Open Mapping for the Entire World: OpenStreetMap

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Think about a trip you take...

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- You have knowledge about that trip:
  - Knowledge of the environment
  - Knowledge of the components
  - Knowledge of the intricacies
  - Knowledge that is *current*
- Now, imagine compiling that information from volunteers globally to create an open source database of GIS features.
- That is OpenStreetMap!

Outline

1. Introduction to and philosophy of OSM
2. Data structure of OSM
3. Using OSM data
    a. Raw format
   b. Web maps
4. Related projects

What is OpenStreetMap?

- OpenStreetMap is often called the Wikipedia of maps.
- At its core, OpenStreetMap is grassroots mapping.
  - Regular citizens working together to create the greatest free map of the world.
- OpenStreetMap offers free data under the Open Data Commons Open Database License.
- OpenStreetMap isn't just an online map; it is a GIS database!

Founding of OSM

- Steve Coast in early 2000s, wishing to find an alternative to proprietary map data in the UK, would ride his bike around town.
- Using GPS traces, he would compile data into a database.
- From there, OSM grew into a worldwide community with over one million registered users under the umbrella of the OSM Foundation.
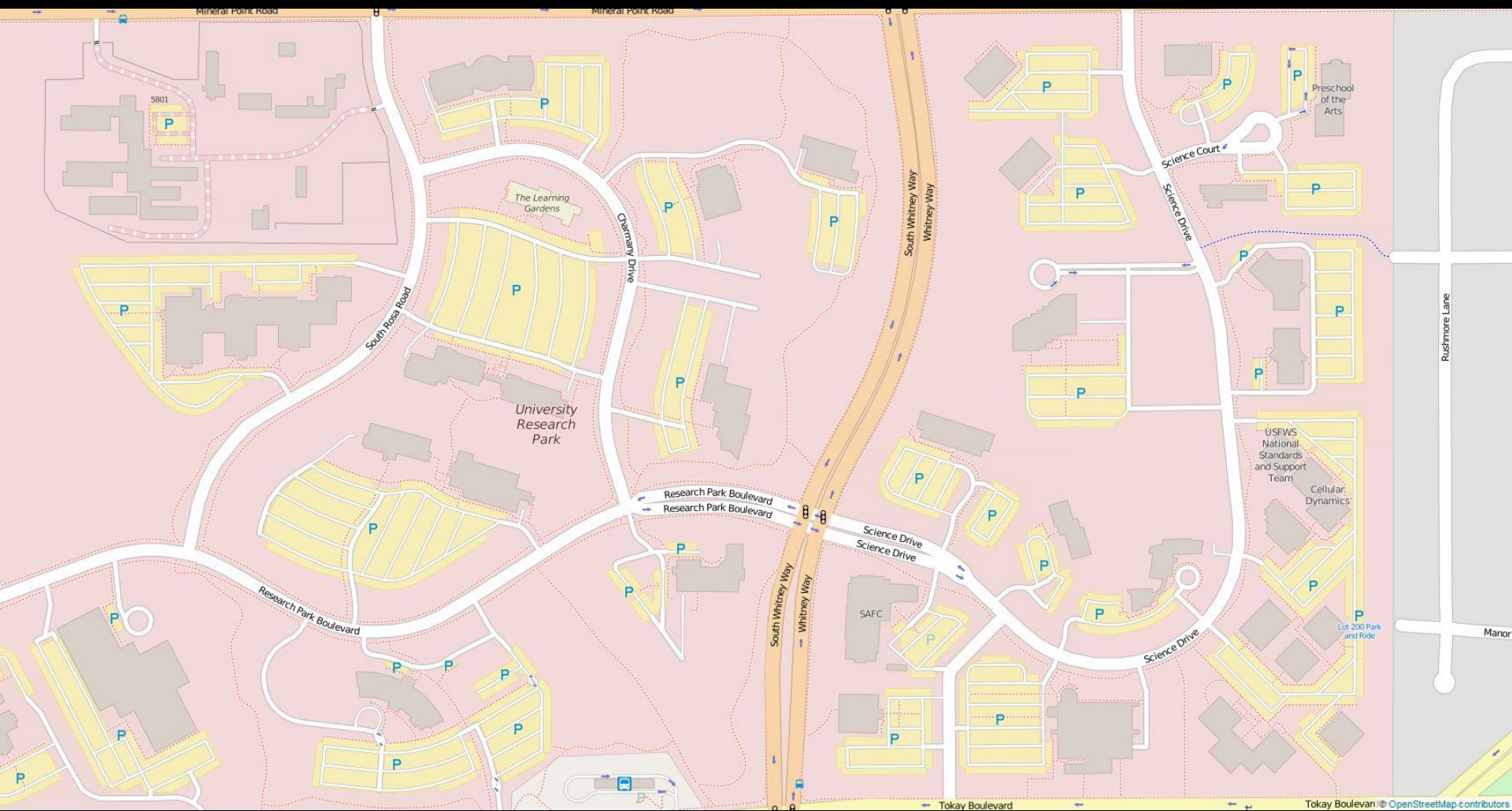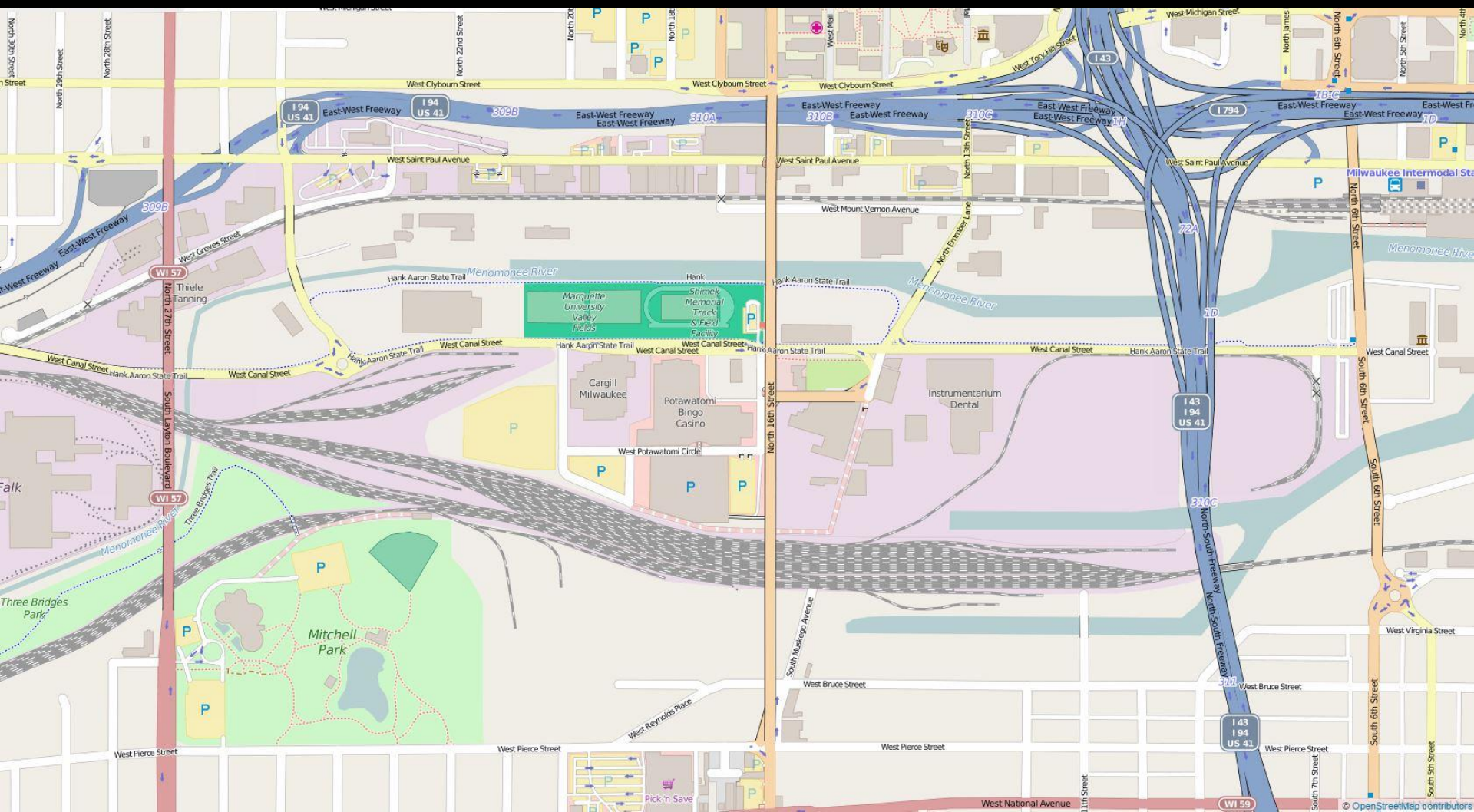
How volunteers contribute data

- Going somewhere:
  - Logging a route with GPS
  - Using Walking Papers or Field Papers to manually annotate features
- Tracing satellite imagery
- Viewing submitted photos/video
- Adding a note on the OSM homepage
- Developing software to use for or with OSM

Caveats of adding data

- Data must be user-derived with no copyright (i.e. not using other maps)
- Large-scale imports are handled only after consultation with the community.

OSM treasures quality edits with a value-added human touch.

Data sources beyond volunteers

- In many countries, datasets were donated or provided under a compatible license.
- For the US, Census Bureau TIGER data was added as a first pass.
- Bing imagery is donated for use with tracing data into OSM.
- Other satellite imagery often provided, especially during disaster response.

Who uses OSM data? Examples:

This is not a paid advertisement.

Basics of the data license (ODbL 1)

You are free:

- *To Share*
- *To Create*
- *To Adapt*
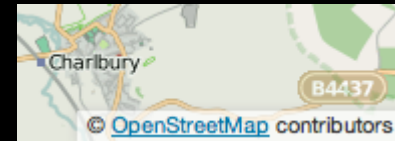
As long as you:

- *Attribute*
- *Share-Alike*
- *Keep open*

http://www.openstreetmap.org/copyright

30 second legalese: I'm no lawyer

- OSM data alone:
  - Attribute and share if the data is requested.
- OSM data for internal use *only*:
  - You can do/combine/derive anything
- OSM data + your data:
  - Depends on relationship of databases
    - If separate, only OSM data must be shared
    - If combined, license must be compatible
- N.B. OSM data with any merged datasets must be made available to anyone free of charge (in spite of services offered)

More detailed legal explanations

- http://www.openstreetmap.org/copyright
- http://wiki.openstreetmap.org/wiki/Legal_FAQ
- http://wiki.openstreetmap.org/wiki/License/Use_Cases

Bottom line(s):

You are free to use OSM data. If you layer it with other sources, only OSM data is affected by the license. If you combine it with other sources, the whole dataset is affected by the OSM license.

Data types

- Node
  - Single point feature
  - POI, tree, town center
- Way
  - More than one point connected
  - Street, river, power line
- Closed Way
  - Building, park, city
- Relation
  - Collection of nodes, ways, and/or relations that together create a feature

Items actually mapped

Wide range of things:

- Administrative areas
- Highways, railroads, sidewalks
- Natural features like rivers, forests, islands
- POIs like businesses, government agencies, houses and their building shape
- Land use areas
- Power lines, power plants, wind farms
- Traffic lights, speed limits, crosswalks
- Water fountains, wells, benches

How data is stored

- OSM data uses tags to give geographic features meaning.
- Multiple values are separated;by.
- Namespaces sometimes are included for additional information.

Examples:

- building = house
- highway = residential
- amenity = fast_food
- parking:lane:right = parallel

List of tags

- A list of the majority of tags used are found on the OSM Wiki or TagInfo page:
  - http://wiki.osm.org/wiki/Map_Features
  - http://taginfo.osm.org
- Tags are in flux as more are always being proposed by the community.
  - Sometimes users use tags without any proposal.
  - Taginfo is a good place to narrow down features.
  - Also, trial and error helps with API searches.

Common tag types

- Streets/paths/cycleways are usually tagged under highway = *
- General guidance:
  - Interstates: highway = motorway
  - Divided highways: highway = trunk
  - Other highways: highway = primary, secondary
  - Major roads: highway = tertiary
  - Other city roads: highway = residential
  - Alleys, parking lots: highway = service
  - Bike roads: highway = cycleway
  - Farm roads: highway = track
  - Sidewalks, paths: highway = footway

Common tag types

- Jurisdictional boundaries are tagged under boundary = administrative.
- For the United States, usually
  - Country: admin_level = 2
  - State: admin_level = 4
  - Counties: admin_level = 6
  - Cities: admin_level = 8
- No consensus on Indian reservations.
  - Often boundary = aboriginal_lands or boundary = protected_area and protect_class = 24

OSM data available

- Database dumps (planet files)
- Regional extracts
- Specified extracts (locations/features)
- GPS traces (not updated lately)
- Limited access (moderate traffic):
  - Direct API
  - Geographic feature search (Nominatim)
- Software for using data

Not available:

- Map tiles served from osm.org

Acquiring database dumps

- Planet files are found at http://planet.osm.org
  - Files are in XML or PBF format
- Regional extracts are found at http://download.geofabrik.de/
- Listing of other sources: http://wiki.osm.org/wiki/Planet.osm

Acquiring specific extracts

- http://www.osm.org/export
  - Only for a small area (usually a few counties)
- http://overpass-api.de/api/map?bbox=
  - Mirror of above site
- http://map-zen.com/metro-extracts/
- Overpass Turbo
- Java OSM Editor

Conversion to different data types

- osmosis is an all-purpose command line tool for dealing with OSM data files.
  - https://github.com/openstreetmap/osmosis
  - Extraction
  - Addition
  - Diff-ing

```
osmosis --read-xml wisconsin.osm \
    --tf accept-ways highway=* \
    --tf reject-ways highway = track
    --used-node --write-xml wiroads.osm
```

Conversion to different data types

- osmium can also be used to work with OSM data in C++
  - http://osmcode.org/libosmium

```
#include <osmium/io/any_input.hpp>
osmium::io::File input_file("wisconsin.osm.pbf")
```

Conversion to different data types

- osm2pgsql populates a PostgreSQL postGIS database with OSM data.
  - https://github.com/openstreetmap/osm2pgsql

osm2pgsql --create --database wisconsin
  wisconsin.osm.pbf

Conversion to different data types

- ArcGIS for Desktop can import OSM data with an addon
  - https://github.com/Esri/arcgis-osm-editor
- osmtogeojson converts to GeoJSON
  - https://github.com/tyrasd/osmtogeojson
- Plethora of other formats
  - http://wiki.openstreetmap. org/wiki/Converting_map_data_between_formats
  - Adobe Illustrator, DXF AutoCad, Garmin, GML, GPX, MATLAB, Shapefile, etc.
- Built in import capabilities in QGIS.

Alternative all-in-one data query

- Use Overpass API to pull out the specific features you want over a certain area
  - http://overpass-api.de
- Queries run at http://overpass-turbo.eu

```
(node["amenity"="fast_food"]({{bbox}});
 way["amenity"="fast_food"]({{bbox}});
 relation["amenity"="fast_food"]({{bbox}}););
out body; >; out skel qt;
```
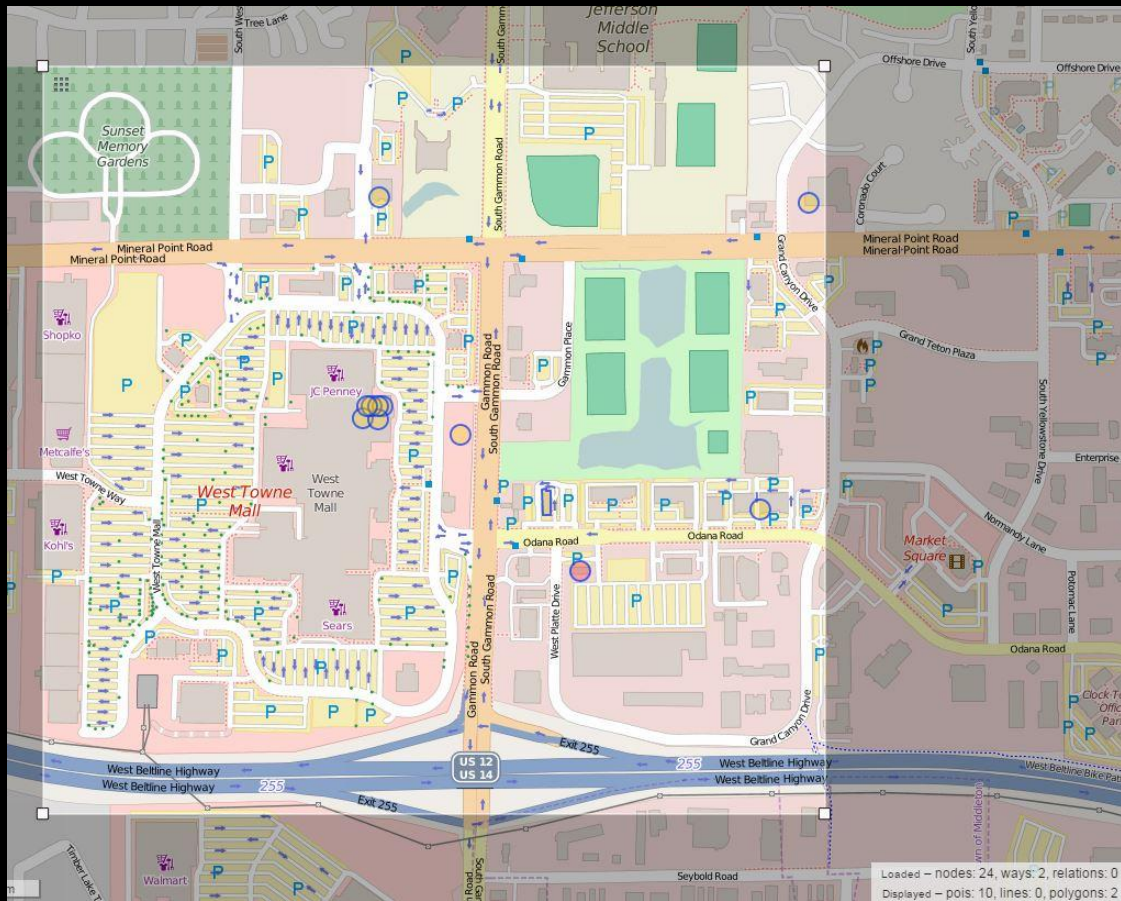
```xml
<?xml version="1.0" encoding="UTF-8"?>
<osm version="0.6" generator="Overpass API">
<note>The data included in this document is from www.openstreetmap.org. The data is made
<meta osm_base="2015-03-05T19:30:02Z"/>

  <node id="567594258" lat="43.0584569" lon="-89.5049099">
    <tag k="amenity" v="fast_food"/>
    <tag k="name" v="Steak Escape"/>
  </node>
  <node id="567594261" lat="43.0582962" lon="-89.5052855">
    <tag k="amenity" v="fast_food"/>
    <tag k="name" v="Taco Bell"/>
  </node>
  <node id="567594262" lat="43.0582726" lon="-89.5050011">
    <tag k="amenity" v="fast_food"/>
    <tag k="cuisine" v="burger"/>
    <tag k="name" v="McDonald's"/>
  </node>
  <node id="587148518" lat="43.0584647" lon="-89.5051217">
    <tag k="amenity" v="fast_food"/>
  </node>
  <node id="587148571" lat="43.0584627" lon="-89.5049957">
    <tag k="amenity" v="fast_food"/>
  </node>
  <node id="1374167224" lat="43.0584628" lon="-89.5051971">
    <tag k="amenity" v="fast_food"/>
    <tag k="name" v="Subway"/>
  </node>
  <node id="2379385298" lat="43.0614451" lon="-89.5049731">
    <tag k="amenity" v="fast_food"/>
    <tag k="cuisine" v="ice_cream"/>
    <tag k="name" v="Cherry Berry"/>
  </node>
  <node id="3161396201" lat="43.0580626" lon="-89.5033924">
    <tag k="addr:city" v="Madison"/>
    <tag k="addr:housenumber" v="430"/>
    <tag k="addr:postcode" v="53719"/>
    <tag k="addr:street" v="South Gammon Road"/>
    <tag k="amenity" v="fast_food"/>
    <tag k="name" v="Chick-Fil-A"/>
  </node>
  <node id="3287036686" lat="43.0613652" lon="-89.4965780">
    <tag k="addr:city" v="Madison"/>
    <tag k="addr:country" v="US"/>
    <tag k="addr:housenumber" v="6650"/>
    <tag k="addr:postcode" v="53705"/>
    <tag k="addr:state" v="WI"/>
    <tag k="addr:street" v="Mineral Point Road"/>
    <tag k="amenity" v="fast_food"/>
    <tag k="name" v="Qdoba"/>
  </node>
  <node id="3324062444" lat="43.0569830" lon="-89.4975235">
    <tag k="amenity" v="fast_food"/>
    <tag k="name" v="La Michoscana"/>
  </node>
  <way id="43922190">
    <nd ref="558595203"/>
    <nd ref="558595205"/>
    <nd ref="3170953222"/>
    <nd ref="3170953228"/>
    <nd ref="558595206"/>
```
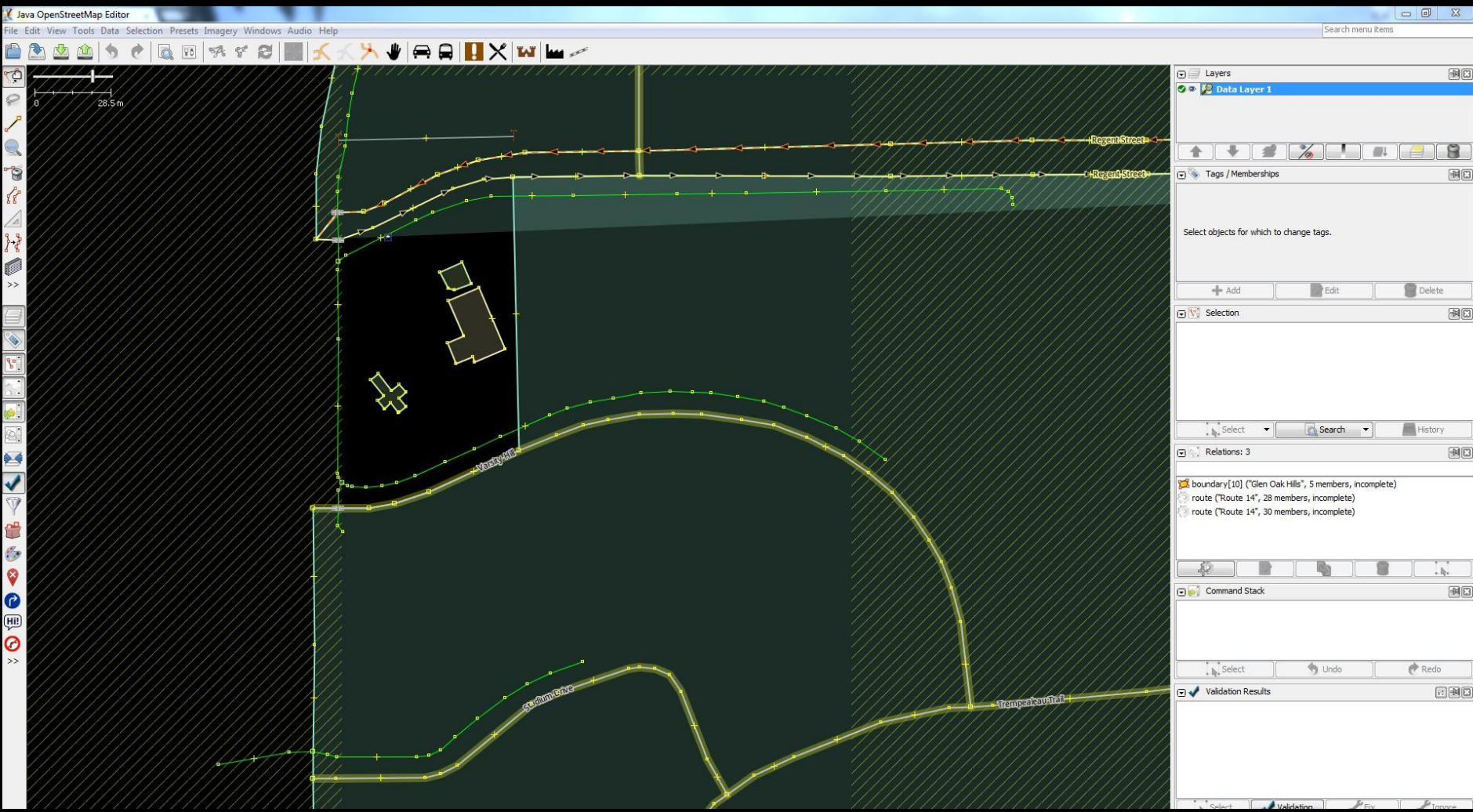
Alternative data explorer

- Java OpenStreetMap editor (JOSM) is a desktop application used to edit data.
- It can be used to download data and export it directly to .osm or .xml types.
- An easy method to download and manipulate data fast over a small area.

Web maps

- Web maps are consist of two components
  - Map tiles, that stitch together the map at every zoom level in every location
  - Slippy map, or the actual map object
- Map tiles can be static or dynamic
  - Static are rendered once and done
  - Dynamic are generated as users request them
    - Either locally or by a third party
- Slippy map libraries communicate between the user and the tile server
- See http://switch2osm.org for detailed info

Web maps

- Static or dynamic tile servers use OSM data that you specifically download.
- You have complete control over the looks.
- A dynamic tile server (which updates automatically as the data source is updated) requires a dedicated computer.
- Third party providers are plug and play, whereby they provide you a link and an API key to access their servers.
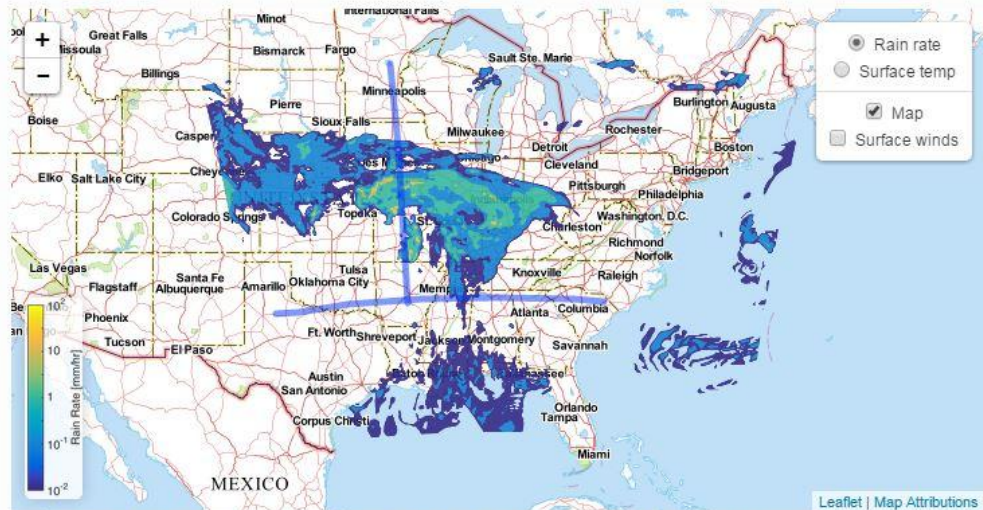
Web maps

- A few example slippy map libraries:
    - Leaflet (http://leafletjs.com)
    - OpenLayers (http://openlayers.org)
- Little customization required for a simple slippy map inclusion.

`<script src="leaflet.js"></script>`

`<div id="map"></div>`
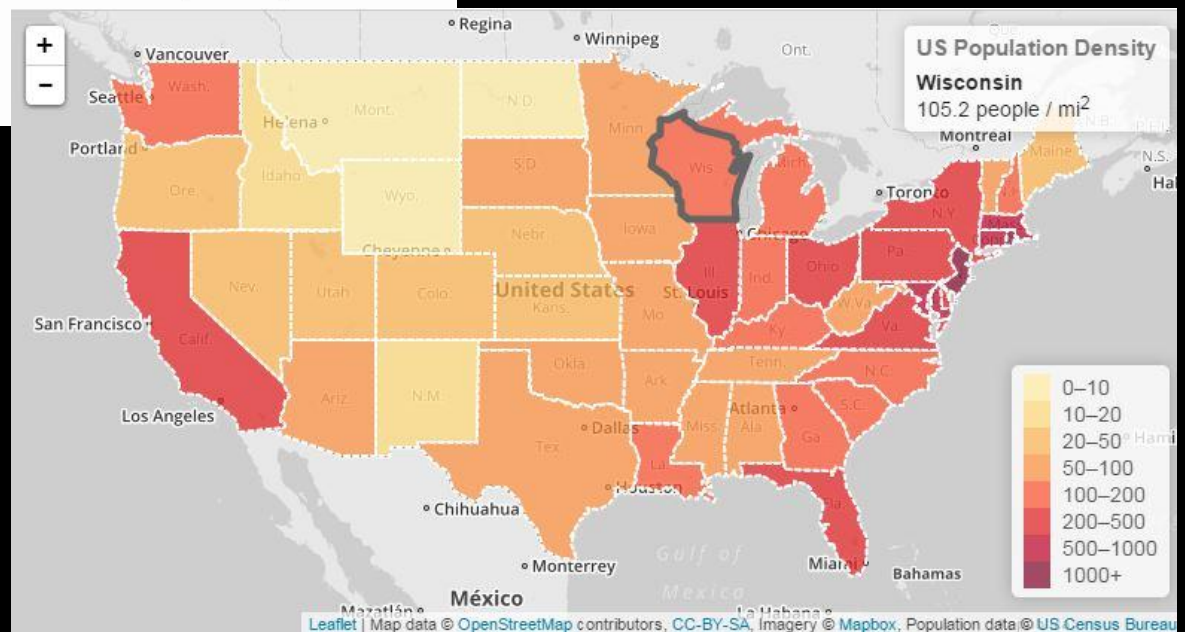
- These can be used to display other data.
- Javascript functions can add additional capabilities to the map.

Alternative: Commercial providers

- Custom-generated extracts
- Tile servers
- Routing
- Software development
- Cartography

Routing

- Associated projects have been developed to use OSM for routing data.
- OpenStreetRoutingMachine (OSRM) is one of the leading open source contenders.
- This feature has been implemented on the OSM main site, where you can test it out.

Mapillary

- A related project, where volunteers upload videos or photos of travel.
  - http://www.mapillary.com
  - Driving, bike riding, walking, etc.
- License is compatible for use with OSM and anything else under the CC Attribution-Share Alike license.
- Can be useful for non-mapping applications .

Crowdsourcing disaster relief

- The Humanitarian OSM Team works to provide map data for disaster relief.
- HOT commissioned a Tasking Manager, which sections off easy to complete tasks that mappers choose to work on.
- This coordinates the effort in an easy and organized manner.

Editing OSM plug

- If OSM looks like something you are interested in contributing to, all you have to do is register and you can edit.
- Two in browser editors as well as JOSM.
- Plenty of editing tutorials online.
- You can freelance edits, or join a concerted effort to map for a specific cause (e.g. railroads, HOT).

OSM data import plug

- If you have access to a high-quality data set that you think may be a great contribution to OSM, feel free to contact me.
- We can discuss the process for imports and the general guidelines associated with them.

Conclusion

- OpenStreetMap: open mapping the entire world, often used for GIS applications or web slippy maps.
- Multiple programs developed to manipulate and use OSM data.
- Licensure allows freedom to use the data as long as you "pay it forward".
- Worldwide community that is constantly growing, and data that is being adapted by more and more organizations.

Questions?

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OSMF Data Working Group Member

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