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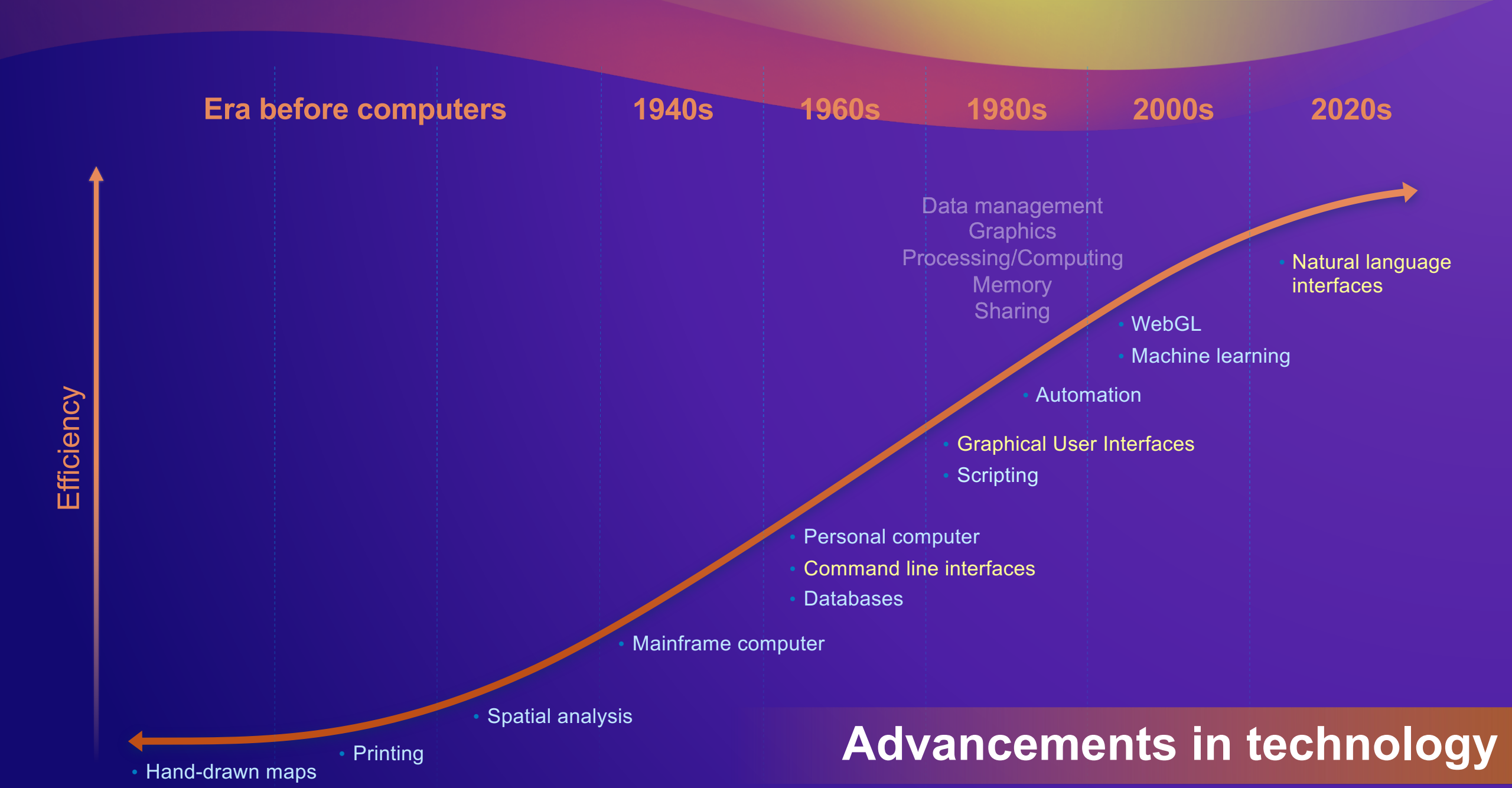
Creating Thematic Maps with the Help of Generative AI

Kristian Ekenes, Esri

NACIS Annual Meeting

Tacoma, WA

October 18, 2024



Advancements in technology

Evolution of User Interfaces (UI)

- **Command line (CLI)**
  - Commands/Scripting in programming language
  - e.g. Shell, Bash, Python, JavaScript, etc.
  - Programming experience required
- **Graphical User (GUI)**
  - Commands/Scripts executed by interaction with graphical components
  - e.g. buttons, forms, mouse and key inputs, etc.
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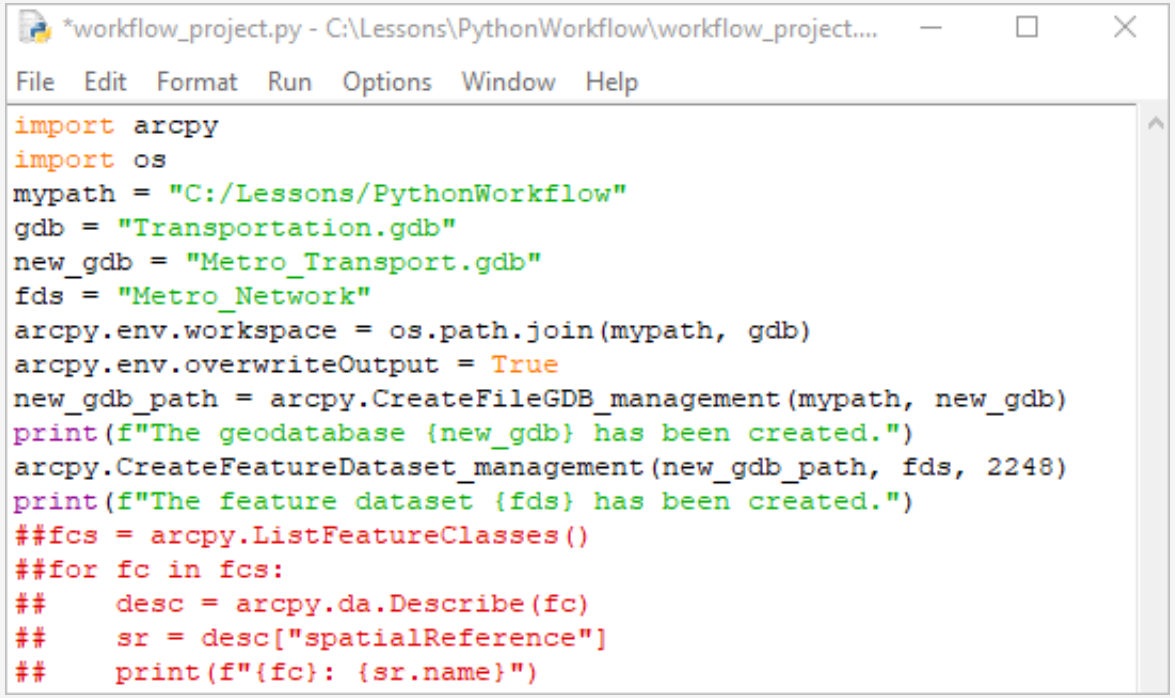
- **Natural Language (NLUI)**
  - Commands/Scripting in natural language
  - e.g. English, Spanish, French, etc.
  - Powered by generative AI



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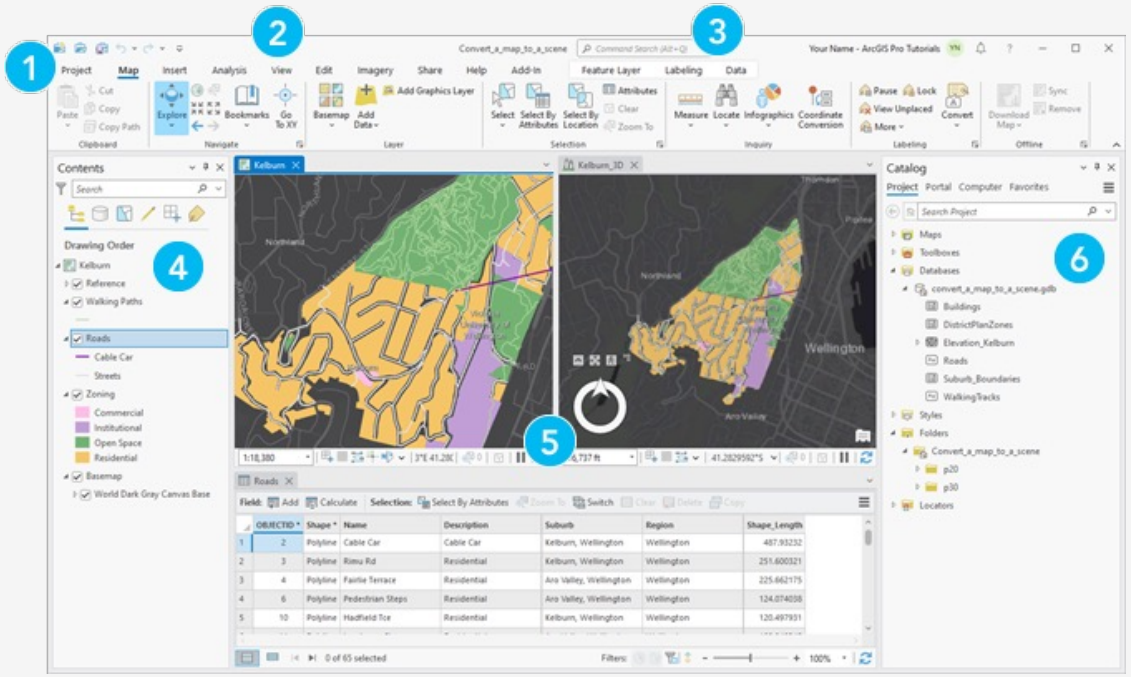

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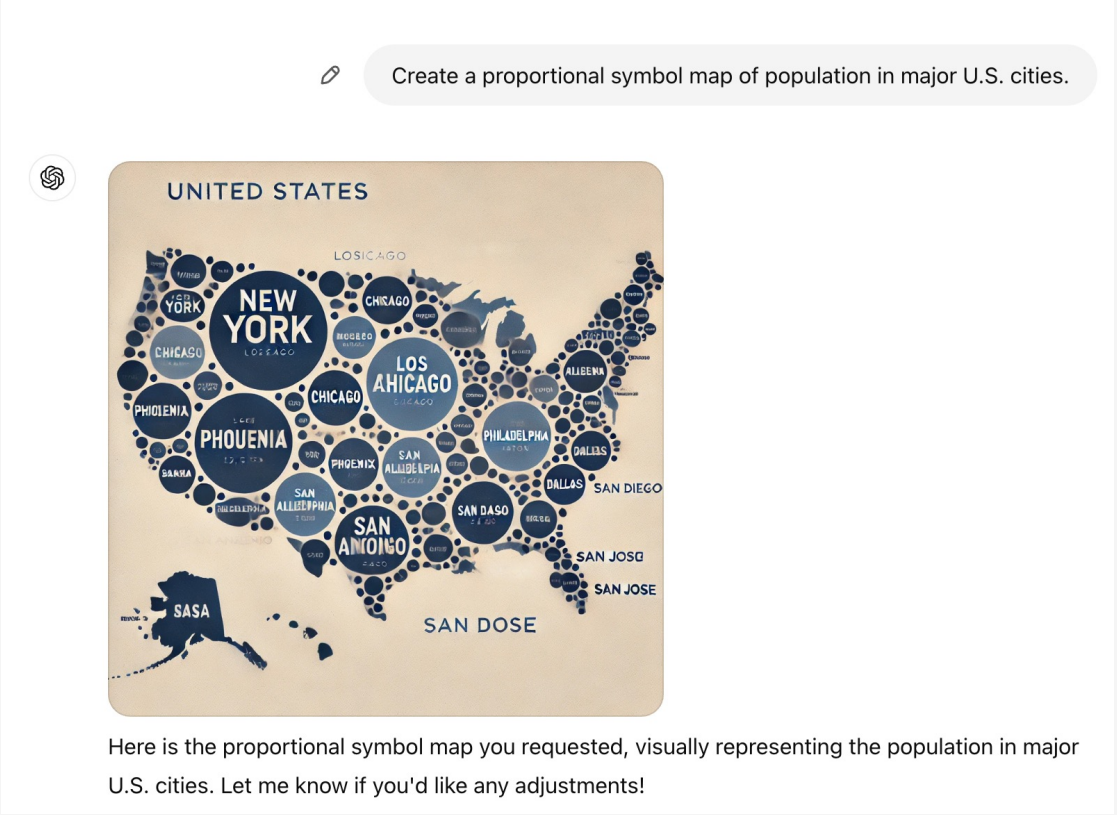
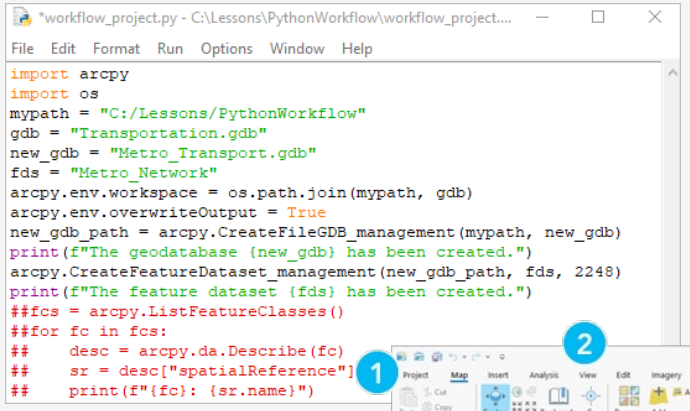


GIS processes

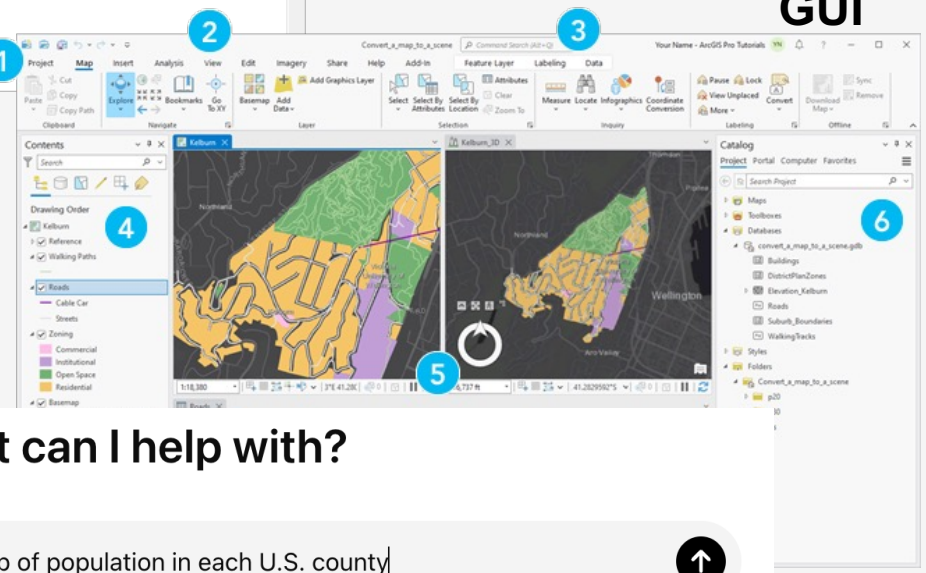
- **Data entry**
  - Data extraction/pre-processing
- **Analysis**
  - Spatial and statistical operations
- **Data management**
  - Editing (create, delete, update)
  - Optimizing performance
- **Presentation**
  - Cartography
    - Styling basemaps
    - Thematic mapping/data visualization
  - Layouts

Interfaces

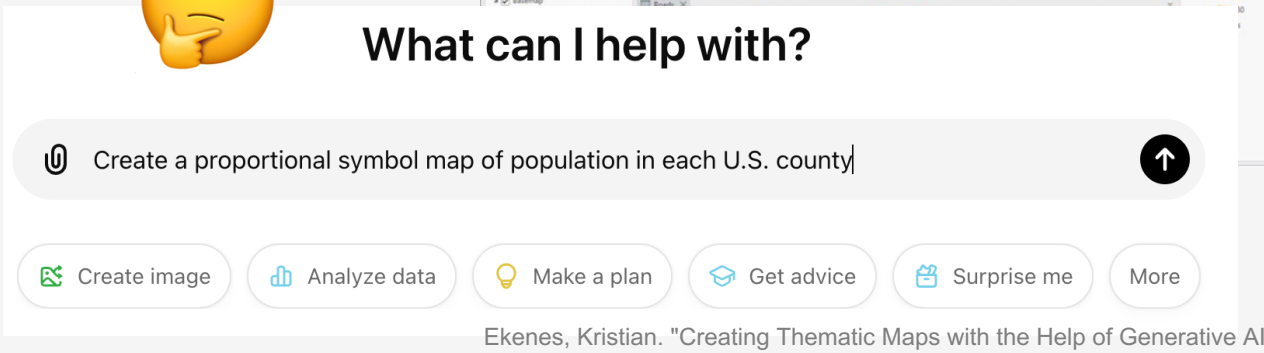
CLI



GUI



NLUI



Ekenes, Kristian. "Creating Thematic Maps with the Help of Generative AI". NACIS Annual Meeting, 2024.

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Generative AI in GIS

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Michael McNeil, NACIS 2023

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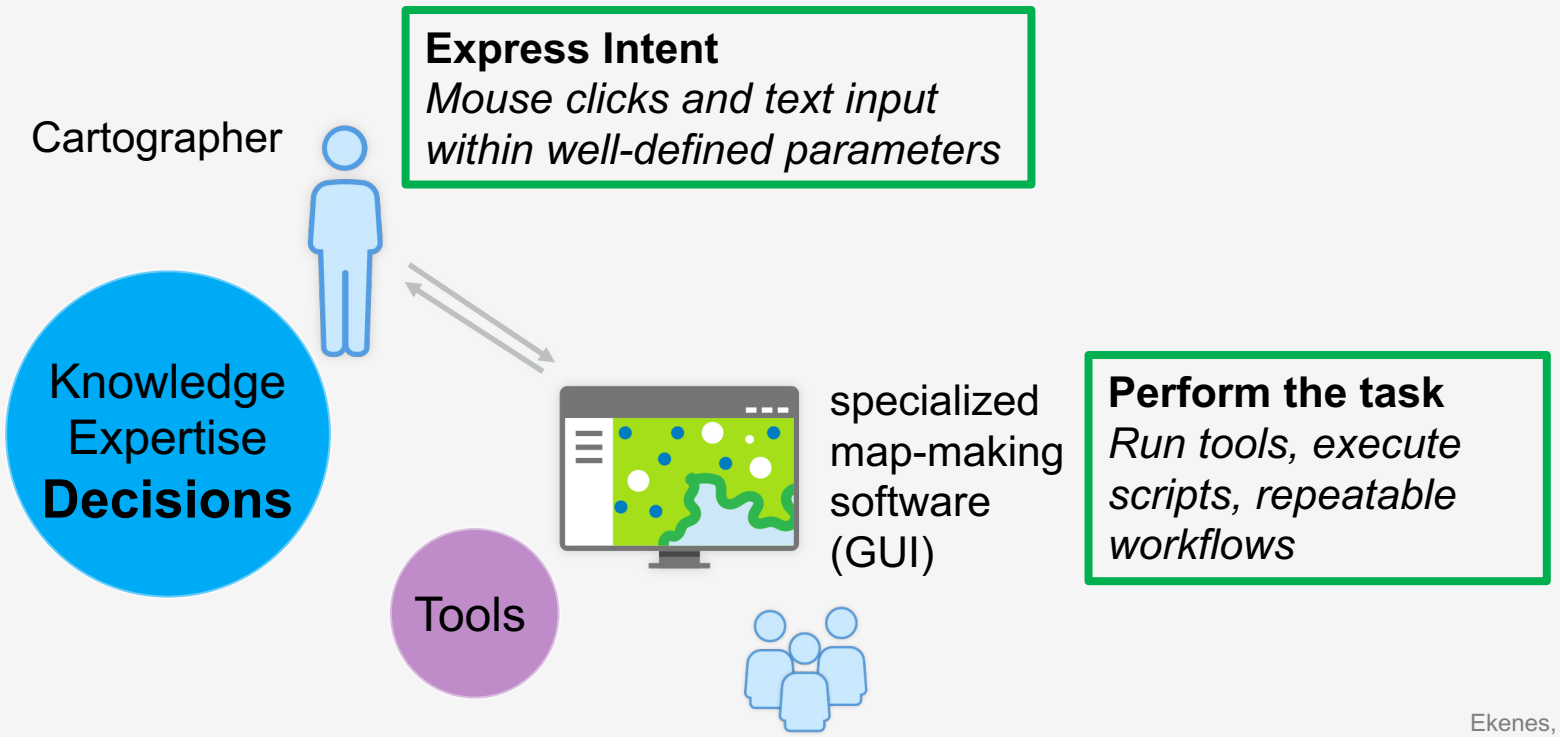
Creating thematic maps with the help of Generative AI
Kristian Ekenes, NACIS 2024

Cartographer expresses intent through **GUI** interactions; Creates the map using specialized software



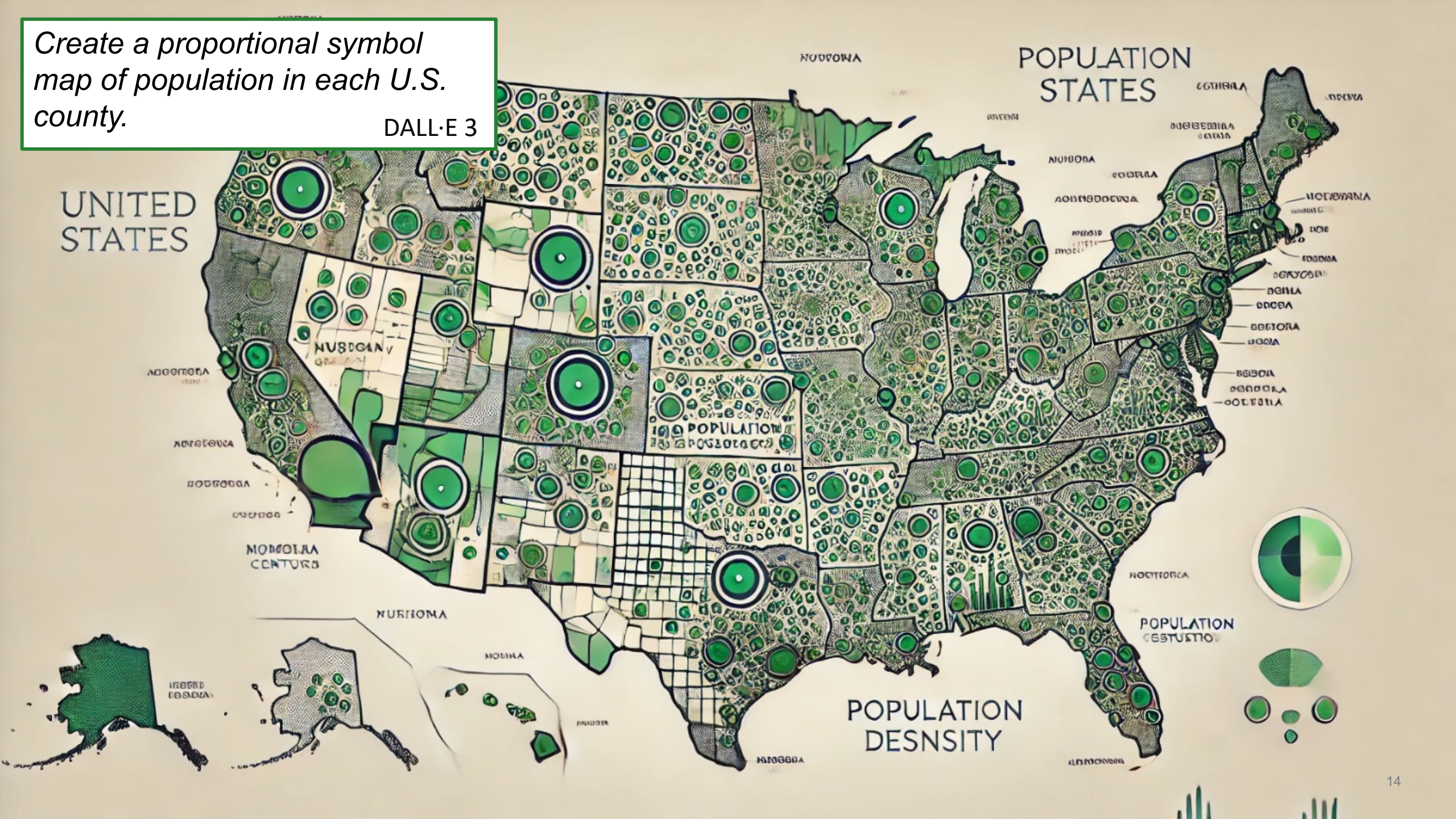
Can natural language interfaces be useful and valuable in thematic mapping?

Efficiency

…but not at the expense of quality

Create a proportional symbol map of population in each U.S. county.

DALL·E 3



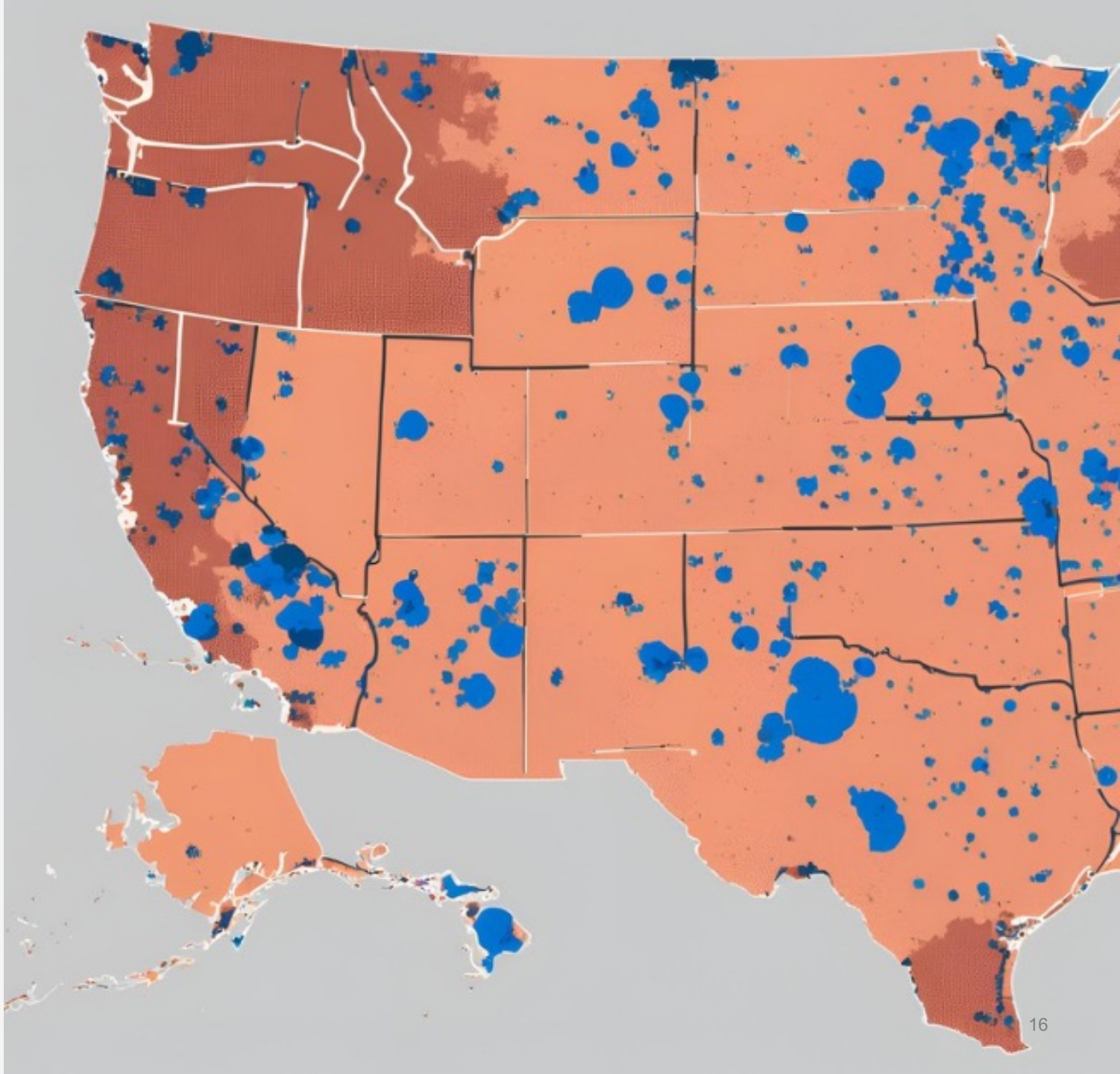
Create a proportional symbol map of population in each U.S. county.

Canva

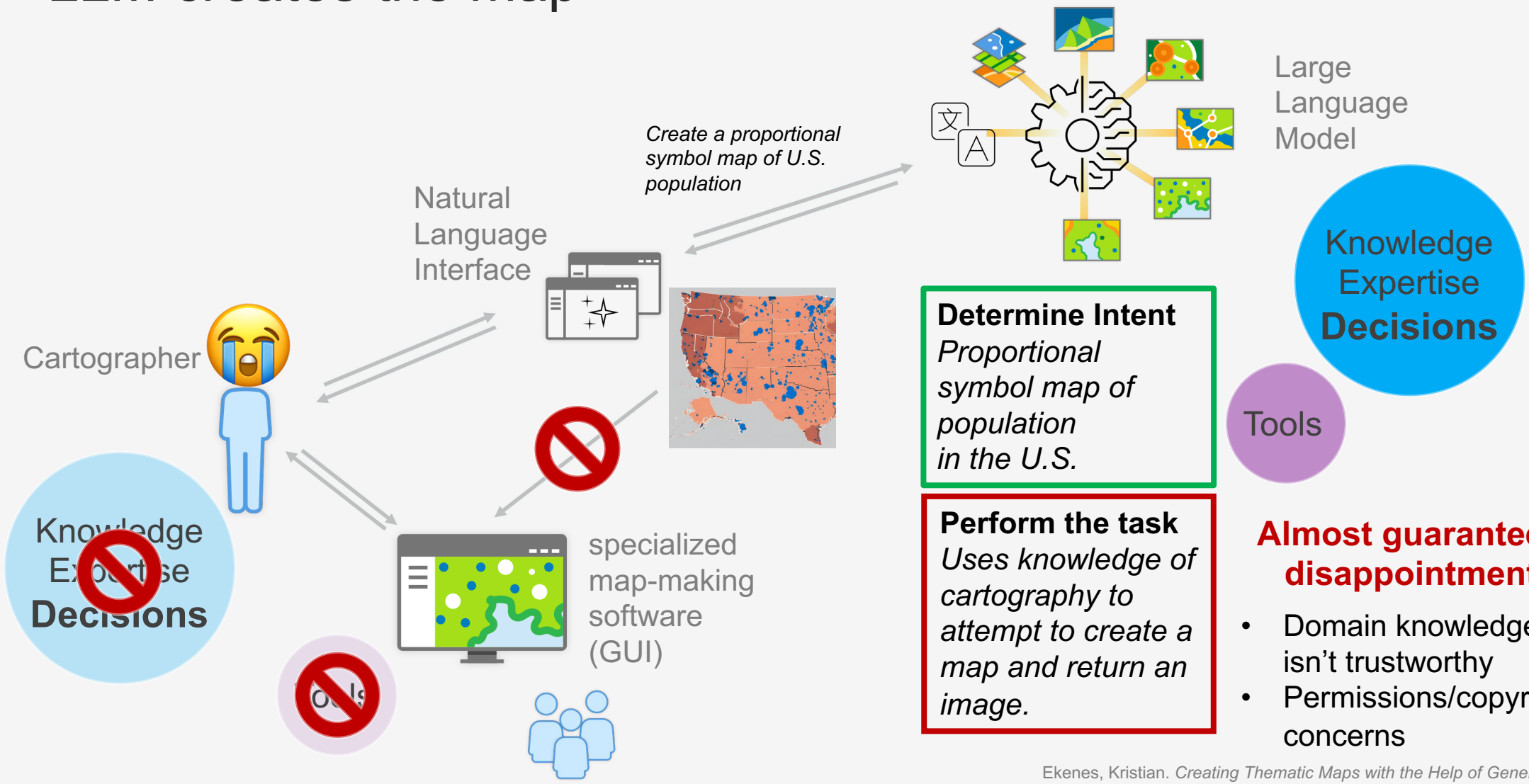
Why are the results so bad?

- Not designed to be map-making software
- High degree of variability
- Reproducibility is difficult
- Results can't easily be modified

Almost guaranteed disappointment



LLM determines intent; LLM creates the map



Determine Intent
Proportional symbol map of population in the U.S.

Perform the task
Uses knowledge of cartography to attempt to create a map and return an image.

Almost guaranteed disappointment

- Domain knowledge isn't trustworthy
- Permissions/copyright concerns

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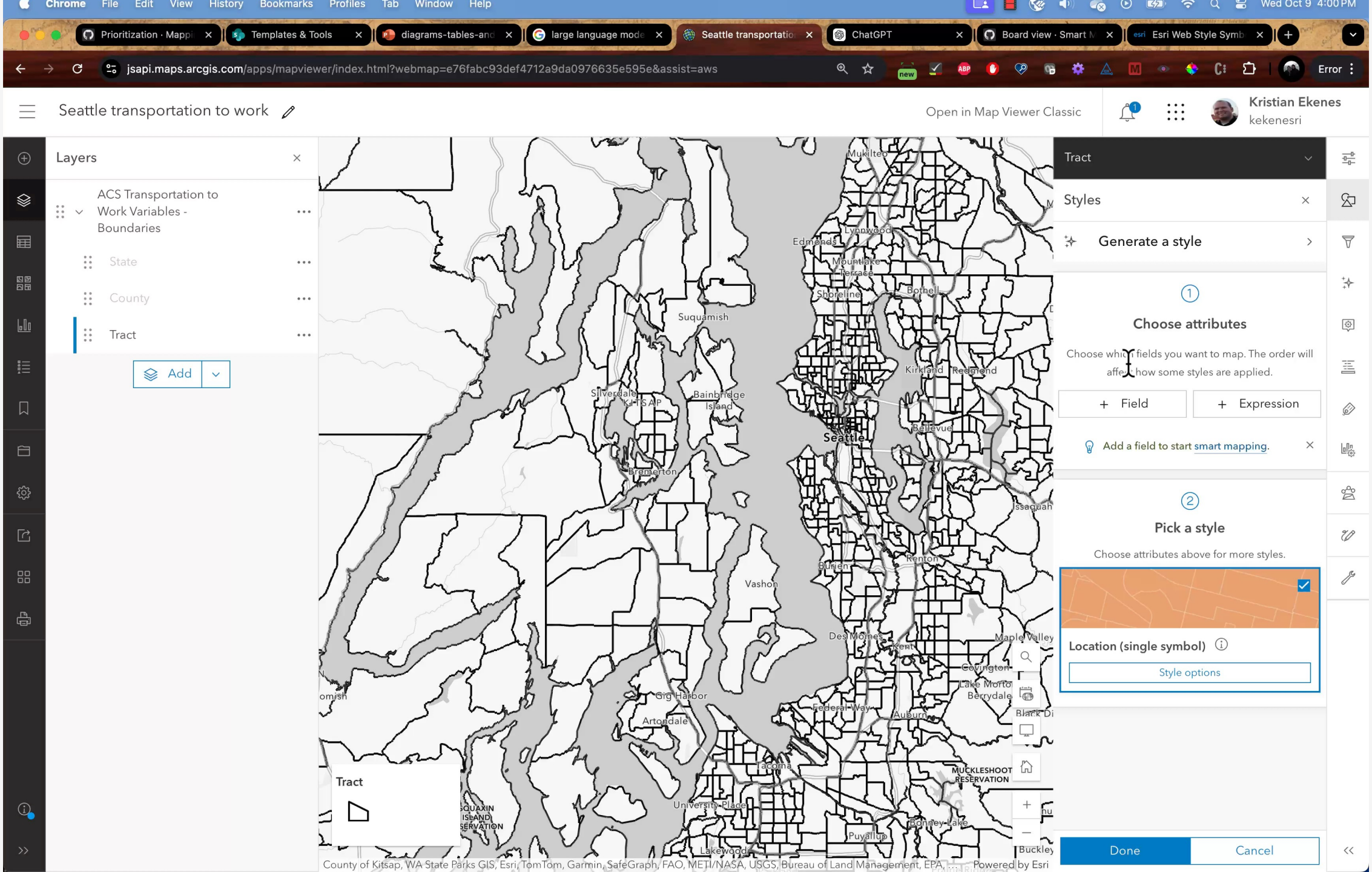
Esri’s mapping assistant

Using a natural language interface

Esri’s philosophy for creating a map with generative AI

- An LLM’s knowledge of cartography cannot be trusted without **human validation**
- **A human cartographer must always be part of the map-making process**
- Generative AI may be used for **creating a natural language interface** in the map making process to:
  - Increase **accessibility**
  - Improve **efficiency**
  - **Inspire** creativity
  - **Discover** alternate ways of visualizing data
- Integrate the assistant within the specialized software, but never replacing the GUI so generated content can be modified and finished by the cartographer (NLI + GUI).
- **The cartographer must always have the final say in the visualization.**
- Capabilities, audiences, and use cases will evolve and expand over time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Kristian Ekenes
kekenesri
Layers
ACS Transportation to Work Variables - Boundaries
State
County
Tract
Add
Tract
Styles
Generate a style
1
Choose attributes
Choose which fields you want to map. The order will affect how some styles are applied.
+ Field
+ Expression
Add a field to start smart mapping.
2
Pick a style
Choose attributes above for more styles.
Location (single symbol)
Style options
Done
Cancel
Tract
Mukilteo
Lynnwood
Edmonds
Mountlake Terrace
Shoreline
Bothell
Suquamish
Kirkland
Redmond
Silverdale
Kitsap
Bainbridge Island
Seattle
Bellevue
Bremerton
Issaquah
Renton
Burien
Vashon
Des Moines
Kent
Maple Valley
Covington
Lake Morton Berrydale
Gig Harbor
Federal Way
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Bonney Lake
Puyallup
Lakewood
Buckley
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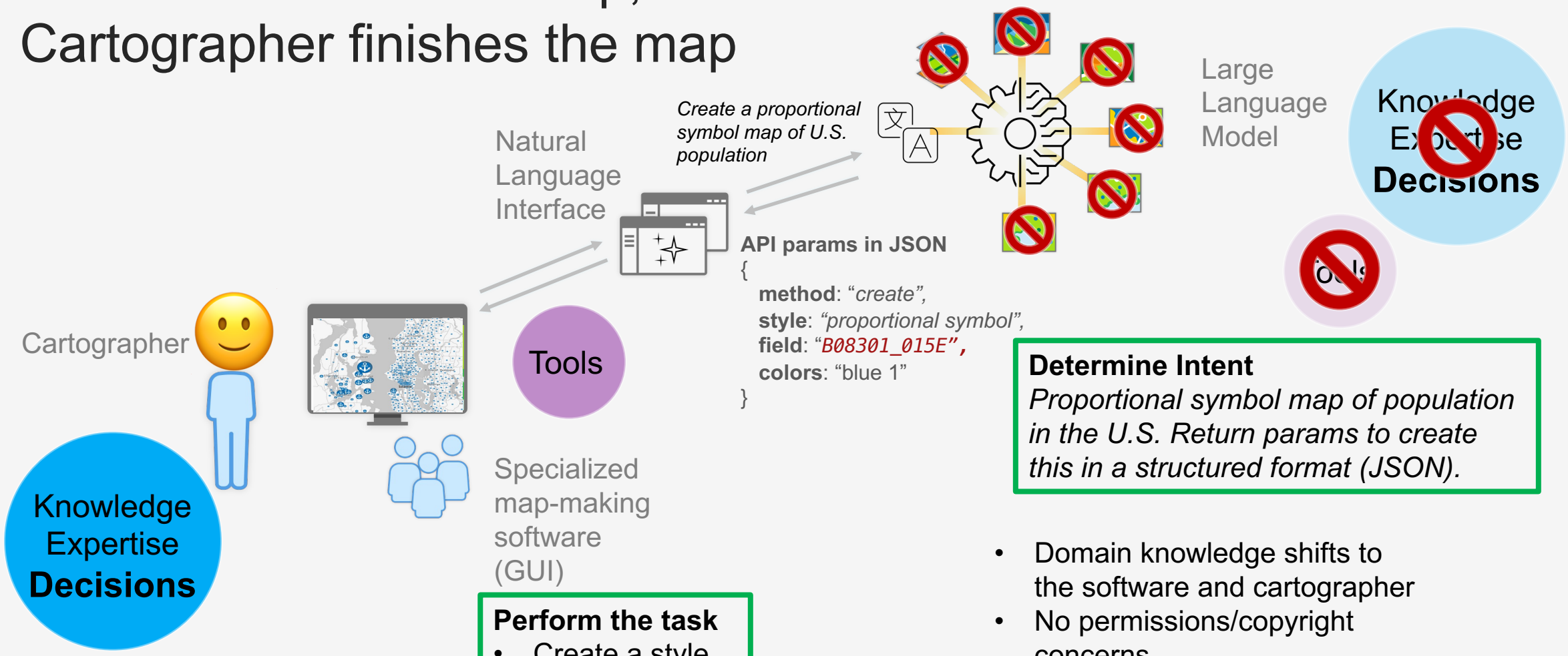
How?

LLM used for ***determining intent***, not ***cartography***

LLM determines intent; Software creates the map; Cartographer finishes the map



- Domain knowledge shifts to the software and cartographer
- No permissions/copyright concerns

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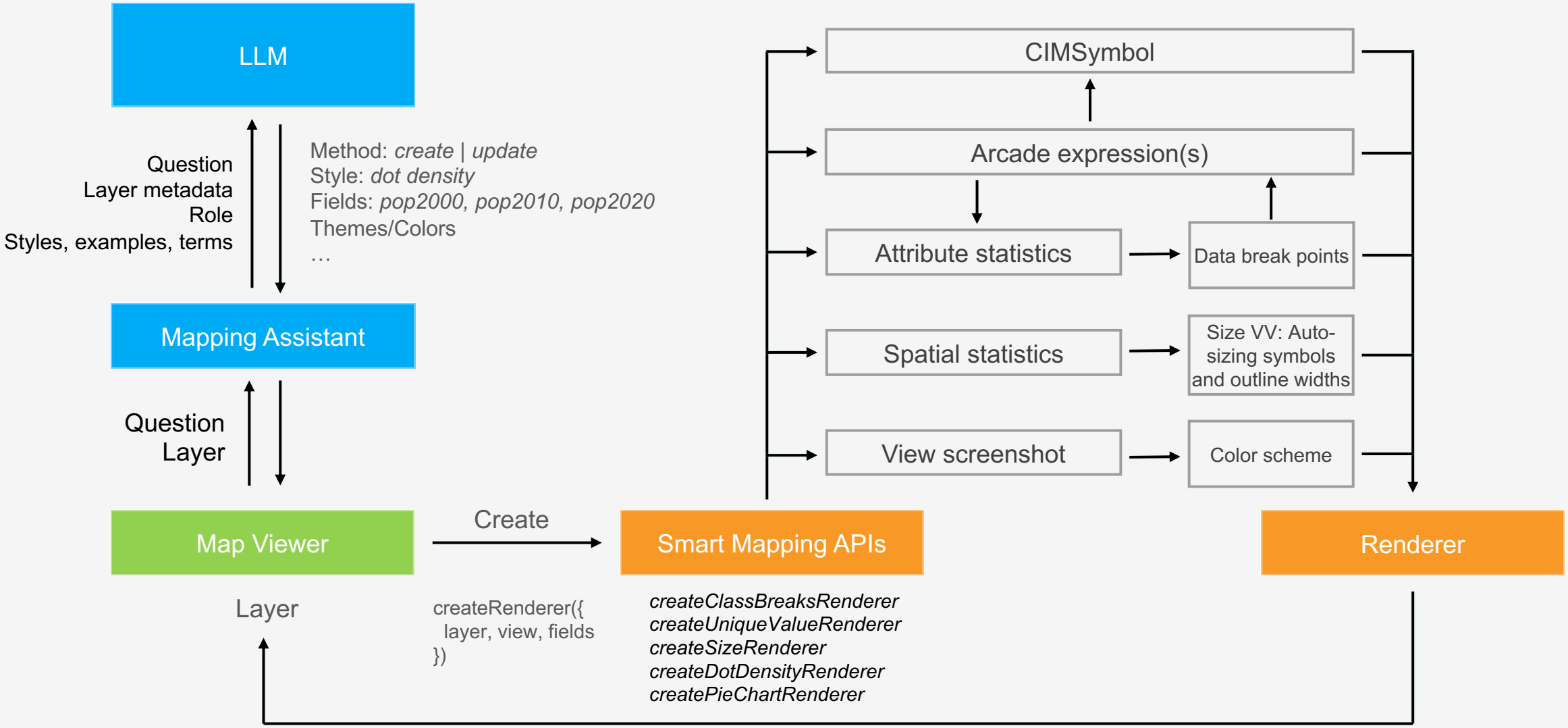
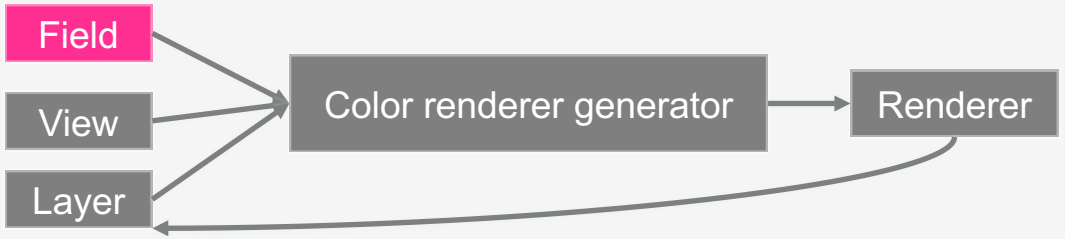
ArcGIS Mapping Assistant under the hood

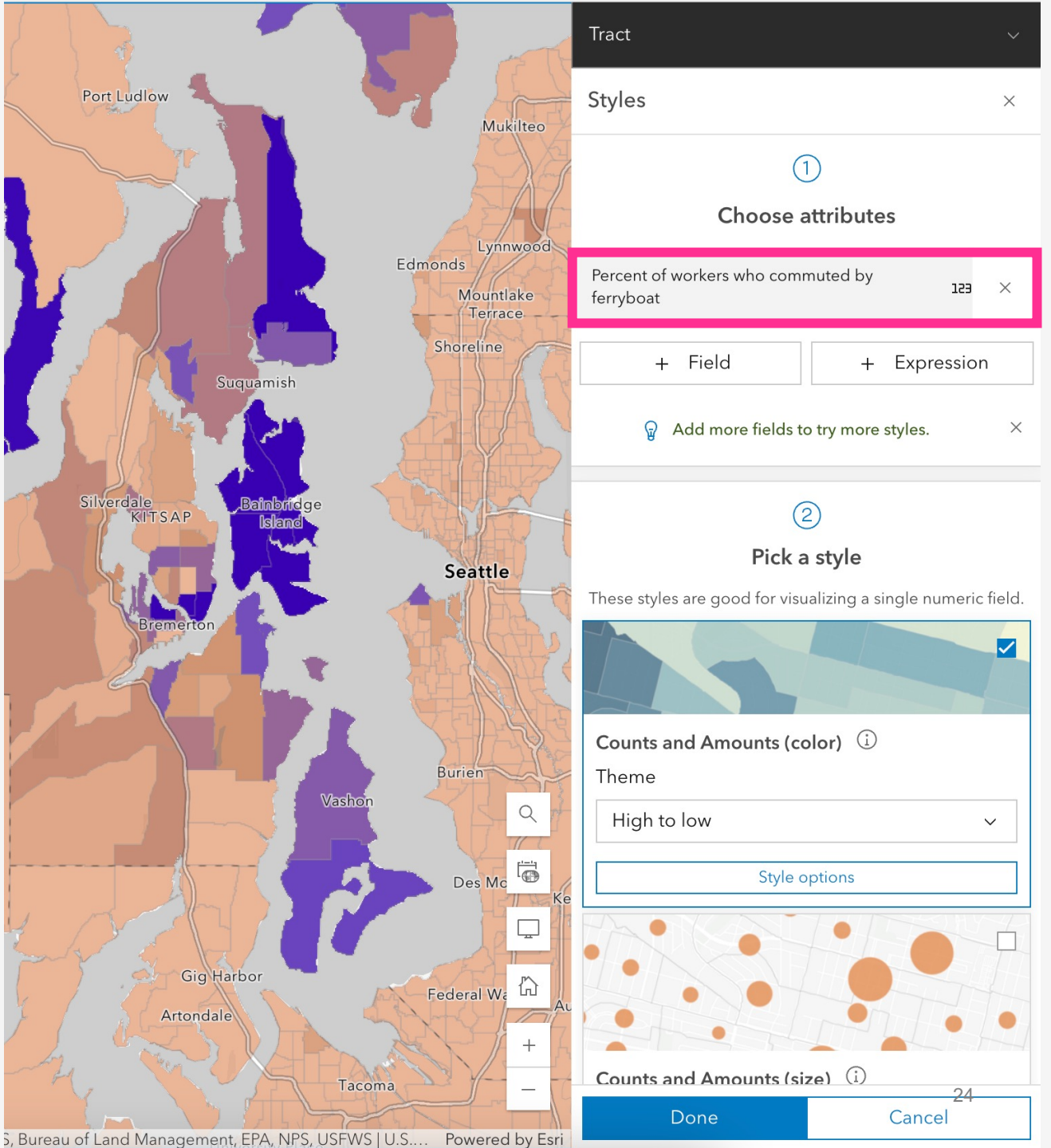


Cartographer expresses intent through GUI interactions

```
const { renderer } = await
  createColorRenderer({
    layer,
    view,
    field: "B08301_015E"
  });

layer.renderer = renderer;
```





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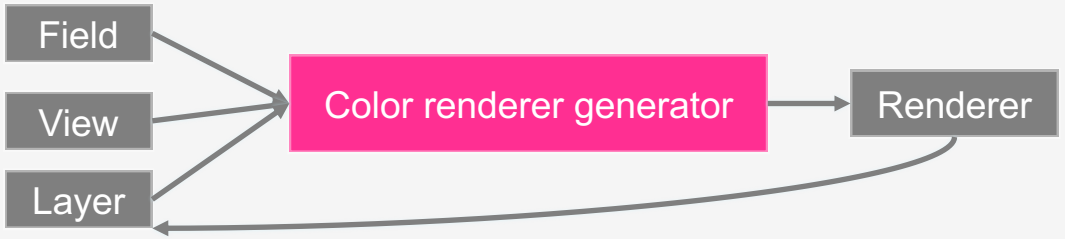

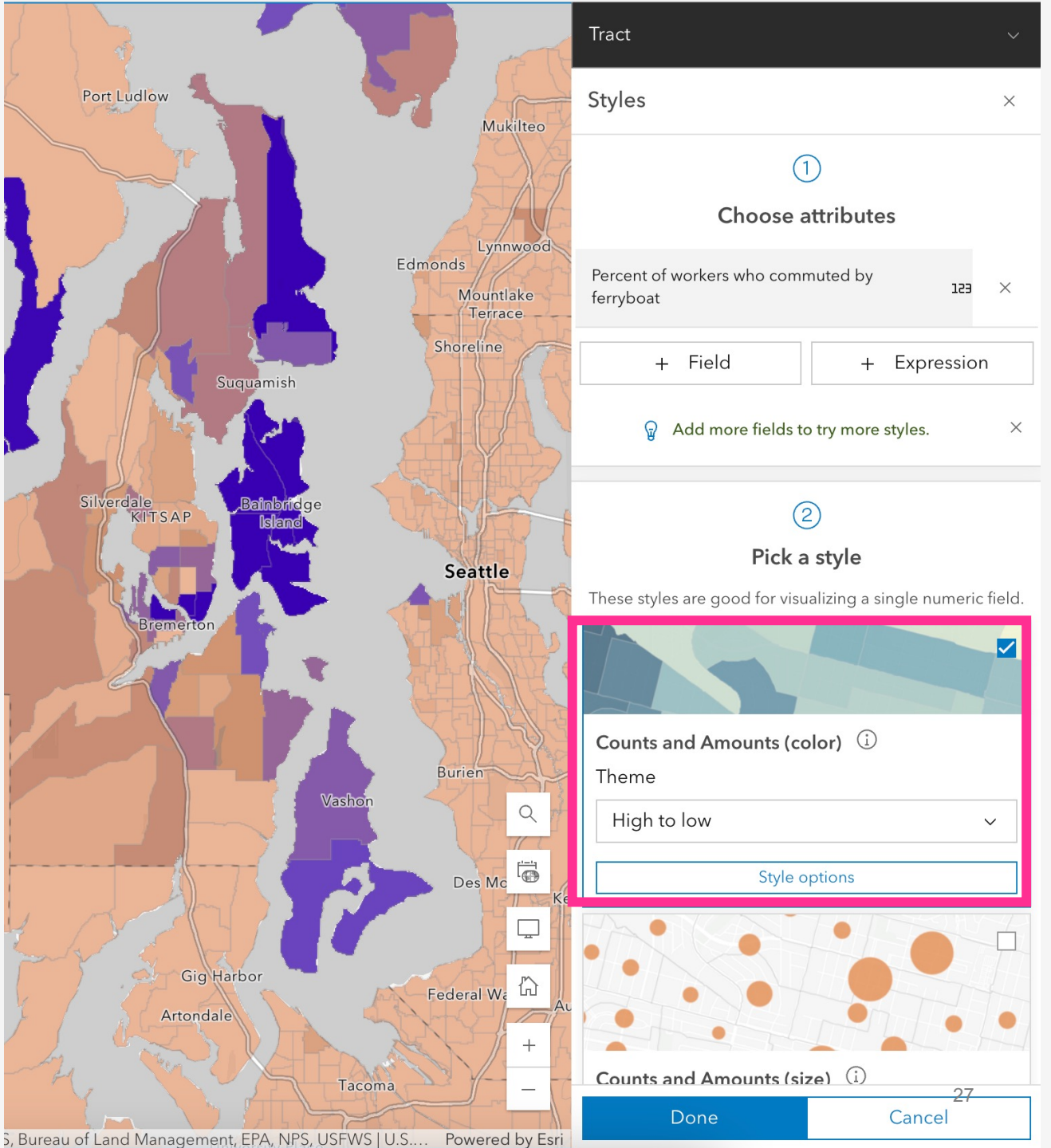

Cartographer expresses intent through natural language

```
const { renderer } = await
  createSizeRenderer({
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layer.renderer = renderer;
```
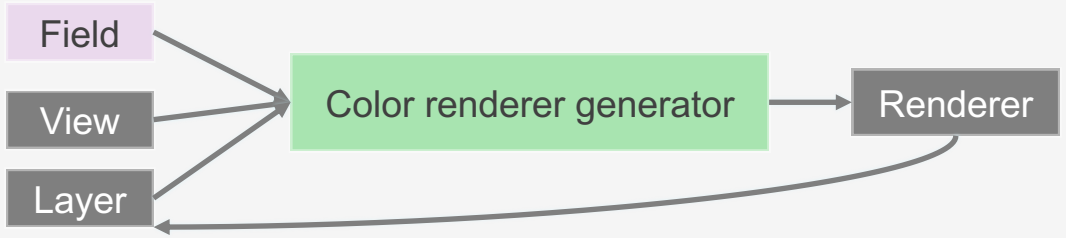
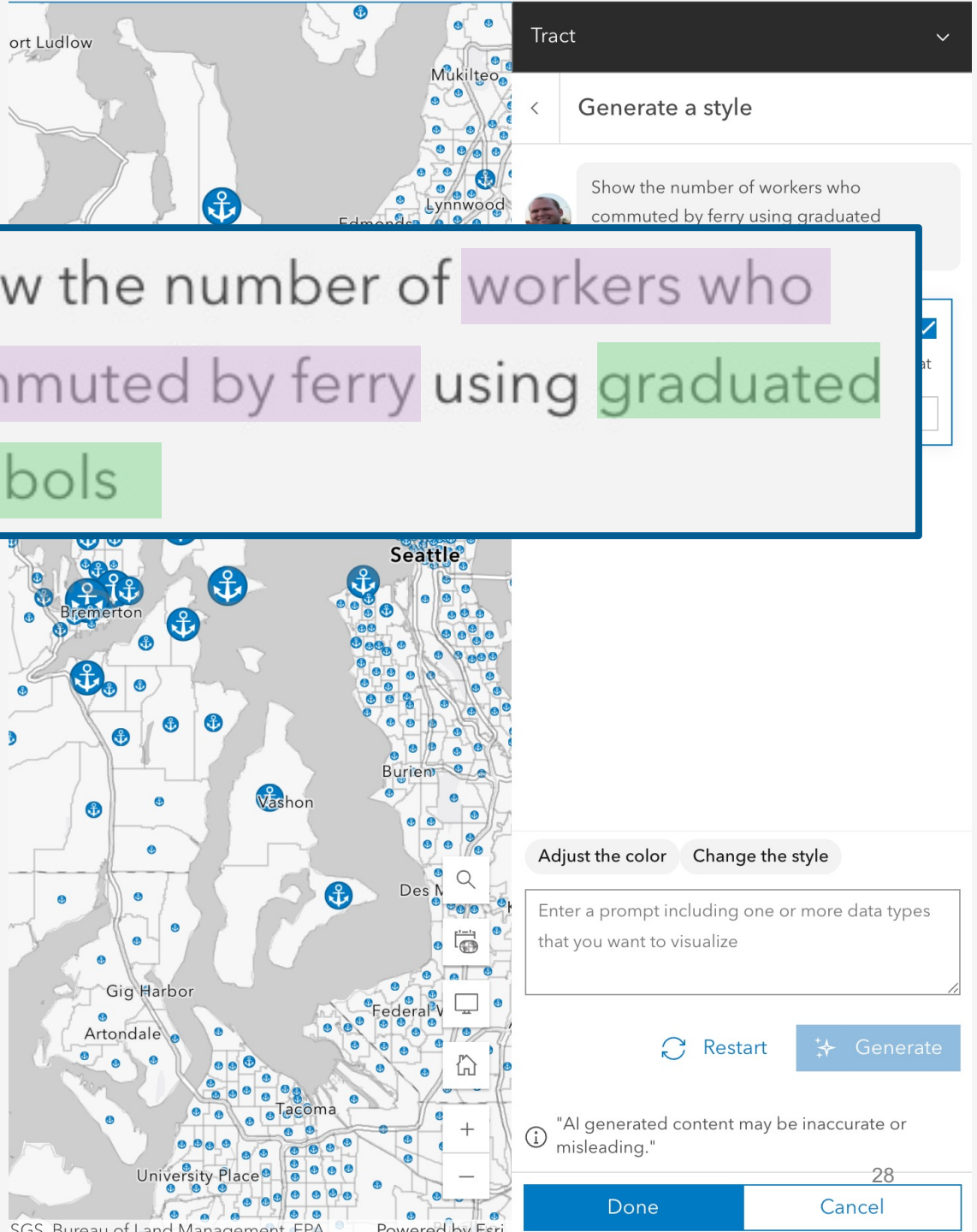

LLM

Show the number of workers who commuted by ferry using graduated symbols





Summary of responses from user studies

- Lots of excitement
- Potential for time saving apparent for more complex visualizations
- High expectations…(e.g. “It must be perfect for me to use it”)
- Expect assistance with ideas to springboard inspiration (e.g. “I don’t know where to start”)
- Some are resistant to evolving tech
- **Doesn’t save me much time. The existing UX is already efficient.**
- The existing UX already provides a means of inspiration through a style gallery
- Inconsistent responses

My first thought is, How awesome! My second thought is, ***wait, that's the part of my job I love! I love the creativity of being a cartographer****... what we need is AI to do the tasks we loathe or don't have time for like cleaning up data and creating all that in-depth metadata.*

Final thoughts

- The generated map is never finished!
- If building a natural language interface for creating thematic maps, **the software must permit the cartographer to make the final design decisions**.
- Ultimately, the cartographer is the one who should be in control and as a result, held accountable for what they create.
- The project is still in its infancy
  - Efficiency will increase
  - Consistency will improve

Thank you!

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Shivani Choudhary
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Sud Menon
Esri User Community
Esri


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