

SPRING 2025



AI FOR CARTOGRAPHY

GRG 356 – Cartography & Maps - Lab 7

LECTURER

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Lab Guidelines

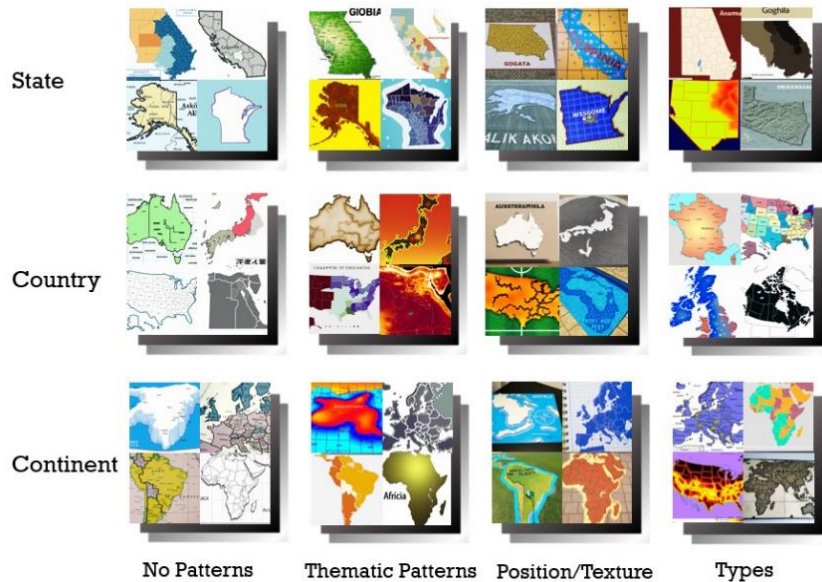
- To ensure a productive and efficient lab experience, please follow these guidelines:
 - I will guide you through the exercises, it is essential to follow along closely. Avoid working ahead only if you are familiar with the software, as you may miss key steps.
 - Don't hesitate to ask questions or seek clarification if something is unclear. If you encounter difficulties or have inquiries, feel free to raise your hand to get assistance.

Lab Objectives

- Use generative AI to create maps and discuss the ethical issues
- Use generative AI for map reading
- Use generative AI for map critique
- Use generative AI for map style transfer

Map Generation

- Try using the following prompt to generate a map:
 - “A {MapType} of {Region} with {Description}”



Ethical Issues

Assess the ethical issues of the generated maps

1. Inaccuracies

(a)

Unclear Borderlines

(b)

Inconsistent Shapes

(c)

Truncated Content

2. Misleading Information

(d)

(e)

Pseudo-words

(f)

(g)

Fake Regions

3. Unanticipated Features

(h)

Jumbled Linework

(i)

Lava Style Maps

(j)

Geopolitical Identities

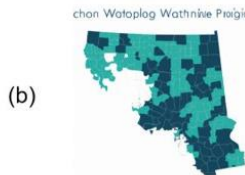
Inaccuracies

- Unclear Borderlines:
 - (a) shows California with distorted borders between counties
- Inconsistent Shapes:
 - (b) shows a map of Washington State which is distorted while preserving pattern of the state
- Truncated Content:
 - (c) only shows part of United States rather than the whole country

1. Inaccuracies



Unclear Borderlines



Inconsistent Shapes



Truncated Content

Misleading Information

2. Misleading Information



Pseudo-words



Fake Regions

- Pseudo-words:
 - (d) and (e) represents California and Alaska with incorrectly spelled names
- Fake Regions:
 - (f) is Michigan with non-exist area of land to its east
 - (g) is a map of Japan with non-exist lands to its west

Unanticipated Features

- Jumbled Lines:
 - (h) shows city of New York's road network with jumbled lines
- Lava Style Maps:
 - (i) shows a map of California in lava style with prompt "A heat map of California"
- Geopolitical Identities:
 - (j) shows a map of "A physical map of North Korea on the pavement" with North Korea's national flag on it

3. Unanticipated Features

(h)



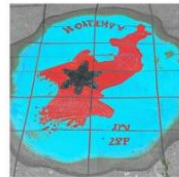
Jumbled Linework

(i)



Lava Style Maps

(j)

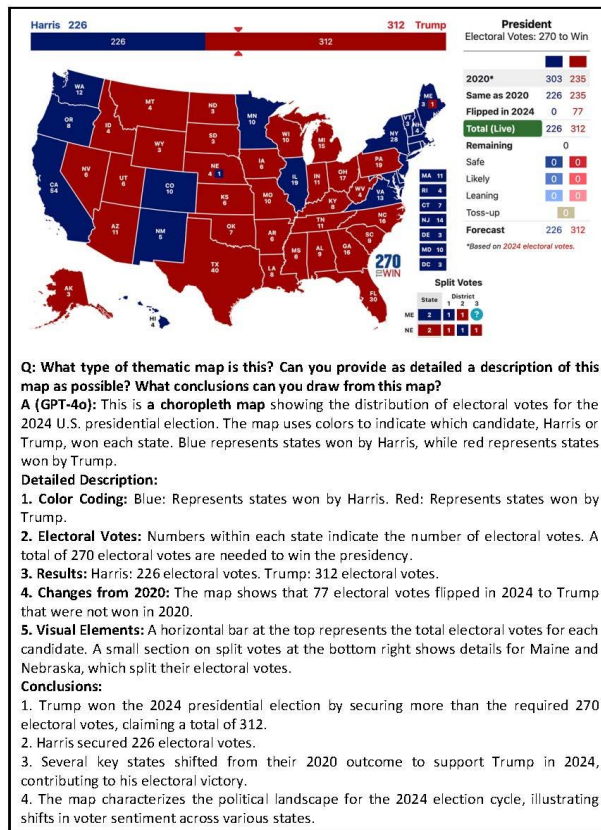


Geopolitical Identities

Map Reading

- Try using the following prompt to generate a map:
 - What type of thematic map is this? Can you provide as detailed a description of this map as possible? What conclusions can you draw from this map?

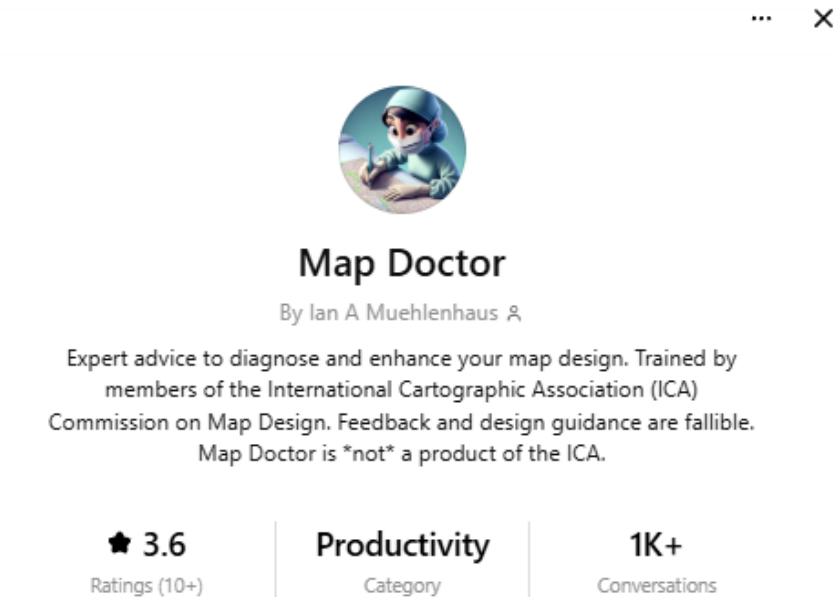
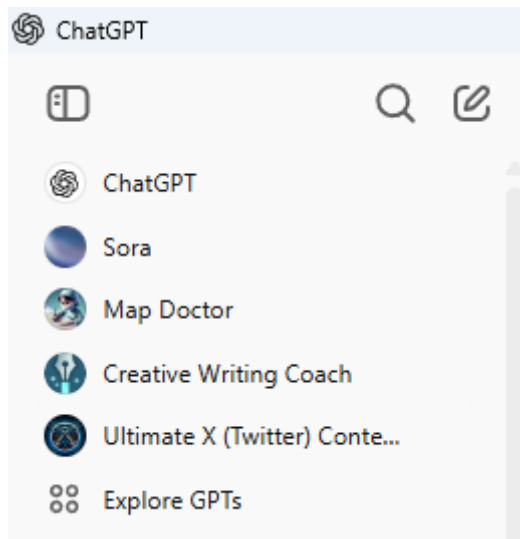
Example



Map Critique

Explore GPTs

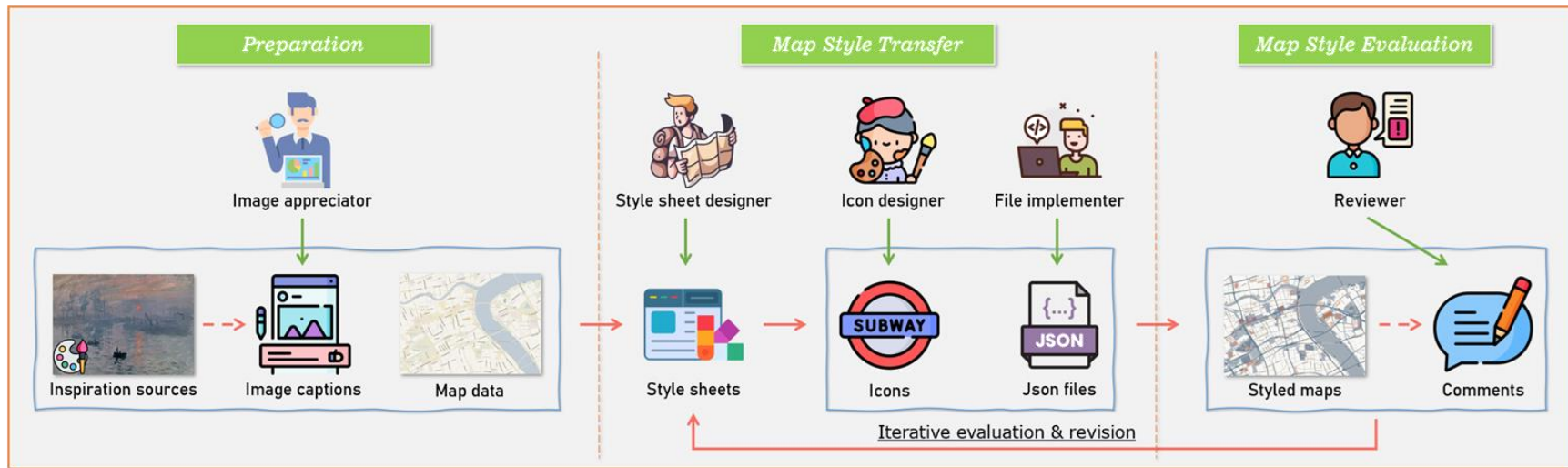
Map Doctor



MAP STYLE TRANSFER

Map Style Transfer

Map style transfer: The process of reproducing artistic styles from existing maps, paintings, or other visual artwork into input map data



CartoAgent: using LLMs for map style transfer

Wang, C., Kang, Y., Gong, Z., Zhao, P., Feng, Y., Zhang, W., Li, G. (2025). CartoAgent: a multimodal large language model-powered multi-agent cartographic framework for map style transfer and evaluation. *International Journal of Geographical Information Science*.

Map Style Transfer – Image Appreciation



I want you to act as an image appreciator. I will provide you with an image. Your task is to describe it as detailed as possible, which means that the following topics should be covered:

- **Content:** What is in the image? What are the attributes and relationships of these things? What objects cannot possibly appear in this image? What temporal and spatial information does the image reflect?
- **Color:** What is the color of objects and background? Please provide hexadecimal color values as accurately as possible, e.g. #000000. What effect does the combination of these colors give to the brightness and contrast of the image?
- **Theme & Design:** If the provided image is a painting, then what is the theme of the painting? (e.g. Realistic, Surreal) What are the characteristics of the design? (e.g. Simple, Detailed, Complex)

If you understand the requirements of this task, you can reply 'OK' and provide your description after I provide the image.



#A2B5CD



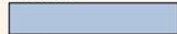
#708090



#FF4500



#B0C4DE



#FFA07A



Content: The image is a painting depicting an industrial harbor scene at dusk or dawn. The central focus is a calm body of water reflecting the sky's colors and the shapes of the structures and ships around it. In the foreground, there's a small boat with a solitary figure, possibly a rower or a fisherman. The background features several larger sailing ships and smokestacks emitting smoke, suggesting industrial activity. There are cranes and other signs of a working port. The scene is serene, with no signs of heavy movement or stormy weather. Temporally, the painting suggests either the early hours of the morning or the twilight of the evening. Spatially, it captures a moment at a busy port, but the exact location is not discernible. Objects that cannot possibly appear in this image are modern elements like contemporary ships or buildings, given the style and content suggesting an earlier time period.

Color: The painting is dominated by cool tones with a palette of blues and greys, punctuated by the warm hues of the sun and its reflection. The sky ranges from a light grey-blue near the horizon, color #A2B5CD, to a darker slate grey, #708090, towards the top. The sun is a vibrant spot of orange-red, #FF4500, contrasting sharply with its surroundings. The water reflects these colors, transitioning from a muted blue, #B0C4DE, to a trail of the sun's reflection in a shimmering path of lighter orange, #FFA07A. The cool colors give the image a tranquil feeling, while the warm sun adds a focal point of energy and contrast.

Theme & Design: The theme of the painting is industrial realism, capturing the everyday activity of a working port in a realistic yet slightly impressionistic style. The brushwork is loose and expressive, not overly concerned with fine detail but rather with conveying the atmosphere and mood of the scene. The design is relatively simple in composition but complex in its interplay of light and shadow, with the reflection of the sun providing a striking visual pathway that draws the viewer's eye through the image. It reflects an interlude in industrial activity, a pause in the day where nature's beauty briefly overshadows human enterprise.

1 - Image Appreciation Inspiration source + Prompt → Image captions

Map Style Transfer – Style Sheet Generation



2 - Style sheet design

I want you to act as **a cartographer**. I will provide you with a reference image and its description, covering the content, color, theme & design. Your task is to design a suitable style sheet to render the following map elements so that the style of the rendered map is as consistent as possible with the reference image:

[Geographical scope]; ;

[Map elements]; .

In the process of designing the style sheet, you can perform different actions for different types of elements:

For each **icon element**, you can describe the expected style as detailed as possible, e.g. its content, color, theme & design. The artist will design this icon according to your expectations;

For each **label element**, you can set the text color, and the text halo color;

For each **line element**, you can set the line opacity, and the line color;

For each **fill element**, you can set the fill opacity, the fill color, and the fill outline color;

For **background**, you can set the background color.

Meanwhile, please pay attention to the following requirements:

1. **Completeness**: please set the styles for all elements;
2. **Unity**: the styles of relevant elements should be as close as possible, such as roads of different levels, and when choosing a style, please consider the contrast and visual hierarchy of the map as much as possible;
3. **Rationality**: when choosing a style, it is necessary to take into account the semantic information of the elements, that is, the real-world connotations of the elements;
4. **Explainability**: please explain the specific reason for your rendering;
5. **Normativeness**: all colors should be given in hexadecimal format, e.g. #000000, and opacity should be a decimal between 0 and 1, where 0 represents transparent and 1 represents opaque.

Please strictly follow the following JSON format to return results:

If you understand the requirements of this task, you can reply 'OK' and provide your answer after I provide the reference image and its description.



3 - Icon design

I want you to act as **an icon designer**. I will provide you with the referent and expectations for the icon design. Your task is to consider the characteristics of the referent and follow my expectations for icon design. Please ensure that each image contains only one icon and the background is pure white. If you understand the requirements of this task, you can reply 'OK' and provide your designed icons after I provide the referent and expectations.



4 - File implementation

I want you to act as **a senior computer expert**. I will provide you with a style specification file and a new style sheet. Your task is to modify the style specification file based on the new style sheet while strictly following the original style specification file format. Please note that the returned result should be the entire modified style specification file, including the unmodified parts. Also, when encountering a filtering expression, please refrain from modifying the filtering condition and only modify the variable value. If you understand the requirements of this task, you can reply 'OK' and provide the modified style specification file after I provide the original style specification file and the new style sheet.

Output: style sheet

```
{
  "symbol (icon)": {
    "Metro station": {
      "expectation": "A simple, stylized icon with a muted blue color to blend with the water tones, and a touch of orange to tie it to the warm accents of the sunrise or sunset.",
      "explanation": "Metro stations are key points of interest and should be easily identifiable without dominating the scene."
    },
    ...
  },
  "symbol (label)": {
    "Water label": {
      "text-color": "#B0C4DE",
      "text-halo-color": "#FFA500",
      "explanation": "The water label uses blue to correspond with the water it labels, and an orange halo to relate to the sunrise/sunset."
    },
    ...
  },
  "line": {
    "Metro": {
      "line-opacity": 0.8,
      "line-color": "#FFA500",
      "explanation": "The vibrant color of the metro lines represents connectivity and should stand out, with slight transparency to blend with the map."
    },
    "Primary road": {
      "line-opacity": 1,
      "line-color": "#470B90",
      "explanation": "Primary roads are fully opaque to denote their importance, using the dark slate gray to integrate with the industrial theme."
    },
    "Secondary road": {
      "line-opacity": 1,
      "line-color": "#A2B5CD",
      "explanation": "Secondary roads are distinct yet less prominent, using the lighter blue from the sky."
    },
    ...
  },
  ...
}
```

Map Evaluation



5 - Map evaluation

I want you to act as a **map evaluation expert**. I will provide you with two images. One is a reference image and the other is a map designed according to the style of the reference image. Your task is to evaluate whether the style of the map is consistent with the style of the reference image, based on a comprehensive consideration of the color, theme & design. Once you have completed the evaluation, you can make one of the following two choices: Accept/Revision. If you choose 'Accept', then you do not need to do anything else; If you choose 'Revision', then you need to provide the modified style sheet and corresponding explanations. Note that you do not need to modify all map elements.

Specifically, our map elements include:

Label elements: ;

Line elements: ;

Fill elements: ;

Background.

In the process of modifying the style sheet, you can perform different actions for different types of elements:

For each **label element**, you can change the text color, and the text halo color;

For each **line element**, you can change the line opacity, and the line color;

For each **fill element**, you can change the fill opacity, the fill color, and the fill outline color;

For **background**, you can change the background color.

Please pay attention to the following requirements:

Normativeness: all colors should be given in hexadecimal format, e.g. #000000, and opacity should be a decimal between 0 and 1, where 0 represents transparent and 1 represents opaque.

Please strictly follow the following JSON format to return results and do not output any other text:

If you choose '**Accept**', then return this JSON: {"Action": "Accept"}

If you choose '**Revision**', then return this JSON: {"Action": "Revision", "Modified style sheet": {}}

If you understand the requirements of this task, you can reply 'OK' and provide your answer after I provide the reference image and the map. Next, I will upload the reference image and the map in order.



(a) Inspiration source



(b) Styled map.R1



(c) Styled map.R2



(d) Styled map.R3



(e) Styled map.R4



(f) Styled map.R5

1. Which candidate map's style most closely resemble that of the reference image?

Reference image
(Inspiration source)



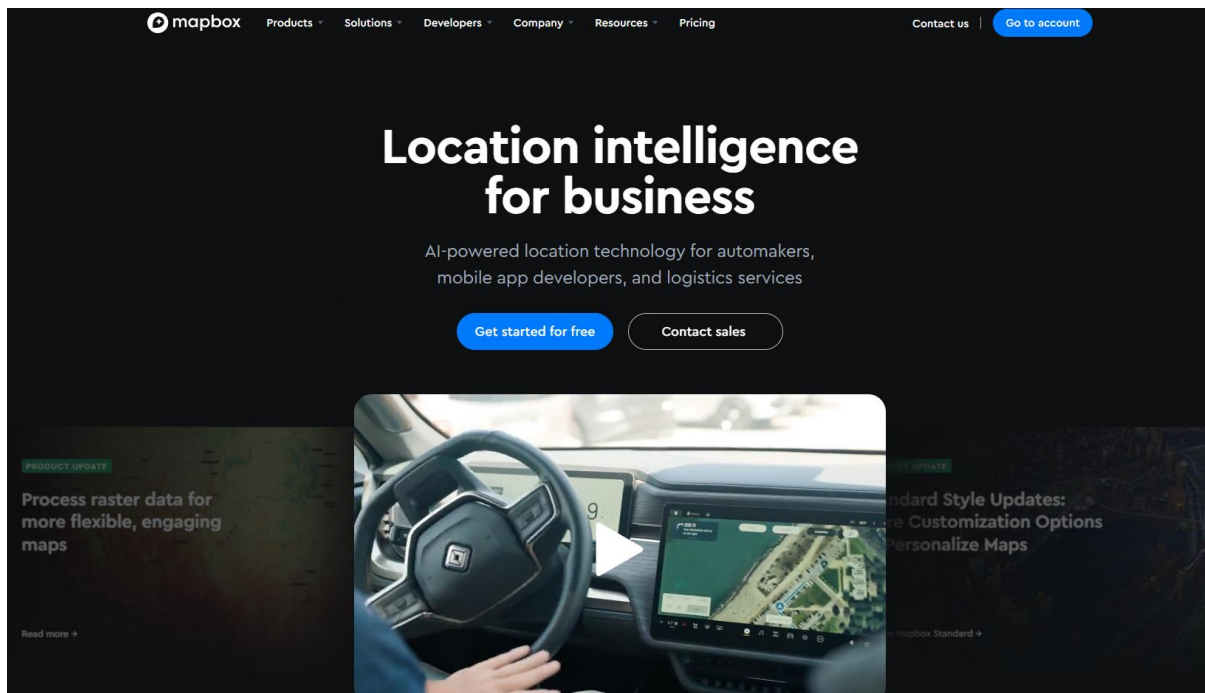
The styled maps after different rounds of revision

Map Style Transfer

Stage	Inputs	Outputs
Image appreciation	1. Prompt-1 2. Inspiration source	1. Image captions
Style sheet design	1. Prompt-2 2. Map data 3. Inspiration source 4. Image captions	1. Style sheet
File configuration	1. Prompt-3 2. Style sheet 3. Original style specification file	1. Style specification file
Mapbox	1. Style specification file 2. Map data	1. Styled map
Map evaluation	1. Prompt-4 2. Inspiration source 3. Styled map	1. Comments

Mapbox

<https://www.mapbox.com/>



The screenshot shows the Mapbox website homepage. At the top is a dark navigation bar with the Mapbox logo and links for Products, Solutions, Developers, Company, Resources, Pricing, Contact us, and a blue 'Go to account' button. The main content area has a dark background with the heading 'Location intelligence for business' in large white text. Below this is a sub-headline: 'AI-powered location technology for automakers, mobile app developers, and logistics services'. Two buttons are present: 'Get started for free' (blue) and 'Contact sales' (white with a dark border). Below the main text is a central image of a car's interior showing a digital dashboard with a map. On either side of this image are two article teasers. The left teaser is titled 'Process raster data for more flexible, engaging maps' and includes a 'PRODUCT UPDATE' tag and a 'Read more' link. The right teaser is titled 'Standard Style Updates: More Customization Options Personalize Maps' and also includes a 'PRODUCT UPDATE' tag and a 'Mapbox Standard' link.

mapbox Products Solutions Developers Company Resources Pricing Contact us Go to account

Location intelligence for business

AI-powered location technology for automakers, mobile app developers, and logistics services

Get started for free Contact sales

PRODUCT UPDATE
Process raster data for more flexible, engaging maps
Read more →

PRODUCT UPDATE
Standard Style Updates: More Customization Options Personalize Maps
Mapbox Standard →

Data

Inspiration image



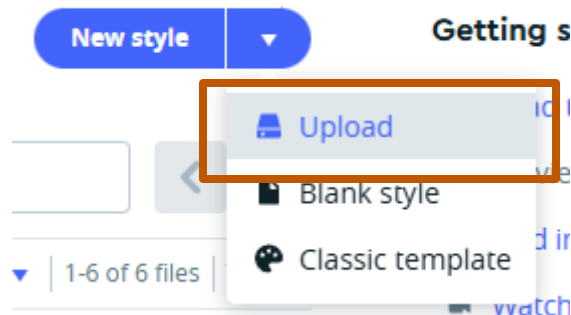
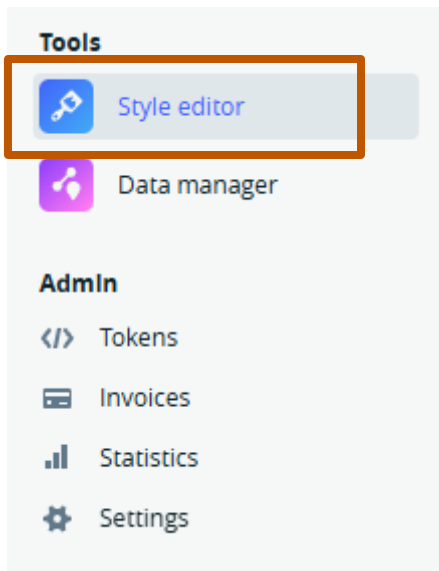
Style JSON

```
1 {  
2   "version": 8,  
3   "name": "Neighborhood",  
4   "metadata": {  
5     "mapbox:print": {  
6       "width": 1024,  
7       "height": 768,  
8       "units": "px",  
9       "format": "png",  
10      "resolution": 300  
11    }  
12  },  
13  "center": [121.485, 31.236],  
14  "zoom": 14.2,  
15  "sources": {  
16    "composite": {  
17      "url": "mapbox://mapbox.mapbox-streets-v8",  
18      "type": "vector"  
19    }  
20  },  
21  "sprite": "mapbox://sprites/{username}/{style_id}",  
22  "glyphs": "mapbox://fonts/{username}/{fontstack}/{range}.pbf",  
23  "layers": [  
24    {  
25      "id": "Background",  
26      "type": "background",  
27      "paint": {  
28        "background-color": "#f5f4ef"  
29      }  
30    },  
31  ]  
}
```

Upload Stylesheet

Add a new style in the editor

Upload the stylesheet json file



Load an Existing Style

Upload

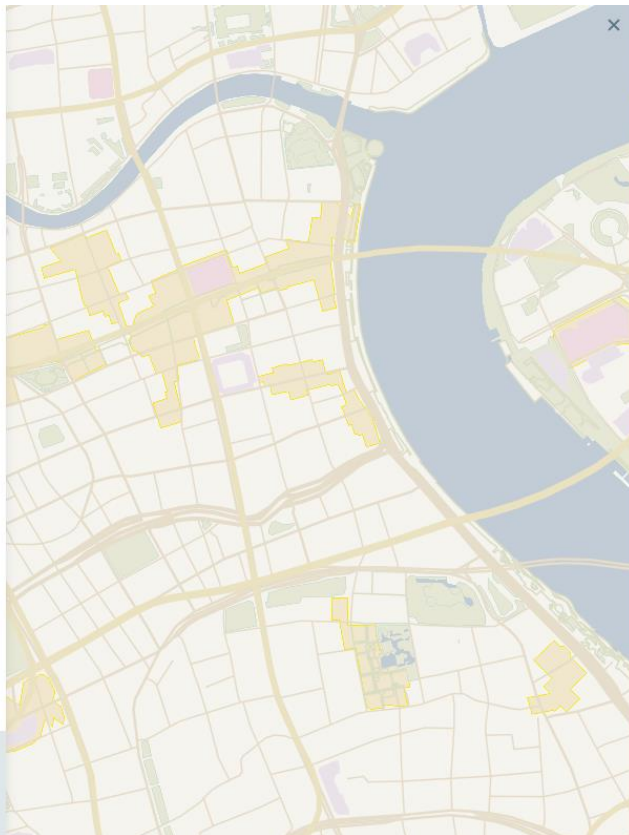


Drag and drop style JSON here

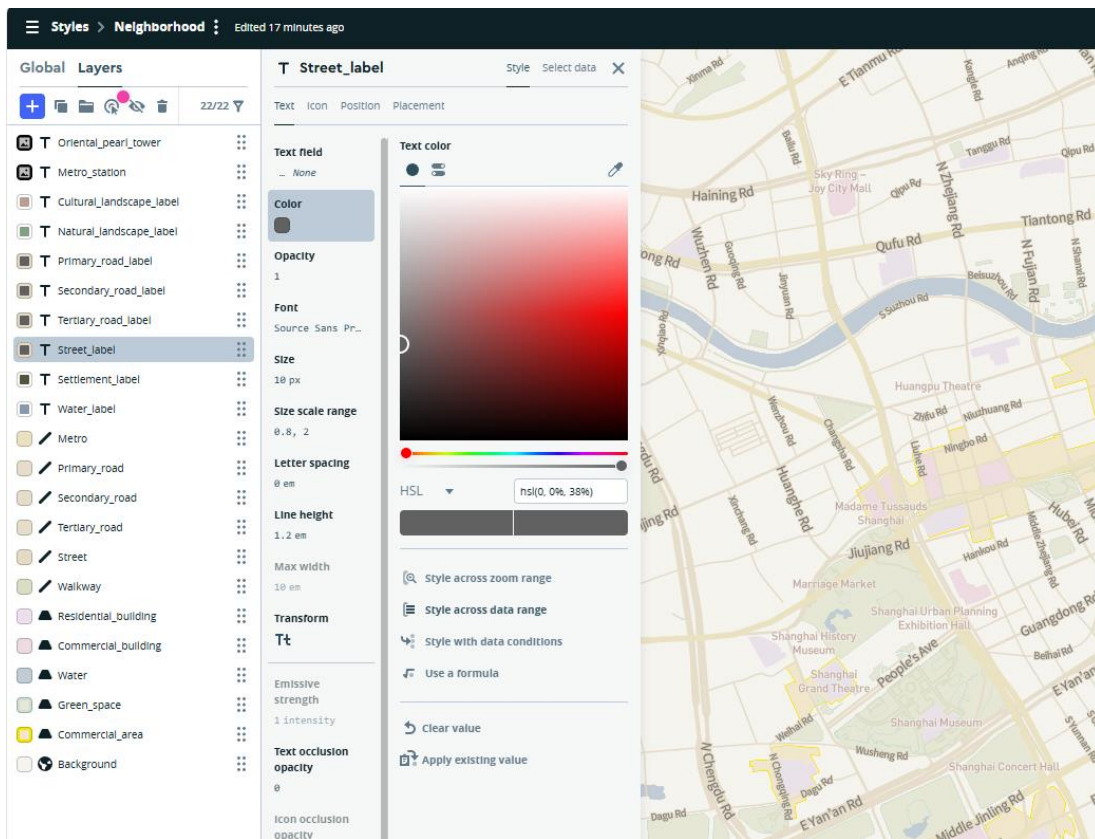
 neighborhood_style.json

Cancel

Customize

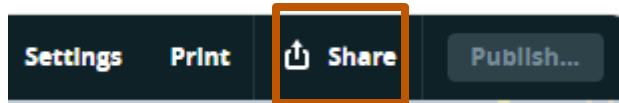


Change Style Settings



The screenshot displays the Mapbox Studio interface for editing a map style. The top navigation bar shows 'Styles > Neighborhood' and 'Edited 17 minutes ago'. The left sidebar lists various layers, with 'Street_label' selected. The main panel shows the 'Street_label' style settings, including options for Text field, Color, Opacity, Font, Size, Size scale range, Letter spacing, Line height, Transform, Emissive strength, Text occlusion opacity, and Icon occlusion opacity. A color picker is visible, showing a red color selection. The right side of the interface shows a map of a city area with various streets and landmarks.

Download the Stylesheet



Share & develop

Draft Production

The Production URL is cached for performance and scale, so new changes may take a few minutes to appear.

Published 17 minutes ago

Allow copying Make public Private styles cannot be copied.

Website embed `<iframe width='100%' height='400px' s...`

[Learn more](#) about using an iframe to embed your style in a website.

Developer resources

Web iOS Android Unity Third party

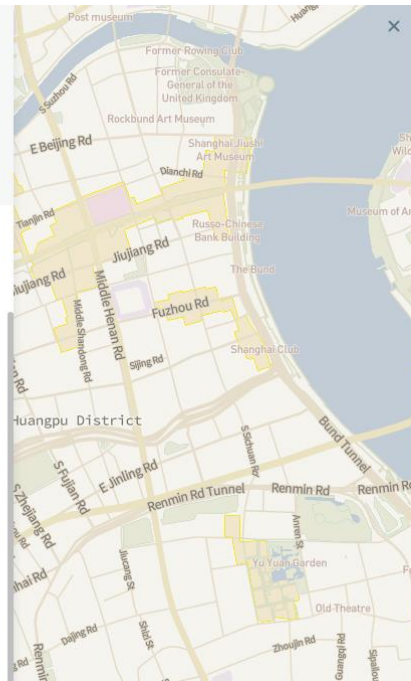
Style URL `mapbox://styles/kkyyhh96/cm98oocne00n...`

Access token `pk.eyJ1Ijoia2t5eihoOTY1LCJhIjo1Y2I6Y3...`

Read the [Mapbox GL JS](#) docs to start building for the web.

Download: [↓ Neighborhood.zip](#)

Stylesheet (JSON), icons (SVG), and fonts (TTF or OTF)



Run the Prompts

See Lab7PromptTutorial.docx

I want you to act as an image appreciator. I will provide you with an image. Your task is to describe it as detailed as possible, which means that the following topics should be covered:

- **Content:** What is in the image? What are the attributes and relationships of these things? What objects cannot possibly appear in this image? What temporal and spatial information does the image reflect?
- **Color:** What is the color of objects and background? Please provide hexadecimal color values as accurately as possible, e.g. #000000. What effect does the combination of these colors give to the brightness and contrast of the image?
- **Theme & Design:** If the provided image is a painting, then what is the theme of the painting? (e.g. Realistic, Surreal) What are the characteristics of the design? (e.g. Simple, Detailed, Complex) If you understand the requirements of this task, you can reply 'OK' and provide your description after I provide the image.

OK



Here is a detailed appreciation of the image you've provided:

Content

This image captures a vast mountainous landscape covered predominantly in dense evergreen forest. The following are present:

- **Foreground:** The lower part of the image is rich with green vegetation, primarily made up of shrubs and coniferous trees.
- **Middle Ground:** A thick forest of tall pine or fir trees stretches across the slopes. Tree tops are relatively dark, suggesting mature, old-growth forest.
- **Background:** Multiple mountain ridges fade into the distance. These ridges are layered, creating a sense of depth. Mist or low-lying clouds drift among them, partially obscuring the lower valleys.
- **Sky:** The upper half is dominated by a cloudy sky, with heavy, moisture-laden clouds hanging low.

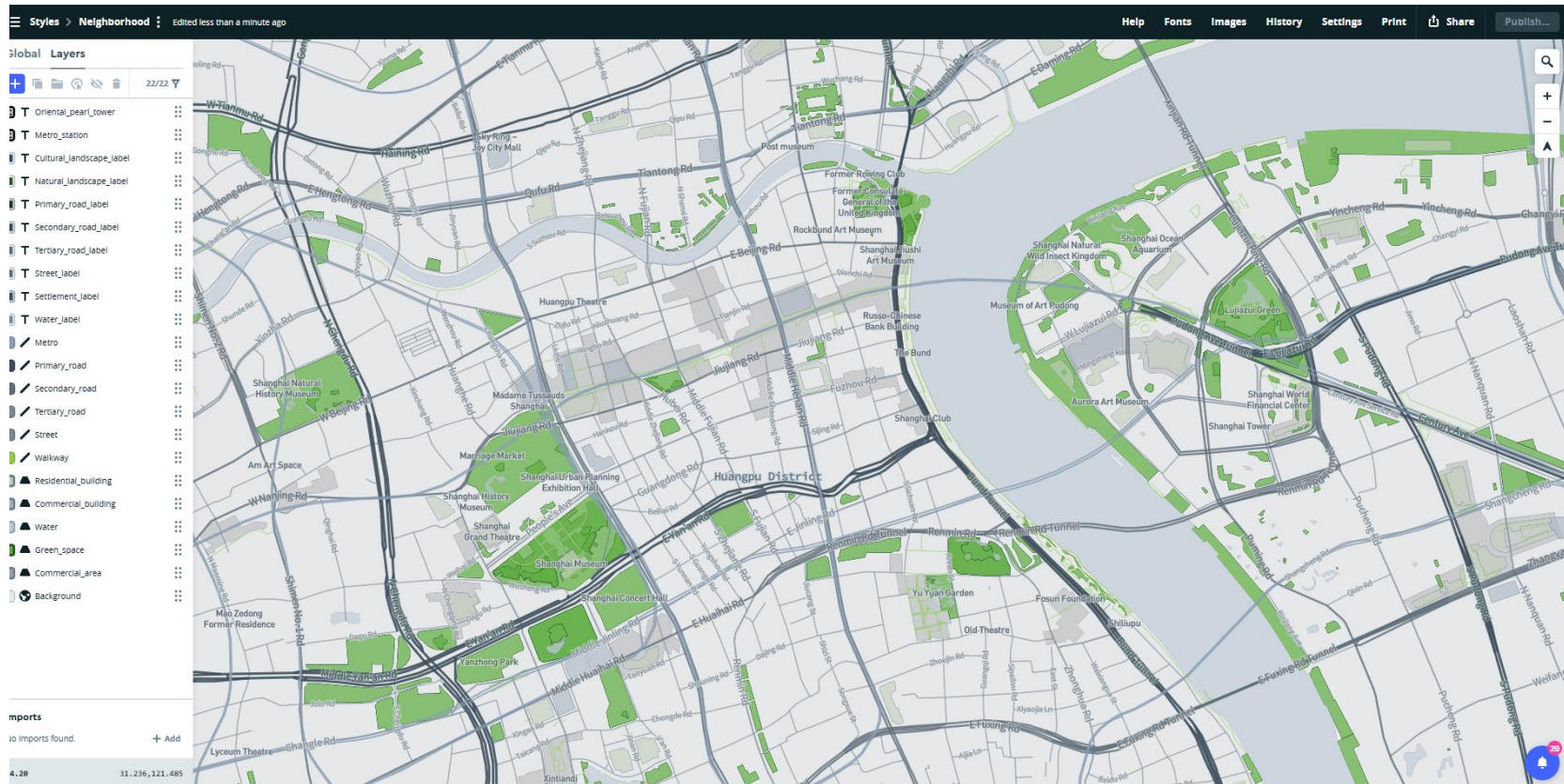
Attributes and relationships:

- The image shows a typical highland or montane ecosystem, likely a temperate or subtropical mountainous region.
- The vegetation is dense, indicating a healthy, perhaps undisturbed natural environment.
- The cloud layers indicate ongoing or recent precipitation.
- No artificial or human-made structures are visible, reinforcing a sense of natural purity.

Objects that cannot appear:

- Urban infrastructure (e.g., roads, buildings) is absent.
- Marine animals or desert-related features cannot logically appear in this image due to the ecosystem type.
- Bright sunlight and harsh shadows are missing due to the overcast conditions.

Map Style Transfer Results



ASSIGNMENTS

Assignments

- Create at least three distinct maps. For each map, identify and discuss their ethical concerns that might arise. Provide the prompts for generating the maps.
- Utilize Generative AI to read the maps you have submitted (Assignments 1, 2, 3, 4). Based on the descriptions generated, craft concise, informative captions for each map.
- Utilize Generative AI and conduct a thorough critique for each map. Based on the suggestions provided by Generative AI, craft concise map critique for each map.

Assignments

- Choose an image source that differs from those used in class to inspire your map's visual style. Create a map with a different style in Mapbox. Execute a style transfer to your map from the inspiration source. Include: (1) the image source; (2) the screenshot of the map style in Mapbox; and (3) the screenshot of the transferred map style in your submission.
- Compile all the required elements, including map files (screenshots), AI prompts, AI-generated outputs, your refined captions and critiques, and style transfer results, into a single PDF document for submission. Please use the FinalReportTemplate.docx.



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Innovation starts **here**