

GEO 447 PRINCIPLES OF GIS

- Course Syllabus
- Basics

Before GIS there were

- maps: what are they, how are they used, and key concepts
- computers: what are they, how are they used, and key concepts

Class slides are based on readings, the current NCGIA Core Curriculum for GIS(ystems) and GIS(cience), Kemp & Goodchild (1991), the NCGIA Core Curriculum Project at UBC, and Foote & Heubner's *The Geographer's Craft*

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Maps

- A map is. . .

“a representation, normally to scale and on a flat medium, of a selection of material or abstract features on, or in relation to, the surface of the Earth” (ICA)

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Maps

- Maps are more than representations of the Earth
 - We ‘map’ concepts
 - We ‘map’ ideas
 - We ‘map’ arguments

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Maps

- As Cartographic representation:
 - selective reality (i.e. bridges, churches, railways)
 - simplification of world
 - rocky coastlines
 - missing roads
 - exaggeration of world
 - small rivers
 - Pink countries
 - symbolization to represent the different classes of features chosen

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Types of Maps

- Topographic: reference of natural & human landmarks & features
 - Most often associated with topography (relief)
 - Usually considered ‘accurate’
 - a standard reference map
 - “Topo Quads”

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Type of Maps

- Thematic: Convey a theme or concept
 - Choropleth: states, counties, etc..
 - Isoline: Closely associated with elevation & weather-related phenomena--but can also be used to convey other data
 - Dot-Density: density of dots denotes value
 - Graduated Symbol: size of symbol denotes value
 - Extruded/3D: height denotes value

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About Maps . . .

- usually out of date
- stylized, generalized or abstracted, requiring careful interpretation
- temporal limits

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Maps are good for....

- Getting from point A to Point B
- Locating a single object
- Hanging on a wall, stuffing in a drawer, & losing (of course, that's a joke)

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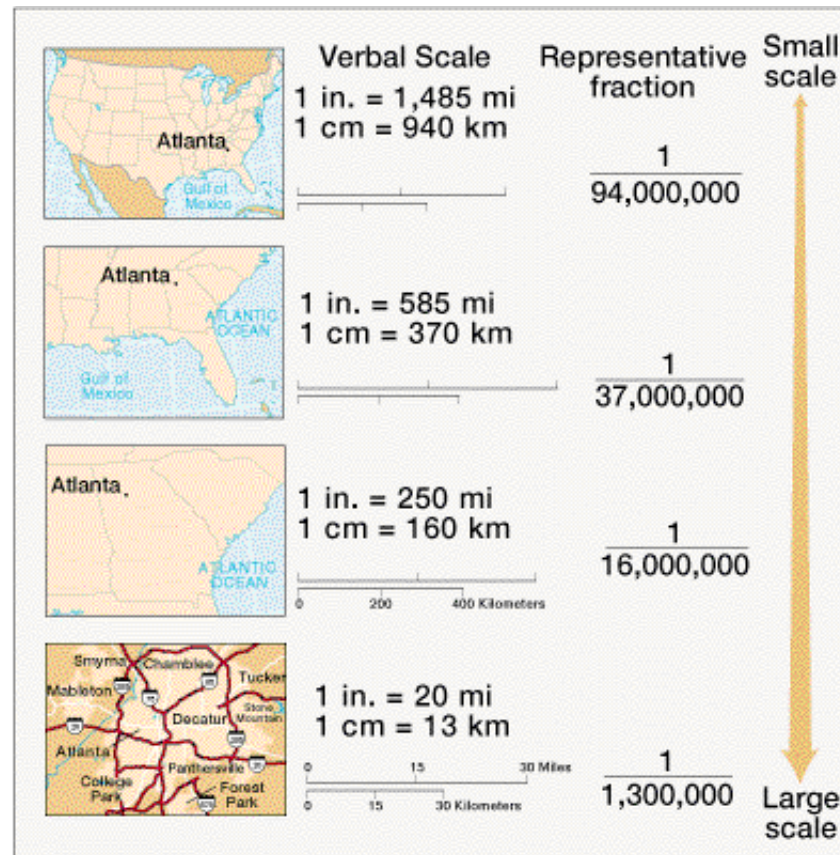
Maps aren't good for . . .

- Calculating the area of a parking lot
- Determining how many cubic yards of fertilizer will be needed to farm a mapped region
- Determining viewsheds
- What is the exact value at a given point?

Maps: Scale

- Scale refers to ratio between map objects and real world objects
 - expressed as representational fraction
 - controls which features are shown
 - large scale maps show small areas (1:1,000)
 - small scale maps show large areas (1:100,000)

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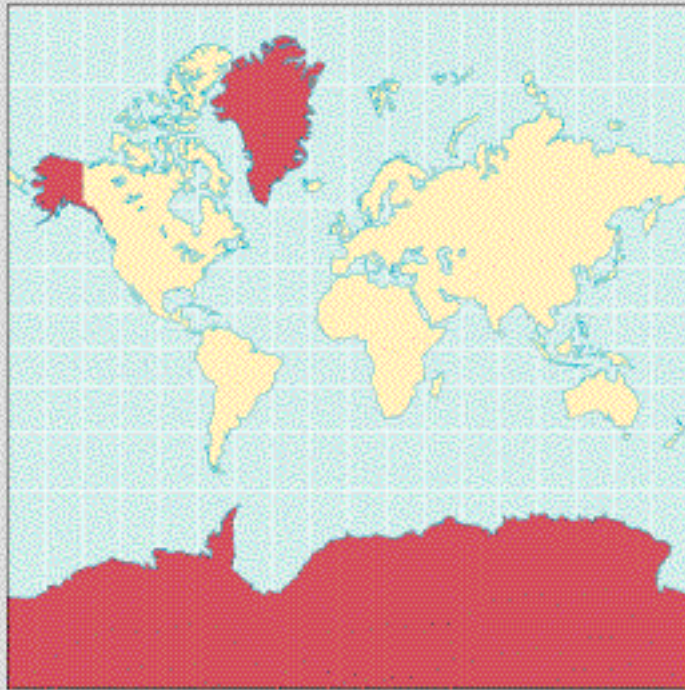


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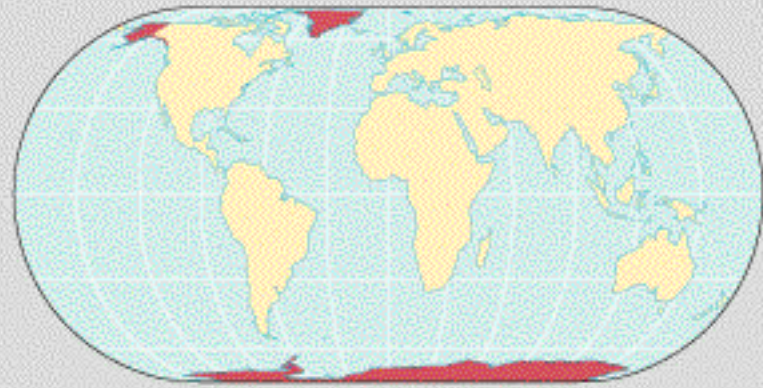
Maps: Projections

- Since the Earth is curved, distortion is inevitable
- Projection type determines which characteristics are distorted
- A single projection can only preserve one of these characteristics:
 - shape (conformal), area (equivalent 1), distance (equivalent 2)

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(a) Conformal



(b) Equivalent

Other Map Issues

- Maps can be used to aid in:
 - Data Storage
 - Constructing boundaries (identify clusters/classes)
 - Informing & forming theory (spatial clusters may lead to testing hypotheses)
 - Inventorying Phenomena (counting & classifying)
 - Performing ‘rough’ analysis (eyeballing the data)
 - overlay with tracing paper

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Computers

- Software
 - encoded instructions
 - the heart of contemporary computer science
- Hardware
 - CPU, Monitor, Input Devices (scanners, digitizers, keyboard, mouse), Output Devices, (Plotters/Printers), Storage Devices (HD, Remote Servers), Other Peripherals (modems, video/sound cards, etc..)

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Computers: Coding

- Electronic devices are on or off
 - The Boolean Logic of electronics results in a binary environment (ON/OFF, YES/NO, OPEN/CLOSED)

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Computers: Binary Notation

- One 'toggle switch' can be turned on or turned off
 - Yes/No = 1/0 = On/Off
- All binary notation extends from the possible combinations of 1 & 0 when additional switches are added
 - 2 switches = 00, 01, 10, 11
 - 3 switches = 000, 001, 010, 011, 100, 101, 110, 111

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Binary, Bits, & Bytes

- Today, there are commonly 8, 16, & 32 switches
 - 8 switches=256 combinations of 1/0
- Each switch (a single binary digit 1 or 0) is a **bit**
- There are 8 bits in a **byte**.
 - A byte is ‘numbered’ based on the position of the binary digit. Below is the position of digits in a byte:

7	6	5	4	3	2	1	0
128s	64s	32s	16s	8s	4s	2s	1s

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ASCII Notation

- ASCII is a standardized format for exchanging binary data between machines
- ASCII assigns 128 ‘alpha-numeric’ characters to 7 bits
 - the 8th may be a formal separator, simply ignored, redundant, or use to extend to 256
- Non-ASCII, plain "binary", are often software & machine specific
- Instructions 0-32 are special instructions

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Computers: Key Hardware Concepts

- CPU: Central Processing Unit
- Memory
 - measured & stored in bits, bytes, Kbytes (K, Kb, 10³ bytes), Megabytes (Mb, 10⁶ bytes), Gigabytes (Gb, 10⁹), Terabytes (Tb, 10¹²)
 - Two Types: Main/Operational (RAM) & Secondary/Storage (ROM)

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Software Basics

- Encoded Executable Instructions which operate the CPU (an operating systems) & perform specialized tasks (applications)