# geodjango

## Rapid Geographic Web Application with GeoDjango

May 14, 2008

Where 2.0

1 Django Intro

2 Installation

3 Third-Party Libraries

4 Inspection & Import

5 Exploration

6 Admin

7 Mapping

8 Conclusion

# Django Intro

# geodjango

ubuntu

# (Crazily brief) Introduction

“Django is a high-level Python web framework that encourages rapid development and clean, pragmatic design.”

# More...

http://toys.jacobian.org/presentations/2008/pycon/tutorial/

http://www.djangoproject.com/documentation/design_philosophies/

http://www.djangobook.com/en/1.0/chapter01/

```
$ django-admin.py startproject where2
```

```
where2/
    __init__.py
    manage.py
    settings.py
    urls.py
```

```
from django.db import models
class County(models.Model):
    name = models.CharField(...)

>>> County(name='x').save()
>>> County(name='y').save()
>>> County.objects.count()
2
>>> c = County.objects.get(name='y')
```

```
CREATE TABLE "app_county" (
    "id" integer NOT NULL PRIMARY KEY,
    "name" varchar(50) NOT NULL
);
```

```
from django.contrib.gis.db \
    import models
from django.contrib.gis.geos \
    import Point
class County(models.Model):
    name = models.CharField(...)
    center = models.PointField(srid=4269)
    objects = models.GeoManager()
```

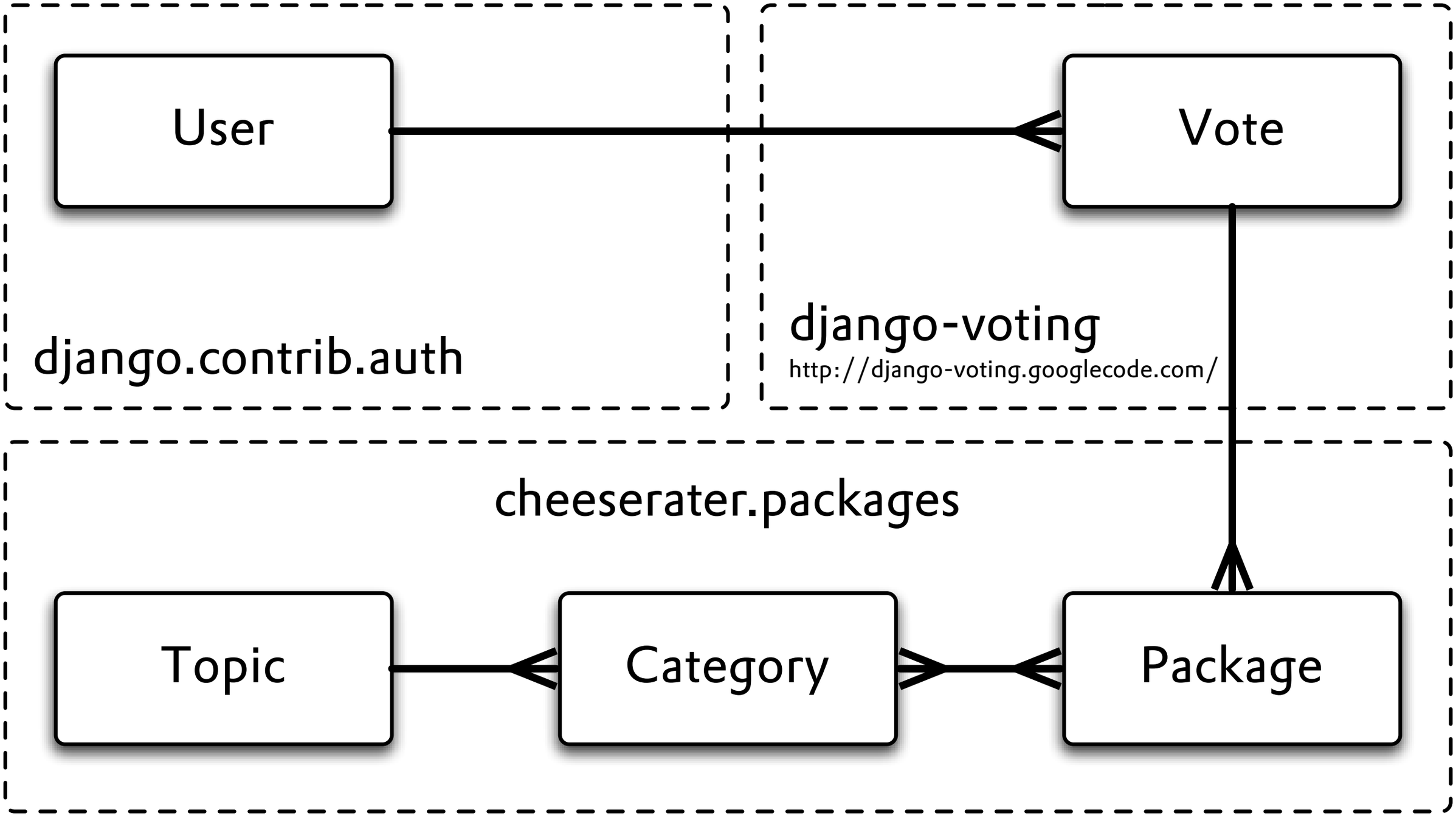
```
>>> p1 = 'POINT (0 1)'
>>> p2 = Point(10, 20)
>>> County(name='x', center=p1).save()
>>> County(name='y', center=p2).save()
>>> County.objects.count()
2
>>> y = County.objects.get(center=p2)
```

```
CREATE TABLE "app_county" (
  "id" integer NOT NULL PRIMARY KEY,
  "name" varchar(50) NOT NULL,
   );
 SELECT AddGeometryColumn('app_county',
                                  'center', 4269,
'POINT', 2
     );
```

```
$ ./manage.py syncdb
Creating table auth_message
Creating table auth_group
…
Creating table app_county
…

$./manage.py runserver 0:8000
Validating models...
0 errors found.

Django version 0.97-pre-SVN-7400, using settings 'settings'
Development server is running at http://0:8000/
Quit the server with CONTROL-C.
```

# "Apps"

http://www.b-list.org/weblog/2008/mar/15/slides/


User
Vote
django.contrib.auth
django-voting
http://django-voting.googlecode.com/
cheeserater.packages
Topic
Category
Package

# “Views”

**The guts.**

# Dissecting a request

- ➜ `GET /some_url/`
- ➜ `settings.ROOT_URLCONF = ‘urls’`
- ➜ `urls`
- ➜ `(r'^some_url/', include('app.urls'))`
- ➜ `app.urls`
- ➜ `('^$', county_list)`
- ➜ `county_list(request)`

```
from django.conf.urls.defaults import *
from app.views import *

urlpatterns = patterns('',
    ('^app/$', county_list),
)
```

```
from django.shortcuts import render_to_response
from models import County

def county_list(request):
    cs = County.objects.order_by('name')
    return render_to_response('county_list.html',

{'counties':cs})
```

# Templates

## Skinning

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01//EN">
<html lang="en">
<head><title>Counties</title></head>
<body>
  <ul>
    {% for c in counties %}
      <li>{{ c.name }}</li>
    {% endfor %}
  </ul>
</body>
</html>
```

# The magic dot

- p["name"]
- p.name
- p.name()

# More...

http://www.djangoproject.com/documentation/

http://www.djangoproject.com/documentation/

http://www.djangoproject.com/documentation/

No, really.

http://www.djangoproject.com/documentation/

# Installation

# Installation: it builds character

- Relying on relatively new versions of the most libraries.
- But ctypes saves us (sort-of).
- We plan to fix this at some point.
  - For now, hurrah for virtualization!

# Third-Party Libraries

# Third-Party Libraries

- GEOS
- GDAL
- GeoIP (BSD-licensed)

# Third-Party Libraries

- Why?
  - Powerful open source libraries; temperamental SWIG interfaces
  - `ctypes` enables all-Python interfaces (no compilation necessary)
  - Use of C APIs allows for high degree of cross-platform compatibility

# GEOS

## Geometry Engine Open Source

```
>>> from django.contrib.gis.geos import *
>>> pnt = Point(5, 23)
>>> ring = LinearRing((0, 0), (0, 50), (50, 50), (50, 0),
  (0, 0))
>>> poly = Polygon(ring)
>>> print poly.contains(pnt)
True
>>> print poly
POLYGON ((0.0000000000000000 0.0000000000000000,
  0.0000000000000000 50.0000000000000000,
  50.0000000000000000 50.0000000000000000,
  50.0000000000000000 0.0000000000000000, 0.0000000000000000
  0.0000000000000000))
>>> print poly.kml
<Polygon><outerBoundaryIs><LinearRing><coordinates>0.0,0.0,0
  0.0,50.0,0 50.0,50.0,0 50.0,0.0,0 0.0,0.0,0</
  coordinates></LinearRing></outerBoundaryIs></Polygon>
```

# GDAL
## Geospatial Data Abstraction Library

```
>>> from django.contrib.gis.gdal import *
>>> s1 = SpatialReference(4326)
>>> s2 = SpatialReference('NAD83')
>>> s3 = SpatialReference('+proj=lcc +lat_1=27.5 +lat_2=35
  +lat_0=18 +lon_0=-100 +x_0=1500000 +y_0=5000000 +ellps=GRS80
  +units=m +no_defs')
>>> geom = OGRGeometry('POINT(5 23)', s1)
>>> geom.transform(900913)
>>> print geom
POINT (556597.453966367174871 2632018.637504272162914)
```

# GeoIP

```
>>> from django.contrib.gis.utils import GeoIP
>>> g = GeoIP()
>>> print g.country('refractions.net')
{'country_name': 'Canada', 'country_code': 'CA'}
>>> print g.city('refractions.net')
{'city': 'Vancouver', 'region': 'BC', 'area_code': 0,
  'longitude': -123.13330078125, 'country_code3': 'CAN',
  'latitude': 49.25, 'postal_code': 'v6c2b5', 'dma_code': 0,
  'country_code': 'CA', 'country_name': 'Canada'}
>>> print g.geos(‘refractions.net’)
POINT (-123.133007812500000 49.250000000000000)
```

* This is not enabled on the VM.

# Inspection & Import

# Gameplan

- Delete all states (so we have room to play)
- Inspect shapefile
  - ogrinfo - human-readable
  - ogrinspect - model creation
- Define model
- Load with LayerMapping

# Delete states

```
>>> from census.models import State
>>> State.objects.all().delete()
```

# Inspect Shapefile

```
>>> from django.contrib.gis.utils \
...     import ogrinfo, ogrinspect
>>> ogrinfo(df('st'), num_features=2)
...
>>> print ogrinspect(df('st'), \
...     'State', srid=4269)
...
```

# Define Model

```
class State(models.Model):
    #STATE
    fips = models.CharField(max_length=2)
    #NAME
    name = models.CharField(max_length=20)
    #MULTIPOLYGON
    mpoly = models.MultiPolygonField(srid=4269)
    objects = models.GeoManager()
```

# Define

```
>>> mapping = {
...     'fips': 'STATE',
...     'name': 'NAME',
...     'mpoly': 'MULTIPOLYGON'
... }
```

```
>>> lm = LayerMapping(State, \
...     df('st'), mapping, \
...     unique=('name', 'fips'),\
...     encoding='cp437', \
...     transform=False)
>>> lm.save(verbose=True)
```

# (Bonus if time)

Your turn:
Load Counties!
Ask questions.

# Exploration

# Spatial Queries

```
Neighborhood.objects.filter(poly__intersects=zipcode.mpoly) |
    Neighborhood.objects.filter(poly__within=county.mpoly)
```

vs.

```
SELECT "houston_neighborhood"."id",
"houston_neighborhood"."name", "houston_neighborhood"."poly"
FROM "houston_neighborhood" WHERE
(ST_Intersects("houston_neighborhood"."poly",
ST_Transform(ST_GeomFromWKB('\\001\\006\\000\ ... ', 4269),
    32140)) OR ST_Within("houston_neighborhood"."poly",
ST_GeomFromWKB('\\001\\006\\000 ... ', 32140))
```

# Spatial Queries

- Available PostGIS lookup types:
  - `overlaps, bboverlaps`
  - `overlaps_left, overlaps_right`
  - `overlaps_below, overlaps_above`
  - `strictly_below, strictly_above`
  - `left, right`
  - `same_as/exact`
  - `contained, bbcontains`
  - `equals, disjoint, touches, crosses, within, intersects, relate`

# Distance Queries

- Projected/Geodetic coordinate system a source of confusion for beginners.
  - Inherent PostGIS limitation,
- Distance Lookups:
  - `distance_lte`, `distance_lt`
  - `distance_gte`, `distance_gt`

# Distance Queries

```
# Distances will be calculated from this point,
# which does _not_ have to be projected.
>>> pnt = fromstr('POINT(-96.876369 29.905320)', srid=4326)

# If numeric parameter, units of field (meters in this case)
# are assumed.
>>> qs = SouthTexasCity.objects.filter(
                    point__distance_lte=(pnt, 7000))
```

```
# Find all Cities w/in 7km of pnt
>>> qs =SouthTexasCity.objects.filter(
                    point__distance_lte=(pnt, D(km=7)))

# Find all Cities > 20 miles away from pnt.
>>> qs = SouthTexasCity.objects.filter(
                    point__distance_gte=(pnt, D(mi=20)))

# More obscure units, such as chains, are supported.
>>> qs = SouthTexasCity.objects.filter(
                    point__distance_gte=(pnt, D(chain=100)))
```

# Distance Queries

- `Distance` object eases conversion between units of measure.

```
>>> from django.contrib.gis.measure import Distance
>>> dist = Distance(ft=5280)
>>> print dist.mi
1.0
```

- Projected/Geodetic coordinate system a source of confusion for beginners.

# Automatic Transformation

- If a geometry with a different SRID is used, it will be automatically transformed -- one less thing to worry about.

```
>>> pnt = Point(-95.4067, 29.7183, srid=4326)
>>> qs = Neighborhood.objects.filter(mpoly__intersects=pnt)
>>> print qs.query.as_sql()
SELECT "texas_neighborhood"."id",
"texas_neighborhood"."name", "texas_neighborhood"."state",
"texas_neighborhood"."city", "texas_neighborhood"."county",
"texas_neighborhood"."region", "texas_neighborhood"."mpoly"
FROM "texas_neighborhood" WHERE
ST_Intersects("texas_neighborhood"."mpoly", ST_Transform(%s,
3084))
```

# GeoQuerySet Methods

- gml
  - `County.objects.all().gml`
  - `Neighborhood.objects.all().gml()[0].gml`
  - `<gml:MultiPolygon srsName="EPSG:3084">...</gml:MultiPolygon>`

# GeoQuerySet Methods

- kml
  - `Neighborhood.objects.all().kml()[0].kml`
    - `<MultiGeometry><Polygon><outerBoundaryIs>...</MultiGeometry>`

# GeoQuerySet Methods

- distance
  - `p=Neighborhood.objects.all()[2].mpoly.centroid`
  - `Neighborhood.objects.all().distance(p)[0].distance`

# Admin

# "Old" Admin

How you currently create an admin interface in trunk:

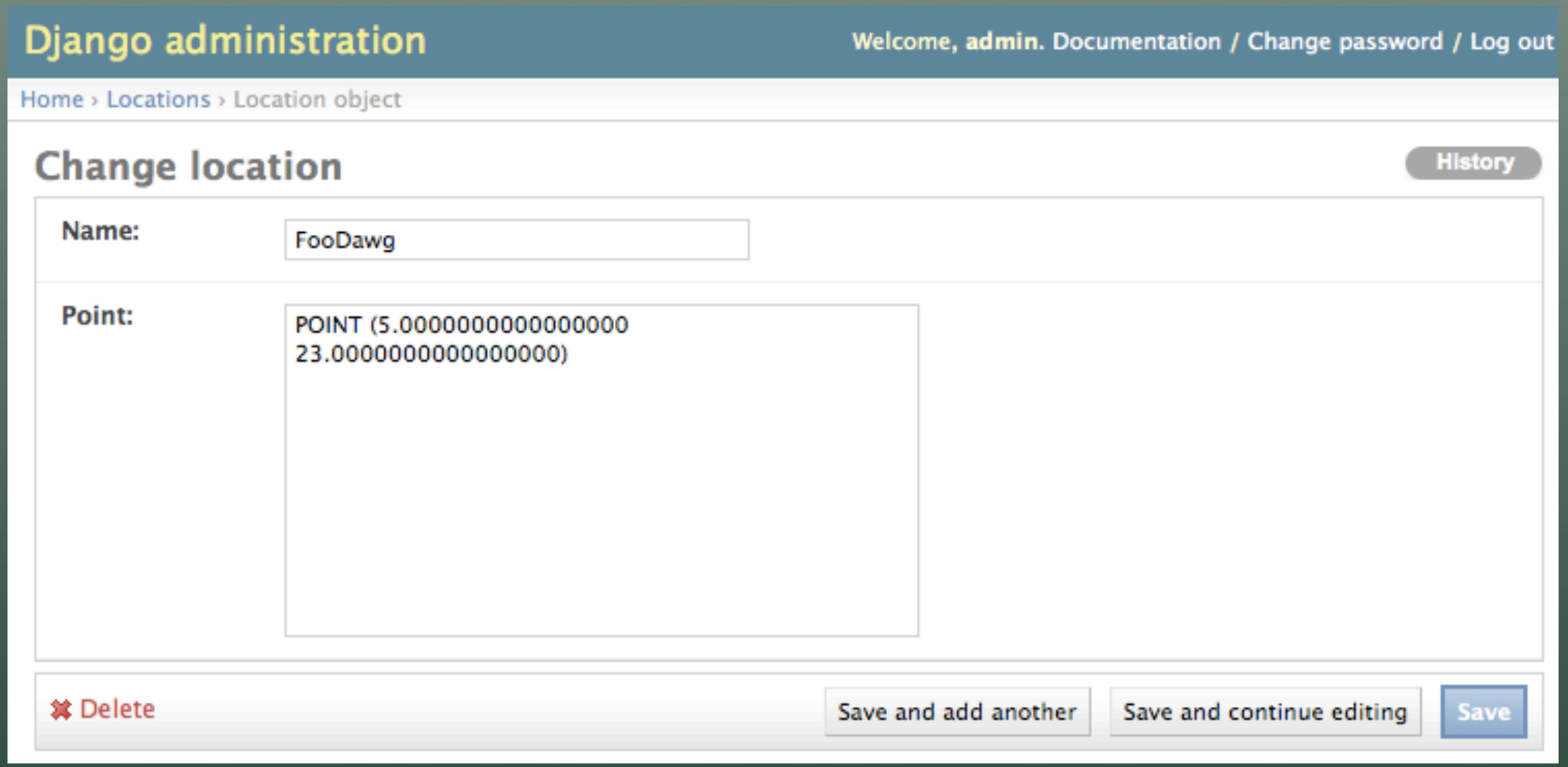
```
from django.contrib.gis.db import models

class Location(models.Model):
    name = models.CharField(max_length=30)
    point = models.PointField()

    class Admin:
        list_display = ['name']
        search_fields = ['name']
```

# "Old" Admin

Old style admin URLs:

```
urlpatterns = patterns('',
    (r'^admin/', include('django.contrib.admin.urls')),
)
```

# "Old" Admin


Django administration
Welcome, admin. Documentation / Change password / Log out
Home › Locations › Location object
Change location
History
Name:
FooDawg
Point:
POINT (5.0000000000000000
23.0000000000000000)
Delete
Save and add another
Save and continue editing
Save

# newforms-admin

- The newforms-admin branch decouples Admin settings from your models.
  - More flexibility and customization
- Other goal is to convert the Admin to use Django's "newforms."

# gis-newforms

- Django has branch policy prohibiting merges between SVN branches.
- I couldn't wait for new functionality -- so I created mercurial merge between two branches.

# gis-newforms

How to create new admin interface:

```
from django.contrib.gis import admin
from django.contrib.gis.db import models

class Location(models.Model):
    name = models.CharField(max_length=30)
    point = models.PointField()

class LocationAdmin(admin.GeoModelAdmin):
    list_display = ['name']
    search_fields = ['name']
```

# gis-newforms

How to create new admin interface (in `urls.py`):

```
from django.contrib.gis import admin
from geoapp.models import Location
from geoapp.admin import LocationAdmin

admin.site.regster(Location, LocationAdmin)

urlpatterns = patterns('',
    (r'^admin/(.*)', admin.site.root),
)
```

# gis-newforms

Included in your VM as the default distribution.

May change to GIS SVN trunk via:

```
$ sudo chdjango.py gis
```

**To change back:**

```
$ sudo chdjango.py gis-newforms
```

# 7 Mapping

# Mapping

- We will leave the presentation to explore a mini app (included on your VM) that shows TABC (Texas Alcoholic Beverage Commission) license permits in a particular Houston neighborhood
- Neighborhood data provided by Zillow ®.

# Conclusion