Data Visualization – Thematic Layers

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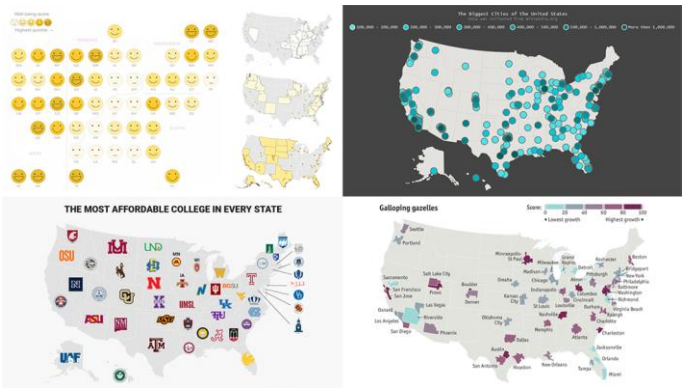
Introduction

Data visualization is the graphical representation of information and data by using visual elements like charts, graphs, and maps

Provide an accessible way to see and understand trends, outliers, and patterns in data



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The Meaning of Mapping

Maps are unique

A map places geospatial data in their correct relationship to one another

Map transfer your ideas about a place into the mind of a map reader

Mapping is the mental interpretation of the world i.e. how we perceive the world around us and interpret it spatially, often into a mapped form

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Maps are perfect interfaces between geoinformation and human users

Maps are efficient systems to structure and order information by spatial component

It is about efficient communication of spatial information to

- answer space-related questions
- support spatial behaviour
- enable spatial problem solving (reasoning, planning)
- support spatial awareness

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"A graphic depiction of all or part of a geographic realm in which the real-world features have been replaced by symbols in their correct spatial location at a reduced scale." (Clarke, 2001)

"Maps are used to visualize geospatial data, that is data that refer to the location or the attributes of objects or phenomena located on Earth."(Kraak & Ormeling, 2003)

The graphic representation of the geographical setting is what we call a map."(Robinson , 1995)

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Definitions

Purpose of Maps

Maps perform two important functions:

- Storage medium for information
- Provides a picture of the world to help understand:
  - Spatial patterns
  - Spatial relationships
  - Environmental complexity

Maps tell us:

- Where it is
- What it is
- When it is (often but not always)
- What is nearby
  - How far away
  - In which direction
  - How do I get there
- How might they be related

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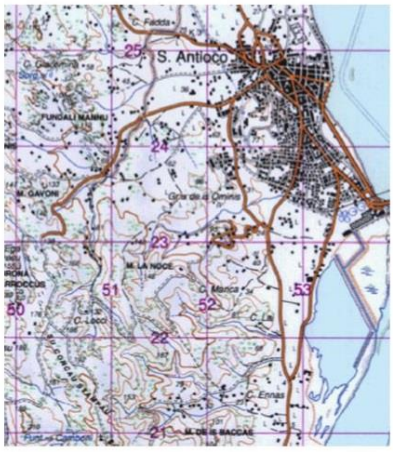
Map Types

- Topographical maps
  - Are multipurpose
- Thematic maps
  - Qualitative
  - Quantitative



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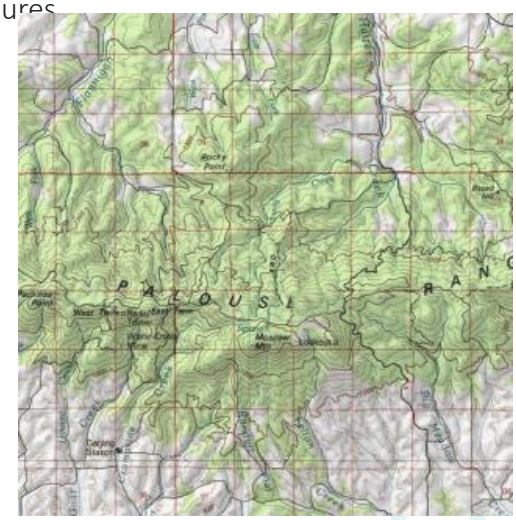
Showing locations of a variety of different features

- Distribution of land and sea
- Rivers and lakes
- Surface features and altitude relations
- Land cover
- Settlements
- Traffic network
- Power supply lines
- Reasonable single objects, like viewpoints
- Administrative borders
- Borders of protected areas



Topographical Maps

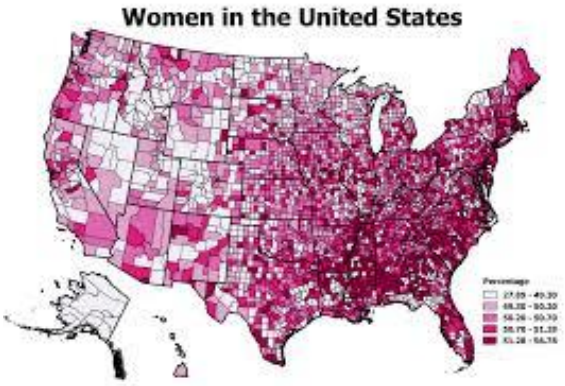
Concentrate on the distribution of a single attribute or the relationship among several

Spatial attribute can imply numbers, and forms the theme

Emphasize the spatial pattern of one or more geographic attributes qualitative vs. quantitative

Data displayed on the map is called a thematic variable

Different types of thematic maps, useful for showing different types of thematic variables



Thematic Maps

Common thematic map types include:

- Choropleth maps
- Dot density maps
- Proportional symbol maps
- Charts in thematic maps
- Gridded maps (heatmaps)
- Cartograms

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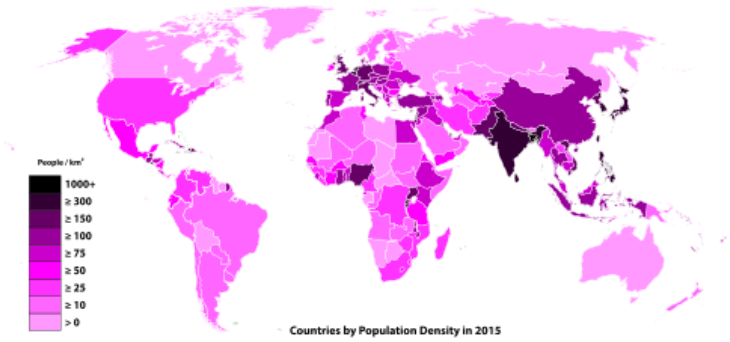
Types of Thematic Maps

Involves colouring geographic areas to represent categories of rates or densities

Most common type of thematic map

Represent a single georeferenced variable

Show variations over discrete regions



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Choropleth Maps

Showing a symbol (e.g., a dot) for each individual or group of individuals

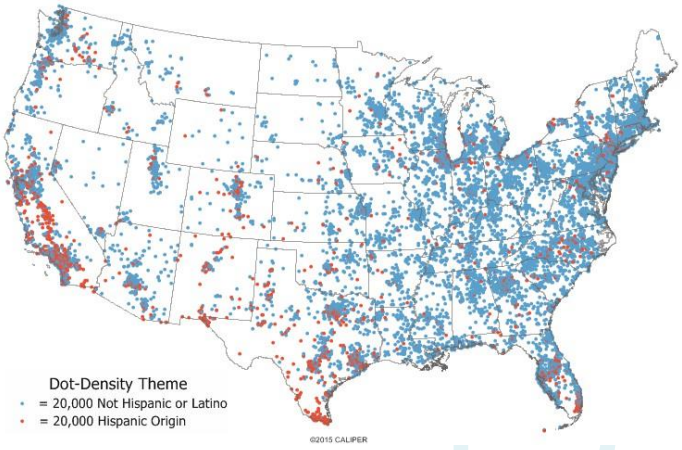
Used together with polygons

Useful to show densities or values in a continuous way

Can be used to show multiple variables (e.g., through multiple colours, dot sizes, symbols, etc.)

Fails when many individuals or groups are present

Only used when exact location is unknown



Dot Density Maps

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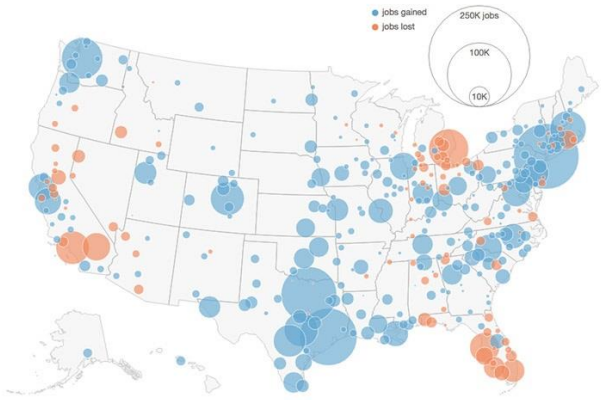
Also called graduated/graded symbol maps

Represent classes of counts, not individual counts

Useful for counts that lack exact location (use regions)

Can represent continuous or discrete (ranged) values

Can represent multiple variables through juxtaposed symbols at same locations



Proportional Symbol Maps

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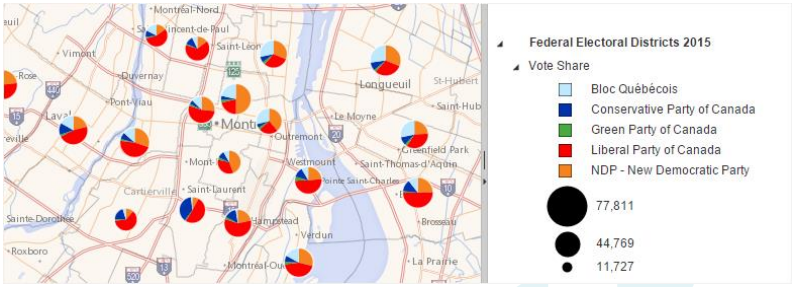
Can show numeric rates, numeric densities, or nominal values

For densities, the divisor is usually the magnitude of a geographic area

Can use various formats for the charts

Can show multiple variables



Charts in Thematic Maps

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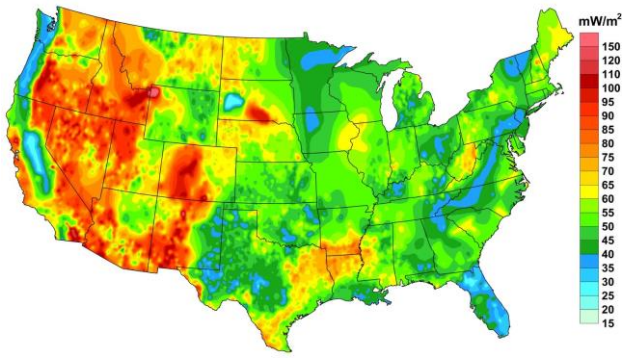
Can show numeric rates or numeric densities

Shows continuous variations for a single variable

Colours can be based on interpolated values from centroids



Gridded Maps (Heatmaps)

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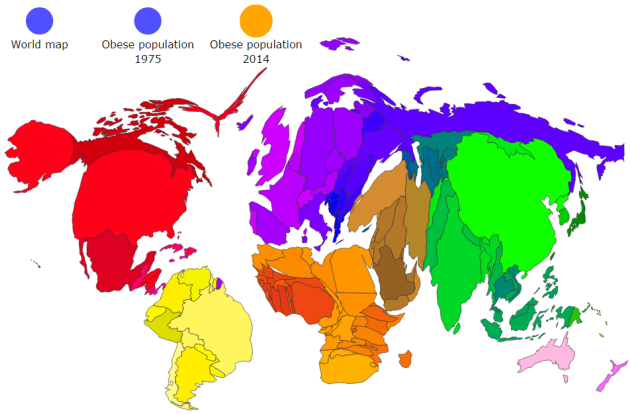
Deform map area or map distance with basis on the variable being represented

- *Area cartograms*
- *Distance cartograms*

Shows a single variable e.g., travel times, population, …

Usually combined with other types of thematic mapping techniques



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Cartograms

Choosing a Map Type

Know your purpose (& audience)

- What do you/they want to see?
- What might you/they want to focus on?

Know the data

- Number of attributes
- Dimensions of the features: point, line, area, volume
- Date types: ordinal vs ordered (ordinal or quantitative)
- Trustworthiness: bad fields, inaccuracies, missing values

Decide how to visually encode the data

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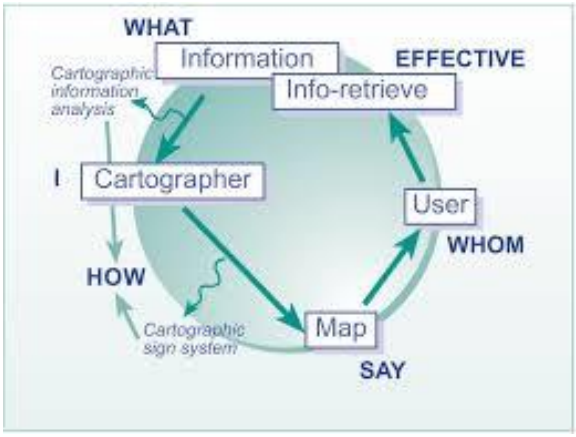
What = the information to be transferred to the map user

Whom = specific map user(s)

How = by using the grammatical rules of the language of cartographic symbols



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Purpose and Audience

Spatial dimension is the measurable extent of a symbol or phenomenon in space

Data representing a phenomena is grouped into 4 spatial dimensions which overlap with the graphic primitives used to create most graphical symbols (points, lines, and polygons)

Data dimensionality is scale specific

For instance, cities may occur at points on a small-scale map, but on a large-scale map it is more logical to display their areal extent

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Spatial Dimensions

Points

- Zero-dimensional
- Represented by a single coordinate
- Houses, buildings, and cities

Lines

- One-dimensional
- Represented by a sequence or point coordinates, connected by lines when drawn or analysed
- Rivers, roads and political boundaries.

Areas

- Two-dimensional
- Represented by polygons representing the boundary of the feature
- Vegetation types, lakes and land use patterns are examples of features commonly represented as regions

Volumes

- Three-dimensional
- Represented by a number of techniques adopted from computer graphics technology, as in a Triangulated irregular network

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The level of measurement refers to the relationship among the values that are assigned to the attributes for a variable

Data are classified into one of four empirical levels of measurement, which refers to how a phenomenon or variable was measured:

- Nominal
- Ordinal
- Interval
- Ratio

Each successively higher level contains all the characteristics of the lower levels

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Levels of Measurement

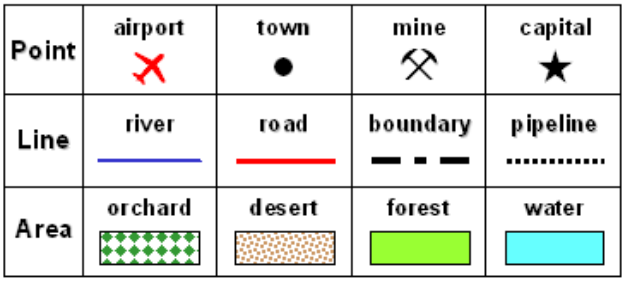
The lowest level

Qualitative in nature

Have no natural or implied order

- **Point**: labels at locations
- **Lines**: Network shown with symbols
- **Areas**: Classes shown by colour and pattern

e.g. soil types, gender, language



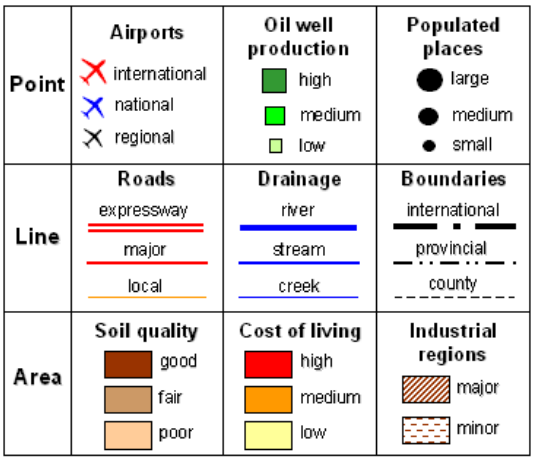
23 Nominal

The second level

Ordered or ranked data with no assigned numerical values

- **Point**: Use symbols size, shape and colour
- **Line**: Different symbols, line weights, colours
- **Area**: Colour, pattern. Legends often high, medium, low or similar

e.g. road classes. 'warm' versus 'cool'



24 Ordinal

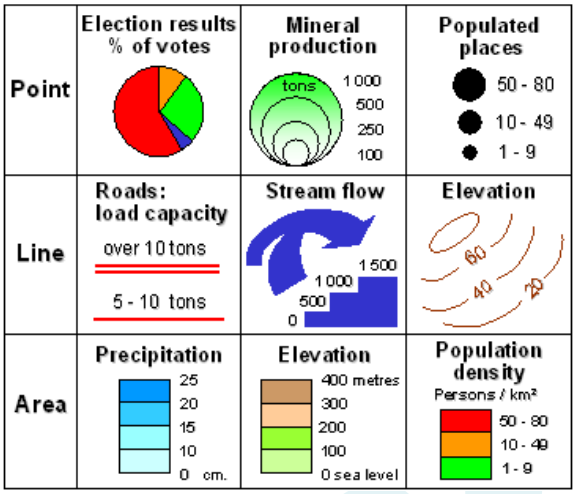
The third level

Numerically ordered data with an arbitrary zero point

Point: Proportional symbol, usually geometric object, varies in size, sometimes classed

Line: Flow map, line width proportional to value

Area: Prism map, shaded map, choropleth



25 Interval

The highest level

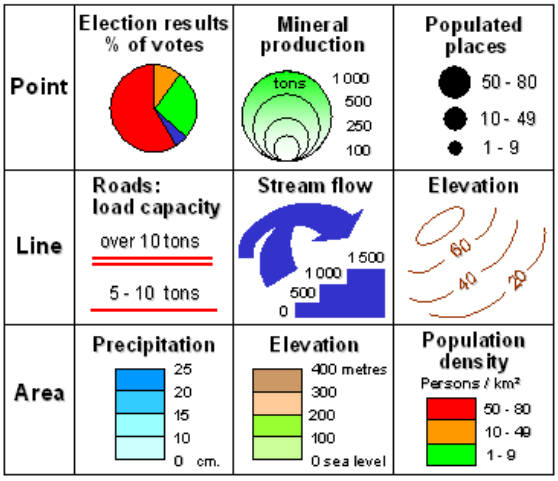
Numerical data with a non-arbitrary zero point

Point: Compound point symbol with encoded data

Line: Vectors, isolines

Area: Choropleth and other methods, e.g. dasymetric

Population density is an example of ratio-level data



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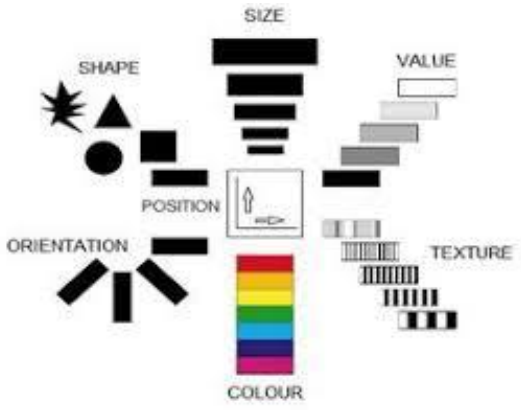
Jacques Bertin (1967 - 2010) proposed a system of visual variables by which map symbols could be used to encode information

It is a term used to describe the various perceived differences in map symbols that are used to represent geographic phenomena

Visual Variables are on basis of the level of measurement to be applied by different types of geodata



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The Visual Variable System

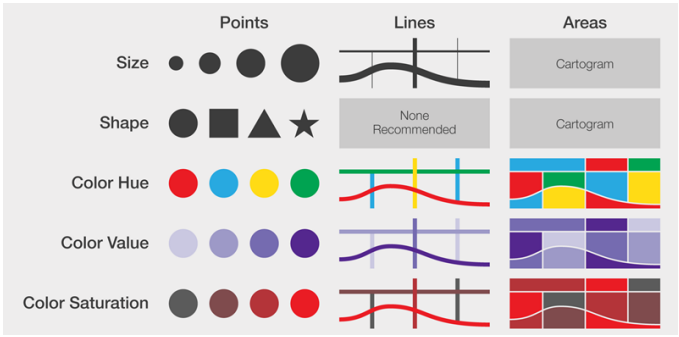
Size
Variations in the length, area, or volume of a symbol

Shape
Variations in the appearance or form of a symbol

Colour Value
Light or dark variations of a single hue

Colour Hue
A dominant wavelength of visible light (e.g., red, blue, green)

Colour Saturation
The intensity of a single hue



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Orientation

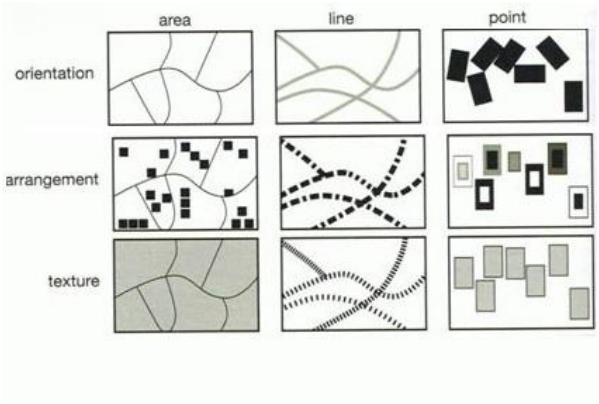
The direction or angle of rotation of a symbol

Texture

The relative coarseness of a map symbol

Arrangement

The distribution of individual marks that make up a symbol



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Conclusion

Geographic information is important to mapping

Thematic cartography vs. reference

Data organization and classification is vital

Data types and map types

Much dictated by continuity, data level and dimension of data

Map type should be appropriate for data type

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Thank You!