Cityscapes:
An Online Discovery Tool for Urban and Cultural Studies

Andy Anderson
Academic Technology Services
Presentation Overview

- Amherst College & GIS
- Cityscapes
- Reinventing Tokyo
- Imagining Paris
- Image Processing
- Georeferencing
- Google Maps Tiling
Amherst College and GIS

- A liberal-arts college
  - 1600 students, most in residence
  - 1:8 faculty-student ratio

GIS Education:

- Interterm Community-Based Course (9 in Jan. 2010, 3 in 2011)
- Minor use regular in geology classes until last year (a visitor!)
- Occasional use of Google Earth for classes and projects
- Heaviest use for research, ~one thesis student a year
Simplifying Geographic Discovery

- Most of our professors feel GIS is too time-consuming for casual use during a semester.
- Some professors do understand the value of thinking geographically.
- Could we provide an easier-to-use mapping app such as this one for Tokyo?

Encyclopedia of Edo-Meiji-Tokyo Digital Map or Superimposed Map (Epipi Company, 2004)

⊕ zooming ⊕ layering ⊕ CD-based ⊕ in Japanese ⊕ ¥¥
Could Google Earth and its Rumsey Historical Maps provide a similar service?

Students could also use it to build presentations with added content such as images, audio, and video.

- zooming
- layering+transparency
- multimedia balloons
- 3D buildings
- semi-web-based
- semi-georeferenced
- HTML formatting
Cityscapes Map Platform

- Google Map
- Open API:
  - Web-based
  - Zooming
  - Layering
  - Transparency
  - Markers
  - Satellite/Terrain
Cityscapes is Geohistorical

- Allow students to investigate a city over time, e.g. Tokyo:
  - 1680
  - 1799
  - 1858
  - 1892
  - 1945
Cityscapes Historical Maps

- Historical maps are closely georeferenced using ArcGIS Google Earth:

- Converted to Google format with open source Amherst GTiler
Cityscapes Location Balloons

- Location balloons provide structured media inclusion

Dialogues don’t require knowledge of HTML.

Open source: Amherst aMapApp; Ext JS, PHP, and MySQL.
Cityscapes Multimedia

- Location balloons link to an image database using thumbnails, and display them in a dedicated viewer.

- Images can be from different collections:
  - DigiTool (Amherst)
  - Luna (Smith College)
  - Flickr (students & others)
Cityscapes Location Blogging

- Location balloons can have blogs associated with them, letting students converse about the location and included media.

During my Junior year abroad in Tokyo, I visited the Senso-ji Buddhist Temple. It has a traditional architecture for a Japanese temple and
Cityscapes Access Control

- Privacy of student projects is important.*
- *aMapApp* location balloons are created outside of Google maps, so their content is not web-searchable.
- Built-in access control and groups for classes.

* e.g. Family Educational Rights and Privacy Act (FERPA)
Cityscapes Tokyo

- Reinventing Tokyo: The Art, Literature, and Politics of Japan's Modern Capital

- “Tokyo is the political, cultural, and economic center of Japan, the largest urban conglomeration on the planet, holding 35 million people… Since its founding 400 years ago, when a small fishing village became Edo, the castle headquarters of the Tokugawa shoguns, the city has been reinvented multiple times…”

- Amherst College Professors Morse, Maxey, Van Compernolle
Cityscapes Paris

- **Colloquia in French Studies: Paris, a Multi-Layered City**

  “An exploration of the cultural and urban development of Paris across time and in space with an emphasis on the 19th and 20th centuries. We will use an interactive digital platform to reconstruct the spaces, both real and imaginary, featured in novels, poetry, short stories, popular songs, visual documents, and maps that have evoked the city throughout its history. Works by Corneille, Maupassant, Baudelaire, Apollinaire, Desnos, Modiano, Vargas, Gavalda.”

- **Smith College Professor Visentin**

  Boulevard des Capucines, Paris
  Claude Monet, 1873
Cityscapes Paris  

- Pariscape: Imagining Paris in the Twentieth Century

- “Paris has been for centuries one of the exemplary sites of our urban sensibility, a city that has indelibly and controversially influenced the twentieth-century imagination. Poets, novelists and essayists, painters, photographers and film-makers: all have made use of Paris and its cityscape to examine relationships among technology, literature, city planning, art, social organizations, politics and what we might call the urban imagination.”

- Amherst College Professor Rosbottom
Cityscapes Issues

- Some negatives of the platform:
  - many staff hours
  - occasional bugs
  - no 3D buildings (as of yet)
  - some maps are topologically incorrect (e.g. see the right).
  - many digital images obtained from other libraries, who sometimes claim copyright — getting permission to open to the public is problematic.
Map Image Processing

- Images were downloaded at the highest available resolution.

- Typically images were limited to disjoint pieces ~2048 pixels\(^2\), e.g.:

  http://ids.lib.harvard.edu/ids/view/Converter?
id=7157748&c=jpgnocap&s=1&r=0&x=0&y=0&w=2400&h=2400

- These needed to be stitched together with Photoshop, etc., and trimmed of unnecessary margins.

- The resulting maps were usually on the order of 10K pixels\(^2\), with a scale of 1-2 meters per pixel.
Georeferencing with ArcGIS

- ArcGIS is a very convenient platform for georeferencing images to a map background.
- Best to use the projection WGS84 Web Mercator (Auxiliary Sphere) to georeference, since that’s what Google uses. Don’t use “Google Mercator”!
- As a background, the ArcGIS Map Service World Street Map had great performance.
Georeferencing: Control Points

- Control points align two maps at locations that are recognizable on both:

- The Cityscapes maps varied from having many hundreds to several thousands of control points!
Georeferencing: Link Choice

- Streets are recognized by their pattern of connections, so intersections are by far the most important locations to add control points.
  - Not all intersections necessary, if they’re close enough.
  - Urban areas require more control points to help distinguish adjacent streets.
- Intersections with railroads, rivers, streams, and canals can also be used.
Georeferencing: Cautions

- Seldom will streets on two maps completely align; if the difference is small or extreme, leave as-is.
- Streets, railroads, and rivers can all change over time!
  - Streets are often built and rerouted; rivers meander.
- Deliberate abstractions are common!
  - Roads and railroads on a printed map are often widened to be distinguishable, which can “bump” other features.
Google Tiles

- Google tiles are square and $256 = 2^8$ pixels across.

- The Mercator pixel size is:
  \[ \text{cellSize}(z) = \frac{2\pi r}{2^z+8} \]
  where $r = 6378137$ m is the equatorial radius, and $z$ is the Google zoom level.

- By definition, $z = 0$ produces a single tile covering the Earth exclusive of the polar regions (a distance of $2\pi r$).

- Incrementing the zoom level doubles the number of tiles.

- The zoom levels for large cities like Tokyo or Paris range from about 17 (1.2 m/px) to 7 (1.2 Km/px).
GTiler Script

- Tiling a georeferenced and rescaled image can be effected with programs such as Photoshop, etc.

- But, to automate the process, I wrote a Python script.
GTiler Procedure

1. User-georeferenced map:

2. Tile-referenced background:

3. Map & background mosaic:

4. Mosaic tiles:
GTiler Execution

Executing: GTiler.py G:\Paris\1855\1855R.jp2 G:\Paris\1855\Tiles 1855 1.049552999999999 11 76.4370282851763 11 11 76.4370282851763
Start Time: Tue Dec 07 21:06:34 2010
Running script GTiler.py...
Input Raster = "G:\Paris\1855\1855R.jp2"
Raster bands = 3
Raster Pixel Type = 8_BIT_UNSIGNED
Output Folder = "G:\Paris\1855\Tiles"
Output Tile Base Name = "1855"
Zoom level range = [11, 11]
Cell size range = [76.4370282852, 76.4370282852]
z = 11:
Cell size = 76.4370282852
Creating Z Raster...
Z Raster Extent:
X Range = [253971.755115, 268187.950500]
Y Range = [6245030.286391, 6256196.480758]
Indices of Tiles Covering Z Raster:
X Range = [1036, 1037]
Y Range = [704, 704]
Extent of Tiles Covering Z Raster:
X Range = [234814.550892, 273950.309374]
Y Range = [6242153.477881, 6261721.557122]
Creating Background Raster from the Extent of the Covering Tiles...
Mosaicking together the Background Raster and the Z Raster...
Clipping the Extended Z Raster into tiles in "G:\Paris\1855\Tiles\1855_z11"
Creating tile 1855_z11-00-00.png...
Creating tile 1855_z11-01-00.png...
End Time: Tue Dec 07 21:10:07 2010 (Elapsed Time: 3 minutes 33 seconds)
Amherst Mapping App

- aMapApp uses the Google Maps API, directing it to use the tiles from the local web server to build a combined map.

- aMapApp is a light-weight framework, requiring:
  - PHP
  - MySQL

- A small amount of configuration, e.g.

  ```
  require_once "/path_to_config_file/your_config_file.php";
  ```

- A simple API — if you want to extend its behavior, e.g.

  ```
  newLocation(configObject)
  ```
Cityscapes Team

- **Inspiration:** Professors Sam Morse and Hélène Visentin

- **Organizer:** Scott Payne, Director of [Academic Technology Services](#) at [Amherst College](#)

- **Historical Map Georeferencing:** [Andy Anderson](#), ATS; Zoë Zaferiou and Jon Caris, Smith College

- **GTiler Creation:** [Andy Anderson](#), ATS

- **aMapApp Creation:** Paul Chapin, ATS

- **Image Database Interface:** Miodrag Glumac, ATS

- **Historical Maps:** Smith College, Harvard University, University of California at Berkeley, David Rumsey Map Collection