Scalable, Server-side Mapping in Drupal with the Geocluster-Leaflet Stack

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Phase2

Phase2 Technology

Twin Cities Drupal Camp
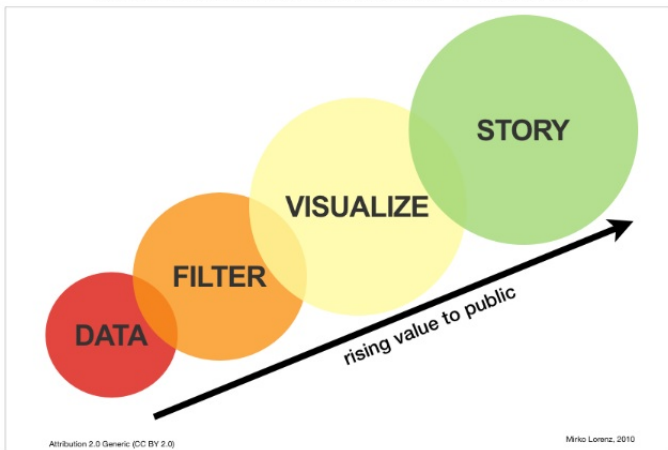June 27, 2015

Table of contents

Mapping: What Is Going On Here?

The Process

Data Driven Journalism as a Process

- Given a set of data
- And a question to be asked
- Find a useful visualization
- Data can then tell the story

The Process

Data Driven Journalism as a Process

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- And a question to be asked
- Find a useful visualization
- Data can then tell the story

This allows content authors to present data in context in ways that would be difficult with words alone.

- We can adopt this media-industry notion and generalize it to usability.

Mapping: Why is This Important?

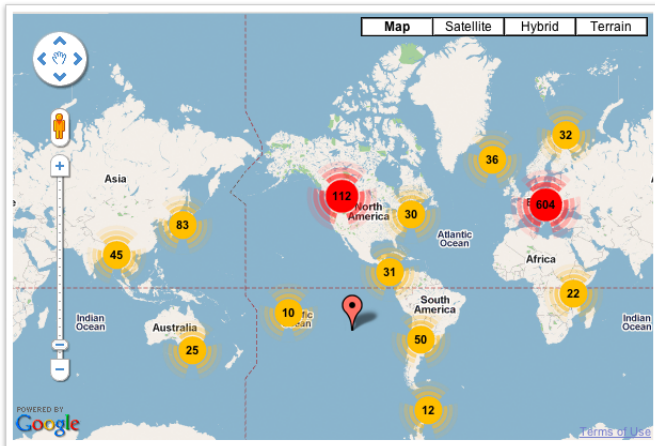# The Problem: Dense-Point Data

First pass: we have point crowding.

Really not usable.

One Solution: Client-Side Clustering
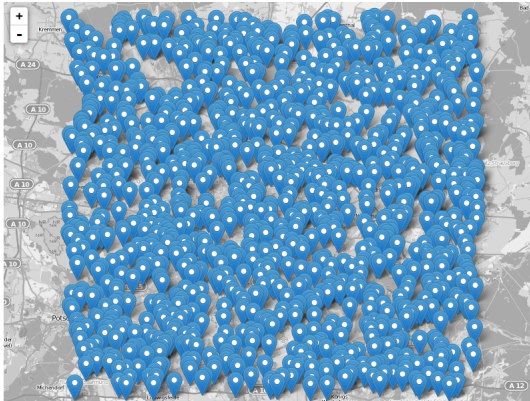
First step: lets cluster on the client side.

More usable, we gain context and can zoom in on areas of interest.

Solution Breakdown: Clustering Thousands of Points

What if we have thousands of points?

Client-side clustering breaks down upwards of a few hundred points.

Roadblock: Client-Side Clustering at Large Scale

Why Does it Break?

1. Views (PHP) renders each data point as a row of output, one at a time (thousands).
2. Views (PHP) renders the popup info (hidden) at page-load time.
3. The mapping library (JS) must parse the data.
4. The mapping library (JS) clusters the points.
5. The mapping library (JS) renders the map.

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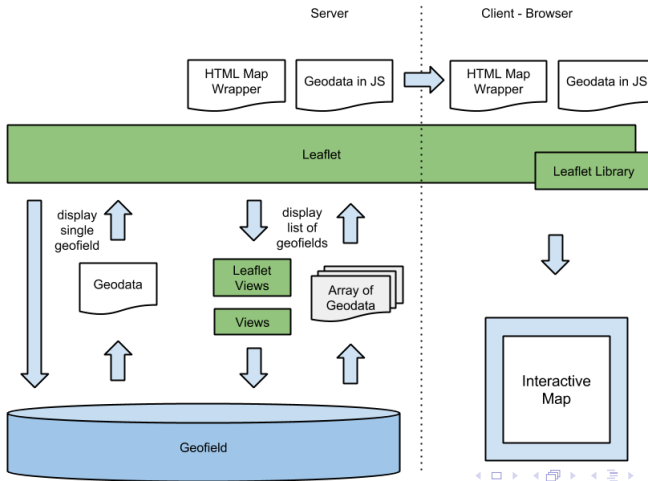5. The mapping library (JS) renders the map.

Both PHP and JS are asked to do too much at once.

- The breaking point is about 300 data points (empirical).

Client-Side Clustering Visualized

Drupal Mapping query and display modules - Leaflet

Demo

http://vistacampus.gov/map
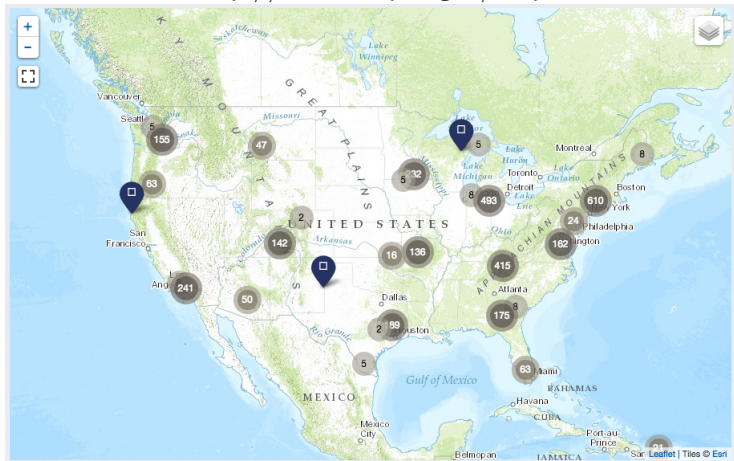
Demo: Things of Note

Map has been in production for just over a year.

- About 4K points at launch time (2k now)
- Bounded mapping (bbox strategy)
- Load time under 1sec
- Clusters are single things, not collections of things
- On-demand, AJAX-delivered infobubbles with complex data
- Dynamic reclustering on pan/zoom
- Layer interference (boo!)
- New maintenance team (boo!)

The Recipe

Basic Recipe

- Address Field (location storage)
- Geocoder (geocoding addresses, requires GeoPHP)
- Geofield (geocode storage)
- **Geocluster** (server-side clustering)
- Views
- Views GeoJSON (GeoJSON feeds)
- Leaflet GeoJSON (2.x for Panels support, 1.x for Bean)
- Leaflet Integration (requires Leaflet core library)

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But... we need lots of patches.

A Working Model: A Starter Build

If you really want to build this...

1. Clone the starter build, then modify to suit.
2. Building the configuration from scratch is tedious.

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Starter Kit: https://github.com/mpgeek/Geocluster-Demo

- Kit built with Grunt Drupal Tasks (automation)
- Minimal core/contrib build including required patches
- Includes exported demo content to demonstrate correct config
- Does not include all patches for the client build.

A Working Model: The Client Build

The client build has been released as GPL2.0

- https://github.com/mpgeek/VistaMap

Patch mania!

- See the makefile

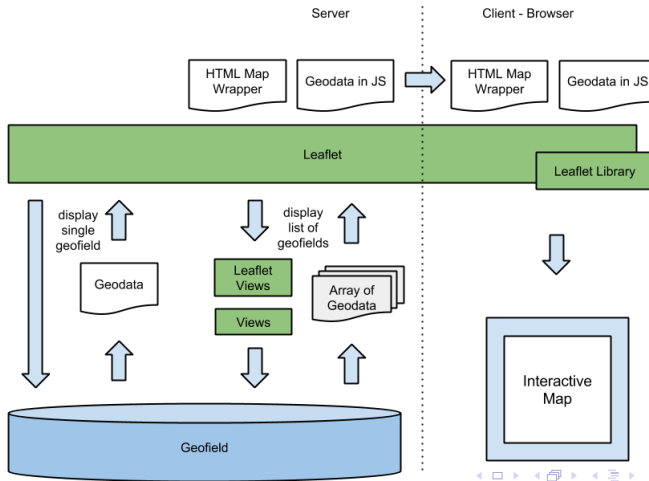# Client-Side Clustering Visualized (Redux)

Drupal Mapping query and display modules - Leaflet

Server-Side Clustering with Geocluster Visualized
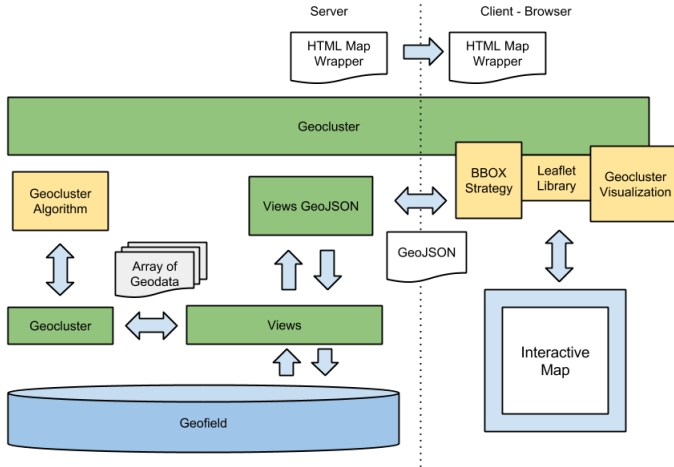
Key Architectural Feature

Geocluster Keys

- Clustering is performed at the query level by Geocluster
- PHP and JS only see the clusters as single (Views) rows.
- This feature alone is almost entirely responsible for the performance gain.

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But How?

- By geohashing!

Geocluster & Geohash

In a nutshell:

- Geocluster adds a hierarchical, spatial index to geofields based on the Geohash algorithm.
- Each geofield has columns for varying levels of precision (geohash index) created/updated on `entity_save`.
- A query for points/clusters specifies a geohash index and asks for clusters based on that index.

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- Geocluster adds a hierarchical, spatial index to geofields based on the Geohash algorithm.
- Each geofield has columns for varying levels of precision (geohash index) created/updated on `entity_save`.
- A query for points/clusters specifies a geohash index and asks for clusters based on that index.

Notice:

- The clustering information is created when the content is created.
- A request for points and clusters doesn't actually cluster. Rather it's a simple query of a spatial index.

How Do We Build with the Stack?

The starter kit lays the technical foundation for large-scale mapping. But ...

- Anything useful will need custom application and behavior logic to achieve a real goal.

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What you'll need:

- The starter kit
- A feature module for configuration.
- Custom PHP code in a module (application logic).
- Custom JS code (behavior logic).
- PHP and JS debuggers (PHPStorm gives you both in one)
- UI polish

Mass Geocoding

Working with public geocoding services and large datasets

- Typical limit is 2.5k points per day, i.e. Google
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- How do we geocode iteratively?

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- How do we geocode iteratively?

- With `drush geocode-backfill`

Near-point Clusters vs. Exact-point Clusters

Monolithic Clusters

- Leaflet doesn't discern between points that are near to one another versus multiple points at the same location.

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- `vista_map.module`, lines 115-155
  Views GeoJSON field rendering is altered

On-Demand Popups

AJAX!

- We don't load the popup info into the DOM at map-load time (performance tactic).

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- `vista_map.js`, lines 141-167, 324-404
  a View is executed with AJAX and themed statically

Current-user Zoom

Focus the Map on the Current-user's Location

- One of the purposes of the map was to emphasize making local connections.

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- `vista_map.module`, lines 290-351
  A Leaflet map pane's zoom and bounds is dynamically altered

Limit Geocoder Granularity

Geocode to Center of ZIP-code Only

- One of two data layers needed to geocode only to ZIP-code precision.

- Removing more-specific information and passing abbreviated info only to geocoder.

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Geocode to Center of ZIP-code Only

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- Removing more-specific information and passing abbreviated info only to geocoder.

- `vista_map.module`, lines 12-72
  Precision info was removed from geocoded data

Multiple Data Layers

Implement Data Layering and Panels Support

- OG membership drove layer membership, and source geofield.

- Views necessitated that different source geofields be separate data layers.

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- Views necessitated that different source geofields be separate data layers.

- Contributed the 2.x branch of Leaflet GeoJSON for panels support with multiple data layers

Scalability Requirement

How big did we need to go?

- Mapping user profiles, about 18k users were migrated

- Originally, it was expected that all users would be map

- Application scale, then is 10^4

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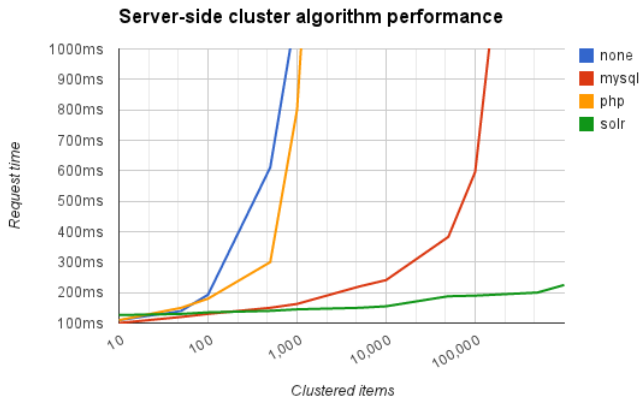
- Application scale, then is 10^4

Geocluster's clustering backend is pluggable

- PHP clustering (post-query clusternig)

- MySQL clustering (query-level clustering)

- Apache solr clustering (alternative query-level clustering)

Scalability Metrics

Cold caches

We implemented MySQL clustering

Possible Improvements

Geocluster

- Progressively enhance with client side clustering below a certain point threshold.

  https://www.drupal.org/node/1914704

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Leaflet GeoJSON

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- Make data feeds cacheable by quantizing bounding box parameters.
  `/$view_url?bbox=$left,$right,$top,$bottom?zoom=$zoom_level`

  - The `bbox` arguments are floating-point numbers that depend on viewport size and zoom. Takes a long time for caches to warm up for non-mobile viewports.

  - https://www.drupal.org/node/1868982

Take-out Knowledge

What we know

- Large-scale mapping is now possible in Drupal.

- Geocluster needs work.

- Leaflet GeoJSON needs work.

- Despite that, production-quality map applications can now be built.

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- Large-scale mapping is now possible in Drupal.

- Geocluster needs work.

- Leaflet GeoJSON needs work.

- Despite that, production-quality map applications can now be built.

- You will need a debugger.

What about Drupal 8?

A ways off...

- **Address Field:** no release (in development)
  https://www.drupal.org/node/2136263
- **Geocoder:** dev release
  https://www.drupal.org/node/2141353
- **Geofield:** alpha release
  https://www.drupal.org/node/2365135
- **Geocluster:** nothing planned
- **Views:** in core
- **Views GeoJSON**: sandbox only
  https://www.drupal.org/sandbox/kostajh/2478765
- **Leaflet GeoJSON:** nothing planned
- **Leaflet Library:** dev release
  https://www.drupal.org/node/2070343

What about Drupal 8?

The biggest obstacle: How do we add geohash columns to geofields in Drupal 8?

- Would it still be with `hook_field_schema_alter`
- Is there a better architecture than altering the schema using D8 to store geohash data for a location?
- Do you have any ideas?

References & Resources

Things we saw and more resources:

- Map starter kit:
  https://github.com/mpgeek/Geocluster-Demo

- Map application in production:
  http://www.vistacampus.gov/map

- Map application Drupal feature:
  https://github.com/mpgeek/Vista-Map

- Geohash Algorithm:
  http://en.wikipedia.org/wiki/Geohash

- Geocluster Master's Thesis (by @dasjo):
  http://dasjo.at/thesis

Questions?

Find me on twitter, IRC, or drupal.org: **@mpgeek**