WELCOME

to

Introduction to
Quantum GIS (QGIS)

Technical GIS

- Software packages
- Software development, scripting
- Data model configuration
- Data types/formats
- Data management
- Configuring/managing web/desktop applications

author: Todd J. Schuble, University of Chicago

GIS/Spatial Analysis Desktop Software Packages

- ***AutoCAD Map 2000***
  - Autodesk
- ***ArcGIS***
  - ESRI
- ***Crimestat IV***
  - Open source
- ***ERDAS Imagine***
  - Hexagon Geospatial
- ***ER Mapper***
  - Hexagon Geospatial
- ***GeoDa***
  - Open source
- ***Geomedia Professional***
  - Intergraph
- ***GRASS***
  - Open Source
- ***IDRISI***
  - Clark Labs
- ***MapInfo Professional***
  - Mapinfo
- ***MapPoint***
  - Microsoft
- ***Maptitude***
  - Caliper Corp.
- ***Microstation***
  - Bentley
- ***Quantum GIS***
  - Open source
- ***SAS/GIS, SAS/GEO***
  - SAS
- ***Smallworld GIS***
  - GE
- ***uDig***
  - Open source

author: Todd J. Schuble, University of Chicago

GIS Software on Campus

- Many packages available on campus/in labs:
  - Quantum GIS
  - ArcGIS Desktop, ArcGIS Pro and ArcGIS Online
  - GeoDa
  - R
  - PostGIS (PostgreSQL)
  - Python

author: Todd J. Schuble, University of Chicago

Sources of Information on GIS/spatial analysis and GIS data

- Visit RCC-GIS (http://gis.rcc.uchicago.edu)
  - Data sources
  - Professional guidance
  - Learning resources
- Journal articles
  - Use the Scopus search engine (https://www-scopus-com.proxy.uchicago.edu/home.uri)
- Google search with the proper "key" terms
  - GIS
  - Download
  - Spatial
- Email gis-help@rcc.uchicago.edu
- https://www.qgistutorials.com

author: Todd J. Schuble, University of Chicago

Geographic References

- Correlation of data layers is the cornerstone of spatial analysis
  - Visualize a spatial distribution and interconnect different thematic databases (e.g. demographic data, economic data, environmental data, etc.)
  - First solve reference issues to ensure geographical comparability
- Different GIS data sets constitute separate information **layers**
  - Overlay is possible if geographic components (X,Y) use the same projection and coordinate system

author: Todd J. Schuble, University of Chicago

Geographic References

- A projection system is a method of representing the surface of a sphere on a plane, which is necessary for creating maps
- Spatial data sets are produced in diverse projection systems
  - The location on the earth and the purpose of the map influence the choice of the projection/coordinate system

author: Todd J. Schuble, University of Chicago

Coordinate Systems for the USA

- Some standard coordinate systems used in the United States are:
  - Geographic coordinates (lat/long)
  - Universal Transverse Mercator system
  - Military grid
  - State plane
  - Township and range
- TO COMPARE OR EDGE-MATCH MAPS IN A GIS, BOTH MAPS MUST BE IN THE SAME COORDINATE SYSTEM.

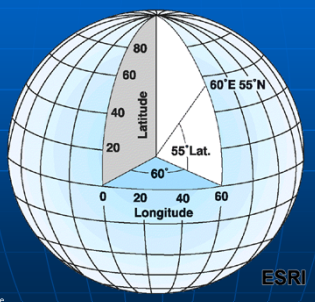
author: Todd J. Schuble, University of Chicago

Geographic Coordinates (Latitude/Longitude)

- Latitude lines (parallels) run horizontally, and longitude lines (meridians) run vertically.
- Degrees of latitude are numbered from 0 to 90 north and south.
- Zero degrees is the equator, 90 north is the North Pole and 90 south is the South Pole
- Unprojected data sets use geographic coordinates
  - World Geodetic System (WGS 84) is often used as the surface model and usually the only other geographic feature attached to data

author: Todd J. Schuble, University of Chicago

Geographic Coordinates



author: Todd J. Schuble, University of Chicago

Geographic Coordinates (Latitude/Longitude)

- Geographic coordinates can be recorded in two formats
  - Degrees, minutes, seconds (DMS)
    - 41° 50' 26" N, 87° 40' 45" W
  - Decimal degrees (DD)
    - 41.8405556, -87.6791667
- Unprojected data, using geographic coordinates, is NOT best form to conduct spatial measurements
- ***Layer>Add Layer>Add Delimited Text Layer***
- ***Right-click on layer name>Export>Save Features As***
  - ***Format: ESRI Shapefile***
  - ***CRS: EPSG 4326, WGS84***

author: Todd J. Schuble, University of Chicago

Projected Coordinate Systems

- Projected systems are preferred where XY coordinates can be expressed in meters or feet
  - National or regional systems usually have preferred projections for various tasks
- Where no national system exists, use the Universal Transverse Mercator (UTM) coordinate system, a projected coordinate system covering the entire globe
  - Divides the earth into sixty 6°-wide longitudinal zones
- European Petroleum Survey Group (**EPSG**) database is a widely used and provides each projected coordinate system with a unique ID (e.g. EPSG: 4326 = WGS84)
- ***To project a layer with QGIS, right-click on the layer and choose Save As***
  - ***Choose the appropriate projection/coordinate system and save your new file in a shapefile format***

author: Todd J. Schuble, University of Chicago

Universal Transverse Mercator

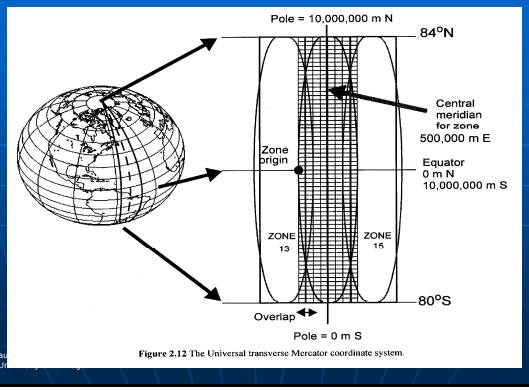


Figure 2.12 The Universal transverse Mercator coordinate system.

UTM Zones

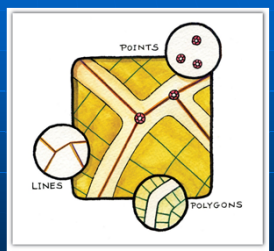
- UTM (Universal Transverse Mercator) - International projection
- Total 120 zones (60 for North & 60 for South)

N (North)

S (South)

Vector Data

- Vector layers are composed of discrete geographic features that relate to each other to build more complex features
- Points
- Lines
- Polygons



author: Todd J. Schuble, University of Chicago

Vector Data Model

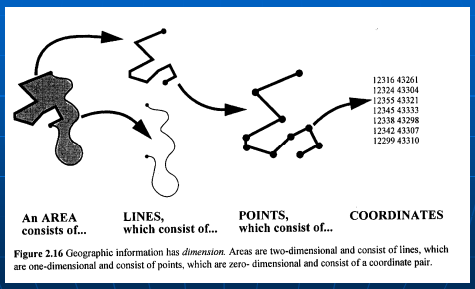


Figure 2.16 Geographic information has *dimension*. Areas are two-dimensional and consist of lines, which are one-dimensional and consist of points, which are zero- dimensional and consist of a coordinate pair.

author: Todd J. Schuble, University of Chicago

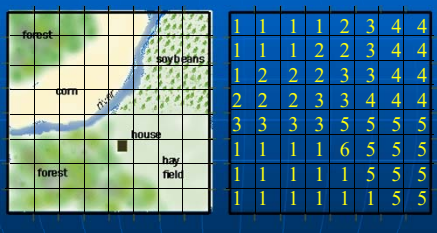
Raster Data

- Matrix of pixels either composed of:
  - Multiple spectral bands (RGB : Red-Green-Blue).
  - Z variable (Altitude, slope, interpolated temperature, etc.)

Commonly used raster layers in a GIS : Aerial photography (left) and Digital Elevation Model (right)

author: Todd J. Schuble, University of Chicago

Raster GIS Data



Reality | Raster Model of Reality

author: Todd J. Schuble, University of Chicago

Raster vs. Vector Data

- RASTER
- Very good at representing surfaces or continuous data
- Rasters are a natural for scanned or remotely sensed data
  - Satellite data (source of other derived data, i.e. elevation, landuse, vegetation, etc.) and aerial photographs
- Mathematical modeling is easy because all spatial entities have a simple regular shape

- VECTOR
- Can represent discrete features accurately (point, line, polygon)
  - Compact data structure
- Topology can be represented
- Input methods work well with pen and light-plotting devices, tablet digitizers, and heads-up digitizing
- File size is comparably much smaller than raster.

author: Todd J. Schuble, University of Chicago

Adding Vector and Raster Layers

- ***Layer>Add Layer>Add Vector Layer***
- ***Layer>Add Layer>Add Raster Layer***
- ***Right-click on layer name>Export>Save Features As***
  - ***Format: ESRI Shapefile***
  - ***CRS: EPSG 4326, WGS84***
- ***Right-click on layer name>Export>Save Features As***
  - ***Format: GeoTiff***
  - ***CRS: EPSG 4326, WGS84***

author: Todd J. Schuble, University of Chicago

Data Quality: Why is it Important?

- Increased data production in the private sector where no standards are required.
- Low-quality data use is becoming more widespread.
- Increased reliance on secondary data sources: THE INTERNET

author: Todd J. Schuble, University of Chicago

METADATA: Your Only Hope

- Documentation of GIS data
- Data about data
- In the U.S. standards set by the FGDC (Federal Geographic Data Committee) for government data have been adopted by others
- In the global community, standards set by ISO have been adopted
- Tool to create and edit metadata:
  - http://www.fgdc.gov/metadata/geospatial-metadata-tools

author: Todd J. Schuble, University of Chicago

Looking for Experimental Data?

- Start simple, use well established datasets
  - Social Explorer (demographic data) (http://www.socialexplorer.com)
  - City of Chicago GIS data (http://www.cityofchicago.org/gis) (https://data.cityofchicago.org/)
  - OpenStreetMap (http://www.openstreetmap.org)

author: Todd J. Schuble, University of Chicago

Looking for Experimental Data?

- Start simple, use well established datasets
  - Humanitarian Data Exchange (https://data.hdx.rwlabs.org/)
  - USDA Geospatial Data Gateway (https://gdg.sc.egov.usda.gov/)
  - National Weather Service GIS Data Portal (http://www.nws.noaa.gov/gis/)
  - Global Landcover Facility (http://landcover.org/)

author: Todd J. Schuble, University of Chicago

Looking for Experimental Data?

- Anything with locations associated with them can be used
- Visit your LIBRARY!!!
  - http://guides.lib.uchicago.edu/data
  - http://guides.lib.uchicago.edu/c.php?g=297072&p=1983376
- General?
  - http://rfe.org/showCat.php?cat_id=2
- Agriculture?
  - https://nassgeodata.gmu.edu/CropScape/
  - http://www.fao.org/faostat/en/#data

author: Todd J. Schuble, University of Chicago

Looking for Experimental Data?

- Demographic segmentation?
  - ArcGIS Business Analyst Online
    - https://bao.arcgis.com/esriBAO/login/
- Environmental pollution?
  - ToxMap
    - https://toxmap.nlm.nih.gov/toxmap/
- Banking?
  - https://www.fdic.gov/bank/statistical/
- Green infrastructure?
  - https://datahub.cmap.illinois.gov/dataset/green-infrastructure-vision-data

author: Todd J. Schuble, University of Chicago

Geocoding Address Data

- Many geocoding services exist, the primary issue is accuracy and coverage…is it placing the address in the correct place?
- Numerous geocoding solutions
  - http://geoservices.tamu.edu/Services/Geocode/
  - https://geocoding.geo.census.gov/
  - https://pypi.python.org/pypi/geocoder
  - https://www.shanelynn.ie/massive-geocoding-with-r-and-google-maps/
  - UChicago's Own Geocoder?!?
    - Unlimited geocoding?!? Super high accuracy?!?
    - https://gis.rcc.uchicago.edu/content/rcc-gis-geocoding-service

author: Todd J. Schuble, University of Chicago

Joining Tables to Geometry

- ***Prepare CSV data table***
- ***Layer>Add Layer>Add Delimited Text Layer***
  - ***Click radio button next to No Geometry***
- ***Right-click on destination layer>Properties***
- ***Click Joins>Click Green Plus sign>Choose Join Layer, Join Field, Target Field***

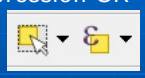
author: Todd J. Schuble, University of Chicago

Adding Background Datasets

- Activate QuickMapServices plugin in QGIS allows the addition of a background base-map to the QGIS interface
  - From raster data or from an online maps (Google, Bing, OpenStreetMap)
- ***Plugins>Manage and Install Plugins>QuickMapServices plugin***
  - ***Highlight and click Install Plugin***
- ***Search QMS***
  - ***Choose which background you would like to see***

author: Todd J. Schuble, University of Chicago

Selecting Data

- Select Features Using an Expression OR
- Select features interactively 
- Select within a distance of certain features
  - ***Vector>Geoprocessing Tools>Fixed Distance Buffer***
  - ***Vector>Research Tools>Select by Location***
    - ***Right-click on selected layer>Save As***
    - ***Check box next to Save Only Selected Features***

author: Todd J. Schuble, University of Chicago

Creating New Layers

- ***Layer>Create Layer>New Shapefile Layer***
  - ***Choose Layer Type***
  - ***Add Fields if necessary***
- ***Highlight layer and click the Toggle Editing Button***
  - Digitizing tools will activate

- ***Click Add Feature Button***
  - ***Start drawing with interactive tool***
  - ***Right click when done to fill in data fields***
  - ***Intermittently click Save***

author: Todd J. Schuble,
University of Chicago