# GIS in Water Resources
# Fall 2018

| CE 394K.3 | CEE 6440 |
|---|---|
| University of Texas | Utah State University |
| Tue, Thur: 12:30-1:45 PM, | Tue: Thur, 11:30-12:45 PM, Distance |
| ETC 5.148 | Education 211 |
| Unique Num: 15660 | Optional Lab Friday 11.30 to 12.20 ENGR 305 |
| | Catalog Number:  42583 |

**Instructors:**

| David Maidment | David Tarboton |
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| Office Hours: Tuesday - Thursday, 2PM - 3:30PM | Office Hours: Monday 3-4PM, Thursday 1-2PM |
| http://www.caee.utexas.edu/prof/maidment | http://hydrology.usu.edu/dtarb |
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**Course Description**

Application of Geographic Information Systems in Water Resources. Digital mapping of water resources information. Spatial coordinate systems. Hydrologic terrain analysis using digital elevation models. River and watershed networks. Soil and land use mapping. Flood hydrology modeling and flood plain mapping. Integration of time series and geospatial data. Hydrologic modeling and information systems.

**Prerequisites**

Graduate standing in engineering or a related discipline.

**Course Objectives**

The five course exercises are intended to enable you to be able to:

- Prepare a map of a hydrologic region including measurement sites and associate it with time series of data measured at those locations;
- Use web mapping to access geospatial and temporal water resources information;
- Create a base map of a study region including watersheds, streams, and aquifers by selecting features from regional maps;
- Interpolate measured data at points to form raster surfaces over a region, and spatially average those surfaces over polygons of interest;
- Do hydrologic calculations using map algebra on raster grids;
- Analyze a digital elevation model of land surface terrain to derive watersheds and stream networks.
- Calculate hydraulic properties of stream channels from a digital elevation model using the height above nearest drainage (HAND) approach.

**Course Web Sites**

University of Texas.

Public web site: http://www.caee.utexas.edu/prof/maidment/giswr2018/giswr2018.htm  This contains the course outline, PowerPoint presentations, class exercises for the course and University of Texas specific information such as UT student work and term papers.
An archive of the video of each class in Windows Media format is provided at:
https://mediasite.engr.utexas.edu/UTMediasite/Catalog/catalogs/-2018-fall---maidment---gis-

Utah State University.

Public web site: http://hydrology.usu.edu/dtarb/giswr/2018/.  This contains links to the course outline, PowerPoint presentations, class exercises and other USU specific information such as USU term paper and student work.  The Canvas instructure site:
https://usu.instructure.com/courses/495243 will be used to turn in homework and manage grades.

**Method of Instruction**

The course has six elements: lectures, assigned reading materials, homework exercises, a term paper, class interaction, and examinations. All students will prepare a term project in Adobe pdf format that will be posted on the course web site. Part of the final examination will involve synthesis of the term papers presented in the class to provide an assessment of the state of knowledge in particular subject areas. The course material is divided into modules with each module having one or two lectures and a homework exercise involving extensive use of GIS software.

**Term Project**

The purposes of the term project are:

1. To enable you to explore in-depth some aspect of the subject of personal interest to you and to develop experience in the use of GIS technology to solve that problem.
2. To provide experience in the formulation, execution and presentation of original research, including the proper documentation of a GIS project.
3. To make an oral presentation and produce a report in PDF on the world-wide-web that will be informative to you and to your classmates.

The steps in carrying out the project are:

1. Identify your course web page. At Texas, the term papers will be linked to the class web page http://www.caee.utexas.edu/prof/maidment/giswr2018/giswr2018.htm .  At Utah State University, we will use http://www.hydroshare.org to save term project material. See the USU course website http://hydrology.usu.edu/dtarb/giswr/2018/ for instructions on doing this.
2. Prepare a 1-page proposal in PDF on your website by Thurs Sept 20 specifying the objective of your project and outlining how you plan to go about executing it. At Texas, you will submit your proposal using the Canvas system and the instructor will post it on the class web page for you.  You'll get comments back in the Canvas environment.  At USU submit your proposal in HydroShare. The instructor will review your proposal and you will receive a response by email containing an assessment of the scope of work that

you propose. After making any revisions in your proposal that seem necessary in the light of this assessment, this proposal defines the scope of your term project.

3. Prepare a two-page status report in PDF on your project to be posted on your website by Tues Oct 23. You are expected to make some progress by mid-semester but the main effort on your term project is in the later part of the course once you've learned more about the methods in the course. This report will be read and commented on by the instructor, and perhaps other students.  At Texas, this report should be submitted via Canvas.  At USU submit your report in HydroShare.

4. Present a final report orally in class near the end of the semester (you will have 10 -12 minutes for your presentation) and present your term paper in PDF by December 7 (last day of classes). At Texas, this report should be submitted via Canvas.  At USU submit your project in HydroShare.  It is critical that you post your paper by this date because your classmates may need to read your paper in order to complete their final exam.

If you would like to work in a group to pursue a term project, that is fine, but you must carry out a particular section of the project on which you will present your oral and written report. Generally team-based term projects are hard to unscramble at the end when it comes time to present the oral and written versions of your term project, so individual term projects are preferred.

Archives are available showing the reports from more than 500 term papers done by students in this course from Spring 1997 to last year. See:
http://www.caee.utexas.edu/prof/maidment/giswr2018/docs/termpaperlibrary.htm
http://hydrology.usu.edu/dtarb/giswr/GISWRTPLibrary.html

**Course Computer Environment**
This course uses the ArcGIS Pro Version 2.2. A number of Toolboxes within ArcGIS Pro, such as The Spatial Analyst and 3D Analyst toolboxes will be used in the course. ArcGIS Pro runs under the Windows operating system.

Texas. ArcGIS is available in the Civil Engineering Learning Resource Center. You may want to get a magnetic card so that you can enter the LRC in the evenings or weekends. If you work at the LRC, you'll be assigned a standard amount of disk space for your personal use.

Utah. ArcGIS is available in the Engineering PC lab, ENGR 305. You will also receive information about downloading and installing on your own computer.

If you have access to the software elsewhere, you can do the computer assignments at that location. You should plan to back up your work on a removable drive (e.g. zip or thumb) to avoid complications from lack of disk space in your personal area.

**Course Readings**
Readings for this course will be given out as in-class handouts, links to resources on the web, and written synopses of class lectures.

**Method of Evaluation**

Course grades will be based on a weighted average of results as follows:

Homework 20%
Term Project Written Report 30%
Term Project Oral Presentation 10%
Midterm Exam 20%
Final Exam 20%

The midterm exam will be an in class exam. The final exam will be a take home distributed in class on Thursday Dec 6 and due a week later. The final exam should be submitted using Canvas. The final exam will include project type GIS analysis as well as essays and short reports that synthesize material from the class and from the term projects of other students in the class.

Letter grades will be assigned as follows:

A = 95 - 100%
A- = 90 - 95%
B+ = 87 - 90%
B = 83 - 87%
B- = 80 - 83%
C+ = 77 - 80%
C = 73 - 77%
C- = 70 - 73%
D+ = 65 - 70%
D = 60 - 65%
F < 60%

There will be no make-up exams or incomplete grades in this course. We reserve the right to change the date of an exam with notice in advance. Class attendance will not be recorded in this class and will not form part of the criteria for establishing grades. All lectures are video recorded and the lecture can be viewed from the archive whose web address is linked on the class web page.

**Course/Instructor Evaluation Plan**
Course/Instructor evaluation will be conducted separately at each University according to the policies of each University.
Texas. An evaluation of the course and instructor will be conducted at the end of the semester using the electronic version of the approved UT Course/Instructor evaluation forms.
Utah. USU will use the IDEA system for student evaluations. You will receive email from the university with instructions for how to fill out evaluations online.

We also encourage students to speak to us during the semester, and are open to suggestions relating to the course.

**Students with Disabilities**
Texas. The University of Texas at Austin provides, upon request, appropriate academic accommodations for qualified students with disabilities.   For more information, contact the Division of Diversity and Community Engagement, Services for Students with Disabilities, 512-471-6259 (Videophone: 512-410-6644) or http://diversity.utexas.edu/disability/.
Utah. USU welcomes students with disabilities. If you have, or suspect you may have, a physical, mental health, or learning disability that may require accommodations in this course, please contact the Disability Resource Center (DRC) as early in the semester as possible (University Inn # 101, 435- 797- 2444, drc@usu.edu). All disability related accommodations must be approved by the DRC.  Once approved, the DRC will coordinate with faculty to provide accommodations.


**Course Drop Policies**
**University of Texas**
From the 1st through the 4th class day, graduate students can drop a course via the web and receive a refund.  During the 5th through 12th class day, graduate students must initiate drops in the department that offers the course and receive a refund.  After the 12th class day, no refund is given.  No class can be added after the 12th class day.  From the 13th through the 20th class day, an automatic Q is assigned with approval from the Graduate Advisor and the Graduate Dean.  From the 21st class day through the last class day, graduate students can drop a class with permission from the instructor, Graduate Advisor, and the Graduate Dean.  **Students with 20-hr/week GRA/TA appointment or a fellowship may not drop below 9 hours.**

**Utah State University**
The USU Academic and Registration calendar at http://catalog.usu.edu/ gives the deadlines for dropping, dropping without notation on your transcript and receiving a refund.

**Schedule**

| Class | Date | Subject | Lecturer |
|---|---|---|---|
| 0 | Tue Aug 28 | Intro class at USU | Tarboton |
| 1 | Thu Aug 30 | Introduction to GIS in Water Resources | Maidment |
| 2 | Tue Sep 4 | Introduction to ArcGIS | Maidment |
| 3 | Thu Sep 6 | Exercise 1: Introduction to ArcGIS | Maidment |
| 4 | Tue Sep 11 | Data Sources for GIS in Water Resources | Maidment |
| 5 | Thu Sep 13 | Map Projections and Coordinate Systems | Maidment |
| 6 | Tue Sep 18 | Exercise 2: Building a base map. | Maidment |
| 7 | Thu Sep 20 | Spatial Analysis [1 page term project proposal due] | Tarboton |
| 8 | Tue Sep 25 | Exercise 3: Spatial analysis in Hydrology | Tarboton |
| 9 | Thu Sep 27 | Digital Elevation Model Watershed and Stream Network Delineation | Tarboton |
| 10 | Tue Oct 2 | Extended Hydrologic Terrain Analysis | Tarboton |
| 11 | Thu Oct 4 | Exercise 4. Watershed and Stream Network Delineation | Tarboton |
| 12 | Tue Oct 9 | National Water Model | Maidment |
| 13 | Thu Oct 11 | Review for Midterm Exam | Maidment |
| 14 | Tue Oct 16 | Midterm exam | Both |
| 15 | Thu Oct 18 | Groundwater.  Midterm return | Maidment |
| 16 | Tue Oct 23 | Height above Nearest Drainage (HAND) flood inundation mapping. [Term project 2 page progress report due] | Tarboton |
| 17 | Thu Oct 25 | Exercise 5: Height above nearest drainage (HAND) Flood Inundation mapping | Tarboton |
| 18 | Tue Oct 30 | Extending ArcGIS using Programming (Python) | Tarboton |
| 19 | Thu Nov 1 | Demography | Maidment |
| 20 | Tue Nov 6 | LIDAR | Maidment |
| 21 | Thu Nov 8 | Water information sharing and HydroShare | Tarboton |
| 22 | Tue Nov 13 | Term Paper Presentations Texas | Maidment |
| 23 | Thu Nov 15 | Term Paper Presentations Texas | Maidment |
| 24 | Tue Nov 20 | Term Paper Presentations USU | |
| | Thu Nov 22 | Thanksgiving | |
| 25 | Tue Nov 27 | Term Paper Presentations Texas | Maidment |
| 26 | Thu Nov 29 | Term Paper Presentations USU | Tarboton |
| 27 | Tue Dec 4 | Term Paper Presentations Texas | Maidment |
| 28 | Thu Dec 6 | Term Paper Presentations Texas | Maidment |
| | Fri Dec 7 | Term project due | |