

# An Introduction to OpenStreetMap

Mele Sax-Barnett  
State of the Map US 2014

# OpenStreetWhat?

- <http://www.osm.org>
- OpenStreetMap or OSM
- **Not** “Open Street Maps”
- Founded in 2004
- Worldwide and seamless
- “Wikipedia of Maps”
- Editable by anyone with an account



**OpenStreetMap**  
The Free Wiki World Map

# So, what is it really?

- It's a very large database of XML data
- Each feature is of a certain basic type, and is defined by tags (key value pairs)
- Basic types:
  - Nodes (points)
  - Ways (lines)
  - Areas (polygons)
  - Relations (groups)
- Example tags:
  - highway = primary, bridge = yes

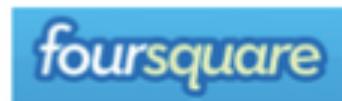


# What is it *not*?

- A rendered map that uses particular cartography, whether for web or paper.
- Proprietary—anyone can use it for free as long as they provide proper credit
- Something static—it changes and grows all the time
- Controlled by an authority—it is driven and maintained by a large community of contributors and data consumers

# Who uses OpenStreetMap?

- <http://switch2osm.org>



WIKIPEDIA  
The Free Encyclopedia



# What kind of things can you find in OpenStreetMap?

- Roads, highways, bridges, and tunnels
- Bus stops, bus routes, bike routes, and railways
- Businesses: shops, restaurants, bars
- Buildings: schools, churches, houses
- Parks, lakes, mountains, and even trees
- Airports, power networks, and mailboxes
- Administrative boundaries
- Almost anything that stays the same for a while,  
see <http://wiki.osm.org> for more

# How did all this data get there?

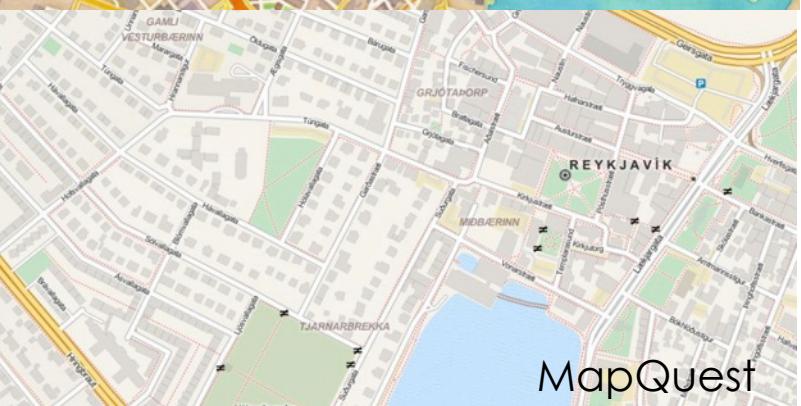
- In the United States: 2007 TIGER data import  
<http://wiki.openstreetmap.org/wiki/TIGER>
- Other imports of open data
- Around the world: lots of people uploading and tidying up GPS tracks
- More recently, tracing aerial imagery (Bing gave special permission for contributors to use its aerials)
- Local knowledge
- *A real person put it there, and other people have looked at it and confirmed that it is correct*
- **Challenge: data maintenance**

# What does it look like?

OSM.org default



Stamen Design



# What does it look like?

OpenStreetMap

Edit History Export GPS Traces User Diaries Copyright Help About Log In Sign Up

Search Where am I? Go

Way: Oregon State Capitol (27442271)

Salem Oregon  
Edited 3 months ago by Palolo  
Version #14 · Changeset #18474313

Tags

addr:state	OR
amenity	public_building
building	yes
ele	51
gnis:county_name	Marion
gnis:feature_id	1163188
name	Oregon State Capitol
source	Local knowledge

Nodes

Willson State Park

Oregon State Capitol

State Street

20 m 50 ft

P

Map Layers

- Standard
- Cycle Map
- Transport Map
- MapQuest Open
- Humanitarian

Enable overlays for troubleshooting the map

Map Notes  Map Data

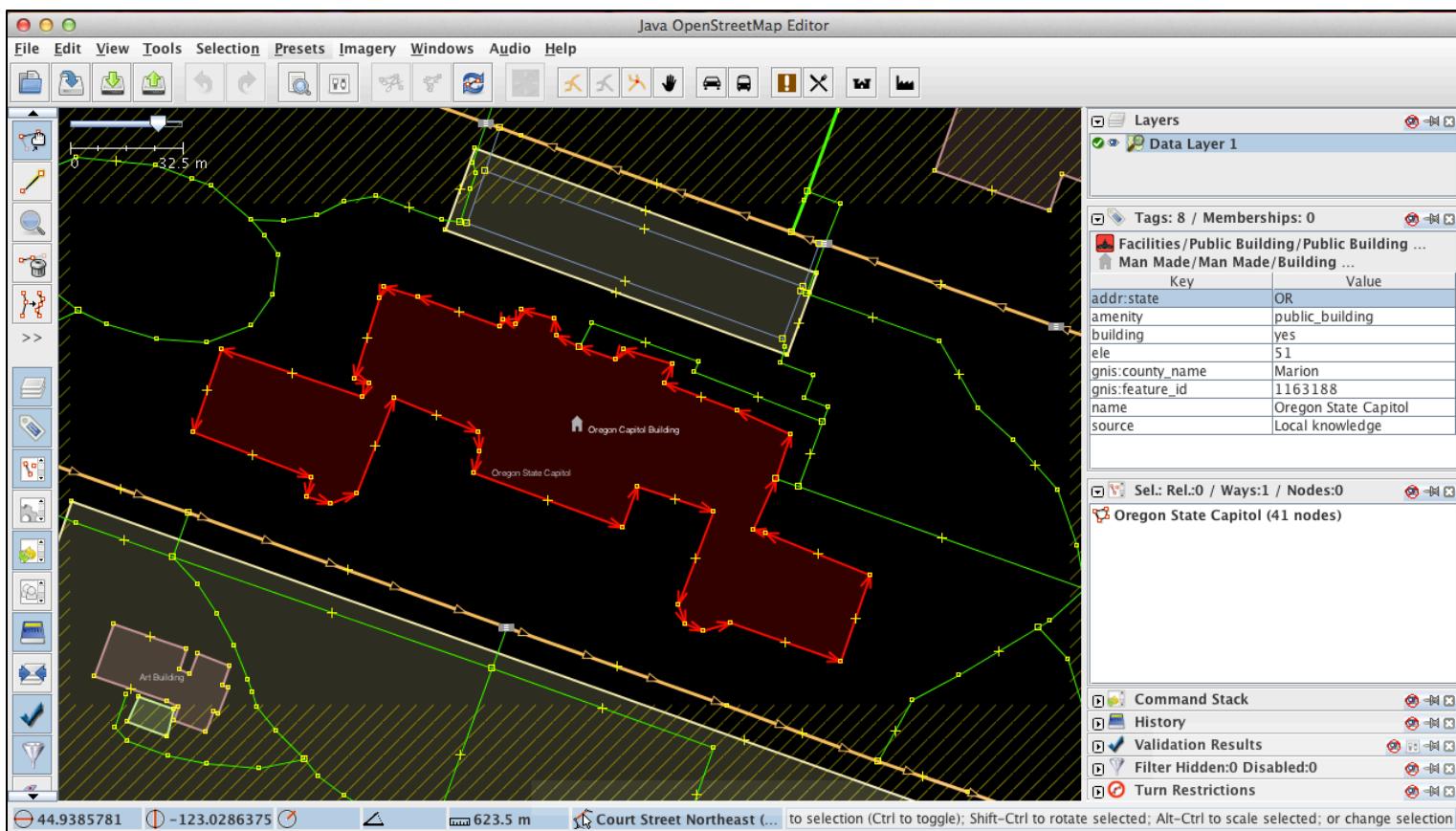
openstreetmap.org data view

# What does it look like?

The screenshot shows the OpenStreetMap iD editor interface. At the top, there's a navigation bar with links for 'Edit', 'History', and 'Export'. On the right side of the bar, there's a user profile for 'Mele Sax-Barnett'. Below the bar, a modal window titled 'Edit feature' is open, specifically for an 'Amenity' type. Inside this window, there are four input fields: 'Name' (set to 'Oregon State Capitol'), 'Type' (set to 'public\_building'), 'Elevation' (set to '51'), and 'Source' (set to 'Local knowledge'). Above the modal, there are three selection buttons: 'Point', 'Line', and 'Area', with 'Area' being selected. The main map area shows a satellite view of the Oregon State Capitol grounds. A red polygonal boundary has been drawn around the capitol building and its immediate surroundings, representing the edited area. Labels on the map include 'Willson State Park' and 'Oregon State Capitol'. A street labeled 'State Street' is visible at the bottom. The bottom right corner of the map area shows a copyright notice: 'Edits by Palolo, Sabarade, Mele Sax-Barnett, and 5 others'. The bottom left corner of the map area contains the 'bing' logo. The overall interface is clean and modern, designed for easy editing of geographical data.

iD editor

# What does it look like?



JOSM editor

# OSM data

Properties: 6 / Memberships: 9

**Highways/Streets/Secondary ...**

Key	Value
highway	secondary
is_in	Marion, OR
name	Court Street Northeast
oneway	yes
tiger:zip_left	97301
tiger:zip_right	97301

Member Of

Route	Role	P...
route ("16 - State Street", 49 members, ...)	37	
route ("1X - Wilsonville/Salem", 109 mem...)	99	
route ("2 - D St / Brown Rd", 41 member...)	13	
route ("20 - 17th/CCC", 32 members, in...)	7	
route ("3 - Portland Road / CCC", 70 me...)	60	
route ("5 - Royal Oaks", 33 members, in...)	15	
route ("5A - Lancaster Mall", 37 member...)	12	
route ("6 - 12th Street / Battle Creek", 5...	49	
route ("7 - Fairview Industrial Park", 54 ...)	11	

Sel.: Rel.:0 / Ways:1 / Nodes:0

Court Street Northeast (12 nodes)

Select Search

# JOSM



# iD



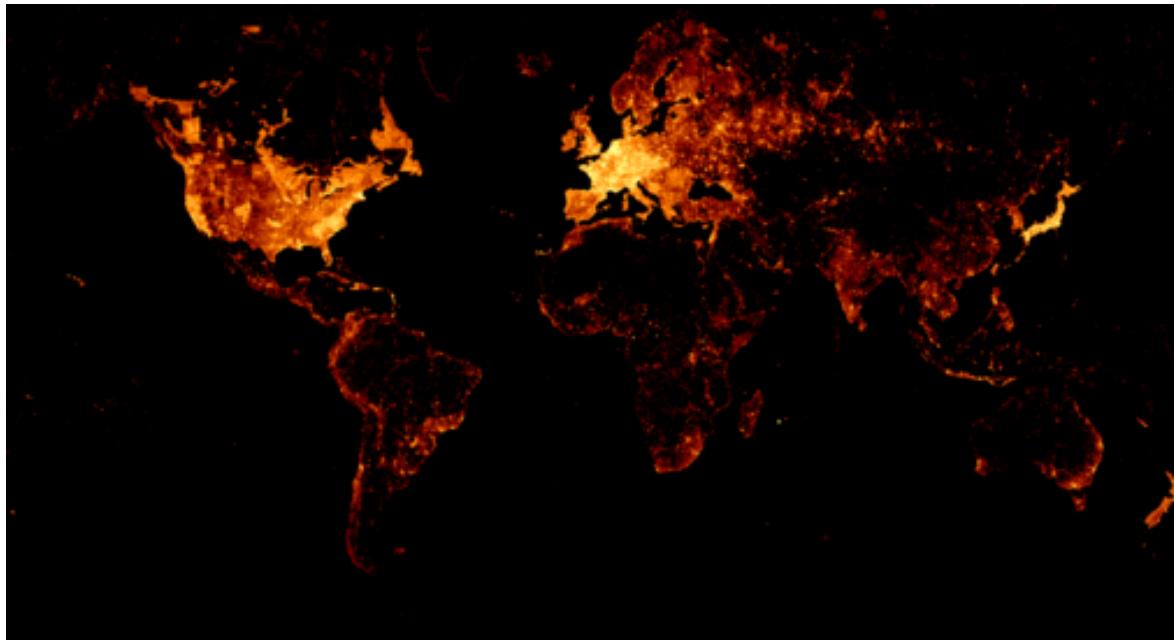
All tags (6)

highway	secondary
is_in	Marion, OR
name	Court Street Northe...
oneway	yes
tiger:zip_left	97301
tiger:zip_right	97301

All relations (9)

- Bus Route 2 - D St / Brown Rd
- Bus Route 1X - Wilsonville/Salem
- Route 5 - Royal Oaks
- Bus Route 3 - Portland Road / CCC
- Route 5A - Lancaster Mall
- Bus Route 20 - 17th/CCC
- Bus Route 16 - State Street

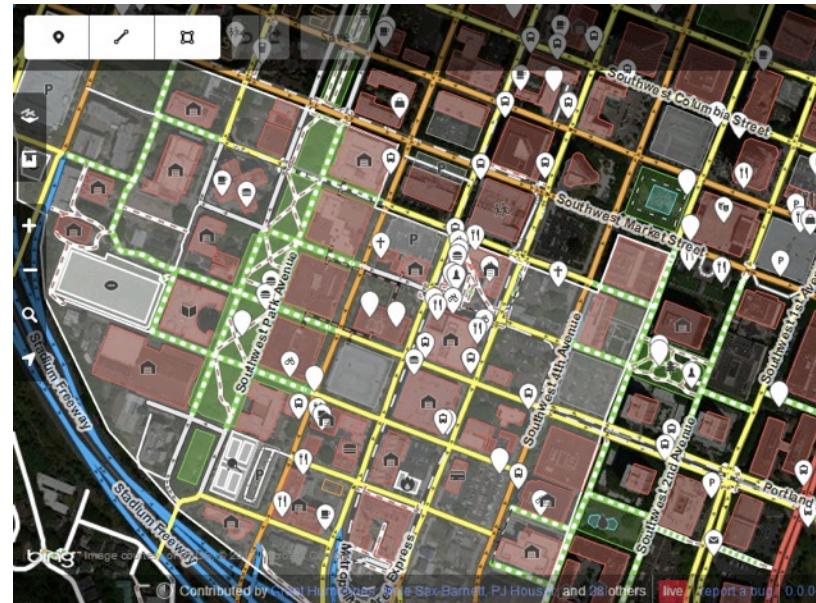
# Taking the next step: Editing OpenStreetMap



[http://www.openstreetmap.org/user/tyr\\_asd/diary/19549](http://www.openstreetmap.org/user/tyr_asd/diary/19549)

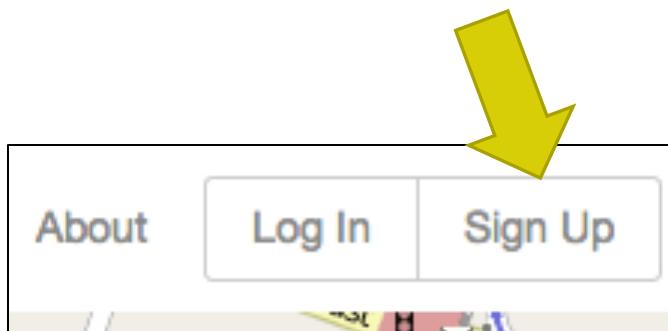
# How do you edit OSM?

1. Sign up for an account
2. Choose one of several free and open source editors
  - iD and JOSM are popular
  - Examples here will use iD, a new in-browser editor



# Step 1: Sign up for an account

- Go to <http://osm.org>
- Click the “Sign Up” link in the **top right corner**

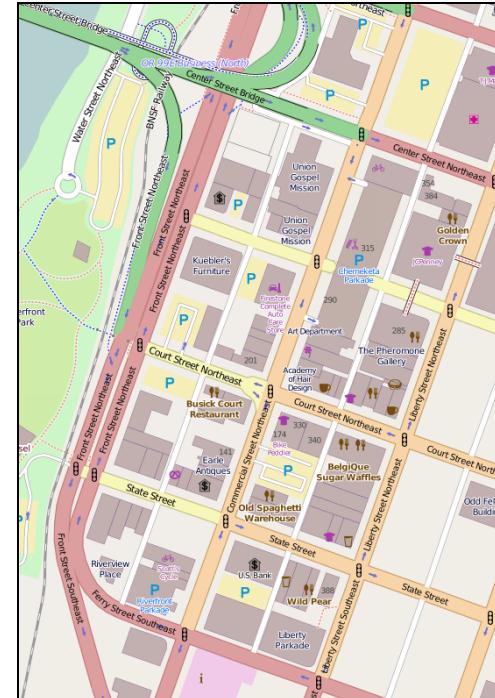


- Set up your account!

A screenshot of the "Sign Up" form on the OpenStreetMap website. The form includes fields for "Email Address" and "Confirm Email Address", both with placeholder text "Email address". Below these are sections for "Display Name" and "Not displayed publicly (see privacy policy)". To the right of the form, there is descriptive text about account creation and a note about confirming the email address.

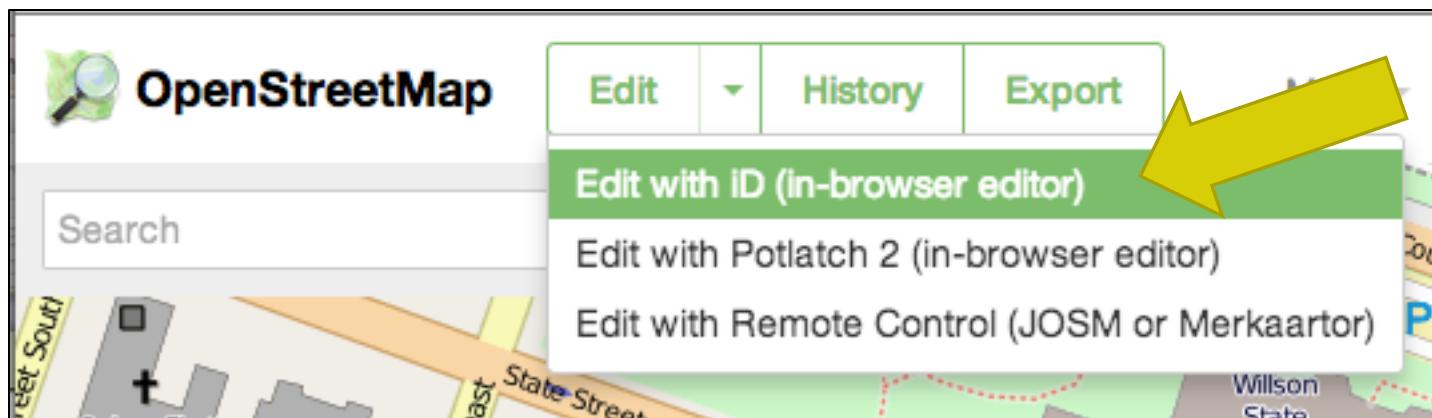
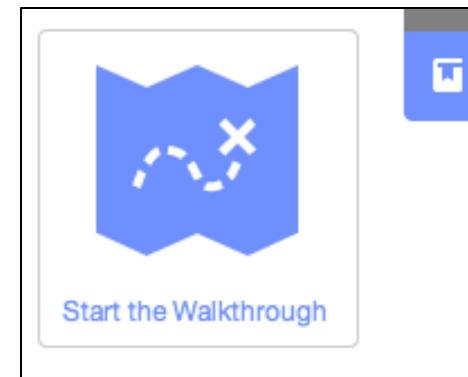
# Step 2: Where and what

- Congratulations! You are now the owner of one of > 1.5 million OSM editing accounts!
- Go back to <http://osm.org>
- Find a neighborhood that you know well
- Think about the places that you know about there - **local knowledge**
- Notice anything missing?



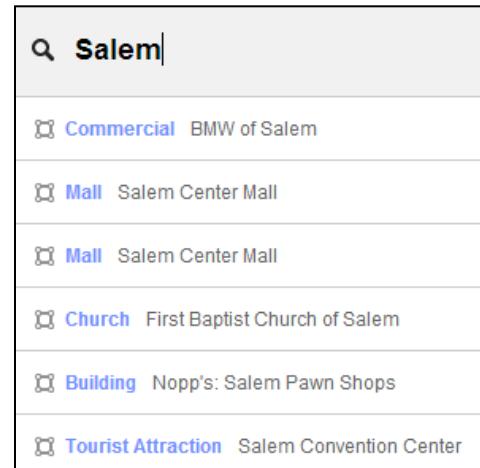
# Step 3: Getting started with iD

- Start familiarizing yourself with iD:
  - Select Edit -> Edit with iD
  - Go through the walkthrough



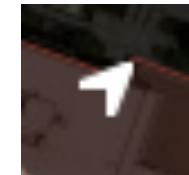
# Step 3: Getting started with iD

- After the walkthrough:
  - Click things to see how they're classified
  - Don't worry, you can't break anything ***until you click "Save"***
  - Click the magnifying glass to search for a city or place
  - Or, click the arrow to find your current location



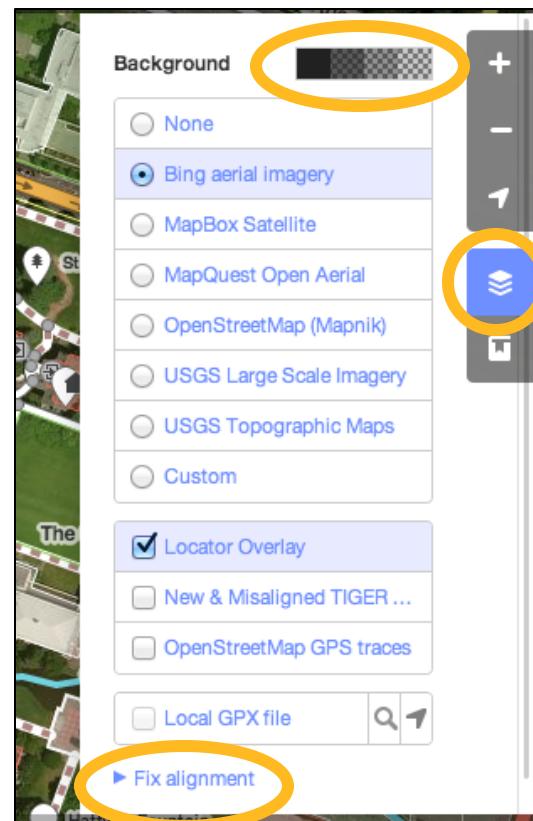
A screenshot of the iD application interface. At the top, there is a search bar with the text "Salem" and a magnifying glass icon. Below the search bar is a list of search results, each consisting of a small icon followed by a category name and a specific location name. The results are:

- Commercial BMW of Salem
- Mall Salem Center Mall
- Mall Salem Center Mall
- Church First Baptist Church of Salem
- Building Nopp's: Salem Pawn Shops
- Tourist Attraction Salem Convention Center



# Step 3: Getting started with iD

- Changing the background imagery
  - Adjust brightness
  - Lots of imagery choices
  - TIGER data overlay
  - Custom/local files and imagery
  - Adjust alignment



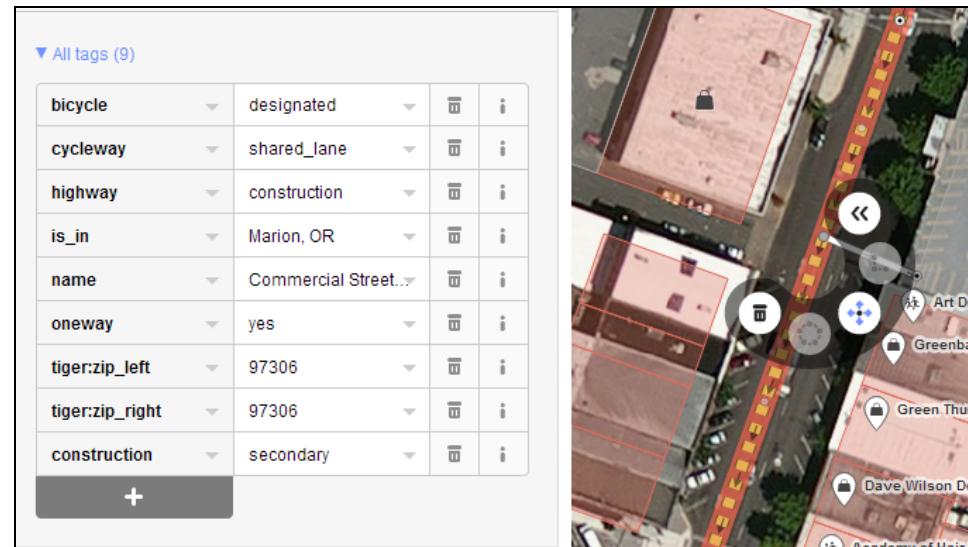
# Step 4: Change something

- But first, what's your source?
- **Don't copy from other maps**
- Local knowledge is best, but a dataset with the correct license and permissions can be a source
- You even need permission for aerial imagery (imagery included in OSM editors is OK)
- More info about the OpenStreetMap license (ODBL) can be found at  
<http://www.openstreetmap.org/copyright>

# Step 4: Change something

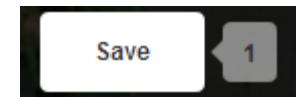
- Let's say a road will be closed for construction for a long period of time
- Select it, click the triangle to show all tags

Change from  
**highway=secondary**  
to  
**highway=construction**  
and  
**construction=secondary**



# Step 5: Save your edits

- Save early, save often
- This creates a “changeset” that is sent to the database
- **Give an informative changeset comment** that includes what you were working on and your sources
- What imagery are you using?



Save Changes X

Commit message

This section of Commercial Street will be closed, undergoing construction until X/Y/2014. Source: ODOT (<http://URL>)

The changes you upload as Mele Sax-Barnett will be visible on all maps that use OpenStreetMap data.

**Save**

**1 Modified**

line Commercial Street Northeast

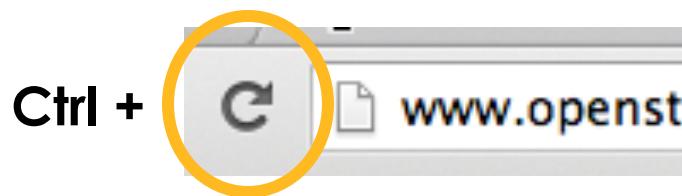
A larger screenshot of a "Save Changes" dialog box. At the top, it says "Save Changes" with a close button. Below that is a "Commit message" field containing a note about closing a street for construction. Underneath is a note about the changes being visible on maps. A "Save" button is at the bottom. Below the dialog, a summary shows "1 Modified" and a list item "line Commercial Street Northeast".

## Step 6: View your edits

- Click “View on OSM” (or go to <http://osm.org>)
- Hold down *Ctrl* while clicking *refresh* to clear your browser’s cache of map tiles (shift-refresh with Firefox)
- Should be updated within a few minutes



[View on OSM](#)



# More about editing

- JOSM (Java OpenStreetMap Editor) is another very good editor
  - Powerful and not too hard to learn, especially if you're familiar with GIS software
  - Allows you to toggle multiple layers of data and imagery on and off
  - <http://josm.openstreetmap.de/>
  - <http://learnosm.org>
- Visit <http://wiki.osm.org> for tagging help, or ask on the newbies listserv  
<http://lists.openstreetmap.org/listinfo/newbies>

## More about the OpenStreetMap data structure: Tags

- Tags are the equivalent of feature attributes
- They consist of two text fields, a key and a value
  - highway = residential
  - leisure = park
  - bicycle = designated
  - cycleway = lane
  - foot = no
  - name = Salem Bus Station

# More about the OpenStreetMap data structure: Nodes

- Nodes:
  - A node/point can be used to mark a particular place on the map
  - For example, a bus stop may be marked using a node tagged with `highway = bus_stop`

**Node: Summer & Union (1943512283)** [X](#)

mapped bicycle routes and infrastructure in Salem based on City of Salem bike data and Bing aerial imagery

Edited over 1 year ago by [Grant Humphries](#)  
Version #1 · Changeset #13341522  
Location: [44.9436487, -123.0276827](#)

Tags

<code>highway</code>	<code>bus_stop</code>
<code>name</code>	Summer & Union

Part of

[Relation 2 - Jan Ree \(71207\)](#)

[Download XML](#) · [View History](#)



# More about the OpenStreetMap data structure: Ways

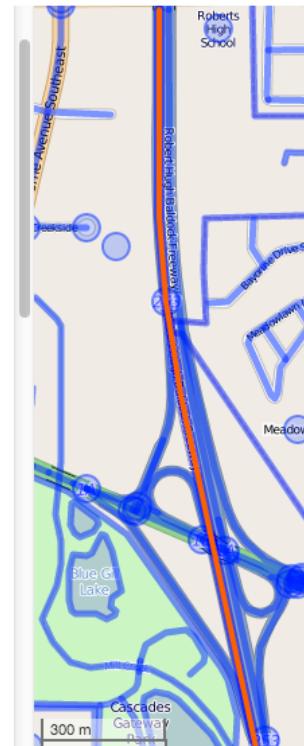
- Ways:
  - A way is a line feature, made up of two or more connected nodes
  - For example, a freeway would be a way tagged with `highway = motorway`

Way: Robert Hugh Baldock Freeway (29170696)

Marion County, OR fixes to Marion County GIS data, Bing  
Edited over 1 year ago by Mele Sax-Barnett  
Version #54 · Changeset #13189176

Tags

alt_name	Pacific Highway
bicycle	yes
comment	Named after Sam Baldock.
hgv	designated
highway	motorway
lanes	3
maxspeed	60 mph
maxspeed:hgv	55 mph
name	Robert Hugh Baldock Freeway



# More about the OpenStreetMap data structure: Areas

- Areas:
  - An area is a closed way
  - For example, a plaza would be an area tagged with `highway = pedestrian` and `area = yes`



Tags that can apply to ways or areas, like `highway = pedestrian`, may also require an `area = yes` tag

# More about the OpenStreetMap data structure: Relations

- Relations:
  - Groups of nodes, ways, or areas
  - Types:
    - Route: includes interstate routes, cycling routes, and bus routes
    - Multipolygon: areas with multiple parts or holes
    - Boundary: for administrative boundaries
    - Restriction: to describe turn restrictions

## OSM peculiarities to keep in mind

- Most keys and values should not be capitalized (the only exceptions are values for the “name” key)
- Avoid using abbreviations of any kind
- If a key must have two values, separate them with a semicolon

# More OSM peculiarities

- Street names should be what you see on the street sign, but expand the abbreviation
- Highways may also have ref codes, which are not the same as the name
  - For example, I5 is known by many names (Robert Hugh Baldock Freeway, etc.) but it is always `ref = I 5`
- On and off ramps and service roads are generally unnamed
- Separated roadways should be mapped as separate ways in OpenStreetMap

# Topology/Connectivity

- Does this street actually go through and connect to this other street?
- Adding new streets and paths that are missing
- Keeping up to date on prolonged closures due to construction projects is important for routing
- Directionality (`one_way = yes`)



# Topology/Connectivity

- Bridges and tunnels
  - Only connect them to other features according to reality (ok if they overlap other features)
  - `bridge = yes`
  - `tunnel = yes`
  - Associated layer tags:
    - `layer = 0` is implied, ground level
    - `layer = 1` is the next layer up
    - `layer = -1` is the next layer down
    - Continue incrementing up/down as needed

# Highway classification

- **highway** =
  - **motorway**: freeway
  - **trunk**: not an official freeway, but bicycles and pedestrians not usually allowed
  - **primary**: major arterial
  - **secondary**: secondary arterial
  - **tertiary**: yellow centerline
  - **residential**: no centerline
  - **service**: often unnamed driveway or alley
- <http://wiki.openstreetmap.org/wiki/Highway>

# Highway classification

- \_links, for instance, `motorway_link`:
  - Defined by the highest-classification roadway it connects to
  - Unnamed links between named roadways
- Highways are for pedestrians and bicycles too
  - `footway`: primarily for foot traffic
  - `cycleway`: primarily for bicycle traffic
  - `path`: for both foot and bike traffic
  - `pedestrian`: wider way for pedestrian and bicycle traffic, occasional service vehicles
- <http://wiki.openstreetmap.org/wiki/Highway>

# Access tags

- `access = no` : nobody can go there (unless you also add exceptions)
- `access = private` : only allowed if you are ending or beginning the trip there
- `bicycle = yes` : for places they're not usually allowed, like motorways and trunks
- `bicycle = designated`
- `foot = no`
- `psv = designated, bus = yes`
- <http://wiki.openstreetmap.org/wiki/Access>

# Turn restrictions

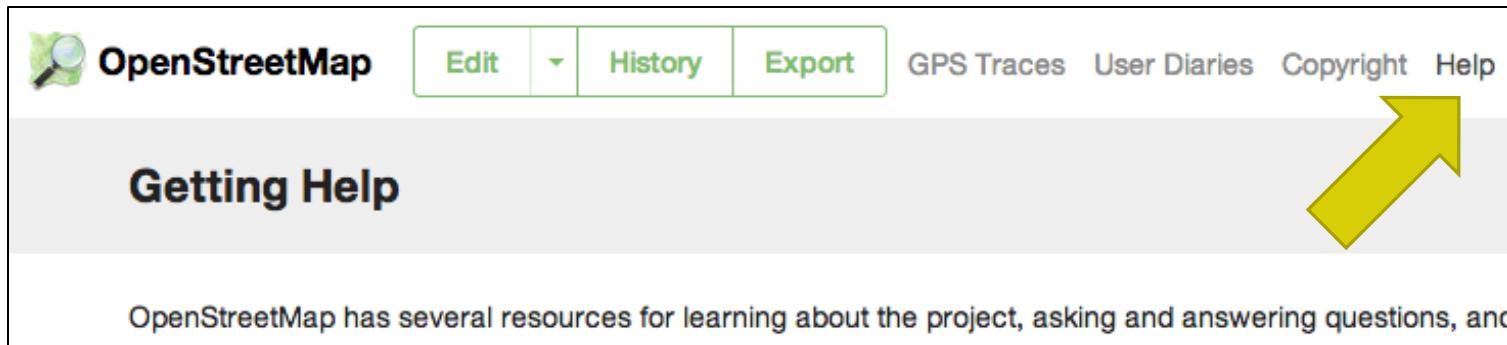
- Relations that say you can or cannot go from one way to another via a particular node
  - A “type”: no\_right\_turn, no\_left\_turn, no\_u\_turn, no\_straight\_on, only\_right\_turn, only\_left\_turn, only\_straight\_on
  - A “from” way, a “via” node, and a “to” way
  - Can except or apply to only certain kinds of vehicles or bicycles
- [http://wiki.openstreetmap.org/wiki/Turn\\_restrictions](http://wiki.openstreetmap.org/wiki/Turn_restrictions)

# Bicycle facilities

- `cycleway = lane` : bike lane
- `cycleway = opposite_lane` : bike lane going against traffic (for one way streets)
- `cycleway = shared_lane` : sharrows
- `cycleway = share_busway` : shared bike/bus lane
- `cycleway:right = lane`, `cycleway:left = shared_lane` : for when different sides of the street have different facilities
- <http://wiki.openstreetmap.org/wiki/Cycleway>

# Resources

- <http://www.openstreetmap.org/help>
- <http://wiki.osm.org>
- <http://help.osm.org>
- Ask on the newbies listserv:  
<http://lists.openstreetmap.org/listinfo/newbies>



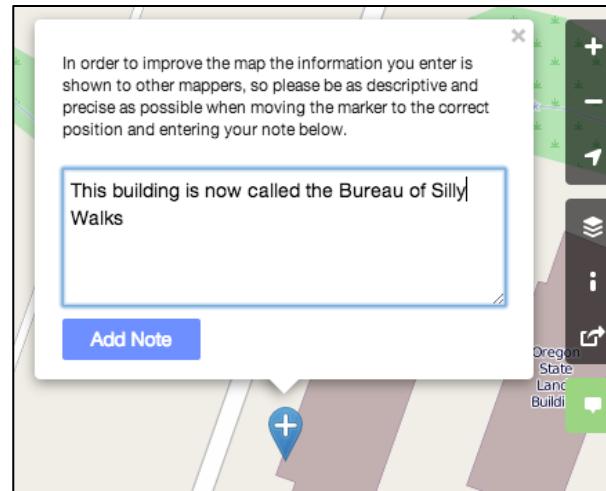
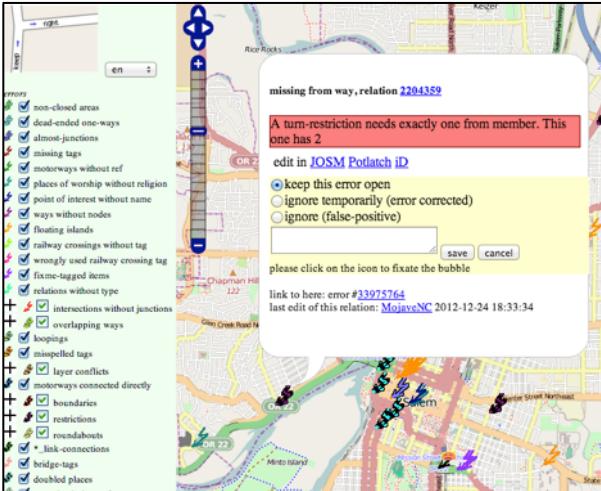
The screenshot shows the top navigation bar of the OpenStreetMap website. It includes links for 'Edit', 'History', 'Export', 'GPS Traces', 'User Diaries', 'Copyright', and 'Help'. A large yellow arrow points from the word 'Help' in the navigation bar down to the 'Getting Help' section of the page. The 'Getting Help' section features a heading and a descriptive paragraph.

**Getting Help**

OpenStreetMap has several resources for learning about the project, asking and answering questions, and

# More resources

- QA tools:
  - [http://wiki.openstreetmap.org/wiki/Quality\\_assurance](http://wiki.openstreetmap.org/wiki/Quality_assurance)
  - Keep right: <http://keepright.ipax.at/>
  - Notes: <http://wiki.openstreetmap.org/wiki/Notes>

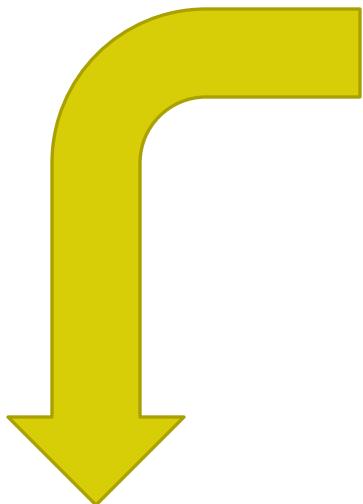


# Practice time!

1. Try adding a new walkway or road, and make sure you connect it to the surrounding features correctly
  2. Try changing a road classification or adding a bike lane tag
  3. See if you can figure out how to split or orthogonalize a feature, or change the direction of a way
- You can always re-run the iD walkthrough or look at the manual (behind the book icon) if you forget how to do something
  - <http://wiki.openstreetmap.org/wiki/ID>
  - <http://wiki.openstreetmap.org/wiki/ID/Shortcuts>

# Getting Data Back Out of OpenStreetMap

# Nodes



**Node: Starbucks (585335295)**

pois, cleanup and rm duplicate parks around national mall,

Edited over 4 years ago by [aude](#)  
Version #1 · Changeset #3345094  
Location: 38.9032821, -77.0233587

Tags

amenity	cafe
name	Starbucks

[Download XML](#) [View History](#)

```
<node id="585335295" visible="true" version="1" changeset="3345094" timestamp="2009-12-10T21:20:14Z" user="aude" uid="12055" lat="38.9032821" lon="-77.0233587">
<tag k="amenity" v="cafe"/>
<tag k="name" v="Starbucks"/>
</node>
```

# Ways: groups of nodes

```
<way id="130808379" visible="true" version="5" changeset="17609617"
timestamp="2013-08-31T20:22:37Z" user="DennisL" uid="32952">
<nd ref="49809698"/>
<nd ref="49810904"/>
<nd ref="49791685"/>
<nd ref="49810901"/>
<nd ref="49756850"/>
<nd ref="49775980"/>
<nd ref="1017385609"/>
<nd ref="49810896"/>
<nd ref="49810893"/>
<nd ref="49775563"/>
<nd ref="1364961105"/>
<nd ref="49796993"/>
<nd ref="49780078"/>
<nd ref="49810877"/>
<nd ref="49810876"/>
<nd ref="2440765433"/>
<nd ref="774340109"/>
<nd ref="49810871"/>
<tag k="HFCS" v="Minor Arterial"/>
<tag k="highway" v="primary"/>
<tag k="lanes" v="4"/>
<tag k="name" v="9th Street Northwest"/>
...
</way>
```



# Areas: closed ways

- They contain the same node twice, once at the start and once at the end

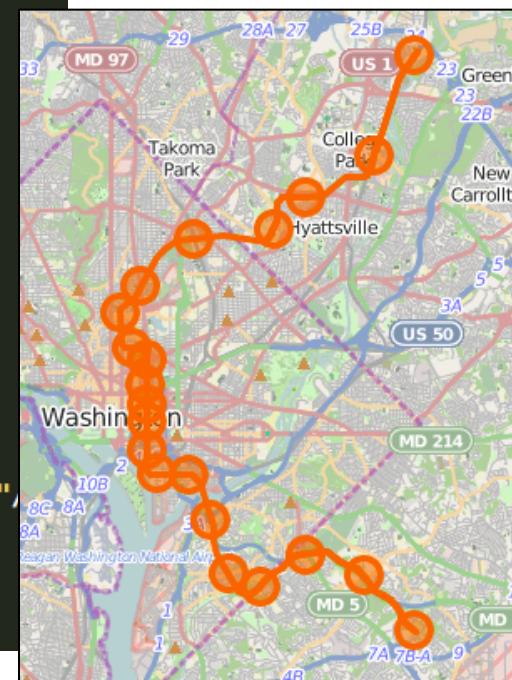
```
<way id="55316481" visible="true" version="6" changeset="12822583"
timestamp="2012-08-22T15:53:14Z" user="ajashton" uid="135329">
<nd ref="694858439"/>
<nd ref="694860576"/>
<nd ref="694861318"/>
<nd ref="694859685"/>
<nd ref="694860113"/>
...
<nd ref="694860111"/>
<nd ref="694858119"/>
<nd ref="694861293"/>
<nd ref="694858822"/>
<nd ref="694858456"/>
<nd ref="694858439"/>
<tag k="addr:state" v="DC"/>
<tag k="building" v="yes"/>
...
<tag k="name" v="Walter E. Washington Convention Center"/>
<tag k="source" v="USGS Geonames"/>
</way>
```



# Relations: groups of nodes and ways

- Various types, for example, a route:

```
<relation id="2609895" visible="true" version="7" changeset="16634333"
timestamp="2013-06-20T19:05:13Z" user="ajashton" uid="135329">
<member type="way" ref="59525464" role="forward"/>
<member type="way" ref="59525461" role="forward"/>
<member type="way" ref="169058768" role="forward"/>
<member type="way" ref="169058765" role="forward"/>
<member type="way" ref="59525460" role="forward"/>
...
<member type="node" ref="738189367" role="stop"/>
<member type="node" ref="738189383" role="stop"/>
<member type="node" ref="738189345" role="stop"/>
<member type="node" ref="738189344" role="stop"/>
<member type="node" ref="738189376" role="stop"/>
<tag k="colour" v="green"/>
<tag k="name" v="Green Line"/>
<tag k="network" v="Washington Metro"/>
<tag k="operator" v="Washington Metropolitan Area Transit Authority"/>
<tag k="ref" v="GR"/>
<tag k="route" v="subway"/>
<tag k="type" v="route"/>
</relation>
```

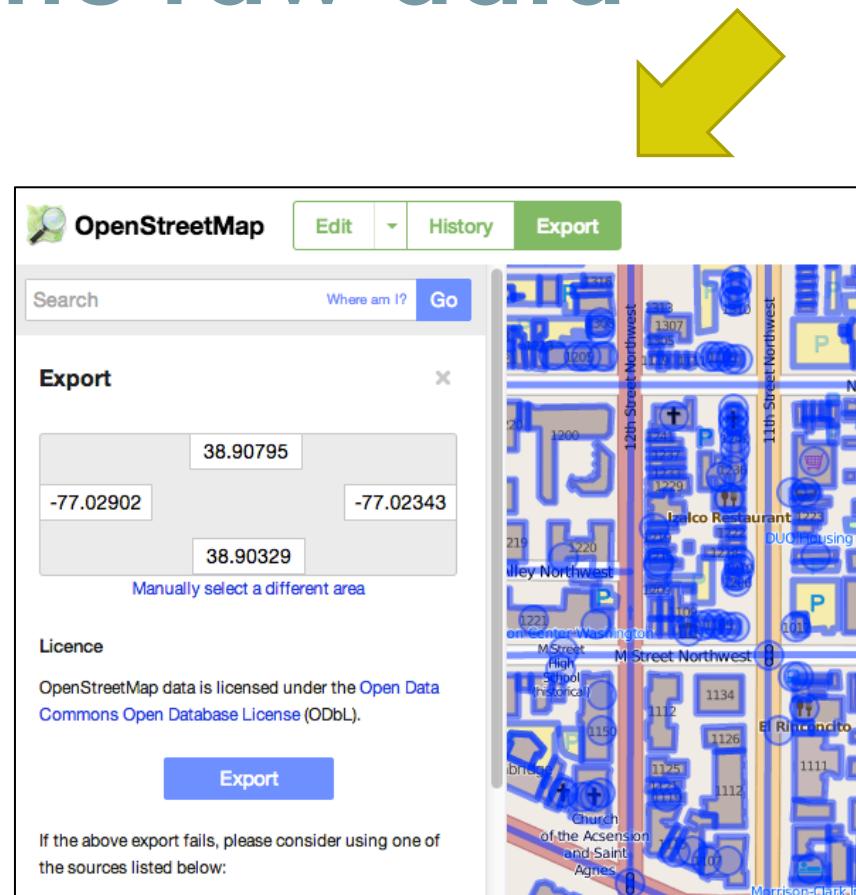


# Before you begin: Think about what you want to do

- Let's assume we want to use OSM data for cartography
- What are you making? A web map? A print map?
- What software do you want to use to make it?
- What formats can that software use? Do you prefer to work with certain data formats?
- What is your geographic extent?
- Which features do you want to show? Everything? Only the highways? Only the coffee shops? Only a few select features?
- How often do you want to update your map?

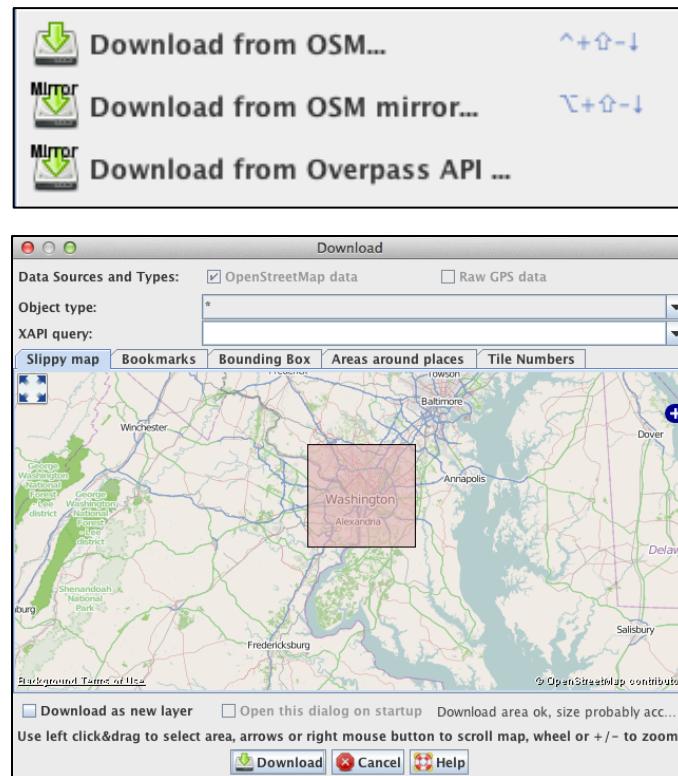
# Step 1: Get the raw data

- [http://wiki.osm.org/wiki/Downloading\\_data](http://wiki.osm.org/wiki/Downloading_data)
- Small areas and individual features from the OSM website
  - <http://www.osm.org>
  - “Export” button



## Step 1: Get the raw data

- From a standalone OSM editor:
  - JOSM
    - Just download and save, or use “Download from OSM mirror” or “Download from Overpass API” for large areas
    - QGIS 2.0+
      - Plugin for earlier versions

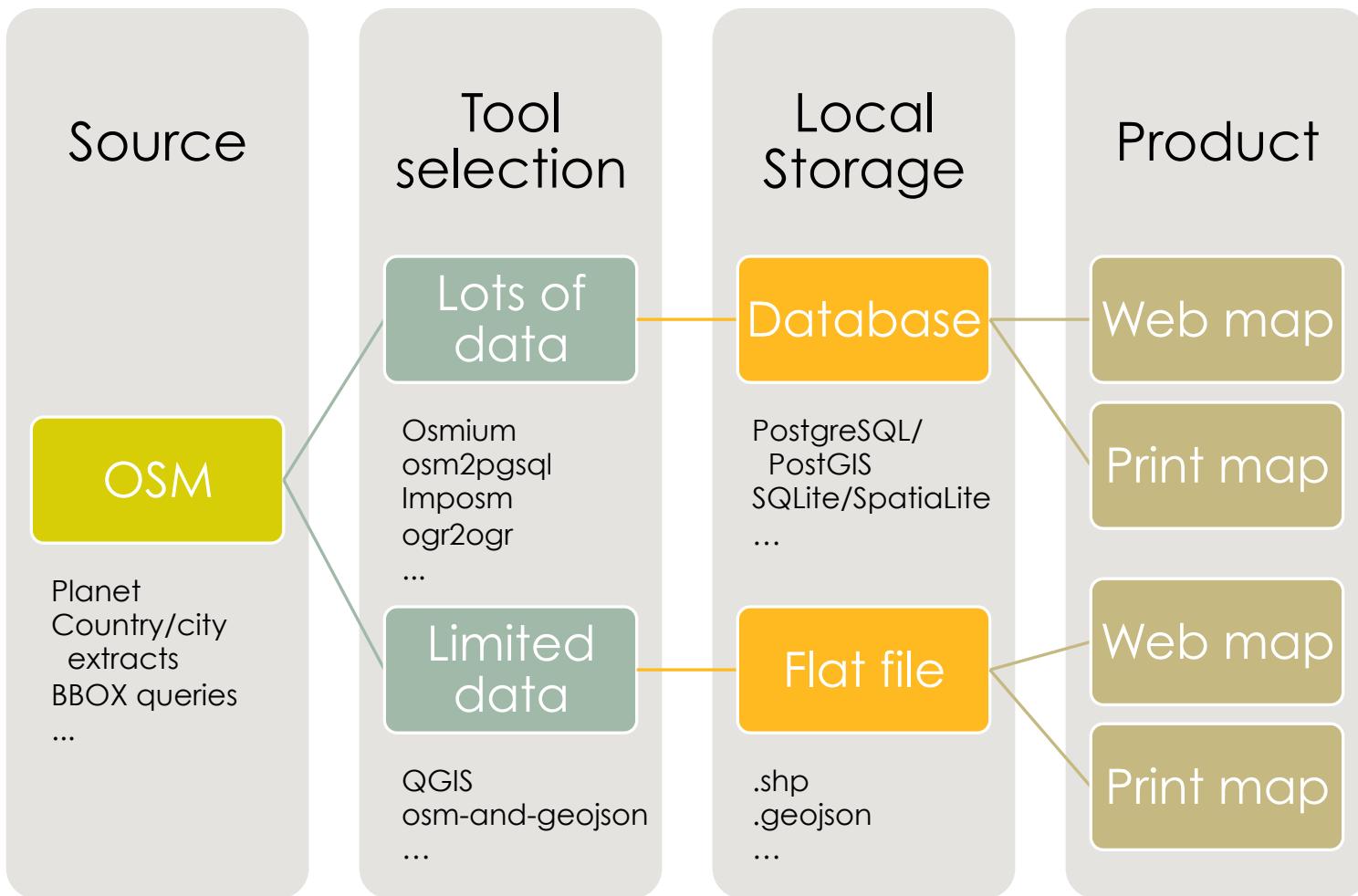


# Step 1: Get the raw data

- Download large areas from various places, free or at cost:
  - “The planet”, countries, cities, etc.
  - APIs: <http://wiki.openstreetmap.org/wiki/Xapi> ,  
[http://wiki.openstreetmap.org/wiki/Overpass\\_API](http://wiki.openstreetmap.org/wiki/Overpass_API)
  - <http://download.geofabrik.de/>
  - <http://osmdata.thinkgeo.com/>
  - <http://metro.teczno.com/>
  - <http://download.bbbike.org/osm/>
  - <http://market.weogeo.com/>
  - Some of it is already in shapefile format, but it might not have exactly what you're looking for
  - Remember to check the date

## Step 2: Process the data

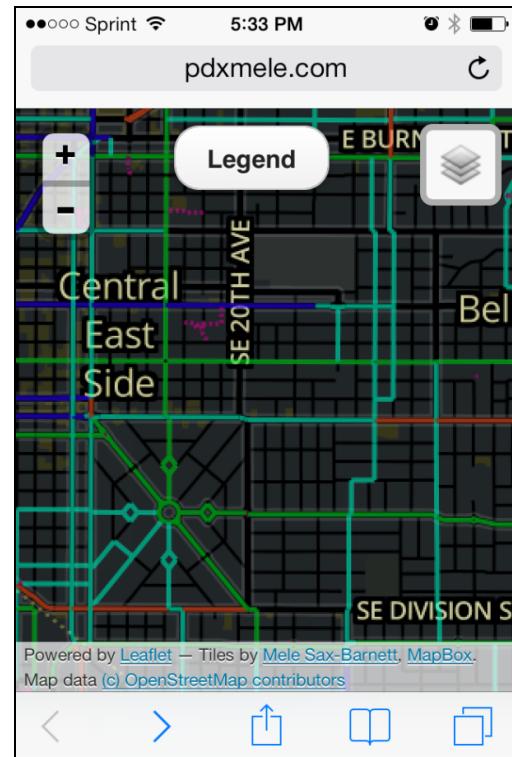
- There are an ever-increasing number of tools and scripts that you can use
- Many of them involve using the command line
- I will go over some popular options, and two use cases in detail
- Full list at <https://github.com/pdxmele/gwyw-osm>



More at <https://github.com/pdxmele/gwyw-osm>

# Use case 1: Web map with TileMill

- Can use both flat files and databases
  - Shapefile, GeoJSON
  - PostGIS, SQLite
- This means it can work for both creating a complete basemap from scratch, or for layering a number of features on another basemap
- This use case: make a custom bike map of a city

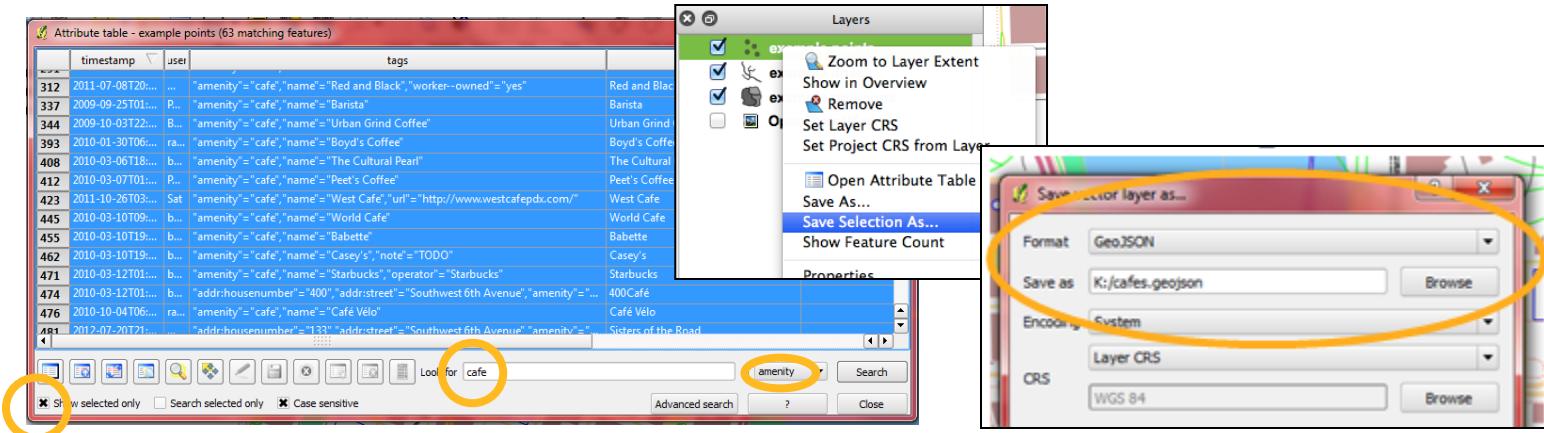


# Use case 1: Web map with TileMill

1. Download the metro area with **JOSM**'s mirrored download plugin and save as a .osm file
2. Use **osm2pgsql** to import the data into a **PostGIS** database, customizing the style file to include specialized tags
3. In **TileMill**, add the layer by connecting to the “planet\_osm\_line” table
4. Style with CartoCSS
5. Upload to MapBox or host on your own
6. Update easily by downloading the same bounding box, running the same osm2pgsql command, and dropping it into TileMill with the same styling

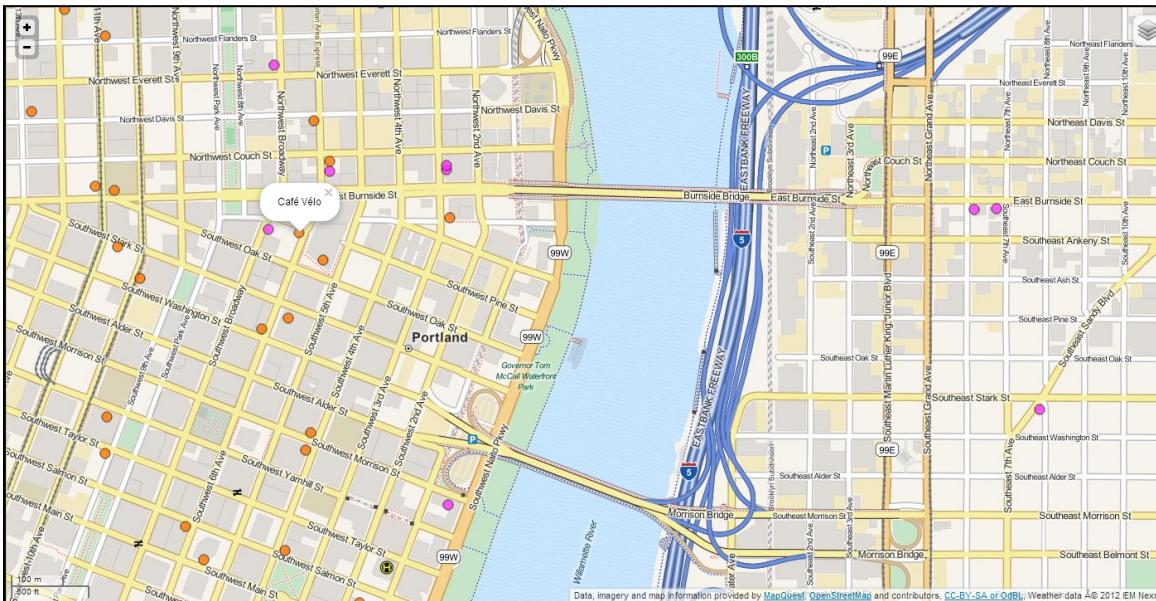
# Use case 2: Leaflet POI web map

- Leaflet works nicely with **GeoJSON**
- Let's say we want to show all of the coffee shops and bars in an area
- Download the data with your preferred method
- Open it in **QGIS** and select only the features you want



## Use case 2: Leaflet POI web map

- Save the selected features out as a .geojson file
- Include the GeoJSON in your Leaflet map by your preferred method



# So, you say you want to process the planet

- Pack your patience – it can easily take months to find the method that works for you, fiddle with settings, and get all of the resources you will need ready
- Ask for help from the mailing lists and OSM/GIS help sites when you need it
  - <http://help.osm.org>
  - <https://lists.openstreetmap.org/listinfo>
  - <https://lists.openstreetmap.org/listinfo/newbies>
  - <https://lists.openstreetmap.org/listinfo/dev>
  - <http://gis.stackexchange.com/>

# Go for it—the data is yours!

- Your main resource for OSM tags (how to filter the data) is <http://wiki.osm.org>
- I've also made a list of common tag keys for you at <https://github.com/pdxmele/gwyw-osm>
- Please remember to credit the OSM contributors: <http://www.openstreetmap.org/copyright>
- Questions? Twitter @pdxmele / saxbarm at gmail.com

# The Future: Vector tiles

- TileMill 2
  - “Slim enough to fit the entire world on a single USB stick”
  - <http://www.mapbox.com/blog/vector-tiles/>
  - <https://github.com/mapbox/tm2>
- OSM vector tiles
  - Mapnik vector tiles:  
<http://openstreetmap.us/~migurski/vector-datasource/>