**Part I: Institutional and Program Information**

<table>
<thead>
<tr>
<th>Name of Institution:</th>
<th>Date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Pennsylvania State University</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Institution President’s Name:</th>
<th>Mailing Address of Institution:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Eric J. Barron</td>
<td>The Pennsylvania State University 201 Old Main University Park, PA 16802</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Official Email Address:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="mailto:president@psu.edu">president@psu.edu</a></td>
<td></td>
</tr>
</tbody>
</table>

**Department Submitting Application:**

<table>
<thead>
<tr>
<th>Geography and Dutton e-Education Institute</th>
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</thead>
</table>

**Applying at which program level:**

<table>
<thead>
<tr>
<th>Undergraduate ( ) Graduate ( ) Both ( X )</th>
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**Accreditations**

<table>
<thead>
<tr>
<th>Nationally accredited?</th>
<th>Regionally accredited?</th>
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</thead>
<tbody>
<tr>
<td>Yes ( ) No ( X )</td>
<td>Yes ( X ) No ( )</td>
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<table>
<thead>
<tr>
<th>Name of National Accreditation Body:</th>
<th>Name of Regional Accreditation Body:</th>
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<tbody>
<tr>
<td></td>
<td>Middle States Commission on Higher Education</td>
</tr>
</tbody>
</table>

**Institution Points of Contact (POC)**

<table>
<thead>
<tr>
<th>Primary POC Name:</th>
<th>Alternate POC #1 Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Donna J. Peuquet</td>
<td>Dr. Alan MacEachren</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Primary POC Office Phone:</th>
<th>Alternate POC #1 Office Phone:</th>
</tr>
</thead>
<tbody>
<tr>
<td>814-863-0390</td>
<td>814-865-491</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Primary POC Office Email:</th>
<th>Alternate POC #1 Office Email:</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="mailto:djp11@psu.edu">djp11@psu.edu</a></td>
<td><a href="mailto:nyb@psu.edu">nyb@psu.edu</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alternate POC #2 Name:</th>
<th>Alternate POC #3 Name:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Anthony C. Robinson</td>
<td>Dr. Todd S. Bacastow</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alternate POC #2 Office Phone:</th>
<th>Alternate POC #3 Office Phone:</th>
</tr>
</thead>
<tbody>
<tr>
<td>814-867-4638</td>
<td>814-863-0049</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alternate POC #2 Office Email:</th>
<th>Alternate POC #3 Office Email:</th>
</tr>
</thead>
<tbody>
<tr>
<td><a href="mailto:ccr181@psu.edu">ccr181@psu.edu</a></td>
<td><a href="mailto:tsb4@psu.edu">tsb4@psu.edu</a></td>
</tr>
</tbody>
</table>
Criterion 1: Outreach and Collaboration.
Demonstrate how Geospatial Science is extended beyond the normal boundaries of the Institution. See the NGA-USGS CAE in Geospatial Science Education Program Criteria for specific items to be addressed). Use up to one additional page for this criterion, if needed:

1a) Shared curriculum: All of the 400 level and higher courses offered by Geography/Dutton Institute are available in their entirety for review by anyone on the Internet: [https://gis.e-education.psu.edu/programs/class_calendar](https://gis.e-education.psu.edu/programs/class_calendar). Click on individual courses. We also offer two free MOOC’s (Maps and the Geospatial Revolution and Geospatial Intelligence) via Coursera.

1b) Reciprocity of credits from a diverse cohort of colleges/universities: Undergraduate geography Students who have completed more than 18 credits at another institution are admitted as "advanced standing" students (transfer students). Transcripts must be sent and will be evaluated by the University’s admissions office. Students must discuss with an advisor how transfer courses can meet their Penn State major or general education requirements. All general education substitutions must be approved by the Office of the Associate Dean for Undergraduate Education (http://www.ems.psu.edu/prospective_undergrad_students/staff) in the College of Earth and Mineral Sciences (http://www.ems.psu.edu/prospective_undergrad_students/staff). For graduate students, a maximum of 3 credits of high-quality graduate work completed at an accredited institution may be applied toward the Certificate of Achievement in GIS. Up to 10 credits may be counted toward the MGIS degree. To be eligible for transfer, academic work must have been completed within five years prior to the date of first degree registration at the Graduate School of Penn State (as a degree-seeking or non-degree graduate student), must be of at least B quality, must appear on an official graduate transcript of an accredited university, and must be documented in a course syllabus or other authoritative description. Credits earned to complete a previous degree, whether at Penn State or elsewhere, may not be applied to the MGIS degree or the Certificate.

1c) Sponsorship or participation in state, regional, or national GS events/activities:
1. Annual hosting of PA State National Geographic Society Geography Bee.
2. Host Pennsylvania Geographical Society Annual Meeting
3. Hosted “Geographies of Mass Incarceration” Mini-Conference 2-3 Nov 2013
5. Annual attendance at USGIF Symposium, and presentation of the Penn State Michael Murphy Award in Geospatial Intelligence.

1d) Local or state government outreach:
   2. Mr. Ryan Baxter serves as the Pennsylvania Spatial Data Access (PASDA) Information Technology Coordinator and lead developer of the physical systems, database design, website search engine and interactive mapping applications.
3. Dr. Bacastow and Dr. Bellafiore delivered a public seminar on the spatial aspects of the Three Mile Island nuclear incident to the Three Mile Island Lessons Learned Conference, Oct. 2013.

4. Riparia Research and Outreach in Geography; Mid-Atlantic Wetlands Workgroup (MAWWG), Robert P. Brooks, Ph.D., Principal Investigator, Riparia at Penn State serving: Pennsylvania, Delaware, Virginia, West Virginia, Maryland (Mid-Atlantic region: multi-state)


1e) Community outreach:

1. Erica Smithwick is a principal investigator on Carbon EARTH, Carbon Educators and Researchers Together for Humanity. The project is part of a National Science Foundation GK-12 grant designed to team Penn State Science, Technology, Engineering and Mathematics (STEM) graduate students with elementary and middle school science teachers from Philipsburg-Osceola and Harrisburg school districts. The STEM graduate fellows will work with the science teachers to enhance their curriculum on carbon-related themes like geography, astronomy, physics, and more.

2. Each summer, the College of EMS collaborates with the Fattah Learning Lab: Science Skills on Wheels to offer hands-on workshops with Philadelphia middle school students; different departments, including geography, conduct activities each day.

3. Each summer, The College of EMS hosts seventh- and eighth-grade students visiting from Washington, D.C.’s Higher Achievement Program, and geography staff and alumni have conducted hands-on workshops.

4. In collaboration with the Pennsylvania Alliance for Geographic Education, of which Jodi Vender is a current steering committee member and past co-coordinator, the department does outreach to K-12 teachers and students. For example, the department has done geography workshops for local elementary and middle school teachers for Saturday Science through the College of Education’s Center for Science and the Schools (CSATS).

5. The department has participated in “Expanding Your Horizons,” an annual one-day camp for girls, teachers, and parents -- sponsored by the Women in Science and Engineering (WISE) Institute.

6. Jodi Vender, along with middle school teachers Lisa Draper (Nitschmann Middle School, Bethlehem) and Kristy Snider (Clear Run Intermediate School, Tobyhanna), are Pennsylvania’s state coordinators for Geography Awareness Week (GAW). The department has offered programs for teachers and students in preparation for GAW.

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Criterion 2: Center for Geospatial Science Education.
Describe how your institution has a formal organizational structure such as a department, program of study or “Center” for GS Education, which serves as a resource for faculty and
students. The term “Center” is used in a general sense and includes “departments,” “laboratories,” etc. The formal organizational structure should provide guidance on GS curriculum and programs, general GS information, and promote collaboration and interaction among students, faculty and related programs of study. The “Center” must be operational, dynamic and current. Use up to one additional page for this criterion, if needed:

Penn State’s Geography Department, to include the online Geospatial Programs of the Dutton e-Education Institute, serves as the university hub for GS education and research. We offer the following degrees and certificates:

**RESIDENT:**
1. Bachelor of Science (B.S.) in Geography ([http://bulletins.psu.edu/undergrad/programs/baccalaureate/G/GEOBS](http://bulletins.psu.edu/undergrad/programs/baccalaureate/G/GEOBS))
2. Master of Science (M.S.) in Geography ([http://www.geog.psu.edu/grad-program/future-graduate-students/degrees-offered/ms-geography](http://www.geog.psu.edu/grad-program/future-graduate-students/degrees-offered/ms-geography))
3. Five-year Doctor of Philosophy (Ph.D.) with Master of Science (M.S.) in Geography ([http://www.geog.psu.edu/graduate-program-information/future-graduate-students/degrees-offered/five-year-phd-ms-geography](http://www.geog.psu.edu/graduate-program-information/future-graduate-students/degrees-offered/five-year-phd-ms-geography))
4. Four-year Doctor of Philosophy (Ph.D.) in Geography ([http://www.geog.psu.edu/grad-program/future-graduate-students/degrees-offered/phd-geography](http://www.geog.psu.edu/grad-program/future-graduate-students/degrees-offered/phd-geography))

**ONLINE:**
2. Intercollege Masters of Professional Studies in Homeland Security, GEOINT Option Program Office ([http://bulletins.psu.edu/graduate/programs/h/GRAD%20IMPSHLSL](http://bulletins.psu.edu/graduate/programs/h/GRAD%20IMPSHLSL))

Note: At Penn State, 100, 200, and 300 level courses are undergraduate, 400 level are undergraduate or graduate, 500 are graduate, and 800 are professional level. Undergraduate students may take graduate and professional level courses with the permission of the professor.

2a) Geography Department URL: [http://www.geog.psu.edu](http://www.geog.psu.edu)
   Dutton Institute URL: [https://www.e-education.psu.edu/node/4](https://www.e-education.psu.edu/node/4)
2b) Demonstrate the Center is operational. See 2a above.
2c) Demonstrate GS Journals are available:
   [http://www.libraries.psu.edu/psul/researchguides/geoearthsci/geography.html](http://www.libraries.psu.edu/psul/researchguides/geoearthsci/geography.html)
2d) Demonstrate that physical and/or virtual geospatial science labs, software, etc. is available and used: The Geography Dept. has 4 labs for teaching and student projects. We have a total of 60 PC’s, all connected to the Internet. Major software includes MS Office 2013, ArcGIS 10.2, ENVI 5.0, statistical packages, open source, and custom software. Except for emergency patches, the labs are updated every summer when student count is lower. Our online students are provided ArcGIS, Quick Terrain Modeler, LP360, eCognition, PhotoScan, and Pix4D as needed for their courses. They also use ArcGIS Online. Our research
Criterion 3: **Robust and Active Geospatial Science Academic Program.**
Demonstrate how students successfully participate in the academic program requirements aligned to GS curriculum that map to the CAE KUs. Use up to one additional page for this criterion, if needed:

*Provide evidence that students take at least 18 credit hours in a GS curriculum.*

All of our geospatial science programs require a minimum of 18 hours in geospatial sciences, and due to the flexibility of choosing electives, could easily satisfy any of the first 5 focus areas. Specific details for each program can be found at the URLs below, along with course details at the matrix on page 13.

Geography B.S.:  
[http://www.ems.psu.edu/sites/default/files/u5/students/schedules/pdfs/GEOBS-GIS.pdf](http://www.ems.psu.edu/sites/default/files/u5/students/schedules/pdfs/GEOBS-GIS.pdf)

Geography M.S.:  
[http://www.geog.psu.edu/grad-program/future-graduate-students/degrees-offered/ms-geography](http://www.geog.psu.edu/grad-program/future-graduate-students/degrees-offered/ms-geography)

Geography PhD:  
[http://www.geog.psu.edu/graduate-program-information/future-graduate-students/degrees-offered/five-year-phd-ms-geography](http://www.geog.psu.edu/graduate-program-information/future-graduate-students/degrees-offered/five-year-phd-ms-geography)

MGIS M.S.:  
[https://gis.e-education.psu.edu/mgis/curriculum](https://gis.e-education.psu.edu/mgis/curriculum)

iMPS – GEINT:  

Additional information on the residential MS and PhD programs and sample curricula can be found under CRITERION 3 at:  
[https://gis.e-education.psu.edu/gsc](https://gis.e-education.psu.edu/gsc)

Criterion 4: **Geospatial Science is Multidisciplinary within the Institution.**
Demonstrate that GS is not treated as a separate discipline at your institution, but as a multidisciplinary science with the body of GS knowledge incorporated into various disciplines, such as geography, engineering, environmental management, etc. See the NGA-USGS CAE in Geospatial Science Education Program Criteria for specific items to be addressed. Use up to one additional page for this criterion, if needed:

4a) **Evidence that the geospatial science curriculum is taught in existing non-geospatial sciences courses and that non-geospatial science students are being introduced to geospatial science:** The following courses are related to GS, but located in many different places throughout the university. It should be noted that many of these courses are available for...
our GS students to take as electives. Courses with * indicate research papers or projects:

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Instructor</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anthropology 421* – Intro to Geospatial Science in Anthropology and Archaeology</td>
<td><a href="http://bulletins.psu.edu/undergrad/courses/A/ANTH/421/200809S1">http://bulletins.psu.edu/undergrad/courses/A/ANTH/421/200809S1</a></td>
<td></td>
</tr>
<tr>
<td>Anthropology 579* – Spatial Demography</td>
<td><a href="http://bulletins.psu.edu/graduate/courses/A/ANTH/579/200708SP">http://bulletins.psu.edu/graduate/courses/A/ANTH/579/200708SP</a></td>
<td></td>
</tr>
<tr>
<td>Architecture 417 – The Language of Boundaries in Architecture and the Landscape</td>
<td><a href="http://bulletins.psu.edu/undergrad/courses/A/ARCH/417/200809S1">http://bulletins.psu.edu/undergrad/courses/A/ARCH/417/200809S1</a></td>
<td></td>
</tr>
<tr>
<td>Army 204 – Land Navigation: Topographic Maps and Orienteering</td>
<td><a href="http://bulletins.psu.edu/undergrad/courses/A/ARMY/204/199292FA">http://bulletins.psu.edu/undergrad/courses/A/ARMY/204/199292FA</a></td>
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<tr>
<td>Civil Engineering 310 – Surveying</td>
<td><a href="http://bulletins.psu.edu/undergrad/courses/C/C/E/310/200708FA">http://bulletins.psu.edu/undergrad/courses/C/C/E/310/200708FA</a></td>
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</tr>
<tr>
<td>Electrical Engineering 455* - An Introduction to Digital Image Processing</td>
<td><a href="http://bulletins.psu.edu/undergrad/courses/E/E/E/455/200708SP">http://bulletins.psu.edu/undergrad/courses/E/E/E/455/200708SP</a></td>
<td></td>
</tr>
<tr>
<td>Engineering Design 110 – Spatial Analysis in Engineering Design</td>
<td><a href="http://bulletins.psu.edu/undergrad/courses/E/EDSGN/110/200910S1">http://bulletins.psu.edu/undergrad/courses/E/EDSGN/110/200910S1</a></td>
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</tr>
<tr>
<td>Engineering Design 210 – Tolerances and Spatial Models</td>
<td><a href="http://bulletins.psu.edu/undergrad/courses/E/EDSGN/210/200910S1">http://bulletins.psu.edu/undergrad/courses/E/EDSGN/210/200910S1</a></td>
<td></td>
</tr>
<tr>
<td>Engineering Graphics Technology 114 – Spatial Analysis and Computer Aided Drafting</td>
<td><a href="http://bulletins.psu.edu/undergrad/courses/F/FOR/255/201213S1">http://bulletins.psu.edu/undergrad/courses/F/FOR/255/201213S1</a></td>
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<tr>
<td>Forestry 255 – GPS and GIS Applications for Natural Resources Professionals</td>
<td><a href="http://bulletins.psu.edu/undergrad/courses/F/FOR/255/201213S1">http://bulletins.psu.edu/undergrad/courses/F/FOR/255/201213S1</a></td>
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<tr>
<td>Forestry 455 – Remote Sensing and Spatial Data Handling</td>
<td><a href="http://bulletins.psu.edu/undergrad/courses/F/FOR/455/201213S1">http://bulletins.psu.edu/undergrad/courses/F/FOR/455/201213S1</a></td>
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<tr>
<td>Information Science and Technology 868 – Topics in Visual Analytics for Security Intelligence</td>
<td><a href="http://bulletins.psu.edu/graduate/courses/I/IST/868/201415SP">http://bulletins.psu.edu/graduate/courses/I/IST/868/201415SP</a></td>
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<tr>
<td>Information Science and Technology 885 - Introduction to Multisensor Data Fusion</td>
<td><a href="http://bulletins.psu.edu/graduate/courses/I/IST/885/200809S1">http://bulletins.psu.edu/graduate/courses/I/IST/885/200809S1</a></td>
<td></td>
</tr>
<tr>
<td>Geological Sciences 497B – Introduction to Remote-Sensing</td>
<td><a href="http://bulletins.psu.edu/undergrad/courses/G/GEOSC/497B/201415SP">http://bulletins.psu.edu/undergrad/courses/G/GEOSC/497B/201415SP</a></td>
<td></td>
</tr>
<tr>
<td>Landscape Architecture 065* – Built Environment and Culture</td>
<td><a href="http://bulletins.psu.edu/undergrad/courses/L/LARCH/065/200405S1">http://bulletins.psu.edu/undergrad/courses/L/LARCH/065/200405S1</a></td>
<td></td>
</tr>
<tr>
<td>Landscape Architecture 450 – Geodesign: Geospatial Technologies for Design</td>
<td><a href="http://bulletins.psu.edu/undergrad/courses/L/LARCH/450/201213FA">http://bulletins.psu.edu/undergrad/courses/L/LARCH/450/201213FA</a></td>
<td></td>
</tr>
<tr>
<td>Meteorology 477 - Fundamentals of Remote Sensing Systems</td>
<td><a href="http://bulletins.psu.edu/undergrad/courses/M/METEO/477/200708SP">http://bulletins.psu.edu/undergrad/courses/M/METEO/477/200708SP</a></td>
<td></td>
</tr>
<tr>
<td>Naval Science 205 – (Marine) Navigation</td>
<td><a href="http://bulletins.psu.edu/undergrad/courses/N/NAVSC/205/200506SP">http://bulletins.psu.edu/undergrad/courses/N/NAVSC/205/200506SP</a></td>
<td></td>
</tr>
<tr>
<td>Survey Engineering – eight courses</td>
<td><a href="http://bulletins.psu.edu/undergrad/courses/S/SurE">http://bulletins.psu.edu/undergrad/courses/S/SurE</a></td>
<td></td>
</tr>
<tr>
<td>Wildlife 211 – Aerial Photo Interpretation</td>
<td><a href="http://bulletins.psu.edu/undergrad/courses/W/WILDL/211/201213S1">http://bulletins.psu.edu/undergrad/courses/W/WILDL/211/201213S1</a></td>
<td></td>
</tr>
</tbody>
</table>
### Criterion 5: Student-based Geospatial Science Research.
Describe how your institution encourages student research in GS. Research should relate back to one or more of the KUs. See the NGA-USGS CAE in Geospatial Science Education Program Criteria for specific items to be addressed. Use up to one additional page for this criterion, if needed:

<table>
<thead>
<tr>
<th>5a) Program with GS focus has thesis, dissertation, student papers or independent research project requirements.</th>
<th>Please refer to CRITERION 5a at: <a href="https://gis.e-education.psu.edu/gsc">https://gis.e-education.psu.edu/gsc</a></th>
</tr>
</thead>
<tbody>
<tr>
<td>5b) List GS courses that require research papers or projects. Provide course titles and url. All geography courses listed in the matrix, and IST 885, require research papers or projects, except GEOG 364.</td>
<td></td>
</tr>
</tbody>
</table>

### Criterion 6: Number of Geospatial Science Faculty and Course Load.
Describe the composition of the Geospatial Science faculty at your institution. List all full-time Geospatial Science faculty members and additional faculty members (part-time, adjunct, visiting professor, etc.) teaching at least one Geospatial Science course. Provide a short (one page or less) synopsis of the CV or biography here and links to the full biographies or curriculum vita for each faculty member. See the NGA/USGS CAE in Geospatial Science Education Program Criteria for specific items to be addressed. Use up to one additional page for this criterion, if needed:

<table>
<thead>
<tr>
<th>6a) Identify by name full-time employee(s) with overall responsibilities for a GS program:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Dr. Cynthia A. Brewer, Geography Department Head</td>
</tr>
<tr>
<td>2. Dr. Anthony C. Robinson, Director of Online Geospatial Education Programs</td>
</tr>
<tr>
<td>3. Dr. Todd S. Bacastow, Director, iMPS-HLS, GEOINT Option</td>
</tr>
</tbody>
</table>

For CV’s, please refer to CRITERION 6 at: [https://gis.e-education.psu.edu/gsc](https://gis.e-education.psu.edu/gsc)

<table>
<thead>
<tr>
<th>6b) Identify by name additional full-time GS faculty members teaching GS courses within the department that sponsors the GS programs:</th>
</tr>
</thead>
</table>

Note: The College of Earth and Mineral Sciences and the Geography Department expect all full-time faculty members to teach at least eight courses over a two-year rotation.

For CV’s, please refer to CRITERION 6b at: [https://gis.e-education.psu.edu/gsc](https://gis.e-education.psu.edu/gsc)

<table>
<thead>
<tr>
<th>6c) Identify by name part-time/adjunct GS faculty members teaching GS courses within the department that sponsors the GS programs:</th>
</tr>
</thead>
</table>

For CV’s, please refer to CRITERION 6c at: [https://gis.e-education.psu.edu/gsc](https://gis.e-education.psu.edu/gsc)
Criterion 7: Active Faculty in Current GS practice and research.
Describe how your institutions geospatial science faculty members are active in current GS practice and research, contribute to GS literature, are members in GS professional societies, are subject matter experts or attend/present at professional GS conferences. Use up to one additional page for this criterion, if needed:

7a) Peer reviewed publications

| 1. GeoVISTA Digital Library (http://drupal.geovista.psu.edu/biblio?f%5Bauthor%5D=769) |
| 5. Schnebele, E., Cervone, G., Kumar, S., Waters, N. Real time estimation of the Calgary floods using limited remote sensing data, Water, 6:381–398, 2014 |

7b) Published books or chapters of books:

7c) Faculty is involved in writing grants and obtaining funding for GS education and/or research:

2. Evaluation of Candidate Vaccine Technologies Using Computational Models, Donald Burke U of Pittsburgh (PI), Neil Ferguson (CoPI), Bryan Grenfell (CoPI) {one of 7 other Penn State investigators} – Gates Foundation; Spring 2008-Spring 2012.
3. Visualization and Analytics for Command, Control, and Interoperability Environments – DHS Center of Excellence for Command, Control and Interoperability, David Ebert, Purdue (PI), Alan MacEachren (CoPI) {one of several CoPIs} – Dept. of Homeland Security; Summer, 2009-Summer, 2013.
5. IGERT - Big Data Social Science: An Integrative Research Program in Social Data Analytics, National Science Foundation, July 2012–June, 2017.

7d) Faculty members are SME’s in GS areas for professional certification or accreditation bodies and/or professional societies:

1. Dr. A. Robinson is Vice President elect of North American Cartographic Information Society (NACIS)
2. Ms. K. Schuckman is past president of American Society for Photogrammetry and Remote Sensing (ASPRS)
3. Dr. T. Bacastow – co-chair of USGIF Academic Committee
4. Dr. A. MacEachren, professor of geography and director of the GeoVISTA Center, has been chosen for Fellows of the American Association for the Advancement of Science (AAAS).
5. Ms. K. Schuckman: Vice Chair of the NOAA Advisory Committee for Commercial Remote Sensing
6. Dr. C. Brewer, Affiliate Faculty, Center of Excellence for Geospatial Information Science (CEGIS), U.S. Geological Survey, Department of Interior, 2008 to present.
7. Penn State faculty attends the Annual Esri User Conferences, both in the US and Asia.
8. Penn State faculty attends the annual NGA/NSG Community GEOINT Training Council (CGTC).

7e) Faculty are engaged in and/or initiate student participation or membership in GS
professional societies:

1. **S. Cooley**, iMPS-HLS (GEOINT) candidate: Served as a student aide at the 2013 USGIF symposium.

7f) Faculty presents GS papers or thought leadership content at major Regional/National/International conferences and events:

1. **Dr. T. Bacastow**, “What is GEOINT”, GeoIntelligence India, June 2014.
Part II: Curriculum Mapping to Knowledge Units and Focus Areas

<table>
<thead>
<tr>
<th>Course #</th>
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In the table above, list your institution’s Geospatial Science courses (as described in the following pages) and, for each core knowledge unit, indicate whether the course completely satisfies (“C”) or partially satisfies (“P”) the core KU. List the numbers for the optional knowledge units (up to 12) that your curriculum satisfies at the top of the “Optional KU” columns and indicate whether the course completely satisfies (“C”) or partially satisfies (“P”) the optional KU. See the example above. Use up to one additional sheet, if needed.
Course Synopsis (provide this form for each course as summarized on page 12)

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<td>Fall 2014</td>
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</tbody>
</table>

Course Description (provide URL link to syllabus)

There has never been a more exciting time to work with spatial technology. These technologies help us identify socio-economic trends, they power the GPS in your smartphone, enable check-ins on your favorite website, and will guide the driverless vehicles of tomorrow safely along their routes. Throughout this course, you will encounter several new concepts, ideas, and tools related to geographic applications and services some of which you already use on a daily basis. We will cover what geospatial technologies are, the important concepts behind their operation, careers in the geospatial industry, and how all of these topics intersect your daily lives. Location-based services and spatially aware devices pervade nearly everything we do - whether we realize it or not. Simply put: there's no escaping the reach of geospatial technology! As a result, we will also discuss important issues in privacy and ethics related to the collection and use of geospatial data.

URL:

Course Objectives

1. Familiarize you with important concepts related to geography and geospatial technologies,
2. Enable you to identify basic geographic problems and suggest solutions to them,
3. Teach you how to recognize, collect, and create spatial data using the internet and freely available resources,
4. Transform you into "cartographically literate" consumers and producers of geospatial information. You will be able to critically evaluate maps and recognize common errors that make maps misleading, as well as the positive traits of effective maps, and
5. Prepare you for more advanced study in Geography, Geographic Information Science (GIS), Remote Sensing, and/or Cartography.

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 160: [https](#)
Course Synopsis (provide this form for each course as summarized on page 12)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 301</td>
<td>Thinking Geographically</td>
<td>Currently</td>
<td>Twice annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

The course explores the process of thinking geographically. As a discipline that draws on elements of four intellectual traditions - the physical sciences, the social sciences, the information sciences, and the humanities - geography offers an extensive palette of approaches to the study of the interactions among people, places, and environments. In addition to those traditions, geography also draws on key themes: setting events and activities into multiple spatial and temporal contexts; setting events and activities into multiple spatial scales from the local to the global; seeing complex, multi-way interactions between human and physical systems; recognizing the interconnectedness between places. In terms of methods, the fundamental building block is the idea of geospatial location and the associated spatially- or geo-referenced data. Data, both quantitative and qualitative in character, is increasingly available in terms of amounts and quality. Students must come to appreciate and be able to use this powerful way of thinking about the world. GEOG 301 assumes a beginning understanding of geography, in terms of basic content knowledge, and builds an understanding of how to think geographically, how to ask geographic questions, how to find geographic answers, how to assess the quality of those answers, and how to present and communicate those answers convincingly and compellingly in multiple formats. Students will learn how to think geographically and to appreciate the power, applicability, and limitations of the geographic approach. Each year the course is organized around a significant contemporary problem as a commonly shared case study. Students will work in small groups to analyze the case study, presenting their own portfolio of work for 60% of the course grade and collaborating with group colleagues for a collective presentation for 40% of the grade.

Course Objectives

1. Reflecting on connections among geographic knowledge and skills:
   – what do you know and what are you able to do as a geography graduate?
   – what do people expect you to know and be able as a geography graduate?
2. Understanding the relationships between the discipline of geography and the world of careers, civic responsibility, and life beyond Penn State:
   – how and in what contexts can you use your geographic knowledge and skills?
   – how can you ensure that your geographic knowledge and skills remain relevant and up-to-date?
3. To review, enhance, and integrate the knowledge and basic skills that are relevant to your career (awareness of who you are as a geographer).
4. To set Geography into the context of society (awareness of where your geographic knowledge and skills fit into the multiple worlds of work, civic responsibility, and life).

Course Satisfaction of Knowledge Units (as summarized on page 12)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last Updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 313</td>
<td>Introduction to Field Geography</td>
<td>Fall 2014</td>
<td>Annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Synopsis (provide this form for each course as summarized on page 12)

Course Description (provide URL link to syllabus)

The Merriam-Webster dictionary defines geography as “a science that deals with the description, distribution, and interaction of the diverse physical, biological, and cultural features of the earth's surface”. This course strives to provide an introduction to methods likely to be useful in conducting field work within the realm of “geography”, and that invariably will generate data with a spatial (geographical) component. Aspects of physical, chemical, biological, and cultural factors are examined, albeit without ever getting too far from how one might tie these kinds of data to their location in some absolute or relative space, i.e. where was it, or how did it compare to surrounding ones? Thus, describing, quantifying the spatial relationship of the “things” we study is often as important as the specific measurements we seek to obtain. To that end, the course is designed to equip students with effective field mapping skills, ranging from simple baseline mapping, elementary surveying techniques and instruments, to the use and principles of what is currently the most technologically advanced method, the global positioning system (GPS). The course includes weekly laboratories to afford students the opportunity to experience as well as develop mapping skills while in the field rather than in the comfort of a climate controlled classroom. Course evaluation requires successful completion of three (3) journal article-styled written reports, laboratory assignments, and exams.

URL:

Course Objectives
Course Satisfaction of Knowledge Units (as summarized on page 12)

Course Synopsis (provide this form for each course as summarized on page 12)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 361</td>
<td>Cartography—Maps and Map Construction</td>
<td>Fall 2014</td>
<td>Annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

Mapping is crucial to exploring and understanding distributions of geographic phenomena. It is also an important phase of many database-intensive analyses, because a map is often the best way to visualize results and show them to others. Our emphases in this course will be on designing and producing both thematic and reference maps using symbols and visual hierarchies that allow the content of the maps to be effectively communicated. Maps are often built from existing geospatial data and images created by government mapping programs and from GIS databases and remote-sensing software. Therefore, your lab work this semester will involve working with varied digital data sources in ArcMap 10 which has sufficient design tools to allow excellence in cartographic production.

**URL:**

Course Objectives

In this course you will learn how to graphically symbolize, arrange, and present geographic data. At the completion of this course, students will know how to:

- create map layouts,
- label maps using cartographic placement conventions,
- select symbols and colors to suitably represent geospatial data,
- design basemap content that supports data interpretation,
- generalize data to suit reduced map scales,
- select map projections to suit map purposes, and
- discuss advances in cartographic practice.

You are also expected to demonstrate mastery of cartography concepts through design and production of maps using ArcGIS.

Course Satisfaction of Knowledge Units (as summarized on page 12)

**GEOGRAPHY 361:**

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## Course Synopsis (provide this form for each course as summarized on page 12)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
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</thead>
<tbody>
<tr>
<td>GEOG 362</td>
<td>Imagery Analysis</td>
<td>Fall 2014</td>
<td>Annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

## Course Description (provide URL link to syllabus)

Use of digital imagery and elevation data for visualization and analysis is a fundamental skill that must be mastered by today’s geospatial professional. This course assumes that the student has some familiarity with GIS concepts and is proficient with ArcGIS software at a basic level. Formal instruction is given in the production and use of digital imagery and elevation data from a variety of remote sensing sources. Students are taught to identify appropriate data for a variety of potential applications. They are also given experience discovering and using imagery and elevation data from a variety of federal, state, and local public domain sources. The **culminating project** presents students with the challenge of identifying data, visualization, and analysis methods in the context of a real-world scenario.

**URL:**

## Course Objectives

Students who excel in this course are able to:

1) Describe the basic principles of image and elevation data acquisition.
2) Summarize the basic operational characteristics of commercial remote sensing systems.
3) Critically assess the strengths and weaknesses of remote sensing imaging instruments and platforms for a broad range of application scenarios.
4) Perform orthorectification of digital imagery.
5) Perform simple image enhancement, image interpretation, and automated analysis using digital optical imagery.
6) Perform simple terrain analysis using digital elevation/terrain models.
7) Describe the quantitative methods and industry standards for geometric accuracy assessment of imagery and elevation data products.
8) Describe the qualitative methods and industry standards for quality assurance and quality control of imagery and elevation data products.
9) Use acquired knowledge and critical thinking skills to create visualizations and perform analysis of imagery, elevation, and supplemental vector data in GIS.
Course Synopsis (provide this form for each course as summarized on page 12)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 363</td>
<td>Geographic Information Systems</td>
<td>Fall 2014</td>
<td>Annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

This course describes and explains the principles of GIScience (Geographic Information Science) and GIS (Geographic Information Systems), and focuses upon how to input data and how to develop solutions for geographic analysis and modeling tasks using GIS software.

Geographic Information Science is a rapidly changing field. Although Geographic Information Systems have been in existence for forty years, the field is now changing in a fundamental way: In 10 years, the ability to work with geographic information will have less to do with possession of a unique software package called "GIS" and much more to do with an understanding of how digital information of geographic phenomena are constructed, how information can be assembled and processed in massive distributed environments and how information can be passed freely from one environment to another. (Michael Goodchild, GIS World, Vol. 10, No. 1, p. 42)

The purpose of this course is to familiarize you with how GIS can be used as a methodology for geographic data handling and analysis, and to provide you with a firm basis for further work in Geographic Information Science in practical application or in follow-on courses. Certainly, in the short term, this includes the ability to appropriately use whatever GIS software package you have access to or need to use for a specific data handling or analytical task. A key component of this is to be able to easily adapt to changes in technology and software environments given an understanding of the concepts involved.

URL:

Course Objectives

When you are finished with this course, you should:
1) have a broad-based understanding of the principles of Geographic Information Science;
2) have an understanding of how GIS can be used as a methodology for geographic data handling and analysis for a variety of applications;
3) have an understanding of the overall capabilities, as well as the limitations of current GIS software packages;
4) be able to use the more important and frequently used capabilities of the ArcMap GIS software package;
5) be able to design and carry out spatial analyses using GIS;
6) be able to communicate the results of geographic analyses to others, both in oral and in
Course Satisfaction of Knowledge Units (as summarized on page 12)

**GEOGRAPHY 363:**

Course Synopses (provide this form for each course as summarized on page 12)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 364</td>
<td>Spatial Analysis</td>
<td>Fall 2014</td>
<td>Annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

Geography 364 is an introduction to spatial analysis that focuses on statistical methods for geographers. It is necessary that you have some familiarity with statistical methods (Stats 200 is a prerequisite for this course). We will start off from basic statistical methods and will explore their spatial counterparts/peculiarities. We will discover what is special about spatial analysis and will use correlation analysis, spatial autocorrelation, regression analysis, and various methods for the analysis of point patterns.

URL:

Course Objectives

1) Deepen existing statistical knowledge
2) Extend statistical knowledge to the specifics of spatial analysis
3) Connect statistical theories to software applications
4) Become confident in applying quantitative methods

Learning Outcomes

1) Students will be able to perform spatial analysis tasks
2) Students will have an understanding of several software solutions that aid in performing quantitative analysis
3) Students will master the interpretation of quantitative data techniques
4) Students will have an understanding of several software solutions that aid in performing quantitative analysis
5) Students will master the interpretation of quantitative data

Course Satisfaction of Knowledge Units (as summarized on page 12)
GEOGRAPHY 364:

Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 463</td>
<td>Geographic Information Management</td>
<td>Currently</td>
<td>Annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

This course examines models and algorithmic techniques that are used to organize, store and manipulate map and other forms of geographical data in digital form. Emphasis is placed on database management systems and database design and implementation using Relational Database Systems technology. Students will develop both conceptual understanding and practical experience with Relational Databases and Relational Database Software as applied to geographic data.

URL:

Course Objectives

1) Assess the role geographic databases play in providing infrastructure for the handling of geoinformation, including their role in broader GIS environments
2) Design and evaluate a database using SQL
3) Acquire practical and realistic experience of working in a team to design and develop a geographic database project
4) Explore the problems associated with representing geographic data in digital form; specifically how the choice of systems, data structures and algorithms affects what we can represent and the analyses we can perform.

Learning Outcomes: These objectives are designed so that students in the course become knowledgeable in the area of spatial databases and also become operationally familiar with SQL. Students become aware of the process and potential pitfalls of designing and implementing spatial databases.

This course includes a team project.

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 463:
Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 464</td>
<td>Analysis and GIS</td>
<td>Spring 2014</td>
<td>Annually</td>
<td>Spring 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

This course will provide students with an extended introduction to methods of statistics and spatial analysis. We will cover aspects of characterizing spatial data, general methods and problems related to spatial data. This course will provide an introduction to techniques used for the visualization and analysis of data in general, point patterns, areal, and linear data. Besides the classical methods used in spatial analysis we will focus on techniques of multivariate statistical analysis such as cluster analysis, multidimensional scaling, and spatial regression as a means to identify patterns and conceptual relationships. The course will also provide an extensive introduction to the open source programming language and software for statistics and graphics --- R, which is used in many spatial analysis and visualization tasks (e.g., by incorporating maps from Google directly into R).

URL:

Course Objectives

1) Understand basic and advanced concepts of statistics and spatial analysis
2) Apply theoretical knowledge to common spatial analysis problems
3) Introduce several software solutions to perform spatial analysis
4) Introduce students to multivariate statistics
5) Become familiar with R

Learning outcome: Students will become knowledgeable in the field of spatial data analysis. The course will also provide an extensive introduction to the open source programming language and software for statistics and graphics --- R, which is used in many spatial analysis and visualization tasks (e.g., by incorporating maps from Google directly into R).

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 464:
Course # | Course Title | Date Last Taught | Frequency Offered | Date Last Updated
--- | --- | --- | --- | ---
GEOG 467 | Applied Cartographic Design | Currently | Annually | Fall 2014

Course Description (provide URL link to syllabus)

The course objective is to immerse the student in applied problems of map production and geographic representation. Topics include advanced software methods for labeling and data editing; advanced symbolization and production of extended map series; conversion between software environments; and representation for multiple media, scales and purposes. The challenge of working with clients for mapping is often included in a project. Evaluation is based primarily on meeting draft deadlines, map project quality, written reports on project decisions, and an exam.

URL:

Course Objectives

At the completion of this course, you will know how to produce and critique online maps, select among and using online mapping options. The case study on which we will ground this experience will be recommending best choices for the Penn State campus mapping and producing prototypes. We will hear from physical plant geospatial experts and campus mapping graphics experts, and people expert in volunteered geographic information. We will examine commercial and open source options for campus mapping. By the end of the course you will be able to:

· understand the terminology associated with online and open source mapping
· add and design content in open mapping, such as OpenStreetMap and Google
· critique and recommend options for campus mapping
· customize a dynamic online campus map.

You will be able to critique research and opinion on map design and usability from the academic literature. These are all aspects of being a geospatial expert.

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 467:
Course # | Course Title | Date Last Taught | Frequency Offered | Date Last updated
---|---|---|---|---
GEOG 481 | Lidar | Fall 2014 | Three times annually | Fall 2014

Course Description (provide URL link to syllabus)

An introduction to the capabilities of lidar sensors and platforms, data processing systems, and derived digital data products. Students in this course will master basic skills needed to leverage commercial lidar data sources and information products in a broad range of applications, including topographic mapping, flood inundation studies, vegetation analysis, and 3D modeling of urban infrastructure.

URL:

Course Objectives

Students who excel in this course are able to:

1) Summarize the basic operational characteristics of lidar instruments and platforms used for topographic mapping and geospatial applications.
2) Describe the basic principles of calibrating, georeferencing, and processing of lidar data.
3) Describe quantitative and qualitative methods used in industry standards for quality assurance and accuracy assessment of lidar-derived data products.
4) Critically assess the strengths and weaknesses of various lidar platforms and instruments for a broad range of application scenarios.
5) Apply acquired knowledge and critical thinking skills to solve a real-world problem with appropriate lidar data processing and analysis methods.

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 481:
Course # | Course Title | Date Last Taught | Frequency Offered | Date Last updated
--- | --- | --- | --- | ---
GEOG 485 | GIS Programming | Currently | Annually | Fall 2014

Course Description (provide URL link to syllabus)

This course teaches how to automate GIS tasks using the Python scripting language. Automation can make your work easier, faster, and more accurate, and knowledge of a scripting language is a highly desired skill in GIS analysts.

This course dedicates time to programming fundamentals so that the skills learned can be applied to languages other than Python. Your increased ability to adapt to new technologies and programming languages will be the greatest benefit that you get from this course.

**URL:**

Course Objectives

By the end of this course, you should be able to:

- Design and implement solutions in Python (and ModelBuilder) to automate geoprocessing tasks.
- Demonstrate an understanding of programming concepts, methods, and approaches such as debugging, error checking, and documentation.
- Demonstrate an awareness of advanced concepts such as external libraries.

Be aware of and able to integrate content, examples, and concepts from external resources such as [esri.com](http://esri.com) (link is external) and [stackoverflow.com](http://stackoverflow.com) (link is external).

Course Satisfaction of Knowledge Units (as summarized on page 12)

**GEOGRAPHY 485:**

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<th>GEOGRAPHY 485</th>
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Course Synopsis (provide this form for each course as summarized on page 8)

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<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 480</td>
<td>Remote Sensing Analysis and Applications</td>
<td>Currently</td>
<td>Four times annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

An introductory level course focusing on the use of remotely sensed imagery and elevation data in GIS applications. Students enrolling in Geography 480 should have a solid conceptual foundation in geospatial information science and technology (equivalent to Geog 482). Geography 480 is appropriate for those who are entering into the geospatial profession and wish to use imagery and elevation data in visualization and spatial analysis.

URL:

Course Objectives

1) Describe the basic principles of image and elevation data acquisition.
2) Summarize the basic operational characteristics of commercial imaging systems.
3) Critically assess the strengths and weaknesses of optical imaging instruments and platforms for a broad range of application scenarios.
4) Perform orthorectification of digital imagery.
5) Perform simple image enhancement, image interpretation, and automated analysis using digital optical imagery.
6) Perform simple terrain analysis using digital elevation/terrain models.
7) Describe the quantitative methods and industry standards for geometric accuracy assessment of imagery and elevation data products.
8) Describe the qualitative methods and industry standards for quality assurance and quality control of imagery and elevation data products.
9) Use acquired knowledge and critical thinking skills to create visualizations and perform analysis of imagery, elevation, and supplemental vector data in GIS.

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 480:
Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
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</thead>
<tbody>
<tr>
<td>GEOG 481</td>
<td>Topographic Mapping with Lidar</td>
<td>Currently</td>
<td>Three times annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

An introduction to the capabilities of lidar sensors and platforms, data processing systems, and derived digital data products. Students in this course will master basic skills needed to leverage commercial lidar data sources and information products in a broad range of applications, including topographic mapping, flood inundation studies, vegetation analysis, and 3D modeling of urban infrastructure. Lidar (Light Detection and Ranging) is an optical remote sensing technology that uses laser pulses to determine distance between the sensor and a surface or object. In recent years, lidar has emerged as one of most important sources of data for topographic mapping, vegetation analysis, and 3D modeling of urban infrastructure. Federal, state, and local government agencies are acquiring lidar data and derived products for use in floodplain mapping, transportation planning and design, resource and environmental management, law enforcement, and emergency response. Much of this data is freely available to the public, and new uses for the data are emerging at a rapid pace. A thorough understanding of lidar technology and its application in GIS is part of the essential body of knowledge for today’s geospatial professional.

URL:

Course Objectives

Students who excel in this course are able to:
1) Summarize the basic operational characteristics of lidar instruments and platforms used for topographic mapping and geospatial applications.
2) Describe the basic principles of calibrating, georeferencing, and processing of lidar data.
3) Describe quantitative and qualitative methods used in industry standards for quality assurance and accuracy assessment of lidar-derived data products.
4) Critically assess the strengths and weaknesses of various lidar platforms and instruments for a broad range of application scenarios.
5) Apply acquired knowledge and critical thinking skills to solve a real-world problem with appropriate lidar data processing and analysis methods.
**GEOGRAPHY 481:**

Course Synopsis (provide this form for each course as summarized on page 8)

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<tr>
<th>Course #</th>
<th>Course Title</th>
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<th>Date Last updated</th>
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<tbody>
<tr>
<td>GEOG 482</td>
<td>Nature of Geographic Information</td>
<td>Currently</td>
<td>Five times annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

This course explores the nature of geographic information. To study the nature of something is to investigate its essential characteristics and qualities. To understand the nature of the energy produced in a coal-fired power plant, you would need to study the properties, morphology, and geographic distribution of coal. By the same reasoning, I believe that a good approach to understanding the information produced by GIS is to investigate the properties of geographic data and the technologies, professions, and institutions that produce it.

**URL:**

Course Objectives

The overall goals of GEOG 482 are to:

1. promote understanding of the geographic information science and technology (GIS&T) enterprise;
2. promote geographic information literacy - the ability to identify the kind(s) of geographic information needed for a particular task; to determine whether needed data are available; to acquire and assess the quality of the data if available, or specify the technologies and professions needed to produce new data if necessary; and
3. promote effective distance education by providing high quality open courseware and detailed individual critiques in response to every student project assignment.

Course Satisfaction of Knowledge Units (as summarized on page 12)

**GEOGRAPHY 482:**
Course Synopsis (provide this form for each course as summarized on page 8)

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<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 483</td>
<td>Problem Solving with GIS</td>
<td>Currently</td>
<td>Five times annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

Geography 483 consists of tutorials, readings, projects, and discussions concerned with the ways in which geographic information systems facilitate data analysis and communication to address common geographic problems. Students who successfully complete the course are able to use GIS software to analyze both vector and raster data using a variety of techniques, including spatial and attribute queries, map overlay, and buffering. Students also gain experience in designing and producing effective maps. Geography 483 requires use of ESRI's ArcGIS and Spatial Analyst software. Prerequisites: GEOG 482.

URL:

Course Objectives

At the successful completion of this course, students should be able to:

- **Project One: Decision Support with a GIS**
  1) Map GIS data using a coordinate system appropriate for its end use.
  2) Symbolize geographic features.
  3) Perform spatial and attribute queries.

- **Project Two: Summarizing and Displaying Property Damage from Tornadoes**
  1) Extract coordinate system information from metadata.
  2) Define a relational database in basic terms.
  3) Distinguish between feature attribute tables and external attribute tables.
  4) Describe table cardinality and its importance in making associations between tables.
  5) Perform tabular joins and relates using key fields.
  6) Perform mass table updates using SQL.
  7) Update feature geometry values (area, perimeter, length).
  8) Create thematic maps.

- **Project Three: Locating Tornado Relief Sites**
  1) Perform spatial analysis using buffer zones.
  2) Use geoprocessing operations (dissolve, merge, clip, intersect, union) to produce new datasets.
  3) Overlay various map layers for optimal feature display.
• **Project Four: Geocoding Addresses of Customers Who Performed Home Radon Tests**
  1) Describe address geocoding and provide examples of its use.
  2) Locate addresses on a map using geocoding tools.

• **Project Five: Designing a Thematic Map Presentation**
  1) Apply the concepts of visual hierarchy and color theory to compose a presentation-quality map.
  2) Label map features and use labeling variables (type size, weight, and font) effectively.

• **Project Six: Creating a Layout for a Final Map Presentation**
  1) Add map elements (scale bar, north arrow, title, insets, etc.) to create presentation-quality maps.
  2) Discuss map presentation media and methods.

• **Project Seven: Introduction to Raster GIS Analysis**
  1) Describe the difference between discrete and continuous data.
  2) Convert between vector and raster data formats.
  3) Create hillshade and aspect layers from elevation data.
  4) Perform distance calculations.
  5) Reclassify continuous surface grids into discrete categories.
  6) Perform map algebra calculations.

• **Project Eight: Peer Review Project**
  1) Create a presentation quality map.
  2) Critique the design, layout, symbology, etc. of a peer's map.

• **Final Project: Identifying Priority Conservation Areas in Centre County**
  1) Create workflows demonstrating skills learned in the course with outlined steps, procedures and data necessary for a GIS project.
Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 484</td>
<td>GIS Database Development</td>
<td>Currently</td>
<td>Five times annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

The course consists of activities, projects, readings and discussions concerned with how GIS software can be used to integrate geographic data compiled from various sources. Students who successfully complete the course are able to specify and perform the tasks involved in creating a digital geographic database, including georeferencing scanned base maps, digitizing vector features, entering attribute data, and compiling metadata. Geography 484 requires use of Esri's ArcGIS software.

URL:

Course Objectives

At the successful completion of this course, students should be able to:

1) describe the primary methods of capturing spatial features from a paper map.
2) use tracing tools to create new point, line, or polygon features in a GIS database.
3) make proper snapping settings to avoid common digitizing errors like undershoots and overshoots.
4) describe topology and provide examples of topological relationships.
5) integrate XY coordinate data stored in a text file.
6) recognize various types of digitizing errors (undershoots, overshoots, polygon overlap etc.).
7) correct digitizing errors and poorly digitized features.
8) merge and edgematch data covering adjacent areas.
9) explain the concepts behind transforming an image from pixel coordinates to geographic coordinates.
10) describe rubber sheeting and how it differs from georeferencing.
11) georeference an image to match a layer projected in the desired coordinate system.
12) georeference an image using explicit XY coordinates (e.g., collected by a GPS unit).
13) explain how RMS error reflects the spatial accuracy of a georeferenced image.
14) list the stages of database design.
15) define database terms like field, record, primary key, lookup table, etc.
16) provide examples of possible table relationships (one-to-one, one-to-many, many-to-many).
17) describe the elements of a well-designed table.
18) explain in basic terms how SQL is used to bring together information in a relational database.
19) implement a database design and define tables and fields to maximize database
20) acquire existing GIS data from an online clearinghouse.
21) use the Content Standards for Digital Geospatial Metadata (CSDGM) as a reference when creating metadata.
22) extract the critical elements from a metadata document.
23) explain why projected datasets have both projected coordinate system parameters and geographic coordinate system parameters.
24) define the coordinate system used by a dataset when that information is incorrect or missing.
25) re-project a dataset from one coordinate system to another.
26) explain and perform spatial joins.
27) calculate summary statistics for geographic areas.
28) create various types of thematic maps to convey geographic patterns effectively.
29) describe how different classification methods can be used to generate different map patterns.
30) define the term “normalization.”
31) analyze a geographic problem and develop a workflow to solve the problem.

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 484:

Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 485</td>
<td>GIS Programming and Automation</td>
<td>Currently</td>
<td>Four times annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

This course teaches how to automate GIS tasks using the Python scripting language. Automation can make your work easier, faster, and more accurate, and knowledge of a scripting language is a highly desired skill in GIS analysts. This course dedicates time to programming fundamentals so that the skills learned can be applied to languages other than Python. Your increased ability to adapt to new technologies and programming languages will be the greatest benefit that you get from this course.

Course Objectives

By the end of this course, you should be able to:
1) Design and implement solutions in Python (and ModelBuilder) to automate geoprocessing tasks.
2) Demonstrate an understanding of programming concepts, methods, and approaches.
such as debugging, error checking, and documentation.

3) Demonstrate an awareness of advanced concepts such as external libraries.

4) Be aware of and able to integrate content, examples, and concepts from external resources such as esri.com (link is external) and stackoverflow.com (link is external).

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 485:

Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 486</td>
<td>Cartography and Visualization</td>
<td>Fall 2014</td>
<td>Three times annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

The goal of GEOG 486 is for the students to understand and apply cartographic theory for visual communication and visual thinking, and be able to create, evaluate, and critique reference and thematic maps using GIS software. The course is organized around seven projects and a capstone assignment. Each project includes readings, quizzes, and discussions about concepts and tools in cartography and visualization. Through the course projects, students confront realistic problem scenarios that incorporate such skills and concepts as creating symbolization schemes, coordinate systems and map projections, creating isoline and other terrain representations, interpolation, classification schemes, multivariate representation and representation of data uncertainty. Those who successfully complete the course are able to design and produce effective reference and thematic maps using GIS software, and can interpret and critique maps and related information graphics.

URL:

Course Objectives

At the successful completion of this course, students should be able to:

1) Acquire GIS data and create a map that visually communicates two or more variables related to a subject.

2) Employ cartographic theory to select visual representations and symbols that fit the logic of the data being mapped.

3) Design a layout using visual hierarchy, balance, and figure-ground of text and graphics to quickly communicate the subject and purpose of the map.

4) Interpret, evaluate and critique maps in writing with the goal of increasing discourse, understanding and appreciation of map design.
Course Satisfaction of Knowledge Units (as summarized on page 12)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last Updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 487</td>
<td>Environmental Applications of GIS</td>
<td>Currently</td>
<td>Three times annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Synopsis (provide this form for each course as summarized on page 8)

GEOG 487 is an elective course in the Master of Geographic Information Systems degree program which is offered exclusively through Penn State’s World Campus. It is also one of the optional capstone courses that leads to Penn State’s Post baccalaureate Certificate in GIS. The course consists of projects, associated readings, quizzes, and discussions about concepts, operations and tools in geographic information systems and spatial analysis in a variety of environmental scenarios.

It provides a simulated internship experience with real-world activity-based scenarios covering such operations as data acquisition and preparation, raster calculations, surface analysis, statistical analysis, and interpolation. Students who successfully complete the course are able to use GIS tools to access, display, manipulate, edit, and analyze geographic data. Students will be exposed to a variety of GIS tools, data formats, sources of data, and environmental issues they are likely to encounter in a career involving GIS and the environment.

**URL:**

Course Objectives

Students who successfully complete this course will be prepared to:

1) Describe a broad range of current environmental issues.
2) Understand how GIS can be used to address environmental questions.
3) Find answers to software questions using the Esri ArcGIS Resource Center.
4) Identify and acquire sources of publically available datasets relevant to current environmental issues.
5) Locate and interpret metadata.
6) Describe common GIS data formats; be able to display and manipulate them using GIS software.
7) Customize data and perform analysis using ArcGIS.
8) Design and conduct a workflow using spatial analyst and other GIS tools to address
specific environmental questions.
9) Present results of GIS analysis in a professional format such as maps, tables, interactive websites, and videos.
10) Utilize resources other than ArcGIS Desktop such as ArcGIS.com, ArcGIS Explore Online, Google Earth, Jing, and Prezi.

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 487:

Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 497C</td>
<td>GIS for Transportation: Principles, Data, and Applications</td>
<td>To begin Spring 2 - 2015</td>
<td>Twice annually</td>
<td>In preparation</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

This course examines the use of GIS principles, data, and applications that have been developed for the field of transportation. GIS for Transportation is a large application area of GIS. It also includes specifically developed GIS functionality that applies to all modes of transportation. A large number of topics could be included in a GIS-T online course, and I have selected the ones I thought would be most relevant and useful in providing a good, solid background for you. I have also tried to build some flexibility into the course, so that if you would like to explore a specific area of GIS-T more there is opportunity for you to do so. The course is divided into five parts - Why GIS Is Important, Foundations, Data Collection, Specification, and Management, Applications, and Organizational Factors.

URL:

Course Objectives

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 497C:
Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 501D</td>
<td>Research Perspectives in GIScience</td>
<td>Fall 2014</td>
<td>Annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

This course presents contemporary perspectives on Geographic Information Science, emphasizing the major issues and integrative themes of the sub-discipline.

GIScience has its own body of theory focused on geographic scale, geographic representation, spatial information, and systems for the capture and use of spatial data. This theory draws heavily from a variety of other disciplines beyond Geography, including: computer science, information science and technology, cognitive science, graphic design, statistics, geodesy, and geometry. This course introduces these various underpinnings, with a focus on current research themes and directions within an integrative framework. The objective is to help graduate students become familiar with GIScience research, specifically: the major intellectual foundations of GIScience, the current state of the field, and the ongoing researcher agenda. The course aims are achieved through a combination of lectures, discussion of 2-3 seminal papers per week, and a half-term paper. Although GEOG 501D is a stand-alone course, it dovetails with the 3 other graduate-level courses proposed in Geography (Physical, Nature-Society, and Human).

URL:

Course Objectives

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 501D
Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 560</td>
<td>Seminar in GIScience</td>
<td>Currently</td>
<td>Three times annually</td>
<td>Continually</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

Seminar in Geographic Information Science (3 per semester/maximum of 18) Geographic information science problems/theory, e.g. GIS, cartography, remote sensing, spatial analysis, modeling. Graduate students can take this course every semester to a maximum of 18 credit hours. Specific topics are as agreed to by student and professor.

URL:

Course Objectives

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 560:
Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 565</td>
<td>Selected Topics in GI Science</td>
<td>Currently</td>
<td>Three times annually</td>
<td>Continually</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

Examination of geographic information science topics: GIS, cartography, remote sensing, spatial analysis, modeling, spatial cognition, geospatial semantics, geovisualization. Specific topics are as agreed to by student and professor.

URL:

Course Objectives

Course Satisfaction of Knowledge Units (as summarized on page 12)

**GEOGRAPHY 565:**
### Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 571</td>
<td>Intelligence Analysis, Cultural Geography, and Homeland Security</td>
<td>Fall 2014</td>
<td>Three times annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

### Course Description (provide URL link to syllabus)

This course examines and illuminates the relationships between cultural geography, civil security and the stability of the existing world order. It rests firmly upon the application of the tools of spatial analysis that are at the heart of the discipline of geography, and is designed to help students develop the analytical processes that will lead to enlightened syntheses (intelligence products) about the connections associated with cultural differences and current internal and external threats to the security of the American homeland. It also is designed to encourage students to examine the impacts of cultural differences on the stability of the existing world order. The overarching objective of this course is to help successful students develop the knowledge, comprehension, and skills needed to effectively analyze current geospatial realities and, through the prism of cultural geography, create a rational predictive synthesis (intelligence summary) about potential human threats to the security of the nation.

**URL:**

### Course Objectives

**GEOG 571:** The successful student will be able to demonstrate comprehension of the following course materials by logically applying the information learned to the analyses of civil security problems and by offering lucid presentations and solutions based on clearly reasoned syntheses:

- Civil Security and globalization
- The environmental mandate (resources, climate, etc.) and civil security
- Culture, cultural wars, and civil security
- American culture, educational challenges, changing demographics, and economic realities
- Civil security and the U.S./Mexico Border Region
- International Terrorism
- Organized Crime, Drugs and the Stability of the World Order
- Future challenges relative to civil security
Course Satisfaction of Knowledge Units (as summarized on page 12)

<table>
<thead>
<tr>
<th>GEOGRAPHY 571</th>
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Course Synopsis (provide this form for each course as summarized on page 8)

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<tr>
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<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 583</td>
<td>Geospatial System Analysis and Design</td>
<td>Currently</td>
<td>Four times annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

Geography 583 is a required course in the Penn State Master of Geographic Information Systems degree program. This course surveys a range of contemporary systems analysis and design methods through case studies, collaborative work, and critical reading / writing. Key topics in this course outline the broad range of current GIS systems, how they are designed and evaluated, and how emerging technologies may impact their design and implementation in the near future.

This course will challenge you to exercise the analytical and writing skills needed to develop successful project reports and proposals. Assignments focus on helping students improve their ability to discuss, write, and critique technical and research articles on the design of geographic information systems. A semester-long project involves writing a design proposal or system requirements document for the development of a real or hypothetical geographic information system.

URL:

Course Objectives

- GEOG 583: Upon successful completion of the course, you will be able to:
  1) understand the stages of GIS System Design;
  2) determine which specific GIS capabilities are needed based on user requirements, and which technologies can support those capabilities;
  3) explain the tradeoffs associated with different system architecture choices;
  4) prepare a plan that describes a GIS design, including ideas for evaluating the end product;
  5) assess the potential of new, evolving technologies to meet GIS-related needs.

- Report & Proposal writing - Upon successful completion of the course, you will be able to:
  1) **develop a report, design plan, or project proposal** that identifies or responds to a GIS system design and analysis challenge;
  2) identify and explain possible matches between your organization’s needs or capabilities and relevant new GIS technologies;
3) write an effective statement of goals or purpose for your report or proposal that makes its content and motivation clear;
4) structure a report or proposal in a logical manner that can be understood easily by reviewers;
5) if you choose to write a proposal, generate a convincing case for: (a) your organization’s need (or expertise to meet a need) (b) your organization’s ability to carry out the proposed work;
6) if you choose to write a report, generate a convincing case for: (a) your understanding of prior work and relevant literature (b) what the implications are of your findings.

- Critical Reading - Upon successful completion of the course, you will be able to:
evaluate professional literature critically (thus be able to systematically identify strengths and weaknesses in an author’s arguments, innovative ideas, connections to previous work);
   1) provide constructive feedback on work written by others;
   2) provide fair, objective reviews of work written by others.

Course Satisfaction of Knowledge Units (as summarized on page 12)

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<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 584</td>
<td>Geospatial Technology Project Management</td>
<td>Fall 2014</td>
<td>Four times a year</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

In GEOG 584, we will take a critical look at geospatial project management. Project management is a broad discipline that encompasses both technical methods such as system design and analysis, and interpersonal factors that affect professional relationships. Project management is also a discipline that has matured outside of, but can be incorporated into, geospatial technology. By the end of this course, you will have devised a project plan from a scenario built upon a real-life project involving the city of Philadelphia pole and pole attachment geodatabase. Your project plan will include a scope, detailed work structure with a timeline, a budget, a project roles and responsibility matrix, a quality plan, and a plan to address risk.

URL:
Course Objectives

Lesson 1: Introduction to Project Management
• Describe what a project is, and the difference between a project, program and a product.
• Describe the constraints of projects.
• Describe project management and its profession.
• Describe the framework within which project management exists (stakeholders, knowledge areas, tools/techniques and portfolios).
• Explore factors unique to GIS project management.

Lesson 2: Organizational System, Project Life Cycle, Processes, and Procurement
• Describe the system view of project management, and how it differs from system design and analysis.
• Describe organizational systems, structures, boundaries, and the roles of users, sponsors and stakeholders within and outside of the organization.
• Describe the phases of a project life cycle, highlighting the unique context of GIS projects.
• Describe the five project management process groups, and how each occurs within each project phase.
• Describe procurement, including the utility of Statements of Work and Requests for Proposals.
• Describe the importance of procurement management from both within and outside of the system, and the importance of contracts in defining these relationships.

Lesson 3: Scope
• Describe how strategic planning should influence projects undertaken by an organization.
• Describe various methods used for project selection including net present value and weighted scoring.
• Describe the scope of a project and its relationship to deliverables.
• Describe how to use system boundaries to control scope and address scope-related issues.
• Describe the importance, use, and design of a project charter.

Lesson 4: The Human Factor and Communication
• Understand human resource issues associated with personnel assignment, loading and leveling.
• Create and use appropriate HR tools, such as project org. charts, responsibility matrices, and HR histograms.
• Describe current understanding of motivation, influence, and team building, including personality types.
• Describe communication planning, and the best use of communication skills, tools, and technology.

Lesson 5: Time
• Describe the importance, use and design approaches of a Work Breakdown Structure (WBS).
• Describe how network diagrams show dependencies of activities and the critical path.
• Describe the Gantt chart’s use in planning and tracking tasks.

Lesson 6: Cost
• Describe the basic principles and concepts of cost management.
• Describe the relationship between cost management and project resources.
• Describe key inputs into cost estimates and budgets.
• Describe cost control and its tools such as earned value management.

Lesson 7: Quality
• Describe the differences between quality planning, assurance and control; and describe where each fits into the project life cycle.
• Describe benchmarking as a tool for quality assurance.
• Describe the history, techniques and tools of quality control and management.
• Describe aspects of GIS projects that require special attention to quality.

Lesson 8: Risk
• Describe methods to identify common sources of risk in GIS projects.
• Describe qualitative risk analysis processes such as probability/impact matrices.
• Describe quantitative risk analysis processes such as Monte Carlo simulations and decision trees.
• Describe strategies to respond to risk (avoidance, acceptance, transference, and mitigation).

Lesson 9: Integration
• Describe how project integration management draws upon all other knowledge areas of project management.
• Describe what a project plan is and how it is developed.

Lesson 10: Project Plan
• Discuss effective execution of a project plan.
• Describe how the system view of an organization and integrated change control processes are important to GIS project managers.

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 584:
Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
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<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 585</td>
<td>Open Web Mapping</td>
<td>Currently</td>
<td>Twice annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

Geography 585: Open Web Mapping is a 10-week online course that gives you experience with sharing geographic information on the Internet using free and open source software (FOSS) and open specifications.

The two main purposes of Geog 585 are to help you understand the importance of web services and to give you some experience making web maps with FOSS and open standards. You could certainly implement web services using proprietary software, too; however, the cost of a proprietary GIS server package makes FOSS an attractive area of study for basic web mapping tasks.

The purpose of Geog 585 is not to promote FOSS over proprietary software, or vice versa (you could find plenty of materials on the Internet debating this subject); however, Geog 585 should familiarize you with the capabilities and shortfalls of the current FOSS landscape to the point that you can make an informed decision about whether to use FOSS in your own web mapping tasks.

The set of FOSS and open data sources you will be exposed to in Geog 585 includes QGIS, GDAL, GeoServer, GeoWebCache, TileMill, OpenStreetMap, and OpenLayers. You will also learn about open data standards such as GeoJSON, KML, and OGC web service specifications.

URL:
Course Objectives

- Describe the roles of clients, servers, and requests and how they contribute to web service communication patterns
- Identify benefits and challenges to FOSS and how they should be weighed when choosing a software platform.
- List common FOSS solutions for general computing and GIS and discuss how you have seen these used in the “real world”
- Recognize when and how FOSS might be used in a “hybrid” model with elements of proprietary software
- Add and symbolize GIS data in QGIS
- Identify the pieces of hardware and software architecture used in web mapping and describe the role played by each
- Recognize the roles of basemaps and thematic layers in a web map, and identify examples of each
- Critique the layer construction and architecture of a web map
- Log in to the GeoServer administrator page and preview layers
- List common open formats for spatial data and give appropriate uses for each
- Recognize the advantages of various data storage architectures and formats
- Process (clip and project) GIS data using QGIS and GDAL, and describe when it would be appropriate to use each
- Experiment with a new GDAL function and use the documentation to learn how to invoke it
- Identify the pros and cons to using a dynamically drawn web map service (as opposed to a tiled service)
- Recognize the role of OGC in defining open geospatial web service specifications
- List the basic functions of a WMS and describe how and why each would be invoked
- Expose GIS datasets as a WMS using GeoServer
- Use SLDs to define layer styling in a WMS. Create the SLDs using code and using the GUI environment of QGIS.
- Identify and critique a WMS used in a public-facing web site
- Describe the advantages of tiled web maps and identify when it is appropriate to use them
- Recognize strategies and techniques for creating and updating large tiled web maps
• Create tiles for a WMS using GeoWebCache
• Use best practices in multiscale map design to create a tiled basemap using TileMill.
• Discuss hosting options for tiled maps. Unpack and upload your tiled map to your own web space (on PASS).
• Identify commonly-used web mapping APIs (both proprietary and FOSS) and recognize programming patterns that are common to each.
• Choose developer examples that relate to your web mapping task and adjust the code to meet the needs of your own application
• Use OpenLayers to create a mashup from a tiled basemap and a WMS thematic layer
• Create informational popups for your web map features using OpenLayers
• Describe benefits and challenges of drawing thematic vector map layers in the web browser
• Choose between KML, GeoJSON, and other formats for drawing vector data in the browser
• Understand how vector layers can be symbolized on the fly to provide a more interactive web map experience.
• Draw thematic vector layers in a web map using OpenLayers and change the symbolization in response to map events.
• Implement techniques for data filtering and classification using OpenLayers
• Describe OGC specifications for vector data editing (WFS) and geoprocessing (WPS) in web maps.
• Implement the layer switcher and other controls from OpenLayers according to application needs
• Choose a web presentation framework such as Bootstrap and apply it to your OpenLayers applications
• Query and display geographic attributes (including links to images and web pages) in your web map application
• Learn and critically evaluate a new piece of FOSS GIS
• Define “open data” and describe some of the differences in use conditions among open data options
• Recognize the benefits and weaknesses of OpenStreetMap and its process of crowdsourcing
• Describe options for retrieving data from OpenStreetMap
• Edit OpenStreetMap according to community-defined tagging standards, and describe what this experience taught you about open data sources
• Synthesize the material from the previous lessons to create an interactive web map combining data sources of your choosing. Justify your choices of data storage formats, web service types, and API elements used, with respect to both aesthetics and performance.

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 585:
Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 586</td>
<td>Geographic Information Analysis</td>
<td>Currently</td>
<td>Four times annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

This is a course in analytical methods for handling specifically spatial data, that is, data where the arrangement of observations in space is thought to be of significance. The techniques introduced are often mathematically complex, but while these aspects are covered in the course, the emphasis is on the choice and application of appropriate methods for the analysis of the spatial data often encountered in applied geography. Weekly projects are hands-on, using geographic information systems or other appropriate computational tools, so that students appreciate the practical complexities involved, and the relative limitations of these methods in contemporary desktop GIS.

Through the weekly projects, students acquire familiarity with use of a single method or family of methods in standard desktop tools, so that they can focus on aspects of that method and develop a thorough understanding of its potential and of its limitations. Problem scenarios range across demographic, planning, crime analysis, landscape analysis, and other application areas. The term-long project is intended to allow students to formulate a research problem in a topic area of their own choosing, to gather and organize appropriate available datasets, and to understand how a variety of methods among those covered in the course can be applied in combination to thoroughly explore real questions.

URL:

Course Objectives

1) Explain why spatial data is special
2) Explain the basic concepts of inferential and descriptive statistics
3) Describe classical spatial analysis
4) Describe point pattern analysis
5) Outline interpolation – from simple to advanced
6) Describe surface analysis
7) Explain Boolean map overlays
8) Perform spatial auto correlation

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 586:
Dutton page has this in the weekly objectives

Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 587</td>
<td>Conservation GIS</td>
<td>Fall 2014</td>
<td>Twice annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

Conservation GIS strives to address the multiple factors influencing the conservation planning process by applying appropriate geospatial techniques. Conservation planning requires interdisciplinary approaches that blend spatial and temporal information on physical, biological, and socio-economic factors as a basis to establish current conditions, monitor change, and predict possible futures. Practitioners work in support of resource management agencies, non-profit conservation organizations, and environmental consulting companies and address projects encompassing local to global ecological scales. They combine geospatial capability with core concepts from conservation biology, landscape ecology, biodiversity monitoring, environmental impact analysis, watershed assessment, and wildlife management to address specific planning challenges.

GEOG 587 provides students the opportunity to expand on the GIS concepts introduced in GEOG 487: Environmental Applications of GIS while incorporating a problem-solving approach. This course emphasizes the unique nature of each conservation problem and the multiple pathways that may result depending upon the geospatial techniques that are applied. Problem understanding is emphasized as a prerequisite to the application of the full range of possible geospatial techniques that could be used to unravel complex conservation challenges. Map making, a common thread when working with GIS is only the beginning in this course. Your ability to use the written word to describe the decision process that you used to address each problem will dictate your success in this course.

URL:
Course Objectives

1) Examine local scale conservation – “Setting and Protecting Conservation Targets”
2) Explore the methods of local to regional conservation – “Habitat Suitability and Preserve Design”
3) Examine regional conservation priorities – “Multi-State/Large Watersheds”
4) Explore international conservation planning – “National Reserve Design”

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 587: Dutton page has the details

Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 588</td>
<td>Planning GIS for Emergency Management</td>
<td>Fall 2014</td>
<td>Annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

The course provides a framework for understanding the real-world application of GIS for crisis management and for addressing the applied research needed to enable more effective GIS application in this context. It provides the background and perspective needed by project managers, consultants, and other professionals who are engaged in activities that range from initial requirements analysis (to determine whether and how to implement or extend GIS capabilities for emergency management), through design of training exercises (to develop requisite staff expertise in application of GIS to different kinds of emergency situations), to development of technological enhancements intended to improve the effectiveness of GIS in specific emergency management activities.

URL:

Course Objectives

- Emergency management as an application domain for GIS - Upon successful completion of the course, you will be able to:
  1) Understand the stages of emergency management and the roles of GIS in each stage;
  2) Determine which specific GIS capabilities and kinds of data are required to support emergency management work at each stage;
  3) Explain how GIS techniques have been applied effectively within each stage of emergency management;
  4) Identify challenges in application of GIS to specific emergency management problems
(e.g., evacuation planning and execution, real-time data integration) – thus articulate the future potential of current GIS in this domain;
5) Assess the potential of new, evolving GIS technologies to meet emergency management needs.

• Report and Proposal writing - Upon successful completion of the course, you will be able to:
  1) **Develop a report or project proposal** that identifies or responds to needs for GIS solutions in emergency management;
  2) Identify and explain possible matches between your organization’s needs or capabilities and relevant new GIS technologies and/or funding agency priorities;
  3) Write an effective statement of goals or purpose for your report or proposal that makes its content and motivation clear;
  4) Structure a report or proposal in a logical manner that can be understood easily by reviewers;
  5) If you choose to write a proposal, generate a convincing case for: (a) your organization’s need (or expertise to meet a need) (b) your organization’s ability to carry out the proposed work;
  6) If you choose to write a report, generate a convincing case for: (a) your understanding of prior work and relevant literature (b) what the implications are of your findings.

• Critical Reading - Upon successful completion of the course, you will be able to
  1) Evaluate professional literature critically (thus are able to systematically identify strengths and weaknesses in an author’s arguments, innovative ideas, connections to previous work);
  2) Provide constructive feedback on work written by others;
  3) Provide fair, objective reviews of work written by others.

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**Course Satisfaction of Knowledge Units (as summarized on page 12)**

**GEOGRAPHY 588:** Dutton angel has it
Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 597G</td>
<td>Geospatial Applications of Unmanned Aerial systems (UAS)</td>
<td>New course</td>
<td>Twice annually</td>
<td>Under development</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

GEOG 597G cultivates students’ knowledge of the capabilities and limitations of the UAS and data post-processing systems. The course also introduces fundamental concepts surrounding operating a UAS such as strategies for selecting the right UAS, assessing its performance, managing resulting products (i.e. imagery), selecting the appropriate commercially available processing software, assessing products accuracy, figuring ways and means of producing metric products from UAS, and understanding rules and regulations governing operating a UAS in the United States of America.

URL:

Course Objectives

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 597G:

Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
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<th>Date Last updated</th>
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<tbody>
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</table>
Course Description (provide URL link to syllabus)
This course teaches students the fundamentals of cyberspace including why cyber geography is important, how data and observables are used, what products are produced for decision making, and a look at emerging forces of change in the field. The course will be taught over 10 weeks, and activities will include both individual and team work.
This course will teach students the following concepts:
• the impacts of increased flow of information across the world and the risks associated with that increase
• the role and use of Geospatial Intelligence in the cyber domain ranging from cyberwarfare to cyberterrorism, disaster response, and humanitarian relief
• the degree and impact of Internet censorship in various parts of the world and how it is commonly measured

Course Objectives
At the end of this course, students will be able to:
• apply the fundamentals and principles of cyber geography and classify the spatial aspects of information;
• interpret/uncover cyber events using the relationship to location on the earth where the start, end, and content of the interactions provide meaning;
• compare expectations and rights of individuals and governments related to the use of geolocation technologies, data, and privacy from various perspectives;
• describe ways to model and visualize the increase of information resources;
• discuss ways the Intelligence Community collects and analyzes cyber information;
• demonstrate the application of geospatial intelligence to cyberspace operations;
• evaluate potential technology paths to mitigate Intelligence blind spots;
• anticipate the impact of the Information Communications Technology explosion on the continent of Africa;
• perform social media network analysis using application software to create analytic products.

Course Satisfaction of Knowledge Units (as summarized on page 12)
GEOGRAPHY 597I: in Dutton
Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 862</td>
<td>GPS and GNSS</td>
<td>Currently</td>
<td>Twice annually</td>
<td>New course</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

The Global Positioning System (GPS) and the wider Global Navigation Satellite System (GNSS) include constellations of earth-orbiting satellites that broadcast their locations in space and time, a network of ground control stations, and military and civilian receivers that calculate ground positions by trilateration. Geospatial professionals need to possess a working knowledge of current and future GPS and GNSS capabilities because satellite positioning is so prevalent in geographic information systems (GIS) applications in government, industry, and academia.

GPS has always been a dual use system, military and civilian. From the beginning, GPS signals have been available with no direct user fees. GNSS has built on those concepts and added some new ones. GPS and GNSS are used now in all of transportation—aviation, maritime, railroad, highway and mass transit. Satellite positioning also plays critical roles in telecommunications, land surveying, law enforcement, emergency response, precision agriculture, mining, finance, and scientific research. It controls computer networks, air traffic, power grids, and so on. As the scope of satellite positioning has expanded, the systems continue to evolve.

URL:
Course Objectives
At the successful completion of this course, students should be able to:
• demonstrate a clear understanding of the GPS signal, codes and biases
• discuss the practical applications of GPS and the implications of its modernization
• be aware of some of the opportunities afforded by the coming GNSS systems
• explain the difficulties inherent in determining heights with satellite positioning and how they can be overcome
• describe the differences between relative and autonomous GPS positioning, code phase carrier phase, DGPS and RTK

Course Satisfaction of Knowledge Units (as summarized on page 12)

| GEOGRAPHY 862: in Angel |

Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
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<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 863</td>
<td>Mashups for Geospatial Professionals</td>
<td>Fall 2014</td>
<td>Annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

GEOG 863 Cultivates a working knowledge of how geospatial professionals can develop web mapping applications that bring together data from multiple sources.

In the context of information technology, the term "mashup" refers to a web application that combines content from multiple sources into a whole that is greater than its parts. A GIS mashup is one in which at least a portion of the content is geographic in nature and in which information is typically conveyed through a map. For example, tabular crime data published on a city's website can be combined with base data layers such as municipal boundaries and roads to produce a map that is valuable for both the city's police department and its citizens. GIS vendors have offered web mapping software products for many years. However, several companies offer free application programming interfaces (APIs), which make it easier and more affordable to publish online maps. These APIs provide a set of base layers upon which the map developer can overlay his/her own geocoded data. These data may be stored in files on the developer’s own server or they may be obtained dynamically through public web services or by parsing data embedded within other web pages. This course demonstrates how GIS mashups can be created using the Google Maps API and Esri's JavaScript API.

URL:
Course Objectives

At the successful completion of this course, students should be able to:
- describe the advantages/disadvantages of internet-based maps vs. paper-based maps;
- identify some ground-breaking early web mapping sites;
- describe categories of web maps based on function/sophistication;
- detail the major steps in the evolution of web mapping technology;
- discuss the advantages/disadvantages of current commercial, open-source and public Application Programming Interface (API) web mapping technologies;
- understand the basic rules/terminology of Hypertext Transfer Markup Language (HTML);
- author a simple web page containing paragraphs, lists, tables, images and links without the aid of an HTML editor;
- describe notation schemes that are not handled well by HTML;
- explain the need for and uses of eXtensible Markup Language (XML);
- describe the advantages of authoring web pages using eXtensible HTML (XHTML) and its syntax differences from HTML;
- describe the benefits of using Cascading Style Sheet (CSS) technology;
- author a simple web page using XHTML and CSS;
- use the Google Maps website to locate places by various search methods;
- manually construct a URL that will load a desired Google Map;
- create a basic Google map without programming;
- insert JavaScript into a web page;
- understand the basics of the HTML Document Object Model (DOM);
- use JavaScript and the Google Maps API to add a custom map to a web page;
- set the initial extent parameters of a custom map;
- obtain information on how to work with objects defined in the API through the API Reference;
- add markers (points) to a map;
- cite examples of well-known mashups;
- add map type controls (e.g., Satellite and Hybrid), map navigation controls and a scale bar control to a Google map;
- add event handling code that produces custom behavior when certain events are triggered by the user (e.g., opening a callout window when a marker is clicked);
- display map markers using icons that have been created and published by others;
- understand the process involved in creating an icon and shadow image that can be used for displaying map markers;
- work with JavaScript arrays to add lines and polygons to a map;
- use GIS software to obtain the latitude/longitude coordinates of points to be displayed on a Google map;
- convert tabular data to XML;
- use JavaScript to read points from an XML file and plot them on a map;
- add a sidebar that lists selected attribute information about the points on the map;
- explain how the Ajax programming technique produces more responsive web
• understand how server-side scripting can be used to read data from a DBMS and package the data so it can be consumed by JavaScript;
• use the Google geocoder to obtain lat/long coordinates for addresses;
• explain how web scraping can be used to incorporate data into a mashup;
• produce maps using Esri’s JavaScript API that are similar to the Google Maps examples from earlier in the course;
• explain the difference between tiled and dynamic map services;
• find and consume ArcGIS Server-authored map services in a mashup;
• work with the Dojo JavaScript toolkit;
• manipulate Esri FeatureLayer objects;
• understand the difference between client-side and server-side web scripting languages;
• embed PHP: Hypertext Processor (PHP) code in a web page to deliver dynamic content;
• describe the advantages/disadvantages of storing map data in a relational database vs. an XML file;
• use Structured Query Language (SQL) to extract data from a database;
• develop an efficient database schema for the storage of map data;
• use PHP to connect to a database and assemble the map data required for a mashup.

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 863:

Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 864</td>
<td>Professionalism in GIS&amp;T</td>
<td>Spring 2014</td>
<td>Annually</td>
<td>Spring 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

“Being professional” in the Geographic Information Science and Technology field (GIS&T, a.k.a. geospatial) means being both competent in one’s work and reflective about its legal and ethical implications. Licensed and certified GIS&T professionals are required to affirm their commitment to legal and ethical practice. Fulfiling such commitments requires the ability to recognize and analyze legal and ethical problems and to act with integrity. In this course students investigate the nature of professions generally and the characteristics of the professions that occupy the GIS&T field in particular. Students gain awareness of pertinent legal and ethical issues and hone their moral reasoning skills through methodical analyses of case studies in relation to the GIS Code of Ethics and Rules of Conduct. Assignments include readings, investigations of GIS&T professions, and methodical analyses of legal and ethical case studies.
## URL:

### Course Objectives

The overall goals of GEOG 864 are to prepare students to:

- Define the GIS&T field in relation to its constituent professions;
- Explain the legal and ethical issues that pertain to the GIS&T field;
- Demonstrate moral reasoning skills through methodical analyses of ethical case studies;
- Demonstrate understanding of academic integrity policies and guidelines.

### Course Satisfaction of Knowledge Units (as summarized on page 12)

**GEOGRAPHY 864:** no detailed syllabus found, but this course is a required Core KU

### Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
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<th>Date Last Updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 865</td>
<td>Cloud and Server GIS</td>
<td>Currently</td>
<td>Twice annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

### Course Description (provide URL link to syllabus)

This course teaches students to use cloud and server GIS resources to solve problems for which geospatial data is an integral element. We will evaluate and implement systems using three cloud service models (infrastructure services, platform services, and software services). The course will contain both worked exercises and critical reading and writing for infrastructure, platform, and software service models.

The course will teach you to set up cloud services for creating maps, cloud services for managing spatial data, and cloud services for processing spatial data. This course will challenge you to exercise the critical thinking and technical needed to evaluate and develop successful cloud GIS projects. Assignments focus on helping students improve their ability to write about and execute cloud GIS projects. A semester-long project involves creating a working cloud and server GIS project, including public presentation of results.

### URL:

### Course Objectives

Cloud computing objectives, based on the NIST definition of cloud computing:

- Be able to evaluate cloud computing technologies in terms of their essential
characteristics
  o Network access
  o On-demand self-service
  o Resource pooling
  o Elasticity
  o Measured Service
• Be able to evaluate cloud computing technologies in terms of their service models
  o Cloud Software as a Service (SaaS)
  o Cloud Platform as a Service (PaaS)
  o Cloud Infrastruture as a Service (IaaS)
• Cloud GIS Skills
  o Scalable web mapping using the Esri ArcGIS Server platform
  o Scalable web mapping using open source GIS
  o Scalable geo-processing using open source GIS
  o Web mapping using Google Fusion Tables
  o Web mapping using ArcGIS Online

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 865:

Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
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<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 882</td>
<td>Geographic Foundations of Geospatial Intelligence</td>
<td>currently</td>
<td>Five times annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

Geospatial intelligence (GEOINT) leverages geographic information science and technology (including cartography, geographic information systems, remote sensing, and global positioning systems) with intelligence tradecraft to develop intelligence products that support national security, disaster response, and international relief efforts. GEOG 882 is designed to challenge current and aspiring GEOINT professionals to be more than technicians. Students who successfully complete GEOG 882 will appreciate that while geospatial technologies are useful in revealing "what, who, where, and to some extent how" events are taking place, it is less useful in explaining "why" events occur, or what response is most appropriate. Students will learn that the political, cultural, historical, and economic perspectives of human geography are needed to put GEOINT analyses in context. The course will also challenge students to approach analyses critically, to consider alternative viewpoints and explanations, and to question their own assumptions.
Course Objectives

- Demonstrate the ability in writing and speech to apply critical thinking skills.
- Explain the fundamental relevance of human geography to geospatial intelligence analysis.
- Discuss the fundamental concepts of geospatial intelligence in national security and disaster management.
- Critically assess ethical and social justice issues that arise in the application of geospatial intelligence analysis.
- Challenge their own assumptions and consider alternative discourses.

Course Satisfaction of Knowledge Units (as summarized on page 12)

**GEOGRAPHY 882:**

Course Synopses (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
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<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last Updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 883</td>
<td>Remote Sensing for the GEOINT Professional</td>
<td>Currently</td>
<td>Four times annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

A graduate level course focusing on remotely sensed data for geospatial applications. This course assumes that students have prior knowledge in the basics of remote sensing, mapping, and GIS, and have experience with geospatial software, particularly ArcGIS. Students will develop a strong understanding of the tools and techniques used to display, process, and analyze remotely sensed data. Upon completion of GEOG 883 students will be able to develop analytical workflows to derive products and extract information from remotely sensed data for a broad range of applications. The culmination of this course is an independent final project in which students will demonstrate their ability to apply new skills to a real-world situation of personal or professional interest.

URL:

Course Objectives

Upon completion of the course, students who excel are able to:
Course Synopses of Knowledge Units (as summarized on page 12)

**GEOGRAPHY 883:**

- Process remotely sensed data to make it useful in geographic information systems;
- Perform image enhancement on remotely sensed imagery;
- Extract information from remotely sensed data using a variety of manual and automated techniques;
- Critically assess the strengths and weaknesses of remote sensing instruments and platforms for a variety of application scenarios;
- Develop multi-step remote sensing workflows to solve problems in a variety of application areas;
- Apply acquired knowledge and critical thinking skills to solve a real-world problem with appropriate remote sensing data and processing methods.

Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
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<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last Updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 884</td>
<td>GIS for the GEOINT Professional</td>
<td>Currently</td>
<td>Three times annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

Geospatial intelligence (GEOINT) leverages geographic information science and technology (including cartography, geographic information systems, remote sensing, and global positioning systems) with intelligence tradecraft to develop intelligence products that support national security, disaster response, and international relief efforts. GEOG 884 cultivates in students the knowledge of the capabilities and limitations of geographic information systems (GIS) and the skills needed to realize their potential in the context of the geospatial intelligence tradecraft.

**URL:**

Course Objectives

Students who excel in this course are able to:

- Discuss the differences between raster and vector GIS data, the comparative advantages
and disadvantages of each, and how scale affects each type of data.

- Describe the importance of metadata and data standards, and some of the standard types and sources of data.
- Discuss the organization and structure of spatial data bases.
- Explain the importance of geovisualization and spatial analysis.
- Perform GIS operations including queries, filters, buffers, viewsheds, hillshading, map algebra, digitizing.
- Discuss the challenges facing GIS, and the likely direction of changes in the future.
- Analyze and interpret geospatial patterns.

Course Satisfaction of Knowledge Units (as summarized on page 12)

**GEOGRAPHY 884:**

Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 885</td>
<td>Advanced Analytic Methods in GEOINT</td>
<td>Currently</td>
<td>Four times annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

The traditional approach to geospatial analysis is the intuitive technique. In order to improve analysis, relatively uncomplicated methods exist to help intelligence analysts structure their analysis. These structured methods, which can be applied to a broad range of problems, provide a scientific-like and demonstrable approach to analysis that can enhance the intelligence analyst objectivity. Structured methodologies do not replace the subjective insight of the intelligence analyst. Instead, the intent is to use a logical framework to illustrate and capitalize on intuition, experience, and judgment. A structured methodology provides a traceable and repeatable means to reach a conclusion. Significant for us, structured methods have significant value in that they can be taught. Structured methodologies are severely neglected in the geospatial realm. This course teaches the theory and practice behind a structured analytic method designed for geospatial intelligence, with particular emphasis given to selecting and applying appropriate analysis techniques to create and test hypotheses. Students will assess the various connotative biases and spatial fallacies that interfere with sound spatial thinking. Students also appraise basic analysis techniques
including imagination, diagnostic, and challenging & reframing.

URL:

Course Objectives

Students who excel in this course are able to:

• Critically assess the limits of automated analysis.
• Apply the basic Structured Analytic Techniques (SAT) that geospatial analysts in the domains of national security, law enforcement, and business can use to overcome mindsets, leverage their imagination, and instil rigor in their analysis.
• Apply the Structured Geospatial Analytic Method.
• Perform Analysis of Competing Hypotheses (ACH) using actual case studies.
• Describe how organizations make decisions and how best to include geospatial information.
• Use acquired knowledge and critical thinking skills to solve a real-world problem using the appropriate Structured Analytic Techniques.

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 885:

Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 897D</td>
<td>Spatial Database Management</td>
<td>Fall 2014</td>
<td>Twice annually</td>
<td>Fall 2014</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)
Access to accurate data is a cornerstone on which all successful organizations are built. The data stewards who maintain an organization’s information systems thus have a crucial role to play. This course is intended for students who want to learn how to create, maintain, and retrieve data from a spatially enabled database. The course begins by covering relational database topics that are of relevance in both geographic and non-geographic contexts (e.g., Structured Query Language and database design). It then focuses on the special considerations involved in the management of a spatial database by demonstrating two broad approaches. The first utilizes open-source technologies (specifically, the Postgres database management system and its spatial extension PostGIS); the second utilizes technology from a leading vendor (Esri’s geodatabase).

URL:

Course Objectives

At the successful completion of this course, students should be able to:

- retrieve data from an existing database using SQL Select queries
- design a database schema from a set of requirements
- implement that design through the creation of related tables
- insert and update rows in a table
- create spatially enabled tables in Postgres/PostGIS
- work with PostGIS data using open-source desktop GIS software (QGIS)
- answer questions using PostGIS spatial functions
- create an Esri file geodatabase
- model real-world entities through subtypes, domains, topology rules, and relationship classes
- set up and administer an enterprise (ArcSDE) geodatabase
- manage vector and raster data in an enterprise geodatabase
- understand enterprise geodatabase editing workflows
- discuss the suitability of an open-source or proprietary approach to various project scenarios

Course Satisfaction of Knowledge Units (as summarized on page 12)

GEOGRAPHY 897D:

Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
<th>Course Title</th>
<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last Updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 897K</td>
<td>Map Projections</td>
<td>Currently</td>
<td>Twice annually</td>
<td>New course</td>
</tr>
</tbody>
</table>
Course Description (provide URL link to syllabus)

*Map Projections for Geospatial Professionals* cultivates a working knowledge of map projections that professionals need to process geospatial data effectively for mapping and analysis. This course discusses three fundamental mapping topics: datums, map projections, and grid systems.

**URL:** [Provide URL link to syllabus]

Course Objectives

At the successful completion of this course, students should be able to:

- Be conversant with and continue building a working knowledge of datum, map projection, and grid system terminology;
- Effectively implement that terminology to modify and adjust datum, map projection, and grid system parameters for specific mapping purpose outcomes;
- Explain why specific datum, map projection, and grid systems are adopted for various mapping situations in the GIS environment;
- Understand how to weave through the often complex GIS environment’s interface when specifying datum, map projection, and grid system parameters;
- Understand what impacts will occur as map projection parameters and datum definitions are modified for a specific coordinate system;
- Transform coordinates from one map projection into coordinates into a different map projection;
- Read metadata documents, retrieve, and implement map projection information contained within;
- Import geospatial data into an existing GIS environment, paying particular attention to the situation when the data to import is not in the same projection or datum as the existing data;
- Ensure that the coordinate systems are appropriately defined in the metadata document (e.g., important when exporting geospatial data from a GIS environment);
- Survey the mathematical processes involved in a coordinate conversion and datum transformation.

Course Satisfaction of Knowledge Units (as summarized on page 12)

**GEOGRAPHY 897K:**

Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
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<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last Updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>IST 885</td>
<td>Introduction to Multisensor Data Fusion</td>
<td>Currently</td>
<td>2-3 times annually</td>
<td>July 2014</td>
</tr>
</tbody>
</table>
Course Description (provide URL link to syllabus)

**IST 885 Introduction to Multisensor Data Fusion (3)**

This course provides an introduction to multisensor information fusion. Multisensor information fusion seeks to combine information from multiple sensors and sources to achieve inferences that are not feasible from a single sensor or source. The proliferation of micro and nano-scale sensors, wireless communication, and ubiquitous computing enables the assembly of information from sensors, models, and human input for a wide variety of applications such as environmental monitoring, crisis management, medical diagnosis, monitoring and control of manufacturing processes, and intelligent buildings. This course will help students understand the concepts, techniques and issues associated with developing and using multisensor data fusion systems. The course will provide a combination of background information (via readings from the textbook and selected papers), links to resource materials for current and future study via a special web site, and practical experience in understanding an application and designing a conceptual data fusion system. For those students who are not mathematically inclined, the course will provide an introduction to techniques by describing the concept of the methods and an understanding of how they work. For students who have an interest and background in applied mathematics, the course will provide references to resources to show actual equations and algorithms. However, this mathematical understanding will not be necessary to successfully complete the course.

**URL:**

Course Objectives

At the end of this course students should be able to:

1) Explain different models of multisensor data fusion
2) Describe the six levels of data fusion in the Joint Directors of Laboratories (JDL) data fusion model
3) Identify various techniques used in multisensor data fusion ranging from pattern recognition and statistical estimation to automated reasoning.
4) Analyze a data fusion application (such as for environmental monitoring) and assess the types of sensor and other input data, the required inferences and decision timeline, identify fusion needs and challenges, and develop a functional design for a fusion system to address the application
5) Articulate the advantages and limitations of data fusion
6) Describe the role of the human in the loop analysts/decision-maker in a fusion system

Course Satisfaction of Knowledge Units (as summarized on page 12)
Course Synopsis (provide this form for each course as summarized on page 8)

<table>
<thead>
<tr>
<th>Course #</th>
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<th>Date Last Taught</th>
<th>Frequency Offered</th>
<th>Date Last updated</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOG 589</td>
<td>Emerging Trends in Remote Sensing</td>
<td>Under development</td>
<td>Twice annually</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Course Description (provide URL link to syllabus)

Under development – Spring 2016

URL:

Course Objectives

Under development.

Course Satisfaction of Knowledge Units (as summarized on page 12)

Certification:

Our Institution understands and believes that our program meets the criteria defined for designation as an NGA/USGS Centers of Academic Excellence in Geospatial Science Education. Our program has active courses that cover the mandatory core knowledge units and at least five of the optional units to meet the academic content requirements. Our Institution agrees, as part of the application process, that we may be asked to participate in
an in-person or remote curriculum review of our courses to verify satisfaction of the mandatory and optional knowledge units.

Optional:
We additionally certify that we believe our program satisfies the additional requirements for designation as an NGA/USGS CAE in Geospatial Sciences in the following focus area(s):
Cartographic Sciences and Geovisualization.

______________________________  ____________
Signature                       Date

February 27, 2015