Geog 126: Maps in Science and Society

A history of Multimedia and Web GIS
If only we’d known

“I think there may be a world market for five computers in the world”

Thomas Watson Chairman IBM 1943

“There is no reason for individuals to have a computer in their home”

Ken Olson CEO DEC 1977

“640,000 bytes of memory ought to be enough for anybody”

Bill Gates Microsoft 1981

“The Internet? We are not interested in it.”

Bill Gates Microsoft 1993
Early Internet History

- J.C.R. Licklider of MIT, then DARPA, first proposed a global network of computers in 1962.
- Leonard Kleinrock of MIT and later UCLA developed the theory of packet switching.
- Lawrence Roberts of MIT connected a Massachusetts computer with a California computer in 1965 over dial-up telephone lines.
- Kleinrock's packet switching theory was confirmed.
- Roberts moved over to DARPA in 1966 and developed his plan for ARPANET.
Leonard Kleinrock demonstrates how the first Internet communication was made with the help of an Interface Message Processor machine at his office at the UCLA Computer Science Department in Los Angeles.
Simple beginnings

• ARPANET, was brought online in 1969
• Initially connected four major computers at universities in the southwestern US (UCLA, Stanford Research Institute, UCSB, and the University of Utah)
• 1970, MIT, Harvard, BBN, and Systems Development Corp in Santa Monica, Cal. were added.
• 1971, Stanford, MIT's Lincoln Labs, Carnegie-Mellon, and Case-Western Reserve U were added. Also, NASA/Ames, Mitre, Burroughs, RAND, and the U of Illinois plugged in.
• First message: Charlie Kline at UCLA sent the first packets on ARPANet as he tried to connect to Stanford Research Institute on Oct 29, 1969
• The system crashed as he reached the G in LOGIN!
The doubling begins
Important landmarks

- E-mail 1972 (Ray Tomlinson of BBN selects @)
- Telnet, ftp 1972-3
- Ethernet 1974, outgrowth of Bob Metcalfe's Harvard dissertation on "Packet Networks."
  - The dissertation was initially rejected by the University for not being analytical enough
- Frederick G. Kilgour of the Ohio College Library Center (now OCLC, Inc.) led networking of Ohio libraries during the '60s and '70s.
- TCP/IP develops 1970s onward
- BITNET connected IBM mainframes around the educational community and the world to provide mail services beginning in 1981 (includes listserves)
- 1986, the National Science Foundation funded NSFNet
- 1989 Archie, WAIS
Web landmarks

• **Gopher** (distributed document search and retrieval network protocol )
  – Used hyperlinking features
  – Replaced by HTTP protocol
• Later tools built upon HTTP: e.g. Mosaic, Mozilla
• Mosaic was developed at the National Center for Supercomputing Applications (NCSA) beginning in late 1992. NCSA released the browser in 1993, and officially discontinued development and support on January 7, 1997
Apple’s Hypercard “Stacks”

Welcome to the GNU Project web server, www.gnu.org. The GNU Project was launched in 1984 to develop a complete UNIX style operating system which is free software: the GNU system (GNU is a recursive acronym for &ldquo;GNU's Not UNIX;&rdquo; it is pronounced &ldquo;guh-noo;&rdquo;) Variants of the GNU operating system, which use the kernel Linux, are now widely used; though these systems are often referred to as &ldquo;Linux;&rdquo; they are more accurately called GNU/Linux systems.

This is also the web site of the Free Software Foundation (FSF). FSF is the principal organisational sponsor of the GNU Project. FSF receives very little funding from corporations or grant-making foundations. We rely on support from individuals like you who support FSF’s mission to preserve, protect, and promote the freedom to use, study, copy, modify, and redistribute computer software, and to defend the rights of Free

This is a new version of the NextStep WorldWideWeb application with the libWWW library. Bug reports to tmb@info.cern.ch, quoting the version information above. Check the list of known bugs in the web too.

This was the original prototype for the World-Wide Web. Many browsers for other platforms now exist (Read the web for details). After many years lying dormant, this application has now sprouted images and nested HTML elements and things. If you have an Internet connection, then using “Help” under the Info menu will tell you all about this application. If you don’t have an internet connection-- get one! ;)

If you want to be able to read news, you should set the name of your local news server in the preferences.

http://www.gnu.org/
Arrival of the Browsers

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NCSA Mosaic for MS Windows

**Document Title:** NCSA Mosaic Home Page

**Document URL:** http://www.ncsa.uiuc.edu/SDG/Software/Mosaic/NC

Welcome to NCSA Mosaic, an Internet information browser. Mosaic was developed at the National Center for Supercomputing Applications, University of Illinois, in Urbana-Champaign. NCSA Mosaic is for Windows 3.1 or Later Required. Evaluation Copy. (Please Read License Agreement)
Browsers galore
2016 market share

Chrome: 47.5%
Safari: 20.1%
Internet Explorer & Edge: 12.4%
Firefox: 12.0%
Opera: 3.1%
Web cartography would have been impossible without…

• The Internet
• Precise positioning
• Mobile computing
• Wireless communications
• Standards
• Open Source software
The first GNSS: GPS
Mobile computing
Standards
Open Source Software

Welcome to the Quantum GIS Project

Quantum GIS (QGIS) is a user friendly Open Source Geographic Information System (GIS) licensed under the GNU General Public License. QGIS is an official project of the Open Source Geospatial Foundation (OSGeo). It runs on Linux, Unix, Mac OSX, and Windows and supports numerous vector, raster, and database formats and functionalities.

Our latest release is QGIS 1.7.3 you can read the release announcement here.

Learn more about QGIS

Quantum GIS provides a continuously growing number of capabilities provided by core functions and plugins. You can visualize, manage, edit, analyse data, and compose printable maps. Get a first impression with some screenshots and a more detailed feature list.

Download Now
Free!

Want to learn even more?
Isla Vista is an unincorporated community in Santa Barbara County, California, United States. As of the 2000 census, it had a population of 16,344. The majority of residents are college students at nearby UC Santa Barbara or at Santa Barbara City College. The beach-side community is a census-designated place west of the University of California, Santa Barbara, on a flat plateau about 30 feet (9 m) in elevation, separated from the beach by a bluff. Many paths connect the town to the beach.

Isla Vista enjoys a Mediterranean climate and often has slightly less precipitation than either Santa Barbara or the adjacent community of Goleta. Isla Vista is located on a south-facing portion of the Santa Barbara County coast, between two small peninsulas, Coal Oil Point and Campus Point, in view of the Channel Islands. During El Niño years, precipitation in Isla Vista can be excessive and potentially dangerous. Some homes and apartments built on the south side of Del Playa Drive, most popular with students due to their direct ocean views, are in danger of collapse, since they are built on quickly-erosing bluffs thirty to sixty feet above the relentless Pacific Ocean. Recent erosion has exposed foundation supports in several of the properties closest to the university campus, UCSB.

As Isla Vista is on the south coast of Santa Barbara County, which has some of the highest housing prices in the United States, the student population shares densely packed housing with a working Hispanic population. Since Isla Vista has not been annexed by either Goleta or Santa Barbara, remaining unincorporated, only County funds are available for civic projects.

Isla Vista is home to a student housing cooperative, the Santa Barbara Student Housing Coop, as well as a food cooperative, the Isla Vista Food Co-op.

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2 Isla Vista's History
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   13 Isla Vista's Future

Isla Vista, California

Location in Santa Barbara County and the state of California

Coordinates: 34°24′53″N 119°51′38″W

Country: United States
State: California
County: Santa Barbara

Government
- HSA
- Senate: Tom McClintock (R)
- Assembly: Pedro Nava (D)
- U.S. Congress: Lois Capps (D)

Area
- Total: 2.2 sq mi (5.7 km²)
- Land: 2.1 sq mi (5.4 km²)
- Water: 0.1 sq mi (0.2 km²)

Elevation: 45 ft (14 m)

Population (2000):
Geohack: 43 Geospatial info sources

View the location above by click a mapping link below.

**Global services**

<table>
<thead>
<tr>
<th>Service</th>
<th>Map</th>
<th>Satellite</th>
<th>Other</th>
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<tbody>
<tr>
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<td>Map</td>
<td>Satellite</td>
<td>Terrain, Mapnik</td>
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<td>Ayna</td>
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<td>Satellite</td>
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<td>Map</td>
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<td>Bird’s Eye</td>
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<td>Satellite</td>
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<td>ExploreOurPlanet</td>
<td>Map</td>
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<td>Flash Earth</td>
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<td>Satellite</td>
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<td>GloBeXplorer</td>
<td>Satellite</td>
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<tr>
<td>Google Earth</td>
<td>Open</td>
<td>/ meta data</td>
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**United States**

<table>
<thead>
<tr>
<th>Service</th>
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<tr>
<td>ACME</td>
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<td>USGS Aerial</td>
<td>USGS Topo</td>
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<td>MapQuest</td>
<td>Map</td>
<td>Labeled satellite</td>
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<tr>
<td>MSN Maps USA</td>
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<td>Satellite</td>
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<td>National Weather Service</td>
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<tr>
<td>TerraServer-USA</td>
<td>Aerial</td>
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<td>Topo</td>
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<td>Topo</td>
</tr>
<tr>
<td>Trails.com</td>
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<td></td>
<td>Topo</td>
</tr>
</tbody>
</table>
Software Mash-Ups

The Homicide Report
THE TIMES CHRONICLES: L.A. COUNTY HOMICIDE VICTIMS

Showing 24 homicides from Jan. 1, 2012 to Jan. 15, 2012

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gerardo Fernandez</td>
<td>20</td>
<td>1/8/12</td>
</tr>
<tr>
<td>Hector Hernandez</td>
<td>42</td>
<td>1/8/12</td>
</tr>
<tr>
<td>Alberto Cruz</td>
<td>38</td>
<td>1/7/12</td>
</tr>
<tr>
<td>Juan Nunez</td>
<td>34</td>
<td>1/7/12</td>
</tr>
<tr>
<td>Mark Miles</td>
<td>43</td>
<td>1/6/12</td>
</tr>
<tr>
<td>Jeff Pouncil Jr.</td>
<td>19</td>
<td>1/5/12</td>
</tr>
<tr>
<td>Richard Hughes</td>
<td>38</td>
<td>1/5/12</td>
</tr>
<tr>
<td>Jane Doe #1</td>
<td>0</td>
<td>1/4/12</td>
</tr>
<tr>
<td>Jazmyne Eng</td>
<td>40</td>
<td>1/4/12</td>
</tr>
<tr>
<td>Calvin Millie</td>
<td>62</td>
<td>1/3/12</td>
</tr>
<tr>
<td>Asia Sonnier</td>
<td>33</td>
<td>1/3/12</td>
</tr>
<tr>
<td>David Morales Jr.</td>
<td>18</td>
<td>1/3/12</td>
</tr>
<tr>
<td>Jimmie Jackson Jr.</td>
<td>21</td>
<td>1/2/12</td>
</tr>
</tbody>
</table>

Homicides are grouped based on number of homicides in an area. Click a group to zoom there.
Enter the GeoBrowser

- Google Local 2004-5
- Data “Portals”
- Data “Clearinghouses”
- NSDI -> GSDI
- Vision of Digital Earth
NASA World Wind
ArcGlobe: 3D Analyst Extension
ArcExplorer (Release Nov. 29th 2006)
Punt Open Source Viewer
Microsoft: Virtual Earth
VRML and GeoVRML
GML (XML) and SVG
Cooperative computing BOINC

- The Berkeley Open Infrastructure for Network Computing platform is currently the most popular volunteer-based distributed computing platform
- Over 1,280,000 participants
- Over 2,730,000 computers
- Over 910 TeraFLOPS (more than supercomputer Blue Gene)
- Over 12 Petabytes of free disk space
- SETI@home: 3.4 million years of computing time (January 2008)
This globe shows your climate model running
Model date and time: 08/03/2044 13:00

Use keyboard keys to change view
Use CTRL + key when in screensaver mode
T - Temperature
R - Rain & snow
P - Pressure
C - Clouds
S - Stop/Start rotation
G - Show/Hide grid
H - Help & more options

Timestep
1121570 of 2073960

Your progress:
54.08%

2000 2080

Hours of computing:
08:25:02:25
An example: Google Earth
“We are like an iPod for Earth images.”

Michael T. Jones, Chief Technologist, Google Earth (Nov 2006)
Google Earth: A history

• Dayton Peace Agreement /Wright-Patterson Air Force Base, Ohio Dec 1995, ends war in Bosnia
• Google founded 1998
• Keyhole Earthviewer (2002) In-Q-tel funding
• Google buys Keyhole (Oct. 2004)
  – Google Maps/Local Feb. 8th 2005
  – Google Earth (June 2005)
  – Google Earth Community added (2005)
  – Partnership with National Geographic (2006)
• 100 million downloads: Version 4 (Nov. 2006)
• 1 Billion downloads: Version 6 (2011)
• API development ends 2015
Keyhole EarthViewer 3D
Google Earth Today

• Google Earth viewer 6
  – Timeline
  – Historical
  – Community Bulletin Board

• Google Earth Plus
• Google Earth Pro
• Google Earth Builder
• Google Earth Enterprise
Google Earth Mania
Google SketchUp
Model of the Alte Oper, Frankfurt
3D Warehouse
Multi-temporal: Rumsey Map Collection
<?xml version="1.0" encoding="UTF-8"?>
  <kml
    xmlns="http://earth.google.com/kml/2.2">
    <Placemark>
      <name>Simple placemark</name>
      <description>Attached to the ground. Intelligently places itself at the height of the underlying terrain.</description>
      <Point>
        <coordinates>-122.0822035425683,37.42228990140251,0</coordinates>
      </Point>
    </Placemark>
  </kml>
Computer mapping

• Now ubiquitous e.g. GoogleMaps
• Supports mobile applications and LBS
• Birth of Location Enabled Social Networking
Computer mapping

• Classic paper "Automation and cartography" W. R. Tobler 1959

AUTOMATION AND CARTOGRAPHY*

WALDO R. TOBLER

Automation, it would seem, is here to stay. Advantages in speed and accuracy seem likely to make the use of computing machinery more common, despite the relatively high initial cost. In view of recent developments in automation and high-speed data processing, it is appropriate to ask, Do possibilities for automation exist in cartography? And if so, where can these possibilities be found? In order to answer these questions, the preparation of maps should be viewed as a complex data-processing system. Certain similarities then become apparent between data processing in general and cartographic processing in particular.

Fig. 2—The data-manipulation phase of a data-processing system.

The Map as a Computer Input

The conceptualization of a map as a data-storage medium leads directly to the concept of it as a computer input element (Fig. 4). Here two methods of use seem possible. In the simpler, data are extracted from a map, translated into some symbology that available machinery will accept, and then operated upon by the data-manipulation unit. Examples would include the
SAGE computing (distributed and IO)

250 tons and 60,000 vacuum tubes
Operational 1963
Automation and cartography
A Brief History of GIS

• GIS’s origins lie in thematic cartography
• Many planners used the method of map overlay using manual techniques
• Manual map overlay as a method was first described comprehensively by Jacqueline Tyrwhitt in a 1950 planning textbook
• HcHarg used blacked out transparent overlays for site selection in *Design with Nature*
McHarg: Binary Overlays
A Brief History of GIS (ctd)

- The 1960s saw many new forms of geographic data and mapping software
- Computer cartography developed the first basic GIS concepts during the late 1950s and 1960s
- Linked software modules, rather than stand-alone programs, preceded GISs
- Early influential data sets were the World Data Bank and the GBF/DIME files
- Early systems were CGIS, MLMIS, GRID and LUNR
- The Harvard University ODYSSEY system was influential due to its topological arc-node (vector) data structure
Some software

- The first GIS, Canada Geographic Information System, was developed in mid-1960s to identify the nation's land resources and their existing, and potential uses.
- In the late 1960s, US Bureau of the Census created the DIME program (Dual Independent Map Encoding) for all US streets to support automatic referencing and aggregation of census data.
- In late 1970s, Harvard University's Laboratory for Computer Graphics and Spatial Analysis developed a general-purpose GIS (ODYSSEY GIS).
GBF/DIME 1965-1979

<table>
<thead>
<tr>
<th>Segment name</th>
<th>From node</th>
<th>To node</th>
<th>Block left</th>
<th>Block right</th>
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</thead>
<tbody>
<tr>
<td>Salem Rd.</td>
<td>75</td>
<td>75</td>
<td>302</td>
<td>308</td>
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<tr>
<td>Elm St.</td>
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<td>77</td>
<td>304</td>
<td>305</td>
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<tr>
<td>Elm St.</td>
<td>77</td>
<td>80</td>
<td>304</td>
<td>305</td>
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<tr>
<td>Taunus Ave.</td>
<td>80</td>
<td>79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belt Dr.</td>
<td>79</td>
<td>77</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pine Place</td>
<td>77</td>
<td>78</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Diagram showing road segments and block numbers.
CGIS

- Canada Land Inventory was designed in the late 1960's and implemented between 1967 and 1977.
- CGIS was the driver software.
- In its lifetime over 15,000 capability maps were produced.
A Brief History of GIS (ctd)

• GIS was significantly altered by (1) the PC and (2) the workstation
• During the 1980s, new GIS software could better exploit more advanced hardware
• User Interface developments led to GIS's vastly improved ease of use during the 1990s
• During the 1980s, new GIS software could better exploit more advanced hardware
GIS software in 1979

- A historical GIS “snapshot” was the IGC survey conducted in 1979
- In the 1979 survey, most GISs were sets of loosely linked FORTRAN programs performing spatial operations
- Computer mapping programs had evolved GIS functionality
GIS in the 1980s

- Spreadsheet was ported to the microcomputer, allowing “active” data
- Relational DBMS evolved as the leading means for database management
- Single integrated user interface
- Degree of device independence
- Led to the first true GIS software
- ESRI Arc/INFO 1981
GIS in the 90s

- Used graphical user interfaces and the desktop/WIMP model
- Unix workstations integrated GIS with the X-windows GUI
- GISs began to use the OS GUI instead of their own
- PCs integrated GIS with the variants of Windows and other OSs
ArcView 1.0 1995
GIS in the 2000s

- Mobile systems
- Web-based extensions
- Distributed systems and data
- Most software now object-oriented
- New competition
- Web services
- Location-based services
Arc Internet Map Server (ArcIMS)

- Advanced web GIS
- Product of ESRI
- Simplified ArcView
  - Basic GIS functions
- Single interface
- Uses ArcView Shapefiles
ArcGIS Online: The “Cloud”
Web server GIS tools
New distributed applications
New mobile applications
Visualization options

The text mentions a Madonna Concert held in Stadio Olimpico Rome on 2006-08-06. The text describes the cell phone activity in the stadium and notes that Madonna appeared against a mirrored cross. The text also mentions a location about three kilometers from the Vatican, with a song titled 'Live to Tell.'
Summary

- Internet origins 1960s ARPA
- Development leading to web browser, then geobrowser
- Many factors aligned after about 2000
- Google Earth as an example
- Covered early history of computer mapping, GIS
- Reviewed new applications