Lecture 16: Web-based cartography
Web cartography

- Examine history of the WWW
- Maps and the web, and how they developed
- New capabilities, data, search, distribution, interaction
- The evolution of the client-server model
- Mobile computing and the web
- The GoogleMaps/Earth Era
- Spatially enabled Location-based services and maps
- What next?
Early Internet History

• J.C.R. Licklider of MIT, then DARPA, first proposed a global network of computers in 1962. Predicted interactivity, GUIs
• Leonard Kleinrock of MIT and later UCLA developed the theory of networks and 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 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 @) When Tomlinson showed it to his colleague Jerry Burchfiel, Tomlinson said "Don't tell anyone! This isn't what we're supposed to be working on."
• 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
Packet switching

Protocols
Send/Acknowledge
Wrapper: target
IP address
Divided content
Handshake
Header, Path
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

• Led to Netscape and Mozilla

• NSF Network project BITNET
Apple’s Hypercard “Stacks”
Interactive map software

- Created interactive Choropleth mapping program using hypercard and Fortran: MacChoro 1986
- Added animation in 1988
Arrival of the Browsers
Browsers galore: MapMyUser
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
Isla Vista, California

Isla Vista is an unincorporated community and census-designated place in Santa Barbara County, California in the United States. As of the 2010 census, it had a population of 23,068. The majority of residents are college students at nearby University of California, Santa Barbara (located to the east of the community) or at Santa Barbara City College. The beachside community lies on a flat plateau about 30 feet (9 m) in elevation, separated from the beach by a bluff.

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 Coal Oil Point and Campus Point. 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-eroding bluffs thirty to sixty feet above the 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 Co-op, as well as a food cooperative, the Isla Vista Food Co-op.
GeoHack - Isla Vista, California

Popular Services:
- Bing Maps
- Google Maps
- Google Earth
- OpenStreetMap

Global services:

<table>
<thead>
<tr>
<th>Service</th>
<th>Map</th>
<th>Satellite</th>
<th>More</th>
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<tbody>
<tr>
<td>ACME Mapper</td>
<td>Map</td>
<td>Satellite</td>
<td>Topo, Terrain, Mapnik</td>
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<td>Apple Maps</td>
<td>Map</td>
<td>Satellite</td>
<td>Daily Satellite</td>
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<td>Arctic.io</td>
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<td>Bing Maps</td>
<td>Map</td>
<td>Aerial</td>
<td>Bird’s Eye</td>
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<td>Blue Marble Navigator</td>
<td>Satellite</td>
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<td>Night Lights</td>
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<td>Fourmio</td>
<td>Satellite</td>
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<td>GeoBlox</td>
<td>Satellite</td>
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<td>GeoNames</td>
<td>Satellite</td>
<td>Text (XML)</td>
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<tr>
<td>Google Earth</td>
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<td>w/ meta data</td>
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<tr>
<td>Google Maps</td>
<td>Map</td>
<td>Satellite</td>
<td>Terrain, Street View</td>
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<tr>
<td>GPS Visualizer</td>
<td>Map</td>
<td>Satellite</td>
<td>Topo, Drawing utility</td>
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<td>HERE</td>
<td>Map</td>
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United States:

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<tr>
<td>GPS Visualizer</td>
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<td>USDA Aerial, USGS Topo</td>
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<td>National Weather Service</td>
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<td>Area weather and forecast, Graphical hourly pinpoint forecast</td>
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<td>Natural Atlas</td>
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<td>Legacy TNM</td>
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Contents: Global services - Local services - Photos - Wikipedia articles - Other

Edit | Report inaccuracies

Geohack
Software Mash-Ups
Enter the GeoBrowser

- Google Local 2004-5, Google Earth/Maps 2005
- Data “Portals”
- Data “Clearinghouses”
- NSDI -> GSDI
- Vision of Digital Earth
NASA World Wind
ArcExplorer (2006) -> ArcGIS Online
Microsoft: Virtual Earth
VRML and GeoVRML
GML (XML) and SVG
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
- 100 million downloads: Version 4 (Nov. 2006)
- 1 Billion downloads: Version 6 (2011)
- 4 Billion by about 2017
- An entirely redesigned version of the program; Currently only available for Google Chrome and Android. The desktop application continues to be Google Earth Pro, with regular updates
3D Google Earth Coverage

By Eugen Simion 14 - Own work, CC0, https://commons.wikimedia.org/w/index.php?curid=40198759
Keyhole EarthViewer 3D
Google Earth Today

• Google Earth viewer 6
  – Timeline
  – Historical
  – Community Bulletin Board
• Google Earth Plus
• Google Earth Pro (now the standard, free)
• Google Earth Builder
• Google Earth Enterprise
• API support from Google ended in 2015
Google Earth Mania
Google SketchUp
Model of the Alte Oper, Frankfurt
3D Warehouse (ended 2015)
Multi-temporal: Rumsey Map Collection
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</Placemark>
</kml>
Photos and 3D Panoramas
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.

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**Fig. 7—Map of the United States drawn directly by machine from a deck of 333 punched cards. Printing time, approximately 12 minutes. The map has been reduced, but not reshaped. Bipolar oblique conic conformal projection (outline of original map from the American Geographical Society's Map of the Americas, 1:9,000,000).** (Flower courtesy the Bureau-Lenhart Corporation, Los Angeles.)

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**The Map as a Computer Input**

The conceptualization of a map as a data-storage medium lends directly to the concept of it as a computer input element (Fig. 4). Here two methods of use are possible. In the simple, 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
Automation and cartography
Arc Internet Map Server (ArcIMS)

- Advanced web GIS
- Product of ESRI
- Simplified ArcView
  - Basic GIS functions
- Single interface
- Uses ArcView Shapefiles
New mobile applications
Server-side applications today
Data discovery
National Map Viewer
Earth explorer
Openstreetmap.org
GPS traces/User diaries
Wikimapia
Foursquare/Swarm
Summary

- Examined history of Internet WWW and early web mapping
- Search -> Discovery, Static -> Interactive
- Evolution of the browser/geobrowser
- Importance of parallel technologies
- GIS and computer mapping goes web based (Client Server model)
- New applications possible, VGI, social media etc.