**Geography 572**

**Lab #3: Advanced CartoCSS Styling**

**Lab Objectives:**

* Create an aesthetic tileset based off of the pastiche lecture material
* Serve your own set of tiles using Mapbox Studio and CartoCSS
* Continue to build your knowledge of Illustrator, Photoshop, and HTML5/CSS

**Evaluation:**

This lab is worth **40 points** toward the Lab Assignments evaluation item, which is worth 25% of your overall course grade. A grading rubric is provided at the end of the lab to inform your work.

**Schedule of Deliverables:**

* **October 30th:** Lab #3 Assigned //client contract begins
* **November 6th:** Inspiration Board Due (2pts) //design & feedback from client
* **November 13th:** POIs list Due (6pts) //input & feedback from client
* **November 20th:** Lab #3 Due (32pts) //contract deadline

**Challenge Description**

The director of an art museum wants to incorporate artistic principles into a tourism slippy map they’ll display on their website. They want to promote the City’s natural, cultural, historical, and/or economic points of interest, or ***POIs*** (i.e., places that tourists may wish to visit during their stay). Since the museum is renowned for its forward thinking, the map should incorporate an aesthetic time period or movement in cartography. The Director has made clear that a trained cartographer must be hired to design a map tile set that is innovative and aesthetically pleasing.

CartoCSS is a styling language specific to mapping that uses existing CSS principles and enhances them to be used for designing vector or raster tile sets online. Professional cartographers have found a way of styling web tiles via the CartoCSS framework to push the limits of what people expect from slippy maps. These maps are highly designed and are innovating the possibilities of the field.

***Notes from the Director of the Chazen***

Your inspiration board serves as a deliverable, to show that you understand how to interpret advanced map stylings that fit with a particular aesthetic look. Your tileset will be built to incorporate all zoom levels, from a view of the world (zoom 1) to street level view (zoom 15) and must be designed for all appropriate scenarios.

The tilesets will be embedded in a webpage, with basic HTML/CSS and Javascript provided to guide you with basic slippy map interaction. Your tilesets must include **at least** 30 POIs icons on the map (i.e., point markers with a basic description). POIs can include a variety of locations, like restaurants, parks, etc. that might be useful in this scenario. You may choose any city for your scenario, as long as you follow the basic requirements for the POIs. It is important to keep in mind that the contract includes ***both*** the design of the tileset at every zoom level ***and*** the insertion of this map with markers denoting POIs. Finally, you must make use of Mapbox Studio for Lab #3, an open source product for serving custom vector tiles provided by the company MapBox that is introduced in the lab.

**Table 1**. **An example inspiration board, based off a Roy Lichtenstein painting.**

**1. Creating an Inspiration Board**

The first step in Lab #3 is to demonstrate the inspiration for your tileset, based off of two scenarios. Scenario One is incorporating one of the aesthetic styles of mapping as described in Lecture X, and providing appropriate examples from maps and art that reference specific details you plan on including in the map that you find appropriate for the map style. Scenario Two is using a specific map or media (such as a painting or video game) to determine the tileset style. Scenario One will be the example for this lab, creating a ‘Pop Art’ tileset based off of the work of Roy Lichtenstein, a famous 1960’s artist who is famous for his comic-like paintings of people.

Some visual variables to consider for your inspiration board include:

1. **Color:** What colors are you going to use? Make sure they are either relevant to the aesthetic style you are mimicking or included in your sample images.
2. **Texture:** Are there specific textures common to the style?
3. **Typefaces:** Mapbox Studio provides over 300 fonts, but you can (and definitely should) included your own to be used, which typeface best fit your map?
4. **Stylistic effects:** Are waterlines or certain effects like drop shadow common? Should your design be minimalistic? Should your line weight be heavy or light? Colors dark or transparent?

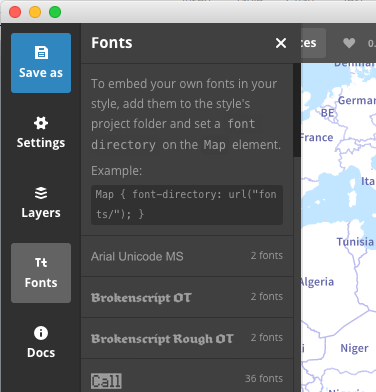
Your inspiration board should have sufficient images to describe what you will attempt to accomplish in your tileset and your artistic/cartographic vision. You should have at least 5 various specific pieces of inspiration for your tileset described in short sentences to guide you through the tileset design process. ‘

The sky is the limit, and if you have questions- look at the example gallery or ask your TA/Professor if you have questions. You are required to have a PDF of the inspiration board assembled and ready for mapping by **November 6th**.

To examine different fonts included in Mapbox Studio, click on the ‘Fonts’ button on the sidebar of Studio when open:



**2. Assembling Your POIs**

The next step in Lab #3 is assembling some data for your places of interest to be added to your map. The information set for Lab #3 emphasizes features at the point dimensionality. While you can include linear or areal features in your map (e.g., a scenic drive, a park), you will need to represent them as points for Lab #3; while this may seem like a limitation, the conceptualization of features as points is common on web maps due to the provision of integrated map designs at multiple scales, the smallest of which require collapsing to points.

It is up to you to decide which features of interest will be included in your map; if you choose a large city, consider giving your map a specific theme rather than including all possible POIs that may be found on a tourism map. Regardless of which features you ultimately decide to map, you will need to collect five pieces of information about each feature:

1. **Category:** The category representing the type of POI (i.e., the iconic point symbol used to represent the POI); this is not the higher-level category further organizing groups of POIs mentioned above.
2. **Latitude:** In decimal degrees, using negative numbers for latitudes in the Southern Hemisphere. There are many places to get the coordinates of places, whether through Google Maps or a free geo-referencing service.
3. **Longitude:** In decimal degrees, using negative numbers for longitudes in the Western Hemisphere.
4. **Name:** The specific name of the instance of the feature. This is different from the category, as several mapped features may receive the same iconic point symbol.
5. **Description:** A brief (100 words or less) description of the feature, perhaps with a link to additional information. You should compose the descriptions yourself such that the set of descriptions are at a common length and contain a common set of summary information. Both the name and description columns will be used to populate an information window upon clicking the icon.

Your information must be stored in a *comma separated file*, or ***.csv***, for loading into Mapbox Studio. As its name implies, a *.csv* file is a flat text file that delimits rows using the comma (“,”) character. Therefore, you may not include commas in any cell in the file unless you make use of the escape character \_\_. To create your *.csv* file, you can assemble your spreadsheet in Microsoft Excel (as shown in **Table 1**) and export using *Save As->Save As Type: CSV.* You are required to have your *.csv* file assembled and ready for mapping by **November 13th**.



**Table 1**. **An example *.csv* file, formatted for loading into TileMill**.

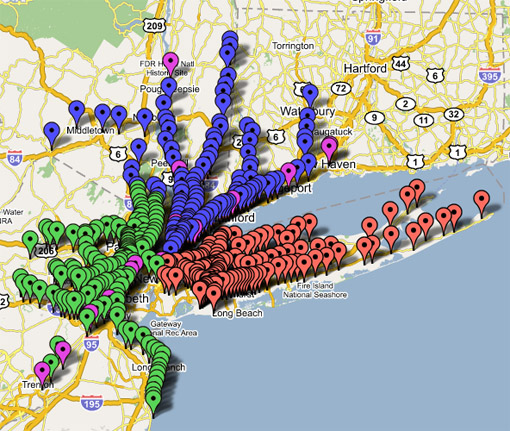
**Table 1** provides the example information for Madison, WI, used in the following tutorial.

**3. Intro to Mapbox Studio**

Cartography has forever been altered with the influx of mapping on the web, using interactivity to animate and create more functional maps than ever before. Popularized by Google Maps and Mapquest for their navigation-oriented basemaps, the term ***slippy map*** describes a mashup that draws upon web mapping services to provide integrated, multiscale map designs, typically using a tile-based raster system.

A slippy map also exhibits basic interactive functionality, such as, panning, zooming (together where the ‘slippy’ term came from), overlay of different basemaps, and retrieval of details through information windows (e.g., your point icons). The advantage of slippy map mashups is that their creation requires very little custom code by combining existing services.

While originally used as reference maps for Google Maps or Mapquest, slippy maps have undergone a revolution with CartoCSS. As original slippy maps were considered poorly designed and under-developed, the cartographic world has worked to alter the stigma around slippy maps. Companies like Mapbox incorporate CartoCSS into their business model, creating a platform to make custom map tiles that are best for what a cartographer is creating for a client. These range from basic transportation maps, to minimalist designs, to the highly designed (the latter of which is the concentration of this lab).



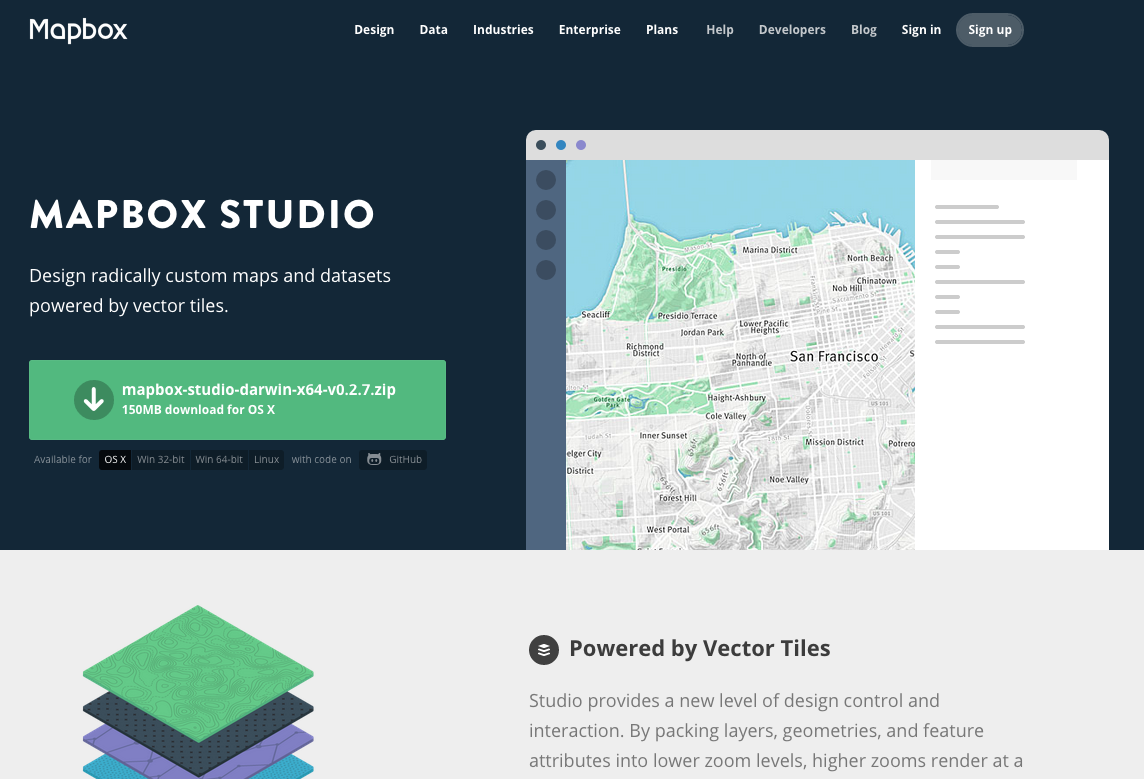
**Figure 8:** The transformation of tilesets, from the original Google Maps ‘Pushpin’ raster tileset to the highly designed Mapbox Studio vector tileset

**a. Getting Started with Mapbox Studio:**

Despite initial cartographic frustrations with the limitations in designing map tiles, the ability to customize the cartographic display has improved substantially in recent years through expansion and refinement of tools for styling and rendering your own basemap tiles.

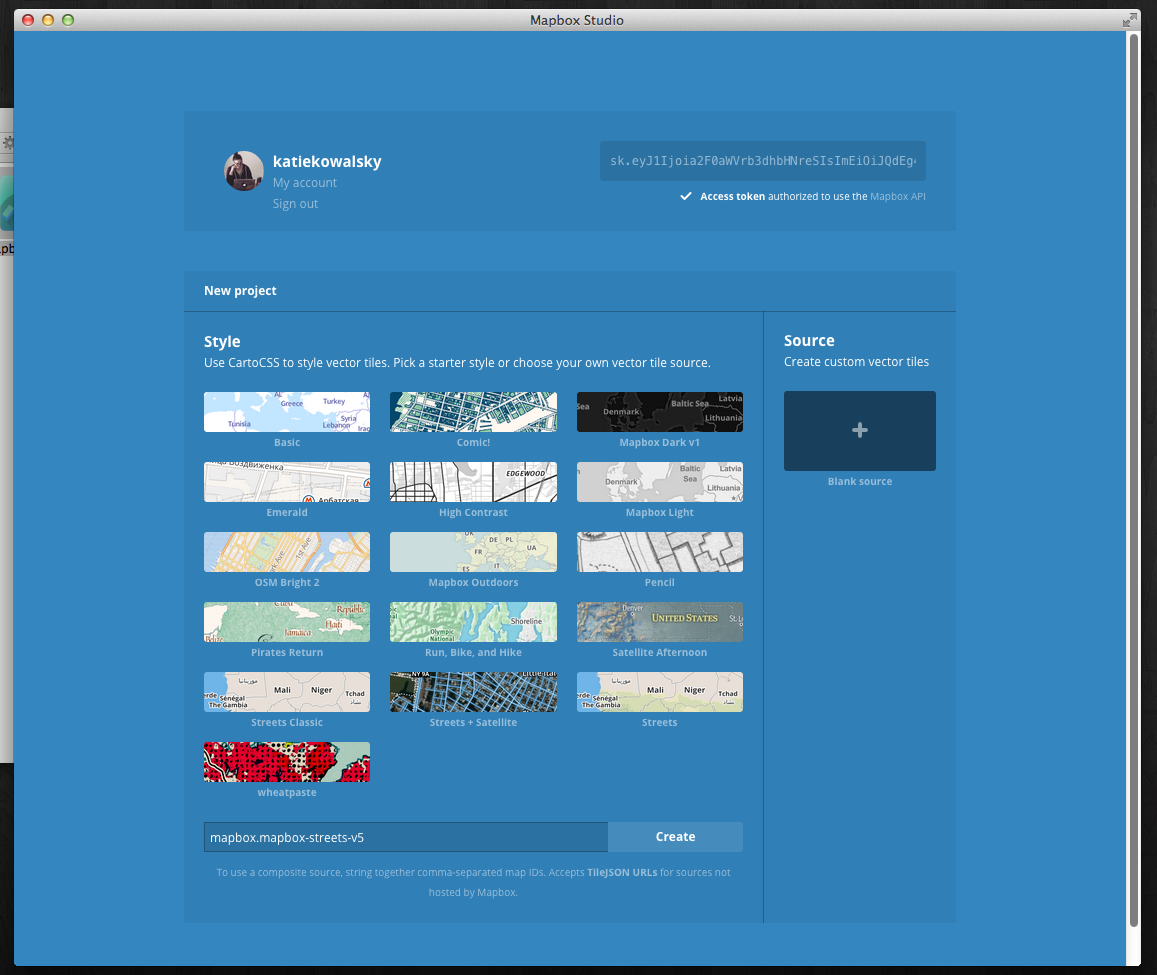
Your Lab #3 slippy map mashup will make use of ***Mapbox Studio****,* an open source project developed by a company called ***MapBox*** that supports custom styling and rendering of basemap tiles. MapBox is quickly becoming a leader in the geospatial industry, particularly in the area of web mapping. Mapbox Studio allows you load and style your own datasets, such as your set of POIs, or to draw from existing data services, such as OpenStreetMap or Natural Earth.

It is important to note that Mapbox Studio can be used for free, using their educational pricing that allows you a basic plan for free with a .edu email address: <https://www.mapbox.com/education/>. If you exceed the limit, which for the purposes of Lab #3 challenge you definitely will not, you would need to pay. Finally, we will be serving raster tiles for Lab #3, given the commonality of this solution. MapBox has been highly innovative in the development of vector-based tiling, a promising solution for responsive web cartography in the future.

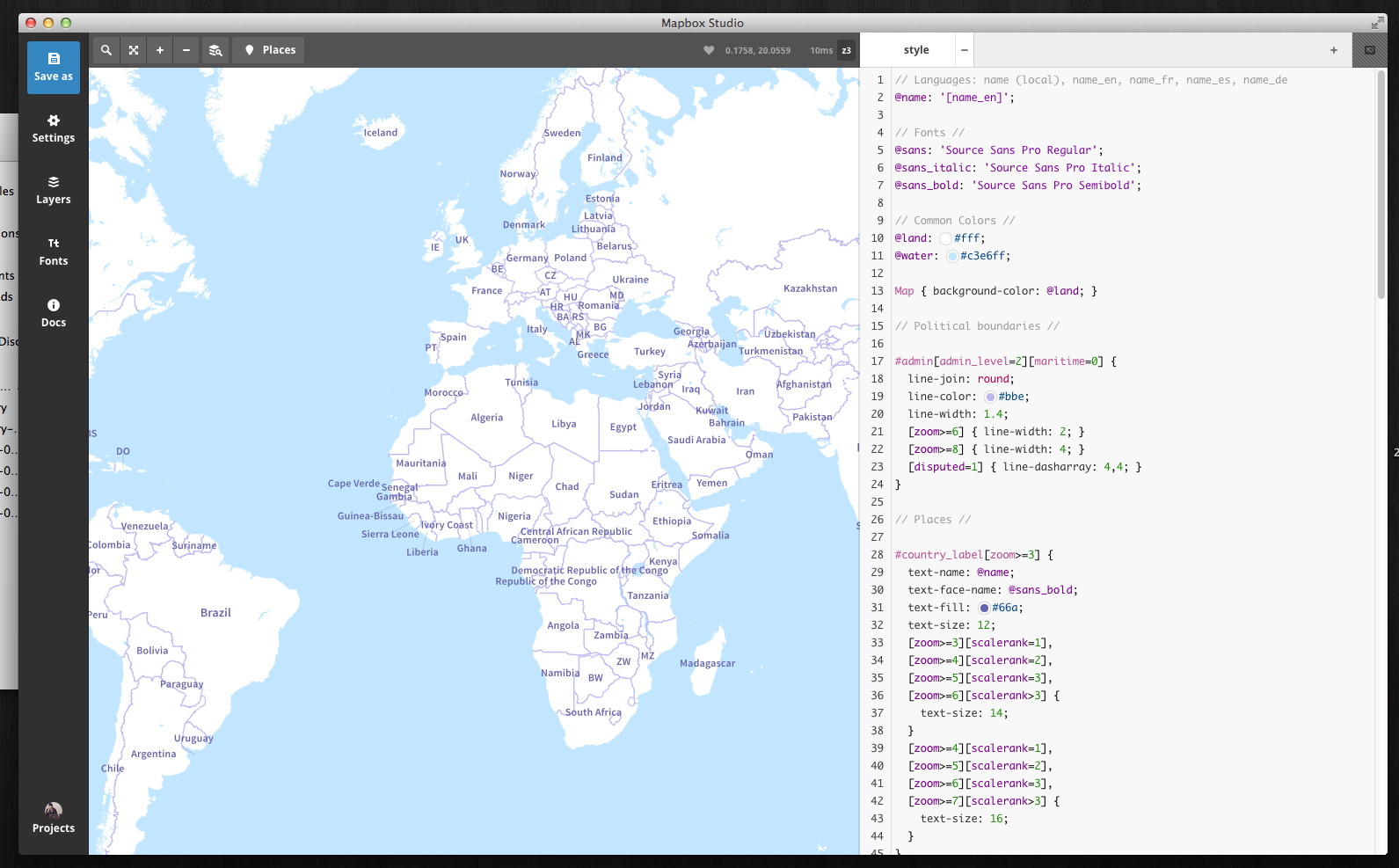


**Figure 9:** The Mapbox Website for Mapbox Studio

Get started with Mapbox Studio after registering for the Education account (you should be all set a minute or two after sending, but double check your SPAM folder) and go to the Mapbox website for Mapbox Studio: [https://www.mapbox.com/mapbox-studio/](https://www.mapbox.com/mapbox-studio/#darwin) (**Figure 9a**). If you prefer to work on your own machine, you then can install Mapbox Studio by selecting the appropriate operating system from the download options (**Figure 9b**). Studio is also available on all machines in Science Hall 380 and M376. If you are working on a Science Hall machine, open Mapbox Studio to begin (**Figure 10**). It’s important that you create an account and login; you can save everything to Mapbox’s cloud and can be accessed on any computer.



**Figure 10: The Mapbox Studio Application.**



**Projects**

**Settings**

**Docs**

**Settings**

**Fonts**

**Settings**

**Layers**

**Settings**

**Save as**

**Settings**

Once open, click on a sample template to get a feel of where things are in Mapbox Studio. Under the ‘Docs’ tab, there is an **Interface Tour that is highly recommended** to get a sense of where things are in the application.

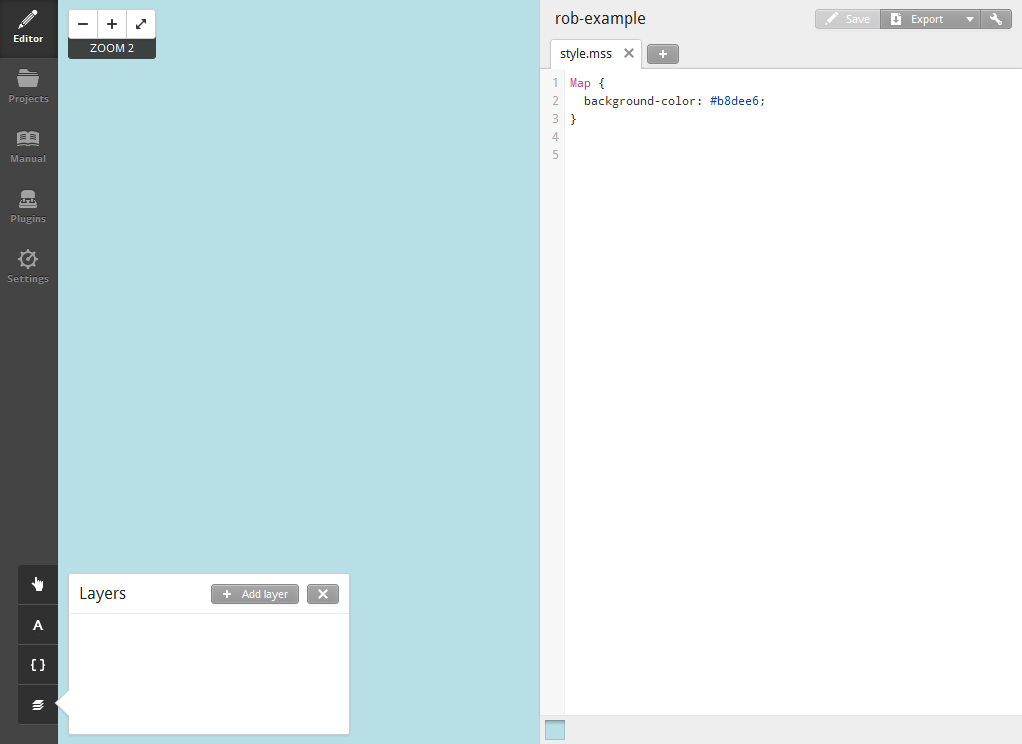
The application includes five tabs along the left bar (**Figure 11**):

* The ***Save As*** allows you to constantly save any changes made to your tileset (make sure you choose either the Desktop or your flash drive if working in 380).
* The ***Settings***tab allows you to upload your style to Mapbox when finished to be viewed/hosted on their website, to name and describe it, and various settings like altering the center position, changing the min/max zoom and so on.
* The ***Layer*** tab is extremely important for CartoCSS, allowing you to add/change sources and see the layer order for your source. You can also click on each source layer to see the data properties (that can be used as selectors in CartoCSS)
* The ***Fonts*** tab show the variety of typefaces available and built into Mapbox Studio. Clicking on each will allow you to see each and every font possible. You can also see the documentation for adding your own fonts as well.
* The ***Docs***tab gives you access to all of the acceptable CartoCSS documentation and has the interface tour, which is highly recommended that you use.
* The ***Projects*** tab is where you can create a new source or style project, log in and out and browse existing projects you might have. *Be sure to logout of your MapBox account at the end of your work session*.

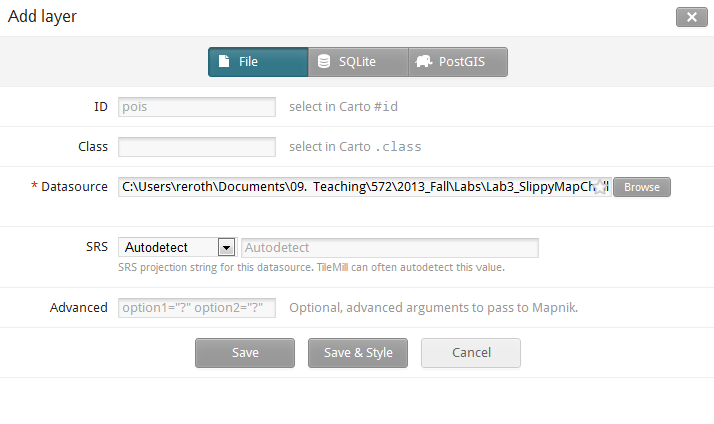
**b. Style vs. Source in Mapbox Studio**

Now that you have explored TileMill, let’s get started by creating a *New Project* in the *Project* tab (**Figure 10**); when prompted, give the project a logical *Filename* and uncheck the option to load *Default data*, as your Lab #3 map will not need world layers. Once created, click on the new project to open it in the *Editor* tab (**Figure 12**). You will see the split-pane interface, with the blank map on the left styled with a default light blue (#b8dee6) color and the associated styles for the blank map in the right styles pane.

The first dateset you are going to load for your slippy map is your processed *.csv* file containing your POIs (see Section 1). Activate the *Layers* panel, select *Add layer*, and browse for your *.csv* file under the *Datasource* input box; click *Done* when you have the correct directory path selected. You will need to give the *.csv* file an ***ID***, which is the name of the layer as referenced in the stylesheet. You have the option of adding a ***class***name as well, which is useful for organizing multiple layers into groups, but is not essential for Lab #3. Allow TileMill to *Autodetect* the ***SRS***, or spatial reference system. When you are done, select *Save & Style* to load the POIs and apply a default styling for preview (**Figure 13**). For additional details about loading a .*csv*, see: <https://www.mapbox.com/tilemill/docs/crashcourse/point-data/>.

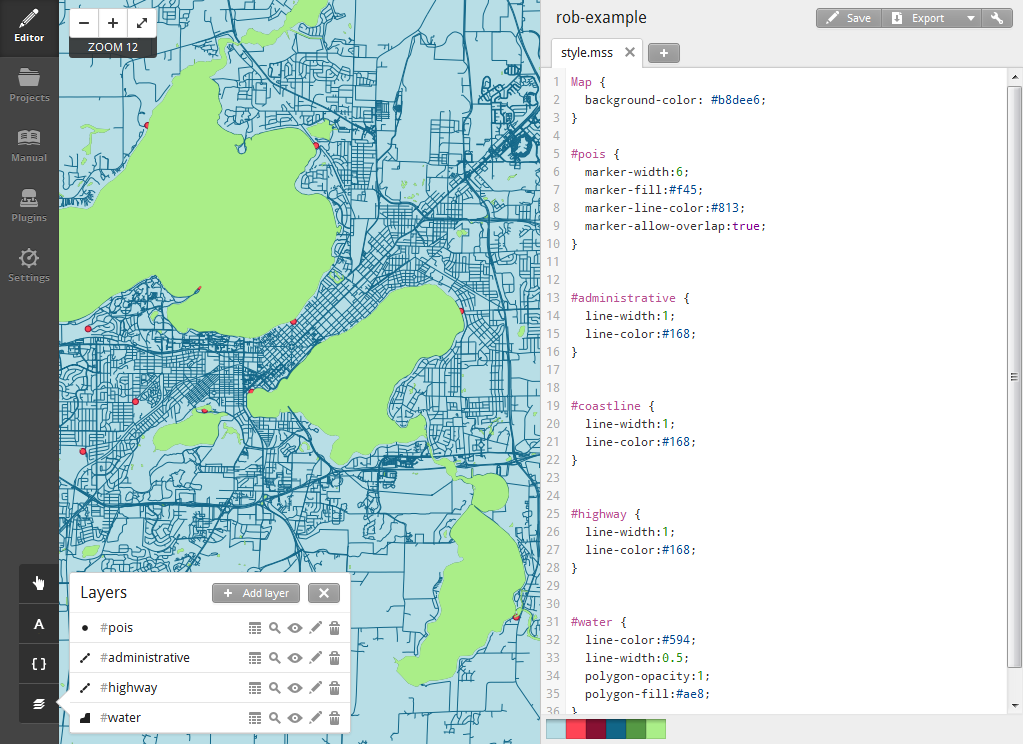


**Figure 12: The *Editor* tab.**



**Figure 13: Loading your *.csv* data.**

Next, you need background context for your POIs. TileMill allows you to load a variety of spatial formats, including shapefiles, GeoJSON, KML, and GeoTIFF, as well as draw data from SQLite and PostGIS databases. For Lab #3, you are going to download linework from OpenStreetMap to create a basemap for your POIs. OpenStreetMap(***OSM***) is a shining example of volunteered geographic information (***VGI***), or the use of public crowdsourcing to collectively create and maintain geographic information. Details about OSM are available at: <http://www.openstreetmap.org/>. The collective contribution to OSM is now over 30GB, a file size far greater than you wish to download at one time. Instead, make use of the region extracts made available by CloudMade, a spin-off company from early OSM contributors that also provide a proprietary tiling service. CloudMade provides extracts at the state level in the US (and many other admin\_1 levels around the world) at: <http://downloads.cloudmade.com/>. **Figure 14** shows the project updated to include default styles for three OSM layers for Wisconsin: administrative, highway, and water. We recommend that you manipulate this linework in ArcGIS or MapShaper before uploading, particularly if you are going to change the generalization of your linework across scales (see discussion on conditional styling in the next subsection). You are welcome to add other context layers as well from OSM or other sources. Note the stacking order in the *Layers* panel reflects the stacking order of the map preview, but the order of the style rules in the stylesheet editor does not impact the drawing order (at least when there is only one style rule per layer).



**Figure 14: Adding OSM Data to Your Project.** Note: This map shows default styling only.

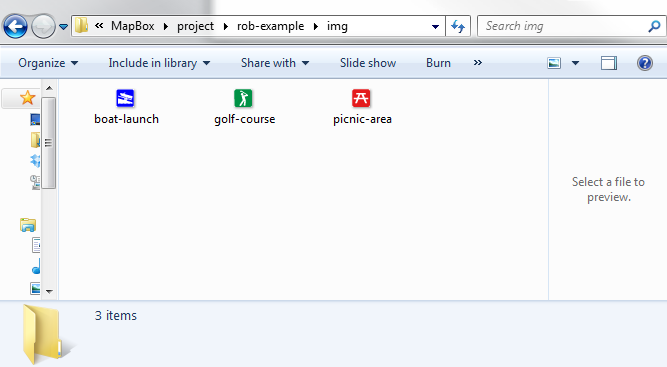
**c. Styling with CartoCSS**

You now have successfully loaded your linework and point features into TileMill. Be sure to saveyour project using the *Save* button in the *Main toolbar*. It is now time to style your map!

TileMill supports the styling of basemap tiles through their ***CartoCSS*** styling specification. In Lab #1, you learned about CSS and the components of style rules (e.g., selectors, properties, values, ids, classes, etc.); return to the second part of Lab #1 if you are not yet comfortable with these concepts. The CartoCSS specification leverages the CSS syntax to allow you to style map features, rather than page elements. Hopefully you now see the value of TileMill: it makes map design much more like web design. The skills learned to build your web portfolio in Lab #1 are now directly applicable to making elegant and aesthetically pleasing tilesets!

Like CSS, CartoCSS apply style rules to map layers by referencing unique IDs (e.g., #pois). You can see in **Figure 14** that default style rules were added to the Map itself, for which there are a small subset of styling rules, as well as each uploaded layer using the unique id you gave it during upload. CartoCSS then is organized into ten different groups of styles based on map features; each group is described as a *symbolizer*, a term derived from the [Mapnik](http://mapnik.org/) rendering engine atop which TileMill is built. Symbolizers include:

* ***Line***: styles for line features and the strokes of polygons;
* ***Polygon***: styles for the fill of polygons;
* ***Point***: styles for point features;
* ***Text***: styles for labeling point, lines, and polygons;
* ***Shield***: styles for symbol annotation for points and lines;
* ***Line Pattern***: styles for applying textures (e.g., dashing) to lines;
* ***Polygon Pattern***: styles for applying textures to polygons;
* ***Raster***: styles for manipulating GeoTIFFs
* ***Markers***: styles for manipulating iconic point features
* ***Buildings***: a subset of polygonal styles explicitly used for build infrastructure.



**Figure 15: Copying your Icon Library into Your Project Folder**

For Lab #3, you will style your POIs using *point* symbolizers, allowing you to symbolize each point location using the appropriate icon. First, create a new folder called *img* in your project directory within the *MapBox* folder and then copy your icon library into the *img* folder; you must do this outside of TileMill (**Figure 15**). Once the icons are copied into your project folder, you then can use the point-file property and set the url() to the relative path of one of your icons (**Code Bank 1**). *Save* your project and wait for the map preview to update.

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1 #pois {

2 point-file: url(img/boat-launch.png);

3 }

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Code Bank 1: Using a Point Symbolizer Style to Load Images from Your Icon Library.**

Congratulations, you now have successfully drawn from your icon library! Unfortunately, all of your POIs currently are symbolized using the same icon. TileMill supports ***conditional******styling*** in two ways: (1) by attributes in the dataset and (2) by zoom level in the slippy map. Beginning with the former, open the *Layers* panel in the *Editor* tab and select the attribute table icon (the first of five icons) for the #pois layer. The information included in the *.csv* file will appear as a table, allowing for inspection of the attribute names (the headers) and the unique attribute values of each POI. For Lab #3, you will be using the nominal variable category created in Section 1 above; CartoCSS also supports conditional styling of numerical attributes, allowing for creation of thematic maps. Conditional styling makes use of bracket notation to specify the attribute and attribute value by which a particular style should be conditionally applied. **Code Bank 2** provides an example of conditional styling by the category attribute.

Two important notes about the syntax for conditional styling with CartoCSS: First, the attribute value must be surrounded by single quotes when a string (i.e., text, or a category attribute); this is not necessary for numbers (i.e., a numerical attribute). Second, the style rule must be contained within curly braces, including the terminating semi-colon.

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1 #pois {

2 [category = 'Boat Launch']{point-file: url(img/boat-launch.png);}

3 [category = 'Golf Course']{point-file: url(img/golf-course.png);}

4 [category = 'Picnic Area']{point-file: url(img/picnic-area.png);}

5 }

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Code Bank 2: Conditional Styling using the category Attribute**

The second form of conditional styling is by zoom level. Returning to principles from G370, you know that the amount of abstraction should change with the map scale; in other words, a map with a large cartographic scale should have more detail, or be less generalized, than a map with a small cartographic scale. The pervasiveness of slippy map mashups requires cartographers to grapple with ***multiscale map design***, providing seamless transitions across scales that have the same aesthetics and style, but that add detail back into the display as you zoom into the map. You can create scale-dependent style rules using the zoom keyword, a numerical attribute that ranges from 0 to 22. **Code Bank 3** provides an example in which two different POI symbol designs are used at different scales. Before zoom level 10-11, a simple circle is used for the POIs using the marker symbolizer; beyond zoom level 12, the iconic point symbols are used. Consider how to make use of zoom levels to resize your icons such that they remain legible at all scales.

With your icons properly loaded, you can now turn your attention to styling the basemap linework. Take some time to experiment with the CartoCSS specification. CartoCSS supports application of multiple styles to the same feature using the double colon (::) notation, allowing you to build up sophisticated and highly aesthetic designs. It is important to note that if you do not make use of the double colon notation, the second style rule will override the first, just as with CSS.

A ‘cheat-sheet’ reference guide is available within the *Editor* tab. The complete CartoCSS documentation is available at: <https://www.mapbox.com/carto/api/2.1.0/>.

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1 #pois {

2 [category = 'Boat Launch'][zoom >= 12]

3 {point-file: url(img/boat-launch.png);}

4 [category = 'Boat Launch'][zoom <= 11]

5 {

6 marker-width:6;

7 marker-fill:#00f;

8 marker-allow-overlap:true;

9 }

10 [category = 'Golf Course'][zoom >=12]

11 {point-file: url(img/golf-course.png);}

12 [category = 'Golf Course'][zoom <=11]

13 {

14 marker-width:6;

15 marker-fill:#009245;

16 marker-allow-overlap:true;

17 }

18 [category = 'Picnic Area'][zoom >=12]

19 {point-file: url(img/picnic-area.png);}

20 [category = 'Picnic Area'][zoom <=11]

21 {

22 marker-width:6;

23 marker-fill:#e41a1c;

24 marker-allow-overlap:true;

25 }

26 }

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

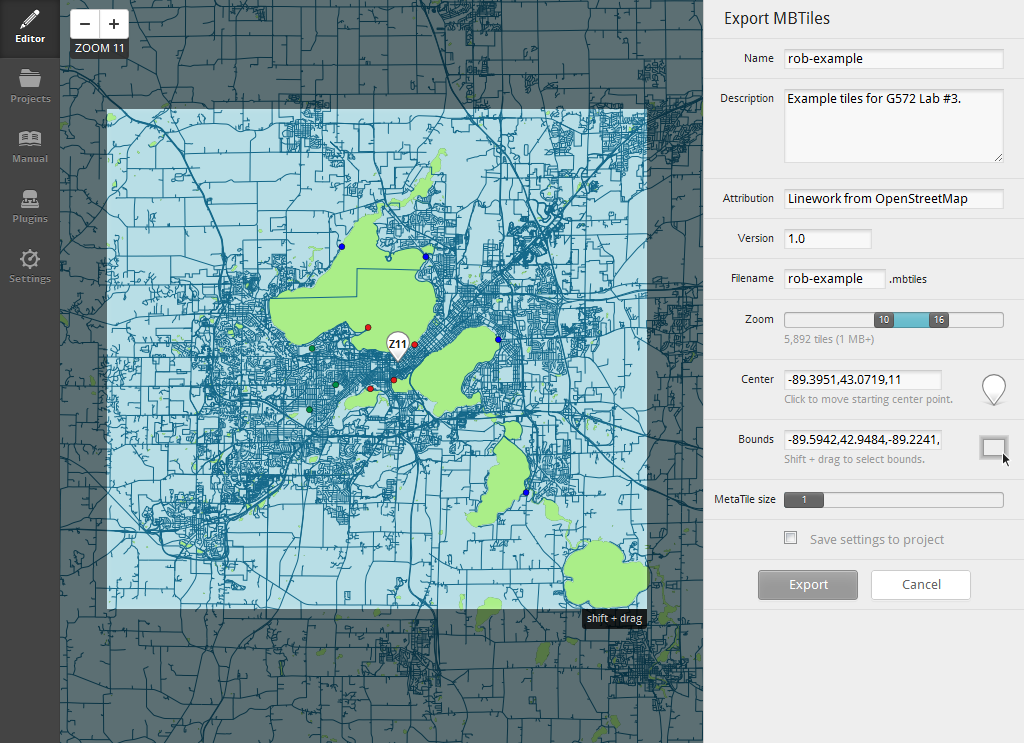
**Code Bank 3: Conditional Styling using the zoom Attribute**

**e. On Your Own: Adding Tooltips and a Legend**

Now that you have designed your tiles, it is time to practice your understanding of TileMill, the TileMill documentation, and HTML/CSS generally by adding interactive functionality for the POIs using tooltips and by adding a custom legend. Make use of the ‘name’ and ‘description’ columns in the *.csv* file when creating the tooltip. For discussion about basic tooltip and legend templates, see: <https://www.mapbox.com/tilemill/docs/crashcourse/tooltips/#legends>. For discussion about advanced legends, see: <https://www.mapbox.com/tilemill/docs/guides/advanced-legends/>. Solutions to both interactive tooltips and a legend will be discussed the week before Lab #3 is due.

**f. Exporting and Serving Your Tiles**

After finishing the design of your tiles, and adding tooltips and a legend, it is time to export and serve them for public viewing on the web. In the *Main toolbar*, click the *Export* button and choose the *MBTiles* option. This will open a dialog window for creating your tileset (**Figure 16**). Provide a logical *Name*, *Description*, *Version*, and *Filename* for your tiles; also list OpenStreetMap under *Attribution*. Importantly, you need to set the *Zoom*, *Center* (click map)*,* and *Bounds* (shift+drag map)of your tileset. Keep in mind that you need to restrict the number of tiles you are producing to 50MB, otherwise you will need to pay for tile service from MapBox or implement the open source [TileStache](http://tilestache.org/doc/) solution; you can inspect a preview of the number of tiles and the tileset filesize under the *Zoom* interface. Once you are satisfied with your export parameters, click the *Export* button. This will activate the rendering and export process; depending on the number of tiles you are exporting, the export process can vary from minutes to hours to even days. Be patient, it is well worth the wait!

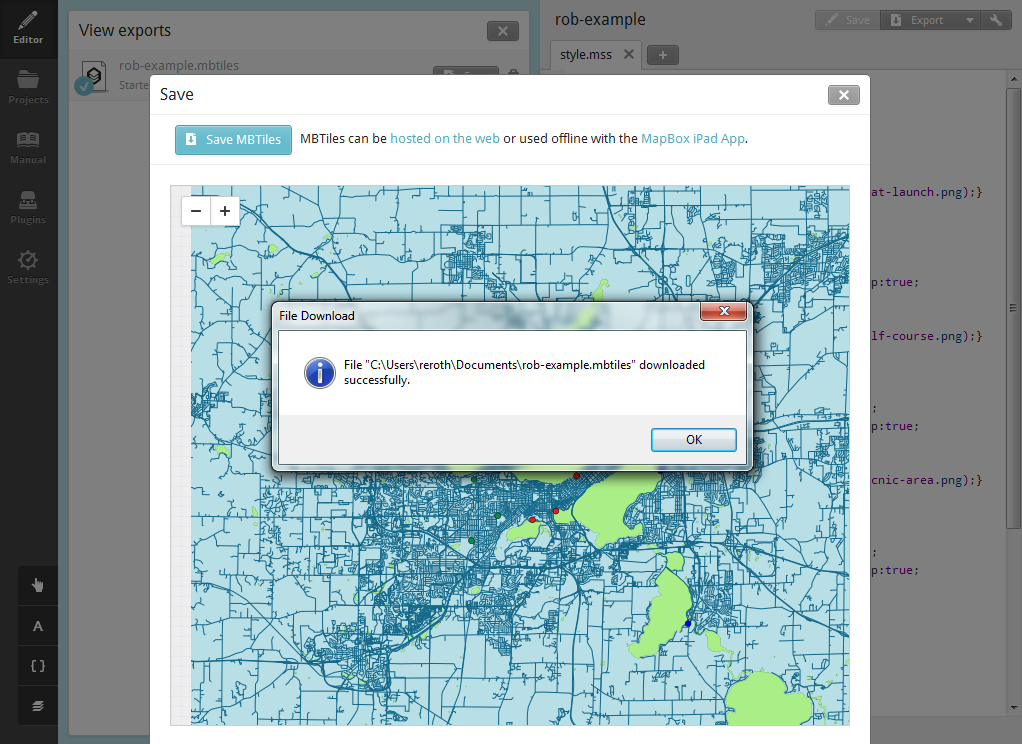


**Figure 16: Exporting Your Tiles.**

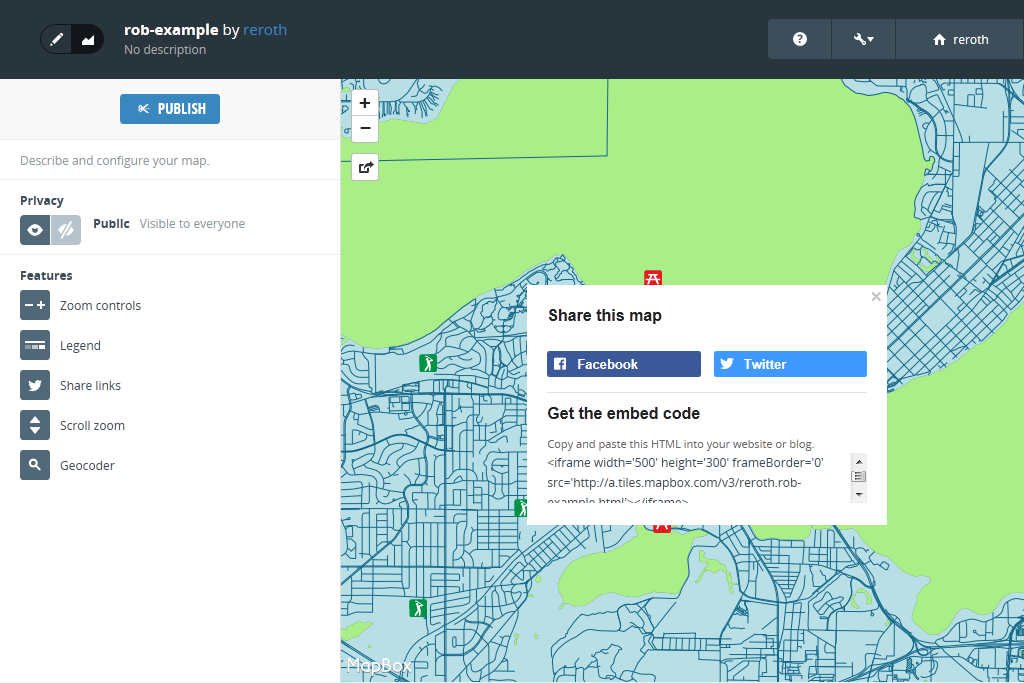
Once the tile rendering is complete, press the *Save* button, which will then navigate you to a preview page of your tiles. On the preview page, press the *Save MBTiles* button and be sure to take note of the file location at which your MBTiles are stored (**Figure 17**); *navigate to that location and save a copy of your MBTiles to your USB drive.* One saved and stored, navigate back to the MapBox website and login to your MapBox account.

Once logged in, click on the wrench icon in the top-right corner of your MapBox profile page and select the *Upload Layer* option. When prompted, select your stored MBTiles file and click *Upload File*; give your tileset a logical name once uploaded. You then will be redirected to a preview of your map tiles. Click on the pencil symbol to edit the settings of your tileset (**Figure 18**). Once the dialog window is activated, click on the eye icon beneath *Privacy* so that the tiles become *Public: Visible to everyone*. Save your changes and then click the *Publish* button.

Congratulations! You now are serving your own custom slippy map mashup. Finish the lab by embedding the map into your portfolio page using the provided HTML (i.e., the *Easy Embed*) from the *Publish* dialog window.

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**Figure 17: Saving Your MBTiles.**

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**Figure 18: Publishing Your Slippy Map to the Web.**

**Evaluation Rubric: Slippy Map Iconicity Challenge (40pts)**

**Inspiration Board Check-In (6)**

**5.5-6.0pts:** The icon library is ready for use in TileMill. All four of the above considerations for icon design were taken into account. All icons hold up when rasterized into the *.png* format.

**4.5-5.0pts**: The icon library needs a few small tweaks before it is ready for use in TileMill. One of the four above considerations for icon design was not fully taken into account during design. Several icons break down when rasterized into the *.png* format.

**3.5-4.0pts**: We need to rethink aspects of the icon library before it is ready for use in TileMill. Several of the four design guidelines were violated systematically. Multiple icons break down when rasterized into the *.png* format.

**3.0 pts or less:** The submitted icon library did not meet the expectations of the assigned challenge, or was not submitted at all.

**Due November 6th**

**POIs Check-In (6)**

**2.0pts:** You have assembled your *.csv* file.

**0pts:** You have not assembled your dataset

**Due November 13th**

**Mapbox Studio Tileset (32): Due Online November 20th**

**30-32pts:** The slippy map mashup is attractive, informative, and engaging; the map is a vast improvement over most web map mashups. The icon library unambiguously signifies the POIs and their higher-level categorization. The icons themselves are at the highest level of the visual hierarchy and hold up at all map scales. Your tileset is loading properly and reinforces the aesthetic style of your icon library. The tooltip and legend solutions are working properly and are well-designed. The aesthetic style of the tileset is consistent across zoom scales; what a stunning example of multiscale map design!

**26-29pts:** The slippy map mashup overall is successful as a web map. The icon library mostly works in representing the POIs and their higher-level categorization, but there are one or two icons that remain problematic. The icons work against the basemap and hold up at most, but not all, map scales. Your tileset is loading properly, as are the tooltip and legend solutions, although these solutions could be improved with further refinement. The aesthetic style of the tileset is mostly consistent across zoom scales, but there are unrefined transitions in linework styling between one or two zoom level changes.

**22-25pts:** The slippy map mashup only marginally improves upon typical web maps. Significant problems remain in the icon library, both in the representation of the unique POIs and their higher-level categorization. Many of the icons do not work against the basemap and/or across map scales. Your tileset is loading properly, but the tooltip and/or legend solutions are non-functional or illogical. Little effort was taken to develop an aesthetic style that is consistent across scales. Much more work needs to go into your linework generalization as you go from a large to a small cartographic scale (e.g., elimination of unneeded detail, simplification of lines and polygons, restyling the sizes or colors of features to maintain a proper visual hierarchy).

**Below 21pts:** The submitted slippy map mashup did not meet the expectations of the assigned challenge in multiple and critical ways. Please speak with Rob and Rashauna about strategies to improve the design.