PostGIS on Rails

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About me

- Programmer
- Love maps
- Building map based rental search engine @ Apartment List

Location Aware Apps

- Where am I?
- What is around me?

Where am I?

- Latitude and Longitude
  - HTML5 geolocation or GPS
- Address
  - Geocoding
  - Reverse geocoding

Where am I?

- What if you need to know ...
  - Neighborhood
  - School district
  - National park
  - Earthquake safety zone

What is around me?

- Yelp and Google Places API
- Restaurants, bars, etc.
- Points of interest

What is around me?

- What if you want to know ...
  - What are three neighborhoods closest to me?
  - Average rent for 1 bedroom in Lower Pacific Heights
  - Crime rate on my city block
  - Who is around me?

When 3rd party APIs fall short ...

- Get your own data set
- Build your own solution

Spatial Systems

- MongoDB
- Solr
- MySQL
- Oracle / DB2
- PostGIS

PostGIS

- Geospatial extension to Postgres
- New datatypes
- Functions to work with those datatypes
- Spatial indices using GiST

```
create extension postgis;
```

A Simple Example

A simple example

- Yosemite Park Ranger
- Tracking bears equipped with GPS transmitters
- Want to show all the bears on Google Maps

Bears (database migration)

```
create_table :bears do |t|
  t.column :lat, :float
  t.column :lon, :float
end

add_index :bears, :lat
add_index :bears, :lon
add_index :bears, [:lat, :lon]
```

Bears (model)

```
class Bear < ActiveRecord::Base

def self.bbox(sw_lon, sw_lat,
              ne_lon, ne_lat)
  self
    .where( :lon => sw_lon..ne_lon )
    .where( :lat => sw_lat..ne_lat )
end

end
```

A PostGIS example (migration)

```
create_table :bears do |t|
  t.column :coordinates,
    :geometry,
    :srid => 4326
end

add_index :bears,
  :coordinates,
  :spatial => true
```

A PostGIS example (model)

```
def self.box(sw_lon, sw_lat, ne_lon, ne_lat)

  factory = Rails.application.spatial_factory

  sw = factory.point(sw_lon, sw_lat)
  nw = factory.point(sw_lon, ne_lat)
  ne = factory.point(ne_lon, ne_lat)
  se = factory.point(ne_lon, sw_lat)

  ring = factory.linear_ring([sw, nw, ne, se])
  bbox = factory.polygon(ring)

  self
    .where('ST_Intersects(coordinates, :bbox)',
           :bbox => bbox)
end
```

A PostGIS example

```
1_000_000.times do
  Bear.create!( ...)
end
```

1,000,000 bears

- PostGIS is 1.5x to 50x faster

Active Record PostGIS Adapter

- Migration support
- Automatic conversion of PostGIS datatypes to Ruby (RGeo) objects and back

```
gem 'pg'
gem 'rgeo'
gem 'activerecord-postgis-adapter'
```

Rails Migrations

```
add_column :bears,
  :coordinates,
  :geometry, :srid => 4326

add_index :bears,
  :coordinates,
  :spatial => true
```

Postgres Table

```
=> \d bears
                  Table "public.bears"
   Column    |                Type
-------------+-----------------------------------
 id          | integer
 coordinates | geometry(Geometry,4326)
Indexes:
    "pins_pkey" PRIMARY KEY, btree (id)
    "index_pins_on_coordinates" gist (coordinates)
```

PostGIS Data

```
=> select id, coordinates from bears limit 4;
 id |                          coordinates
----+-------------------------------------------------------
  1 | 0101000020E61000002A8A632C341F664021805D8DDBEB4BC0
  2 | 0101000020E61000004DF900A54A5866C0A2BAB6AC827D50C0
  3 | 0101000020E6100000 2450EA628F5259C01C789C77C2883040
  4 | 0101000020E610000038760C7B85443C4013206005DC2C48C0
(4 rows)
```

RGeo

```
##> bear=Bear.first
 => #<Bear id: 1,  coordinates:
#<RGeo::Geos::CAPIPointImpl:0x3fd52ab501b4 "POINT
(176.9751188224921 -55.84263770165877)">>

##> bear.coordinates.x
 => 176.9751188224921

##> bear.coordinates.y
 => -55.84263770165877
```

More examples

```
# \d parks
          Column           |            Type
---------------------------+-----------------------------
 id                        | integer
 name                      | character varying(255)
 boundary                  | geometry(Geometry,4326)

Indexes:
    "parks_pkey" PRIMARY KEY, btree (id)
    "index_parks_on_name" btree (name)
    "index_parks_on_boundary" gist (polygon)

# select id, name, boundary from parks limit 2;
   id   |     name      |       boundary
--------+---------------+--------------------------
      1 | Yosemite      |0103000020E6100000010000...
      2 | Yellowstone   |0103000020E6100000010000...
```

How many bears are in Yosemite now?

```
##> park = Park.find_by_name('Yosemite')

##> bears = Bear.where('ST_Intersects(coordinates, :bounds)',
                :bounds => park.boundary)

##> bear_count = bears.count
```

How Many Bears in Yosemite and Yellowstone (Ruby)?

```
##> yosemite = Park.find_by_name('Yosemite')

##> yellowstone = Park.find_by_name('Yellowstone')

##> bounds = yosemite.boundary + yellowstone.boundary

##> bears = Bear.where('ST_Intersects(coordinates, :bounds)',
                :bounds => bounds)

##> bear_count = bears.count
```

How Many Bears in Yosemite and Yellowstone (SQL)?

```
select count(*) from bears
  inner join parks
    on ST_Intersects(bears.coordinates,
                     parks.boundary)
 where parks.name in ('Yosemite',
                      'Yellowstone');
```

Three parks closest to me?

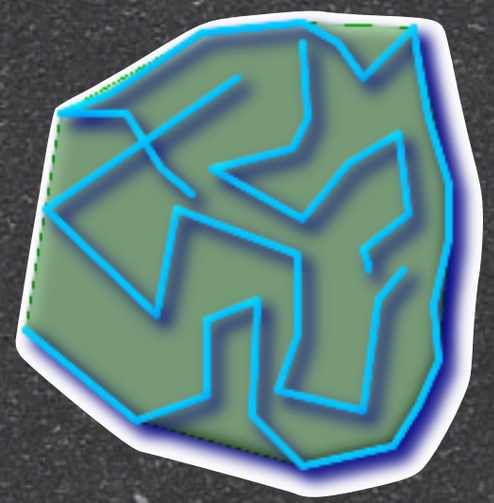
- Distance operator (KNN) is a feature of Postgres 9.1 and above

```
select id, name,
     boundary <-> ST_Point(37.775, -122.44) as distance
from parks
order by distance
limit 3;
```

What else is possible?

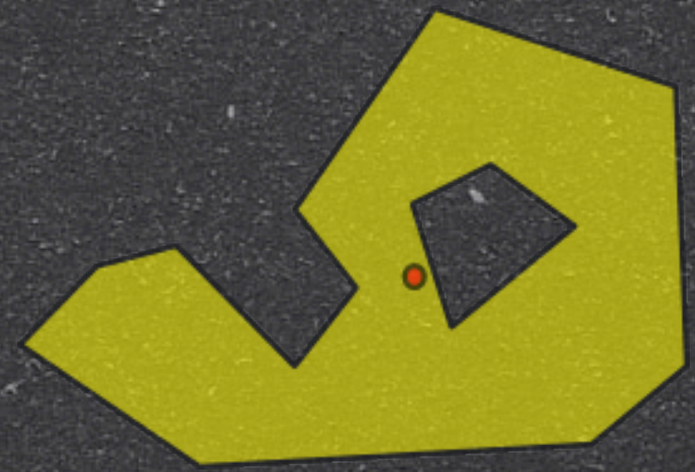
Geometry Simplification

- ST_Simplify
- ST_ConvexHull
- ST_ConcaveHull



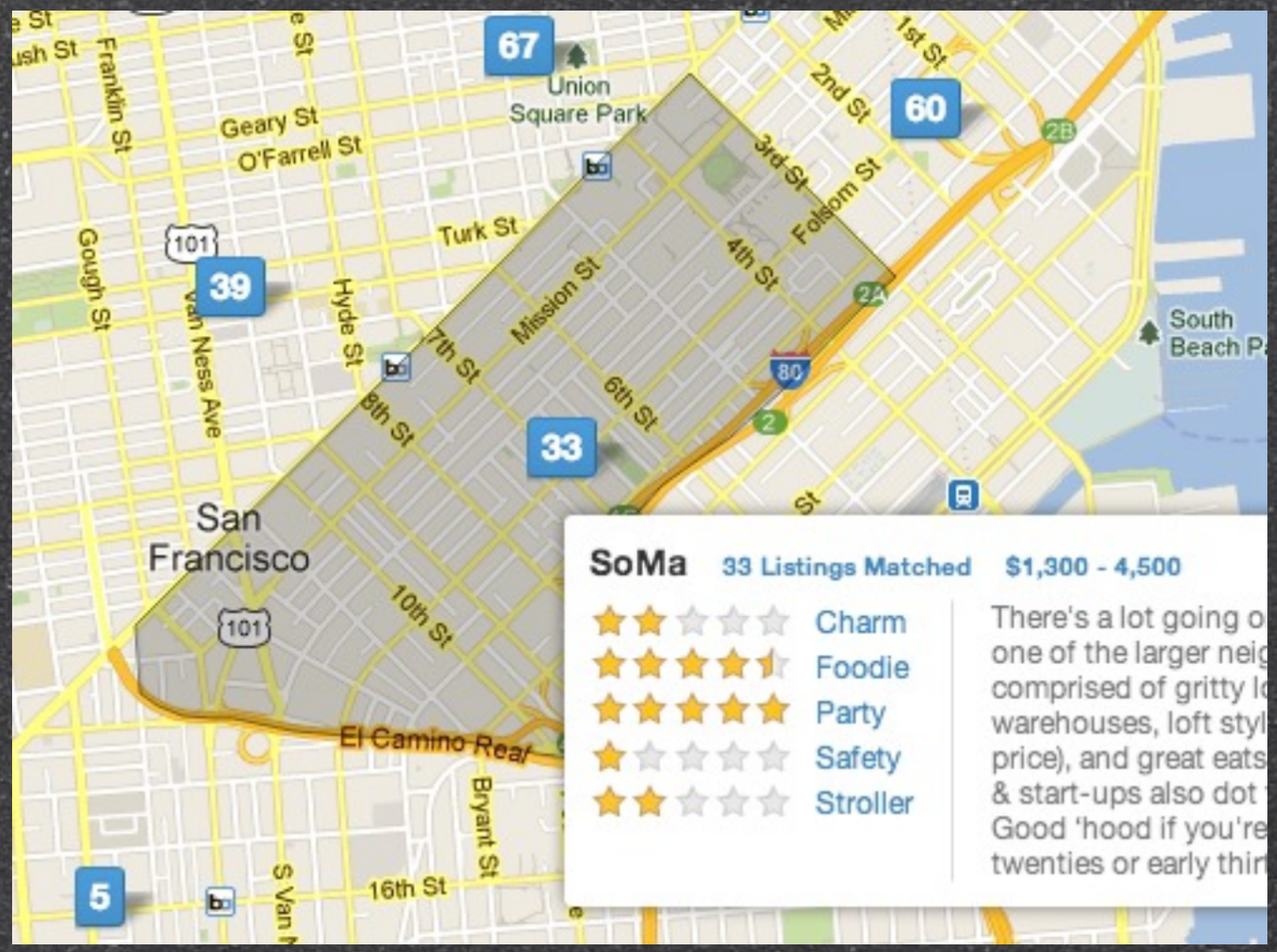
Spatial Relationships

- ST_Centroid
- ST_Contained
- ST_Area
- ST_Perimeter
- ST_DWithin



Format Conversions

- ST_AsGeoJSON
- ST_AsText



Do Try It at Home

- Heroku Postgres
  - https://devcenter.heroku.com/articles/heroku-postgres-extensions-postgis-full-text-search
- Postgres.app
  - http://postgresapp.com/
- select postgis_full_version();

Data Sources (free)

- US Census Data (Tiger)
  - http://www.census.gov/geo/maps-data/data/tiger.html
- Zillow Neighborhoods
  - http://www.zillow.com/howto/api/neighborhood-boundaries.htm

Data Sources (commercial)

- Maponics
  - http://www.maponics.com/
- Urban Mapping
  - http://www.urbanmapping.com/
- Onboard Informatics
  - http://www.onboardinformatics.com/

Links

- PostGIS
  - http://postgis.net/
- Active Record PostGIS Adapter
  - https://github.com/dazuma/activerecord-postgis-adapter
- RGeo
  - https://github.com/dazuma/rgeo

Q & A

We are hiring @apartmentlist!