

## ESM 263 - Geographic Information Systems

### Winter 2017

ESM 263 is a one-quarter introduction to geographic information systems (GIS). The course is intended for MESM students who need to acquire a working knowledge of GIS theory and practice in a single quarter.

**Instructor:** [James Frew](#) (office hours [by appointment](#))

- NB: I often leave the door closed when I'm in my office. It's OK to knock!

**TA:** [Ian McCullough](#) (office hours Tue/Thu 13:00–14:30 in the GIS lab)

**Labs** (all in Bren Hall 3035; attend only the lab you are enrolled in):

1. Tue/Thu 08:00-09:50 (code: 54676)
2. Tue/Thu 14:30-16:20 (code: 54684)

#### Textbooks:

- Bolstad, P. (2016) *GIS Fundamentals: A First Text on Geographic information Systems, Fifth Edition*. White Bear Lake, MN: Elder Press.  
ISBN 978-1-50669-587-7 [[publisher](#)] [[Amazon](#)]
  - **NOTE:** be sure to get the **fifth** edition.
- Law, M. and Collins, A. (2015) *Getting to Know ArcGIS, Fourth Edition*. Redlands, CA: ESRI Press.  
ISBN 978-1-58948-382-8 [[publisher](#)] [[Amazon](#)]
  - **NOTE:** be sure to get the **fourth** edition.

#### Assignments

All assignment should be submitted to the course's [GauchoSpace](#). (This is the only thing we'll be using GauchoSpace for.)

1. Cartography
2. Sea level rise in Santa Barbara
3. Site suitability analysis for wind power subsidies
4. Conservation priorities using multicriteria decision analysis

#### Week 1: Introduction to GIS & cartography

- **Lecture**

- slides: Geographic Information Systems: Introduction
- **Reading**
  - textbook: Bolstad: ch 1: An Introduction to GIS
  - articles
    - [Geographic information science and systems for environmental management](#)
    - [On the Theory of Scales of Measurement](#)
- **Lab**
  - notes
    - Windows file system
    - Windows setup
    - ArcGIS setup, part 1
    - ArcGIS setup, part 2
  - textbook: Law
    - ch 3a: Displaying map data & 3b: Navigating a map
    - ch 10: Making maps for presentation

## **Week 2: Coordinate systems and map projections**

- **Lecture**
  - slides: Coordinate Systems and Map Projections
  - data: projections
- **Reading**
  - textbook: Bolstad: ch 3: Geodesy, Datums, Map Projections, and Coordinate Systems
  - video: ["Are you saying the map is wrong?"](#)
  - ArcGIS help
    - [What are map projections?](#)
    - [What is geocoding?](#)

- **Lab**

- slides: Cartography Basics
- article: [Principles of Cartographic Design](#)
- notes
  - Using ColorBrewer with ArcMap 10
  - Classifying numeric data that includes a "No Data" code
- textbook: Law: ch 10: Making maps for presentation

### **Week 3: Vector data**

- **Lecture**

- slides: Vector Data
- data: vector formats

- **Reading**

- textbooks
  - Bolstad
    - ch 2: Data Models
    - ch 9: Basic Spatial Analysis
  - Law
    - ch 15: Querying data
    - ch 17: Selecting features by location

- **Lab**

- notes: spatial analysis

### **Week 4: Attribute data**

- **Lecture**

- slides
  - Attribute Tables and Tabular Data

- example:
  - data: [U.S. Board on Geographic Names Gazetteer Download Files](#)
    - (just download 1 state; the "National" file has >2M entries)
  - ArcGIS help
    - [Adding a Microsoft Excel table to ArcMap](#)
    - [Adding an ASCII or text file table](#)
    - [Schema.ini file format](#)
    - [Adding x,y coordinate data as a layer](#)
- **Reading**
  - textbooks
    - Bolstad: ch 8: Attribute Data and Tables
    - Law
      - ch 16: Joining and relating data
      - ch 18c: Exporting data
  - book chapter: P. Revesz, *Introduction to Databases: From Biological to Spatio-Temporal*. Springer-Verlag, London, 2010. DOI: [10.1007/978-1-84996-095-3](#)
    - [ch 3: Relational databases](#)

## Week 5: Raster data

- **Lecture**
  - slides: Raster Data
  - data: raster formats
  - data: raster operations demos
- **Reading**
  - textbooks
    - Bolstad: ch 10: Topics in Raster Analysis
    - Law

- ch 7d: Symbolizing rasters
    - ch 8: Classifying features
    - ch 18d: Running tools in a model
  - ArcGIS Help 10.1: ModelBuilder
    - from [What is ModelBuilder?](#)
    - through [Tutorial: Executing tools in ModelBuilder](#)
      - data: [ModelBuilder tutorial data](#)
- **Lab**
  - notes
    - ArcGIS setup, part 3
    - using Spatial Analyst and Model Builder with raster data
      - data: Lab 5
  - self-study: [ArcGIS Spatial Analyst tutorial](#)
    - data: Spatial Analyst tutorial data

## Week 6: GIS models

- **Lecture**
  - slides: GIS Models (with a side of ArcCatalog)
- **Reading**
  - textbook: Bolstad: ch 13: Spatial Models and Modeling
  - book chapters
    - J. Malczewski, *GIS and Multicriteria Decision Analysis*. Wiley, New York, 1999. ISBN: 978-0471329442
      - ch 3: Introduction to Multicriteria Decision Analysis
    - P.A. Longley *et al* (eds.), *Geographical Information Systems*. Wiley, New York, 1999. ISBN: 978-0471321828
      - ch 35: Multi-criteria evaluation and GIS

- T.L. Saaty & L.G. Vargas, *Models, Methods, Concepts & Applications of the Analytic Hierarchy Process*. Springer, New York, 2012. [DOI: 10.1007/978-1-4614-3597-6](https://doi.org/10.1007/978-1-4614-3597-6)
        - [ch 1: How to Make a Decision](#)
    - article: [Ian McHarg](#)
- **Lab**
  - notes
    - ArcGIS environment settings: precedence and persistence
    - ModelBuilder notes
    - HW3 tools
    - Finding and ranking contiguous areas in a raster

#### **Week 7: Terrain and watershed analysis**

- **Lecture**
  - slides: Terrain and Watershed Analysis
  - demos:
    - terrain data
    - watershed modeling
- **Reading**
  - textbook: Bolstad: ch 11: Terrain Analysis
  - book chapter: P.A. Longley *et al* (eds.) *Geographical Information Systems*. Wiley, New York, 1999. ISBN: 978-0471321828
    - ch 9: Representation of terrain
  - article: [Rapid calculation of terrain parameters for radiation modeling from digital elevation data](#)
- **Lab**
  - (work day for assignment 3)

#### **Week 8: GIS data sources and data capture**

- **Lecture**

- slides
  - GIS Data: Sources and Capture
  - Finding GIS Data (Jon Jablonski guest lecture)

- **Reading**

- textbook: Bolstad
  - ch 4: Maps, Data Entry, Editing, and Output
  - ch 5: Global Navigation Satellite Systems and Coordinate Surveying
  - ch 6: Aerial and Satellite Images
  - ch 7: Digital Data
- book chapter: [Data Source Handbook](#)
  - [Locations](#)

- **Lab**

- notes: NDVI and MCA
- data: Lab 8

### **Week 9: Interpolation and uncertainty**

- **Lecture**

- slides: Interpolation and Uncertainty
  - demo
- examples:
  - Snow's cholera map
    - demo
      - [source](#)
    - UCLA Dept of Epidemiology's [John Snow website](#)
    - the [Broad Street pump](#)

- Geostatistical Analyst
  - [tutorial](#)
    - data

- **Readings**

- textbook: Bolstad
  - ch 12: Spatial Estimation: Interpolation, Prediction, and Core Area Delineation
  - ch 14: Data Standards and Quality
- book chapters: P.A. Longley *et al* (eds.) *Geographical Information Systems*. Wiley, New York, 1999. ISBN: 978-0471321828
  - ch 34: Spatial interpolation
  - ch 13: Models of uncertainty in spatial data

- **Lab**

- (work day for assignment 4)

**Week 10: bonus topics (TBD)**

- **Lecture**

- notes: KML: map packaging for the web
- notes: QGIS: a free alternative to ArcGIS

- **Lab**

- (work day for assignment 4)