## First Exam: New Date

❖**Friday, March 2, 2018.**

- **Combination of multiple choice questions and map interpretation. Bring a #2 pencil with eraser.**
- **Based on class lectures supplementing text book chapter 1.** Review lecture slides 1-8.

➢ **If you miss this exam, a written make up consisting of definitions, concepts and explanations will be given.**

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# 8
# Geographers' Tools: Automated Mapping

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## Digitizing a Map

❖ A **digitizer** turns a printed map into electronic format by assigning **X,Y coordinates to every point** on the map like a mesh. *The closer the points the sharper the image (similar to pixels).*

- **Attributes** (details) are added to each coordinate point: *these may include latitude, longitude, time of day, elevation, land use, photographs, crime statistics, colors, symbols or shading, etc.*

➢ This is called **"geocoding"** – The *adding of attributes (or details) to point locations.*

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## Revising a Digitized Map

➢ **We can now revise a map without redrawing it by just updating the attributes at a particular X,Y coordinate.**

1. We go to the geocoded list and make needed changes.
2. The mapping program will reconfigure the data as soon as "enter" is hit.
3. A new, revised map will be produced and is ready to be viewed and/or printed.

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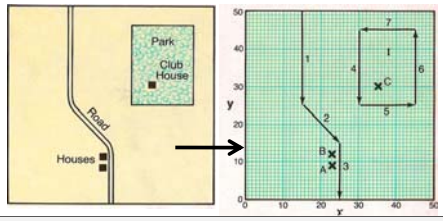
## The Digitized Map




A printed map is turned into electronic format **by covering it with an electronic mesh of reference points.**

This can be done in two different ways by using the **vector format** or the **raster format**.

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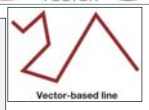
## Vector and Raster Formats

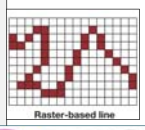

**Vector: Assigns data to X,Y coordinates.**

Thousands of points with different attributes can be placed very close to each other. **This creates a relatively smooth image and can be enlarged without distortion.**

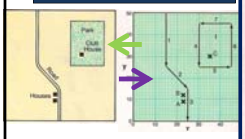



**Raster: Uses equal-sized coded cells (pixels) to show data.** The entire cell has the same value (information).

This gives a boxy appearance, especially when zooming in on an area, because the individual pixels can be seen. When densely packed (HD), **this creates a clear, sharp image.**




## Geocoded Entries



An electronic mesh of X,Y coordinates covers the map.

THEN attributes are added to each coordinate.

*In the file, information is cross-referenced by X,Y coordinates and attributes.*

| Symbol: Point Letter | Attribute (What's there) | x,y Coordinates |
|---|---|---|
| A | House | 23,9 |
| B | House | 23,12 |
| C | Club House | 35,30 |
| **Line Number** | | |
| 1 | Road | 15,50–15,25 |
| 2 | Road | 15,25–25,15 |
| 3 | Road | 25,15–25,0 |
| 4 | Park Boundary | 30,45–30,25 |
| 5 | Park Boundary | 30,25–45,25 |
| 6 | Park Boundary | 45,25–45,45 |
| 7 | Park Boundary | 45,45–30,45 |
| **Area Numeral** | | **Boundary Lines** |
| 1 | Park | 4,5,6,7 |

Map Symbol | Attribute | Geocoded entries

*To each coordinate, symbols and colors may be assigned. Maps can be redrawn using any of the variables programmed into the system = automated cartography.*

## Automated Cartography

❖ **Automated or computer cartography** employs a digital database and software programs to **COMPILE, DESIGN, DRAW** and **REVISE** maps.

- It includes a **Digital Elevation Model (DEM):** a set of equally surfaced surface elevations keyed to latitude and longitude.
- DEM is compiled using **global position system** (**GPS**) (latitude/longitude/elevation/time).
- Flood zone maps are based on water reaching a preset elevation.

https://coast.noaa.gov/floodexposure/#/map

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## Georeferencing: Control Points

**1. In order to match old paper maps, aerial photographs and satellite imagery with each other, objects** (control points) **need to be identified, geocoded** (lat./long. coordinates along with specific information to create data points).

**2. Control points** (minimum of four; the more the better) **are selected for their permanency over time** so as to avoid any argument as to their location past or present.

**3.The paper map, photograph or image is scanned** (digitized) **to convert it to electronic format.** In this way they can be manipulated, moved and saved for future retrieval.

https://www.youtube.com/watch?v=PXiLcYBlq9Y 2 min georeferencing

https://www.youtube.com/watch?v=r9eBx9zoagc 5 min control point

http://nls.georeferencer.com/map/1ArXmBwCXwFtySLq0Jbk7m/201705240629-vvCN21/visualize#

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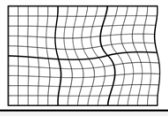
## Georeferencing: matching control points



**4. The digitized images are moved electronically to place them over each other,** making sure the control points match up.

**5. Transformation georeferencing maintains straight lines and reduces distortion by just rotating, scaling or skewing the object.**


**6. Rubber sheeting is a georef. process by which a data layer is distorted** (pulled/bent/shrunk/rotated) **to make it fit with other geographic layers of the same area.**

- ✓ It preserves the interconnectivity between points.
- ✓ It does not preserve straight lines and may have to be re-adjusted to avoid major distortions.

➢ ***This is used to rectify historic maps with present-day landscapes by matching objects found in both.***

http://maps.nls.uk/geo/explore/#zoom=5&lat=60.7087&lon=-17.7409&layers=101943491&b=1

http://maps.nypl.org/warper/maps/8245#Preview_tab

http://www.e-perimetron.org/Vol_2_2/Davie_Frumin.pdf walled city of 18th century Beirut

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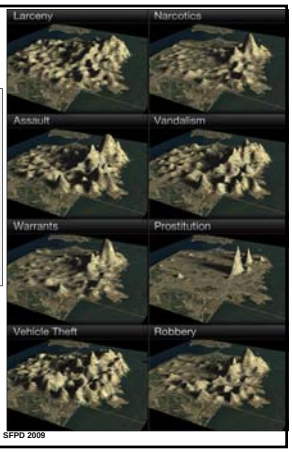
## Crime Data

**San Francisco crime statistics represented in an elevation model.**

Shows concentration by neighborhood. Crime reports are located using X,Y coordinates. Studying individual crime maps can lead to selective policing.

**Here the number of crimes, not altitude, is used by the elevation model to create the "hills."**




SFPD 2009

## 3-D Maps and Animations

**Many attributes can be assigned to each coordinate**: elevation, land use, crime stats, temperature, etc.

❖ **Now we can add information as to how that point will appear under a set of circumstances**: time of day, angle of the sun, approaching a site from a certain direction.

**We can also add time sequencing** (movement).

➢ **The result is an animated 3-D map** that can be manipulated by changing variables in a time sequence that gives the illusion of movement.

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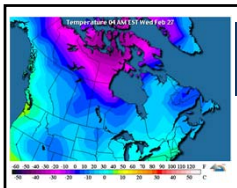
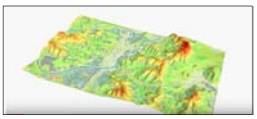
## 3-D Animated Maps





2 minute ARCscene 3-D landscape animation
https://youtu.be/tGOTmgthQxE

3 minute Big Bend National Park, TX animation
https://www.youtube.com/watch?v=d4VEIja7Noc

https://www.youtube.com/watch?v=QApMk7b52Eq
4 min Newark take-off

5 minute Portland, OR 3-D city animation
https://www.youtube.com/watch?v=9CyGqquOhso

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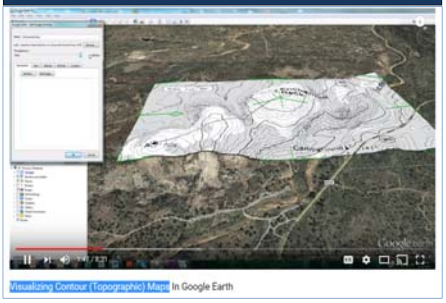
## Draping a Map over an Image




https://www.youtube.com/watch?v=55BNufFfXdc
8 min Visualizing Topographic Maps

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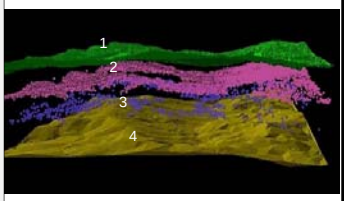
## LIDAR MAPPING

**LIDAR - Light Detection and Ranging** - is a remote sensing method used to examine the surface of the Earth. It can be calibrated to detect layers.

Visualization of multiple LIDAR returns in a forest canopy, showing:

1. Returns from the top of forest canopy,
2. Returns from forest understory
3. Returns near or on the ground.
4. The bare earth surface produced from post-processing is also shown.

*SOURCE: ASPRS*




2 minute ARC GIS landscape modeling animation with LIDAR
https://www.youtube.com/watch?v=og3-Kq9lyeU

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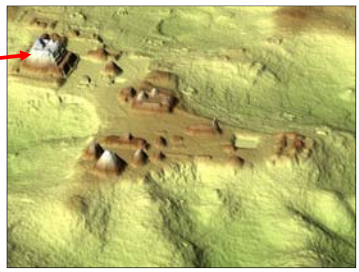
## Using LIDAR to Map a Forest-hidden Archeological Site


## Using LIDAR to Map an area covered by a Dense Forest



**LIDAR sees through the tree cover to locate non-vegetated objects when vegetated "echoes" are removed in processing.**

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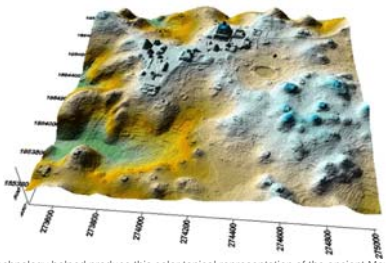
## Caracol, Belize LIDAR Image



Lidar technology helped produce this color topical representation of the ancient Mayan city of Caracol. Photograph: Caracol Archaeological Project, University of Central Florida

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## LIDAR use in GEOLOGIC SURVEYS

❖ **"Bare Earth"** LIDAR technique enables researches to remove overlying land cover, both man-made and natural, to see bedrock formations.


http://lidarportal.dnr.wa.gov/#47.08509:-122.10754:9

https://wadnr.maps.arcgis.com/apps/Cascade/index.html?appid=36b4887370d141fcbb35392f996c82d9

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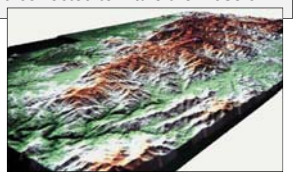
## Computer Cartography

**There are many steps required to prepare images for mapping.** Electronic images must be processed and corrected to make them useful.



**Satellite image of Great Smoky Mts. National Park draped over a DEM.**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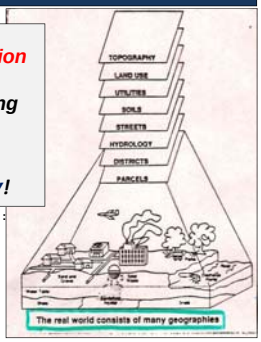
## GIS: Geographic Information Systems

❖ *A **GIS** is a **spatial information system** that is designed for **data management, mapping and analysis.***

***It goes beyond automated cartography!***

https://www.youtube.com/watch?v=oMUGp0rGf7I :
**What is GIS (2 min)**

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## GIS: Geographic Information Systems

*A GIS is a spatial information system that is designed for data management, mapping and analysis.*

❖ **Four features of a GIS make it a useful tool:**

1. It allows data to be manipulated.
2. It is interactive.
3. It helps us to create standardized models.
4. It helps us to create geographic simulations or "Smart GIS".

**Layered data tied to latitude and longitude coordinates allows a GIS to work.**

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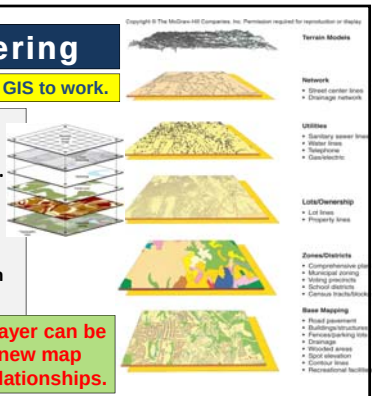
## GIS: Layering

**Layered data allows a GIS to work.**

**Each data set layer is anchored by coordinates of latitude and longitude.**

➢ **Layers can be added and removed from the data base.**

➢ **Layers can be shown in any combination.**




**Variables within any layer can be altered to create a new map based on new data relationships.**

https://www.youtube.com/watch?v=6AlH5TvFoLw:
**Intro to GIS featuring Shasta College (CA) GIS Program (10 min)**

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## GIS: Geographic Information Systems

*A GIS is a spatial information system that is designed for data management, mapping and analysis.*

I. It allows data to be manipulated.

There is a data base of location information **plus** instructions.

- ✓ can produce special purpose maps
- ✓ can help answer the question: WHAT IF ….. ?
- ✓ can analyze situations and come up with a final map

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## GIS: Geographic Information Systems

*A GIS is a spatial information system that is designed for data management, mapping and analysis.*

II. It is interactive.

When one or more variable is changed, all other data will change accordingly based on the pre-programmed instructions.

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## GIS: Geographic Information Systems

*A GIS is a spatial information system that is designed for data management, mapping and analysis.*

III. It helps us to create standardized models.

- **Capability Models**: Are the physical attributes of the area able to support activity "X"?
- **Suitability Models**: Do the socio-economic attributes make this area a good location for activity "X"?

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## GIS: Geographic Information Systems

*A GIS is a spatial information system that is designed for data management, mapping and analysis.*

IV. It helps us to create geographic simulations or "Smart GIS".

*The map of the future is an intelligent image.*

a) **Recognize** a situation (based on a model).

b) **React** to it (based on another model).

c) **Send out instructions** (based on a third model).

**Your car GPS talking to you** (insisting you to make a U-turn).
**Locating and isolating a water main break.**
**Turning traffic lights in favor of emergency vehicles.**
**Creating a detour route for traffic in congested areas.**

https://www.youtube.com/watch?v=DV4QgJNIju0 flood model 6 min

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## Examples of GIS

https://www.youtube.com/watch?v=6AIH5TvFoLw: Intro to GIS featuring Shasta College (CA) GIS Program (10 min)

- http://storymaps.esri.com/stories/2012/whitenose/
- http://storymaps.esri.com/stories/ireland/
- www.google.com/maps
- http://fema.maps.arcgis.com/home/webmap/viewer.html?webmap=cbe088e7c8704464aa0fc34eb99e7f30&extent=-74.023087936646,40.59437834730017,-73.98652406335401,40.605131235247505

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## NEXT CLASS: First Exam

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