Term Information

Effective Term	Autumn 2020
Previous Value	*Summer 2018*

Course Change Information

What change is being proposed? (If more than one, what changes are being proposed?)

We are proposing that GEOG 5222 be offered in alternative formats. In addition to the traditional in person lecture, we propose to teach GEOG 5222 as a hybrid course (predominately online with one 50 minute in class session per week) and as a completely online course.

What is the rationale for the proposed change(s)?

Our goal is to make the course more available to students in all terms who need the course offered in an alternative format to accommodate work or athletic schedules, greater accessibility needs, as well as to accommodate students who are away from the OSU campus. Our hope is to increase enrollments with the completely online option. Alternative formats will also provide greater capacity potential enrollments without detracting from student learning and instructor engagement.

What are the programmatic implications of the proposed change(s)?

(e.g. program requirements to be added or removed, changes to be made in available resources, effect on other programs that use the course)?
None.

Is approval of the request contingent upon the approval of other course or curricular program request? No

Is this a request to withdraw the course? No

General Information

Course Bulletin Listing/Subject Area	Geography
Fiscal Unit/Academic Org	Geography - D0733
College/Academic Group	Arts and Sciences
Level/Career	Graduate, Undergraduate
Course Number/Catalog	5222
Course Title	GIS Algorithms and Programming
Transcript Abbreviation	GIS Programming
Course Description	The theory and algorithms underpinning today's GIS technology and the development of custom GIS applications using the Python programming language.
Semester Credit Hours/Units	Fixed: 3

Offering Information

Length Of Course	14 Week, 12 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	Yes
Is any section of the course offered	100% at a distance
	Greater or equal to 50% at a distance
Previous Value	*No*
Grading Basis	Letter Grade
Repeatable	No
Course Components	Lecture
Grade Roster Component	Lecture

Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Columbus

Prerequisites and Exclusions

Prerequisites/Corequisites	Prereq: A grade of C- or above in 5212.
Exclusions	
Electronically Enforced	Yes

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	27.0304
Subsidy Level	Doctoral Course
Intended Rank	Junior, Senior, Masters, Doctoral

Requirement/Elective Designation

Required for this unit's degrees, majors, and/or minors
The course is an elective (for this or other units) or is a service course for other units

Course Details

Course goals or learning objectives/outcomes	• Understand and apply fundamental constructs and styles of programming using Python
	• Understand the basics of computational issues such as time complexity and indexing
	• Develop and test computer programs to handle spatial data sets
	• Develop and test Python programs for basic geometric processing
	• Understand basic spatial indexing methods for point data sets
	• Write Python programs to conduct spatial analysis and visualization
Previous Value	• *Demonstrate a familiarity with important GIS algorithms and methods*
	• *Develop Python programming language skills to carry out spatial operations*
	• *Design effective approaches to geographical problems using GIS.*
Content Topic List	• Python programming language
	• Geometric algorithms
	• spatial indexing
	• Applications
Previous Value	• *GIS*
	• *Algorithms*
	• *Programming*
	• *Python language*

Sought Concurrence   No

Attachments

- Geog 5222 Online_review.pdf: ASCTech review (online)

  (Other Supporting Documentation. Owner: Xiao,Ningchuan)

- Geog 5222 Hybrid_review.pdf: ASCTech review (hybrid)

  (Other Supporting Documentation. Owner: Xiao,Ningchuan)

- Geog5222_syllabus_online.pdf: Syllabus (online)

  (Syllabus. Owner: Xiao,Ningchuan)

- Geog5222_syllabus_hybrid.pdf: Syllabus (hybrid)

  (Syllabus. Owner: Xiao,Ningchuan)

- Geog5222_syllabus_in_person.pdf: Syllabus (in person)

  (Syllabus. Owner: Xiao,Ningchuan)

Comments

- Please provide in-person syllabus for comparative purposes (for panel review). *(by Vankeerbergen,Bernadette Chantal on 12/04/2019 10:03 AM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Xiao,Ningchuan	12/03/2019 03:13 PM	Submitted for Approval
Approved	Munroe,Darla Karin	12/03/2019 03:26 PM	Unit Approval
Approved	Haddad,Deborah Moore	12/03/2019 04:09 PM	College Approval
Revision Requested	Vankeerbergen,Bernadette Chantal	12/04/2019 10:03 AM	ASCCAO Approval
Submitted	Xiao,Ningchuan	12/04/2019 03:49 PM	Submitted for Approval
Approved	Munroe,Darla Karin	12/04/2019 03:52 PM	Unit Approval
Approved	Haddad,Deborah Moore	12/04/2019 04:52 PM	College Approval
Pending Approval	Jenkins,Mary Ellen Bigler Hanlin,Deborah Kay Oldroyd,Shelby Quinn Vankeerbergen,Bernadette Chantal	12/04/2019 04:52 PM	ASCCAO Approval

SYLLABUS: GEOG 5222 (ONLINE)
GIS PROGRAMMING AND ALGORITHMS
AUTUMN 2020

COURSE OVERVIEW

Instructor

Instructor: Prof. Ningchuan Xiao
Email: xiao.37@osu.edu
Phone: 614-292-4072
Office hours: by appointment only (CarmenZoom)
Office Location: Derby Hall 1132

Course description

This class is about coding. More specifically we learn how to program a computer to handle spatial data. It is obvious, one may argue, that today's software is often quite easy to use and they are quite powerful too. So why should we do coding?

Coding is fun. In his book *The Mythical Man-month*, Frederick P. Brooks, Jr. talked about the reward of coding as the sheer joy of making things. Others agree. In a 1984 *New York Times* piece, Erik Sandberg-Diment gave three reasons of programming: "First, it allows you to develop software that is not available commercially, and in some cases it lets you customize purchased software to serve your specific needs better. Second, programming can be fun. If you enjoy working on puzzles, programming may well turn out to be more pleasurable than solving The Times crossword puzzle or Dr. Crypton's mind-bending puzzle page in Science Digest. Third, there is the intellectual exercise, the honing of logic skills and learning to learn, stressed by pedagogues as a perfect reason to have computers available in schools for pupils from kindergarten age on up." In a blog at the *Invent with Python* website, Al Sweigart pointed out that "Programming transforms your computer from a home appliance to a power tool." It is apparent that writing computer code is becoming an essential part of life. As Steve Jobs once put it, "everybody in this country should learn to program a computer...because it teaches you how to think."

In this class, we aim to help students gain freedom in dealing with spatial data. After completing this class, students will develop understanding on how spatial data works and how to write their own code to handle the data, instead of relying on existing (especially commercial) software packages. We use the powerful and most popular Python programming language in this class. We start from the basics of Python. About halfway through the semester, we should have developed sufficient knowledge about programming with Python and will start to use it on spatial datasets. Most of the materials do not rely on existing software packages, which will provide an intuitive way of understanding spatial data and spatial data processing. By the end of the semester, students should understand the fundamental considerations of computational issues in spatial data processing and should be able to write Python code to complete various tasks of using spatial data.

Course learning outcomes

By the end of this course, students should be able to:
- Understand and apply fundamental constructs and styles of programming using Python
- Understand the basics of computational issues such as time complexity and indexing
- Develop and test computer programs to handle spatial data sets
- Develop and test Python programs for basic geometric processing
- Understand basic spatial indexing methods for point data sets
- Write Python programs to conduct spatial analysis and visualization

How this course works

Mode of delivery: This course is 100% online. There are no required sessions when you must be logged in to Carmen at a scheduled time.

Pace of online activities: This course is divided into **weekly modules** that are released one week ahead of time. Each module is organized around a specific topic (see course schedule below) and consists of introduction videos, coding tutorials, and student activities (see assignment information below). Students are expected to keep pace with weekly deadlines but may schedule their efforts freely within that time frame.

Credit hours and work expectations: This is a 3-credit-hour course. According to Ohio State policy, a 3 credit hour course comprises 3 hours of instruction in class (including online instruction content and Carmen activities) and 6 hours of homework/study time outside class per week, for a total of 9 hours per course per week, for the student to earn a C grade.

Textbooks and Other Materials

Required textbooks

Downey, Allen B. 2016. *Think Python*. 2nd Edition. O'Reilly Media.

Xiao, Ningchuan. 2016. *GIS Algorithms*. SAGE Publications.

Other materials

A GitHub site repository at http://github.com/gisalgs will be used intensively for most part of the class. We will only access this repository through a web browser. This is a public website and everyone can access. The detailed accessibility statement of GitHub can be found at https://government.github.com/accessibility. The privacy statement of GitHub can be found at https://help.github.com/en/github/site-policy/github-privacy-statement.

Tutorials and lecture notes will be made available through the course schedule page on Carmen. There are also numerous useful online sources for learning Python. For example, The Hitchhiker's Guide to Python! (https://docs.python-guide.org/) has information that can be extremely practical for many beginners. The official Python Tutorial (https://docs.python.org/3/tutorial/) is a good place to find the details on most of the topics in Python coding (make sure to choose the right version on top of the page).

Course technology

For help with your password, university e-mail, Carmen, or any other technology issues, questions, or requests, contact the OSU IT Service Desk. Standard support hours are available at https://ocio.osu.edu/help/hours, and support for urgent issues is available 24x7.

- **Self-Service and Chat support:** http://ocio.osu.edu/selfservice
- **Phone:** 614-688-HELP (4357)
- **Email:** 8help@osu.edu
- **TDD:** 614-688-8743

Baseline technical skills necessary for online courses

- Basic computer and web-browsing skills
- Navigating Carmen

Technology skills necessary for this specific course

- CarmenZoom text, audio, and video chat
- Recording a slide presentation with audio narration

- Recording, editing, and uploading video

Necessary equipment

- Computer: current Mac (OS X) or PC (Windows 7+) with high-speed internet connection
- Webcam: built-in or external webcam, fully installed
- Microphone: built-in laptop or tablet mic or external microphone

Necessary software

- Python: students will install Python 3 and necessary libraries on their own computers and detailed instructions will be provided.
- Proctorio: A software program that will monitor online exams

Carmen Access

You will need to use BuckeyePass multi-factor authentication to access your course in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you take the following steps:

- Register multiple devices in case something happens to your primary device. Visit the BuckeyePass-Adding a Device help article for step-by-step instructions.
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click "Enter a Password" and then click "Text me new codes" button that appears. This will text you ten passcodes good for 365 days that can be each used once.
- Download the Duo Mobile application to all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or wi-fi service.

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at 614-688-4537 (HELP) and the IT support staff will work out a solution with you.

Grading and faculty response

Grades

Assignment or category	Percent
Exercises	30
Homework	20
Final projects	20

Quizzes	20
Discussion posts and responses	10
Total	100

Assignment information

The assignments are organized to provide multiple lower stakes opportunities. While they will build of learning from various modules. There are no cumulative high stakes assignments.

Discussion posts & responses: At the end of each week, we will post 2 or more questions on the discussion board and students are required to post their responses. In addition, students should also actively participate the discussion board by either posting their problems or responding to other students' posts (or both).

Exercises: After each week, there will be some review exercises that require students to finish by two days after finishing the online tutorial. These are typically reflection questions that are used to make sure students have completed the contents. Quick feedbacks will be provided to students.

Homework: For each major topic on the course schedule, there will be a homework assignment that includes some more in-depth questions for students to finish. These questions typically require more intensive coding efforts and students have two weeks to finish.

Quizzes: Quiz will be given after we finish a major topic. These are open-book quizzes that will require students use the computer to answer. These quizzes are intensive coding exercises that require students to finish in a fixed timeframe of 50 minutes.

Final projects: A list of guided questions will be provided in the middle of the semester and each student will choose to answer one of these questions. The questions will be based on the topics covered in the semester. Only sufficient information will be provided, which means I will not provide all the implementation details for the questions and students must find solutions by themselves. There will also be open questions that give students a lot of freedom to choose their own project. The open questions will require a short proposal from the students.

Late assignments

Late submissions will be accepted up to a week past the due date. One day late will incur a 10% penalty. Two days late will incur 20% penalty. Three days will incur a 30% penalty. Four days late will incur a 40% penalty. Five to seven days late will only receive 50% credit of the grade you would have received if it was submitted on time. If you contact me ahead of time for deadline adjustments you will not incur any penalty. Please refer to Carmen for due dates.

Grading scale

93–100: A
90–92.9: A-
87–89.9: B+
83–86.9: B
80–82.9: B-
77–79.9: C+
73–76.9: C
70 –72.9: C-
67 –69.9: D+
60 –66.9: D
Below 60: E

Faculty feedback and response time

I am providing the following list to give you an idea of my intended availability throughout the course. (Remember that you can call **614-688-HELP** at any time if you have a technical problem.)

Grading and feedback

For the exercises, students should be able to see the grade and feedback in **2 days**. For large assignments (homework and projects), the timeframe to expect feedback is generally **7 days**.

E-mail

E-mails will be replied within **48 hours**, and we aim for **24 hours during school days.**

Discussion board

We will check and reply to messages in the discussion boards every **24 hours on school days**.

Office Hours

Virtual office hours (held on CarmenZoom) require at least **24 hours notification** and will only be offered **during school days**.

Attendance, participation, and discussions

Student participation requirements

Because this is a distance-education course, your attendance is based on your online activity and participation. The following is a summary of everyone's expected participation:

- **Logging in**: **AT LEAST TWICE PER WEEK**
  Be sure you are logging in to the course in Carmen each week, including weeks with holidays or weeks with minimal online course activity. (During most weeks you will

probably log in many times.) If you have a situation that might cause you to miss an entire week of class, discuss it with me *as soon as possible.*

- **Office hours & video recordings**: **OPTIONAL OR FLEXIBLE**
  All video recordings will be posted, no live sessions. If you are interested in discussing an assignment in person, please contact us at the beginning of the week to schedule office hours by appointment.
- **Participating in discussion forums**: **2+ TIMES PER WEEK**
  As participation, each week you can expect to post at least two times (including your response to the discussion questions, your own questions, and other students' post).

Discussion and communication guidelines

The following are my expectations for how we should communicate as a class. Above all, please remember to be respectful and thoughtful.

- **Writing style**: While there is no need to participate in class discussions as if you were writing a research paper, you should remember to write using good grammar, spelling, and punctuation. Informality (including an occasional emoticon) is fine for non-academic topics.
- **Tone and civility**: Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably. Remember that sarcasm doesn't always come across online.
- **Citing your sources**: When we have academic discussions, please cite your sources to back up what you say. (For the textbook or other course materials, list at least the title and page numbers. For online sources, include a link.)
- **Backing up your work**: Consider composing your academic posts in a word processor, where you can save your work, and then copying into the Carmen discussion.

Other course policies

Academic integrity policy

Policies for this online course

- **Quizzes and exams**: You must complete the midterm and final exams yourself, without any external help or communication. Weekly quizzes are included as self-checks without points attached.
- **Written assignments**: Your written assignment, including discussion posts, should be your own original work. In formal assignments, you should follow The Chicago Manual of Style 17th edition ([click here for online version](#)) to cite the ideas and words of your research sources.

- **Reusing past work**: In general, you are prohibited in university courses from turning in work from a past class to your current class, even if you modify it. If you want to build on past research or revisit a topic you've explored in previous courses, please discuss the situation with me.
- **Falsifying research or results**: All research you will conduct in this course is intended to be a learning experience; you should never feel tempted to make your results or your library research look more successful than it was.
- **Collaboration and informal peer-review**: The course includes many opportunities for formal collaboration with your classmates. While study groups and peer-review of major written projects is encouraged, remember that comparing answers on a quiz or assignment is not permitted. If you're unsure about a particular situation, please feel free just to ask ahead of time.

Ohio State's academic integrity policy

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct http://studentlife.osu.edu/csc/.

Copyright disclaimer

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

Statement on title IX

Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories (e.g., race). If you or someone you know has been sexually harassed or assaulted, you may find the appropriate resources at http://titleix.osu.edu or by contacting the Ohio State Title IX Coordinator, Kellie Brennan, at titleix@osu.edu

Your mental health!

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other

concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling 614- 292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1-800-273- TALK or at suicidepreventionlifeline.org

Accessibility accommodations for students with disabilities

The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.

Accessibility of course technology

This online course requires use of Carmen (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request accommodations with your instructor.

- Carmen (Canvas) accessibility
- Streaming audio and video (Kanopy & DocuSeek)
- Synchronous course tools

Additional Student Support Services

Student Advocacy Center: Answer students' questions, direct students to appropriate resources and departments, provides general university guidance

- 614-292-1111 http://advocacy.osu.edu/

Student Wellness Center: Promoting student wellness through nine dimensions of wellness

- 614-292-4527 http://swc.osu.edu/

Multicultural Center: Offering programs, services and outreach for all OSU students; supporting and celebrating all students through a intercultural model

- 614-688-8449 http://www.mcc.osu.edu/

Academic Advising: Advising for undergraduate students on the Columbus campus is provided by the individual college or department that offers the program of study you are pursuing. This allows you to get advice from someone who knows the specifics of your curriculum

- https://advising.osu.edu/

Student Academic Services: Find information by topic and take care of your personal Buckeye business (i.e. Financial Aid and other services) online at buckeyelink.osu.edu. Or speak with someone in person.

- Student Academic Services Bldg., Lobby
  281 W. Lane Ave. [map]
  Monday–Thursday: 9 a.m. to 5 p.m.
  Friday: 9 a.m. to 4 p.m.

Academic Support Services: This includes various resources for learning support from tutoring and study strategies to stress management and confidence building.

- http://younkinsuccess.osu.edu/academic-services/

Course schedule (tentative)

The following is a tentative course schedule. Detailed links will be provided on the Carmen course page. In the Reading column, the first letter refers to the textbooks by Downey (D) or Xiao (X), and the numbers are chapter and section.

Week	Dates	Topics	Reading
1	8/25/20-8/28/20	Getting started with Python	D1, D2
2	8/31/20-9/4/20	Functions	D3, D6
3	9/7/20-9/11/20	Flow control	D4, D5, D7
4	9/14/20-9/18/20	Python data structures: lists, tuples, dictionaries	D8, D10, D11, D12
5	9/21/20-9/25/20	Classes in Python	D15, D16, D17
6	9/28/20-10/2/20	Geometry: encoding, drawing, and GeoJSON	X2.2

7	10/5/20-10/9/20	Geometry: areas, centroid, and point in polygon algorithms	X2.4, X2.7
8	10/12/20-10/16/20	Geometry: map projections	X2.8
9	10/19/20-10/23/20	Spatial indexing: basics	X1, X4
10	10/26/20-10/30/20	Spatial indexing: point k-D trees	X5.1
11	11/2/20-11/6/20	Spatial indexing: point quadtrees	X6.2
12	11/9/20-11/13/20	Spatial indexing: computational issues	X5.3
13	11/16/20-11/20/20	Spatial analysis: network algorithms	X10.1, X10.2
14	11/23/20-11/27/20	Thanksgiving week	
15	11/30/20-12/4/20	Spatial analysis: pattern and clustering algorithms	X9.1, X9.3

SYLLABUS: GEOG 5222 (HYBRID)
GIS PROGRAMMING AND ALGORITHMS
AUTUMN 2020

COURSE OVERVIEW

Instructor

Instructor: Prof. Ningchuan Xiao
Email address: xiao.37@osu.edu
Phone number: 614-292-4072
Office hours: TBD or by appointment (in person or CarmenZoom)
Office Location: Derby Hall 1132

Course description

This class is about coding. More specifically we learn how to program a computer to handle spatial data. It is obvious, one may argue, that today's software is often quite easy to use and they are quite powerful too. So why should we do coding?

Coding is fun. In his book *The Mythical Man-month*, Frederick P. Brooks, Jr. talked about the reward of coding as the sheer joy of making things. Others agree. In a 1984 *New York Times* piece, Erik Sandberg-Diment gave three reasons of programming: "First, it allows you to develop software that is not available commercially, and in some cases it lets you customize purchased software to serve your specific needs better. Second, programming can be fun. If you enjoy working on puzzles, programming may well turn out to be more pleasurable than solving The Times crossword puzzle or Dr. Crypton's mind-bending puzzle page in Science Digest. Third, there is the intellectual exercise, the honing of logic skills and learning to learn, stressed by pedagogues as a perfect reason to have computers available in schools for pupils from kindergarten age on up." In a blog at the *Invent with Python* website, Al Sweigart pointed out that "Programming transforms your computer from a home appliance to a power tool." It is apparent that writing computer code is becoming an essential part of life. As Steve Jobs once put it, "everybody in this country should learn to program a computer...because it teaches you how to think."

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Course learning outcomes

By the end of this course, students should be able to:
- Understand and apply fundamental constructs and styles of programming using Python
- Understand the basics of computational issues such as time complexity and indexing
- Develop and test computer programs to handle spatial data sets
- Develop and test Python programs for basic geometric processing
- Understand basic spatial indexing methods for point data sets
- Write Python programs to conduct spatial analysis and visualization

How this course works

Hybrid mode of delivery: This course is mostly online. There is one 50 minute session required in person class session per week. Students are expected to study the course materials online and attend the in-class sessions for case studies, quizzes, and final exam.

Pace of online activities: This course is divided into **weekly modules** that are released one week ahead of time. Each module is organized around a specific topic (see course schedule below) and consists of introduction videos, coding tutorials, and student activities (see assignment information below). Students are expected to keep pace with weekly deadlines. Students must be prepared for weekly in-class sessions.

Credit hours and work expectations: This is a 3-credit-hour course. According to Ohio State policy, a 3 credit hour course comprises 3 hours of direct instruction (including online and in-class instruction content and Carmen activities) and 6 hours of homework/study time outside class per week, for a total of 9 hours per course per week, for the student to earn a C grade. Of this allocated time, one 50 minute session will be held in person.

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- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click "Enter a Password" and then click "Text me new codes" button that appears. This will text you ten passcodes good for 365 days that can be each used once.
- Download the Duo Mobile application to all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or wi-fi service.

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at 614-688-4537 (HELP) and the IT support staff will work out a solution with you.

Grading and faculty response

Grades

Assignment or category	Percent
Exercises	20
Homework	20
Final projects	20
Quizzes	20

Discussion posts and responses	10
Final exam	10
Total	100

Assignment information

Discussion posts & responses: At the end of each week, we will post 2 or more questions on the discussion board and students are required to post their responses. In addition, students should also actively participate the discussion board by either posting their problems or responding to other students' posts (or both).

Exercises: After each week, there will be some review exercises that require students to finish by two days after finishing the online tutorial. These are typically reflection questions that are used to make sure students have completed the contents. Quick feedbacks will be provided to students.

Homework: For each major topic on the course schedule, there will be a homework assignment that includes some more in-depth questions for students to finish. These questions typically require more intensive coding efforts and students have two weeks to finish.

Quizzes: Quiz will be given after we finish a major topic. These are open-book quizzes that will require students use the computer to answer. These quizzes are intensive coding exercises that require students to finish in 50 minutes. **Quizzes are taken in-class** at times that will be scheduled at the beginning of the semester.

Final projects: A list of guided questions will be provided in the middle of the semester and each student will choose to answer one of these questions. The questions will be based on the topics covered in the semester. Only sufficient information will be provided, which means I will not provide all the implementation details for the questions and students must find solutions by themselves. There will also be open questions that give students a lot of freedom to choose their own project. The open questions will require a short proposal from the students.

Final exam: This is an **in-class**, closed-book exam that will take place in the finals week of the semester.

Late assignments

Late submissions will be accepted up to a week past the due date. One day late will incur a 10% penalty. Two days late will incur 20% penalty. Three days will incur a 30% penalty. Four days late will incur a 40% penalty. Five to seven days late will only receive 50% credit of the grade you would have received if it was submitted on time. If you contact me ahead of time for

deadline adjustments you will not incur any penalty. Certain in class assignments cannot be made up or accepted late. Please refer to Carmen for due dates.

Grading scale

93–100: A
90–92.9: A-
87–89.9: B+
83–86.9: B
80–82.9: B-
77–79.9: C+
73–76.9: C
70 –72.9: C-
67 –69.9: D+
60 –66.9: D
Below 60: E

Faculty feedback and response time

I am providing the following list to give you an idea of my intended availability throughout the course. (Remember that you can call **614-688-HELP** at any time if you have a technical problem.)

Grading and feedback

For the exercises, students should be able to see the grade and feedback in **2 days**. For large assignments (homework and projects), the timeframe to expect feedback is generally **7 days**.

E-mail

I will reply to e-mails within **48 hours,** I will aim for **24 hours during school days.** .

Discussion board

I will check and reply to messages in the discussion boards every **24 hours on school days**.

Office Hours

In-person and virtual office hours (held on CarmenZoom) require at least **24 hours notification** and will only be offered **during school days**.

Attendance, participation, and discussions

Student participation requirements

Because this is a hybrid course, your attendance is partially based on your online activity and participation. The following is a summary of everyone's expected participation:

- **Logging in**: **AT LEAST TWICE PER WEEK**
  Be sure you are logging in to the course in Carmen each week, including weeks with holidays or weeks with minimal online course activity. (During most weeks you will probably log in many times.) If you have a situation that might cause you to miss an entire week of class, discuss it with me *as soon as possible.*

- **Office hours & video recordings**: **OPTIONAL OR FLEXIBLE**
  All video recordings will be posted, no live sessions. If you are interested in discussing an assignment with me, please contact me at the beginning of the week to schedule virtual office hours by appointment.

- **Participating in discussion forums**: **2+ TIMES PER WEEK**
  As participation, each week you can expect to post at least two times (including your response to the discussion questions, your own questions, and other students' post).

Discussion and communication guidelines

The following are my expectations for how we should communicate as a class. Above all, please remember to be respectful and thoughtful.

- **Writing style**: While there is no need to participate in class discussions as if you were writing a research paper, you should remember to write using good grammar, spelling, and punctuation. Informality (including an occasional emoticon) is fine for non-academic topics.

- **Tone and civility**: Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably. Remember that sarcasm doesn't always come across online.

- **Citing your sources**: When we have academic discussions, please cite your sources to back up what you say. (For the textbook or other course materials, list at least the title and page numbers. For online sources, include a link.)

- **Backing up your work**: Consider composing your academic posts in a word processor, where you can save your work, and then copying into the Carmen discussion.

Other course policies

Academic integrity policy

Policies for this online course

- **Quizzes and exams**: You must complete the midterm and final exams yourself, without any external help or communication. Weekly quizzes are included as self-checks without points attached.

- **Projects**: You must complete the final project by yourself. Unless otherwise authorized, collaborations are not allowed for these projects. If your code is based on sources outside the textbook and code repositories at https://github.com/gisalgs, you must cite the sources in the user's manual.

- **Written assignments**: Your written assignment, including discussion posts, should be your own original work. In formal assignments, you should follow The Chicago Manual of Style 17th edition ([click here for online version](#)) to cite the ideas and words of your research sources.

- **Reusing past work**: In general, you are prohibited in university courses from turning in work from a past class to your current class, even if you modify it. If you want to build on past research or revisit a topic you've explored in previous courses, please discuss the situation with me.

- **Falsifying research or results**: All research you will conduct in this course is intended to be a learning experience; you should never feel tempted to make your results or your library research look more successful than it was.

- **Collaboration and informal peer-review**: The course includes many opportunities for formal collaboration with your classmates. While study groups and peer-review of major written projects is encouraged, remember that comparing answers on a quiz or assignment is not permitted. If you're unsure about a particular situation, please feel free just to ask ahead of time.

Ohio State's academic integrity policy

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct http://studentlife.osu.edu/csc/.

Copyright disclaimer

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

Statement on title IX

Title IX makes it clear that violence and harassment based on sex and gender are Civil Rights offenses subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories (e.g., race). If you or someone you know has been sexually harassed or assaulted, you may find the appropriate resources at http://titleix.osu.edu or by contacting the Ohio State Title IX Coordinator, Kellie Brennan, at titleix@osu.edu

Your mental health!

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling 614- 292-5766. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on call counselor when CCS is closed at 614-292-5766 and 24 hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at 1-800-273- TALK or at suicidepreventionlifeline.org

Accessibility accommodations for students with disabilities

The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.

Accessibility of course technology

This online course requires use of Carmen (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request accommodations with your instructor.

- [Carmen (Canvas) accessibility](#)
- Streaming audio and video (Kanopy & Docuseek)
- Synchronous course tools

Additional Student Support Services

Student Advocacy Center: Answer students' questions, direct students to appropriate resources and departments, provides general university guidance
- 614-292-1111 http://advocacy.osu.edu/

Student Wellness Center: Promoting student wellness through nine dimensions of wellness
- 614-292-4527 http://swc.osu.edu/

Multicultural Center: Offering programs, services and outreach for all OSU students; supporting and celebrating all students through a intercultural model
- 614-688-8449 http://www.mcc.osu.edu/

Academic Advising: Advising for undergraduate students on the Columbus campus is provided by the individual college or department that offers the program of study you are pursuing. This allows you to get advice from someone who knows the specifics of your curriculum
- https://advising.osu.edu/

Student Academic Services: Find information by topic and take care of your personal Buckeye business (i.e. Financial Aid and other services) online at buckeyelink.osu.edu. Or speak with someone in person.

- Student Academic Services Bldg., Lobby
281 W. Lane Ave. [map]
Monday–Thursday: 9 a.m. to 5 p.m.
Friday: 9 a.m. to 4 p.m.

Academic Support Services: This includes various resources for learning support from tutoring and study strategies to stress management and confidence building.
- http://younkinsuccess.osu.edu/academic-services/

Course schedule (tentative)

The following is a tentative course schedule. Detailed links will be provided on the Carmen course page. In the Reading column, the first letter refers to the textbooks by Downey (D) or Xiao (X), and the numbers are chapter and section.

Week	Dates	Topics	Reading
1	8/25/20-8/28/20	Getting started with Python	D1, D2
2	8/31/20-9/4/20	Functions	D3, D6
3	9/7/20-9/11/20	Flow control	D4, D5, D7
4	9/14/20-9/18/20	Python data structures: lists, tuples, dictionaries	D8, D10, D11, D12
5	9/21/20-9/25/20	Classes in Python	D15, D16, D17
6	9/28/20-10/2/20	Geometry: encoding, drawing, and GeoJSON	X2.2
7	10/5/20-10/9/20	Geometry: areas, centroid, and point in polygon algorithms	X2.4, X2.7
8	10/12/20-10/16/20	Geometry: map projections	X2.8
9	10/19/20-10/23/20	Spatial indexing: basics	X1, X4
10	10/26/20-10/30/20	Spatial indexing: point k-D trees	X5.1

11	11/2/20-11/6/20	Spatial indexing: point quadtrees	X6.2
12	11/9/20-11/13/20	Spatial indexing: computational issues	X5.3
13	11/16/20-11/20/20	Spatial analysis: network algorithms	X10.1, X10.2
14	11/23/20-11/27/20	Thanksgiving week	
15	11/30/20-12/4/20	Spatial analysis: pattern and clustering algorithms	X9.1, X9.3

SYLLABUS: GEOG 5222
GIS PROGRAMMING AND ALGORITHMS
AUTUMN 2020

COURSE OVERVIEW

Instructor

Instructor: Prof. Ningchuan Xiao
Email: xiao.37@osu.edu
Phone: 614-292-4072

Meeting time: Monday and Wednesday, 11:10 AM to 12:30 PM
Office hours: Monday and Wednesday 9:30 to 11:00 AM or by appointment
Office Location: Derby Hall 1132

Course description

This class is about coding. More specifically we learn how to program a computer to handle spatial data. It is obvious, one may argue, that today's software is often quite easy to use and they are quite powerful too. So why should we do coding?

Coding is fun. In his book *The Mythical Man-month*, Frederick P. Brooks, Jr. talked about the reward of coding as the sheer joy of making things. Others agree. In a 1984 *New York Times* piece, Erik Sandberg-Diment gave three reasons of programming: "First, it allows you to develop software that is not available commercially, and in some cases it lets you customize purchased software to serve your specific needs better. Second, programming can be fun. If you enjoy working on puzzles, programming may well turn out to be more pleasurable than solving The Times crossword puzzle or Dr. Crypton's mind-bending puzzle page in Science Digest. Third, there is the intellectual exercise, the honing of logic skills and learning to learn, stressed by pedagogues as a perfect reason to have computers available in schools for pupils from kindergarten age on up." In a blog at the *Invent with Python* website, Al Sweigart pointed out that "Programming transforms your computer from a home appliance to a power tool." It is apparent that writing computer code is becoming an essential part of life. As Steve Jobs once put

it, "everybody in this country should learn to program a computer...because it teaches you how to think."

In this class, we aim to help students gain freedom in dealing with spatial data. After completing this class, students will develop understanding on how spatial data works and how to write their own code to handle the data, instead of relying on existing (especially commercial) software packages. We use the powerful and most popular Python programming language in this class. We start from the basics of Python. About halfway through the semester, we should have developed sufficient knowledge about programming with Python and will start to use it on spatial datasets. Most of the materials do not rely on existing software packages, which will provide an intuitive way of understanding spatial data and spatial data processing. By the end of the semester, students should understand the fundamental considerations of computational issues in spatial data processing and should be able to write Python code to complete various tasks of using spatial data.

Course learning outcomes

By the end of this course, students should be able to:
- Understand and apply fundamental constructs and styles of programming using Python
- Understand the basics of computational issues such as time complexity and indexing
- Develop and test computer programs to handle spatial data sets
- Develop and test Python programs for basic geometric processing
- Understand basic spatial indexing methods for point data sets
- Write Python programs to conduct spatial analysis and visualization

Textbooks and Other Materials

Required textbooks

Downey, Allen B. 2016. *Think Python*. 2nd Edition. O'Reilly Media.

Xiao, Ningchuan. 2016. *GIS Algorithms*. SAGE Publications.

Other materials

Tutorials and lecture notes will be made available through the course schedule page on Carmen. There are also numerous useful online sources for learning Python. For example, The Hitchhiker's Guide to Python! (https://docs.python-guide.org/) has information that can be extremely practical for many beginners. The official Python Tutorial (https://docs.python.org/3/tutorial/) is a good place to find the details on most of the topics in Python coding (make sure to choose the right version on top of the page).

We will use Python 3 for this class. This is an open source package and is freely available. A GitHub site repository at http://github.com/gisalgs will be used intensively for most part of the class. We will only access this repository through a web browser. This is a public website and everyone can access. The detailed accessibility statement of GitHub can be found at https://government.github.com/accessibility. The privacy statement of GitHub can be found at https://help.github.com/en/github/site-policy/github-privacy-statement.

Grading and faculty response

Grades

Assignment or category	Percent
Exercises	30
Homework	20
Final projects	20
Quizzes	20
Final exam	10
Total	100

Assignment information

Exercises: After each week, there will be some review exercises that require students to finish by two days after finishing the online tutorial. These are typically reflection questions that are used to make sure students have completed the contents. Quick feedbacks will be provided to students.

Homework: For each major topic on the course schedule, there will be a homework assignment that includes some more in-depth questions for students to finish. These questions typically require more intensive coding efforts and students have two weeks to finish.

Quizzes: Quiz will be given after we finish a major topic. These are open-book quizzes that will require students use the computer to answer. These quizzes are intensive coding exercises that require students to finish in a fixed timeframe of 50 minutes.

Final projects: A list of guided questions will be provided in the middle of the semester and each student will choose to answer one of these questions. The questions will be based on the

topics covered in the semester. Only sufficient information will be provided, which means I will not provide all the implementation details for the questions and students must find solutions by themselves. There will also be open questions that give students a lot of freedom to choose their own project. The open questions will require a short proposal from the students.

Final exam: This is a closed book exam that covers all the topics of this course.

Late assignments

Late submissions will be accepted up to a week past the due date. One day late will incur a 10% penalty. Two days late will incur 20% penalty. Three days will incur a 30% penalty. Four days late will incur a 40% penalty. Five to seven days late will only receive 50% credit of the grade you would have received if it was submitted on time. If you contact me ahead of time for deadline adjustments you will not incur any penalty. Please refer to Carmen for due dates.

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73–76.9: C
70 –72.9: C-
67 –69.9: D+
60 –66.9: D
Below 60: E

Faculty feedback and response time

I am providing the following list to give you an idea of my intended availability throughout the course. (Remember that you can call **614-688-HELP** at any time if you have a technical problem.)

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For the exercises, students should be able to see the grade and feedback in **2 days**. For large assignments (homework and projects), the timeframe to expect feedback is generally **7 days**.

E-mail

E-mails will be replied within **48 hours**, and we aim for **24 hours during school days.**

Office Hours

You can stop by during my office hours. Meetings outside those hours can be arranged **during school days**, but we must decide on the date and time **24 hours prior to** the intended time.

Other course policies

Academic integrity policy

Policies for this online course

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Student Wellness Center: Promoting student wellness through nine dimensions of wellness

- 614-292-4527 http://swc.osu.edu/

Multicultural Center: Offering programs, services and outreach for all OSU students; supporting and celebrating all students through a intercultural model

- 614-688-8449 http://www.mcc.osu.edu/

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- https://advising.osu.edu/

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  Monday–Thursday: 9 a.m. to 5 p.m.
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Academic Support Services: This includes various resources for learning support from tutoring and study strategies to stress management and confidence building.

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Course schedule (tentative)

The following is a tentative course schedule. Detailed links will be provided on the Carmen course page. In the Reading column, the first letter refers to the textbooks by Downey (D) or Xiao (X), and the numbers are chapter and section.

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3	9/7/20-9/11/20	Flow control	D4, D5, D7
4	9/14/20-9/18/20	Python data structures: lists, tuples, dictionaries	D8, D10, D11, D12
5	9/21/20-9/25/20	Classes in Python	D15, D16, D17
6	9/28/20-10/2/20	Geometry: encoding, drawing, and GeoJSON	X2.2
7	10/5/20-10/9/20	Geometry: areas, centroid, and point in polygon algorithms	X2.4, X2.7
8	10/12/20-10/16/20	Geometry: map projections	X2.8
9	10/19/20-10/23/20	Spatial indexing: basics	X1, X4
10	10/26/20-10/30/20	Spatial indexing: point k-D trees	X5.1

11	11/2/20-11/6/20	Spatial indexing: point quadtrees	X6.2
12	11/9/20-11/13/20	Spatial indexing: computational issues	X5.3
13	11/16/20-11/20/20	Spatial analysis: network algorithms	X10.1, X10.2
14	11/23/20-11/27/20	Thanksgiving week	
15	11/30/20-12/4/20	Spatial analysis: pattern and clustering algorithms	X9.1, X9.3

Arts and Sciences Distance Learning Course Component Technical Review Checklist

Course: GEOG 5222
Instructor: Ningchuan Xiao
Summary: GIS Programming and Algorithms

Standard - Course Technology	Yes	Yes with Revisions	No	Feedback/ Recomm.
6.1 The tools used in the course support the learning objectives and competencies.	X			- GitHub - Python - Proctorio - Carmen
6.2 Course tools promote learner engagement and active learning.	X			- Carmen Discussion Posts - Video Recordings
6.3 Technologies required in the course are readily obtainable.	X			.All are available for free
6.4 The course technologies are current.	X			All are kept up to date regularly.
6.5 Links are provided to privacy policies for all external tools required in the course.	X			Privacy policy for github
Standard - Learner Support				
7.1 The course instructions articulate or link to a clear description of the technical support offered and how to access it.	X			Links to 8HELP are provided
7.2 Course instructions articulate or link to the institution's accessibility policies and services.	X			a
7.3 Course instructions articulate or link to an explanation of how the institution's academic support services and resources can help learners succeed in the course and how learners can obtain them.	X			b
7.4 Course instructions articulate or link to an explanation of how the institution's student services and resources can help learners succeed and how learners can obtain them.	X			c
Standard – Accessibility and Usability				
8.1 Course navigation facilitates ease of use.	X			Recommend using the Carmen Distance Learning "Master Course" template developed by ODEE and available in the Canvas Commons to provide student-users with a consistent user experience in terms of navigation and access to course content.
8.2 Information is provided about the accessibility of all technologies required in the course.	X			Accessibility policy for github has been provided.
8.3 The course provides alternative means of access to course materials in formats that meet the needs of diverse learners.	X			Recommend that resources be developed to address any requests for alternative means of access to course materials.
8.4 The course design facilitates readability	X			Recommend using the Carmen Distance Learning "Master Course" template developed by ODEE and available in the Canvas Commons to provide student-users with a consistent user experience in terms of navigation and access to course content.
8.5 Course multimedia facilitate ease of use.	X			All assignments and activities that use the Carmen LMS with embedded multimedia facilitates ease of use. All

				other multimedia resources facilitate ease of use by being available through a standard web browser

Reviewer Information
- Date reviewed: 11/25/19
- Reviewed by: Ian Anderson

Notes: Please change references of CarmenConnect to CarmenZoom as CarmenConnect is no longer offered. Attach dates to course schedule.

[a]The following statement about disability services (recommended 16 point font): Students with disabilities (including mental health, chronic or temporary medical conditions) that have been certified by the Office of Student Life Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office of Student Life Disability Services is located in 098 Baker Hall, 113 W. 12th Avenue; telephone 614- 292-3307, slds@osu.edu; slds.osu.edu.

[b]Add to the syllabus this link with an overview and contact information for the student academic services offered on the OSU main campus. http://advising.osu.edu/welcome.shtml

[c]Add to the syllabus this link with an overview and contact information for student services offered on the OSU main campus. http://ssc.osu.edu. Also, consider including this link in the "Other Course Policies" section of the syllabus.

Arts and Sciences Distance Learning Course Component Technical Review Checklist

Course: GEOG 5222 (Hybrid)
Instructor: Ningchuan Xiao
Summary: GIS Programming and Algorithms

Standard - Course Technology	Yes	Yes with Revisions	No	Feedback/ Recomm.
6.1 The tools used in the course support the learning objectives and competencies.	X			• GitHub • Python • Proctorio • Carmen
6.2 Course tools promote learner engagement and active learning.	X			• Carmen Discussion Posts • Video Recordings
6.3 Technologies required in the course are readily obtainable.	X			.All are available for free
6.4 The course technologies are current.	X			All are kept up to date regularly.
6.5 Links are provided to privacy policies for all external tools required in the course.	X			Privacy policy for github has been provided.
Standard - Learner Support				
7.1 The course instructions articulate or link to a clear description of the technical support offered and how to access it.	X			Links to 8HELP are provided
7.2 Course instructions articulate or link to the institution's accessibility policies and services.	X			a
7.3 Course instructions articulate or link to an explanation of how the institution's academic support services and resources can help learners succeed in the course and how learners can obtain them.	X			b
7.4 Course instructions articulate or link to an explanation of how the institution's student services and resources can help learners succeed and how learners can obtain them.	X			c
Standard – Accessibility and Usability				
8.1 Course navigation facilitates ease of use.	X			Recommend using the Carmen Distance Learning "Master Course" template developed by ODEE and available in the Canvas Commons to provide student-users with a consistent user experience in terms of navigation and access to course content.
8.2 Information is provided about the accessibility of all technologies required in the course.	X			Accessibility policy for github has been included in the course syllabus.
8.3 The course provides alternative means of access to course materials in formats that meet the needs of diverse learners.	X			Recommend that resources be developed to address any requests for alternative means of access to course materials.
8.4 The course design facilitates readability	X			Recommend using the Carmen Distance Learning "Master Course" template developed by ODEE and available in the Canvas Commons to provide student-users with a consistent user experience in terms of navigation and access to course content.
8.5 Course multimedia facilitate ease of use.	X			All assignments and activities that use the Carmen LMS with embedded multimedia

			facilitates ease of use. All other multimedia resources facilitate ease of use by being available through a standard web browser

Reviewer Information
- Date reviewed: 11/25/19
- Reviewed by: Ian Anderson

Notes: Please change references of CarmenConnect to CarmenZoom as CarmenConnect is no longer offered. Attach dates to course schedule.

[a]The following statement about disability services (recommended 16 point font): Students with disabilities (including mental health, chronic or temporary medical conditions) that have been certified by the Office of Student Life Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office of Student Life Disability Services is located in 098 Baker Hall, 113 W. 12th Avenue; telephone 614- 292-3307, slds@osu.edu; slds.osu.edu.

[b]Add to the syllabus this link with an overview and contact information for the student academic services offered on the OSU main campus. http://advising.osu.edu/welcome.shtml

[c]Add to the syllabus this link with an overview and contact information for student services offered on the OSU main campus. http://ssc.osu.edu. Also, consider including this link in the "Other Course Policies" section of the syllabus.