

Supplementary materials

Prompt S1.1:

List all map elements included in the given map.

Same Figure Input as
Prompt 2.1

GPT-4V Answer S1.1:

The map elements included in the given map are:

- Title:** "Spotted Owl *Strix occidentalis*"
- Legend:** Explains the color coding for predicted habitat quality within occupied watersheds (circa 2000) with categories such as None, Poor, Fair, and Good.
- Scale:** Both in miles and kilometers, providing a reference for distance on the map.
- Ecoregional boundaries:** Indicated by a specific hatched line pattern.
- County boundaries:** Indicated by a different hatched line pattern.
- Map area:** The main map area shows the state of Oregon with the habitat distribution of the spotted owl.
- Figure number:** "Figure 20.20. Range map of the spotted owl in Oregon."
- Source/Credit:** "Courtesy of Claudine Tobalske, Oregon Natural Heritage Information Center. Source: Oregon Natural Heritage Information Center, 2005 updated ODFW Conservation Strategy GAP Analysis."

These elements help the reader to interpret the map's information regarding the habitat of the spotted owl in Oregon.

Prompt S1.2:

List all the elements you can identify on this map, including physical features, man-made structures, and any annotations.

Same Figure Input as
Prompt 2.1

GPT-4V Answer S1.2:

This map is titled "Spotted Owl *Strix occidentalis*" and is labeled as "Figure 20.20. Range map of the spotted owl in Oregon." It is a range map showing the predicted habitat within occupied watersheds for the spotted owl in the state of Oregon, circa 2000. The map includes the following elements:

- Color-coded areas** indicating the quality of the habitat:
 - White: No predicted habitat
 - Light green: Poor habitat
 - Medium green: Fair habitat
 - Dark green: Good habitat
 - Lines indicating boundaries:
 - Dashed lines: **Ecoregional boundaries**
 - Solid lines: **County boundaries**
 - The **outline** of the state of Oregon, with county and ecoregional boundaries marked within.
 - A **scale bar** at the bottom left, providing both miles and kilometers for reference.
 - Annotations and credits:**
 - The source of the map is credited to the Oregon Natural Heritage Information Center, 2005, and it mentions an updated ODFW (Oregon Department of Fish and Wildlife) Conservation Strategy GAP Analysis.
 - Courtesy is given to Claudine Tobalske, Oregon Natural Heritage Information Center.
- The map is a visual representation of the distribution and quality of habitats for the spotted owl across different regions of Oregon, which is useful for conservation planning and environmental studies.

Prompt S1.3:

Can you list all the map elements present in the provided map and describe their significance?

Same Figure Input as
Prompt 2.1

GPT-4V Answer S1.3:

The map provided is a range map of the Spotted Owl in Oregon, and it includes several elements that are commonly found in thematic maps:

- Title:** "Spotted Owl *Strix occidentalis*" - This indicates the subject of the map, which is the geographic distribution of the Spotted Owl in Oregon.
 - Legend:** The legend explains the meaning of the colors used on the map:
 - White: No predicted habitat within occupied watersheds (circa 2000)
 - Light Green: Poor predicted habitat quality
 - Medium Green: Fair predicted habitat quality
 - Dark Green: Good predicted habitat quality
 - Scale:** There are two scales provided, one in miles and one in kilometers, which allow the user to understand distances on the map.
 - Directional Indicator:** Although not explicitly shown, maps typically have north at the top unless otherwise indicated.
 - Boundaries:** Two types of boundaries are shown:
 - Dashed lines: Ecoregional boundaries
 - Solid lines: County boundaries
 - Source:** The source of the map is credited to the Oregon Natural Heritage Information Center, 2005, with an updated ODFW Conservation Strategy GAP Analysis.
 - Figure Number and Caption:** "Figure 20.20. Range map of the spotted owl in Oregon." This provides additional context and reference within the document from which the map is taken.
 - Acknowledgment:** Courtesy of Claudine Tobalske, Oregon Natural Heritage Information Center.
- The significance of these elements is to provide a clear and informative representation of the data. The map is designed to communicate the distribution of suitable habitats for the Spotted Owl across the state of Oregon, with the different shades of green indicating the quality of the habitat. The boundaries help to locate these habitats within specific political or ecological regions. The scales are essential for understanding the extent of the habitats and their spatial relationships. The source and acknowledgments ensure transparency and credit the creators and contributors to the map.

Figure S1. Comparison between responses using different prompts (Prompt S1.1, S1.2, S1.3) after prompt engineering.

Table S1. Pearson Correlation Coefficient and *p*-value between crime and income level in Chicago at block-group level.

	Theft vs. Income	Burglary vs. Income
Pearson's <i>r</i>	0.235	0.037
<i>p</i> -value	< 0.001	< 0.001

Prompt S2:

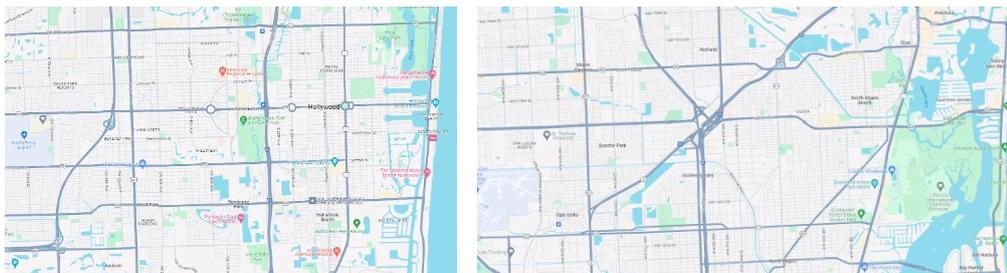
Can you tell me what's the projection used in the following map?

**GPT-4V Answer S2:**

The map you've provided appears to use a simple rectangular or plate carrée projection, which is a type of cylindrical map projection where the meridians and parallels are straight and perpendicular to each other. This projection maps the globe onto a plane by making the meridians and parallels into a grid of equal rectangles. However, the straight lines and the right angles introduce distortions, particularly in areas far from the equator, so this projection is not area-preserving and does not maintain true distances or angles. It's commonly used for wall maps and for some thematic maps where the distortion is not as critical to the representation of data.

Figure S2. Prompt S2 and GPT-4V's Answer regarding to the map projection, image retrieved from The nature of geographic information (https://www.e-education.psu.edu/natureofgeoinfo/c2_p26.html, accessed on 30 December 2023) [36].**Prompt S3:**

Can you tell me what's the relationship between the following two maps?

**GPT-4V Answer S3:**

Both images are maps depicting different parts of the Miami metropolitan area in Florida, USA. The first map shows the area including and around Hollywood, Florida, with notable landmarks such as Memorial Regional Hospital and North Perry Airport highlighted.

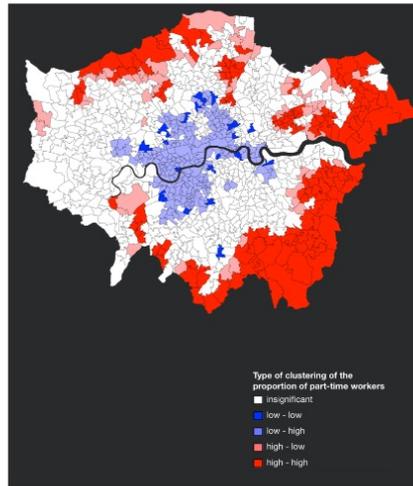
The second map displays a more **northerly** section of the Miami metropolitan area, with areas like Miami Gardens, Golden Glades, and North Miami Beach. Notable landmarks indicated on this map include St. Thomas University and Opa-locka Executive Airport.

The relationship between the two maps is that they both represent geographic areas that are part of the same larger urban and suburban region in South Florida, and someone could travel between the locations shown on these two maps as they are part of a continuous metropolitan area.

Figure S3. Prompt S3 and GPT-4V's Answer regarding to the map comparison with different spatial scales, image retrieved from Google Maps (<https://www.google.com/maps>, accessed on 30 December 2023).

Prompt S5:

Here is a LISA clustering map showing the types of significant clusters of proportion of part-time workers in London. Describe what shows in the map.

**GPT-4V Answer S5:**

The map appears to be a Local Indicators of Spatial Association (LISA) clustering map, which is used to show geographic areas that are significantly associated based on a particular attribute—in this case, the proportion of part-time workers in London.

Here are the key elements it shows:

- **High-High Clusters (in red):** These areas have a high proportion of part-time workers and are surrounded by areas with similarly high proportions. They represent significant clusters where part-time work is more prevalent than the rest of London. These clusters are scattered towards the edges of the map, indicating that there are pockets on the periphery of London with high rates of part-time employment.

- **Low-Low Clusters (in blue):** These areas have a low proportion of part-time workers and are near other areas with low proportions as well. These likely represent more economically active areas or areas where full-time employment is the norm. You can see these clusters concentrated around the central area of the map.

- **Low-High Outliers (in light blue with a red outline):** These are areas with a low proportion of part-time workers but are immediately adjacent to areas with high proportions. These can be seen as outliers which might suggest transitional areas or places where employment patterns are mixed.

- **High-Low Outliers (in red with a light blue outline):** These are areas with a high proportion of part-time workers surrounded by areas with low proportions. Like low-high clusters, they could represent transitional areas or neighborhoods with distinctive economic activities.

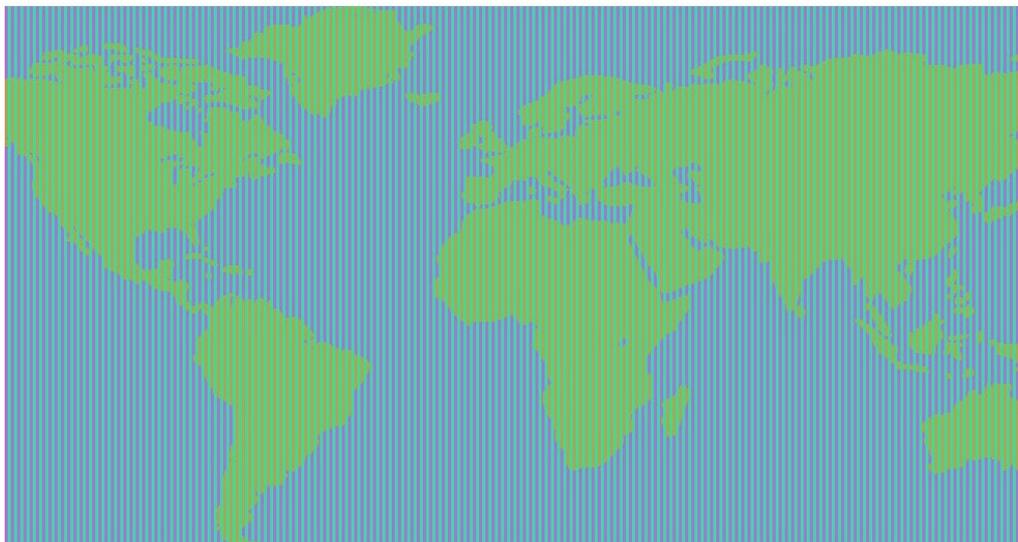
- **Insignificant Areas (in grey):** These areas do not display a statistically significant clustering with regard to the proportion of part-time workers. They may have mixed proportions or patterns of part-time work that do not correspond significantly with their neighboring areas.

The map is color-coded and includes a key in the lower-left corner explaining the color scheme used to represent these clusters and outliers. The thick black line might represent the River Thames, providing a recognizable geographic landmark for orientation. Overall, the map provides insights into how part-time work is distributed across London and reveals areas of spatial clustering.

Figure S5. Prompt S5 and GPT-4V's Answer regarding to the reading of domain-specific maps, making map of Local Indicators of Spatial Association (LISA) as an example, image retrieved from StackExchange (<https://stats.stackexchange.com/questions/335919/how-to-interpret-lisa-clustering-maps>, accessed on 30 December 2023).

Prompt S6:

Describe what is shown in the map and what do each color represent.

**GPT-4V Answer S6:**

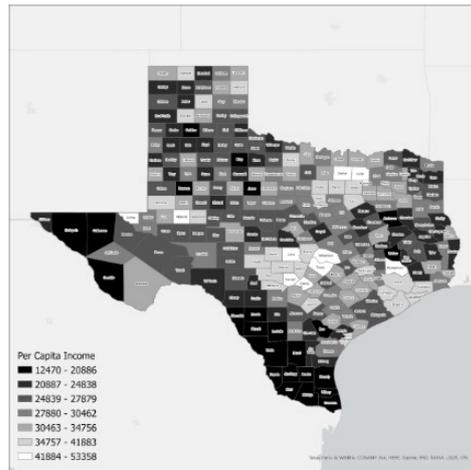
I'm sorry, but the image you've provided seems to have an issue as it shows patterns of vertical lines overlaying the map, which obscures the details and actual colors that would typically be used to differentiate regions or represent geographic data. Due to this, it's not possible to provide an accurate and meaningful interpretation of what each color represents on this map.

If the vertical lines are not an error and are part of a cryptographic or coded message, additional context or instructions are needed for deciphering. Otherwise, if you could provide a clear, unobstructed map, I would be able to help describe what's shown on it and what each color represents.

Figure S6. Prompt S6 and GPT-4V's Answer regarding to the optical illusion, image retrieved from Scientific American (<https://www.scientificamerican.com/gallery/optical-illusion-by-land-or-by-sea/>, accessed on 30 December 2023).

Prompt S7:

Can you summarize what's in the map and list a few counties considered as outliers compared to surrounding areas?

**GPT-4V Answer S7:**

The map appears to be a choropleth map of Texas, showing the per capita income by county. The counties are shaded in varying degrees of gray to represent different income levels, with **darker shades indicating higher income levels**. Here are five counties that could be considered as outliers compared to their surrounding areas:

1. Borden County: This county is shaded in the darkest gray, indicating it has a high per capita income in comparison to several neighboring counties that are lighter.
2. Loving County: Similar to Borden, Loving County is also shaded very dark, suggesting a high per capita income.
3. McMullen County: This county is another area with a dark shade, showing a higher per capita income than the surrounding counties.
4. Kendall County: Located to the northwest of San Antonio, Kendall County is **shaded darker** than most of its adjacent counties.
5. Glasscock County: This county, near Midland, also stands out with a darker shade, indicating a higher per capita income relative to its neighbors.

These counties are distinct from their surroundings in terms of per capita income, as shown on the map. Such outliers might reflect economic factors like the presence of natural resources, specific industries, or other economic activities contributing to higher incomes.

Figure S7. Prompt S7 and GPT-4V's Answer regarding to the map information extraction from high-resolution image with overwhelming labels, image generated from data from American Community Survey 2021 5-Year Estimates in Texas at the county level.

Prompt S8.1:
Identify the type of thematic map the given figure represents.

GPT-4V Answer S8.1:
The thematic map provided is a type of **dot distribution map**. This map uses dots to represent the distribution of a particular variable across a geographic area—in this case, population. The size of the dots corresponds to the population size in different locations, with a legend provided to indicate what population numbers the different dot sizes represent. For example, the smallest dots represent a population of 10,000, while the largest dots represent a population of 500,000. This type of map is useful for visualizing the spatial pattern of a variable such as population density across a region.

Prompt S8.2:
Identify the type of thematic map the given figure represents.

GPT-4V Answer S8.2:
The thematic map shown in the figure is a type of **choropleth map**. This map uses different shades of blue to represent various population density levels within the state of Texas, as indicated by the legend in the lower left corner. The darker the shade of blue, the higher the population in that area. The map also includes a label for the city of Austin, indicating a significant population concentration there.

Prompt S8.3:
Identify the type of thematic map the given figure represents.

GPT-4V Answer S8.3:
The thematic map provided appears to be a **proportional symbol map**. This type of map uses symbols of different sizes to represent data associated with different areas or locations within the map. In this case, the varying sizes of the red dots likely represent different population levels, with larger dots indicating larger populations. The legend in the lower left corner confirms this by showing that the smallest dot represents a population of 10K (10,000), a medium dot represents 50K (50,000), and the largest dot represents 500K (500,000). The map is also overlaid with a hexagonal grid, which might be used for spatial analysis or to aggregate data within each **hexagon**.

Figure S8. Mistakes in GPT-4V’s answer in additional experimented prompts, highlighted in red.