
Watershed Sciences 4930 & 6920

GEOGRAPHIC INFORMATION SYSTEMS

WEEK ONE – Lecture 2

GIS Review & Intro to WebGIS

Joe Wheaton



WATS 4930

TODAY'S PLAN...

- I. **Housekeeping**
- II. Review of GIS
- III. Alternatives to ArcGIS
- IV. WebGIS
- V. Summary



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HOUSEKEEPING: HOMEWORK:

GIS Classroom

- Home
- About the Courses (Syllabi)
 - Grades
 - Instructors
 - Primary Learning Outcomes
 - Software
- Course Topics
- Assignments
 - Labs
 - Project (4931/6921)
 - Reading Assignments
- Class Announcements
- Class Calendar
- Great Maps!
- Class Forum
- GIS Class LibGuide
- Help
- © 2011 - Disclaimer & Copyright

Utah State University Links

- Canvas (Submit Assignments)
- Department of Watershed Sciences
- Banner Access
- Current Students
- Prospective Students
- Open Course Ware

Assignments > Reading Assignments >

Required Reading & Tasks for January 12th

posted Jan 6, 2012 6:54 AM by Joe Wheaton [updated Jan 6, 2012 6:55 AM]

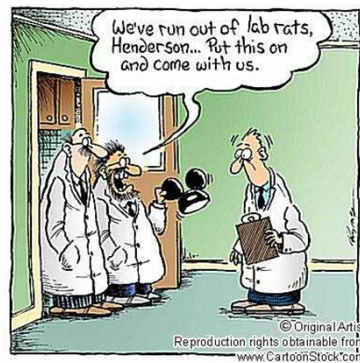
All of the following nine tasks are considered your homework and should be completed by **Thursday, January 12, 2011** (before lecture):

1. Read Chapter One of [Bolstad \(2005\)](#)
2. Browse & become familiar with organization of [Course Website](#)
3. Confirm that you have [Canvas](#) access - You'll need this for submitting assignments
4. Register as a user for the [Class Forum](#) - You'll need this for posting and answering questions
5. [Register as a new user for the Quinney Lab](#) - You'll need this for access to lab computers
6. 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.
7. Install [ArcGIS](#) on your own machine (if you have one)
8. If you do not already have a Google [Gmail account](#) (not your Aggimail account), create one. - You'll need this for creating your Google Sites website and making Google Maps.
9. 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:
 - o USU Banner strong ID & Password for [Canvas](#) & [Banner](#)
 - o Quinney Lab - (uses your A number as username, but has a different password)
 - o [Class Forum](#)
 - o [Gmail](#)
 - o [Esri Support](#) and [ArcGIS.com](#)

HOUSEKEEPING: 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 to your website...



Everything you need:

<http://gis.joewheaton.org/assignments/labs/lab01>

HOUSEKEEPING: OTHER QUESTIONS??

- Post other questions to our Class Forum at <http://forum.bluezone.usu.edu/gis>

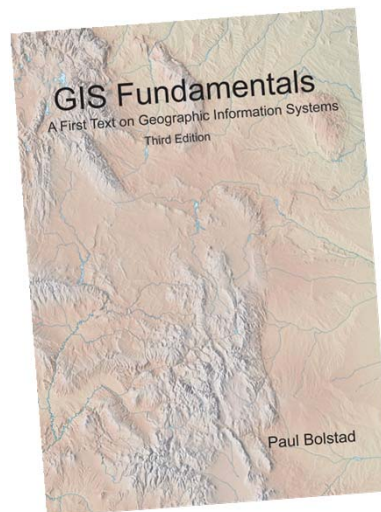
The screenshot shows the Utah State University GIS Classroom website on the left and the phpBB discussion board on the right. The website has a navigation menu with links to Home, About the Courses (Syllabi), Grades, Instructors, Primary Learning Outcomes, Software, Course Topics, Assignments, Labs, Project (4931/6921), Reading Assignments, Class Announcements, Class Calendar, Great Maps!, Class Forum, GIS Class LibGuide, and Help. The phpBB board is titled "GIS - WATS 4930 & 6920 Class Discussion Boards" and lists various topics with their respective counts and last posts.

Topic	Topics	Posts	Last Post
General Logistics & Questions	16	38	by Underdog on Thu Jan 26, 2012 9:47 pm
Lab 01 - ArcGIS Desktop & Intro to WATCS	12	45	by Underdog on Thu Jan 26, 2012 9:47 pm
Lab 02 - Transformations & Projections	0	0	No posts
Lab 03 - Reproducing Maps - Geodetic Maps	16	47	by Underdog on Thu Jan 26, 2012 9:47 pm
Lab 04 - Digitizing, Editing & Sharing Data	16	50	by Underdog on Thu Jan 26, 2012 9:47 pm
Lab 05 - Vector Analysis	3	24	by Underdog on Thu Jan 26, 2012 9:47 pm
Lab 06 - Working with DEMs	22	72	by Underdog on Thu Jan 26, 2012 9:47 pm
Lab 07 - Building DEMs	3	6	by Underdog on Thu Jan 26, 2012 9:47 pm
Lab 08 - Morphometric Analysis	7	20	by Underdog on Thu Jan 26, 2012 9:47 pm
Lab 09 - Georeferencing	20	78	by Underdog on Thu Jan 26, 2012 9:47 pm
Lab 10 - Raster & Georeferencing	1	2	by Underdog on Thu Jan 26, 2012 9:47 pm
Lab 11 - Georeferencing with your Projects	2	4	by Underdog on Thu Jan 26, 2012 9:47 pm

WHAT DID BOLSTAD HAVE TO SAY?

You Read Chapter One of Bolstad: "An Introduction to GIS"

- I. Introduction
 - I. What is GIS?
 - II. GIS in Action
- II. GIS Components
- III. GIS in Organizations
 - I. Structure of Book



TODAY'S PLAN...

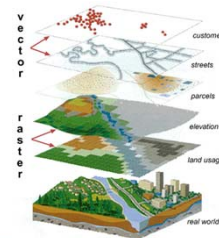
- I. Housekeeping
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GIS-WHAT IS IT?

Bolstad (2009) says:

- "A GIS is a tool for making and using spatial information. Among the many different definitions of GIS, we choose:
 - *A GIS is a computer-based system to aid in the collection, maintenance, storage, analysis, output and distribution of spatial data and information.*
- GIS--what's in the S?
 - Systems: the technology
 - Science: the concepts and theory
 - Studies: the societal context



MATCH VERBS FROM DEFINITION TO OUR LEARNING OUTCOMES & SYLLABUS

A GIS is a computer-based system to aid in the **collection**, maintenance, storage, analysis, output and distribution of spatial data and information."

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 your-self 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)

Course Topics (by week)

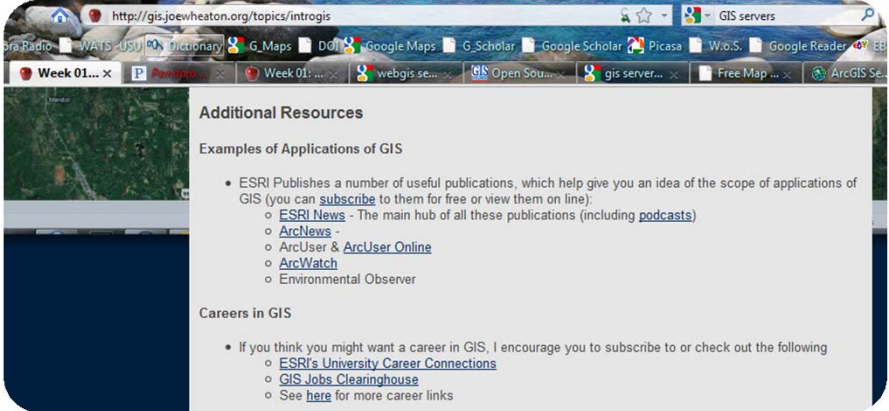
- Research Topics
- Week 01: Introduction/Review of GIS
 - Week 02: Abstracting the World to Digital Maps
 - Week 03 & 04: Working with Data in GIS
 - Week 05: Uncertainty & Vector Analyses
 - Week 06 & 07: Raster Analyses
 - Week 08: GIS Modeling
 - Week 09 & 10: **Collecting Your Own Data**

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EXAMPLES OF APPLIED GIS

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

WANT A LITTLE MORE...



Additional Resources

Examples of Applications of GIS

- ESRI Publishes a number of useful publications, which help give you an idea of the scope of applications of GIS (you can [subscribe](#) to them for free or view them on line):
 - [ESRI News](#) - The main hub of all these publications (including [podcasts](#))
 - [ArcNews](#) -
 - [ArcUser](#) & [ArcUser Online](#)
 - [ArcWatch](#)
 - Environmental Observer

Careers in GIS

- If you think you might want a career in GIS, I encourage you to subscribe to or check out the following
 - [ESRI's University Career Connections](#)
 - [GIS Jobs Clearinghouse](#)
 - See [here](#) for more career links

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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:

Course	Title	Cr	Trm	Notes:
CEE 2240	Engineering Surveying	3	Sp, Su	Fundamentals of geomatics & tachometric surveying.
WILD 6900 (section 3)	GIS Programming with Python I	1	Sp	This is a great follow up that focuses on geoprocessing and scripting in ArcGIS (1/2 Semester)
WILD 6900 (section 4)	GIS Programming with Python II	1	Sp	This section focuses on Python scripting with OpenSource GIS libraries (1/2 semester)
WATS 6900	Restoration Monitoring; Geomorphic Change Detection	1	Su	This is an ICRRR short course I teach in Park City the week after finals.



<http://gis.joewheaton.org/about/alternative-courses>

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SOFTWARE FOR GIS:

Full GIS

- ESRI, Inc.
- MapInfo
- MapWindow
- LandSerf
- Saga GIS
- Quantum GIS
- Intergraph
- Bentley Systems (MicroStation)
- Autodesk (AutoCAD MAP)

Vector GIS

- Smallworld Systems
Manifold
- Mapitude

Raster GIS

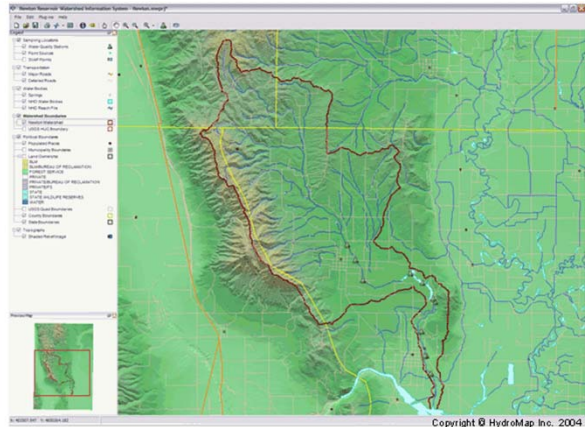
- ERDAS/Imagine
 - long established leader in remote sensing
 - acquired by Leica Geosystems in 2001
- ER MAPPER
 - aggressive newcomer originating in Australia
- ENVI,
 - relative newcomer, radar specialization
 - acquired by Kodak in 2000
- PCI--Geomatica
 - long-term Canadian player
- CARIS
 - newer Canadian entry
- GRASS (Rutgers Univ.)
- IDRSI (Clark Univ)
 - pioneering, university-developed package



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MAPWINDOW

- Free! Open-source GIS
- Developed both here at USU and up at ISU
- Like lots...
Extendible,
Simple



MapWindow
GIS



<http://www.mapwindow.org/>

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LandSerf



landserf.org | [Image gallery](#) | [Discussion forum](#) | [Download latest version](#) | [Jo Wood's Homepage](#)

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 (DEMs), vector Triangulated Irregular Networks (TINs), contours and metric surface networks (MSNs).
- 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/>



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SOME MORE REFERENCES...



The screenshot shows a web page titled "GIS Classroom" with a navigation menu on the left. The menu includes links to Home, About the Courses (Syllabi), Grades, Instructors, Primary Learning Outcomes, Software, Course Topics, Assignments, Labs, Project (4931/6921), Reading Assignments, Class Announcements, Class Calendar, Great Maps!, Class Forum, GIS Class LibGuide, Help, and a copyright notice for 2011. The main content area is titled "Software" and "GIS". It features a box image of the ArcGIS software and text explaining that the course will primarily use ESRI's ArcGIS 10 Desktop (ArcInfo version with all extensions), which is available for free one-year student licenses. It also mentions that the reason for using ArcGIS is its industry standard status. Below this, there is a section titled "Open Source Desktop GIS Alternatives to ArcGIS" with a bulleted list of alternatives: MapWindow GIS, Landserf, GRASS GIS, SAGA GIS, and Quantum GIS.

GIS Classroom

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- Help
- © 2011 - Disclaimer & Copyright

Utah State University Links

- Canvas (Submit Assignments)
- Department of Watershed Sciences
- Banner Access
- Current Students

About the Courses (Syllabi) > Software

GIS

We will primarily use [ESRI's ArcGIS 10 Desktop](#) (ArcInfo version with all extensions), which is available for your use on all the QL304 and QL306 machines. As students taking this course, 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 through USU Software Licensing (<https://hd.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 may 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.

Open Source Desktop GIS Alternatives to ArcGIS

- [MapWindow GIS](#) - Free, open source GIS desktop application and programming component (only runs in Windows).
- [Landserf](#) - 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 hybrid GIS software.
- [Quantum GIS](#) - QGIS is an Open Source GIS that runs on Linux, Unix, Mac OS X, and Windows.

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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?

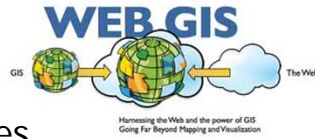
WHAT IS IT?

- Return to our definition of GIS.... Just implemented and delivered over the web
 - Typically simpler user interface than 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."



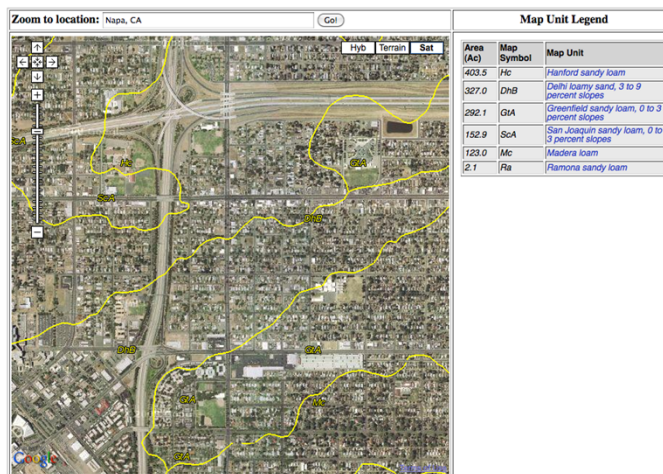
WHAT'S OUT THERE?



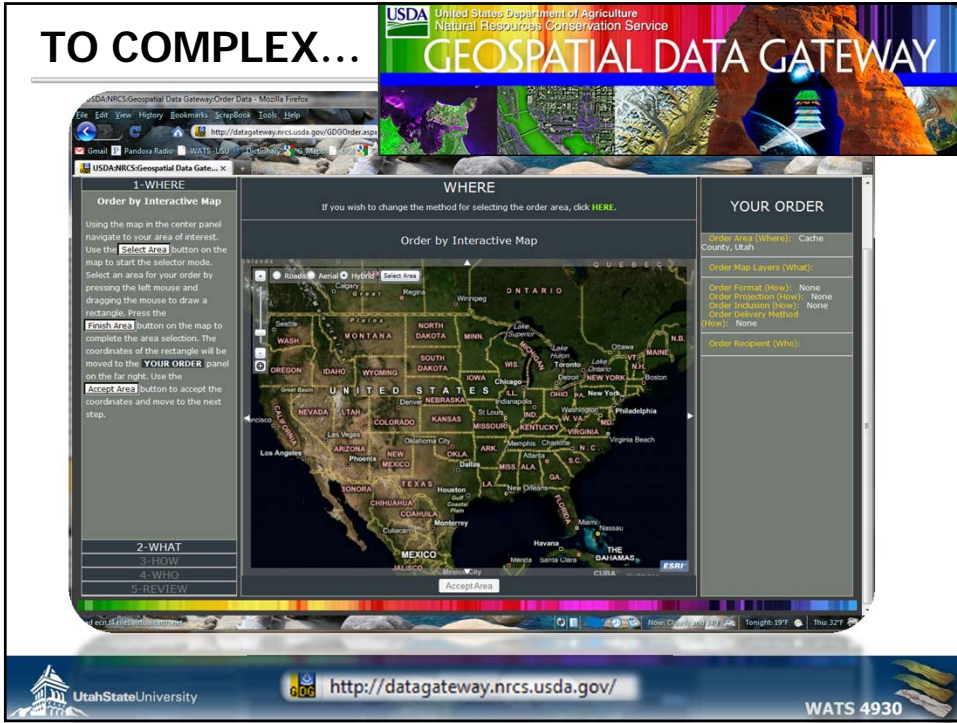
- The common map/directions sites
 - Google Maps
 - Bing Maps (Live)
 - Mapquest
- Data viewers
- Data distribution centers
- Personal data repositories
- Project sites...
- Commercial Sites
- Web mapping services (WMS)

RANGE FROM SIMPLE....

- Soil Web via Gmaps

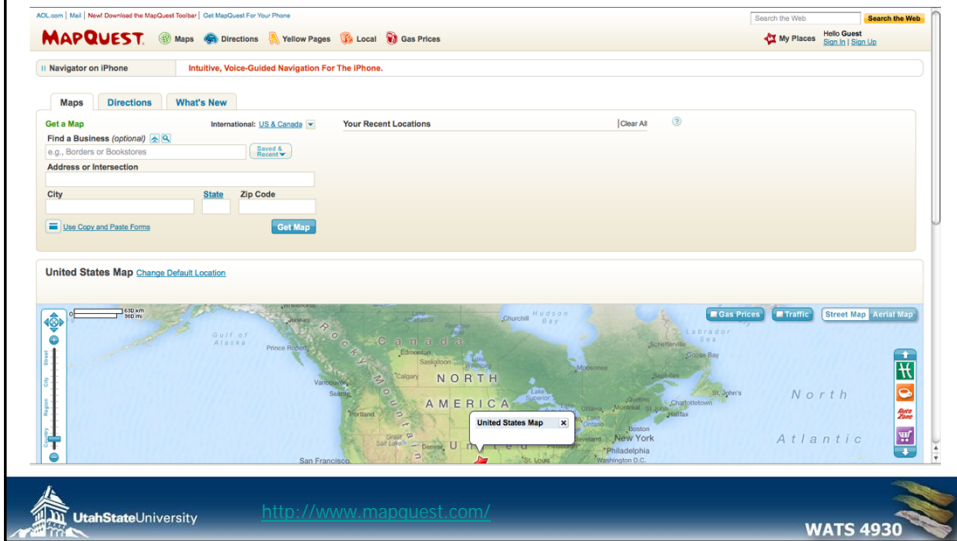


TO COMPLEX...



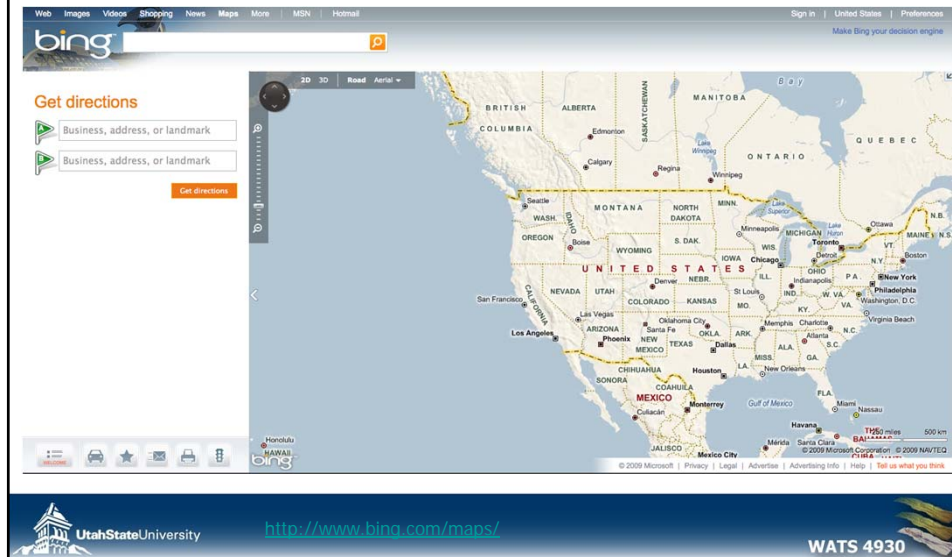
MAPQUEST

- One of the first... lost its marketshare



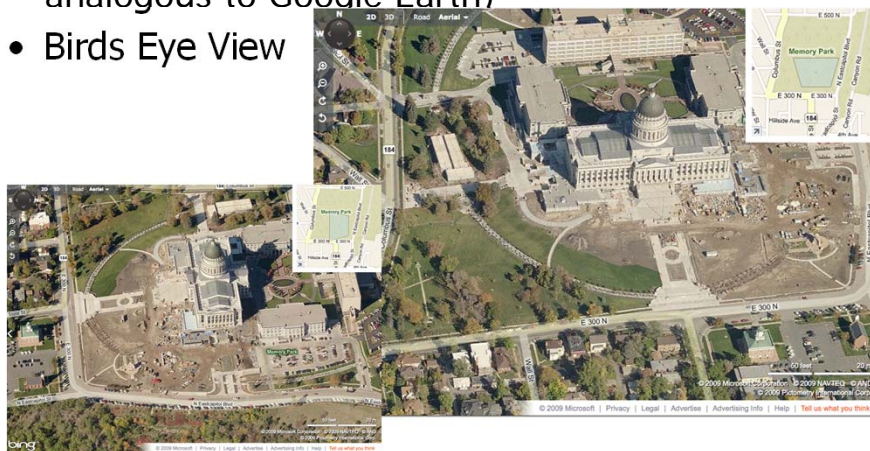
BING.COM/MAPS (FORMERLY LIVE MAPS -> Microsoft)

- 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>

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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?



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HOW DOES IT DIFFER FROM DESKTOP GIS?

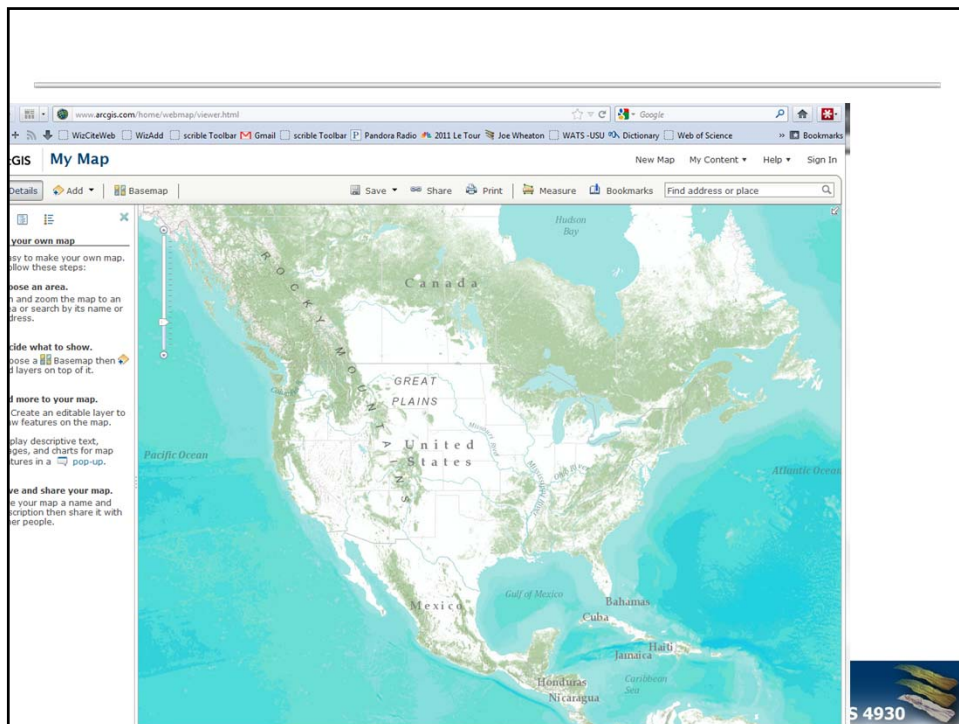
- You can answer this...
- What of the ArcGIS family of products is WebGIS?



ArcGIS EXPLORER ONLINE

- Improved dramatically...





WHAT IS A WEB MAP?

ArcGIS Resource Center | [Help](#) | [Blogs](#) | [Forums](#)

ArcGIS.com

- Overview
- What is ArcGIS Online?
- Types of geographic information
- What's new?
- Getting started
- Working with web maps
- Adding items
- Sharing content
- Finding and opening content
 - Overview
 - Using search
 - Viewing search results
 - Opening content
 - Item details
 - What is a web map?
 - What is a web application?
 - What is a mobile application?
 - What is a tool?
 - Finding content for ArcGIS desktop pro
- Participating in groups
- Managing your account
- Using a subscription
- Terms of use

What is a web map?

[Find out and explore content](#)

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.

[View map in the ArcGIS.com map viewer](#)

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.

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Web GIS QUESTIONS

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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



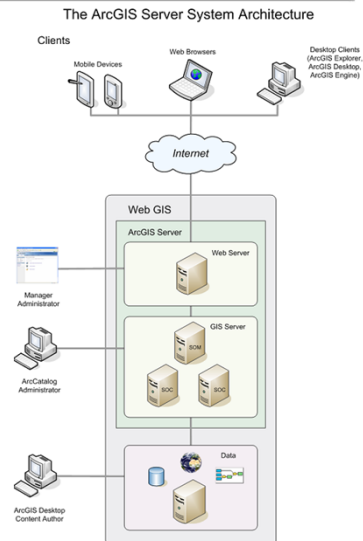
What is a service?

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

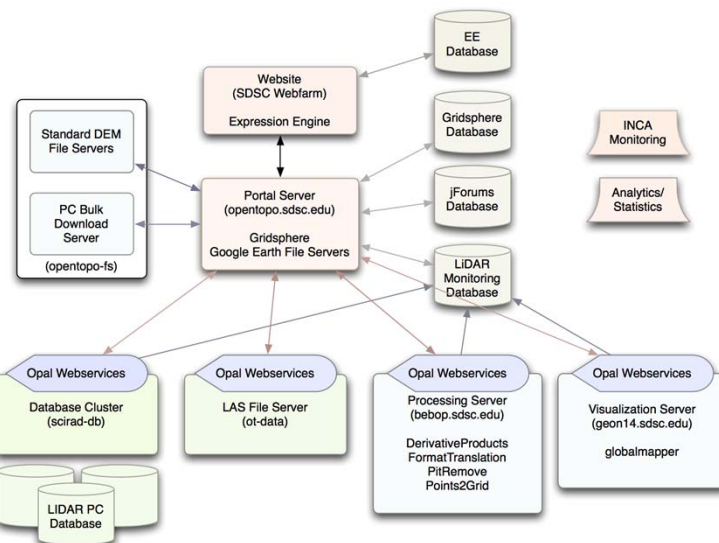
As you use ArcGIS Server, you will follow a workflow of three steps to make your geographic information available through the server:

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



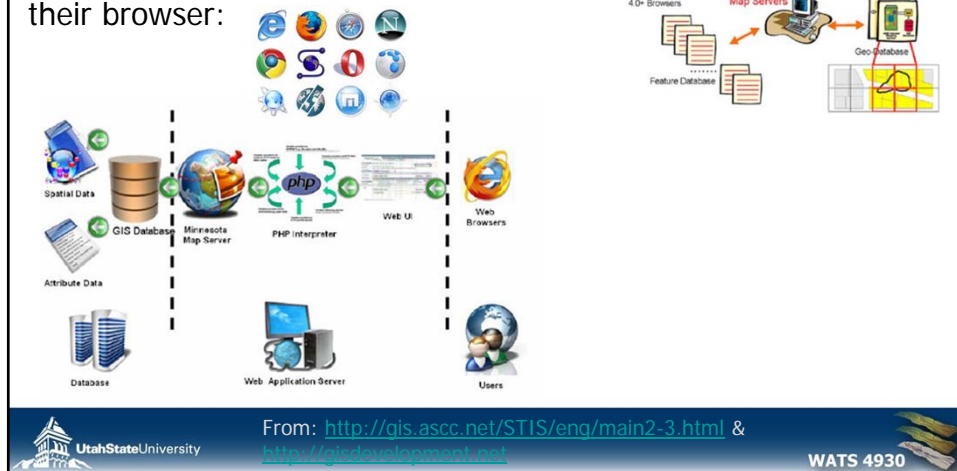
See: http://help.arcgis.com/en/arcgisserver/10.0/help/arcgis_server_dotnet_help/

OPEN TOPOGRAPHY... SYSTEM ARCHITECTURE



SOME OTHER CARTOONS...

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



Web GIS QUESTIONS

- What is it?
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- **How could you deploy it?**

YOUR QUIZ FOR TUESDAY

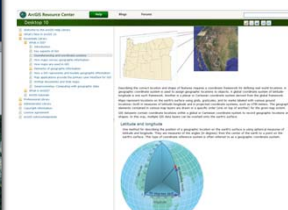
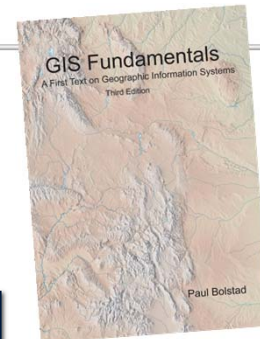
- Find an example of a good map and a bad map and explain why in terms of the 6 C's
- Post these two examples as URL's or images and your justification to the class forum at:
 - GIS Questions & Discussions -> Week 02 -> Quiz 1
 - <http://forum.bluezone.usu.edu/gis/viewforum.php?f=30>
 - Post before Tuesday's Lecture
 - Feel free to comment on others...
 - Also SUBMIT your links to CANVAS under Quiz 1 So I can give you credit
- PURPOSE:
 - Develop a critical eye about other's maps, so that you can make your own maps better
 - Familiarize you with grading criteria



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READING FOR TUESDAY

- Read Chapter Three of Bolstad: "Map Projections & Coordinate Systems" (pp. 69-122)
 - Skim 70-72 (History)
 - Read pp. 72-119 in detail



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NEXT LECTURE

On Tuesday:

- Projections & Coordinate Systems



Image from Corbis ©: <http://www.corbis.com/Image/>