2017-2018
Geographic Information Systems Fundamentals
OUTLINE

DESCRIPTION:

Geographic Information Systems Fundamentals provides an in-depth introduction to the fundamentals of Geographic Information Systems (GIS) including the history of automated mapping and how GIS applications are used in science, government, and business. Basic cartographic principles including map scales, coordinate systems and map projections. Students will experience hands-on use of hardware and software elements emphasizing vector-based data structures using ArcView including raster-based data structures using ArcView Spatial Analysis extension. Specific topics covered include GIS terminology, raster and vector data structures, data sources and accuracy, methods of data acquisition, conversion and input, requirements for metadata, working with spatial data databases (map features and attribute tables), and spatial analysis (map overlays, buffers, networks). GIS Fundamental concepts will be reinforced in the laboratory with hands-on experience in the use of map scales, coordinate systems, data sources and accuracy, data structures, working with spatial data, map features and attributes, map overlays, manipulation of data base, creation of charts and graphs and presentation of data in map layouts. Activities in this course include work-based learning that connects students to industry and the local community.

Geographic information Systems Fundamentals has been UC a-g approved to meet the elective ("g" – History/Social Science) requirement.

INFORMATION:

A. Pre-requisite: Successful completion of classes in computer technology, computerized business applications, computer networking, or with teacher permission. Previous or concurrent enrollment in Algebra recommended.
B. Length: One year
C. Sector: Information and Communications Technology
D. Pathway: Information Support and Services

O*Net SOC Codes	
Code #	Title
15-1131.00	Computer Programmers
15-1141.00	Database Administrator
15-1199.05	GIS Technicians
17-3031.02	Mapping Technicians

Orientation

    A. Introduce the course and facilities.
    B. Discuss the syllabus and major objectives.
    C. Explain applicable classroom management procedures, the ROP Student Rules of Conduct, and any operational guidelines.
    D. Review instructor/student expectations.
    E. Explain enrollment and attendance requirements and procedures.
    F. Review grading and student evaluation procedures.
    G. Discuss the community classroom aspect of the program if applicable.
    H. Discuss the "next steps" related to additional education, training, and employment.
    I. Review classroom safety, emergency and disaster procedures.

1. Communication Skills

    A. Demonstrate positive verbal communication skills using appropriate vocabulary, demeanor, and vocal tone in the classroom and/or worksite.
    B. Read and interpret written information and directions.
    C. Practice various forms of written communication appropriate to the occupation.
    D. Practice positive body language skills.
    E. Practice professional verbal skills for resolving a conflict.
    F. Demonstrate active listening skills including techniques for checking for understanding, and for obtaining clarification of directions.

2. Interpersonal Skills

    A. Demonstrate positive teamwork skills by contributing to a group effort.
    B. Practice the importance of diversity awareness and sensitivity in the workplace.
    C. Define sexual harassment in the workplace and identify the employee's role and responsibility.
    D. Practice participation skills.
    E. Identify different personality types and strategies for working effectively with each type.
    F. Practice business and social etiquette skills appropriate to the occupation.
    G. Discuss the role of business and personal ethics in the decision-making process.
    H. Evaluate various job-related scenarios and justify decisions based on ethics.
    I. Demonstrate flexibility and adaptability in working with others.
    J. Demonstrate the use of time management skills.

3. Employability Skills

A. Demonstrate appropriate attendance and punctuality practices for the classroom and worksite if applicable.
B. Prepare a resume, cover letter, and job application forms.
C. Demonstrate interviewing techniques using appropriate tone and body language.
D. Demonstrate appropriate dress and grooming standards in seeking employment and for the workplace.
E. Identify strategies for employment retention.
F. Analyze the impact of social networking on employability.
G. Identify the need for continuing education, professional development, and professional growth in chosen field.
H. Identify appropriate procedures for leaving a job.
I. Identify sources of job information, including electronic sources.
J. Review company policies and current trends in employee compatibility screening, drug screening, and background checks.

4. Leadership

A. Define leadership and identify the responsibilities, competencies, and behaviors of successful leaders.
B. Work with peers to promote divergent and creative perspectives.
C. Demonstrate how to organize and structure work, individually and in teams, for effective performance and the attainment of goals.
D. Explain multiple approaches to conflict resolution and their appropriateness for a variety of situations in the workplace.
E. Employ ethical behaviors and actions that positively influence others.
F. Use a variety of means to positively impact the direction and actions of a team or organization.
G. Analyze the short-term and long-term effects a leader's actions and attitudes can have on productivity, morale, and organizational culture.

5. Personal and Occupational Safety

A. Demonstrate procedures to be followed in the case of emergencies.
B. Discuss ways to report a potential safety hazard to a supervisor.
C. Identify and discuss cyber ethics, cyber safety, and cyber security.
D. Apply personal safety practices to and from the job.
E. Describe the procedure for reporting a work-related hazard or injury.
F. Recognize the effects of substance abuse in the workplace.
G. Recognize good housekeeping as a safety issue.
H. Identify safety hazards commonly found in the workplace environment.
I. Describe the procedures for reporting a work-related injury.
J. Explain the importance of CAL-OSHA.
K. Define and discuss ergonomics in relation to the working environment.
L. Discuss the electrical hazards of working with electronic equipment.

6. Mapping Fundamentals of GIS

   A. Compare and contrast historical mapping technology to GIS current technology to address future advances.
   B. Differentiate between professional and consumer GIS analysis and geospatial technologies.
   C. Describe the history of early map making including the development of computer aided mapping.
   D. Describe map making and Geographic Information Systems (GIS).
   E. Identify GIS terminology and concepts.

7. Current GIS Applications Overview

   A. Define how different types of GIS applications are managed in science, health, business and government.
   B. Describe how GIS is used in science.
   C. Describe how GIS is used in business.
   D. Describe how GIS is used in local and global governments.
   E. Describe how GIS is used in transportation, telecommunications, and utilities industries.
   F. Describe how GIS is used is natural resource management.
   G. Describe how GIS is used in conservation and environmental modeling.

8. Introduction to GIS Software and Hardware

   A. Identify the basic hardware and software requirements for GIS applications.
   B. Describe various GIS platforms (e.g., server, desktop, mobile computing, cloud based, etc.).
   C. Identify applications for using GIS.
   D. Define software specifications.
   E. Define hardware requirements.
   F. Identify and describe the components of the peripheral devices.

9. Introduction to Cartographic Principles

   A. Distinguish basic cartographic principles in map production.
   B. Apply and use basic cartographic principles to produce a map.
   C. Recognize and use basic map coordinate systems and map scales.
   D. Define what constitutes a map.
   E. Identify basic elements of map layout.
   F. Identify coordinate systems used in map layout including: latitude and longitude, UTM, and state plane coordinate system.
   G. Define a map scale.

H. Identify map projections.
I. Identify advantages and disadvantages of manual and automated mapping techniques.

10. Introduction to Data Structures

A. Define raster data including grid and pixels.
B. Define vector data including points, lines, areas, curves and polygons.
C. Create and interpret geographically referenced data.
D. Define methods and problems associated with acquisition of data and accuracy vs. precision of the data.
E. Define Geocoding, Georeferencing and digitizing.
F. Distinguish which data types are best suited to specific applications (e.g., comma delineated data, excel, KML, CAD file).
G. Compare and contrast which data structure is best suited to specific GIS applications.
H. Describe metadata, how it is created and used to facilitate the use and management of data.
I. Identify map features versus objects in the real world.

11. Spatial Analysis

A. Describe the spatial analysis process.
B. Overlay and produce maps combining the two basic GIS data structures.
C. Describe spatial patterns, create queries, and symbolize geospatial data.
D. Define spatial data.
E. Identify challenges of gaining access to spatial data.
F. Define single and multiple layer operations.
G. Identify strategies to minimize error propagation in data collection.
H. Define containment, proximity, adjacency, terrain analysis, buffers and networks.
I. Use spatial data to measure distance and area.
J. Use spatial data to set map projections.

12. Implementation of a GIS in an Organization

A. Evaluate GIS as an effective tool in decision making processes in a specific GIS application.
B. Describe the costs and benefits expected from the use of GIS for a specific application.
C. Describe and apply basic principles of project management.
D. Describe the planning process of implementing a GIS within an organization.
E. Develop a GIS needs assessment for an organization.
F. Develop a resource assessment for an organization.
G. Identify how applications of GIS can be used in decision making and strategic planning.
H. Identify potential legal issues associated with GIS.

I. Explain the importance and function of project management.
J. Define the roles of a project management team.

13. Analyzing the World with GIS

A. Use the basic functions of GIS software to input data.
B. Demonstrate basic concepts used in GIS database manipulation.
C. Demonstrate how the raster and vector data structures are manipulated.
D. Construct, analyze and manipulate tabular data using GIS software.
E. Construct charts and graphs from analyzed tabular data using GIS software.
F. Produce maps using the correct map coordinate system and map scales.
G. Produce maps for use in interpreting geographically referenced data.
H. Produce professional quality map layouts suitable for GIS applications.
I. Apply GIS to a spatial problem.

Key Assignments

Assignment	Competencies	Career Ready Practices	Anchor Standards	Pathway Standards	CCSS
1. Students will participate in mock interviews that represent current industry practices (e.g., skills demonstrations, resumes, applications, portfolios, personal websites, etc.).	1A, B, D 3B, C, D, I, J	2 3 10	2 3		LS 11-12.6 SLS 11-12.2
1. Create digital maps utilizing the cartographic principles of symbols, colors, legend, scale, North arrow, coordinate systems and appropriate features or data layers.	1A, B, D 2A, D, E, F, I, J 6A – 6F 9A -F, H, I 10A, B, I 13B, F, G	1 2 4 5 9 10 12	2 4 5 8 9 10	A2.0 A3.0 A8.0	LS 11-12.3 LS 11-12.6 SLS 11-12.2 WS 11-12.6
2. Students will conduct geographical "Hot Spot" analyses covering topics such as crime rates, disasters, traffic patterns and/or accidents, disease outbreaks, etc., and produce a map.	1A – F 2A, D, E, F, I, J 6E, F 7A - G 9A -C, E - H	1 2 4 5 9 10 11 12	2 4 5 8 9 10 11	A1.0 A2.0 A3.0 A4.0 A7.0 A8.0	LS 11-12.1 LS 11-12.2 LS 11-12.3 LS 11-12.6 WS 11-12.3 WS 11-12.4 WS 11-12.6
3. Students will use spatial analysis to evaluate ratios and geographic hypotheses and develop cartographic recommendations based on their findings.	1A – F 2A, D, E, I, J 10C -G 11A -J 13A – I	1 2 4 5 9 10 11	2 4 5 9 10 11	A3.0 A4.0 A7.0 A8.0	LS 11-12.1 LS 11-12.2 SLS 11-12.2 WS 11-12.3 WS 11-12.4 WS 11-12.6

Assignment	Competencies	Career Ready Practices	Anchor Standards	Pathway Standards	CCSS
		12			
4. Given a scenario, students will download and analyze relevant data, build data tables and present their data in a digital map.	1A – F 2J 6E 10D -G 11C, E, F, H 12A, G 13B, 13D -H	1 2 4 5 9 10 11 12	2 4 5 8 10 11	A2.0 A3.0 A8.0	LS 11.12.3 LS 11-12.6 WS 11-12.4 WS 11-12.6
5. Students map their own neighborhoods, identifying geographic hazards and developing a disaster plan for their families.	1A – F 2J 6B, E, F 9A -C, 9E, F, H 13A, F, G, H	1 2 4 5 6 10 11 12	2 4 5 10 11	A2.0 A3.0 A8.0	LS 11-12.1 LS 11-12.2 LS 11-12.3 LS 11-12.6 WS 11-12.4 WS 11-12.6
6. Students will create a map reflecting temperature patterns associated with changes in latitude, differences caused by changes in elevation and proximity to the ocean and present findings to class.	1A – F 2J 6B, E, F 9A C, E, F, H 13A, F, G, H	1 2 4 5 10 11 12	2 4 5 8 9 10 11	A1.0 A2.0 A3.0 A4.0 A7.0 A8.0	LS 11-12.1 LS 11-12.2 LS 11-12.3 LS 11-12.6 WS 11-12.4 WS 11-12.6 US 11.8.7
7. Create a map that identifies the social, economic and technical implications of rapid population growth.	1A – F 2J	1 2	2 4	A1.0 A2.0	LS 11-12.1

Assignment	Competencies	Career Ready Practices	Anchor Standards	Pathway Standards	CCSS
	6B, E, F 9A -C, E, F, H 11C -E, H, I, J 13A, F, G, H	4 5 9 10 11 12	5 8 10 11	A3.0 A4.0 A8.0	LS 11-12.2 LS 11-12.3 LS 11-12.6 WS 11-12.4 WS 11-12.6 US 11.8.7
8. Research and collect historical data to create maps that illustrate changes to the earth's surface based on human activities (i.e. deforestation, changes in climate due to construction, mining, landfills, global warming, fire containment, etc.). Write a report and present findings to class.	1A – F 2J 6B, E, F 9B, C, E -H 10C -G 11C -E, H -J 12A – I 13A - I	1 2 4 5 9 10 11 12	2 4 5 8 9 10 11	A1.0 A3.0 A4.0 A8.0	LS 11-12.1 LS 11-12.2 LS 11-12.3 WS 11-12.4 WS 11-12.6 US 11.8.7

Standards Assessed in this Program

Career Ready Practices

1. **Apply appropriate technical skills and academic knowledge.**
2. **Communicate clearly, effectively, and with reason.**
3. **Develop an education and career plan aligned to personal goals.**
4. **Apply technology to enhance productivity.**
5. **Utilize critical thinking to make sense of problems and persevere in solving them.**
7. **Act as a responsible citizen in the workplace and the community.**
8. **Model integrity, ethical leadership, and effective management.**
9. **Work productively in teams while integrating cultural/global competence.**
10. **Demonstrate creativity and innovation.**
11. **Employ valid and reliable research strategies.**
12. **Understand the environmental, social, and economic impacts of decisions.**

Anchor Standards

2.0 Communications
- Acquire and use accurately sector terminology and protocols at the career and college readiness level for communicating effectively in oral, written, and multimedia formats.

3.0 Career Planning and Management
- Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans.

4.0 Technology
- Use existing and emerging technology, to investigate, research, and produce products and services, including new information, as required in the sector workplace environment.

5.0 Problem Solving and Critical Thinking
- Conduct short, as well as more sustained, research to create alternative solutions to answer a question or solve a problem unique to the sector using critical and creative thinking, logical reasoning, analysis, inquiry, and problem-solving techniques.

6.0 Health and Safety
- Demonstrate health and safety procedures, regulations, and personal health practices and determine the meaning of symbols, key terms, and domain-specific words and phrases as related to the sector workplace environment.

7.0 Responsibility and Flexibility
- Initiate, and participate in, a range of collaborations demonstrating behaviors that reflect personal and professional responsibility, flexibility, and respect in the sector workplace environment and community settings.

8.0 Ethics and Legal Responsibilities

- Practice professional, ethical, and legal behavior, responding thoughtfully to diverse perspectives and resolving contradictions when possible, consistent with applicable laws, regulations, and organizational norms.

9.0 Leadership and Teamwork
- Work with peers to promote divergent and creative perspectives, effective leadership, group dynamics, team and individual decision making, benefits of workforce diversity, and conflict resolution.

10.0 Technical Knowledge and Skills
- Apply essential technical knowledge and skills common to all pathways in the sector following procedures when carrying out experiments or performing technical tasks.

Pathway Standards

Information Support and Services Pathway

    A1.0 Describe the role of information and communication technologies in organizations.
    A2.0 Acquire, install, and implement software and systems.
    A3.0 Access and transmit information in a networked environment.
    A4.0 Administer and maintain software and systems.
    A5.0 Identify requirements for maintaining secure network systems.
    A6.0 Diagnose and solve software, hardware, networking, and security problems.
    A7.0 Support and train users on various software, hardware, and network systems.
    A8.0 Manage and implement information, technology, and communication projects.

Common Core State Standards

ENGLISH LANGUAGE ARTS

Language Standards

    LS 11-12.1: Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.
    LS 11-12.2: Demonstrate command of the conventions of standard English capitalization, punctuation, and spelling when writing.
    LS 11-12.3: Apply knowledge of language to understand how language functions in different contexts, to make effective choices for meaning or style, and to comprehend more fully when reading or listening.
    LS 11-12.6: Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the (career and college) readiness level, demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.

Speaking and Listening Standards

    SLS 11-12.2: Integrate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to make informed decisions, and solve problems, evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

SLS 11-12.1: Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners, building on others ideas and expressing their own clearly and persuasively.

SLS 11-12.1d: Respond thoughtfully to diverse perspectives, synthesize comments, claims and evidence made on all sides of an issue, resolve contradictions when possible, and determine what additional information or research is required to deepen the investigation or complete the work.

Writing Standards

WS 11-12.3: Write narratives to develop real or imaged experiences or events using effective technique, well-chosen details, and well-structured event sequences.

WS 11-12.4: Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

WS 11-12.6: Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback including new arguments and information.

WS 11-12.7: Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem, narrow or broaden the inquiry when appropriate, synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

HISTORY/ SOCIAL SCIENCE

US History and Geography

US 11.8.7: Describe the effects on society and the economy of technological developments since 1945, including the computer revolution, changes in communication, advances in medicine, and improvements in agricultural technology.

A-G Approved Key Assignments

1. Hand drawn map of familiar areas specifying key points to emphasize the needs for mapping standards.
2. Online research of map making from caves to computers, and class presentation.
3. Create hand drawn and digital maps utilizing the cartographic principles of symbols, colors, legend, scale, North arrow, coordinate systems and appropriate features or data layers.
4. Online research of longitude and latitude, its origins, and current day applications. Class presentation of research.
5. Students will conduct a geographical "Hot Spot" analysis covering topics such as Crime rates, activities, incidents, Traffic patterns and/or accidents, disease outbreaks, etc.
6. Create an electronic map utilizing GIS skills such as manipulating layers, zooming in and out, and identifying the attributes of geographic features.
7. Students work with map layers (made up of geographic or spatial features) and underlying attribute data tables for U.S. states, cities, counties, and streets.
8. Students create choropleth and pin maps utilizing census data to produce maps that are of interest to demographers and policy makers.
9. Students research, import, and manipulate online data resources to produce a map for a specified scenario.
10. Students will debate the issue of privacy, ownership, and copyright of data and possible impact on the industry.
11. Students test a geographic hypothesis, calculate ratios, and develop a plan of action based on their findings. Report out and compare to

rest of class.
12. Students develop their own geographic hypothesis and follow the process as outlined in the text to research and create their own maps to answer their questions. Class presentation.
13. Build data tables based on information relevant to current events.
14. Utilizing historical data, students analyze patterns and changes to geographic areas and present findings to class. Students predict future changes to geographic area based on determined patterns. Students write a report documenting findings and predictions.
15. Utilizing geographic/demographic data create a map that determines site feasibility for a new business. Present findings to class.
16. Utilizing current USGS earthquake data, students create multiple maps showing areas of increased earthquake activity.
17. Create a local map and analyze fault line data to see if it provides additional insight on locations and movement of plate boundaries.
18. Students map their own neighborhoods, identifying geographic hazards and developing a disaster plan for their families.
19. Utilizing current USGS volcanic data, students create multiple maps identifying "hot spots" along plate boundaries of increased volcanic activity.
20. Based on current earthquake data, map out an area of proximity, including major cities that could be affected by a tsunami.
21. Observe temperature patterns associated with changes in latitude as well as differences caused by factors such as elevation and proximity to the ocean, and present findings to class.

22. Create a map that identifies the social and economic implications of rapid population growth.

23. Research and collect historical data to create maps that illustrate changes to the earth's surface based on human activities (i.e. deforestation, changes in climate due to construction, mining, landfills, global warming, fire containment, etc.). Write a report and present findings to class.