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

Eric Paul (@mpgeek)

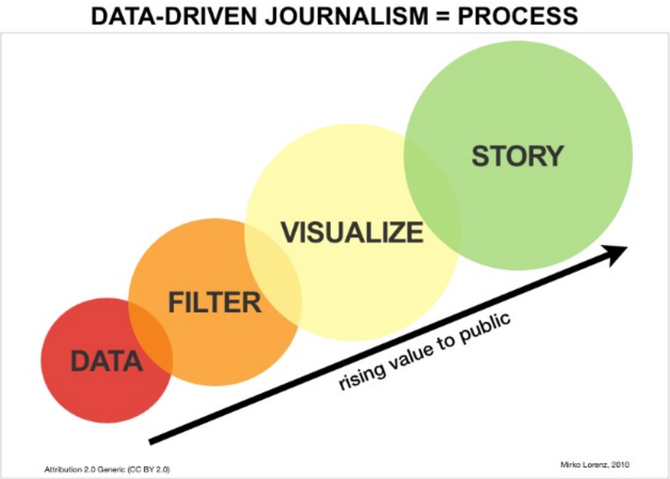
Phase2

Phase2 Technology

October 18, 2014

Table of contents

Mapping: What Is Going On Here?


DATA-DRIVEN JOURNALISM = PROCESS
DATA
FILTER
VISUALIZE
STORY
rising value to public
Attribution 2.0 Generic (CC BY 2.0)
Mirko Lorenz, 2010

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

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

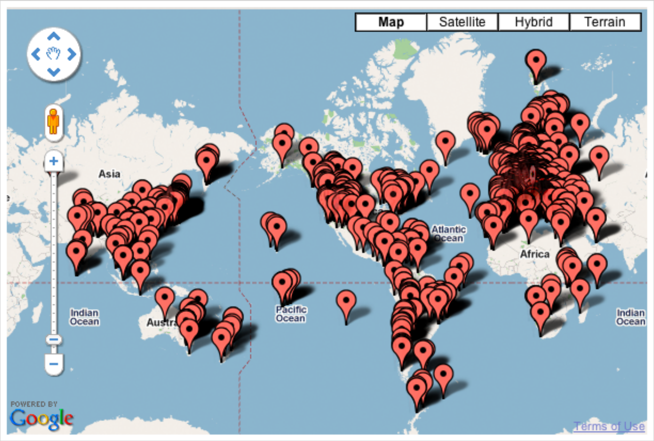
This allows content authors to present data in context in ways that would be difficult with words alone.

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

Mapping: Why is This Important?

The Problem: Dense-Point Data

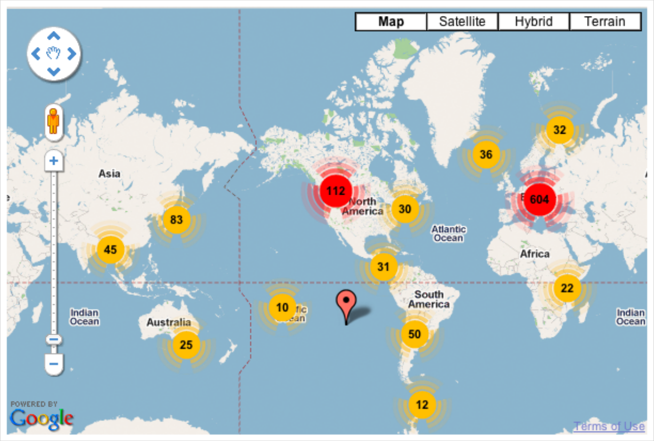
First pass: we have point crowding.



Really not usable.

One Solution: Client-Side Clustering

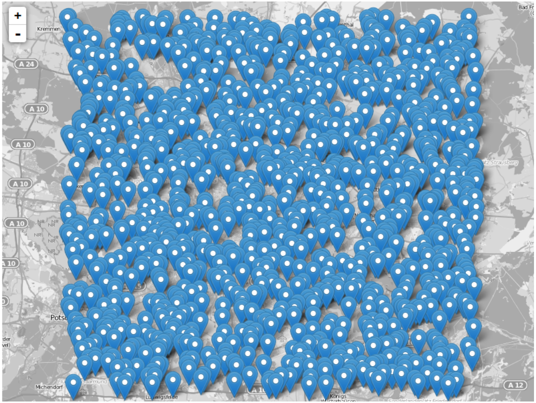
First step: lets cluster on the client side.



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.

Roadblock: Client-Side Clustering at Large Scale

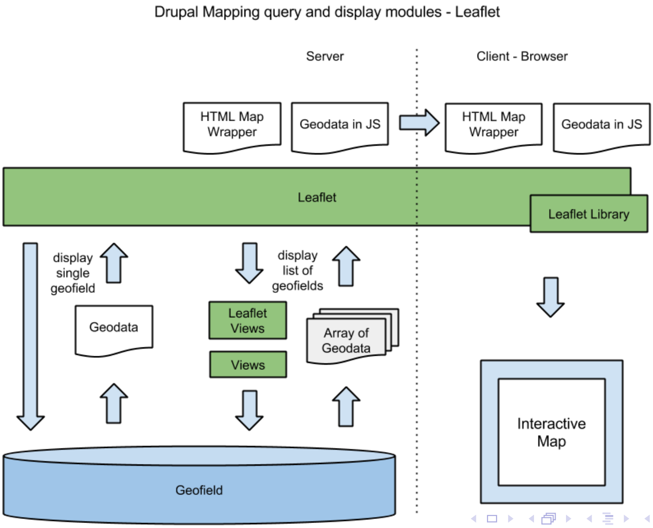
Why Does it Break?

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.

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

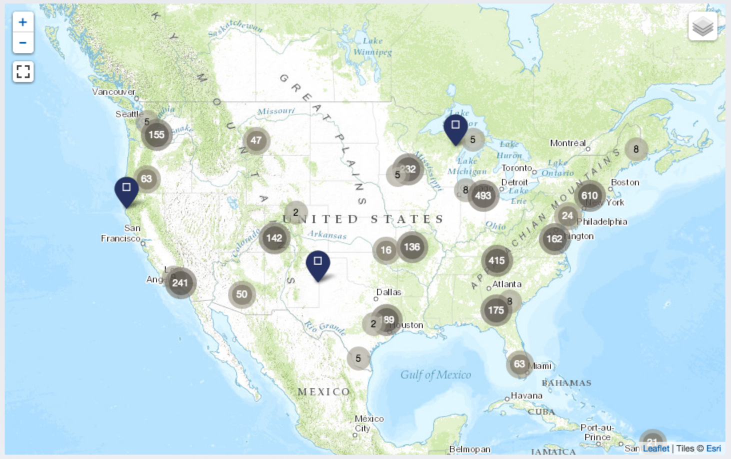
- The breaking point is about 300 data points (empirical).

Client-Side Clustering Visualized



Demo

http://vistacampus.gov/map



Demo: Things of Note

- Bounded mapping (bbox strategy)
- Load time under 1sec
- Clusters are single things, not collections of things
- On-demand, ajax-delivered infobubbles
- Dynamic reclustering on pan/zoom
- About 4K points
- Layer interference (boo!)

Starter Build

If you really want to build this...

1. Clone the starter build
2. Modify to suit

Starter Build

If you really want to build this...

1. Clone the starter build
2. Modify to suit

Starter Build:
http://cgit.drupalcode.org/geocluster/tree/modules/geocluster_demo

- Instructions: https://www.drupal.org/node/1962198

Starter Build

If you really want to build this...

1. Clone the starter build
2. Modify to suit

Starter Build:
http://cgit.drupalcode.org/geocluster/tree/modules/geocluster_demo

- Instructions: https://www.drupal.org/node/1962198

Why?

- The configuration is tedious and complex.
- Way too easy to break to start from scratch.

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)

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)

But... we need lots of patches.

A Working Model

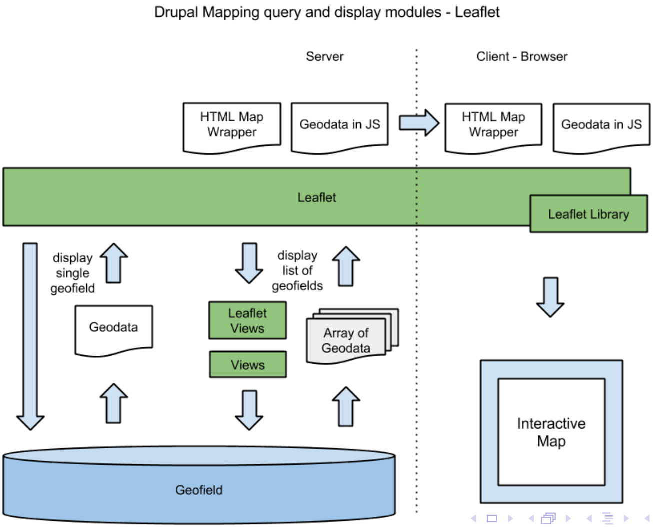
The client build has been released as GPL2.0

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

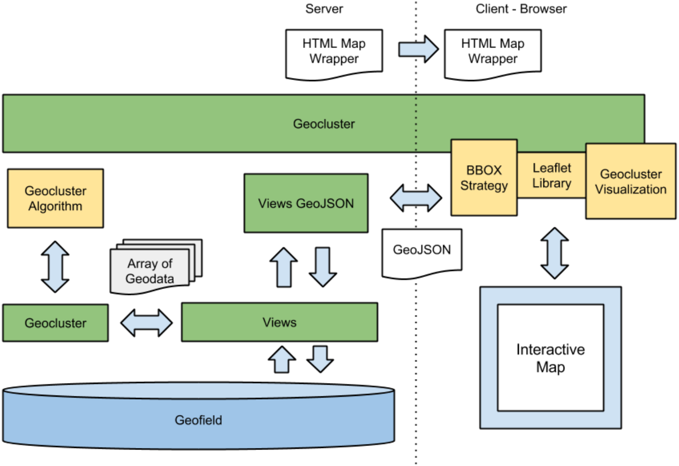
Patch mania! How about a makefile?

- https://github.com/mpgeek/VistaMap/blob/master/vista_map.make

Client-Side Clustering Visualized (Redux)



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.

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.

But How?

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.

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.

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.

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.

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.
- We needed to create two cluster types, on for each condition.

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.
- We needed to create two cluster types, on for each condition.
- `vista_map.module`, lines 115-155

On-Demand Popups

AJAX!

- We don't load the popup info into the DOM at map-load time (performance tactic).
- We needed to load them on demand and allow them to be cached.

On-Demand Popups

AJAX!

- We don't load the popup info into the DOM at map-load time (performance tactic).
- We needed to load them on demand and allow them to be cached.
- `vista_map.js`, lines 324-404

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.
- We wanted to zoom in on the currently logged-in user.

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.
- We wanted to zoom in on the currently logged-in user.
- `vista_map.module`, lines 290-351

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.

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.
- `vista_map.module`, lines 12-72

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.

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.
- Contiributed the 2.x branch of Leaflet GeoJSON for panels support with multiple data layers (https://www.drupal.org/node/2225815)

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

Scalability Requirement

How big did we need to go?

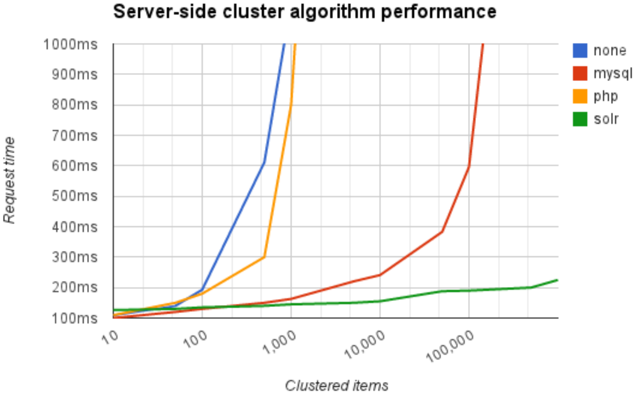
- Mapping user profiles, about 18k users were migrated
- Originally, it was expected that all users would be map
- Application scale, then is 10^4

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

Possible Improvements

Geocluster

- Progressively enhance with client side clustering below a certain point threshold. https://www.drupal.org/node/1914704

Possible Improvements

Leaflet GeoJSON

- Collapse clusters to a single layer to eliminate layer interference.

Possible Improvements

Leaflet GeoJSON

- Collapse clusters to a single layer to eliminate layer interference.
- 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.

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.
- You will need a debugger.

References & Resources

Things we saw and more resources:

- 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