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 textbook chapter 1. Review lecture slides 1-8.
  - If you miss this exam, a written makeup consisting of definitions, concepts and explanations will be given.

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.

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. 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.

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.

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.
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.

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

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 permanence 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.

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 georeferencing 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.

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."

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.

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
3-D Animated Maps

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

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

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

3 minute Big Bend National Park, TX animation
https://www.youtube.com/watch?v=55BNufFfXdc

2 minute ARC GIS landscape modeling animation with LIDAR
https://www.youtube.com/watch?v=1s89hPvI6dU

Draping a Map over an Image

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.

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.

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.

LIDAR - Light Detection and Ranging

Using LIDAR to Map a Forest-hidden Archeological Site

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

“Bare Earth” LIDAR technique enables researchers to remove overlying land cover, both man-made and natural, to see bedrock formations.

https://jdzworld.ee.uw.edu.pl/207-0810-122-1017542
https://wadnr.maps.arcgis.com/apps/Cascade/index.html?appid=36b488757f54d14e6bfae9239960d34

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.

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!

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

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

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.

GIS: Geographic Information Systems

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

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
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.

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"?

IV. It helps us to create geographic simulations or "Smart GIS".
The map of the future is an intelligent image.
- Recognize a situation (based on a model).
- React to it (based on another model).
- 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.

Examples of GIS
- http://storymaps.esri.com/stories/ireland/
- www.google.com/maps
- http://fema.maps.arcgis.com/home/webmap/viewer.html?webmap=cbe088e7c8704464a0f34eb99e7f30&extent=-74.023087936646,40.59437834730017,-73.98652406335401,40.605131235247505

NEXT CLASS: First Exam
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