Watershed Sciences 4930 & 6920
GEOGRAPHIC INFORMATION SYSTEMS

WEEK ONE – Lecture 1
Introduction to Course, Review of Maps & WebGIS

Joe Wheaton
PURPOSE OF TODAY’S LECTURE:

“Introduction to Course, Review of Maps, & WebGIS”

• Cover Introductions
• Go through syllabus & define goals of course
  – Manage your expectations about course & my expectations of you
  – Answer any questions you have about course logistics
• Review some basics about maps to help you do better on lab assignments and become a more effective communicator with maps
• Intro to WebGIS
TODAY’S PLAN

I. Introductions
II. Syllabus
III. Review of Maps
IV. WebGIS
V. Questions/Summary
WHO IS THIS JOE WHEATON GUY?

- Associate Professor in Watershed Sciences (since 2009)
- Fluvial Geomorphologist

Education:
- Started studying Civil Engineering at Utah State University
- BSc in Hydrology from University of California at Davis
- MS in Hydrologic Sciences from University of California at Davis
- PhD in Geography at University of Southampton (England)

Professional Background:
- Consulting Civil Engineering (California - 4 years)
- Researcher - Fluvial Geomorphology, Ecogeomorphology & Ecohydraulics (since 2000)
- Lecturer (i.e. Assistant Professor) in Physical Geography at Aberystwyth University (Wales - 2 years)
- Research Assistant Professor in Geology at Idaho State University (1 year)
YOUR TA & LAB INSTRUCTORS

• Shannon Belmont – Lab Instructor
  – Be nice to her as she’ll be grading your work!
• Matt Meier – ET-AL/WATS Surveyor & your Lab TA
HOW MANY OF YOU....

• Registered for this course because you were told you had to?
• Registered for this course because you thought it might be interesting and you wanted to learn a valuable skill?
• Have changed your major?
• Have some GIS experience?
• Taken a GIS course before?
• Like maps?
• Want to be here?
WHAT CLASS IS RIGHT FOR YOU?

About the Courses (Syllabi)

This page and its subs-pages act as the syllabi for the following Advanced GIS courses offered through Watershed Sciences:

- WATS 4930/6920 - Advanced GIS & Spatial Analyses (3 credits) - 10 Weeks
- WATS 4931/6921 - GIS Research Projects (2 credits) - 5 Weeks
- WATS 6915 - GIS Fundamentals (1 credit) - 4 Weeks

Which Course(s) Should I Take?

WATS 4930/6920 is what you should take if you want to get a comprehensive understanding of GIS and advanced spatial analyses. GEOG 1800 is a prerequisite for WATS 4930.

WATS 6915 is the first four weeks of WATS 6920. The course is targeted at graduate students who want a crash course or refresher introduction to GIS, but don’t have the time or need for the full 10 week course. No prior GIS experience is necessary, but the pace is rapid. It’s perfect for someone wanting to know how to make some basic maps for their thesis or dissertation, as well as an introduction to building interactive web maps and doing basic spatial analyses.

WATS 4931/6921 is a five week follow up course to WATS 4930/6920, which puts the skills and principles learned in Advanced GIS & Spatial Analyses into practice through student research projects. WATS 4930 is available for capstone credit to Watershed Sciences students. Students will prepare a poster to present at a poster session and a mock manuscript for potential publication.

These courses are based on the content from the former WATS 4930/6920 course (4 credits, last offered in Spring 2011), but have been expanded and redesigned to better meet the diverse needs of both our undergraduates and...
WATS 4930/6920 - 10 INTENSE WEEKS

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WATS 4931/6921 - 5 MORE WEEKS

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WATS 6915 - 4 INTENSE WEEKS

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DEATH-GRI P ON THE OBVIOUS

What your friends said about this course was probably true... it is a lot of work

SURGEON GENERAL WARNING:
These classes are a ton of work! Continuing may cause headaches, shortness of breath, loss of sleep, and increased stress levels. But you just might learn a lot about how to leverage GIS to do useful analyses and produce compelling maps.
WHAT WORKS BEST FOR YOU?

- Stay in what you’re in
- Switch to different version
- Last Day to Add w/o instructor signature: 1/13/17
- Last Day to Add w/ instructor signature (1/30/17)
- Need to drop before 1/30/17 to get tuition refund
- You’re welcome to attend w/o being registered and all labs are online if you just want to learn stuff

See [https://www.usu.edu/registrar/](https://www.usu.edu/registrar/) for key dates
By end of this semester, you’re 8 credits toward 17...

I’m the minor advisor
• WATS 6850 - Geomorphic Change Detection (1 cr)
• WATS 6860 – Partnering with Beaver in Restoration Design (1 cr)

Tuesdays: 4:30-6:00
Thursdays: 4:30-6:00
INTRODUCE YOURSELF (< 10 sec.)

- Just your First Name
- Grad or Undergrad
- Major
- Where You’re From
- Arrange yourself geographically into a human map as you introduce yourself!
TODAY’S PLAN

I.  Introductions

II. Syllabus
   I.  Primary Learning Outcomes
   II. Topics
   III. Labs
   IV. Text & Software
   V.  Course Policies
   VI. Grades

III. Review of Maps

IV. WebGIS

V. Questions/Summary
ALL YOU NEED TO KNOW...

http://gis.joewheaton.org
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Primary Learning Outcomes

1. Understand the fundamental theory of Geographic Information Science behind Geographic Information Systems (GIS), and in so doing build an awareness of what GIS can and cannot be used for.
2. Become proficient in the use of GIS tools to conduct spatial analyses and build maps that are fit-for-purpose and effectively convey the information they are intended to.
3. Build confidence in teaching yourself how to undertake new analyses (unfamiliar to you) using GIS, troubleshooting problems in GIS, and seeking help from the GIS community to solve your problems.
4. Use GIS analyses to address applied problems and/or research questions.
5. Become effective in building maps that can be shared with non-GIS users (e.g. PDF maps and interactive webGIS maps).

The above learning outcomes apply to the courses as follows:

<table>
<thead>
<tr>
<th>Learning Outcome</th>
<th>WATS 4930/6920</th>
<th>WATS 4931/6921</th>
<th>WATS 6915</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - GIS Theory</td>
<td>Core</td>
<td>NA</td>
<td>Core</td>
</tr>
<tr>
<td>2 - Proficiency in Spatial Analyses &amp; Cartography</td>
<td>Core</td>
<td>Partial</td>
<td>Partial</td>
</tr>
<tr>
<td>3 - Self-Teaching &amp; Troubleshooting</td>
<td>Partial</td>
<td>Core</td>
<td>Partial</td>
</tr>
<tr>
<td>4 - Spatial Analysis in Research</td>
<td>NA</td>
<td>Core</td>
<td>NA</td>
</tr>
<tr>
<td>5 - Communicating with GIS</td>
<td>Core</td>
<td>Core</td>
<td>Core</td>
</tr>
</tbody>
</table>

GIS being used in the field, here with a ground-based LiDaR.
I WANT YOU TO:

• Gain confidence in **teaching yourself** techy-stuff
• Become more **tech-savvy**
• Learn a bunch of **tricks** that set you apart from the rest…
• Use that knowledge to **address problems and questions** that interest you
• Discover how to **stay on top** of rapidly evolving fields…
• Act like a **professional**, not a student
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BROAD TOPICS

1. Introduction/Review of GIS
2. Abstracting the World to Digital Maps
3. Working with Data in GIS & Geoprocessing
4. Vector Analyses
5. Raster Analyses
6. GIS Modeling
7. Collecting Your Own Data
Course Topics

These courses are organized into a series of topics, which we will cover in the order listed below. For each topic, you will find downloads of lecture materials, links to reading assignments, links to lab assignments and materials, and additional information. Please note, that:

- topic pages may not be fully populated until we get to that topic in lecture; some lecture topics will appear populated with lectures and content from the previous year's lecture.
- topic pages may be updated even after we've covered a topic as typos and inconsistencies are brought to our attention or as we find new material that may help you better understand a topic
- if you find any problems or something that is confusing, please post a comment or question to the appropriate topic forum.

WATS 4930/6920 Topics

Note that Weeks 1-4 are WATS 6915 Topics.

Course Topics (by week)
Week 01: Introduction/Review of GIS
Week 02: Abstracting the World to Digital Maps
Week 03 & 04: Working with Data in GIS
Week 05: Vector Analyses
Week 06 & 07: Raster Analyses
Week 08 & 09: GIS Modeling
Week 10: Collecting Your Own Data & Course Synthesis
Week 02: Abstracting the World to Digital Maps

Contents
1. Background
   1.1 Introduction to Topic
   1.2 Why we're Covering it
   1.3 Learning Outcomes
2. Lectures
   2.1 Projections & Coordinate Systems
   2.2 Data Types
   2.3 Additional Resources
3. Making Good Maps
   3.1 Data Types
   3.2 Projections & Coordinate Systems
   3.3 Making Good Maps

Key Links and Dates
Lecture Dates:
See calendar
Reading Assignments
See here for Reading Assignments
Lab Assignment(s)
Lab 02 - Making Good Maps from Existing Data & Georeferencing
Discussion
Week 02

Background

Introduction to Topic

The spatial or geographic representation of the world has to be abstracted into specific data types to be used in GIS. GIS is all about data and until you appreciate how that data is represented digitally you can not make effective maps. Data is added into maps in GIS as layers which can be overlayed.

One of the most frustrating and typical complaints of GIS students is that my data just disappeared! It was there when I saved it now it's gone! This is indicated by the notorious red exclamation point next to your layer. The reason for this is simple, the link between your map document and the location the data was previously stored has been broken. Many things can break it, and it is easy to repair.

Another common complaint amongst naive and newbie GIS users is that my data doesn't line up when I overlay it! This is most typically because a projection and coordinate system was either not or not correctly defined.

This week, we will help you better understand how data is represented in GIS and how those layers are projected to make maps.

Why we're Covering it

You cannot make effective use of GIS without an in-depth understanding of the a) choices you have in data types to represent your spatial data, and b) the projections & coordinate systems necessary to locate your spatial data correctly. ArcGIS makes some of these choices so easy for you that you can get yourself in trouble. As such, the next two lectures are designed to expose you to each of these aspects, whereas the lab will put those concepts and theories to practice by having you make some good maps with different data types and then taking some unprojected data and georeferencing it.

Although you SHOULD recall most or all of this if you have taken the prerequisites, my past experience has been that most students are very weak when it comes to understanding these fundamentals and it hinders them from progressing as a GIS user. Review never hurts, and we'll take you further and more in depth then you have hopefully gone before.

Learning Outcomes

These lectures, readings and Labs 02 & 03 all help fulfill primary learning outcomes 1 & 2.

Lectures

Projections & Coordinate Systems

Here we dive into the details of what allows us to overlay data so seemingly seamlessly in GIS: projections and coordinate systems. Without projections and coordinate systems, GIS would not be possible.

- 2012 Tuesday Lecture - PDF w/ 2 slides per page
- 2012 Tuesday Lecture - PDF w/ 6 slides per page
- 2012 Video of Tuesday's Lecture

Data Types

Here we review what you should already know, but will surely have forgotten because it is not so exciting. We'll try and make it interesting...

- 2012 Thursday Lecture - PDF w/ 2 slides per page
- 2012 Thursday Lecture - PDF w/ 6 slides per page
- 2012 Video of Thursday's Lecture

Additional Resources

Below are some very useful references on projections and coordinate systems from ESRI's online help (ArcGIS Resource Center), which you should browse through and make sure you understand.

- How a GIS represents and models geographic information

Data Types

- Three fundamental representations of geographic information layers
Advanced GIS Courses
WATS 4930/6920, 4931/6921, 6915

Class Calendar

These calendars show the course and lecture schedules (updated regularly). They do not show due dates for assignments. See here and the Canvas Calendar for assignment deadlines and instructions.

Contents

1. WATS 4930/6920
2. WATS 4931/6921
3. Joe's Office Hours

Note: You can click on any event to see information on the lecture topic (under description). If you use Google Calendars, you can save it to your own Google Calendar.

WATS 4930/6920

WATS 4930/6920, 6915 Lecture Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thursday, Jan 8</td>
<td>10:30am</td>
<td>Lecture - Intro to Course &amp; Review of Maps</td>
</tr>
<tr>
<td>Tuesday, Jan 13</td>
<td>10:30am</td>
<td>Lecture - Projections &amp; Coordinate Systems</td>
</tr>
<tr>
<td>Thursday, Jan 15</td>
<td></td>
<td>PODCAST - Raster Data, Imagery &amp; Remote Sensing Intro</td>
</tr>
<tr>
<td>Tuesday, Jan 20</td>
<td></td>
<td>PODCAST - Vector Data, Editing &amp; Attributing Data, and Metadata</td>
</tr>
<tr>
<td>Thursday, Jan 22</td>
<td>10:30am</td>
<td>Lecture &amp; Demo - TLS (terrestrial laser scanning) or Ground-Based LIDAR</td>
</tr>
<tr>
<td>Tuesday, Jan 27</td>
<td></td>
<td>PODCAST - Geoprocessing, Model Building &amp; Scripting</td>
</tr>
<tr>
<td>Thursday, Jan 29</td>
<td>10:30am</td>
<td>Lecture - Uncertainty in GIS &amp; Synthesis of GIS Fundamentals</td>
</tr>
</tbody>
</table>
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LABS ARE EVERYTHING!

• You only really learn GIS by doing it

• WATS 4930/6920
  – 10 Guided Labs
  • Due following week

• WATS 6915
  – First 4 Labs
  • Due them at your own pace... BUT
LABS CAN BE DONE ANYWHERE

- Data you need is online
- Instructions are spelt out on lab pages often w/ video tutorials
  - Bring headphones!
- ALWAYS backup to a portable drive
  - As often as you’re comfortable redoing something
- Encourage you to work off your own machine
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Text & Readings

WATS 4931/6921 has no required text. WATS 4930/6920 & WATS 6915 share the same required text book:

Required Text:


Dr. Bolstad has put a lot of resources associated with this book online for free.

Other Readings:

See here for reading assignments.

Recommended Text:

You may think this is ridiculous, but much of what you need to know (and students frequently forget) is covered in this Dr. Suess Book! In fact, the six C's you will be graded on are based on principles outlined in this book that a 3 year old can understand!

SOFTWARE - ArcGIS & Google Maps/Earth

GIS

We will primarily use ESRIS ArcGIS to Desktop (ArcInfo version with all extensions), which is available for your use on all the QL30 and QL306 machines. The Quinney Labs all have ArcGIS 10.1 installed on them. You can and are welcome to complete the labs in ArcGIS 10.0 or 10.1. Although the lab computers can work, we highly recommend you working off your own laptop (if you have one). As students, you are entitled to a free one-year student license of ArcGIS for installation on your personal computer (see here for details). Grad students, if you want a version for your research, it can be acquired for free through USU Software Licensing (https://hs.usu.edu/software/).

The reason we use ArcGIS is because it is the industry standard and the vast majority of employers, universities and agencies you end up working for will most likely be using ArcGIS as well. All of the principles and theory we learn in this course, will apply to any GIS software.

GIS projects are not compatible when working between versions 10.0 and 10.1. When working in 10.1 you will have to “save as” type “Personal” and choose version 10.0 in order to open project in 10.0.

- [ArcGIS Installation Instructions](#)

Open Source Desktop GIS Alternatives to ArcGIS

- MapWindow GIS – Free, open source GIS desktop application and programming component (only runs in Windows).
- Landtort - Free GIS, that focuses on modeling of land surface (i.e. DEMS). Java based GIS runs in Linux, Mac and Windows.
- GRASS GIS – Originally developed by the U.S. Army Corps of Engineers, open source. A complete GIS.
- SAGA GIS – System for Automated Geoscientific Analysis- a GIS hybrid software.
- Quantum GIS – QGIS is an Open Source GIS that runs on Linux, Unix, Mac OS X, and Windows.

Website & WebGIS

You are welcome to use any software, hosting and servers that you wish to use, are knowledgeable about and can support dynamic webGIS applications. However, it is strongly recommended that you use Google Sites for your website and Google Maps for your webGIS applications. We will only provide support for Google Sites and Google Maps in lab. The reason we suggest these is because they are free, easy-to-use, and require no programming experience. Moreover, Google Maps and Google Earth are familiar to most web users to whom your spatial analyses and maps might be targeted. However, there are plenty of viable free and commercial alternatives out there.
DESPITE WHAT IMPRESSION ESRI GIVES

• They are **not** the ONLY game in town
• There are lots of commercial and open source alternatives
• If you have interest in these, you may consider WILD 6900 -

Follow Up Courses
At Utah State University

There are too many courses to list, which employ GIS skills that you might learn in WATS 4930/6920 or an equivalent. However, here are a few follow ups that you might find useful:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Cr</th>
<th>Trm</th>
<th>Notes:</th>
</tr>
</thead>
<tbody>
<tr>
<td>WILD 6900 (section 3)</td>
<td>GIS Programming with Phyton I</td>
<td>1</td>
<td>Sp</td>
<td>This is a great follow up that focuses on geoprocessing and scripting in ArcGIS (1/2 Semester)</td>
</tr>
<tr>
<td>WILD 6900 (section 4)</td>
<td>GIS Programming with Phyton II</td>
<td>1</td>
<td>Sp</td>
<td>This section focuses on Python scripting with OpenSource GIS libraries (1/2 semester)</td>
</tr>
<tr>
<td>WATS 6900</td>
<td>Restoration Monitoring; Geomorphic Change Detection</td>
<td>1</td>
<td>Su</td>
<td>This is an ICRR short course I teach in Park City the week after finals.</td>
</tr>
</tbody>
</table>

http://gis.joewheaton.org/about/alternative-courses
SOFTWARE FOR GIS:

**Full GIS**
- ESRI, Inc.
- QGIS
- Maplnfo
- MapWindow
- LandSerf
- Saga GIS
- Quantum GIS
- Intergraph
- Bentley Systems (MicroStation)
- Autodesk (AutoCAD MAP)
- R -> [http://r-gis.net/](http://r-gis.net/)

**Vector GIS**
- Smallworld Systems
- Manifold
- Maptitude

**Raster GIS**
- ERDAS/Imagine
  - long established leader in remote sensing
  - acquired by Leica Geosystems in 2001
- ER MAPPER
  - aggressive newcomer originating in Australia
- ENVI
  - relative newcomer, radar specialization
  - acquired by Kodak in 2000
- PCI--Geomatica
  - long-term Canadian player
- CARIS
  - newer Canadian entry
- GRASS (Rutgers Univ.)
- IDRISI (Clark Univ)
  - pioneering, university-developed package
• Free! Open-source GIS
• Developed both here at USU and up at ISU
• Like lots… Extendible, Simple
LandSerf is a freely available Geographical Information System (GIS) for the visualisation and analysis of surfaces. Applications include visualisation of landscapes; geomorphological analysis; gaming development; GIS file conversion; map output; archaeological mapping and analysis; surface modelling and many others. It runs on any platform that supports the Java Runtime Environment (Windows, MacOSX, Unix, Linux etc.)

Features:

- Handles multiple surface models - raster digital elevation models (DEM), vector Triangulated Irregular Networks (TIN), contours and metric surface networks (MSN).
- Interactive 3D viewing and 'flythrough' of surfaces on platforms that support OpenGL.
- A range of powerful and interactive visualisation techniques including lighting/shade models, multiple image blending and dynamic graphical query.
- Raster and vector transformation including image rectification and map projection.
- Multi-scale surface processing based on quadratic regression.
- Fractal and polynomial surface generation for modelling and simulation.
- Multi-scale parameter and feature extraction (slope, aspect, curvature etc.).
- Import and export of common raster and vector formats.
- Integration with Garmin GPS receivers.

http://www.soi.city.ac.uk/~jwo/landserf/
QGIS – A VIABLE ALTERNATIVE

• Very similar workflow to ArcGIS
• Open Source & Free
• Extendible
• Easy Python Scripting Interfaces
• Growing library

http://www.qgis.org
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COURSE POLICIES

• Just be respectful of your peers
• Turn off your phones
• No texting in lectures
• Laptops fine for notes/demos... but sit in back
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V. Questions/Summary
Our primary concern is that you engage in achieving the learning objectives for this course. Your grade is a secondary concern to us, and if you are effectively learning your grade should be a moot point. However, we recognize how motivated some of you are by grades and we have attempted to provide clear guidelines (below) to help manage your expectations about what you need to do to earn the grade you want.

**WATS 4930/6920**

Your grade consists of lab-based work, a project and occasional quizzes (see assignments):

- 10 Lab Reports (2%-10% each)  95%
- Occasional Quizzes (Some in class and some on Canvas)  5%

**WATS 4931/6921**

Your grade consists entirely of project-based work (see Project Components):

- Proposal, 3 Vignettes and Peer Review  15%
- Poster Presentation  15%
- Final Project Manuscript  70%

**WATS 6915**

Your grade consists of lab-based work (see assignments):

- 4 Lab Reports (2%-10% each)  100%

<table>
<thead>
<tr>
<th>Grade</th>
<th>% of Available Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+</td>
<td>&gt; 97%</td>
</tr>
<tr>
<td>A</td>
<td>&lt; 97% to 93%</td>
</tr>
<tr>
<td>A-</td>
<td>&lt; 93% to 90%</td>
</tr>
<tr>
<td>B+</td>
<td>&lt; 90% to 87%</td>
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<td>B</td>
<td>&lt; 87% to 83%</td>
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<tr>
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<td>&lt; 83% to 80%</td>
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<tr>
<td>C+</td>
<td>&lt; 80% to 77%</td>
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<tr>
<td>C</td>
<td>&lt; 77% to 73%</td>
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<tr>
<td>C-</td>
<td>&lt; 73% to 70%</td>
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<tr>
<td>D+</td>
<td>&lt; 70% to 67%</td>
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<td>D</td>
<td>&lt; 67% to 63%</td>
</tr>
<tr>
<td>D-</td>
<td>&lt; 63% to 60%</td>
</tr>
<tr>
<td>F</td>
<td>&lt; 60%</td>
</tr>
</tbody>
</table>
TODAY’S PLAN

I. Introductions
II. Syllabus
III. Review of Maps
IV. WebGIS
V. Questions/Summary
EVERYTHING YOU NEED TO KNOW TO GET AN A

- A highly recommended text… $8.99
- If for nothing else, impress your folks
HE CAN’T BE SERIOUS... THIS IS A SENIOR / GRADUATE LEVEL CLASS!

• I am...

• Maps are the ultimate end product of GIS and GIS analyses

• GIS makes it easy to make maps

• Making good and effective maps is an art that is being lost (i.e. cartography)

• You intuitively know this... but you probably forgot
I'm the Cat in the Hat and I'm happy to say there's a map on my lap—let's get on our way!

We will travel the world. See the whole U.S.A. And still be back home by the end of the day!
Maps are drawings that help to find out where you are and get where you’re going—no matter how far.

When mapmakers make maps, they must first decide who will be using the map and what it needs to do.

Cartographer
Car-tog-ra-pher is just a more formal name for a mapmaker, but both their jobs are the same.
ALL MAPS HAVE A PURPOSE

• What point is the map trying to convey?
• Context helps convey that point

<table>
<thead>
<tr>
<th>The Map</th>
<th>Example Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location Map</td>
<td>Show the location of something within a broader geographic context of common knowledge to audience (e.g. state, country, world)</td>
</tr>
<tr>
<td>Geology Map</td>
<td>Show spatial distribution of underlying geology</td>
</tr>
<tr>
<td>Habitat Map</td>
<td>Show spatial distribution of different habitat types</td>
</tr>
<tr>
<td>Topographic Map</td>
<td>Show spatial distribution of elevations</td>
</tr>
<tr>
<td>Watershed Map</td>
<td>Show delineated boundary of watershed</td>
</tr>
<tr>
<td>Election Map</td>
<td>Show which areas voted for which candidate</td>
</tr>
<tr>
<td>Grading Plan</td>
<td>Shows an engineering design for grading and drainage (i.e. how to manipulate topography)</td>
</tr>
</tbody>
</table>
A GEOLOGY MAP: JUST GEOLOGY...
A GEOLOGY MAP: MORE VECTOR DATA

A Portion of the Geologic Map of the Logan 30' x 60' Quadrangle

Projection: UTM Zone 12
Units: Meters
Datum: NAD 1927
Spheroid: Clarke 1866

Kilometers

Data from Utah Geological Survey 2006
Miscellaneous Publication MP06-8 DM
Mapping by J.H. Dover

Data from Utah Geological Survey: http://geology.utah.gov/
The map of the earth that we use most of all is a globe. Like the earth, it is round as a ball.

Peel the skin off an orange and lay it out flat. A flat map of the earth would look something like that.

**LONGITUDE:**
These are lon-gi-tude lines, which run up and run down.

**LATITUDE:**
Lat-i-tude lines go around and around.
Now, if maps were the size of the places they show, mapmakers would run out of paper, and so . . .

A chart called a scale makes maps easy to use, shrinking miles into inches on each map that you choose.
You can make a map of far places you roam, or a map—called a plan—of your very own home.

We used this scale—one inch equals three feet. It helped us do something we both think is neat! We drew our whole room so it fits on . . .

. . . one sheet!
There are four main directions.
All maps have got ’em.
North is on top.
South down at the bottom.

If you look to the right,
that is where East will be.
Look to the left—and it’s West that you see.

To remember all four,
here is one easy way:

“Never Eat Soggy Wheat!”
is what I always say.

I have here an atlas.
Come on, take a look!
You will find lots of maps
and they’re all in this book.
Sometimes maps use pictures to show where things are.

A capital city is marked with a star.

A tent shows a campsite.

Tracks show where a train is.

To get to the airport, just find where a plane is.

A chart called a legend, if you look carefully, will list and explain each picture you see.
SYMBOLOGY – COLORS & HATCHES

Some maps use colors to tell you a lot.
I used blue where it’s cold and red where it’s hot.

I made deserts light brown and jungles bright green.

The legend will show you what these colors mean.
SYMBOLS, LINE-TYPES, ABSTRACTIONS

Marine charts help boaters. These maps let them know if a rock, reef, or sandbar is hiding below.

When you visit a city where you've never been, a city map helps you know where to begin.

Here is a map we both carry around. It shows where the subway runs under the ground!
TOPOGRAPHIC MAPS

Top-o-graph-i-cal maps are the kind hikers like. They use them to choose which direction to hike.

They show where the land rises hilly and steep or goes down into valleys all rocky and deep.

It's a big world we live in. Here's one way to hold it. Pick up a map and then simply—unfold it!
SYMBOLIC REPRESENTATION

Dot maps, like this one, are covered with dots. Some have a few dots, but some others have lots.

Each dot stands for something. On this map you see, each dot stands for one Frizzle-Frazzled Frazee. (Most Frazees live up north, where the haircuts are free.)
ROUTE ANALYSES (MIN. COST)

When you look at a map, it’s important to see there is more than one way from point A to point B.

Firefighters use maps when they go fight a fire. The short way would take them down Voogel to Vyer.

But traffic on Vyer can be a disaster.

So they choose a long way that’s also much faster.
MEASUREMENT QUERIES

But in order to go from Fazode to Fahzing on the fifteenth of May for the big Fahzing Sing—

When you want to go from Fazode to Fazend, you can measure the miles, for the road does not bend.

the road twists and turns, so . . .
THE EVER RELIABLE STRING TECHNIQUE

... first cut off some string.

Put it down on the road all the way to Fahzing.

Then take out your ruler and measure the string.

The scale on this map helps you see that it’s far.
One inch equals ten miles, so...

...you should take the car!
GRID REFERENCES & COORDINATES

Use this trick to read maps. You’ll be glad that you did. Some are covered with lines. This is known as a grid.

There are letters on top. Numbers run down the side. Want to find where you are? Let the grid be your guide.

Trace a line down from A. Look across at line four. The lines cross at A4—at your very own door!

We are having a party. We’re waiting for you. Take a look at the grid. There’s our house at E2.
Here is a map that I just got today. It's a puzzle map showing the whole U.S.A.

Puzzle maps come in pieces, and here's the best part—you can put them together, then take them apart.

Here is a question we can't wait to ask ya. What state is the largest? It's this one—Alaska!

Now, which of the states do you think is the smallest? You're right! It's Rhode Island—the smallest of all-est!
Here's a game that we play, so feel free to play too.

What does each of the fifty states look like to you?

Michigan looks like a scarf and a mitten.

Louisiana looks like a chair you could sit in.
Isn't That Nice?

You will have great adventures your whole life, and so I give you these maps. Oh, the places you'll go!

You may travel the world, but no matter how far, with a map on your lap you will know where you are.

You can always use maps. They will help you in knowing where you have been and just where . . .

. . . you are going!
Glossary

**Capital**: A city where the government of a state or country is located.

**Cartographer**: A person who makes maps.

**Equator**: An imaginary line that circles the middle of the earth between the North and South Poles.

**Globe**: A representation of the earth in the shape of a ball.

**Grid**: A pattern of lines on a map usually running north-south and east-west that is used for giving positions.

**Latitude**: Imaginary lines on the earth that run east and west, parallel to the equator.

**Legend**: The part of a map that lists and explains the symbols, colors, and scale used for the map.

**Longitude**: Imaginary lines on the earth that run north and south and meet at the poles.

**Map**: A flat representation of the earth or a part of the earth that shows the relative position of places.

**Scale**: The relationship between the actual size of an area and its size on a map.

**Symbol**: A sign or drawing that stands for something else.

**Topographical map**: A map that shows the shape and changing elevation of the land’s surface.
WHY SHOULD YOU CARE?

• Making bad maps is easy with GIS!
• You need to know how to speak the language (i.e. nomenclature and terminology matters)
• You need to understand the spatial analyses you perform
• We’re going to grade you based on the Cat and the Hat and the 6 C’s
TOO MUCH OVERLAY....

GIS Data from: http://gis.utah.gov/
THE 6 C’s TO EARN BETTER THAN A C

1. Colorful (but not cluttered)
2. Creative (but not confusing)
3. Consistent
4. Context (location, coordinates, scale, orientation, setting)
5. Convincing (fit for purpose)
6. CORRECT
ABOUT BEING CORRECT...

• Although you have an ethical responsibility...

On the power that maps hold in shaping our realities

"It's a bit like another phrase, that history is written by the winners, by the victors. And it's the same with mapmakers. If you have the power to commission a map or make your own map, you're going to make it, you know, reflect your world and reflect your views.

Simon Garfield is a journalist and the best-selling author of *Just My Type.*

• Good mapmakers (you will be) convey & emphasize what you want to -> This is Cartography
On the impact of the digital revolution

"Well, I fall into two camps here. I use, you know, my maps on my phone. And it's far easier to put my GPS on than to have to consult a map. But gosh, I mean, do we lose a lot. We lose the beauty of maps; we lose the romance of maps; we lose that terrible feeling that we'll never be able to fold up a map again.

"And I think the other thing, you know, we lose, is a sense of how big the world is. Because now we look at our map, there's a real sense of, 'Get me to where I want to go.' Now you get the feeling, actually, 'It's all about me' ... It's a terribly egocentric way of looking at the world. So I think the view of where we are in the world, in the history of the world, is changing. And I think in a way it's one of the biggest, if not the biggest impacts of the digital and technological revolution — is how we see ourselves in the world."

What is the role of the mapmaker with egocentric maps (i.e. webGIS)?
STILL A FEW CARTOGRAPHERS OUT THERE

Dave Imus

The best map of the U.S. you'll ever see!

By Jonathan Anker
updated 11:15 AM EST, Thu February 16, 2012

NEED TO KNOW
- Wins 'Best in Show' at major map competition
- Made by one man, when most maps made by corporations
- Creator spent 6,000 hours on it working out of his farmhouse

The Greatest Paper Map of the United States You’ll Ever See

Made by one guy in Oregon.

By Seth Stevenson

American mapmaking's most prestigious honor is the “Best of Show” award at the annual competition of the Cartography and Geographic Information Society. The five most recent winners were all maps designed by huge, well-known institutions.
BEING IN A WATERSHED SCIENCE DEPT.

THE UNITED (WATERSHED) STATES OF AMERICA

What if Powell’s proposal had succeeded? What if all American states were defined by watershed boundary? It might look like this...

Before 1869, no one had successfully navigated the mighty Colorado River. But on August 13, 1869 John Wesley Powell, civil war veteran and geologist, and a small support crew stood at the confluence of the Virgin and Colorado Rivers after having done just that. Powell went on to float the Colorado again in 1872, and recounted the events of these adventures in his book later known simply as Canyons of the Colorado. Lesser known, but perhaps more important, Powell proposed in his 1879 Report on the Lands of the Arid Regions of the United States that the boundaries of the emerging western states be formed around watershed, rather than political boundary. This idea rested on the observation that because of an arid climate, a statewide organization decided by any other factor would lead to water conflict down the road.

But the railroad lobby, buoyed by Cyrus Thomas and his theory that “rain follows the plough”, disagreed with Powell. This now discredited theory suggested that as new land was brought into agriculture, moisture from the soil was exposed to the sky resulting in increased precipitation. Since railroad companies owned substantial tracts of lands that would have been difficult – if not impossible – to capitalize on if Powell’s proposal had taken root, they used Thomas’ theory to successfully sway congressional opinion to accept state boundaries as we see them today.
TODAY’S PLAN

I. Introductions
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V. Questions/Summary
Web GIS QUESTIONS

• What is it?
• What’s out there?
• What’s it used for?
• How does it differ from desktop GIS?
• How is it deployed?
• How could you deploy it?
WHAT IS IT?

• Return to our definition of GIS…. Just implemented and delivered over the web
  - Typically simpler user interface then desktop GIS
  - Typically more complicated backbone...
  - Often free for users

“A GIS is a computer-based system to aid in the collection, maintenance, storage, analysis, output and distribution of spatial data and information.”
WHAT’S OUT THERE?

• The common map/directions sites
  – Google Maps
  – Bing Maps (Live)
  – Mapquest

• Data viewers

• Data distribution centers

• Personal data repositories

• Project sites…

• Commercial Sites

• Web mapping services (WMS)
RANGE FROM SIMPLE....

• Soil Web via Gmaps

http://casoilresource.lawr.ucdavis.edu/soilweb_gmap/
TO COMPLEX...

1. WHERE
Order by Interactive Map
Using the map in the center panel to navigate to your area of interest. Use the Select Area button on the map to start the selector mode. Select an area for your order by pressing the left mouse and dragging the mouse to draw a rectangle. Press the Finish Area button on the map to complete the area selection. The coordinates of the rectangle will be moved to the YOUR ORDER panel on the right. Use the Accept Area button to accept the coordinates and move to the next step.

WHERE
If you wish to change the method for selecting the order area, click HERE.

Order by Interactive Map

YOUR ORDER
Order Area (Where): Cache County, Utah
Order Map Layers (What): None
Order Format (How): None
Order Projection (How): None
Order Inclusion (How): None
Order Delivery Method (How): None
Order Recipient (Who):
MAPQUEST

• One of the first... lost its market share

http://www.mapquest.com/
BING.COM/ MAPS (FORMERLY LIVE MAPS -> Microsoft)

- Microsoft had to do something... to fight back Google
BING.COM - COOL FEATURES

- Built in 3D Viewer: Virtual Earth (w/ plugin; analogous to Google Earth)
- Birds Eye View
WHAT’S IT USED FOR?

• Just directions?
• A better question is: what is it not used for?

Examples of WebGIS at Work

Backed by ESRI ArcGIS Server:
  • Renewable Energy Atlas of Vermont - See article from ESRI Observer

Backed by ESRI’s ArcGIS Online
  • Browse a plethora of public maps at ArcGIS Online’s Gallery.
  • Oregon Watershed Enhancement Board Investment Tracker

Backed by GoogleMaps
  • OpenTopography Portal
  • Housing Maps.com
  • 10 Great Journeys in a Car
  • 2010 Tour de France Route - with interactive profiles
  • 2008 Tour de France - Street View (see video)

Backed by Bing Maps
  • Gas Prices
  • 2010 Tour de France Route - Different features like Bird’s Eye view
  • Photosynth

http://gis.joewheaton.org/topics/introgis#TOC-Examples-of-WebGIS-at-Work
Web GIS QUESTIONS

• What is it?
• What’s out there?
• What’s it used for?
• **How does it differ from desktop GIS?**
• How is it deployed?
• How could you deploy it?
HOW DOES IT DIFFER FROM DESKTOP GIS?

• You can answer this...
• What of the ArcGIS family of products is WebGIS?
ArcGIS EXPLORER ONLINE

- Improved dramatically...
ArcGIS - My Map

1. Choose an area.
   Pan and zoom the map to an area or search by its name or address.

2. Decide what to show.
   Choose a Basemap then Add layers on top of it.

3. Add more to your map.
   Create an editable layer to draw features on the map.
   Display descriptive text, images, and charts for map features in a pop-up.

4. Save and share your map.
   Give your map a name and description then share it with other people.
WHAT IS A WEB MAP?

What is a web map?

Maps are visual presentations of useful information that communicate ideas and designs. They provide an effective metaphor for modeling and organizing geographic information as a series of data layers. For example, you could find a local street map that highlights a new bike path or a map depicting the age distribution of populations across parts of Southern California.

A web map is an interactive display of geographic information that you can use to answer questions. For example, you may find or create a map like the one referenced below that addresses the question, How many people in the United States live within a reasonable walk or drive to a supermarket? This map has layers showing which neighborhoods are within a 10-minute drive or 1-mile walk to a supermarket, and for context, the map has a topographic basemap that includes cities, roads, and buildings overlaid on land cover and shaded relief imagery.

To help answer your questions and make what you see meaningful, web maps include descriptions, legends, and informational pop-up windows as well as tools to pick different basemaps, pan and zoom, find places, and add layers. Once you've created a map, you can share it as a link or through the website, embed it in other sites, and publish your own web mapping application.

Some web maps contain a collection of annotated slides that show a specific view into the map with associated text and graphics. This type of web map is known as a presentation. The slides help communicate the importance of the map's content such as its basemap, features, and layers. You play a presentation with control buttons to start, go forward, go back, end, and so on. Presentations are created in ArcGIS Explorer Online as part of the map and can be viewed from other clients including the ArcGIS.com map viewer and ArcGIS for iOS. Below is an embedded presentation of places to visit in San Diego.
Web GIS QUESTIONS

• What is it?
• What’s out there?
• What’s it used for?
• How does it differ from desktop GIS?
• **How is it deployed?**
• How could you deploy it?
HOW IS IT DEPLOYED

• What platforms is WebGIS consumed in?
  – Web applications (i.e. browsers)
  – Web services (i.e. desktop GIS)
  – Mobile applications (i.e. your smart phone)

• What software does a user need to use it?

• How is it deployed at the back end?
  – WMS Web Map Services (for user interactivity)
    • Allows creation of web maps that can call up data from multiple servers and sources
  – GIS server(s) for hosting GIS data
  – Other services for doing heavy lifting (number crunching)
YOU SHOULD BE AWARE OF ARCGIS SERVER

What is a service?
A service is a representation of a GIS resource that a server is making available to other computers on a network. This network can be a local one, such as your company's computer system, or it can be a broader network, such as the Internet. The computers on the network that access your service are called clients. When you use ArcGIS Server to publish a service, you are giving clients access to a GIS resource. In many cases, clients can do the same things with the service that they could if a copy of the resource were on their own computer.

Using ArcGIS Server
As you use ArcGIS Server, you will follow a workflow of three steps to make your geographic information available through the server:

- **Author** the GIS resource using ArcGIS Desktop.
- **Publish** the resource as a service using ArcGIS Server.
- **Use** the service through a client application.

The arrows and components can vary, but on the outside... there is always the client... blind to the details of the black box behind their browser:

Web GIS QUESTIONS

• What is it?
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TODAY’S PLAN

I. Introductions
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V. Announcements / Summary / Questions

3 Bits of Housekeeping You’ll Care About
READING FOR TUESDAY

- Read Chapter Three of Bolstad: "Map Projections & Coordinate Systems"

1st Reading Assignment - Projections & Coordinate Systems

Finish reading the following before Tuesday's Lecture
- Read Chapter Three (Map Projections & Coordinate Systems) of Bolstad (2016)
- Can you answer the study questions 3.4-3.12 on pp 141-142?
- You may also have a look at the following useful ESRI Help Topics:
  - Georeferencing and Coordinate Systems
  - What are map projections?
  - Projection Basics for the GIS Professional
  - Identifying an unknown coordinate system
THURSDAY’S HOMEWORK:

This assignment does not count toward the final grade.

1st Homework Assignment

Before class on Thursday, January 14th, please do all of the following:

1. Browse & become familiar with organization of Course Website
2. Confirm that you have Canvas access - You’ll need this for submitting assignments
3. If you do not already have an ESRI Global Account, go to ESRI Support and follow the Create New ESRI Account link. ALSO, log into ArcGIS.com and register your global ESRI account for access to ArcGIS Online (see here if confused) - You’ll need this for posting to ESRI’s discussion forums, subscribing to alerts, and making online maps with ArcGIS Online.
4. Install ArcGIS on your own machine (if you have one) - you can request free copies of ArcGIS @http://www.esri.com/EducationEdition to (see here for installation instructions)
5. If you do not already have a Google Gmail account (your Aggiemail account should work), create one. - You’ll need this for creating your Google Sites website and making Google Maps.
6. Don’t forget to take the first quiz! Quiz 1 - Good Map, Bad Map
7. Make sure you have a secure means of remembering all these different usernames and passwords (e.g. LastPass). For this class alone, you will have need to regularly use the following credentials:
   - USU Banner strong ID & Password for Canvas & Quinney Lab (i.e. your A number and password)
   - Gmail (if not using AggieMail)
   - Esri Support and ArcGIS.com

Sorry for the long list of instructions.... But you better get used to it!
YOUR QUIZ FOR THURSDAY – ON CANVAS

• Find an example of a good map and a bad map and explain why in terms of the 6 C’s

• Post these two examples as URL’s or images and your justification

• PURPOSE:
  - Develop a critical eye about other’s maps, so that you can make your own maps better
  - Familiarize you with grading criteria
NEXT LECTURES - IN PERSON

On Thursday:
• Wrap-up WebGIS

On Tuesday:
• Projections & Coordinate Systems

Image from Corbis ©: http://pro.corbis.com/images/
THIS WEEK’S LAB

Introduction

• Lab 01 – ArcGIS Refresher & Intro to WebGIS
  - You’ll make a very basic map in ArcGIS just to get you used to working in ArcGIS again ;)
  - You will create a website that will be the repository for ALL of your lab assignments
  - You will publish your map and build an interactive google map on your website...

Everything you need:
http://gis.joewheaton.org/assignments/labs/lab01
TODAY’S SUMMARY

• Nice to meet you…
• Syllabus is on http://gis.joewheaton.org
• Cat in the Hat and excellent reference
• 6’ C’s to avoid a C
REMEMBER, I WANT YOU TO:

- Gain confidence in teaching 
  yourself techy-stuff
- Become more tech-savvy
- Learn a bunch of tricks that set you apart from the rest…
- Use that knowledge to address problems and questions that interest you
- Discover how to stay on top of rapidly evolving fields…
- Act like a professional, not a student
QUESTIONS??

• Post other questions to our Class Discussion on Canvas