Human Geography With Open GIS :

A Transformative Introductory Higher Education Course

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Open GIS for Development @ github.com/gis4dev

The Canadian Geographer
Le Géographe canadien

Canadian Association of Geographers
Association Canadienne des Géographes

Teaching critical open GIS

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Key Messages

- Teaching critical open GIS has the potential to disrupt common GIS representations and bridge the divide between GIS and non-GIS human geography curricula.
- Open-source GIS creates opportunities for critical GIS to effectively and affectively engage with GIS technology at the level of code.

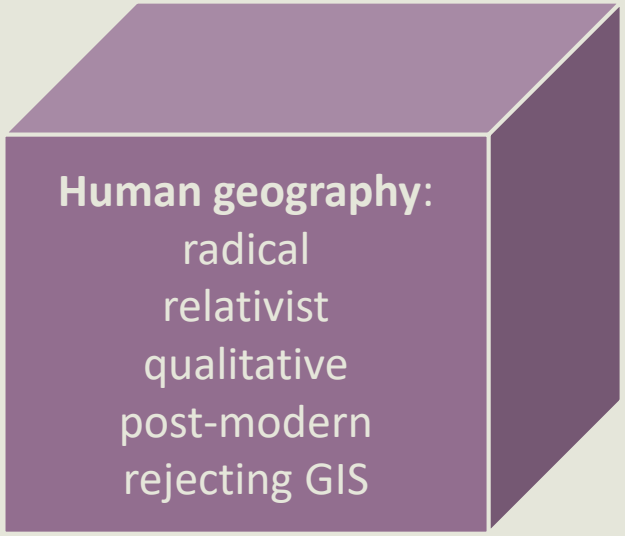
Skeptical Geographers:

- Isn't GIS only capitalist, imperialist, military-industrial, instrumentalist, surveillant, … tech incapable of multiple world views?

Skeptical Reviewers:

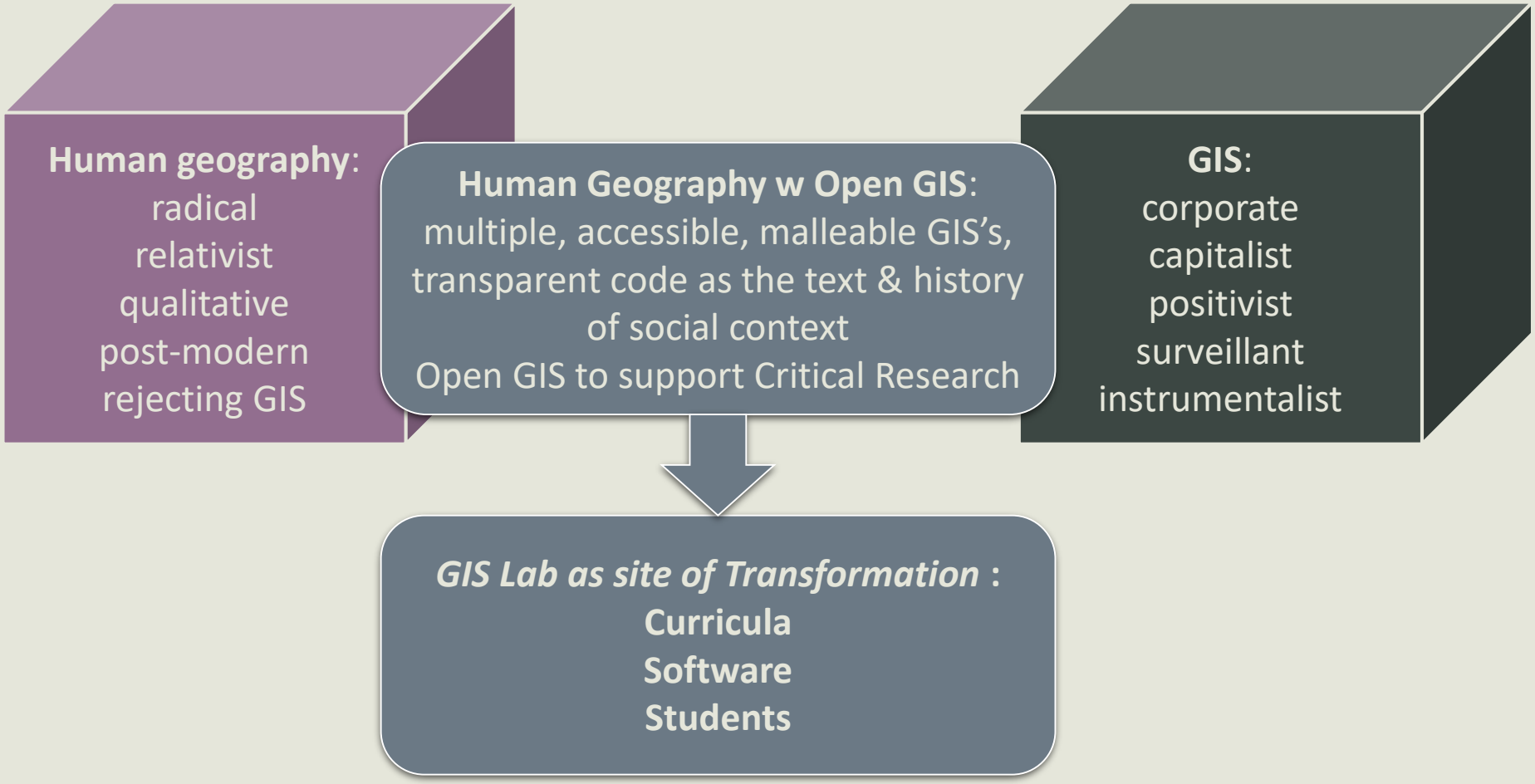
- Is it possible to attempt this at introductory level?
- Can a course really transform GIS while learning social theory?

Critical Human Geography & GIS



divide

Critical Human Geography & GIS



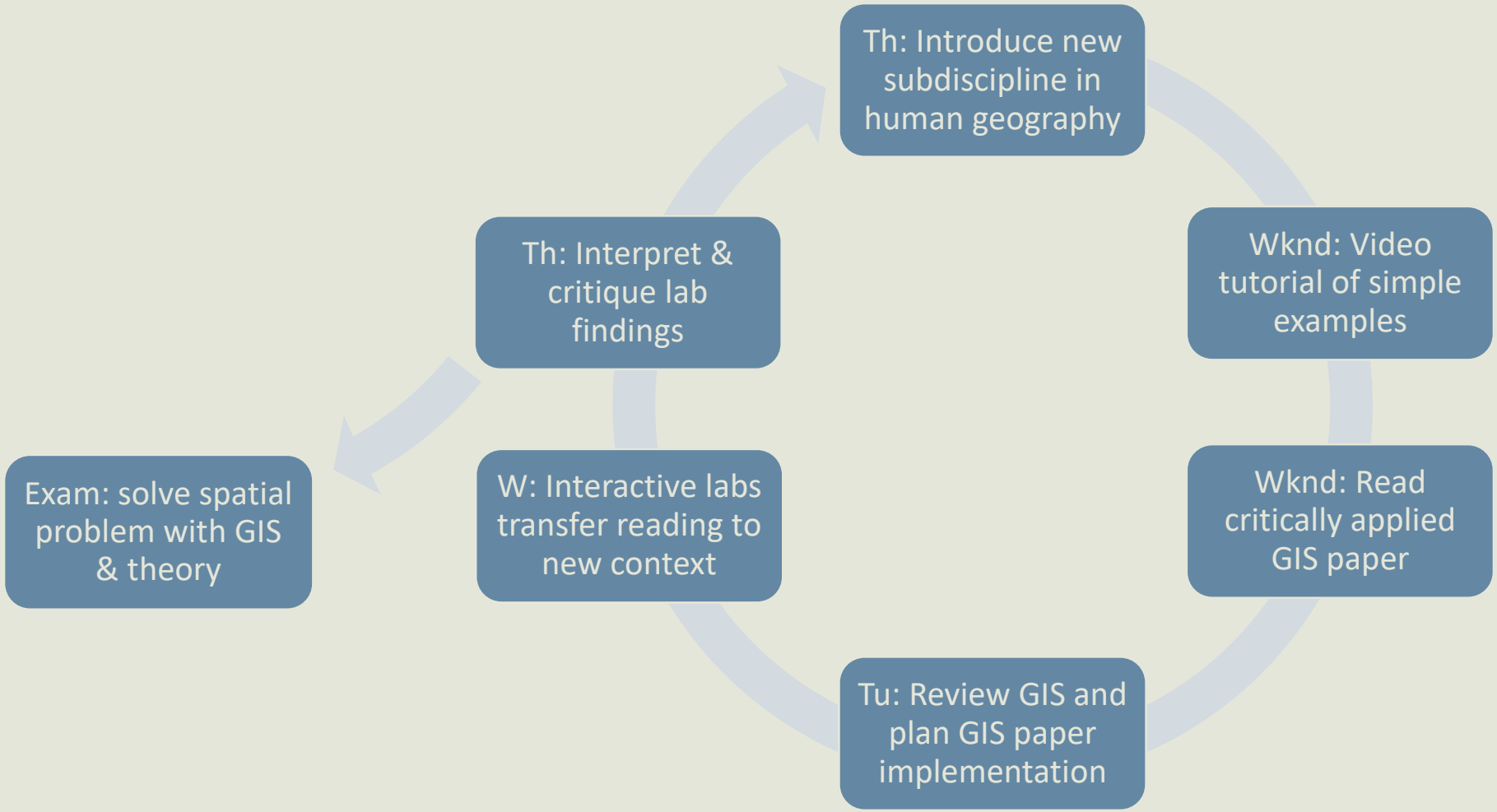
transforming curricula

Learning goals, flow, student work & evaluation

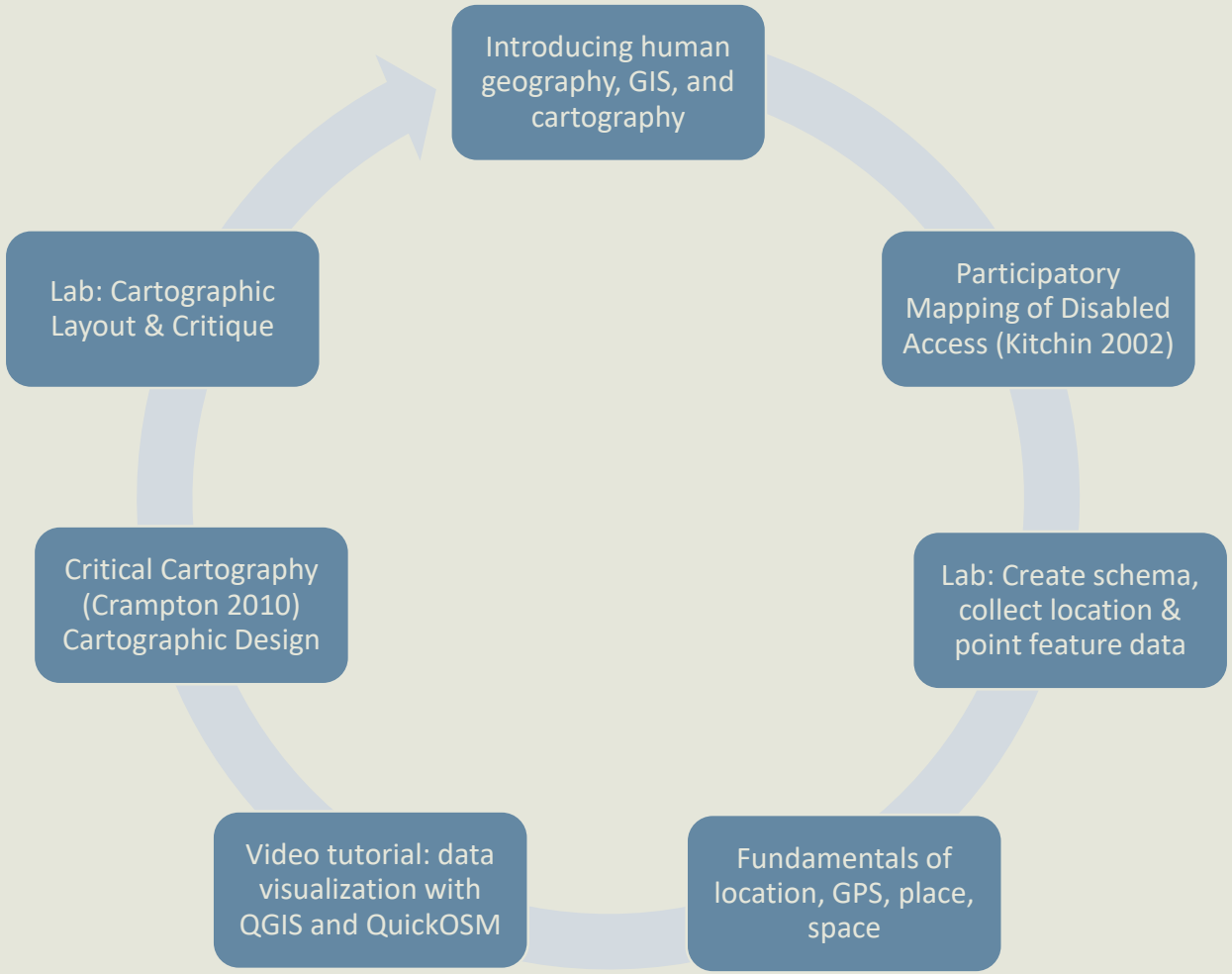
Curricular learning goals

- Understand & apply fundamental concepts in human geography and spatial analysis
- Understand, apply & critique a range of thematic problems and applications of GIS in human geography
- Develop skills interpreting & critiquing evidence
- Solve problems independently by choosing the best methods and interpreting results
- Gain familiarity with GIS and learning new GIS techniques
- Appreciate error, uncertainty, and ethics in GIS.

Curricular flow established in part by Dr. Jeff Howarth

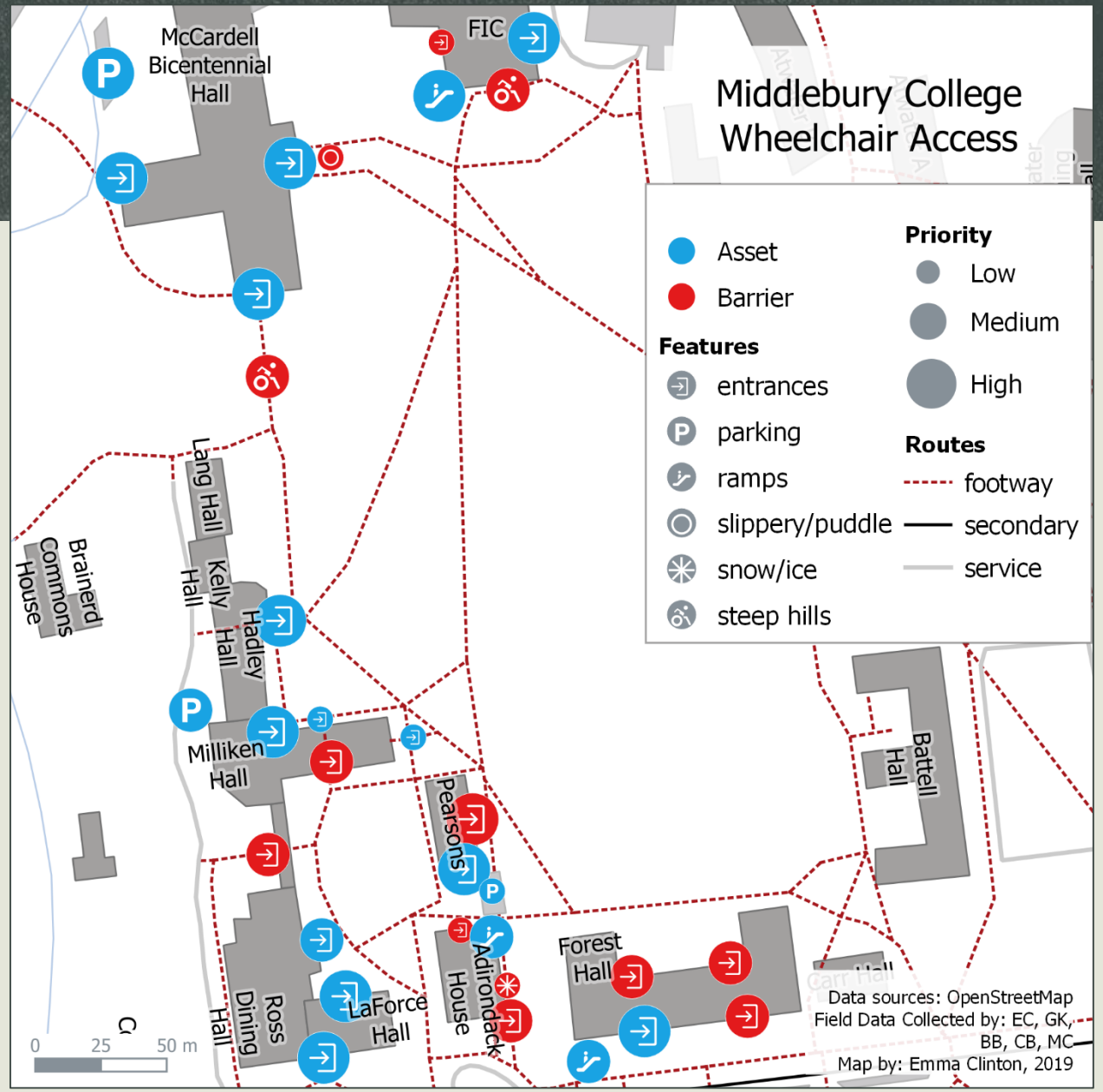


Transformed curricular flow: example of first 1.5 weeks



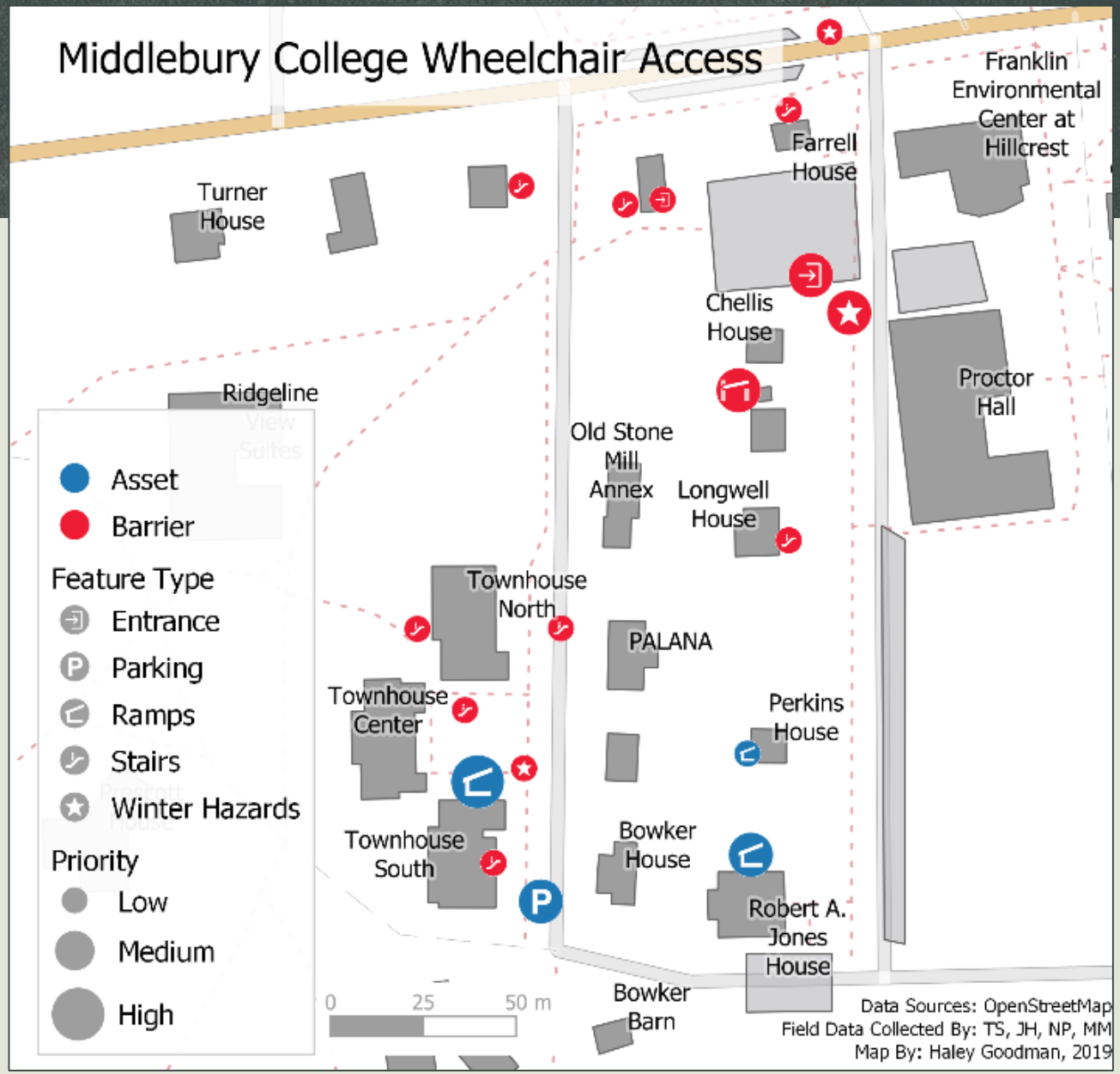
Students' Accessibility Maps
(Emma Clinton, Spring 2019)

- Adapted schema and symbology to add winter hazards
- Handicapped entrances difficult to find and blocked by snow/ice
- Historic campus buildings inaccessible
- Important student life functions inaccessible



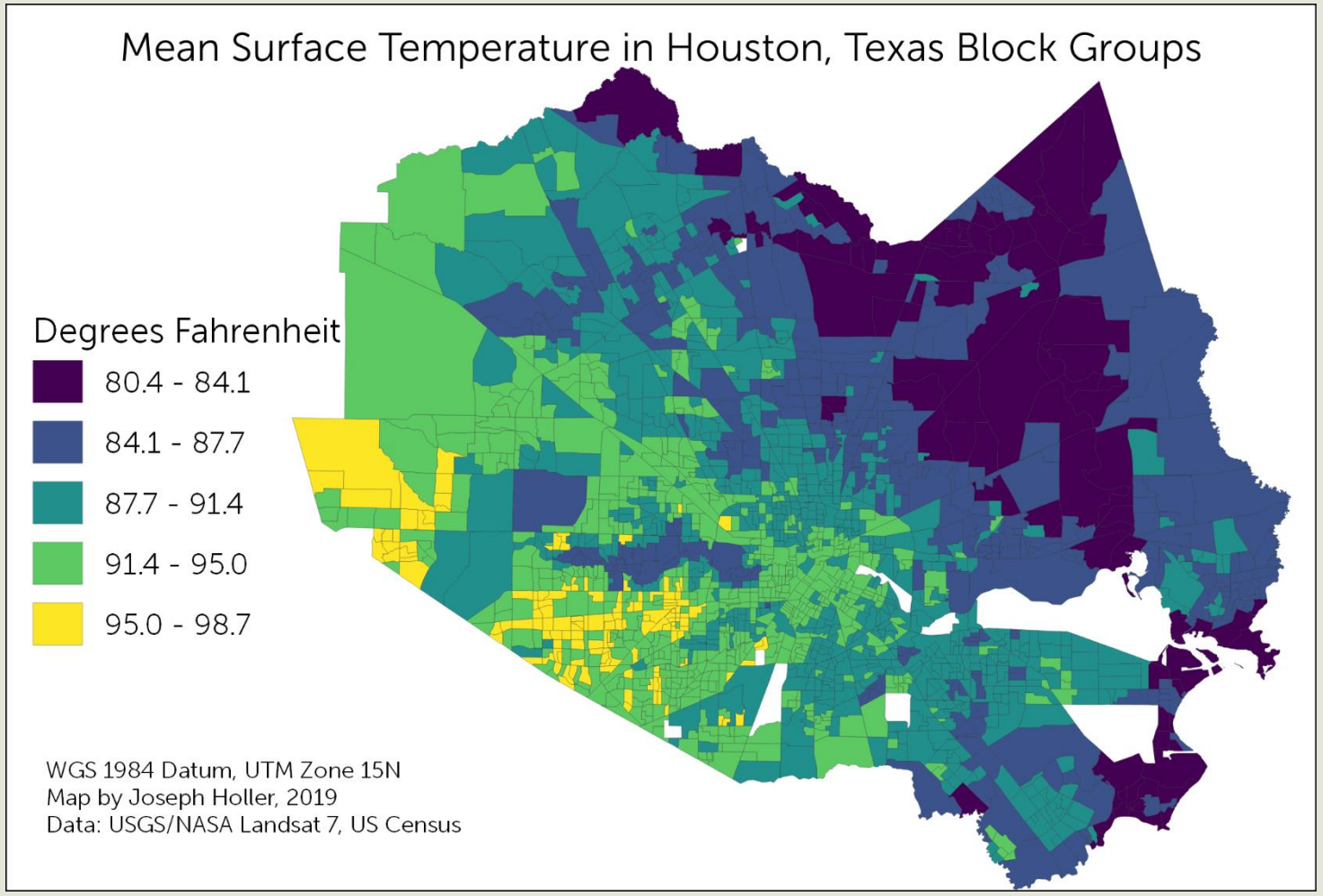
Students' Accessibility Maps
(Haley Goodman, Spring 2019)

- Maps as socially produced
- But critical cartographers can repurpose them…
- With power to change perception of space
- And planning the built environment



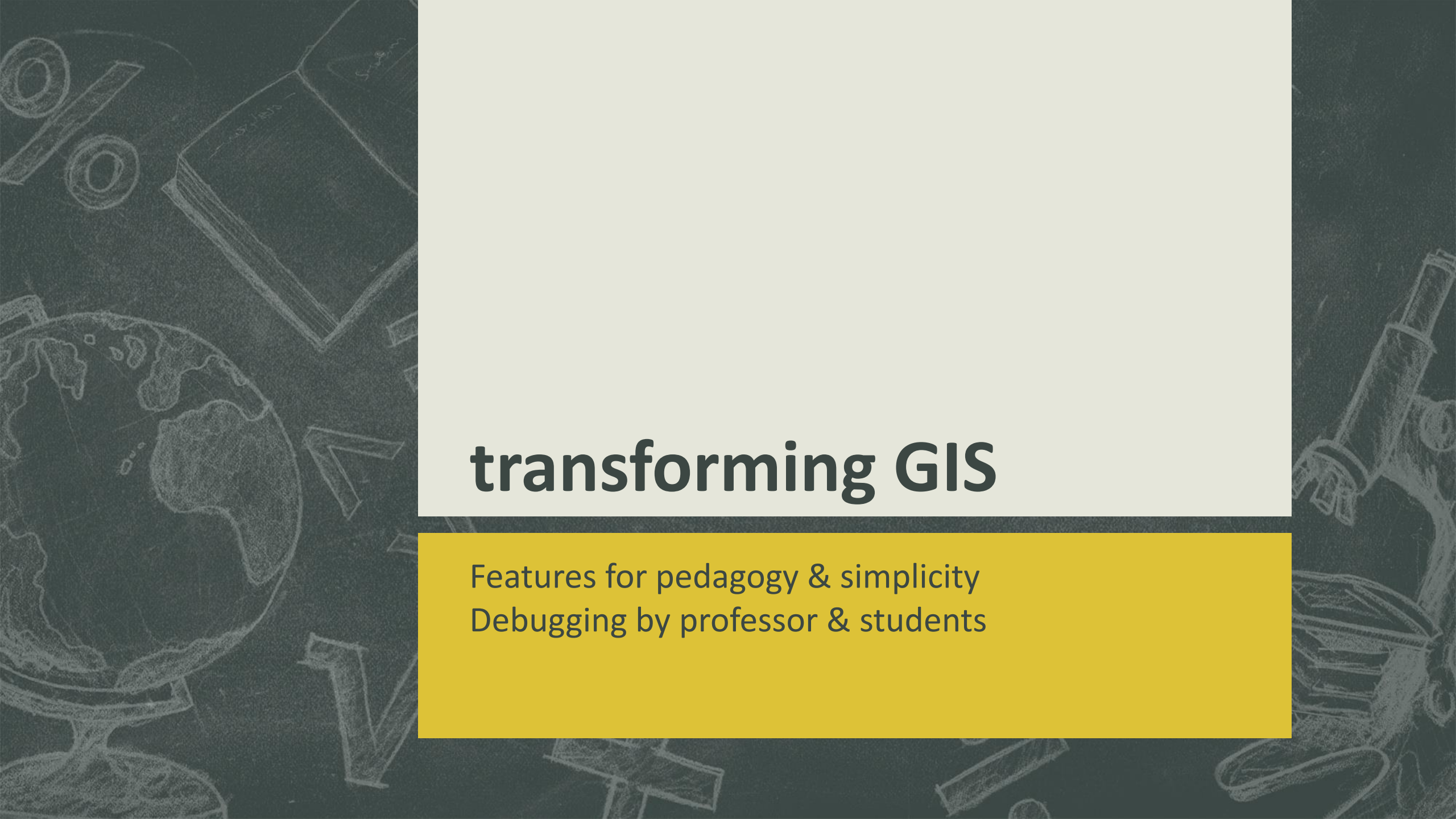
Evaluation: Independent Problem-Solving

- After reading urban geography of urban structure/segregation and urban political ecology of tree canopy…
- Is Houston, Texas segregated?
- If so, is there evidence of environmental injustice in temperature?
- Given: Census 2000 tracts with race data and surface temperature derived from Landsat 7 on Sept 6, 2000



Transformed Curricula

- Human geography theory learned actively with Open GIS
- GIS concepts and techniques taught & critiqued in context of human geography
- GIS problems posed, solved, and interpreted with theory
- Bridging divide between subdisciplines & epistemologies



transforming GIS

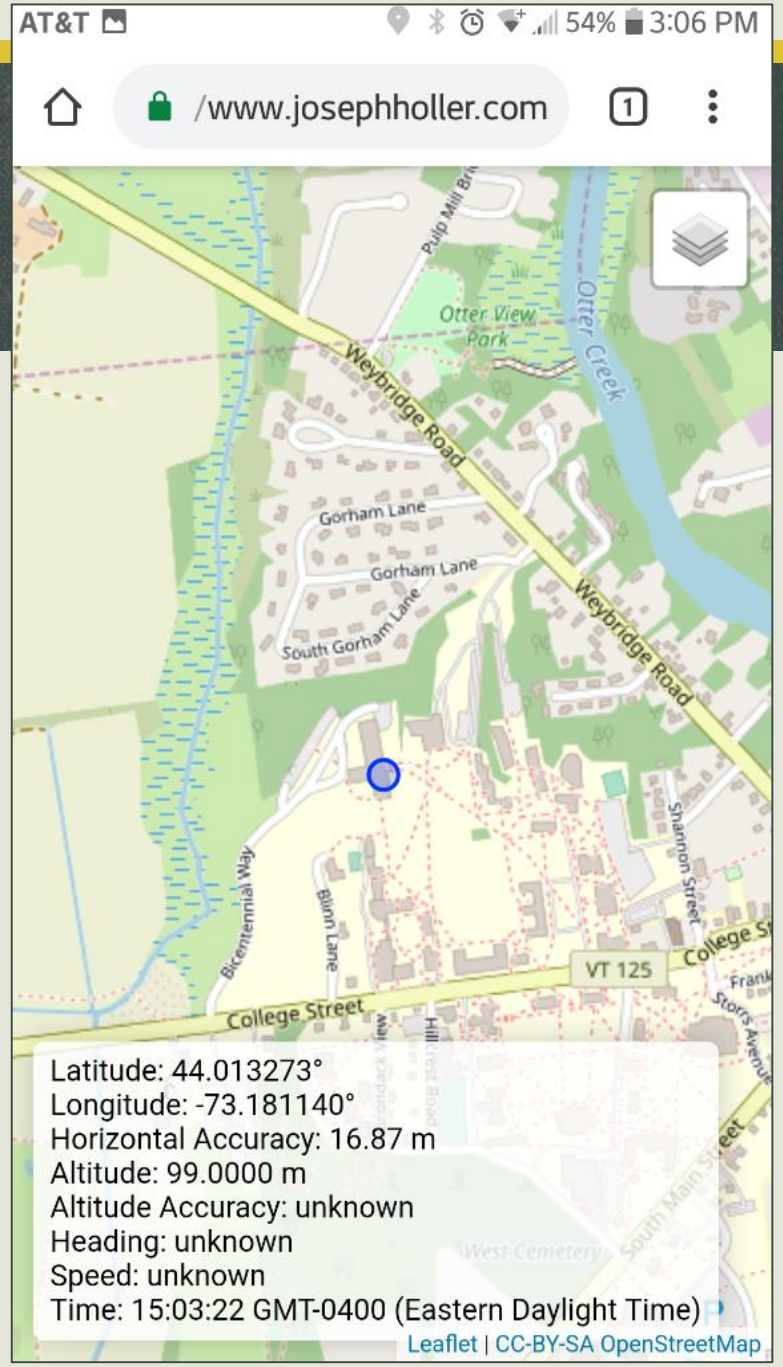
Features for pedagogy & simplicity
Debugging by professor & students

Leaflet Map Exposing Location Services

Need: simple map to expose location services for data collection

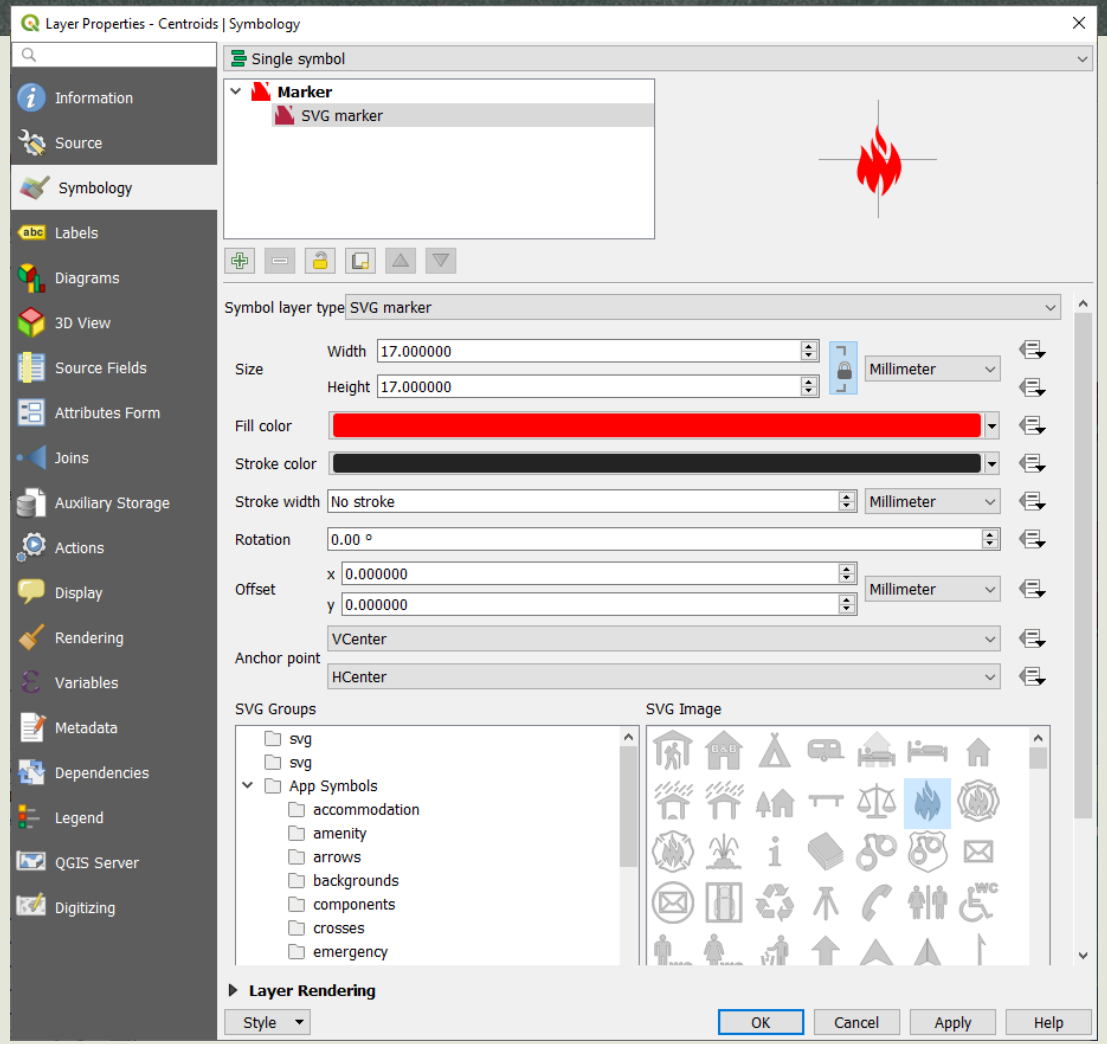
Solution: Leaflet map with information panel

Bonus: base map contains the same OSM data students will use for cartography



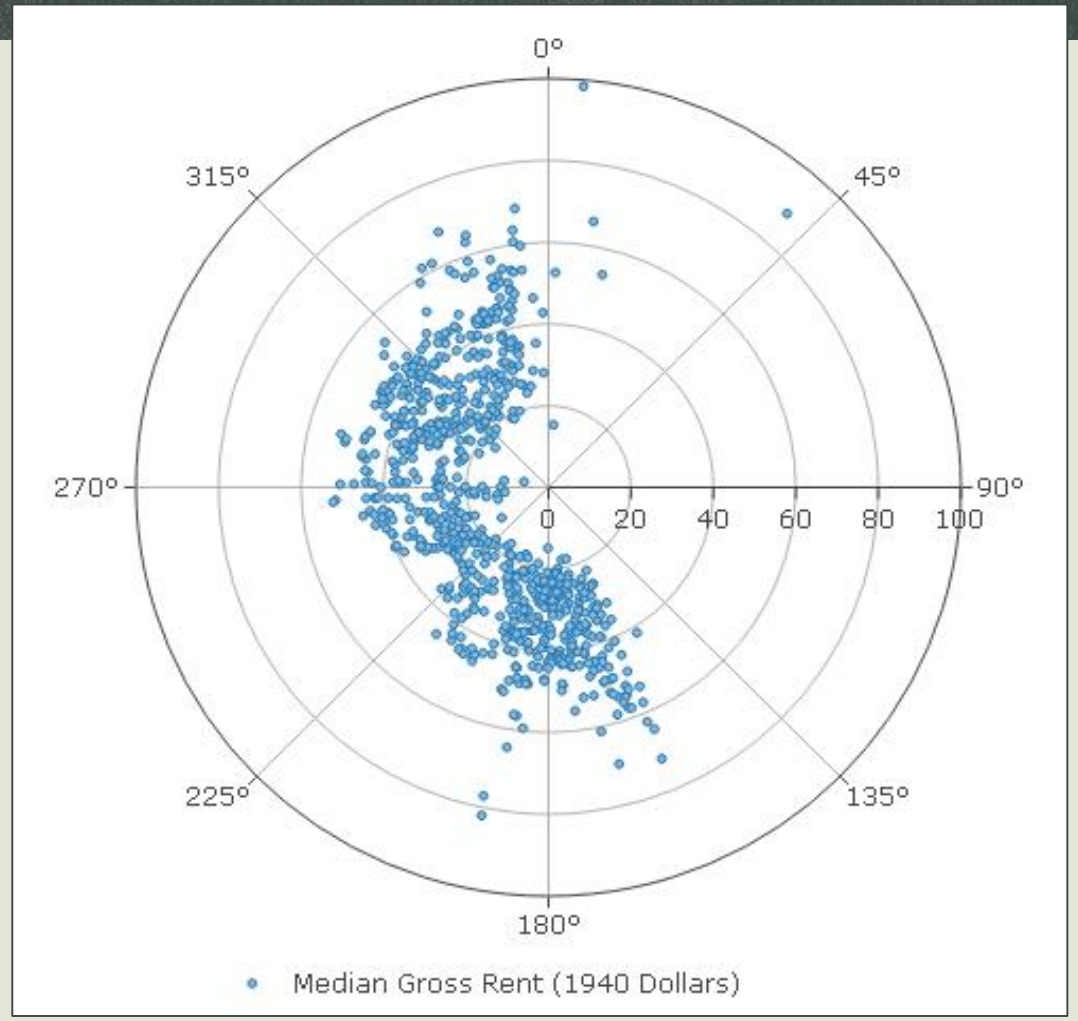
Maki Icons point symbology in QGIS

- Need: better symbol set for point locations in QGIS
- Solution: modify Mapbox Maki SVG code to talk to QGIS symbology + batch code to push into QGIS apps\qgis\svg
- In each SVG: path fill="param(fill)"…



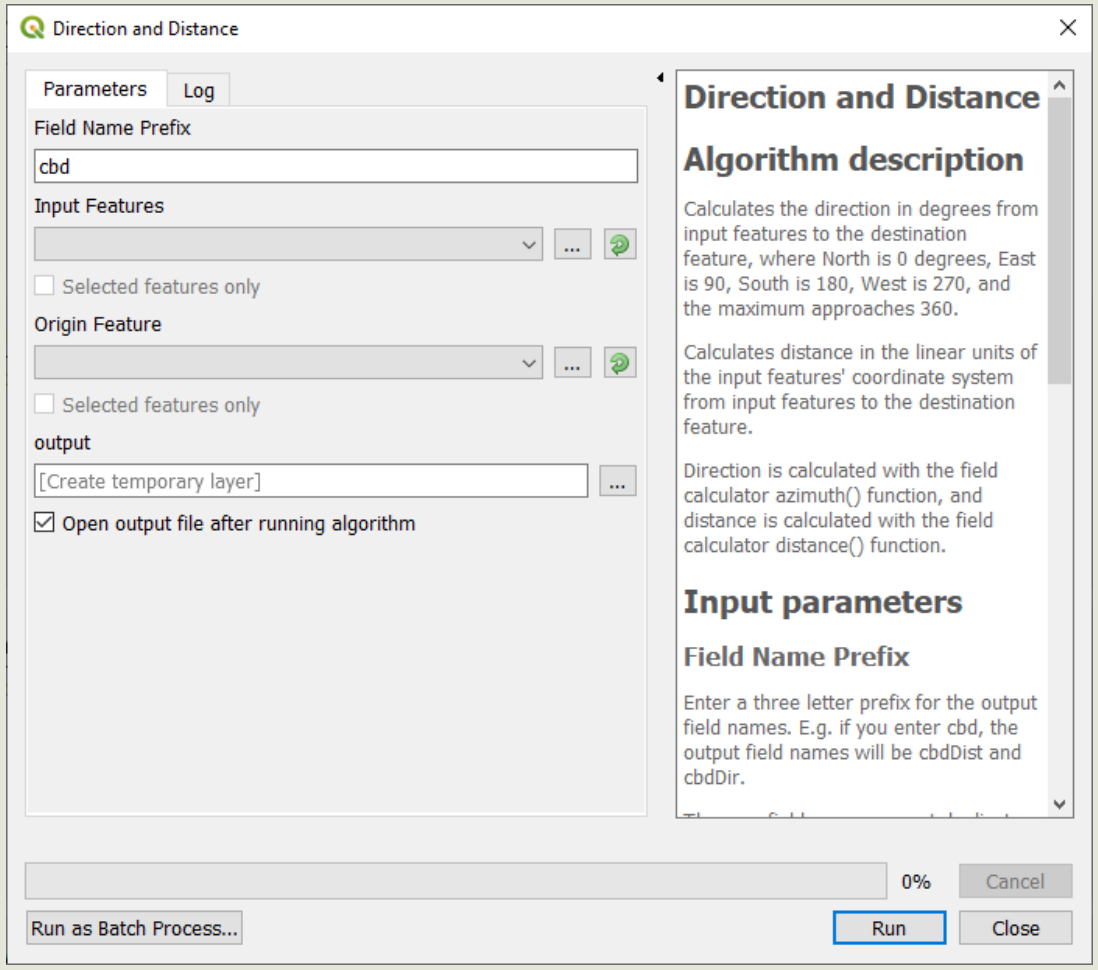
Data Plotly Revision to Polar Plots

- Need: QGIS graph for analysis of Hoyt's Sector Theory: race and housing by direction from central business district
- Solution: modify Data Plotly polar plot
  - Set direction to clockwise
  - map independent variable *x* (direction from CBD) as *theta* and dependent variable *y* (rent) as *r*
  - 'polar': {'angularaxis': {'direction': 'clockwise'}}
  - r=self.plot_properties['y'], theta=self.plot_properties['x']



Prototype new algorithms to facilitate teaching

- *We* can execute SQL to use ST_MakeValid() and group by, but novice students cannot…
- Dissolve
  - Robust against geometry errors
  - Group by many fields
  - Many summary statistics for many summary fields
- Distance and Direction
  - Facilitate field calculator azimuth() and distance() functions with references to 2nd layer for introductory students
- Documentation supports teaching concepts

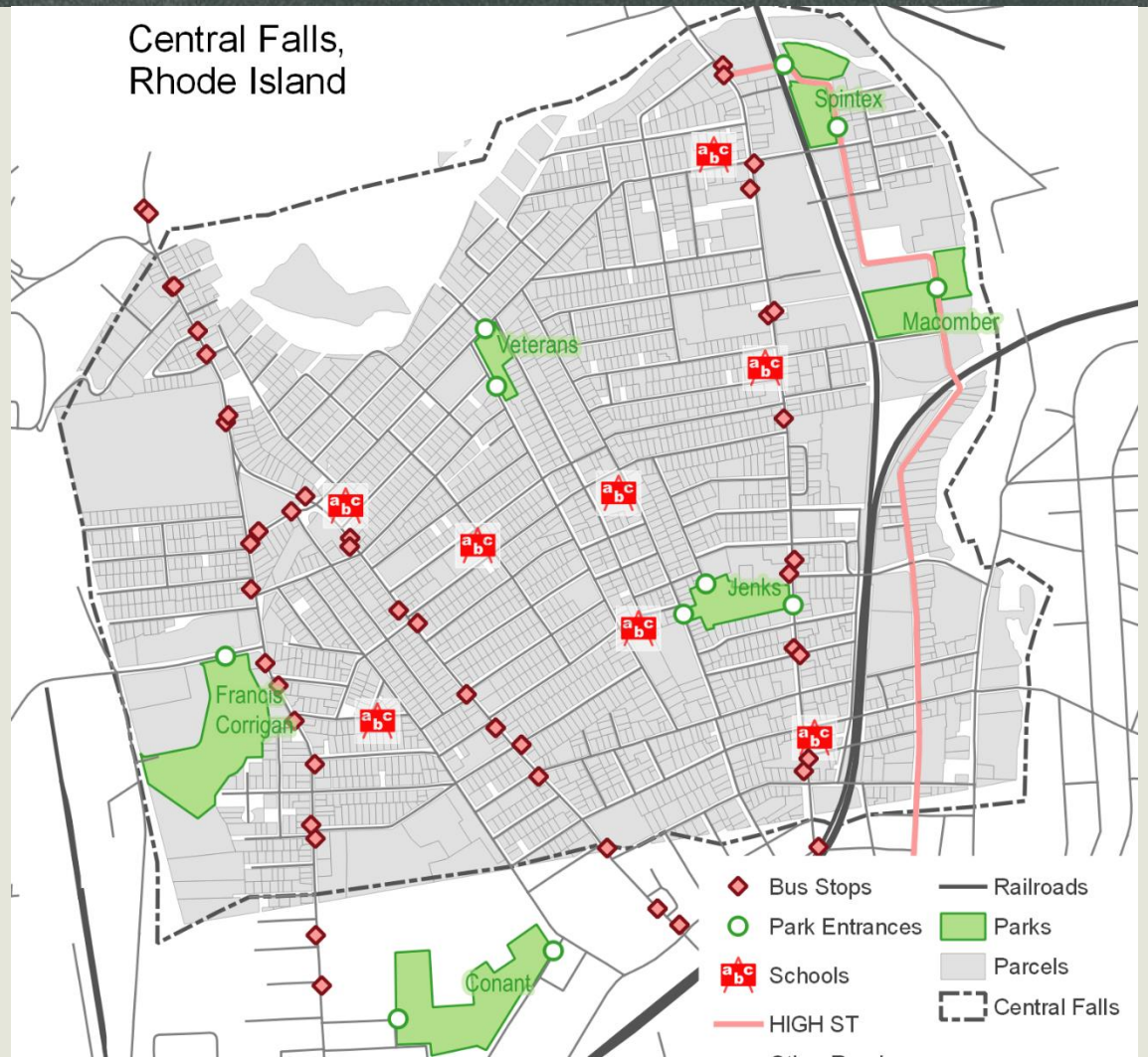


Debugging GeoPackages in QGIS 3.4

- Prepare tutorials with simple data and edge cases, finding…
- Core vector processing algorithms assumed *FID* was unique
  - Problem for Intersection, Union
- Buffer w/ dissolve violated geometry type constraints
- Other bugs frustrate novices
  - Some state plane CRS not supported
  - Feature counts don’t function for layers created as algorithm outputs
- Critical errors all fixed by 3.7

Debugging QNEAT3 Plugin

- Train students to observe inputs, outputs, and descriptive statistics for independent GIS problems
- They notice QNEAT3 OD Matrix is always missing one record
  - GitHub Bug Report submitted, fixed & tested within 6 days
- CRS errors & Iso-areas algorithms can be improved



Transforming students

Transforming Students

- Set stage for independent research integrating geographic theory & techniques
- Better GIS analysts:
  - Aware of subjectivity, error, uncertainty;
  - Developing problem-solving skills
  - Strategies to recognize errors and troubleshoot/debug
  - Interpret problem and results with theory
- Independence & freedom for:
  - Entrepreneurship
  - Not-for profit & grassroots
  - Data science

Thank you

- GitHub: GIS4DEV
- Email: josephh@middlebury.edu