Introduction to QGIS
A Self-directed Workshop

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GIS Lab Baruch College CUNY

Fall 2020
Objectives

Participants will be able to bring both the tools and the knowledge they gain from this workshop to enhance their projects and the organizations they work for. Specifically, this workshop will enable participants to:

▶ Add data to GIS software and navigate a GIS interface
▶ Perform basic geoprocessing operations for preparing data
▶ Convert text-based data to a GIS data format
▶ Conduct geographic analyses using standard GIS tools
▶ Create thematic maps
▶ Locate GIS data on the web and consider the merits of different data sources
▶ Demonstrate competency with a specific GIS package (open source QGIS)
▶ Identify other GIS topics to pursue for future study
Schedule

1st Friday 10am-11:30am

- Orientation
- Introduction to GIS Presentation
- QGIS Demo

Tuesday 10am-11am, 4pm-5pm

- Optional Drop-in Sessions for Help

2nd Friday 10am-11:30am

- Review of Concepts and Material
- Data Sources
- Project Questions
Course Materials

https://www.baruch.cuny.edu/confluence/display/geoportal/GIS+Practicum
Part 1: Overview of GIS
Part 2: Introduction to GIS Interface
Part 3: GIS Analysis
Part 4: Thematic Mapping
Part 5: Going Further with GIS
Today’s Topics

Part 1: Overview of GIS

Part 2: Introduction to GIS Interface

Part 3: GIS Analysis

Part 4: Thematic Mapping

Part 5: Going Further with GIS
An acronym for geographic information systems

“An integrated collection of computer software and data used to manage information about geographic places, analyze spatial relationships, and model spatial processes. A GIS provides a framework for gathering and organizing spatial data and related information so that it can be displayed and analyzed.”

- A to Z GIS, Wade and Sommer, ESRI Press 2006
GIS is a visual system that organizes information around the concepts of location and place.

Narrow definition: software and data. Broader definition: software, hardware, data, metadata, and people.
GIS Files are Features

Geographic features are represented by individual files or layers that can be added to a map. These features are the “raw materials” used for analysis and map making.
Each GIS layer is related (georeferenced) to an actual location on the earth, because it was drawn to and assigned a particular map projection and coordinate system.

Since spatial reference systems are standardized, GIS data can easily be shared as long as all of the GIS files being viewed share the same standard.
Map Projections and Georeferencing

Robinson

GCS (Equirectangular)

Mercator

Mollweide
GIS Software

GIS software acts as an interface, or a window, for viewing and working with the various data files.
Example 1 - Layering
Workbook Part 2
Example 2 - Data Creation & Analysis
Workbook Part 3
Example 3 - Thematic Mapping
Workbook Part 4

Carnegie Public Libraries Built
1896 - 1923

Data Source: The Geography of Reading, Wilson 1938
GIS Software

ArcGIS

QGIS

ESRI

OSGeo

Your Open Source Compass
https://catalog.data.gov/
GIS Data Types

Raster

Vector

Tables

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GIS Files: Rasters

Raster files represent a continuous surface. This surface is divided into grid cells of equal size. Each cell has a numeric value which can be represented by a particular color.

Common raster file formats include Geo formats of Tiffs .tif and JPEGs .jpg (but there are dozens of different types)
Vector files consist of discrete objects that are defined by coordinates. Vectors are visually represented as points, lines, or polygons (areas).

Common vector file formats include Shapefiles .shp and Geopackages .gpkg
Vector Data and Attributes

Each feature within a vector file exists visually but also has a record that is stored in a table that is connected to the file. These records are descriptors, or attributes, that describe each feature. These attributes can be mapped.
Well-structured data tables that share a common field with a GIS feature can be joined to that GIS feature using relational database operations.
Plotting Tabular Coordinate Data

Data tables that contain records for places can be mapped in GIS. Records with XY coordinates can be plotted.

Common table formats: Excel files .xls & .xlsx, Dbase files .dbf, text files .txt, comma-delimited files .csv, and database tables.
Raster vs Vector

The message that a map sends can be altered by:

- Classification schemes
- Geographic units
- Colors, tones, and shading
- Font sizes and styles
- Map projection

http://www-personal.umich.edu/~mejn/election/2016/ (7/24/2017)
Today’s Topics

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The workbook, data files, and links to download QGIS 3.10:
https://www.baruch.cuny.edu/confluence/display/geoportal/GIS+Practicum

Data file setup:

1. Create a directory with a SHORT path on your hard drive (C:\workspace) or flash drive (E:\workspace)
2. Visit the GIS Practicum page on the Baruch Geoportal and download (save) the data file gis_prac_data.zip
3. Move file to your workspace directory
4. Select the zip file, right click, and choose Extract All or Extract Here option to unzip
Part 2 Objectives

Introduction to GIS Interface

- Explore GIS Interface
- Add Vector GIS Data Layers
- Explore the Map View
- Explore Vector Data Features
- Add and Explore Raster Data
- Save Projects
Project Files

**Project File**
E:/workspace/gis_prac/part2/part2.qgs

**Data Files**
Exist outside the project file

- E:/workspace/gis_prac/part2/facilities.shp
- E:/workspace/gis_prac/part2/greenspace.shp
- E:/workspace/gis_prac/part2/pumas_2010.shp
- E:/workspace/gis_prac/part2/pumas_2015acs.xls

Saves:
Links to data, zoom, extent, color scheme, data classification, symbolization, layout for hardcopy maps
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GIS Analysis: Site Selection - Identify potential areas within NYC neighborhoods for locating a new coffee shop.

- Create New Project From Existing One
- Prepare and Geoprocess Vector GIS Data
- Join and Map Attribute Data
- Plot Coordinate Data
- Run Statistics and Query Attributes
- Draw Buffers and Make Selections
- Screen Captures
neighborhoods?
PUMAs
Census Tracts
ZIP / ZCTAs
NTAs
US Census TIGER Files

TIGER/Line® Shapefiles

Select the year and layer you are interested in from the dropdown menus below and click “Submit” for a list of the available geographic areas.

Select year: 2016

Select a layer type:
- Geographic Areas
- American Indian Area Geography
- Blocks
- Block Groups
- Census Tracts
- Congressional Districts
- Consolidated Cities
- Core Based Statistical Areas
- Counties (and equivalent)
- Local Employment Dynamics
- State Legislative Districts
- Subbarrio (SubMinor Civil Division)
- Urban Areas

Source: US Census Bureau

Access our FTP site for additional downloading options

https://www.census.gov/cgi-bin/geo/shapefiles/index.php
To start your search...

Click on the headings to the left to start your search. If you are uncertain what to search for, look for Search Tips within each section to help you along the way.

To further customize your search, select the Record Type you would like to search below to ensure you get the records you are looking for.
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Thematic Mapping: Create a map to show the distribution of voter participation by state in the US.

- Transforming Coordinate Reference Systems
- More Geoprocessing
- Classifying and Symbolizing Data
- Designing Maps
- Adding Labels
Spatial Reference System (SRS)
Standards for modeling and locating objects on the earth that are based on geodesy (measuring and modeling the spherical earth) and cartography (representing the earth on a 2D, flat surface). All systems have 3 ingredients, some have 4.

Spatial Reference System Identifier (SRID)
A unique value that identifies a specific SRS. Within the open source GIS world, EPSG (European Petroleum Survey Group) numbers are commonly used. ESRI uses a comparable system.

Layers in a project that don’t share the same SRS
May not draw or overlay properly, and will either prevent tools from working or will generate empty or false results. SRS should be appropriate for the geographic area and map.
SRS Ingredients

1. ELLIPSOID

2. COORDINATE SYSTEM

GEOGRAPHIC COORDINATE SYSTEM (GCS)

3. DATUM

4. MAP PROJECTION

PROJECTED COORDINATE SYSTEM (PCS)
GEOGCS["NAD83",
    DATUM["North_American_Datum_1983",
        SPHEROID["GRS 1980",6378137,298.257222101,
            AUTHORITY["EPSG","7019"]],
        AUTHORITY["EPSG","6269"]],
    PRIMEM["Greenwich",0,
        AUTHORITY["EPSG","8901"]],
    UNIT["degree",0.01745329251994328,
        AUTHORITY["EPSG","9122"]],
    AUTHORITY["EPSG","4269"]]

http://spatialreference.org/
WKT Definition for a PCS

PROJCS["North_America_Lambert_Conformal_Conic",
    GEOGCS["GCS_North_American_1983",
        DATUM["North_American_Datum_1983",
            SPHEROID["GRS_1980",6378137,298.257222101]],
            PRIMEM["Greenwich",0],
            UNIT["Degree",0.017453292519943295]],
    PROJECTION["Lambert_Conformal_Conic_2SP"],
    PARAMETER["False_Easting",0],
    PARAMETER["False_Northing",0],
    PARAMETER["Central_Meridian",-96],
    PARAMETER["Standard_Parallel_1",20],
    PARAMETER["Standard_Parallel_2",60],
    PARAMETER["Latitude_Of_Origin",40],
    UNIT["Meter",1],
    AUTHORITY["EPSG","102009"]]

http://radicalcartography.net/index.html?projectionref
Use a PCS for most Maps

NAD 83

NA Lambert Conformal Conic

WGS 84

AN Lambert Conformal Conic
Local Systems

- Universal Transverse Mercator (UTM) divides earth into bands measuring 6 degrees north and south of equator.
- State Plane system divides US into series of zones, with larger states having multiple zones.

UTM (showing US zones)  State Plane (showing NY State)

Image source: https://www.nps.gov/gis/gps/gps_info.html
Image source: http://alidade.wikispaces.com/new+york+spcs+zones
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Going Further

- Finding Data
- Data Sources
- Additional Concepts and Applications
- Course Evaluation
GIS Data Producers

- Government
  - Governments and agencies at all geographic levels
  - Produce data of interest to that level
  - At national level - statistical and mapping agencies (Census, USGS)
  - At local level - IT and planning departments

- Academia
  - Produce or provide data for the geographic area where they are located
  - Research centers produce data of interest to the faculty

- Non-profits
  - Vary widely in topic, range, and quality

- Private sector
  - Watch for license restrictions
Download data: browse, point, click

http://www.naturalearthdata.com/
Downloading data: map-based search

https://viewer.nationalmap.gov/basic/
Downloading data: keyword search

https://opendata.cityofnewyork.us/
# Catalogs

Welcome to Geolode, a collaborative catalog of open geodata websites around the world.

Want to suggest a new geodata source? Send a tweet to @geolode

About the project

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<th><a href="https://data.london.gov.uk/">https://data.london.gov.uk/</a></th>
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http://geolode.org/
Metasites

http://data.opengeoportal.org/
Metadata format: ISO 19139

Subway Stops, New York NY, January 2017

ISO 19139 metadata content
- Resource Identification Information
- Spatial Representation Information
- Reference System Information
- Data Quality Information
- Distribution Information
- Metadata Information

Resource Identification Information

CITATION
TITLE Subway Stops, New York NY, January 2017

PUBLICATION DATE 2017-01-31

EDITION jan2017
PRESENTATION FORMAT mapDigital

SERIES
NAME NYC Mass Transit Spatial Layers

RESPONSIBLE PARTY - POINT OF CONTACT
ORGANIZATION'S NAME Newman Library, Baruch CUNY
CONTACT'S POSITION Geospatial Data Librarian
What Next?

Visit the Baruch Geoportal for data, tutorials, and links

- Working with rasters
- Spatial databases
- Web mapping
- GIS Lab
Baruch Geoportal

https://www.baruch.cuny.edu/confluence/display/geoportal/
https://gis.stackexchange.com/
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Contact

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https://www.baruch.cuny.edu/confluence/display/geoportal/GIS+Lab