GEOG 2475: Geographic Information Systems I

Lecture 01 Introduction

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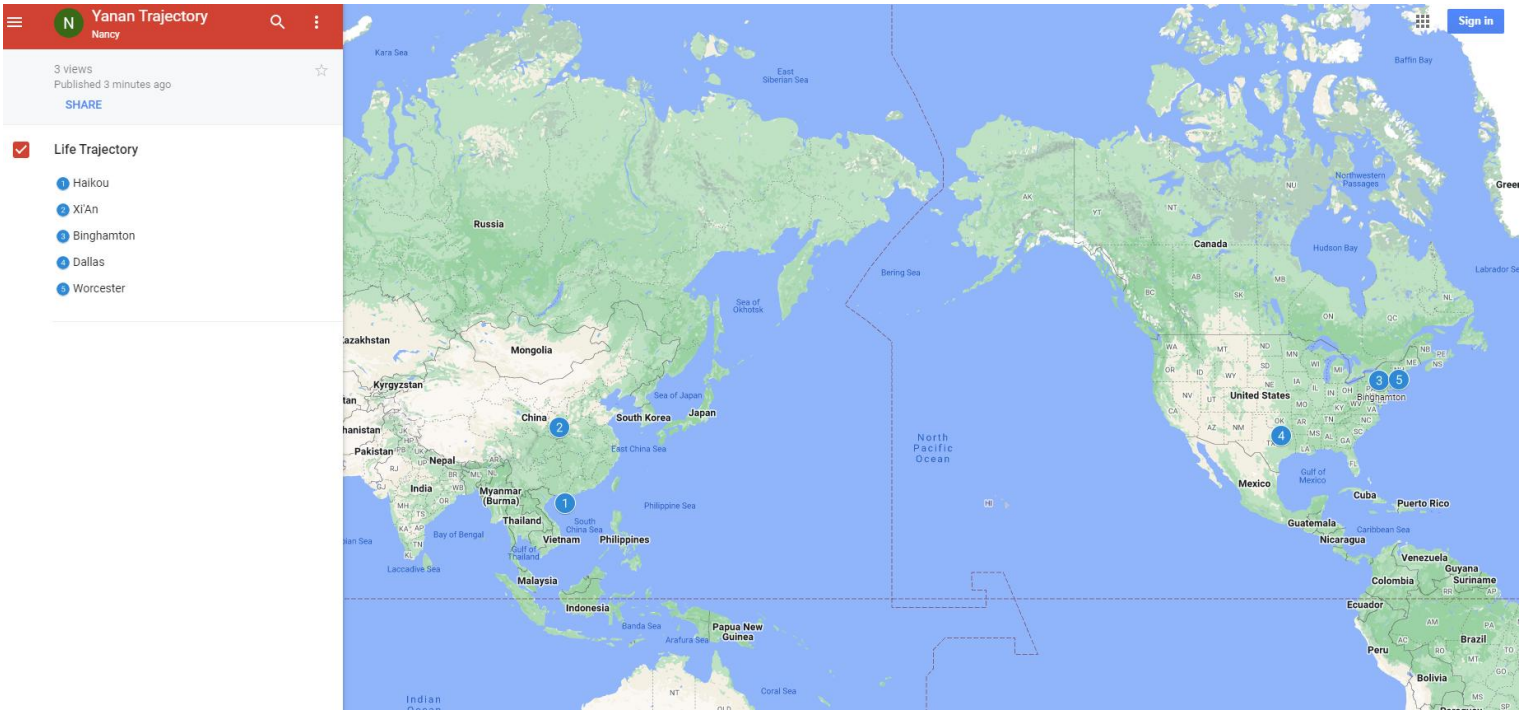
Department of Geography

UNIVERSITY OF CENTRAL ARKANSAS™ | Geography

Overview

- Introduction
  - ✓ Who am I?
  - ✓ Who you are?
- Course overview and expectations
  - ✓ Syllabus
- Software
  - ✓ ArcGIS Pro
  - ✓ Inkscape
- What is GIS?
- Functions of GIS
- GIS components
- GIS applications
- Careers in GIS

Who am I?


Yanan Trajectory
Nancy
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Life Trajectory
1 Haikou
2 Xi'An
3 Binghamton
4 Dallas
5 Worcester
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Russia
Mongolia
China
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Nepal
India
Myanmar (Burma)
Thailand
Vietnam
Philippines
Malaysia
Indonesia
Papua New Guinea
Canada
United States
Mexico
Cuba
Puerto Rico
Guatemala
Nicaragua
Venezuela
Colombia
Ecuador
Peru
Brazil
Bolivia
North Pacific Ocean
Bering Sea
Sea of Okhotsk
Sea of Japan
East China Sea
Philippine Sea
Bay of Bengal
Gulf of Thailand
Laccadive Sea
Banda Sea
Arafura Sea
Coral Sea
Hudson Bay
Gulf of Mexico
Caribbean Sea
Baffin Bay
Kara Sea
East Siberian Sea
Northwestern Passages
Kyrgyzstan
Binghamton

Past Teaching Experience

- **Python Programming**

1. Manipulating Spatial Data
2. Web Mapping
3. Processing Raster
4. Data Analysis
5. Creating Custom Tool
6. Data Visualization
7. …

- **Spatial Database**

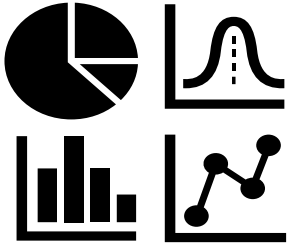
1. Geodatabase
2. SQL
3. Proximity Analysis
4. Geometry processing
5. Raster processing
6. PostSQL with python
7. …

Past Teaching Experience

- **Web Mapping**

1. HTML
2. CSS
3. JS
4. Python Web Mapping
5. R Web Mapping
6. ArcGIS Maps for JavaScript
7. …

- **Intermediate Statistics**



1. Bivariate regression
2. Logistics regression
3. PCA
4. GWR
5. Spatial Autocorrelation
6. …

Teaching in UCA

- **GIS I**

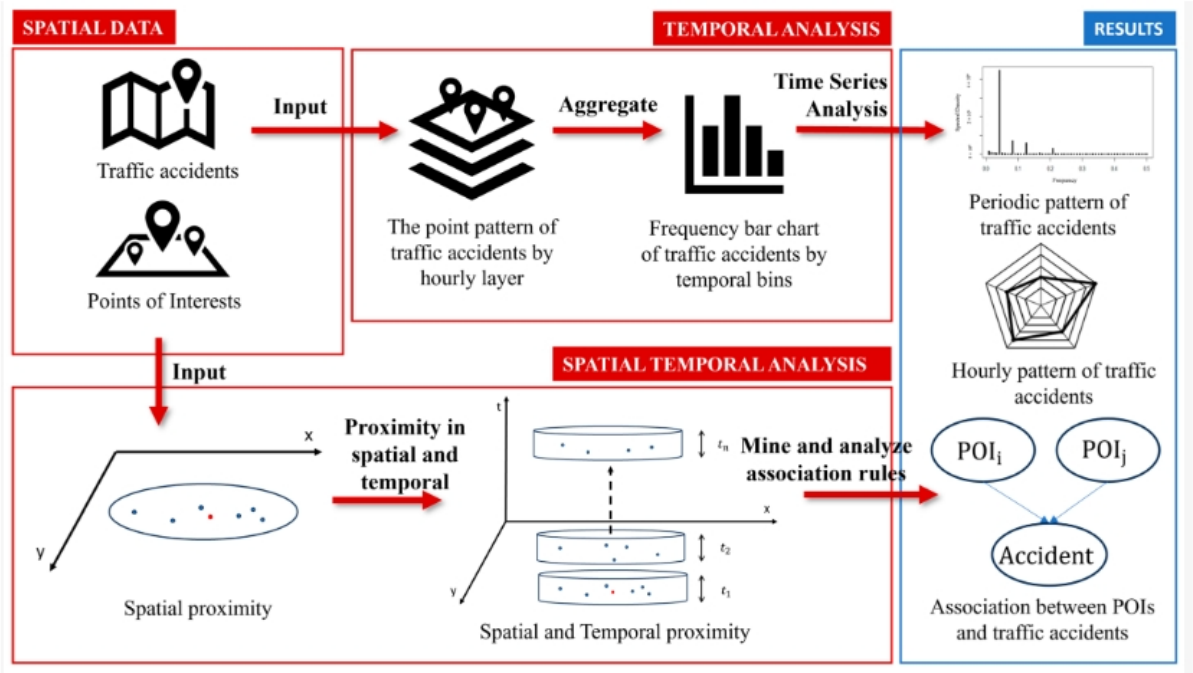
1. **Spatial Data**
2. **GIS software**
3. **Geodatabase**
4. **Cartography**
5. **Raster**
6. **Programming in GIS**
7. **…**

- **Geographic Field Techniques**

1. **GPS**
2. **Drone**
3. **Esri Mobile App**
4. **Field Map**
5. **Survey 123**
6. **ArcGIS Dashboard**
7. **…**

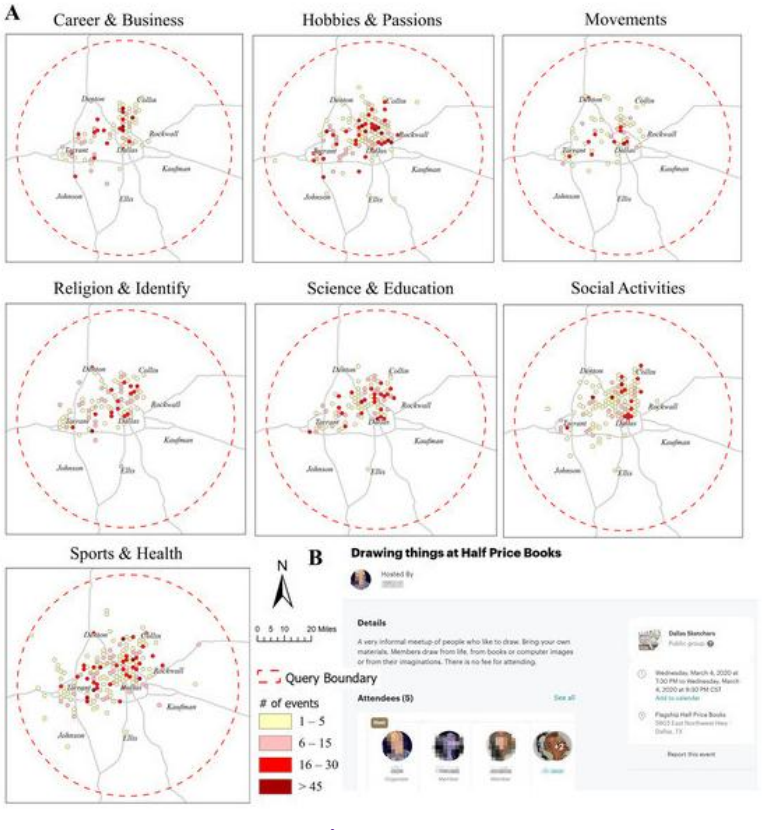
Research

✓ [Repetitive Pattern of Traffic Accidents in City of Dallas, TX]



Research

- What Local Environments Drive Opportunities for Social Events?



Research

NATURAL LANGUAGE PROCESSING

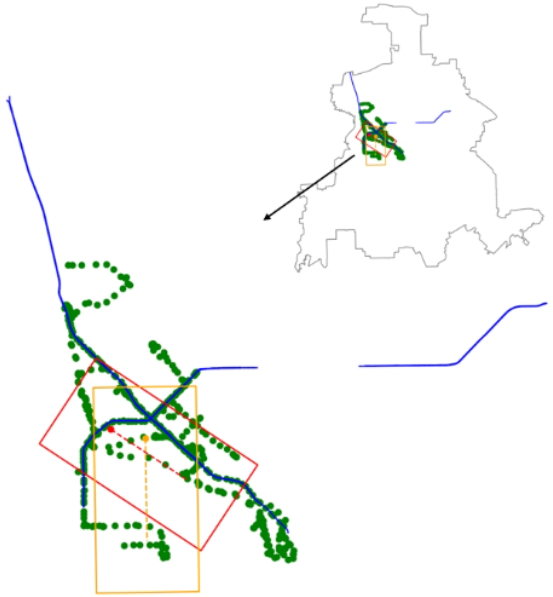
Spatial Entity Recognition - Extracting street names affected by flooding using NLP.

Input: Text

Narrative from Dallas Police Department Report
1. Dallas PD closed portions of **Mockingbird Lane** near **Harry Hines** due to high water.

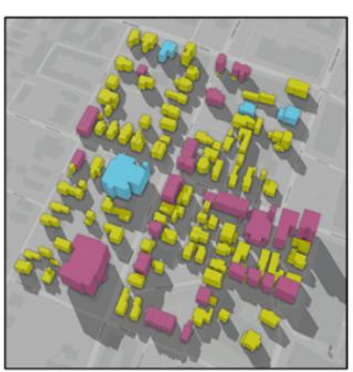
Output: Entity Recognition

Flooding area:
Red polygon and Orange polygon



Research

✓ Sanborn Historical Map



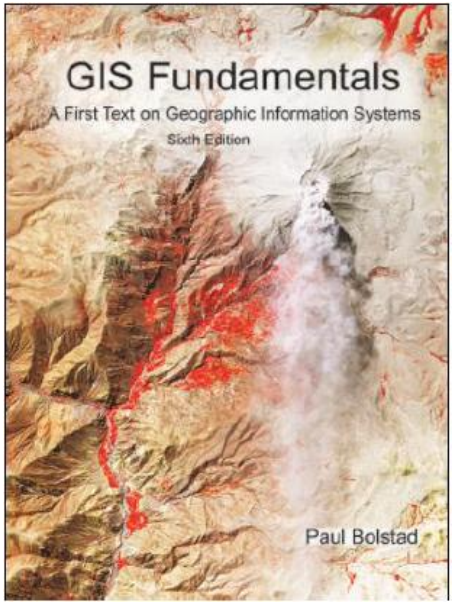
About you

- Your background (e.g., name, major)
- Share something from your summer break
- What relevant experience do you have with GIS?
- What are your expectations for this course?

Course overview and expectations

- Book

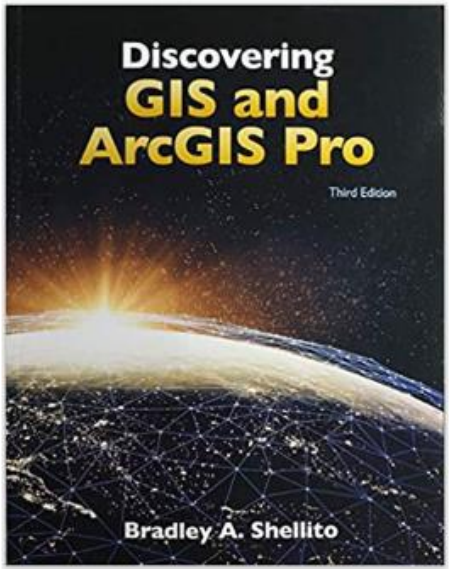
✓ *GIS Fundamentals* by Paul Bolstad (ISBN-10: 978-0971764736; ISBN-13: 0971764735)



Course overview and expectations

- Book

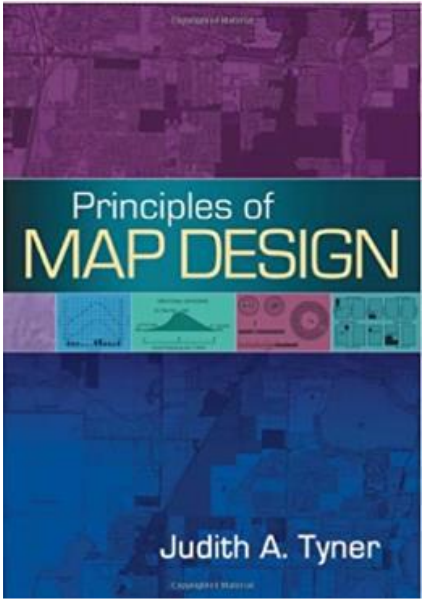
✓ *Discovering GIS and ArcGIS Pro* by Bradley A. Shellito (ISBN-10: 131923075X; ISBN-13: 978-1319230753)



Course overview and expectations

- Book

✓ *Principles of Map Design* by Judith A. Tyner. (ISBN 978-1-60623-544-7, 978-1-4625-1712-1)



Software

- Windows system
  - ✓ Software requirement: Microsoft .NET
  - ✓ Hardware requirement: https://pro.arcgis.com/en/pro-app/latest/get-started/arcgis-pro-system-requirements.htm

Course overview and expectations

- Course Structure (4-credit)
  - ✓ Lecture (TR 10:50- 12:05 pm)
    - Interactive and inclusive environment
    - Feel free at any time during lecture to ask a question and make a comment
    - Lecture will be recorded and delivered to the students if necessary
  - ✓ Lab exercise (TR: 12:15- 1:30 pm)
    - Work individually on the in-class exercise
    - Guidance will be provided; demonstration will be provided if necessary
    - When submit exercise, copy questions in the lab and provide answers in a word file
    - Feel free at any time to ask a question

Course overview and expectations

- Course Structure
  - ✓Exam
    - Middle exam delivery on blackboard
      - Multiple choice, true/false, and short answers
    - Exam time is specified, may be different with the University one
    - One page and one side of A4 cheat sheet is allowed
  - ✓Final project
    - For 4-credit version of this course only
    - Design your own research, get your own data, process the data, generate maps, and write a final report
    - You can refer to the previous exercise to get help

Course Schedule

- Oct. 13-17
  - ✓ Arkansas GIS User Forum: no class & lab
- Oct. 20-24
  - ✓ Midterm and project proposal
- Oct. 27-31
  - ✓ SWAAG conference
- Nov. 24-28
  - ✓ Thanksgiving Break
- Dec. 1-5
  - ✓ Project analysis
- Dec. 8-12
  - ✓ Final Presentation

Course overview and expectations

- Grading (20% later deduction)
  - ✓ 4-credit version

Table 2 Grade distribution for 4-credit version

Item	Description	Detail	Points
Lab exercises	10 labs @ 60 points each	10 lab exercises. Each will be provided with guidelines. In each lab, there are ~10-30 questions to answer.	600
Midterm Exam	1 midterm	Exam will consist of multiple choice, true/false, and short answers.	150
Project	1 project report & 1 final presentation	**1. Project report (50 points)** a. Introduction (10 points) b. Data (10 points) c. Interpretation of the map (10 points) d. Result (10 points) e. (10 points) **2. Final presentation (100 points)**	150
Total			900 Points

Course overview and expectations

- Grading (20% later deduction)
  - ✓ 4-credit version

Table 3 Grade Scale for 4-credit version

90%- 100%	A	> 810 points
80%- 90%	B	> 720 Points
70%- 80%	C	> 630 Points
60%- 70%	D	> 540 Points
0%- 60%	F	< 540 Points

Course overview and expectations

- Late penalty for lab
  - ✓ Labs that are not turned in by the due date can be turned in up to 2 days late with a 20% penalty. Labs will not be accepted after this 2-day period.
- Midterm exam
  - ✓ Make-up exams for absences due to any other reason will be at the discretion of the instructor.
  - ✓ You must notify the instructor beforehand if you need to miss an exam, the instructor will not let you make up an exam without prior notification.
- Final presentation
  - ✓ The final presentation cannot be rescheduled. You are expected to do the final presentation at the time specified.

Course overview and expectations

- Attendance
  - ✓ Prolonged absence from class will inhibit your understanding of the lecture material and prevent you from receiving help on assignments
  - ✓ We may do some bonus exercises during the class time. If you are not shown up, you simply lose it
  - ✓ Up to 3 times of absence may result in moving out from this class
  - ✓ If you cannot attend class, please contact me before class
  - ✓ Sick leave is acceptable, please contact me for re-arranging lab exercise etc.

Course overview and expectations

- Feedback Response Time
  - ✓ The instructor generally replies to emails within 48 hours, except during holidays.
  - ✓ Often the instructor replies much more quickly, but you should not count on a same-day reply.
  - ✓ Please plan accordingly so that you don’t miss deadlines.

Course overview and expectations

- Classroom Etiquette
  - ✓ Switch cell phones off and place them out of view. Do not use phones during class. Resist the impulse!
  - ✓ Computers are permitted for notetaking only.
  - ✓ Do not sleep in class or leave once a lecture has started.
  - ✓ Do not pack up and prepare to leave until the instructor has indicated that class is over
  - ✓ No eCigarettes permitted in the classroom.
  - ✓ You are encouraged to think critically and ask stimulating questions, but always respect your fellow students and your instructor.

Course overview and expectations

- Evaluations
  - ✓ Student evaluations of a course and its professor are a crucial element in helping faculty achieve excellence in the classroom and the institution in demonstrating that students are gaining knowledge.
  - ✓ Students will receive evaluation notification from university.

Course overview and expectations

- Structure
  - ✓ In-person
    - Lecture
    - Lab
    - Middle (delivery through Blackboard)
    - Office hour
      - MW 10:00 am to 11:50 am
      - Location: Lewis 154
  - ✓ May Change!
    - Please regularly check your Blackboard and or email

Course overview and expectations

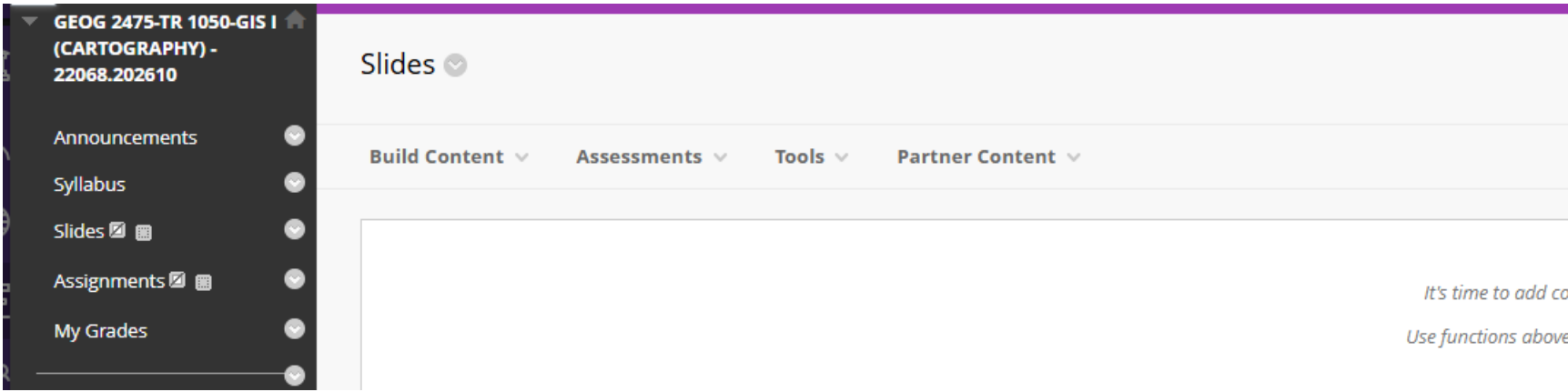
- After this course
  - ✓ explain GIS principles and concepts
  - ✓ acquire the knowledge of how computers store spatial data using the vector and raster data structures
  - ✓ find geospatial data using the web
  - ✓ apply cartographic principles to symbolize and classify geographic data
  - ✓ produce audience-oriented maps using spatial data
  - ✓ build geodatabase and query attribute table
  - ✓ geocode address
  - ✓ conduct basic spatial analyses
  - ✓ gain experience of GIS software (ESRI ArcGIS)

Course overview and expectations

- Contact Info
  - ✓ Lewis 154
  - ✓ Office Hour:
    - MW 10:00-11:50 am
  - ✓ Email: ywu@uca.edu

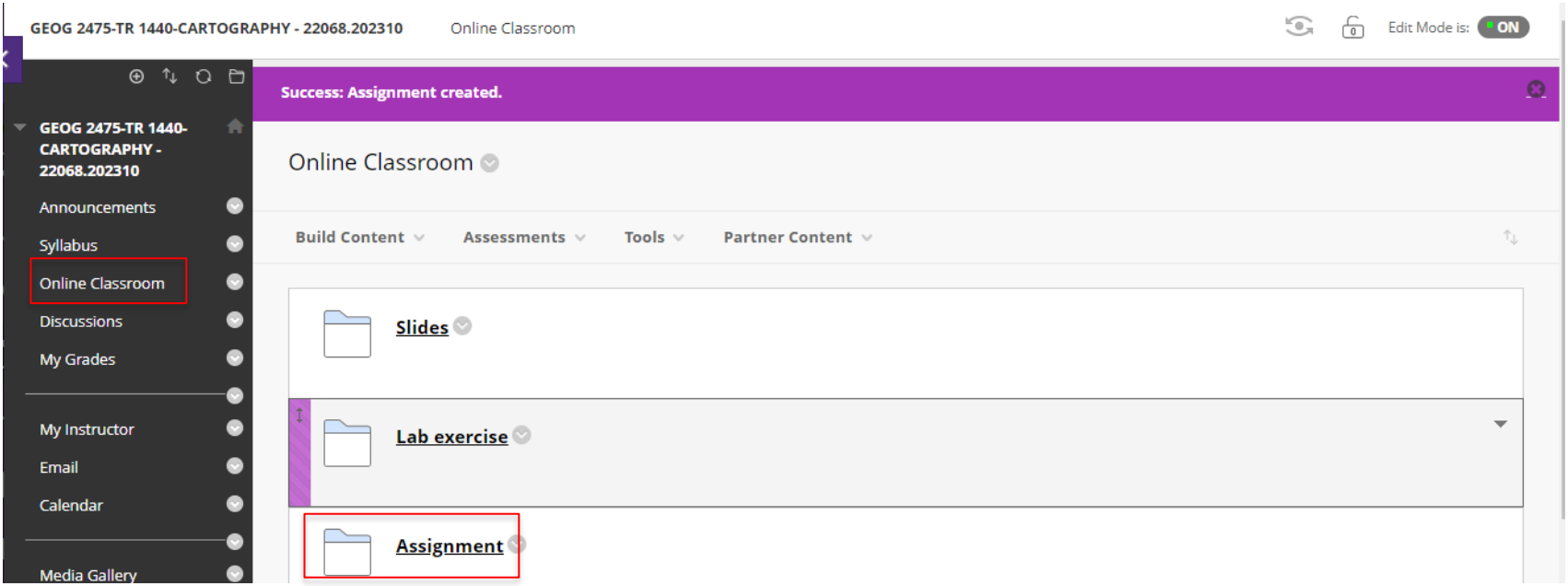
Course overview and expectations

- Place for slides, and submitting lab exercise



Course overview and expectations

- Place for slides, and submitting lab exercise



Software

- ArcGIS Pro installed on Mac/other computer

Mac

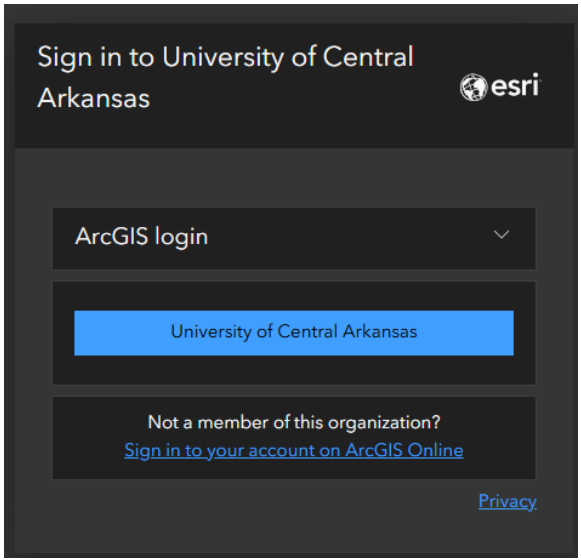
ESRI https://pro.arcgis.com/en/pro-app/latest/get-started/run-pro-on-a-mac.htm

Harvard
https://gis.harvard.edu/faq/how-installing-arcgis-desktop-or-pro-mac-computer

Other PCs (e.g., Chromebook, Microsoft surface)
Please talk with/email to me

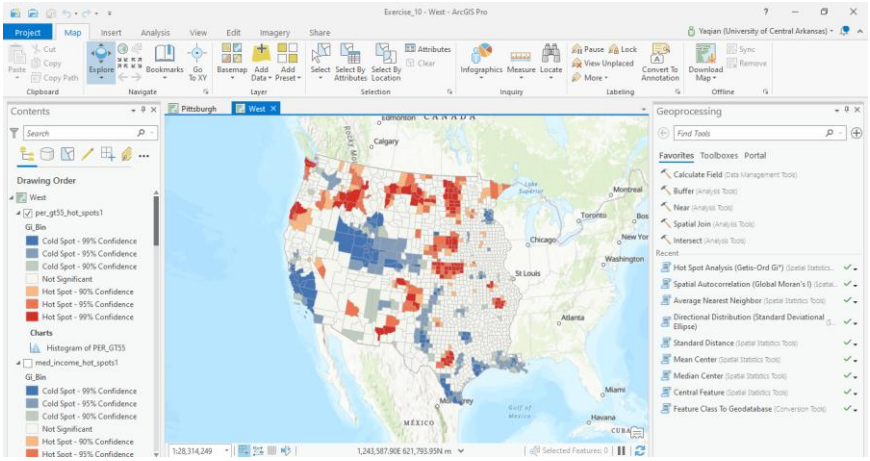
Software – ArcGIS Online

- ArcGIS Online
  - ✓ Log in ArcGIS online https://uca.edu/geography/gis/



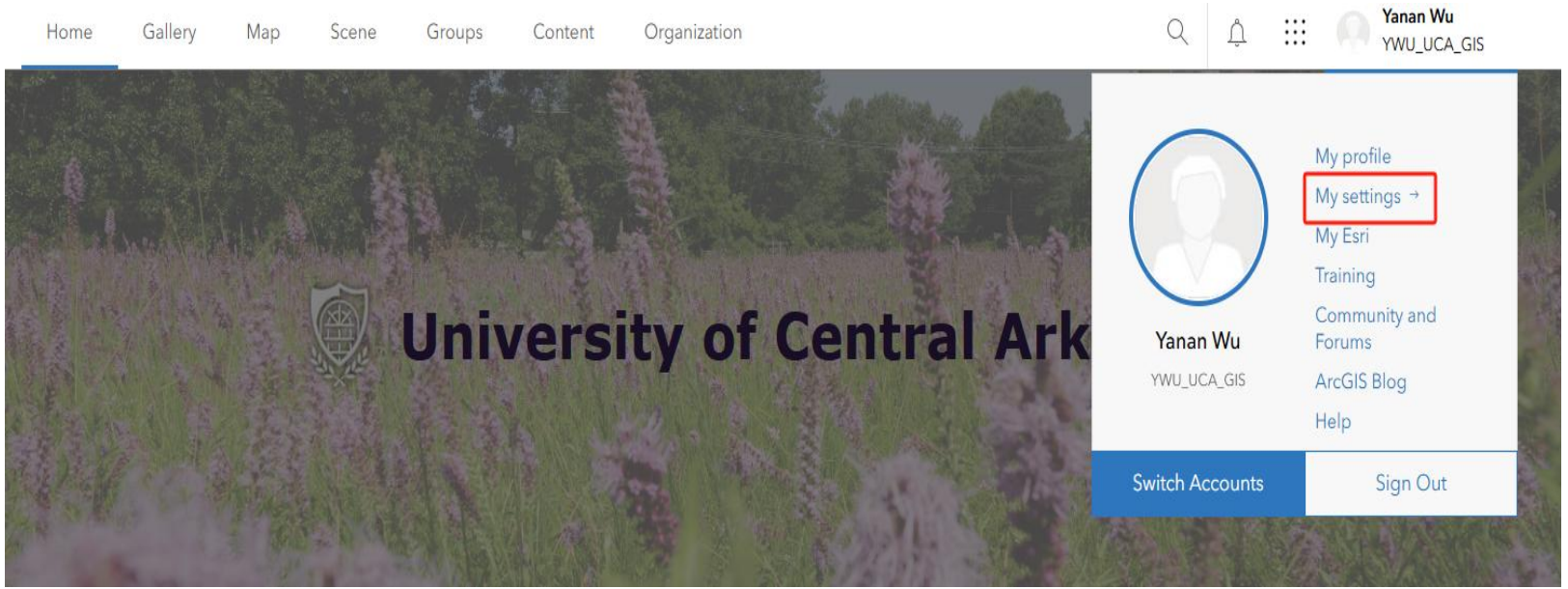
Software – ArcGIS Pro

- ESRI ArcGIS Pro



Software

- ArcGIS Pro installed in your own PC



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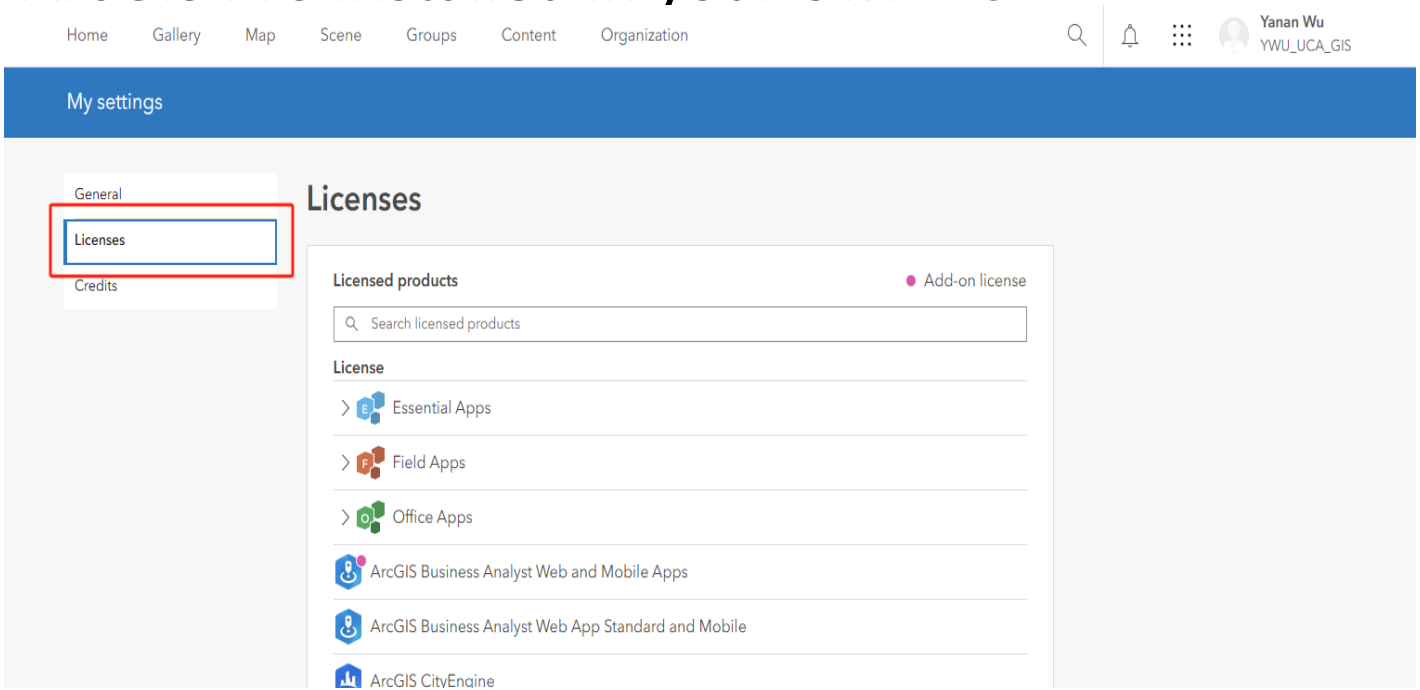

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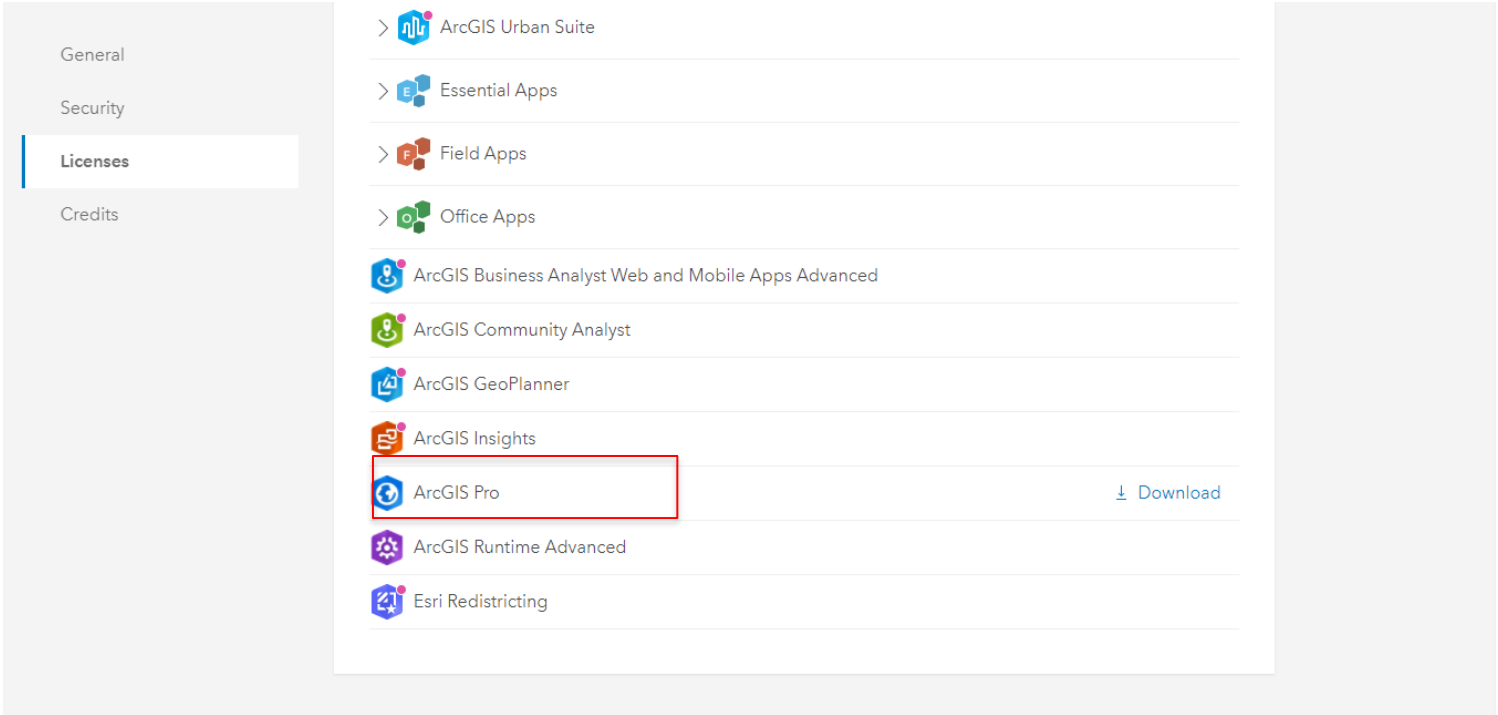
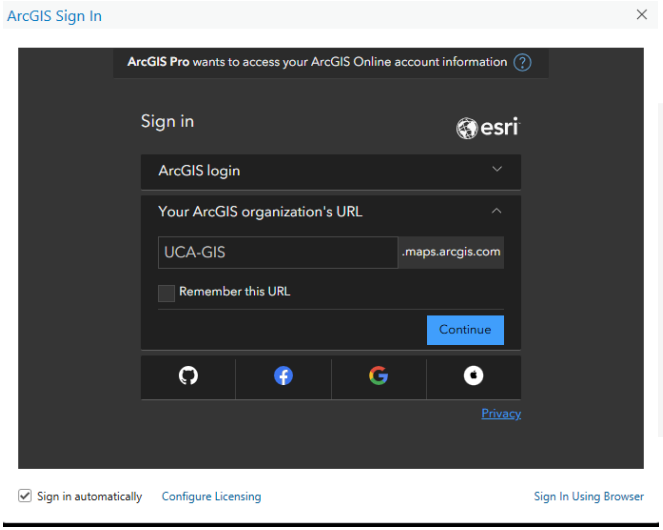
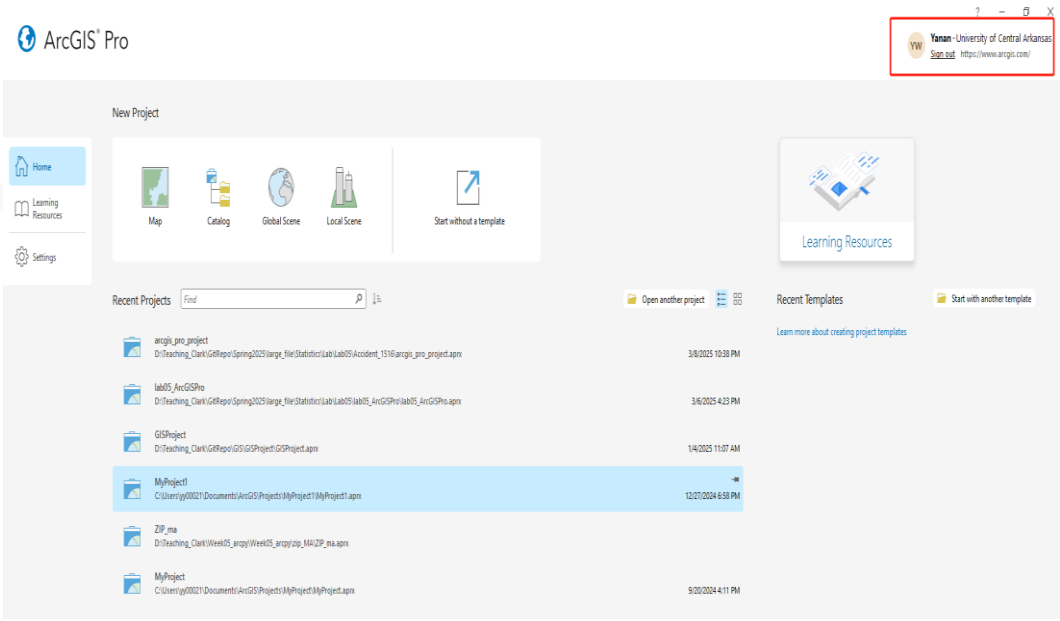


ArcGIS online account

- ArcGIS Pro



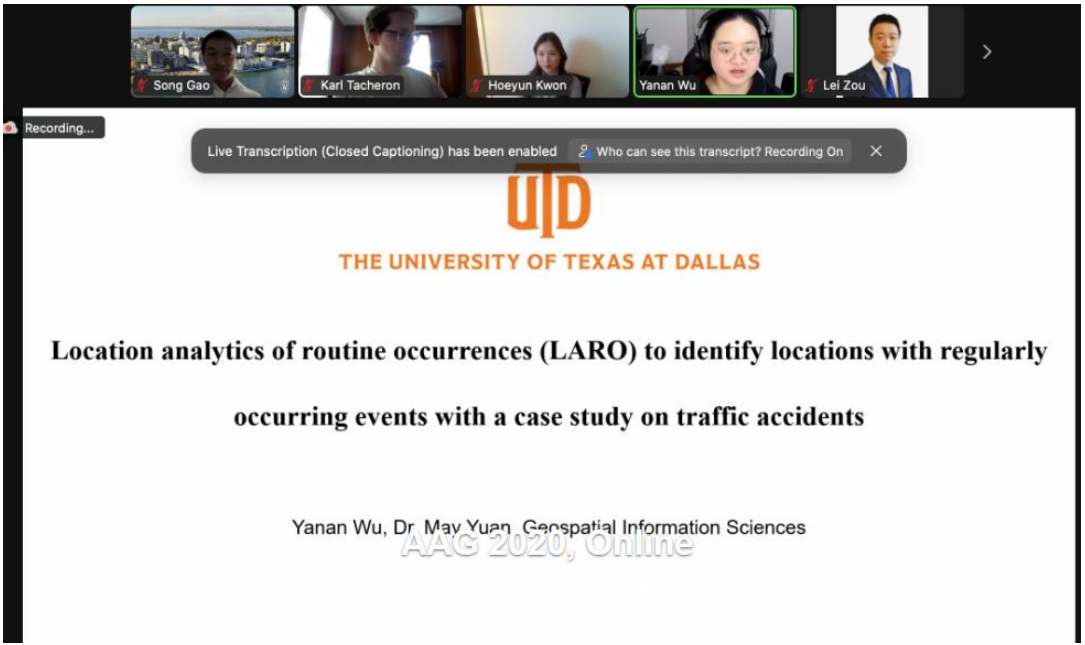


Conference

- Arkansas GIS Users Forum
- SWAAG Conference
  - Student Competition
  - Geobowl

Conference

- AAG Conference
  - Awards and grants

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What is a **GIS**? *No easy answer anymore!*

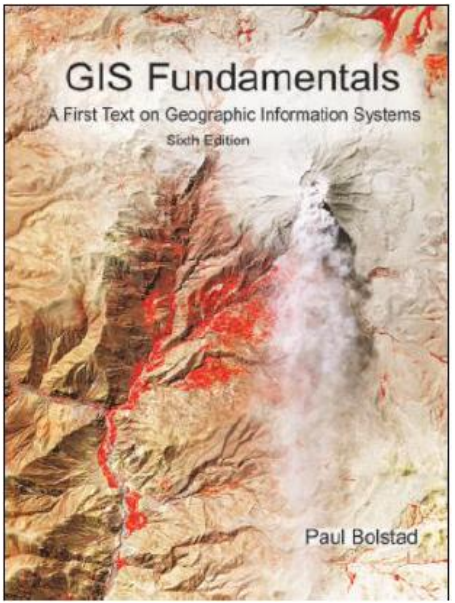
- Geographic Information
  - information about places on the earth's surface
  - knowledge about "what is where when"

- GIS--what's in the S?
  - Systems: the technology
  - Science: the concepts and theory

GI Systems

A computer-based system to aid in the collection, maintenance, storage, analysis, output, and distribution of spatial data and information

-Paul Bolstad

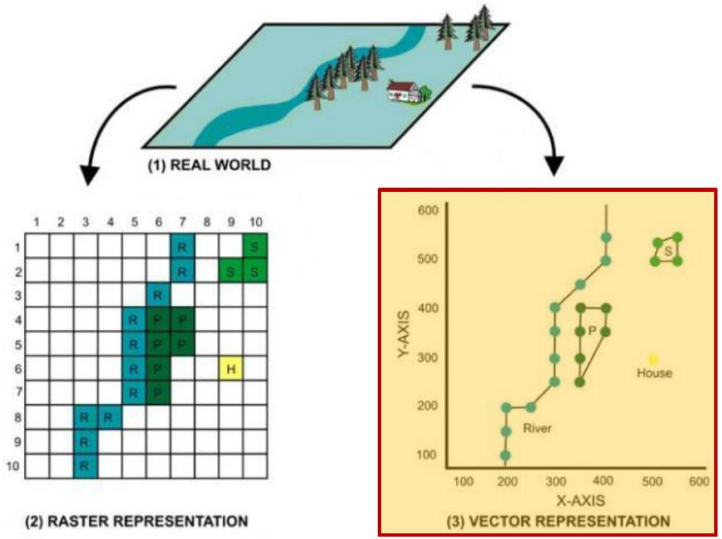


https://www.xanedu.com/higher-education/educators/custom-books%20catalog/gis_fundamentals/

GI Science

Geographic Information Science focuses the generic issues that surround the use of GIS technology, impede its successful implementation, or emerge from an understanding of its potential capabilities.

- Michael Goodchild



https://sqlserverrider.wordpress.com/tag/raster-graphics/

Goodchild, M. F. (1992).

GI technologies

3S

Global Positioning Systems

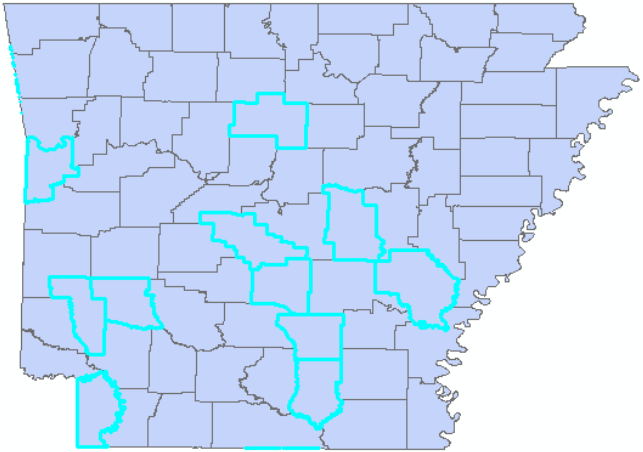
Remote Sensing
RS

https://landsat.usgs.gov/landsat-8

GPS

https://commons.wikimedia.org/wiki/File:Bad_gdop.png

GIS



GI technologies

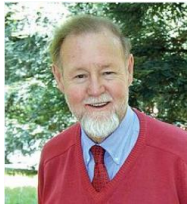
3S

- RS
  - use of satellites or aircraft to capture information about the earth's surface

- GPS
  - a system of earth-orbiting satellites which can provide precise location on the earth's surface (in lat/long coordinates or equiv.)

GPS and RS are sources of input data for a GIS

History



Harvard Laboratory for Computer Graphics: SYMAP

esri

1960s
Dr. Roger Tomlinson

1965
Mr. Howard Fisher

1969
Mr. Jack Dangermond

Arc/info, MapInfo

1970s

1980s

1990s

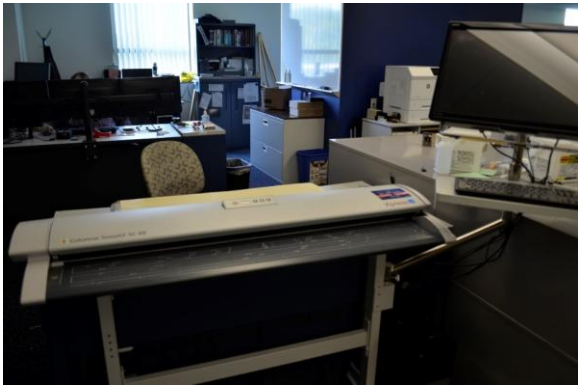
https://www.esri.com/en-us/what-is-gis/history-of-gis

https://en.wikipedia.org/wiki/Geographic_information_system

Functions of a GIS

1. Capture
2. Store
3. Query
4. Analyze
5. Display

Functions: *Capture*



https://commons.wikimedia.org/wiki/File:Intersect_UAV_B_3.1.png

https://landsat.usgs.gov/landsat-8

https://commons.wikimedia.org/wiki/File:Bad_gdop.png

Functions: *Store*

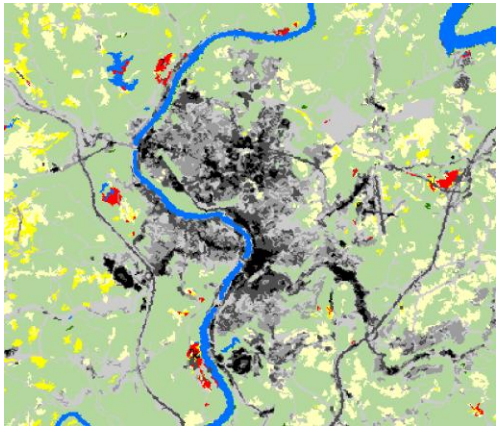
Local disk

Server

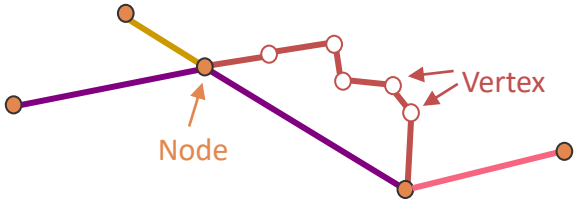
amazon cloud drive

Cloud

Functions: *Store*



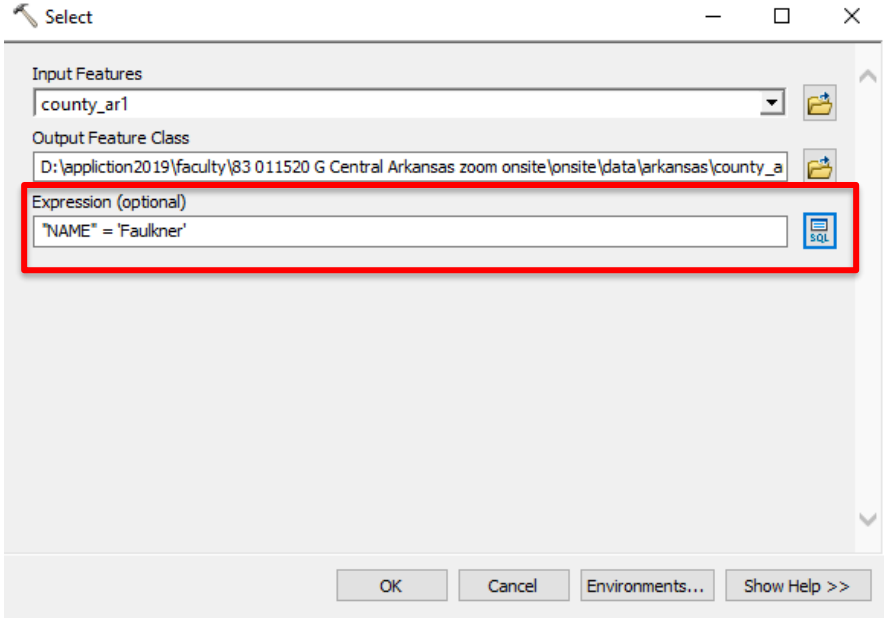
Raster

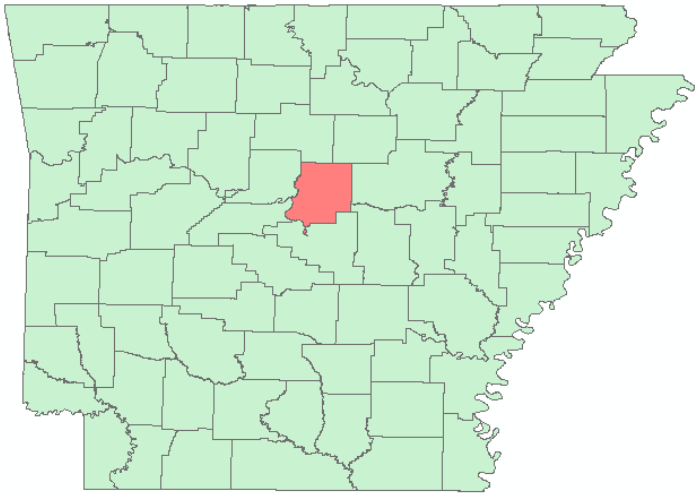


Vector

Functions: *Query*

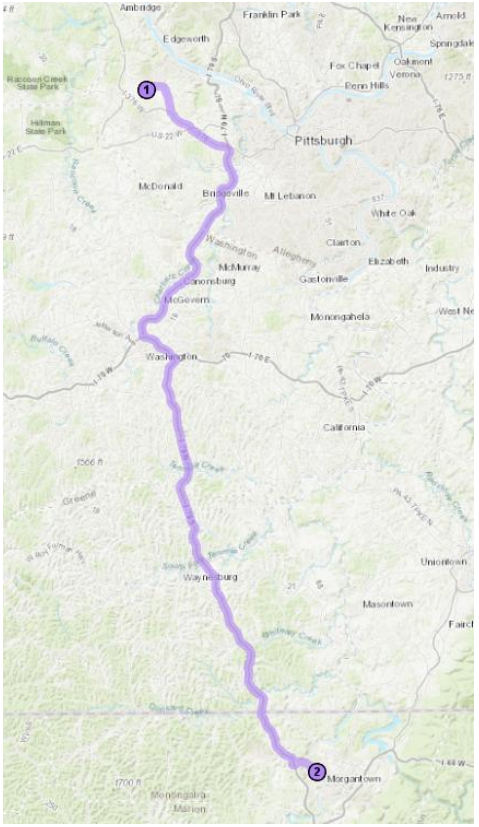
Structured Query Language (SQL)



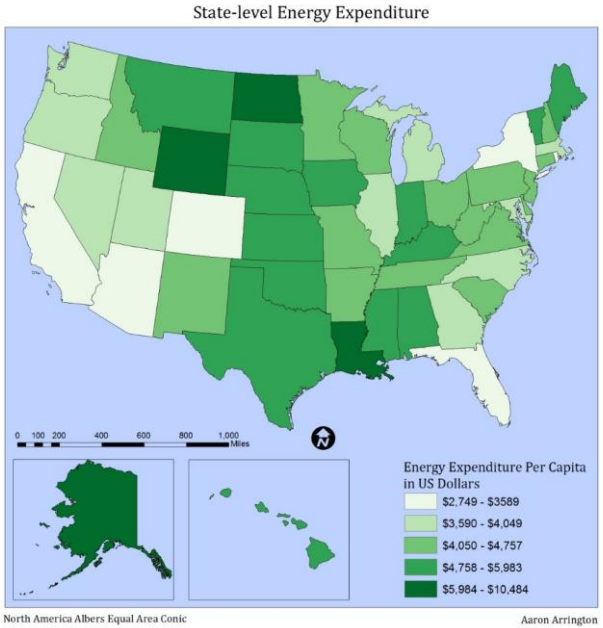


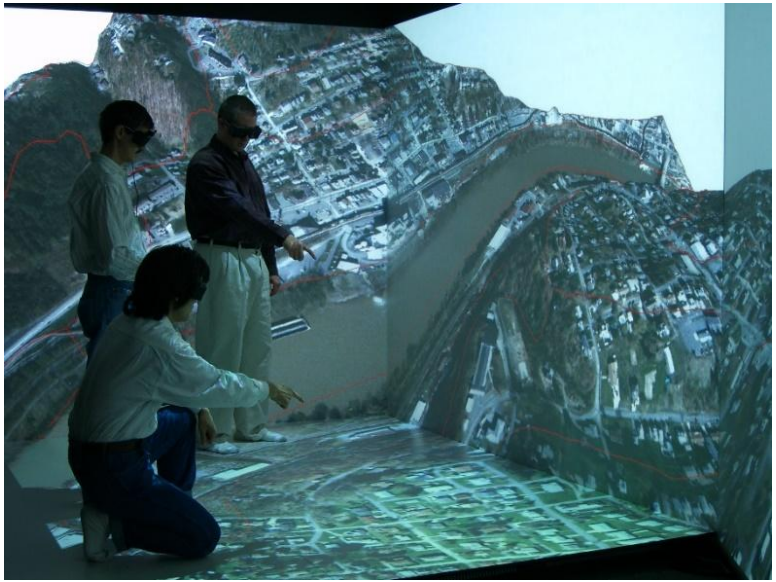
Functions: *Analyze*

1. Directions
2. Buffer
3. Proximity
4. Suitability
5. Likelihood
6. Best locations
7. Worst locations
8. Etc.



Functions: *Display*





Virtual Reality

Components of a GIS

1. People
2. Data
3. Hardware
4. Software
5. Methods/Protocol

https://www.rst2.org/ties/GENTOOLS/comp_gis.html

Components: *People*

https://www.argisusers.org/

http://www.aag.org/

https://www.asprs.org/

https://www.gisci.org/

https://www.esri.com/training/

Logos were obtained from organization websites

Components: *People*

- Department of Geography @UCA

Programs

Undergraduate Majors

Geography

Geospatial Concentration

Environmental Science – Planning & Administration

Undergraduate Minors

Geography

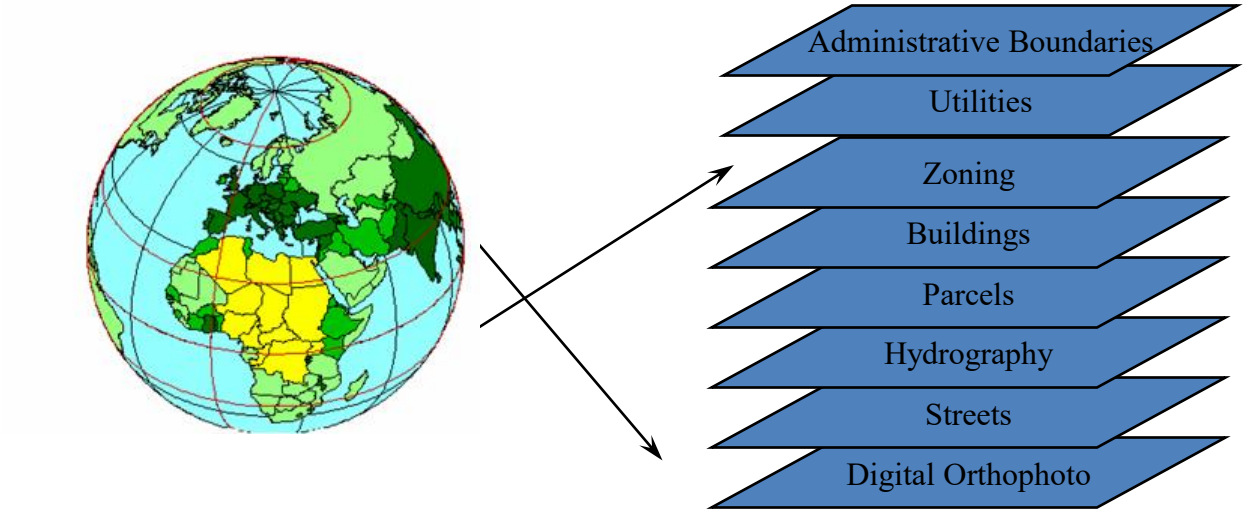
GIS

Graduate

Master of GIS

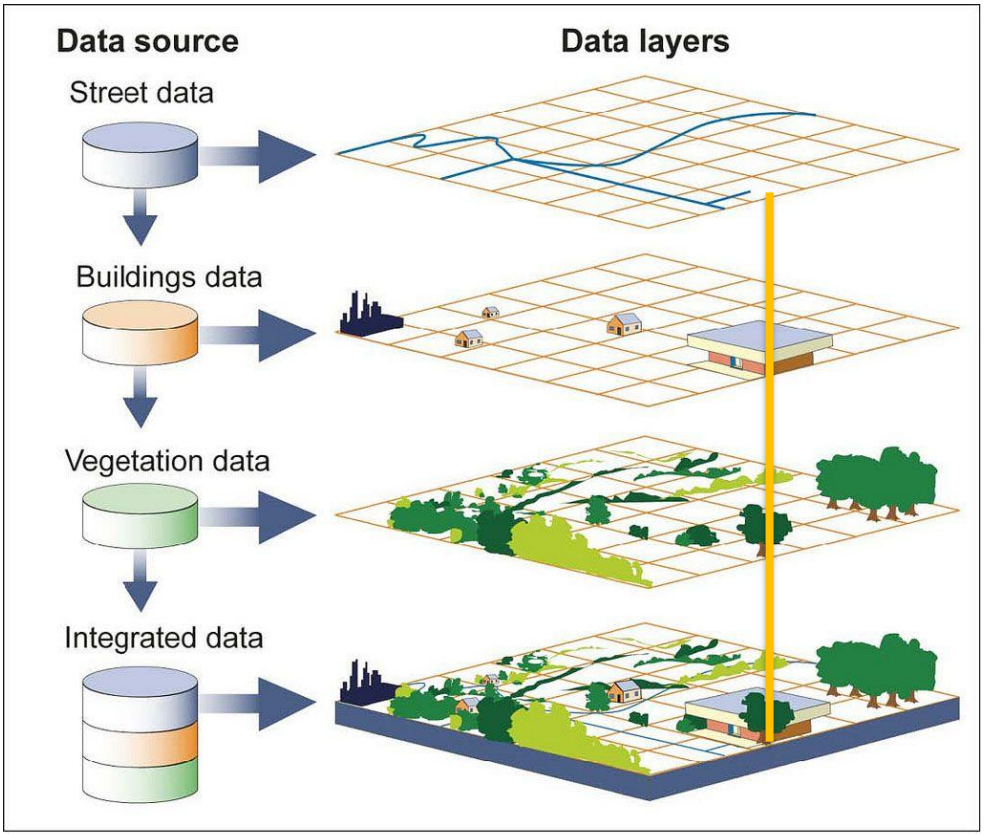
GIS Certificate

Components: *Data*



- Data is organized by layers, coverages or themes*, with each layer representing a common feature.*
- Layers are integrated using explicit location on the earth's surface, *thus geographic location is the organizing principal*.

Components: *Data*



Source: GAO.

Components: *software*

Logos were obtained from organization websites

Components: *hardware*

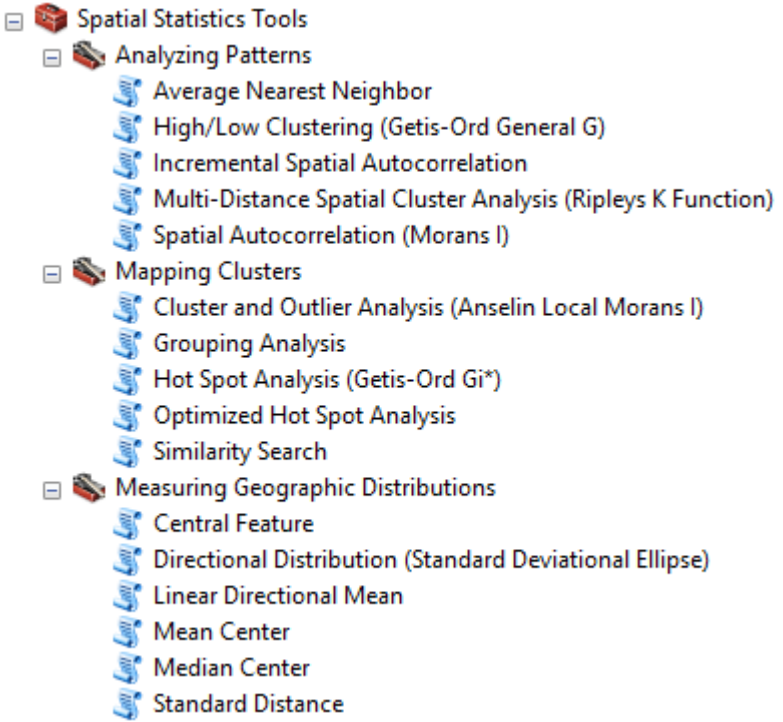
https://commons.wikimedia.org/wiki/File:Interspect_UAV_B_3.1.png

https://www.microsoft.com/en-us/p/surface-laptop-3/8VFGGH1R94TM/F29J?activetab=overview&source=googleshopping&OCID=AID2000022_SEM_mRUxj5Qp

http://geospatialfieldmethodstanner.blogspot.com/2014/04/field-activity-9-surveying-with-topcon.html

Components: *Method*

- ✓ Table Query
- ✓ Map design
- ✓ Digitizing
- ✓ Georeferencing
- ✓ Resampling
- ✓ Vector spatial analysis
- ✓ Raster spatial analysis
- ✓ Digital terrain analysis
- ✓ Geospatial modeling
- ✓ ArcGIS Model Builder
- ✓ Weighted overlay
- ✓ Spatial statistical analysis
- ✓ Spatial interpolation



GIS

MORE than maps

Applications

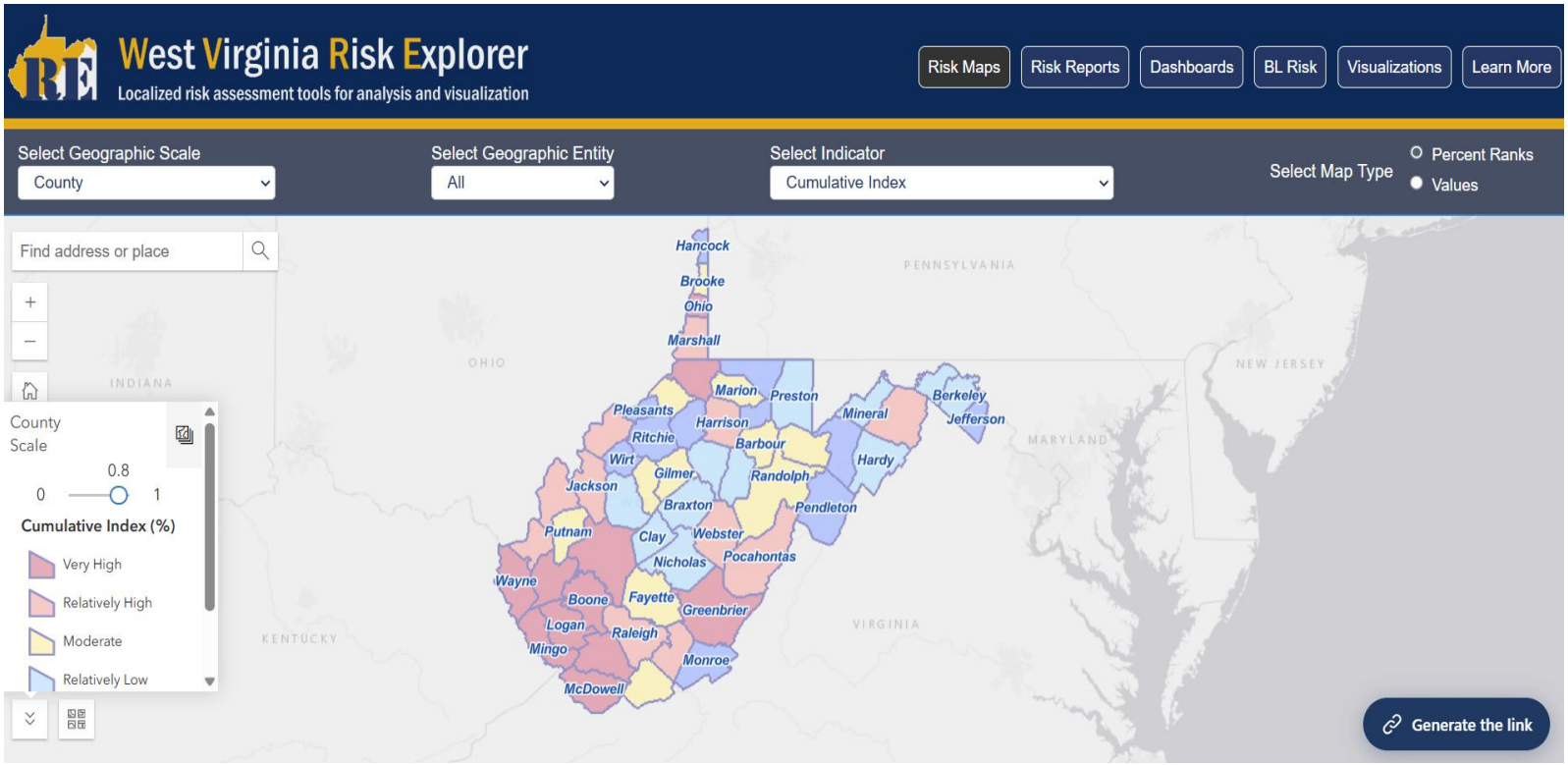
- **Urban Planning, Management & Policy**
  - Land acquisition
  - Housing renovation programs
  - Emergency response
  - Crime analysis
  - Tax assessment
- **Environmental Sciences**
  - Monitoring environmental risk
  - Modeling stormwater runoff
  - Management of watersheds, floodplains, wetlands, forests, aquifers
  - Hazardous or toxic facility siting
  - Groundwater modeling and contamination tracking
- **Political Science**
  - Redistricting
  - Analysis of election results
  - Predictive modeling

Application

- **Civil Engineering/Utility**
  - Locating underground facilities
  - Designing alignment for freeways, transit
  - Coordination of infrastructure maintenance
- **Business**
  - Demographic Analysis
  - Market Penetration/ Share Analysis
  - Site Selection
- **Education Administration**
  - Attendance Area Maintenance
  - Enrollment Projections
  - School Bus Routing
- **Real Estate**
  - Neighborhood land prices
  - Traffic Impact Analysis
  - Determination of Highest and Best Use
- **Health Care**
  - Epidemiology
  - Needs Analysis
  - Service Inventory

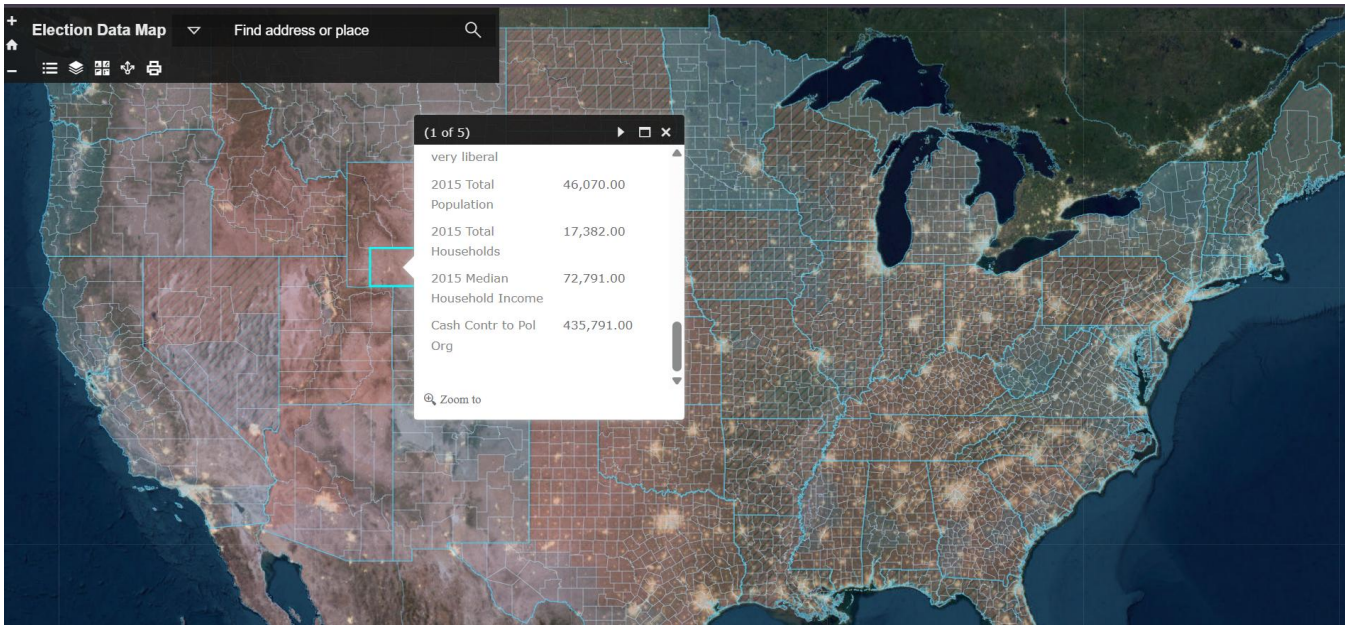
Example: *GIS in Environmental Science*

West Virginia Risk Explorer



Example: *GIS in Political Science*

2020 Presidential Election



Election Data Map

Example: *GIS in Health Care*

Traveling during early stage of COVID-19 period

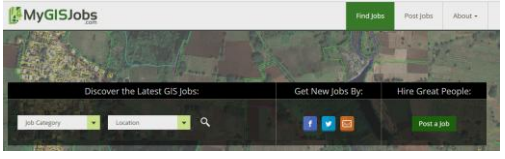
https://geods.geography.wisc.edu/

GIS Application in Modern World

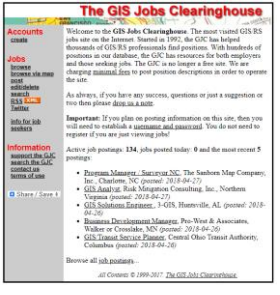
GISer Job Market

- **Local Government**
  - Planning and environmental management
  - property records and appraisal
- **Real Estate and Marketing**
  - Retail site selection, site evaluation
- **Public safety and defense**
  - Crime analysis, fire prevention, emergency management, military/defense
- **Natural resource exploration/extraction**
  - Petroleum, minerals, quarrying
- **Transportation**
  - Airline route planning, transportation planning/modeling
- **Public health and epidemiology**
- **The Geospatial Industry**
  - Data development, application development, programming

https://www.gisjobs.com/



https://www.mygisjobs.com/



http://www.gjc.org/

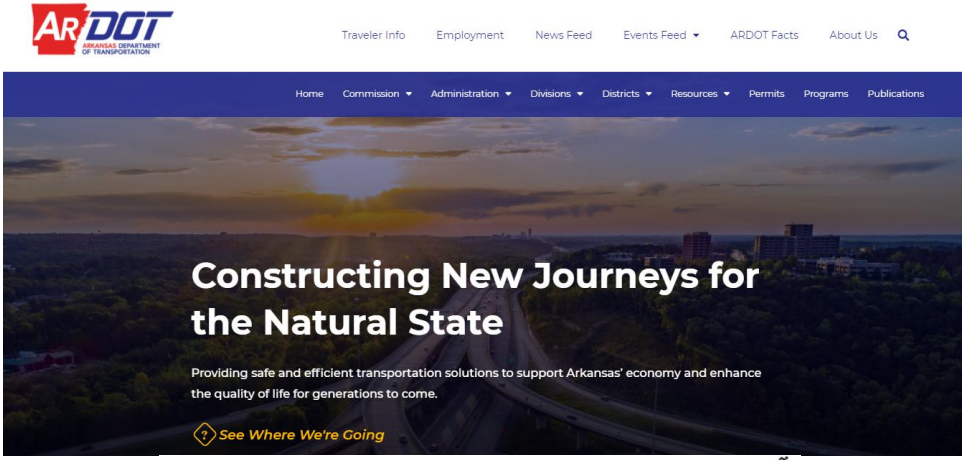
Geography Students placement @UCA

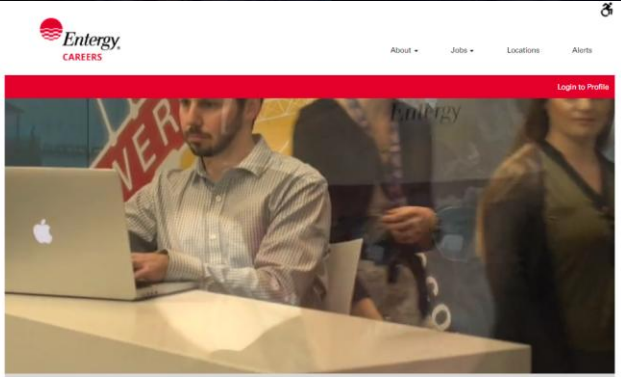
2020-2021

1. Four students worked as full time at ARDOT
2. Three students in master GIS program @UCA (One student is supported by Arkansas Space Grant Consortium project)

2022

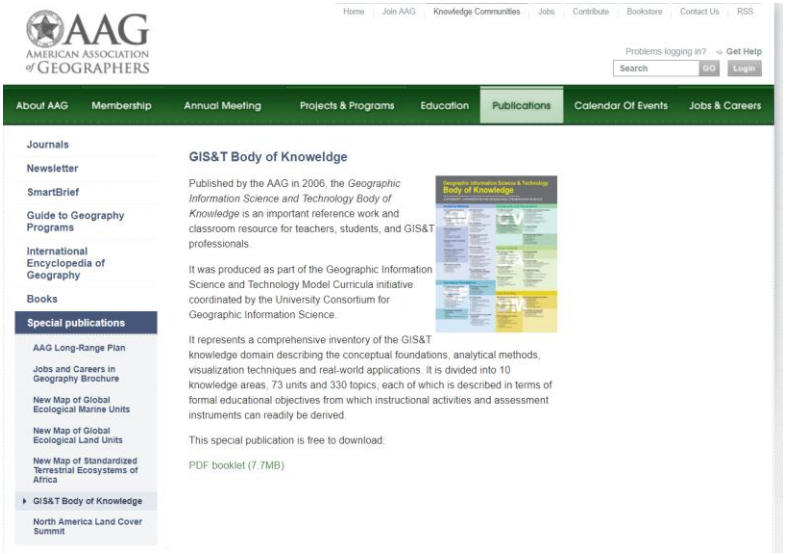
1. Two current students worked as part-time at ARDOT





Geospatial Skillsets

1. Spatial problem solving
2. Spatial analysis
3. Software troubleshooting
4. Statistics
5. Spatial predictive modeling
6. Database management
7. Web GIS
8. Python scripting
9. Cartography/Map design
10. Graphic design
11. Image interpretation
12. GPS tracking



http://www.aag.org/cs/publications/special/gist

Esri Summer Intership

12-WEEK SUMMER INTERNSHIP

Innovation and collaboration

Real work. Real experience.

Work on projects that matter, such as creating an app to speed emergency aid or conducting research for a marketing campaign.

Work hard and play hard

Participate in daily events and programs, including Monday Meetups, Tech Tuesday, What's Next Wednesday, Training Thursdays, and Fun Friday.

Accelerated personal growth

One-on-one mentoring, professional development workshops, and various networking opportunities provide valuable tools to jump-start your career.

Esri Intern Hackathon

Thank you!