University of South Carolina
Carolina Core

# GEOGRAPHY 105
# THE DIGITAL EARTH

## BULLETIN INFORMATION

GEOG 105 – The Digital Earth (3 credit hrs)

**Course Description:**

Introduction to geographic data; use of digital maps and aerial/satellite images as means of Earth observation; basics of spatial data analysis; location-based Web APPs; digital map services.

## SAMPLE COURSE OVERVIEW

GEOG 105 is an introductory course that focuses on how the earth surface is visualized, explored, and analyzed in digital formats. It provides a systematic introduction of map-based analytical approaches to understanding the Earth environment and human society. The topics cover the basics of cartography (map making and reading), aerial photography and satellite image interpretation, geographic information systems (GIS), and map-based reasoning and communication of spatial data. Through lectures and computer/field exercises, students will learn fundamental concepts of digital geographic data to understand vast quantities of geographic information in our ever-changing world. Students will be exposed to leading edge trends in mapping technology – with examples from everyday life like web-based maps and smartphone APPs – as their practical experiences.

## ITEMIZED LEARNING OUTCOMES

**Upon successful completion of GEOG 105, students will be able to:**

1. Explain the basic concepts and principles in processing digital geographic data.
2. Collect, map and analyze spatial data as a mechanism to understand our physical and social world.
3. Make use of online resources of aerial photos, satellite images and maps in various formats.
4. Think spatially and develop problem-solving skills with critical understanding of geographic context.
5. Demonstrate the ability to reason and communicate using map-based technologies such as online maps, Google Earth, mobile GIS and web APPs.

## SAMPLE REQUIRED TEXTS

Bradley A. Shellito, 2014. Introduction to Geospatial Technologies. 2nd Edition. W. H. Freeman and Company, a Macmillan Higher Education Company.

## SUGGESTED READINGS/MATERIALS

1. Shellito, B. (2014). Introduction to Geospatial Technologies. 2nd Edition. W. H. Freeman and Company, Macmillan Higher Education.
2. Gewin, Virginia. (2004), Mapping opportunities. Nature, 427(22). Pp. 376-377. URL: http://www.aag.org/nature/nature.htm.
3. MacEachren, A.M., Wachowicz, M., Edsall, R., Haug, D. and Masters, R. (1999): Constructing knowledge from multivariate spatiotemporal data: integrating geographical visualization with knowledge discovery in database methods. International Journal of Geographical Information Science, 13, 311-334.
4. Monmonier, M. (1996). How to lie with maps. The University of Chicago Press.
5. Stasko, J., Gorg, C., & Liu, Z. (2008): Jigsaw: supporting investigative analysis through interactive Visualization, Information Visualization, 7(2), pp. 118-132.

**SAMPLE ASSIGNMENTS AND/OR EXAMS**

1. **Lectures**: Primarily in a form of Powerpoint presentations. Usually a short-version lecture notes (pdf format) will be uploaded to Blackboard prior to each class.
2. **Exercises:** For specific topics, exercises in the Computer Lab are given in selected weeks. Most exercises are due one week after assigned, although most students could complete in class. Late hand-ins are subject to a 5% reduction per week day. Void after 5 days.
3. **Quizzes**: Pop-up quizzes related to previous lectures are given in randomly selected lectures.
4. **Exams**: This course has two session exams and one comprehensive final exam. All questions in the exams are covered in lecture notes and reading assignments. A brief study guide will be handed out prior to each exam

**SAMPLE COURSE OUTLINE WITH TIMELINE OF TOPICS, READINGS/ ASSIGNMENTS, EXAMS/PROJECTS**

**Week 1:** Introduction to Digital Earth: Basic concepts of location, distance, interrelation; spatial vs. non-spatial data; cartographer's dilemma
Textbook readings: Chapter 1
Exercise1 (Digital Globe): Learning to use Google Earth for an interactive 3D view of Earth surfaces, to read longitude/latitude locations, and to made basic measurements of distances and areas of targets.

**Week 2:** Where in the spatial world are you? Earth shape; Spherical coordinate systems of Earth; Latitude, Longitude, elevation; Ellipsoid and Geoid; Datum; Geodetic Center of North America
Textbook readings: Chapter 2

**Week 3:** From globe to map: map projection; all projected maps tell lies; projection distortion aspects – shape, area, distance, direction; projection surfaces
Textbook readings: Chapter 2
Exercise2 (Projecting the Earth surface to maps): with online tools, exploring how different map projections misrepresent Earth surfaces in different ways, using Columbia, SC as an example.

**Week 4:** Map coordinates – how to target a location on maps: easting vs. northing; origin of a map coordinate system; location measurement in maps; location errors; coordinate conversion
Textbook readings: Chapter 2

**Weeks 5-6:** Map communication - how to read a digital map: map scale; large is small; map generalization; map errors; map misuse
Readings: Monmonier (1996) – How to Lie with Maps
Exercise3 (map reading): learning to view a digital map and to measure locations, distances and areas on the map using basic display and measurement tools in ArcGIS, and to quantify map errors aligning with projections and various map components.

**Week 7:** Exam 1.
Collecting spatial data: GPS and GNSS; GPS components; mobile GPS; navigation
Textbook readings: Chapter 4
Exercise4 (GeoCaching with smartphone): exercising location reading and navigating with a mobile phone, to achieve better understanding of in-field location measurement and navigation in various GPS systems.

**Weeks 8-9:** Displaying and analyzing spatial data in GIS: real-world entities vs. data modeled objects; vector vs. raster; point/line/polygons; data layers; interactive map display; GIS data online
Readings: hands-on materials
Exercise5 (Viewing spatial data in ArcGIS): practicing more with ArcGIS software, to display and explore different layers of spatial data representing natural environment and human society of Columbia (USC campus map; Columbia land cover map; population; school districts; household income, etc.)

**Week 10:** Citizen Sciences – Location based services (LBS): Mobile GIS; crowd sourcing; LBS components; LBS applications; Web Apps; Geo-slavery
Readings: online resources
Exercise6 (Mobile GIS for field data collection): using mobile devices (iPhone or Android) to collect spatial data on campus, record the associated attributes (bike racks, trash cans, dining facilities, etc.), view and interpret their spatial patterns in ArcGIS.

**Week 11:** Digital Streets: Geocoding, address matching; routing with geocoded networks (online maps); Google Street View
Readings: Chapter 8
Exercise7 (placing addresses on a digital map): to practice geocoding an address (e.g., 709 Bull Street on campus) and marking it on a digital map.

**Week 12:** Exam 2.

Aerial and satellite image interpretation: history of remote sensing; 8 elements of photo interpretation; spectra beyond our eyes; pixel and resolution; band; satellite revisit cycle and coverage; remote sensing applications
Readings: hands-on materials
Exercise8 (exploring our environment at Google Earth): interpreting fine-resolution aerial photos and satellite images for land cover/use distributions and human-induced land use changes (e.g. urbanization) on Earth surfaces.

**Weeks 13-14:** Cartography – mapping values: data vs. map types; choropleth map; color design; symbols; elements of map making
Readings: Chapter 5-6
Exercise9 (creating a digital map): making a digital map in ArcGIS. Map materials could be from any topics discussed along the semester. Each student is required to develop a digital map that demonstrates the student's ability of map-based analytical understanding our Digital Earth.

*Final Exam (comprehensive) according to University exam schedule*