osm2streets
Street networks with detailed geometry

Dustin Carlino, Ben Ritter, Michael Droogleever
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Talk outline

• Background

• What osm2streets does

• Example transformations

• Challenges and next steps
Background
My general story

• Quit big tech in 2018
• Open source software to…
  ▪ Transition cities away from motor vehicles, towards walking, cycling, public transit
  ▪ Engage communities in designing, not just voting/approving
A/B Street
A/B Street

- Squeeze detail out of OSM – individual lanes, turns
- Guess missing data
  - Sidewalks, crosswalks
  - Infer traffic signal timing, number of parking spaces
- Two modelling choices in OSM cause havoc over and over
Problem 1: short roads

- OSM represents roads as a center-line
- Some segments of that are the middle of an intersection
- “Dog legs” – almost a 4-way intersection
- Also between dual carriageways
Problem 2: parallel roads, separate objects
Problem 2: parallel roads, separate objects

- A different way for each side of a dual carriageway, cycletracks with some protection from the road, sidewalks
- Why tag this way?
  - More detail
  - String key=value schema makes tagging one object awkward
    - (Would JSON, nested lists help?)
  - 3 years ago: Is the OSM data model creaking? by CycleStreets
Consequences: rendering

- 8 intersections
- 10 road segments that’re really part of the intersection
Consequences: rendering

Not ideal, but still usable
Consequences: rendering

Sometimes parallel roads with inferred width will physically overlap
Consequences: traffic simulation
Consequences: traffic simulation
Consequences: editing a road’s lanes
Consequences: tracing between roads
Consequences: tracing between roads
Consequences: other projects

- Cycling Infrastructure Prioritisation Toolkit says Blackfriars need a cycle lane
- Routing instructions / how many traffic signals crossed
Inspiration

- The state of the art by Berlin OSM community
- [https://strassenraumkarte.osm-berlin.org/?map=micromap#20/52.49555/13.42073](https://strassenraumkarte.osm-berlin.org/?map=micromap#20/52.49555/13.42073)
- Pocket parking, curb bulbs, complex junctions
Inspiration

Can we do this everywhere?
One common problem

- Each of these problems might have a workaround for each domain
  - (But it might be very complicated…)
- What if there’s a better data model to consume instead of OSM directly?
- What if we can solve all of these problems at once?
What osm2streets does
The demo: Tempe
The demo: St George’s cycletrack
The schema

- Roads
  - A center line-string, but thickened with a total width
  - A list of lanes from left-to-right
    - Type (general travel lane, bus lane, cycle lane, parking, sidewalk, grass median, striped buffer with bollards)
    - Width
    - Direction
    - Derived geometry: a thickened line-string
The schema

- Intersections
  - Complexity classification: regular crossing, uninterrupted connection (turn lane appears), multi-connection (a dual carriageway splits), terminus (dead-end)
  - Control: uncontrolled, stop signs, signalized
  - A polygon
    - The roads exactly meet this polygon at a right angle
  - Movements through the intersection
The schema

- Partly a graph (routing)
  - Not a simple one: turn restriction relations with multiple *via* ways
- Semantics
  - Is the cycle lane protected from traffic?
- Geometry
The architecture
The architecture

osm2streets

osm2streets-js (WASM / Javascript)

street_network

import_streets

GeoJSON
- lane polygons
- intersection polygons
- lane markings

JOSM

Overpass

StreetExplorer app
- Leaflet
- osm2streets

ID editor

Java API
How it works

1. Parse OSM XML, extract raw data
2. Split ways into road segments (giving a graph with tags on edges)
3. Lanes per road segment
   - *Still using one big function (with unit tests)*
   - *Proper rewrite: osm2lanes*
   - *Sidewalks are often not tagged, make some configurable guesses*
How it works

4. Transformations to fix various problems
   - collapse “degenerate” intersections between 2 roads
   - find and merge “short” roads into one intersection
   - collapse simple “sausage link” patterns
   - detect and collapse more general dual carriageways
   - if all else fails, shrink physically overlapping roads
   - merge parallel cyclepaths with the main road

5. Generate polygons for the intersections and roads
   - “Trim back” the road center-line from the intersection
How you can use it: OSM community

- a new renderer for your hard work
- validation for lane tagging
- WIP: osm2lanes editor, don’t learn complex lane tagging
How you can use it: GIS

- Export the polygons, use in your QGIS projects
How you can use it: OSM tool authors

• Call the library from any language and build anything on top of it!
  ▪ Working: Rust, JavaScript / browser
  ▪ Planned: Java, Python, R
  ▪ Worst case: call a command-line tool
• Contribute upstream to fix the hard problems
How you can use it: OSM tool authors

- The API
  - Import this osm.xml file (or grab from Overpass)
  - Run these transformations to simplify the network
  - Get lane details (so you could define your own routing score function for walking safety/comfort)
  - Render geometry to GeoJSON (polygon areas, lane markings)
  - More later: routing, isochrones, tracing areas between roads
Technical choices

- Rust: extremely performant, language makes it hard to introduce some bugs, native or web
- Output is just a single file (or in-memory)
  - No databases
  - No complex deployment, just static file hosting
- Up to “city scale”
  - We could look into tiling
Example transformations
Transformation: simple sausage link
Transformation: simple sausage link
Transformation: separate cycletracks
Transformation: separate cycletracks

We're only pattern matching on one type of separate cycleway right now.
This represents a single RawRoad that's parallel to one or more main_roads.

X--X
C  M
C  M
C  X
C  M
C  M
X--X

C is the cycleway segment.
X are intersections.
M are main roads -- note there are two matching up to this one
Transformation: separate cycletracks
Transformation: dual carriageways
Using transformations

• Configurable
  ▪ an OSM editor: don’t merge intersections or parallel roads
  ▪ routing, rendering, transportation analysis: opt into more
Writing transformations

- Pattern match on some situation (looking at both graph and geometry)
- Label what’s matched for debugging
- Resolution:
  - Graph (remove edges, reconnect something)
  - Geometry (straighten the line between dual carriageways)
  - Lanes (append the lanes from one road onto another, inserting a barrier lane)
Writing transformations

- Interactive development / debugging
  - Use StreetExplorer and step through (visual print debugging)
- Testing
  - Clip representative OSM examples
  - Catch regressions
Challenges and next steps
Other features

- Tracing around the block
  - requires edge of the road and intersection polygons
- Routing
  - Score functions for cycling safety/comfort can use detailed lane information
  - How many traffic signals does a route go through?
- Isochrones / 15-minute walk-sheds
Other features

- Why not Valhalla, GraphHopper, OSRM?
- A/B Street needs this, maybe others do too
  - Need to run in a browser offline, no remote servers
  - Edit the street network and efficiently calculate consequences
- Extra layers (or separate projects) built on top of osm2streets
osm2lanes editor
osm2lanes editor

- help needed with osm2lanes itself and the web app (JS)
- prototype as a separate app, but ideally integrate with iD and JOSM
**Promote area:highway tagging**

- We'll never algorithmically figure out all the cases
- Make it easier to map the curb or more detail for hard cases
- osm2streets can generate reasonable defaults for most cases
- How can osm2streets use existing tagged areas to override?
The schema itself

- Lanes aren’t thickened linestrings – the shape could be more detailed
- Crosswalks
- Modal filters / bollards
- Advanced stop lines, bike boxes
- Pedestrian crossing islands
How you can help

- Programming, integrating the API in your tools, working on the schema, design
- Bug reports (for osm2lanes – defining the correct result)
- Lane rendering needs design
Thanks!

- osm2streets.org
- https://github.com/a-b-street/osm2streets
- https://github.com/a-b-street/osm2lanes
- dabreegster@gmail.com
- https://twitter.com/CarlinoDustin
- These slides: https://dabreegster.github.io/talks/sotm_2022/slides.html
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