Course Outline for GEOG 15

INTRODUCTION TO GIS

Effective: Fall 2018

I. CATALOG DESCRIPTION:
GEOG 15 — INTRODUCTION TO GIS — 3.00 units

Study of Geographic Information Systems (GIS) science and its applications to spatial data management. Identification and acquisition of GIS data. Assessment of vector and raster systems, scale, resolution, map projection, coordinate systems, georeferencing and Global Positioning Systems (GPS). Spatial analysis and modeling with GIS.

3.00 Units Lecture

Grading Methods:
Letter Grade

Discipline:
- Geography

	MIN
Lecture Hours:	54.00
Total Hours:	54.00

II. NUMBER OF TIMES COURSE MAY BE TAKEN FOR CREDIT: 1

III. PREREQUISITE AND/OR ADVISORY SKILLS:

IV. MEASURABLE OBJECTIVES:
Upon completion of this course, the student should be able to:
A. Define Geographic Information Systems (GIS)
B. Identify and evaluate GIS data sources and the importance of metadata.
C. Demonstrate the process of converting analogue data to digital data for use in a GIS
D. Identify, compare and contrast vector and raster GIS.
E. Evaluate the capabilities of various GIS software programs
F. Apply cartographic principles of scale, resolution, projection and data management to a problem of a geographic nature
G. Apply spatial analysis functions on a GIS to solve a Geospatial problem

V. CONTENT:
A. What is GIS?
   1. Definition(s)
   2. History
   3. Advantages over traditional mapping
   4. Introduction to GIS subsystems
      a. Data input function
      b. Data storage and retrieval function
      c. Data manipulation and analysis functions
      d. Data output function
   5. Overview of GIS components
      a. Hardware
      b. Software
      c. Data
      d. People
      e. Methods
B. GIS applications overview
   1. Desktop GIS
   2. GIS as a multi-disciplinary learning tool
   3. GIS for spatial analysis
C. Basic computer literacy and skills for GIS
   1. Introduction to a GIS interface
      a. Graphical user interface
      b. Online help system
   2. Fundamental word processor, spreadsheet, and database skills
   3. Introduction to file management and working directories
D. Map feature concepts
   1. Points, lines, polygons
   2. Absolute and relative location

3. Attributes
4. Attribute symbols and codes
5. Coordinate systems (location reference systems)
6. Spatial distributions and relationships
E. Fundamental cartographic concepts
  1. Scale
    a. Definition
    b. Types
    c. Affect on point, line, polygon features and symbols
  2. Map properties
    a. Shape
    b. Area
    c. Distance
    d. Direction
    e. Proximity
  3. Map distortion
    a. Relation to size of area mapped
    b. Relation to projection of Earth to a plane
  4. Projections, ellipsoids, and datums
F. Overview of GIS data types and data models and their map structures
  1. GIS data types
    a. Spatial data
    b. Attribute (tabular) data
    c. Image data
  2. Spatial data models and their map structures
    a. Vector
    b. Raster
    c. Image
  3. Relationship of the "Paper Map World" to the "GIS Map World"
    a. Representation of points, lines, areas on a paper map
    b. Representation of points, lines, polygons on a GIS map
    c. GIS raster and vector storage of points, lines, polygons
  4. Overview of attribute data models
    a. Tabular
    b. Hierarchical
    c. Network
    d. Relational
    e. Object-oriented
G. Introduction to accessing and creating data
  1. Sources
    a. Hard-copy maps
    b. CAD drawings
    c. Aerial photographs
    d. Remotely-sensed satellite imagery
    e. Point data samples from surveys and GPS
    f. Existing digital files and the
  2. Data examples
    a. Demographic
    b. Transportation
    c. Land records
    d. Natural resources
    e. Terrain
    f. Other
  3. Data quality
    a. Metadata
    b. Precision, accuracy, and error
  4. Downloading and input techniques
    a. Digitizing
    b. Scanning
    c. Data compression and decompression
    d. Data conversion (source format to system-compatible format)
    e. Data projection
    f. Registration and conflation
H. Managing, querying, analyzing, and creating spatial data
  1. Thematic data (theme) concept
    a. Vertical organization of features and their attributes
    b. Spatial data source formats for themes
    c. Image and tabular data source formats for themes
  2. Managing thematic data
    a. Adding themes to a data view
    b. Features based on a spatial data source
    c. Images based on aerial photographs or satellite images
    d. X,Y coordinates from a table
    e. Accessing a theme attribute table
  3. Referencing thematic data to the real-world
    a. Review of the fundamental map projection concept
      1. Real-world (globe) locations measured in spherical latitude/longitude coordinates
      2. Corresponding map locations measured in planar x,y coordinates
      3. Distortion of map properties due to conversions of locations from spherical to planar coordinates
    b. Understanding when a map projection is required
      1. Making measurements
      2. Comparing map features
      3. Aligning images and features
    c. Setting properties of a data view
      1. Definitions of unprojected and projected data
      2. Working with unprojected and projected data
      3. Setting distance units
      4. Changing the scale
    d. Measuring distance and area
  4. Classifying, displaying, and symbolizing thematic data

a. Accessing the theme's legend
b. Legend types
   1. Single symbol
   2. Unique value
   3. Graduated color
   4. Graduated symbol
   5. Dot density
   6. Chart symbol
c. Classifying data for symbolization
   1. Natural breaks
   2. Quantile
   3. Equal interval
   4. Equal area
   5. Standard deviation
d. Manipulating classes
   1. Adding and deleting classes
   2. Editing values and labels
e. Modifying legend elements
f. Changing symbols through palettes
g. Scaling symbols

5. Managing thematic data display
   a. Selecting feature subsets
   b. Setting scale thresholds for display of features
   c. Labeling theme features
   d. Creating linkages to images and documents
6. Querying features in a data display
   a. Accessing information about features
   b. Selecting features based on attributes
7. Managing tabular data
   a. Adding tables from external sources
   b. Creating a new table
   c. Editing tables
      1. Field definitions
         a. Numeric
         b. String
         c. Boolean
         d. Data
      2. Adding records
      3. Deleting fields and records
      4. Editing cell values
      5. Calculating new values
   d. Creating a summary table for attributes tables
8. Querying records in a table
   a. Selecting records based on attributes
   b. Modifying the selected set
      1. Adding records
      2. Refining the selection
      3. Creating a new selected set
   c. Displaying statistics for a field
   d. Creating a summary table
9. Joining and linking relationships between tables
   a. Reasons for associating tables
   b. Relational database basic concepts
      1. Destination and source tables
      2. Common field
   c. Table record relationships
      1. One-to-one
      2. Many-to-one
      3. One-to-many
   d. Joining and linking
      1. Operations
      2. Results
10. Analyzing spatial relationships between two themes
    a. Theme-on-theme selection concept:
       1. Selector theme
       2. Target theme(s)
    b. Types of relationships
       1. Proximity
       2. Adjacency
       3. Containment
       4. Intersection
11. Analyzing spatial relationships by spatially joining tables
    a. Spatial join concept
    b. Kinds of spatial relationships to compare locations
       1. Containment
       2. Proximity
    c. Join attributes based on containment
    d. Join attributes based on proximity
12. Creating and editing coordinate files
    a. Functions of coordinate files
       1. Stores feature geometry (shape and location)
       2. Stores indexes of feature geometry
       3. Stores attribute information
    b. Creating new coordinate files
       1. Converting an existing theme to a coordinate file
       2. Converting selected feature(s) to a coordinate file
       3. Adding new features
       4. Snapping features with a tolerance distance
       5. Add attributes
    c. Editing coordinate files

1. Reshaping a feature by moving, adding, or deleting vertices
2. Splitting line or polygon features and update attributes
3. Merging features and updating attributes
4. Optional operations (combine, intersect, subtract)
13. Address geocoding
    a. Concept: linking addresses to geographic locations
    b. Required input data
        1. Reference street theme with attributes
            a. Street name
            b. Street type
            c. Address rang
            d. Direction
            e. ZIP codes
        2. Address table
    c. 3-step geocoding process
        1. Making the reference theme matchable
            a. Set geocoding theme properties
            b. Creating a geocoding index file
        2. Batch-matching addresses in table to reference theme
            a. Creating output geocoded point theme
            b. Interpreting match scores
        3. Re-matching addresses not batch-matched
            a. Interactive re-match
            b. Geocoding editor
    d. Testing: locate a single address
I. Overview of other data analysis functions that enhance visualization and decision-making capabilities of GIS
    1. Buffering and neighborhood functions
    2. Surface analysis
    3. Network analysis
    4. Image analysis
    5. 3D analysis
    6. Business analysis
    7. Tracking analysis
J. Cartographic and graphical presentation of GIS information
    1. Cartographic layouts
        a. Concepts
            1. Interface for creating presentation-quality maps
            2. Collections of documents, images, graphics, and text
        b. Design factors
            1. Purpose of map
            2. Audience
            3. Map elements
                a. Map body
                b. Legend
                c. Scale bar
                d. North arrow
                e. Title
                f. Neatline
        c. Creating a map layout
            1. Page layout: size, orientation, margins, grid
            2. Defining, creating, and scaling frames
        d. Adding and modifying graphics
        e. Layout templates
            1. Using standard templates
            2. Creating custom templates
        f. Layout print options
    2. Charts
        a. Creating a chart
            1. Specifying elements to be graphed
            2. Choosing a chart format
                a. Area
                b. Bar
                c. Column
                d. Line
                e. Pie
                f. S
                g. X,Y scatterplot
        b. Changing chart elements
        c. Querying and editing charts
            1. Extracting information from the table
            2. Editing/selecting records in the table to change chart content
            3. Adding and deleting data markers

VI. METHODS OF INSTRUCTION:
    A. Interactive Web Sessions
    B. Lectures and learning modules (on a need-to-know basis)
    C. **Field Trips** - (some instructors may have field trips to government and commercial sites so students can experience "GIS at work")
    D. Active learning
    E. Hands-on computer experience with desktop GIS software and tutorials

VII. TYPICAL ASSIGNMENTS:
    A. Daily assignments within workbooks over different GIS techniques within each of the chapters
    B. Major project creating and analyzing a GIS for use.
        1. This project will require using data into ARCGis and examining the results given from that data.
        2. The project more examines the use of ARCGis than the concept of the full research paper with the introduction, body and conclusion.

VIII. EVALUATION:
    A. **Methods**

1. Exams/Tests
2. Papers
3. Projects
4. Other:
    a. Methods (including typical examples of evaluation) Performance-based evaluations will be structured around criterion-referenced, competency-based learning modules. Each module will include: goals/objectives; required background reading/related media; procedures; resource information; and the following evaluation methods:
        1. Written (or oral) feedback on assigned background reading/media
        2. Demonstration of procedural skills to instructor
        3. Maintenance of an electronic log or journal

B. **Frequency**

1. Occasional assignments based upon background reading/media
2. The number of units in ArcView Part 2 (approximately 20)
3. The number of criterion-referenced, competency-based learning modules (to be developed)
4. One "final" project (instructor's option)

IX. TYPICAL TEXTS:
1. Law, M., & Collins, T. (2015). *Getting to Know ArcGIS* (4th ed.). Redlands, CA: ESRI.
2. Bolstad, P. (2016). *GIS Fundamentals: A First Text on Geographic Information Systems* (5th ed.). Ann Arbor, MI: XanEdu Publishing.

X. OTHER MATERIALS REQUIRED OF STUDENTS:
A. Computer Usage Card ($4.00 fee)
B. Thumb drive