CGS Agenda Item: 14-07
Effective: Summer 2014

Eastern Illinois University

NEW/REVISED COURSE PROPOSAL FORMAT

(Approved by CAA on 9/29/11 and CGS on 10/18/11, Effective Fall 2011)

This format is to be used for all courses submitted to the Council on Academic Affairs and/or the Council on Graduate Studies.

Please check one: _X_ New course ___ Revised course

PART I: CATALOG DESCRIPTION

1. **Course prefix and number, *such as ART 1000*:** GEG 4910
2. **Title (*may not exceed 30 characters, including spaces*):** GIS Programming
3. **Long title, if any (*may not exceed 100 characters, including spaces*):**
4. **Class hours per week, lab hours per week, and credit [*e.g., (3-0-3)*]:** 3-2-4
5. **Term(s) to be offered:** ___ Fall ___ Spring ___ Summer _X_ On demand
6. **Initial term of offering:** ___ Fall ___ Spring _X_ Summer **Year:** _2014_
7. **Course description:**

   An introduction to programming techniques used in spatial data management and analysis. This course is intended for students with some experience in geographic information systems (GIS) who want to learn how to extend GIS to perform custom analyses, to automate common GIS tasks, or just to learn how spatial data is structured and managed "under the hood". Topics will include visual models and diagrams of GIS workflows, automation, web mapping, spatial data structures and spatial algorithms. No prior programming experience is required.

8. **Registration restrictions:**
   a. **Equivalent Courses**
      - **Identify any equivalent courses** (e.g., cross-listed course, non-honors version of an honors course).

        There are no equivalent courses.

      - Indicate whether coding should be added to Banner to restrict students from registering for the equivalent course(s) of this course. ___ Yes _X_ No

   b. **Prerequisite(s)**
      - **Identify the prerequisite(s),** including required test scores, courses, grades in courses, and technical skills. Indicate whether any prerequisite course(s) MAY be taken concurrently with the proposed/revised course.

        GEG 3810/5810 (Geographic Information Systems I) or equivalent, or permission of instructor.

      - Indicate whether coding should be added to Banner to prevent students from registering for this course if they haven't successfully completed the prerequisite course(s). _X_ Yes __ No

If yes, identify the minimum grade requirement and any equivalent courses for each prerequisite course: C

c. Who can waive the prerequisite(s)?
___ No one ___ Chair _X_ Instructor ___ Advisor ___ Other (Please specify)

d. Co-requisites (course(s) which MUST be taken concurrently with this one):

e. Repeat status: _X_ Course may not be repeated.

___ Course may be repeated once with credit.

Please also specify the limit (if any) on hours which may be applied to a major or minor.

f. Degree, college, major(s), level, or class to which registration in the course is restricted, if any:

g. Degree, college, major(s), level, or class to be excluded from the course, if any:

9. Special course attributes [cultural diversity, general education (indicate component), honors, remedial, writing centered or writing intensive]

10. Grading methods (check all that apply): _X_ Standard letter ___ CR/NC ___ Audit ___ ABC/NC ("Standard letter"—i.e., ABCDF--is assumed to be the default grading method unless the course description indicates otherwise.)

Please check any special grading provision that applies to this course:

___ The grade for this course will not count in a student's grade point average.

___ The credit for this course will not count in hours towards graduation.

If the student already has credit for or is registered in an equivalent or mutually exclusive course, check any that apply:

___ The grade for this course will be removed from the student's grade point average if he/she already has credit for or is registered in _____ (insert course prefix and number).

___ Credit hours for this course will be removed from a student's hours towards graduation if he/she already has credit for or is registered in _____ (insert course prefix and number).

11. Instructional delivery method: (Check all that apply.)

___ lecture ___ lab _X_ lecture/lab combined ___ independent study/research
___ internship ___ performance ___ practicum or clinical ___ study abroad
___ Internet ___ hybrid ___ other (Please specify)

PART II: ASSURANCE OF STUDENT LEARNING

1. List the student learning objectives of this course:

In this course, students will learn to:

1. Translate GIS processes into sequential workflow models
2. Identify and apply basic concepts of functional programming within a GIS environment, including variables, loops, conditional sequences and functions/methods
3. Comprehend fundamental data structures used to encapsulate spatial information, including non-topological and topological vector data structures and raster data structures
4. Select the appropriate data structure for a given task
5. Evaluate alternative algorithms for performing spatial tasks such as selection and overlay
6. Appraise functional requirements for facilitating spatial data management and analysis
7. Synthesize programming concepts and skills to create functional tools to access and modify spatial data, perform spatial analysis and automate map production
8. Organize and document tools and scripts for distribution

a. If this is a general education course, indicate which objectives are designed to help students achieve one or more of the following goals of general education and university-wide assessment:

- **EIU graduates will write and speak effectively.**
- **EIU graduates will think critically.**
- **EIU graduates will function as responsible citizens.**

b. If this is a graduate-level course, indicate which objectives are designed to help students achieve established goals for learning at the graduate level:

- **Depth of content knowledge**
- **Effective critical thinking and problem solving**
- **Effective oral and written communication**
- **Advanced scholarship through research or creative activity**

Objectives #1,2,3,4 and 5 will establish depth of content knowledge.
Objectives #5,6 and 7 will establish effective problem solving.
Objective #6 will foster effective critical thinking.
Objective #8 will help students achieve effective written communication skills.

2. Identify the assignments/activities the instructor will use to determine how well students attained the learning objectives:

Learning Objective	Exercises	Quizzes	Project
1. Translate GIS processes into sequential workflow models	✓	✓	
2. Identify and apply basic concepts of functional programming within a GIS environment, including variables, loops, conditional sequences and functions/methods	✓	✓	
3. Comprehend fundamental data structures used to encapsulate spatial information, including non-topological and topological vector data structures and raster data structures	✓	✓	
4. Select the appropriate data structure for a given task	✓	✓	✓
5. Evaluate alternative algorithms for performing spatial tasks such as selection and overlay	✓	✓	✓
6. Appraise functional requirements for facilitating spatial data management and analysis		✓	✓
7. Synthesize programming concepts and skills to create functional tools to access and modify spatial data, perform spatial analysis and automate map production			✓
8. Organize and document tools and scripts for distribution			✓

3. Explain how the instructor will determine students' grades for the course:

Grades will be determined from a combination of lab exercises, short quizzes and an individual project, weighted as follows for undergraduate students:

Grade Weighting for Undergraduate Students:

Item	Pct
Programming Exercises	50%
Quizzes (5 x 5%)	25%
Individual Project	25%
Total	*100%*

4. For technology-delivered and other nontraditional-delivered courses/sections, address the following:

- **a. Describe how the format/technology will be used to support and assess students' achievement of the specified learning objectives:**
- **b. Describe how the integrity of student work will be assured:**
- **c. Describe provisions for and requirements of instructor-student and student-student interaction, including the kinds of technologies that will be used to support the interaction (e.g., e-mail, web-based discussions, computer conferences, etc.):**

5. **For courses numbered 4750-4999, specify additional or more stringent requirements for students enrolling for graduate credit. These include:**
   a. **course objectives;**
   b. **projects that require application and analysis of the course content; and**
   c. **separate methods of evaluation for undergraduate and graduate students.**

   Graduate students will be expected to do a more in-depth project, involving development of an original analytical process. The individual project for graduate students will be weighted higher, accordingly, as follows:

   Grade Weighting for Graduate Students:

Item	**Pct**
Programming Exercises	40%
Quizzes (5 x 4%)	20%
Individual Project	40%
Total	*100%*

6. **If applicable, indicate whether this course is writing-active, writing-intensive, or writing-centered, and describe how the course satisfies the criteria for the type of writing course identified. (See Appendix *.)**

PART III: OUTLINE OF THE COURSE

Provide a week-by-week outline of the course's content. Specify units of time (e.g., for a 3-0-3 course, 45 fifty-minute class periods over 15 weeks) for each major topic in the outline. Provide clear and sufficient details about content and procedures so that possible questions of overlap with other courses can be addressed. For technology-delivered or other nontraditional-delivered courses/sections, explain how the course content "units" are sufficiently equivalent to the traditional on-campus semester hour units of time described above.

WEEK & THEME	**SELECTED TOPICS**
Week 1: Intro to Programming	• programming languages and paradigms • scripts vs. programs • code vs. pseudocode • history of Python*
Week 2: Intro to GIS Programming	• GIS function libraries • GIS programming environments • Visual programming • history & current trends in GIS programming
Week 3: Python* language fundamentals	• variables & data types • lists & arrays • objects & functions • user interfaces
Week 4: Working with ArcPy*	• common tools, functions, classes and environment settings; message propagation
Week 5: Spatial Data	• spatial data descriptions and formats

Organization	• working with attribute data & dictionaries
Week 6: Attribute Data	• iterating through (spatial) dataset records • retrieving attribute data using Standard Query Language (SQL) • working with text files
Week 7: Vector Data	• vector data structures • reading and writing spatial coordinates • reading and writing coordinate systems • working with multipart features
Week 8: Raster Data	• raster data structures • using map algebra to compute local statistics • working with rasters as arrays
Week 9: Topological Data Structures	• polygon tesselations and the Doubly Connected Edge List (DCEL) • Triangulated Irregular Networks (TINs)
Week 10: Automated Cartography	• map frames, layer management, map layouts, converting to/from PDF
Week 11: Errors & Debugging	• syntax vs. logic errors • error handling & debugging tools • reading & raising exceptions
Week 12: Functions & Classes	• functions and subroutines • abstraction & encapsulation • recursion • organizing & packaging functionality
Week 13: Fundamental GIS Algorithms	• basic geometry algorithms • point-in-polygon algorithms • line crossing & intersection algorithms
Week 14: Tool Development	• translation from scripting to user interface environment • function documentation • parameterization
Week 15: Tool Distribution	• packaging & distribution alternatives • licensing issues • tool documentation • open source movement & alternatives to python/ArcGIS

*Other programming language and function library may be substituted for Python and ArcPy

PART IV: PURPOSE AND NEED

1. **Explain the department's rationale for developing and proposing the course.**

    a. **If this is a general education course, you also must indicate the segment of the general education program into which it will be placed, and describe how the course meets the requirements of that segment.**
    b. **If the course or some sections of the course may be technology delivered, explain why.**

The course will serve to bolster GIS competency and skills for our undergraduate students. It will serve as an elective for the Geography B.S. concentration in Geographic Techniques/Spatial Analysis. In addition to

facilitating a deeper understanding of GIS, scripting and programming skills are a highly sought-after asset in the GIS workforce and in GIS graduate degree programs around the country.

2. Justify the level of the course and any course prerequisites, co-requisites, or registration restrictions.

The course will be targeted toward advanced undergraduate and graduate students. The prerequisites are designed to ensure that students will already have some familiarity with standard (non-spatial) statistical concepts such as central tendency, sampling distributions, correlation, etc., and with managing data and creating maps using geographic information systems software.

3. If the course is similar to an existing course or courses, justify its development and offering.

a. If the contents substantially duplicate those of an existing course, the new proposal should be discussed with the appropriate chairpersons, deans, or curriculum committees and their responses noted in the proposal.
b. Cite course(s) to be deleted if the new course is approved. If no deletions are planned, note the exceptional need to be met or the curricular gap to be filled.

The proposed course does not substantially duplicate any existing course at Eastern Illinois University. GIS programming is an increasingly sought-after skill in the GIS marketplace and is not addressed in other courses.

4. Impact on Program(s):

a. For undergraduate programs, specify whether this course will be required for a major or minor or used as an approved elective.

The course will serve as an elective for the B.S. in Geography, Geographic Techniques/Spatial Analysis Concentration.

b. For graduate programs, specify whether this course will be a core requirement for all candidates in a degree or certificate program or an approved elective.

If the proposed course changes a major, minor, or certificate program in or outside of the department, you must submit a separate proposal requesting that change along with the course proposal. Provide a copy of the existing program in the current catalog with the requested changes noted.

PART V: IMPLEMENTATION

1. **Faculty member(s) to whom the course may be assigned:**

   If this is a graduate course and the department does not currently offer a graduate program, it must document that it employs faculty qualified to teach graduate courses.

   Barry Kronenfeld (member of the Graduate Faculty) or any other qualified Geography faculty member.

2. **Additional costs to students:**

   Include those for supplemental packets, hardware/software, or any other additional instructional, technical, or technological requirements. (Course fees must be approved by the President's Council.)

   n/a

3. **Text and supplementary materials to be used (Include publication dates):**

   (1) Paul A. Zandbergen. 2013. *Python Scripting for ArcGIS*. Redlands, CA: Esri Press.
   (2) Stephen Wise. 2002. *GIS Basics*. CRC Press. (supplementary)

PART VI: COMMUNITY COLLEGE TRANSFER

If the proposed course is a 1000- or 2000-level course, state either, "A community college course may be judged equivalent to this course" OR "A community college course will not be judged equivalent to this course." A community college course will not be judged equivalent to a 3000- or 4000-level course but may be accepted as a substitute; however, upper-division credit will not be awarded.

PART VII: APPROVALS

Date approved by the department or school: October 12, 2012

Date approved by the college curriculum committee:

Date approved by the Honors Council *(if this is an honors course):*

Date approved by CAA: CGS:

*In **writing-active courses**, frequent, brief writing activities and assignments are required. Such activities -- some of which are to be graded – might include five-minute in-class writing assignments, journal keeping, lab reports, essay examinations, short papers, longer papers, or a variety of other writing-to-learn activities of the instructor's invention. Writing assignments and activities in writing-active courses are designed primarily to assist students in mastering course content, secondarily to strengthen students' writing skills. In **writing-intensive courses**, several writing assignments and writing activities are required. These assignments and activities, which are to be spread over the course of the semester, serve the dual purpose of strengthening writing skills and deepening understanding of course content. At least one writing assignment is to be revised by the student after it has been read and commented on by the instructor. In writing-intensive courses, students' writing should constitute no less than 35% of the final course grade. In **writing-centered courses** (English 1001G, English 1002G, and their honors equivalents), students learn the principles and the process of writing in all of its stages, from inception to completion. The quality of students' writing is the principal determinant of the course grade. The minimum writing requirement is 20 pages (5,000 words).

Student Success Center		Career Services	Disability Services
http://www.eiu.edu/~success/	http://www.eiu.edu/~counsctr/	http://www.eiu.edu/~careers/	http://www.eiu.edu/~disablty/
581-6696	**581-3413**	**581-2412**	**581-6583**