ANÁLISIS GEOESPACIAL

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(Versión:March 5, 2021)

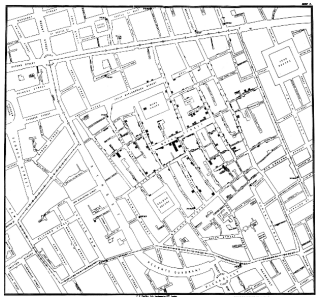
UNIVERSIDAD NACIONAL DE COLOMBIA
SEDE MEDELLÍN

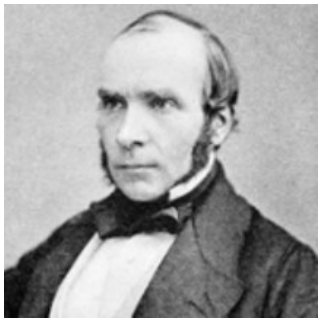
GEOHAZARDS
Semillero de Investigación

Sistemas de Información Geográfica

Elemento para analizar, presentar e interpretar datos espaciales

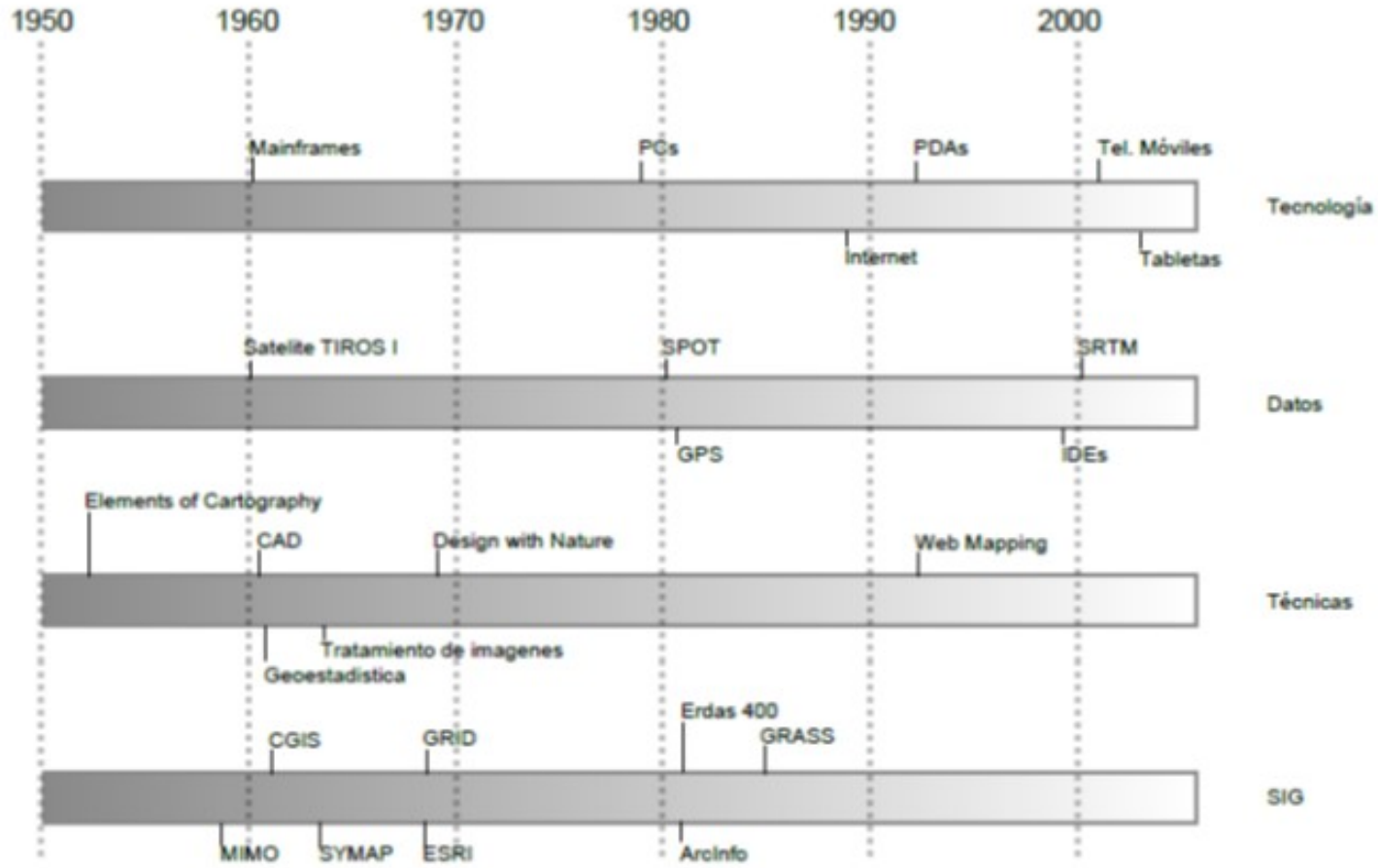
Evolución de GIS





In 1854 cholera hit the city of London, England. No one knew where the disease started. So, British physician *John Snow* started mapping the outbreak. But he also mapped out roads, property boundaries and water lines.

In 1968, *Roger Tomlinson* coined the term "GIS" in his paper "A Geographic Information System for Regional Planning". In 2014, Roger Tomlinson later passed away and will always be remembered as the *father of GIS*.


1950
1960
1970
1980
1990
2000
Mainframes
PCs
PDAs
Tel. Móviles
Internet
Tabletas
Tecnología
Satelite TIROS I
SPOT
SRTM
GPS
IDEs
Datos
Elements of Cartography
CAD
Design with Nature
Web Mapping
Tratamiento de imagenes
Geoestadistica
Técnicas
Erdas 400
CGIS
GRID
GRASS
MIMO
SYMAP
ESRI
ArcInfo
SIG

Componentes de un SIG

Data & Hardware & Software

2. HARDWARE: Hardware runs GIS software. It could be anything from powerful servers, mobile phones or a personal **GIS workstation**. The CPU is your workhorse and data processing is the name of the game. Dual monitors, extra storage and crisp graphic processing cards are must-haves too in GIS.

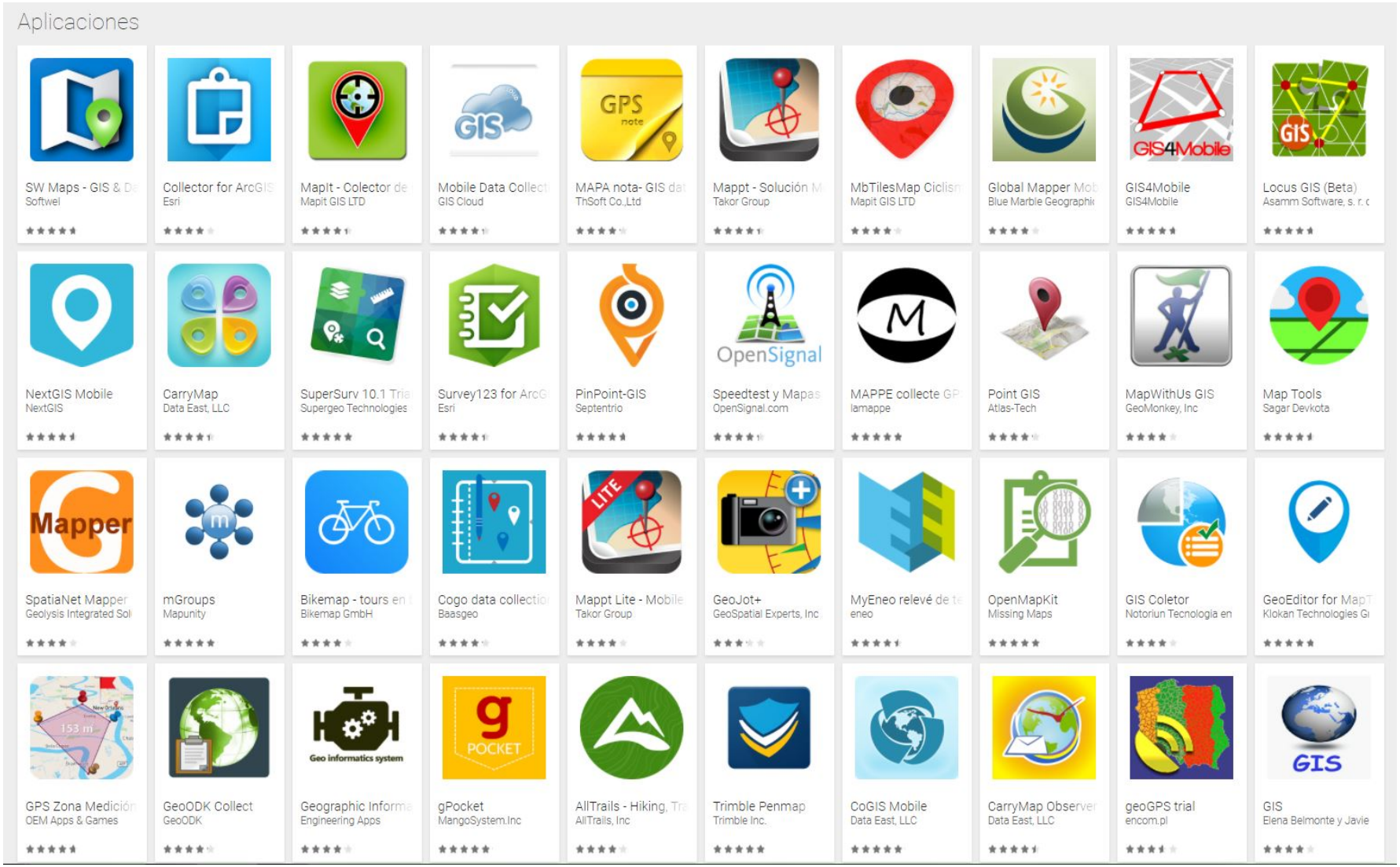
3. SOFTWARE: **ArcGIS and QGIS** are the leaders in **GIS software**. GIS software specialize in spatial analysis by using math in maps. It blends geography with modern technology to measure, quantify and understand our world.

Hardware


ArcGIS
Websites
Viewers
Desktops
Smartphones & tablets
Other mobile devices

Software

Software


Aplicaciones
SW Maps - GIS & D
Softwel
Collector for ArcGIS
Esri
MapIt - Colector de
Mapit GIS LTD
Mobile Data Collect
GIS Cloud
MAPA nota- GIS dat
ThSoft Co.,Ltd
Mappt - Solución M
Takor Group
MbTilesMap Ciclism
Mapit GIS LTD
Global Mapper Mob
Blue Marble Geographic
GIS4Mobile
GIS4Mobile
Locus GIS (Beta)
Asamm Software, s. r. o
NextGIS Mobile
NextGIS
CarryMap
Data East, LLC
SuperSurv 10.1 Trial
Supergeo Technologies
Survey123 for ArcGI
Esri
PinPoint-GIS
Septentrio
Speedtest y Mapas
OpenSignal.com
MAPPE collecte GP
lamappe
Point GIS
Atlas-Tech
MapWithUs GIS
GeoMonkey, Inc
Map Tools
Sagar Devkota
SpatiaNet Mapper
Geolysis Integrated Sol
mGroups
Mapunity
Bikemap - tours en
Bikemap GmbH
Cogo data collectio
Baasgeo
Mappt Lite - Mobile
Takor Group
GeoJot+
GeoSpatial Experts, Inc
MyEneo relevé de te
eneo
OpenMapKit
Missing Maps
GIS Coletor
Notoriun Tecnologia en
GeoEditor for MapT
Klokan Technologies Gi
GPS Zona Medición
OEM Apps & Games
GeoODK Collect
GeoODK
Geographic Informa
Engineering Apps
gPocket
MangoSystem.Inc
AllTrails - Hiking, Tra
AllTrails, Inc
Trimble Penmap
Trimble Inc.
CoGIS Mobile
Data East, LLC
CarryMap Observer
Data East, LLC
geoGPS trial
encom.pl
GIS
Elena Belmonte y Javie

Componentes de un SIG

Data & Hardware & Software

The 3 main components of Geographic Information Systems are:

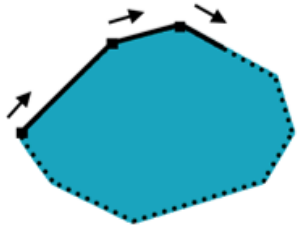
1. DATA: GIS stores location data as thematic layers. Each data set has an attribute table that stores information about the feature. The two main types of GIS data are raster and vector:

RASTER

Raster look like grids because they store data in rows and columns. They can be discrete or continuous. For example, we often represent land cover, temperature data and imagery as raster data.

VECTOR

Vectors are points, lines and polygons with vertices. For example, fire hydrants, contours and administrative boundaries are often vectors.



Geospatial Data

City	Latitude	Longitude
Seattle	47.5°	-122.3°
New York	40.7	-73.9°
Miami	25.8°	-80.2°
Los Angeles	33.9°	-118.2°

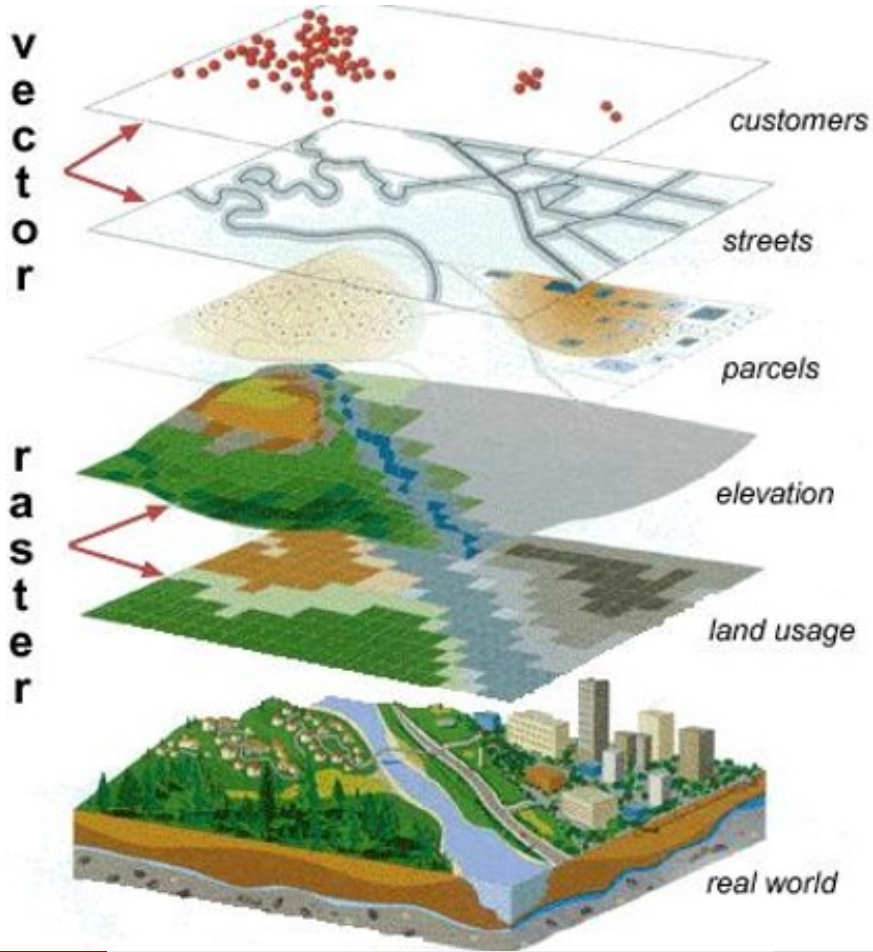
But when you add these positions on a map, it's like magic to the reader.

That's because maps make geographic information easier to understand.

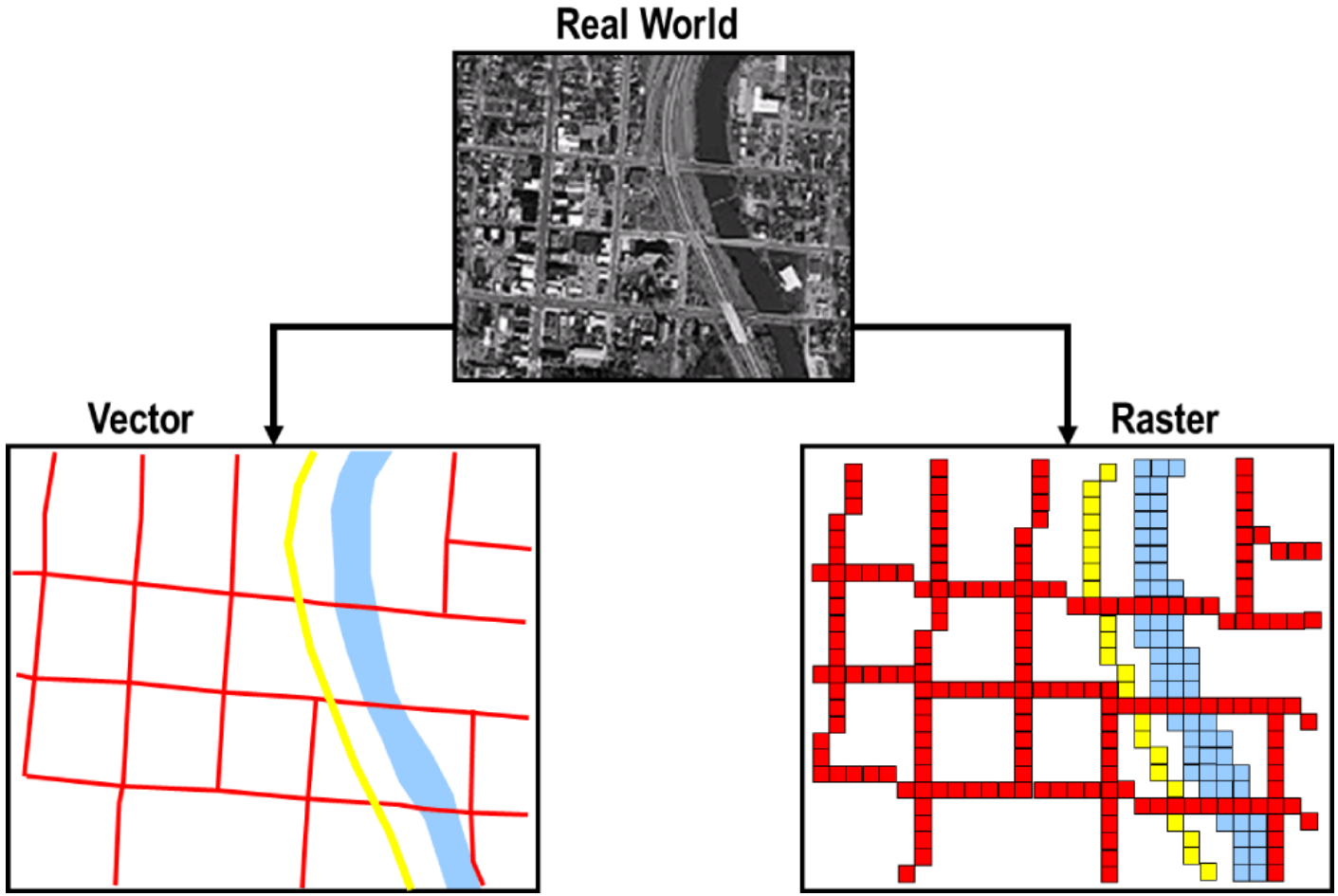
When you have geographic context, you don't only see where they are in a map. But you can:

Geospatial Data

Geospatial data is data about objects, events, or phenomena that have a location on the surface of the earth, including location information (usually coordinates on the earth), attribute information (the characteristics of the object, event, or phenomena concerned), and often also temporal information (the time or life span at which the location and attributes exist).



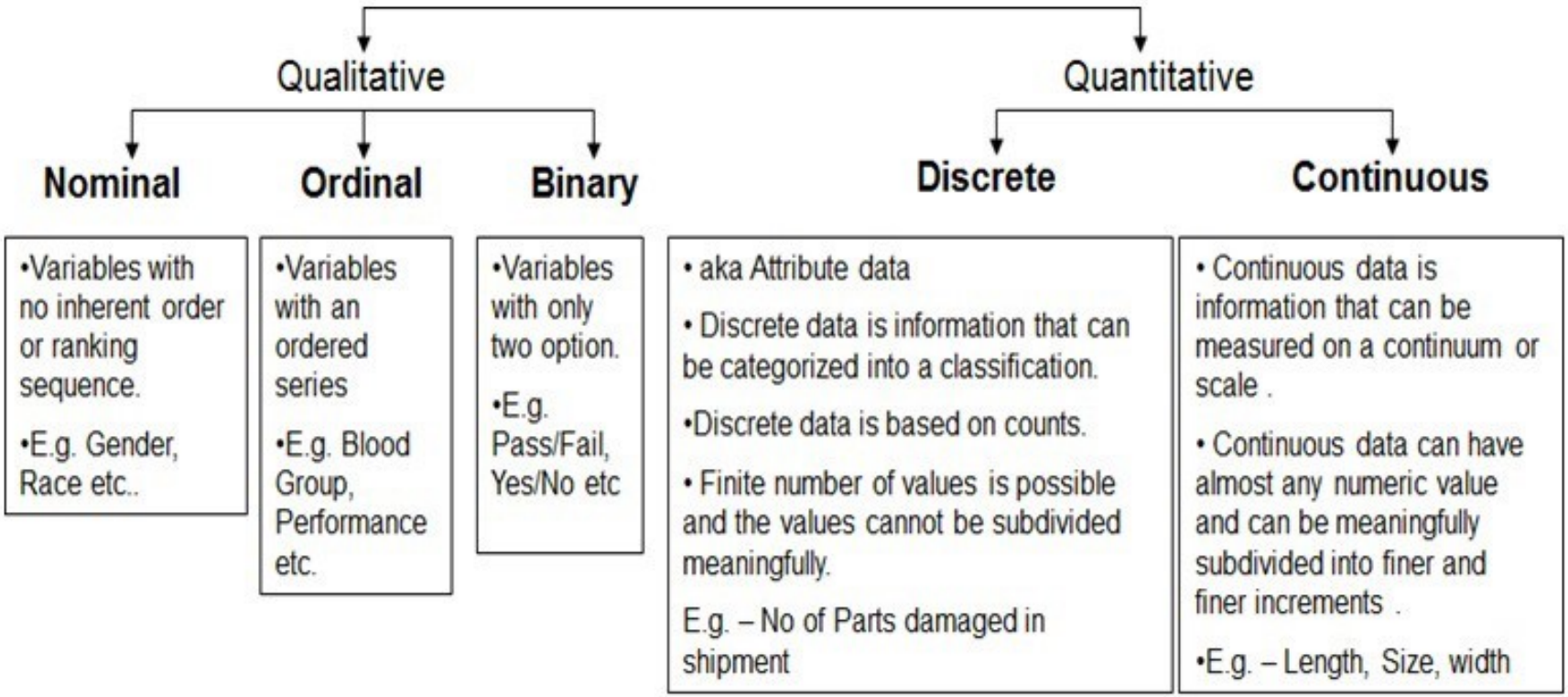
GIS Data Models



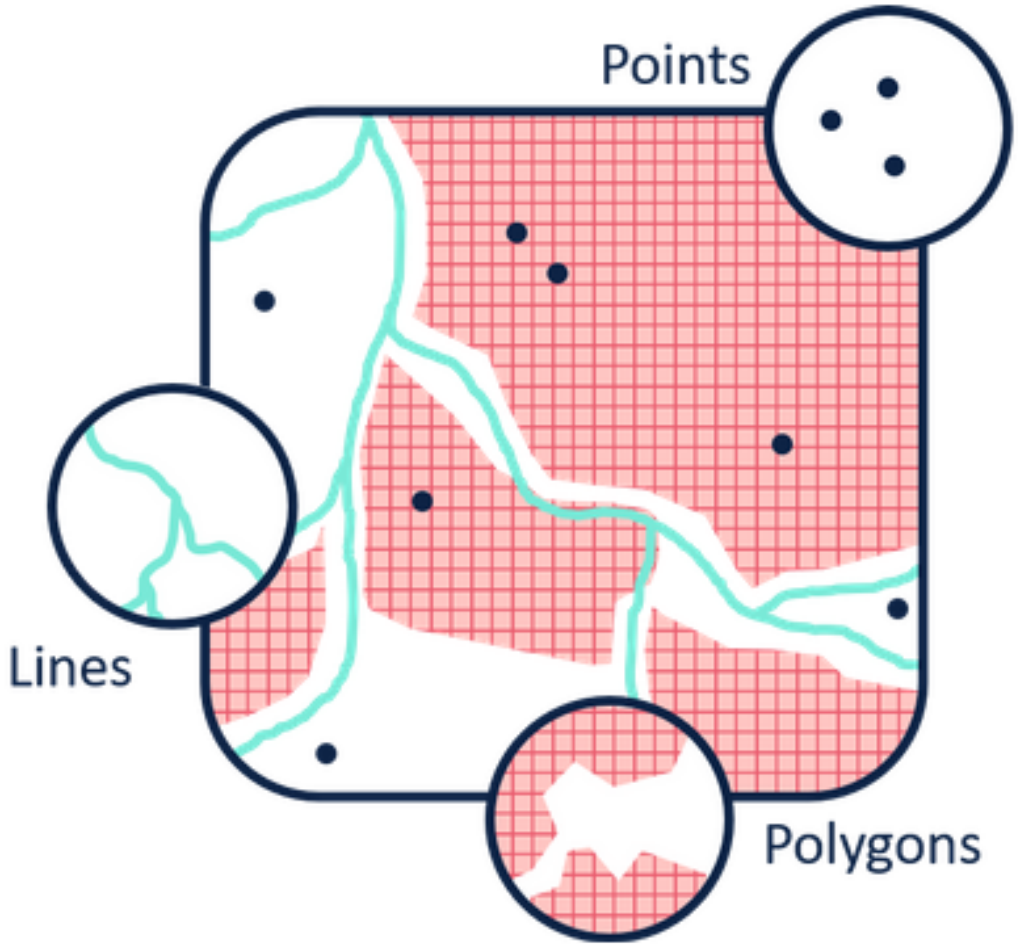
https://transportgeography.org/?page_id=6748


01
VECTOR
Vertices and paths as points, lines and polygons.
RASTER
Raster data is made up of pixels or grid cells.
02
03
DATABASES
Geographic databases store vectors and rasters.
WEB
Data built to serve and display geographic features over the internet.
04
05
MULTITEMPORAL
Multitemporal geodata has a component of location and time.

Data

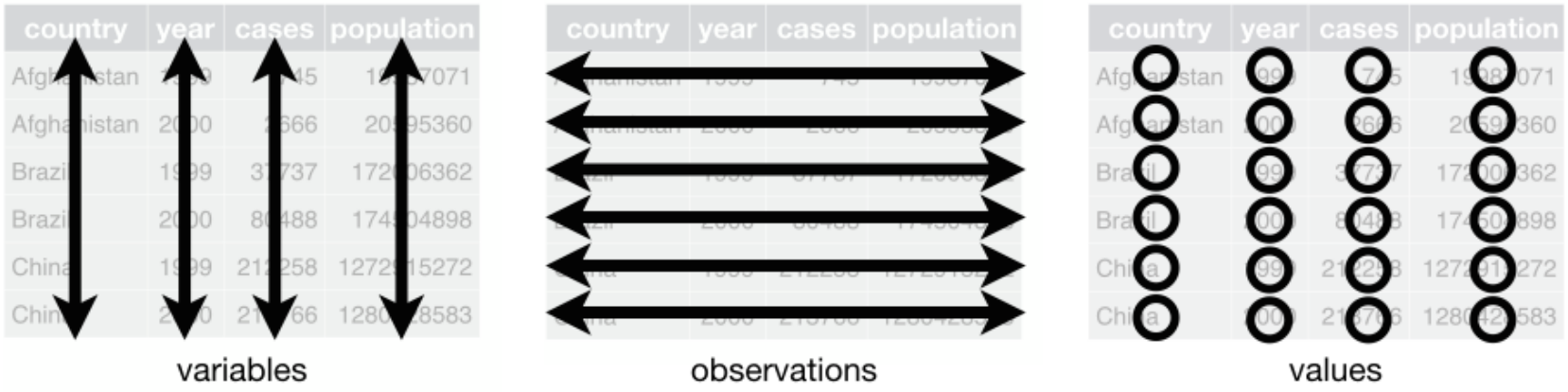

Qualitative
Quantitative
Nominal
Ordinal
Binary
Discrete
Continuous
•Variables with no inherent order or ranking sequence.
•E.g. Gender, Race etc..
•Variables with an ordered series
•E.g. Blood Group, Performance etc.
•Variables with only two option.
•E.g. Pass/Fail, Yes/No etc
• aka Attribute data
• Discrete data is information that can be categorized into a classification.
•Discrete data is based on counts.
• Finite number of values is possible and the values cannot be subdivided meaningfully.
E.g. – No of Parts damaged in shipment
• Continuous data is information that can be measured on a continuum or scale .
• Continuous data can have almost any numeric value and can be meaningfully subdivided into finer and finer increments .
•E.g. – Length, Size, width

Vector



https://datenlage.blog/2019/06/08/geospatial-data-1/

Vector

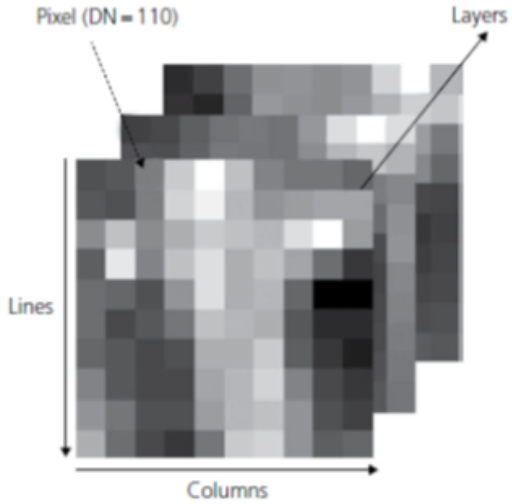


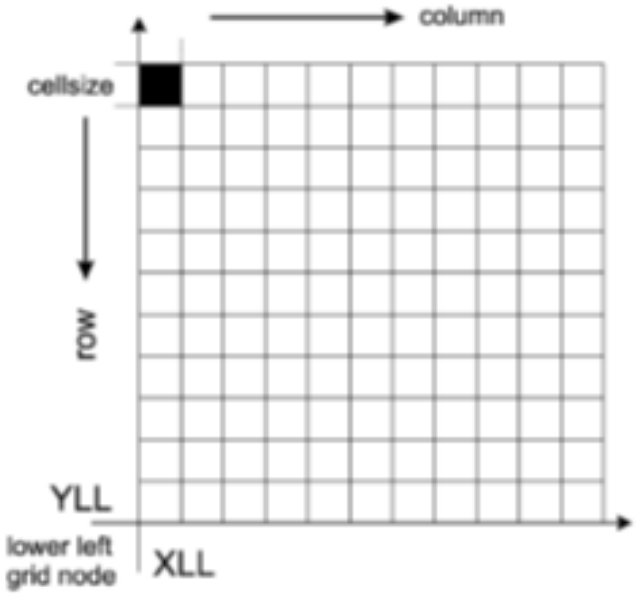
	Age	Gender	Weight	Height
Observation #1	**12**	**M**	**80** lbs	**55** in
Observation #2	**11**	**M**	**85** lbs	**58** in
Observation #3	**12**	**F**	**73** lbs	**52** in
Observation #4	**10**	**F**	**71** lbs	**49** in
. . .				
Observation #150				

Features

Target Variable

Raster



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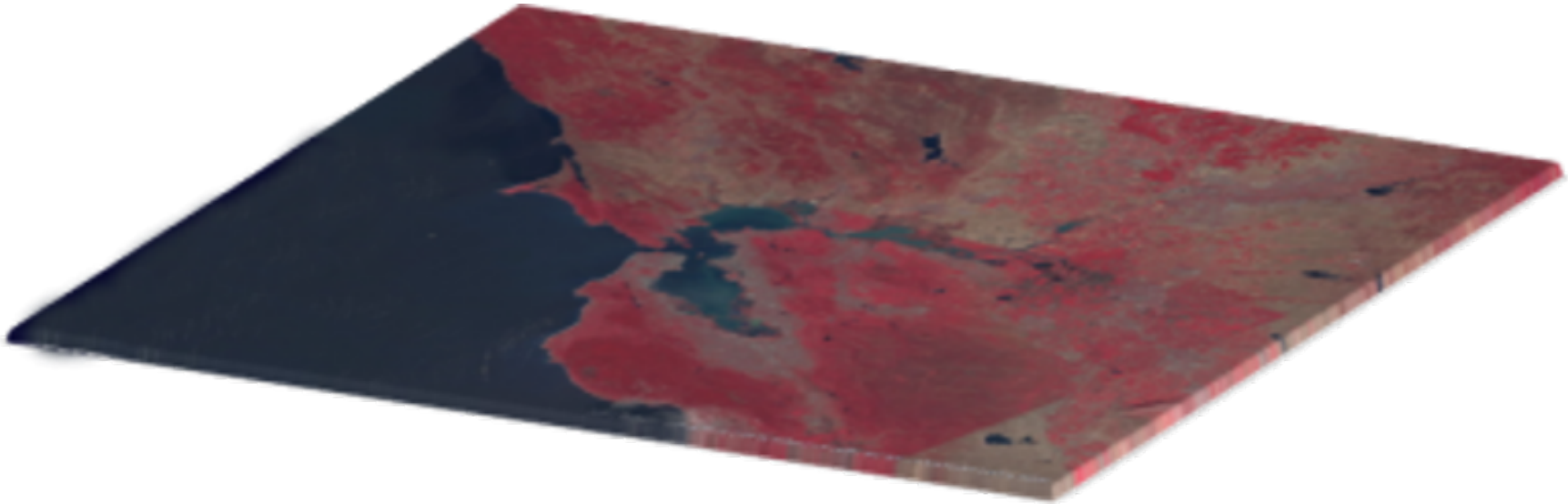
nrows 6
xllcorner 0
yllcorner 0
cellsize 10.00
nodata_value -32767
10 16 23 16 9 6
14 11 18 11 18 19
19 15 13 21 23 25
20 20 19 14 38 45
24 20 20 28 18 49
23 24 34 38 45 51
```

Wood, J. (2009). Geomorphometry - Concepts, Software, Applications. In Developments in Soil Science (Vol. 33). https://doi.org/10.1016/S0166-2481(08)00010-X

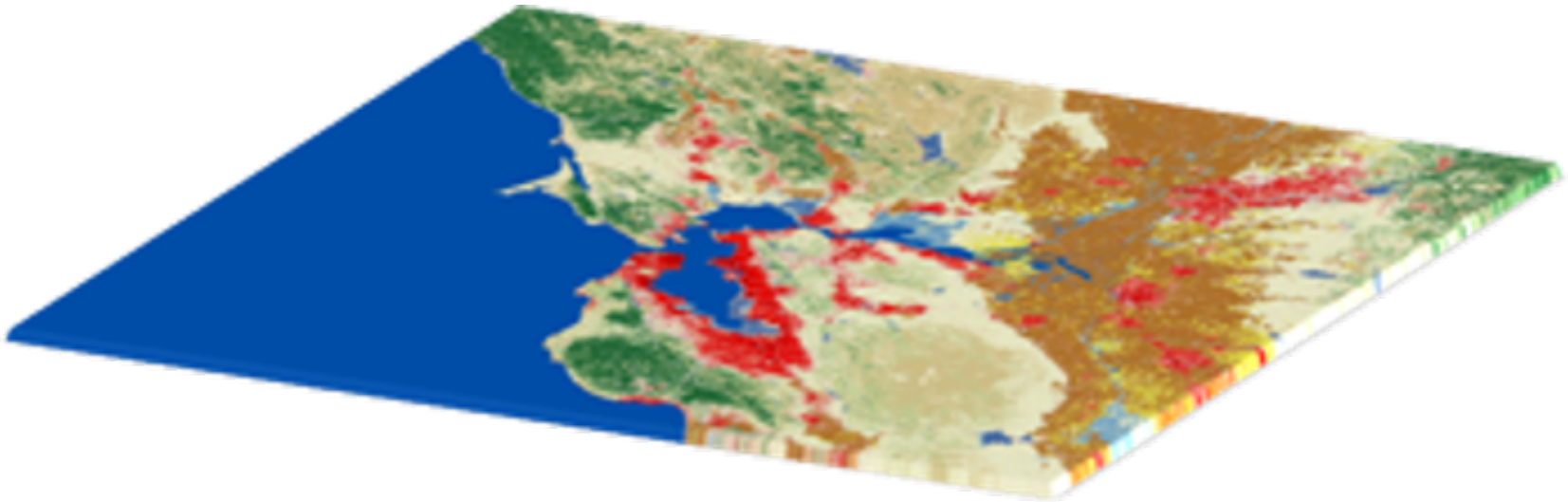
Raster Continuos

Continuous rasters (non-discrete) are grid cells with gradual changing data such as elevation, temperature or an aerial photograph. A continuous raster surface can be derived from a fixed registration point. For example, digital elevation models use sea level as a registration point. Each cell represents a value above or below sea level.



Raster Discretos

Discrete rasters have distinct themes or categories. For example, one grid cell represents a land cover class or a soil type.In a discrete raster land cover/use map, you can distinguish each thematic class. Each class can be discretely defined where it begins and ends. In other words, each land cover cell is definable and it fills the entire area of the cell.Discrete data usually consists of integers to represent classes.



Formatos

Extension	File Type	Description
Esri Shapefile	.SHP, .DBF, .SHX	The shapefile is BY FAR the most common geospatial file type you'll encounter. All commercial and open source accept shapefile as a GIS format. It's so ubiquitous that it's become the industry standard. But you'll need a complete set of three files that are mandatory to make up a shapefile. The three required files are: ▪ SHP is the feature geometry. ▪ SHX is the shape index position. ▪ DBF is the attribute data. You can optionally include these files but are not completely necessary. ▪ PRJ is the projection system metadata. ▪ XML is the associated metadata. ▪ SBN is the spatial index for optimizing queries. ▪ SBX optimizes loading times.

Vector

Geographic JavaScript Object Notation (GeoJSON)	.GEOJSON .JSON	The GeoJSON format is mostly for web-based mapping. GeoJSON stores coordinates as text in JavaScript Object Notation (JSON) form. This includes vector points, lines and polygons as well as tabular information. GeoJSON store objects within curly braces {} and in general have less markup overhead (compared to GML). GeoJSON has straightforward syntax that you can modify in any text editor. Webmaps browsers understand JavaScript so by default GeoJSON is a common web format. But JavaScript only understands binary objects. Fortunately, JavaScript can convert JSON to binary.
Geography Markup Language (GML)	.GML	GML allows for the use of geographic coordinates extension of XML. And eXtensible Markup Language (XML) is both human-readable and machine-readable. GML stores geographic entities (features) in the form of text. Similar to GeoJSON, GML can be updated in any text editor. Each feature has a list of properties, geometry (points, lines, curves, surfaces and polygons) and spatial reference system. There is generally more overhead when compare GML with GeoJSON. This is because GML results in more data for the same amount of information.

Vector

Google Keyhole Markup Language (KML/KMZ)	.KML .KMZ	KML stands for Keyhole Markup Language. This GIS format is XML-based and is primarily used for Google Earth. KML was developed by Keyhole Inc which was later acquired by Google. KMZ (KML-Zipped) replaced KML as being the default Google Earth geospatial format because it is a compressed version of the file. KML/KMZ became an international standard of the Open Geospatial Consortium in 2008. The longitude, latitude components (decimal degrees) are as defined by the World Geodetic System of 1984 (WGS84). The vertical component (altitude) is measured in meters from the WGS84 EGM96 Geoid vertical datum.
GPS eXchange Format (GPX)	.GPX	GPS Exchange format is an XML schema that describes waypoints, tracks and routes captured from a GPS receiver. Because GPX is an exchange format, you can openly transfer GPS data from one program to another based on its description properties. The minimum requirement for GPX are latitude and longitude coordinates. In addition, GPX files optionally stores location properties including time, elevation and geoid height as tags.

Raster

Extension	File Type	Description
ERDAS Imagine (IMG)	.IMG	ERDAS Imagine IMG files is a proprietary file format developed by Hexagon Geospatial. IMG files are commonly used for raster data to store single and multiple bands of satellite data. IMG files use a hierarchical format (HFA) that are optional to store basic information about the file. For example, this can include file information, ground control points and sensor type. Each raster layer as part of an IMG file contains information about its data values. For example, this includes projection, statistics, attributes, pyramids and whether or not it's a continuous or discrete type of raster.
American Standard Code for Information Interchange ASCII Grid	.ASC	ASCII uses a set of numbers (including floats) between 0 and 255 for information storage and processing. They also contain header information with a set of keywords. In their native form, ASCII text files store GIS data in a delimited format. This could be comma, space or tab-delimited format. Going from non-spatial to spatial data, you can run a conversion process tool like ASCII to raster.

Raster

GeoTIFF	.TIF .TIFF .OVR	The GeoTIFF has become an industry image standard file for GIS and satellite remote sensing applications. GeoTIFFs may be accompanied by other files: ▪ TFW is the world file that is required to give your raster geolocation. ▪ XML optionally accompany GeoTIFFs and are your metadata. ▪ AUX auxiliary files store projections and other information. ▪ OVR pyramid files improves performance for raster display.
IDRISI Raster	.RST .RDC	IDRISI assigns RST extensions to all raster layers. They consist of numeric grid c values as integers, real numbers, bytes and RGB24. The raster documentation file (RDC) is a companion text file for RST files. They assign the number of columns and rows to RST files. Further to this, they record file type, coordinate system, reference units and positional error.

Raster

Envi RAW Raster	.BIL .BIP .BSQ	Band Interleaved files are a raster storage extension for single/multi-band aerial and satellite imagery. ▪ Band Interleaved for Line (BIL) stores pixel information based on rows for all bands in an image. ▪ Whereas Band interleaved by pixel (BIP) assigns pixel values for each band by rows. ▪ Finally, Band sequential format (BSQ) stores separate bands by rows. BIL files consist of a header file (HDR) that describes the number of columns, rows, bands, bit depth and layout in an image.
PCI Geomatics Database File (PCIDSK)	.PIX	PIX files are raster storage layers developed by PCI Geomatics. It's a flexible file type that stores all image and auxiliary data called "segments" in a self-contained file. For example, segments can include image channels, training site and histogram information. As a database file, PIX files can hold raster channels with varying bit depths. They can also store projections, attribute information, metadata and imagery/vectors.

Raster

ER Mapper Enhanced Compression Wavelet	.ECW	ECW is a compressed image format typically for aerial and satellite imagery. This GIS file type is known for its high compression ratios while still maintaining quality contrast in images. ECW format was developed by ER Mapper, but it's now owned by Hexagon Geospatial.
Joint Photographic Experts Group JPEG2000	.JP2	JPEG 2000 typically have a JP2 file extension. They are a wavelet compression with the latest JPG format giving an option for lossy or lossless compression. JPEG 2000 GIS formats require a world file which gives your raster geolocation. They are an optimal choice for background imagery because of its lossy compression. JPEG 2000 can achieve a compression ratio of 20:1 which is similar to MrSID format.

Raster

Autodesk Drawing	.DWF, .DWG, .DXF	Autodesk CAD (computer assisted drafting) file formats are designed for 2D and 3D designs. They generally contain elements such as edges, curves, annotation text in layers. DWG/DXF are vector files that use Cartesian coordinates. Every element plots XY points in a grid. ▪ DWF (Design Web Format) is more specific for view and use on the internet. ▪ DWG (DraWinG) is the native format and working version for AutoCAD containing metadata. ▪ Lastly, DXF (Drawing Exchange Format) stores drawing information as exact representations of the data. But the purpose of DXF was for data exchange between CAD programs.
Bentley Microsystems DGN File Format	.DGN	DGN or "Design" is the native format for Bentley Systems MicroStation. Similar to other CAD design formats, engineers and architects use it for construction design. DGN files consists of layers including annotation, points, polylines, polygons and multipath. They also contain style information (ColorIndex) and a spatial reference system.

Raster

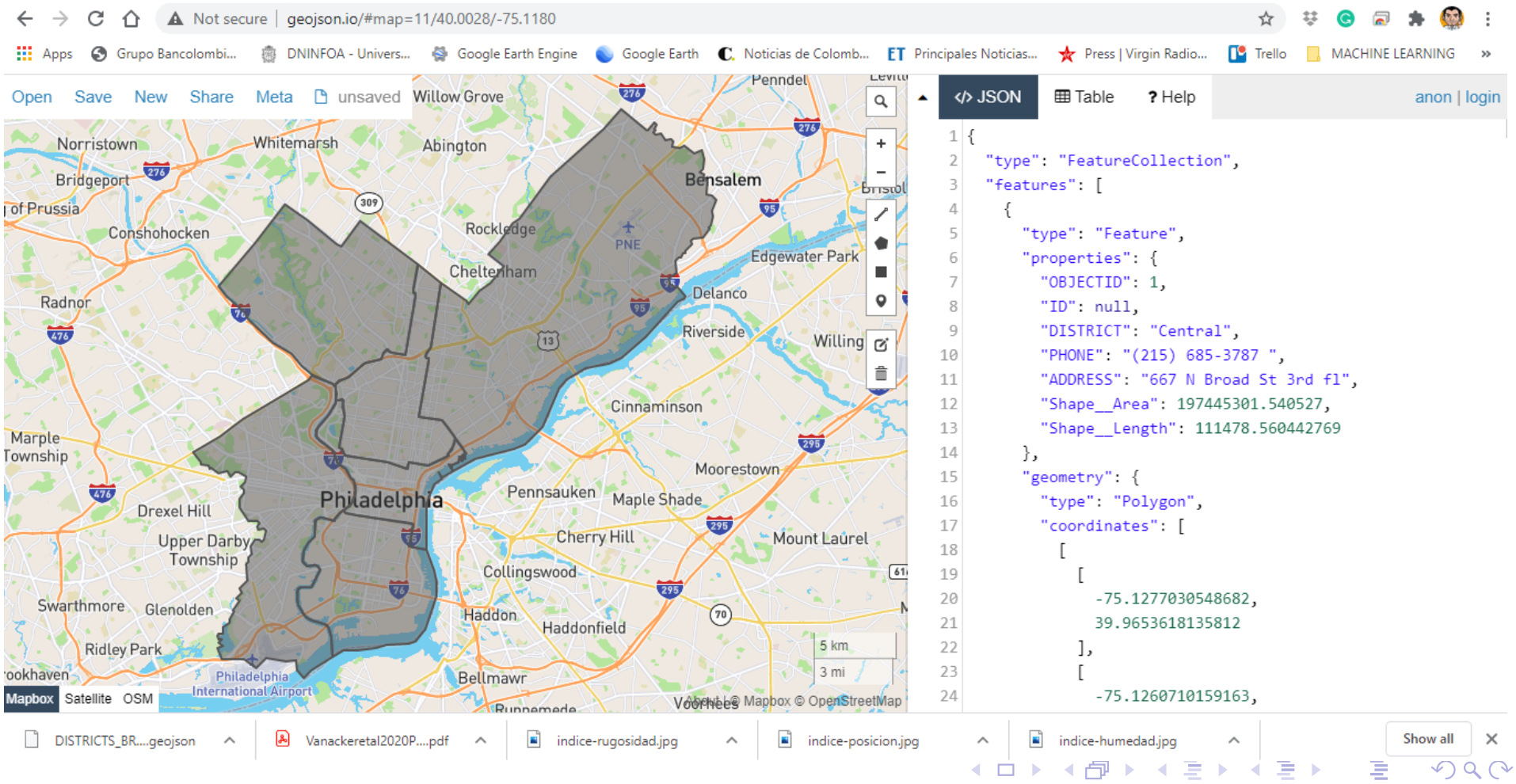
Point Cloud XYZ	.XYZ	XYZ files don't have specifications for storing point cloud data. The first 3 columns ge represent X, Y and Z coordinates. But there's no standard specification so it may inclu intensity values and other LiDAR values. They are in the ASCII point cloud group of file formats which includes TXT, ASC and P Non-binary files like XYZ are advantageous because they can be opened and edited in editor.

Raster

Extension	File Type	Description
Network Common Data Form (NetCDF)	.NC	NetCDF GIS format is an interface for array-oriented data for storing multi-dimensional variables. An example of a multi-dimension NetCDF could be temperature, precipitation or wind speed over time. It's commonly used for scientific data involved in the oceanic and atmospheric community as a GIS data storage format. The ArcGIS multidimensional toolbox and the QGIS NetCDF Browser both support NetCDF files.
Hierarchical Data Format	.HDF	HDF (Hierarchical Data Format) was designed by the National Center for Supercomputing Applications (NCSA) to manage extremely large and complex scientific data. It's a versatile data model with no limit on the number or size of data objects in the collection. ArcGIS is capable of reading HDF4 and HDF5 data. The free open source GDAL (command-line) tools supports the conversion of HDF files to GeoTIFF. The HDFView program allows users to view HDF files.

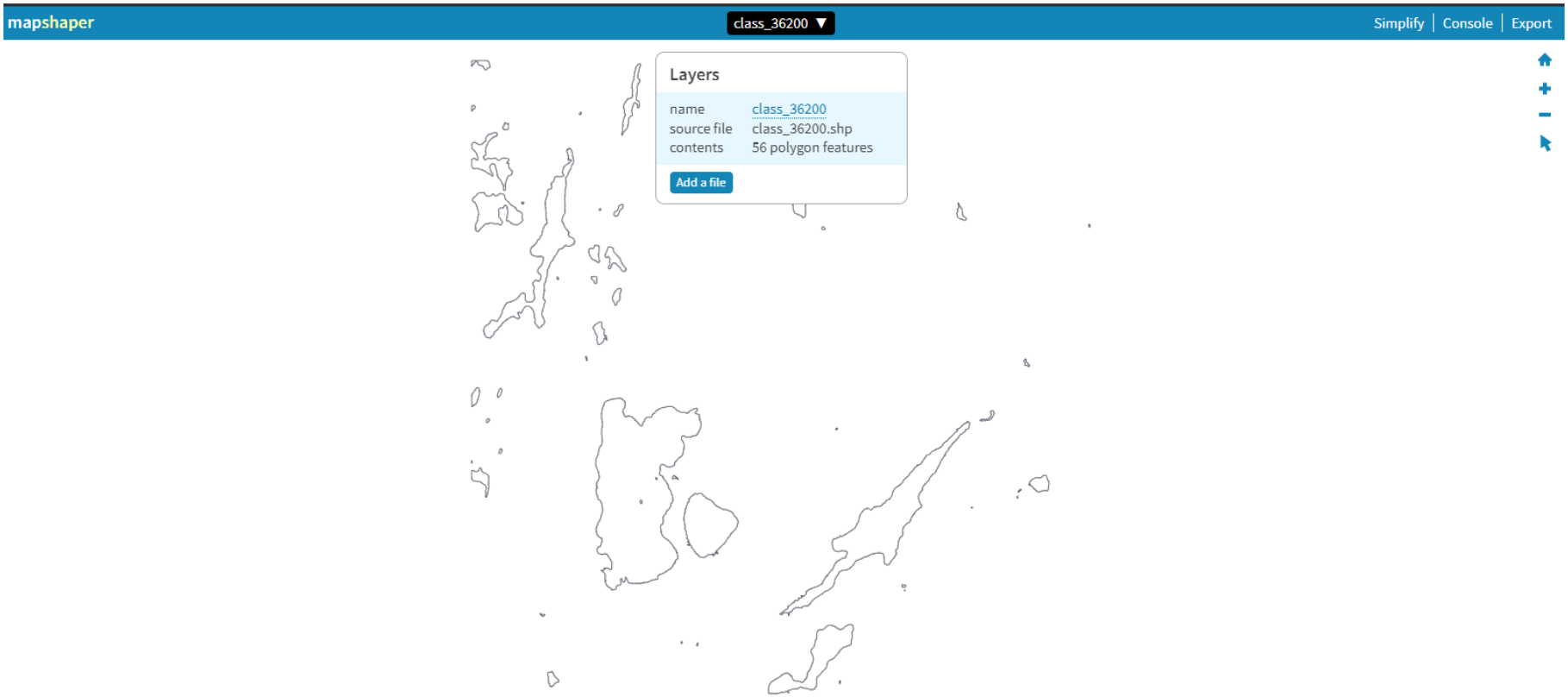
Ejemplo

http://geojson.io/



Ejemplo

https://mapshaper.org/



Ejemplo

https://www.arcgis.com/home/webmap/viewer.html