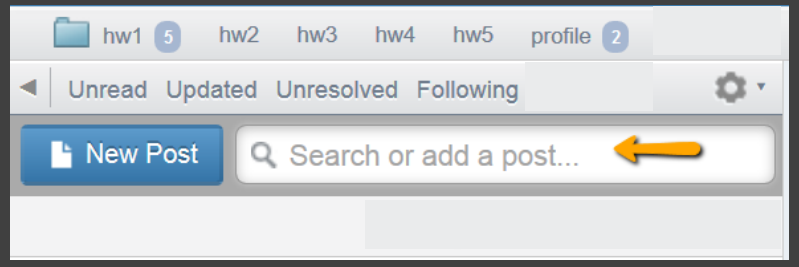
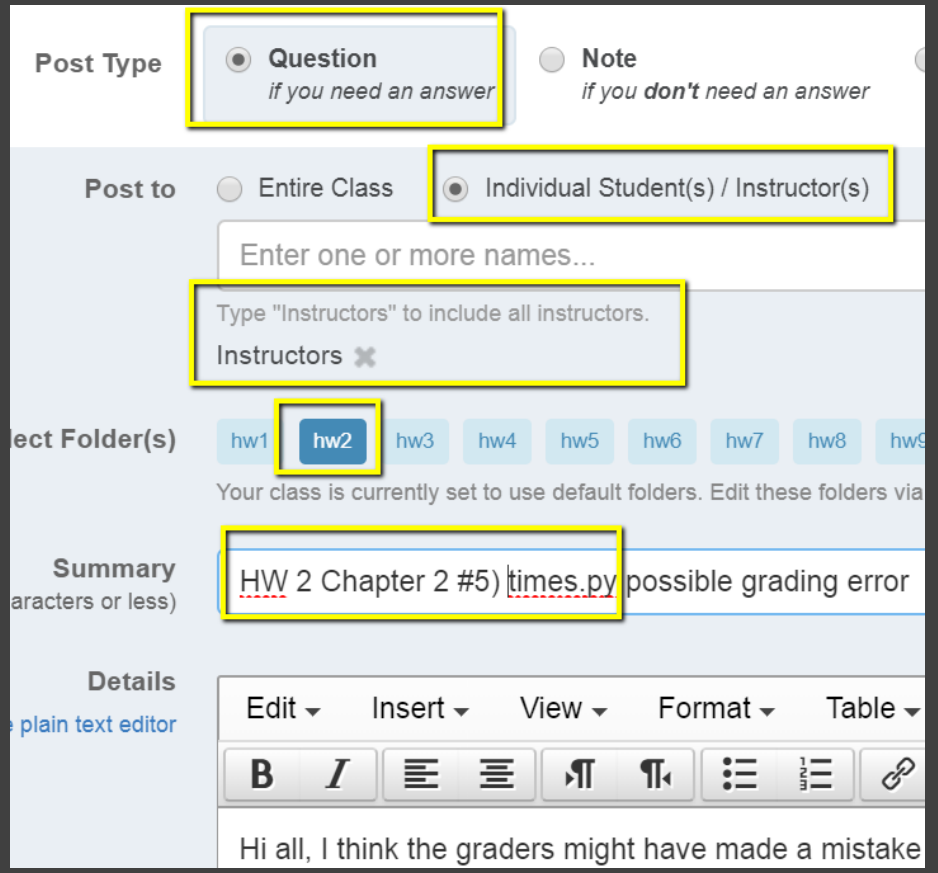


HELP!

Use the message board
Meet with instructors/TAs

Grade changes

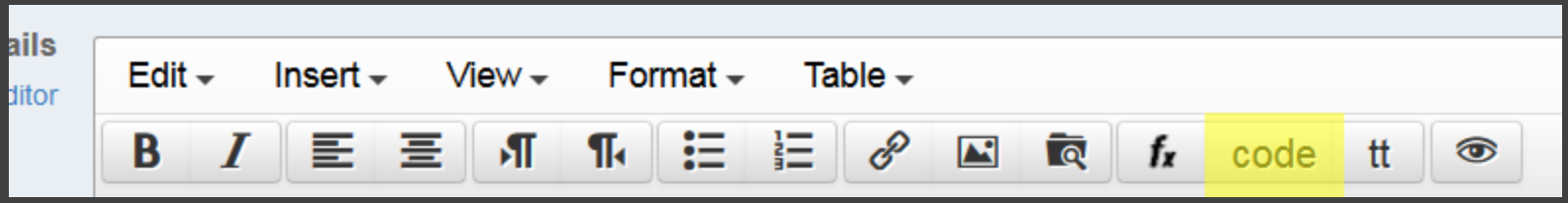
- Grades and comments posted in the Moodle gradebook.
- Grade change requests must be submitted within one week of being returned.



- Submit grade change requests via private (to instructors) note on the message board. Be sure to provide the assignment number and question name and briefly explain the issue.
- Our goal is fair grading and we want to correct any errors.

Posting code questions on forums

- How to create a minimal, complete, and verifiable example
- make questions as specific and focused on one particular problem.
- post the error message and what you're trying to do.
- use the chapter where the homework question comes from.



- use the 'code' button to post code.
- enable students to discover mistakes.

Course schedule

- **1st Quarter**
  Intro to Python basics, integrated development environments, data structures, ArcGIS API, decision making, looping

- **2nd Quarter** project proposal

  Batch processing, debugging, error handling, functions, cursors

- **3rd Quarter** updated proposal

  Dictionaries, reading and writing text files, file GUI's, modules, classes, Mapping with Python

- **4th Quarter**

  Reading and writing HTML and KML, script tools, additional modules, project work

SOFTWARE

Submitting homework scripts

- All deadlines are given in EST.
- Scripts should be named as specified.
- Put your unityID (e.g., jkrowlin) and name in each script.
- Don’t zip submissions.

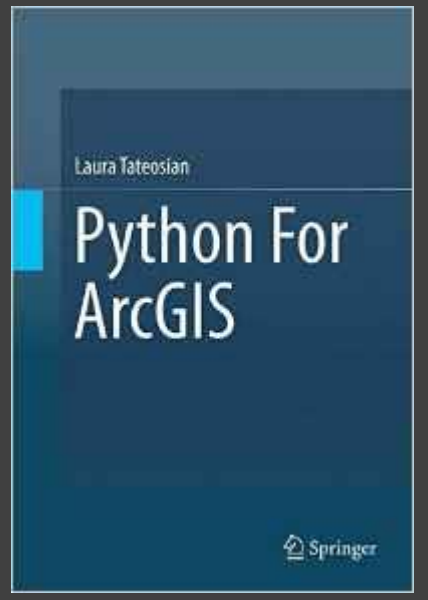
ESSENTIAL RESOURCES

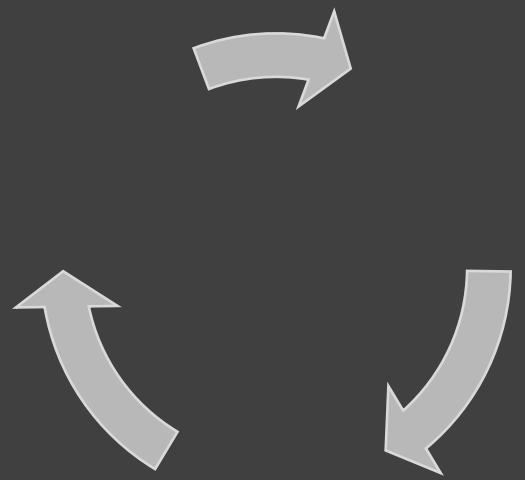
Py4All

- A tool designed to accompany the textbook, *Python for ArcGIS*

- How to use it:
  1. Watch the Intro to Py4All video
  2. Browse to go.ncsu.edu/py4all
  3. Login with your NCSU unity ID and password
  4. Upload a Python script for feedback.

- Can be used iteratively





Essential Resources

- Announcements (“FOLLOW” THESE)
  - General news and announcements will be posted here.
- Syllabus
  - Guidelines, expectations, and responsibilities for GIS540 participants.
- Piazza message board
  - Post your questions or comments (see the how-to) regarding assignments, software issues, and coding challenges here.
- Instructors (a.k.a. Meet the instructor)
  - Professor and Teaching Assistant names, photos, and office hour arrangements.
- Py4All
  - upload textbook exercise scripts to receive automated feedback, compare your output to the solution output, and use this information to improve the script prior to submitting it for a grade.
- gispy.zip
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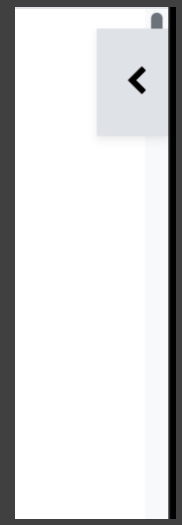

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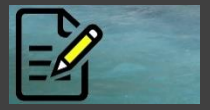
Schedule

- Week blocks
  - Topic 1
    - Readings
    - Videos
    - Slides
    - In-class exercises
  - Topic 2
    - Readings
    - Videos
    - …



Homework blocks

Quiz blocks

- Links to the quiz

READ AGAIN → TRY IT

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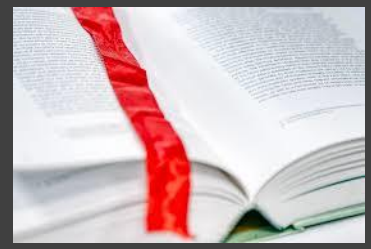

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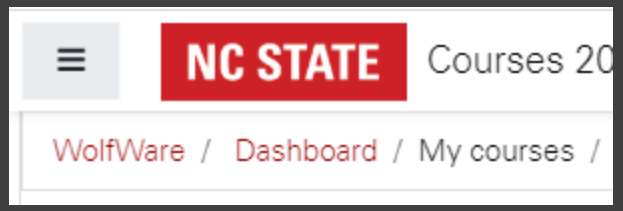
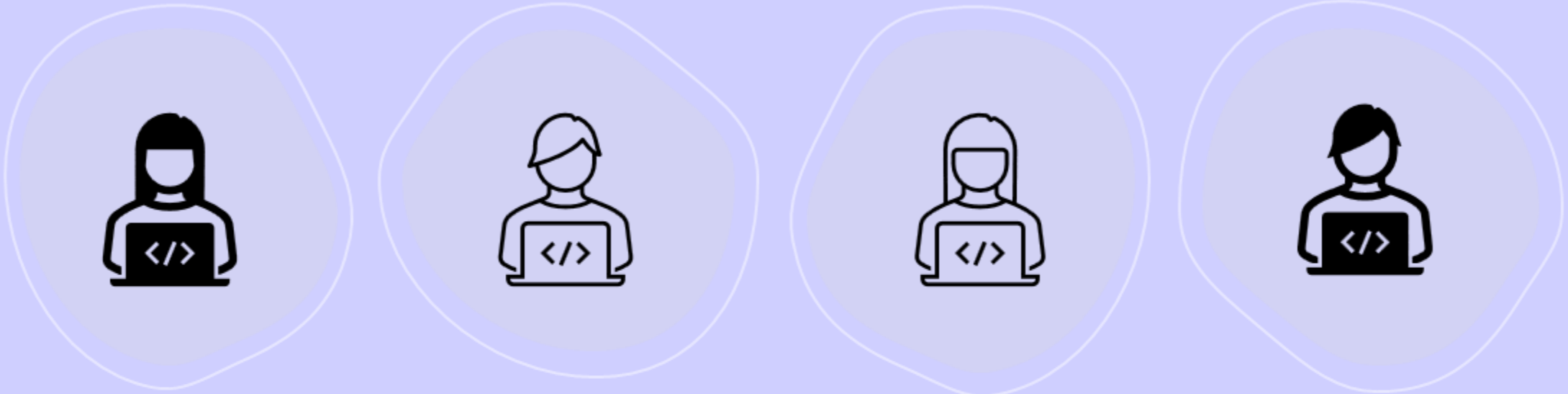
Moodle navigation

Click the hamburger to expand or collapse the navigation bands on the left –hand side.

“hamburger”





Hello world!

GIS 540 Geospatial Programming Fundamentals

Course | Participants | Grades

Essential Resources

Course ZOOM Link | Announcements | Syllabus | Py4All code checker

Course project instructions | Data & scripts (gispy.zip) | Schedule overview

HELP! PIAZZA MESSAGE BOARD (using Moodle login)

Software you need to install

- ArcGIS Pro
- DO NOT install Python (it is already installed with ArcGIS)
- PythonWin
  - Python is automatically installed with ArcGIS
  - PythonWin is not.
- Test if PythonWin is installed correctly
  - Type this at the prompt in the PythonWin Interactive Window:

    import arcpy
  - If you don't get an error message, you've got it.
- PyCharm is another easy IDE has some advantages over PythonWin (e.g., tabbed script windows and immediate tab completion) but has a steeper learning curve than PythonWin
- VS Code
  - We will use this to run Python notebooks when we run them outside of ArcGIS Pro