GeoServer CSS:
Mapping in Style

FOSS4G 2010

Barcelona, Spain

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www.opengeo.org

Hi Everybody!

- David Winslow

  Developer, OpenGeo
- Technical Lead, GeoNode
- Contributor to GeoServer
- User of GeoExt, OpenLayers, GeoNetwork, PostGIS, ...
- `dwins` on github, freenode, etc.

Overview

- SLD is for robots
- CSS is for *people*
- Use CSS!

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Styling Basics

- What?
- How?

Styled Layer Descriptors:
XML – General Purpose

Styled Layer Descriptors:
XML - Validating

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Styled Layer Descriptors:
XML – Hierarchies

Styled Layer Descriptor: Feature Set

Styling attributes

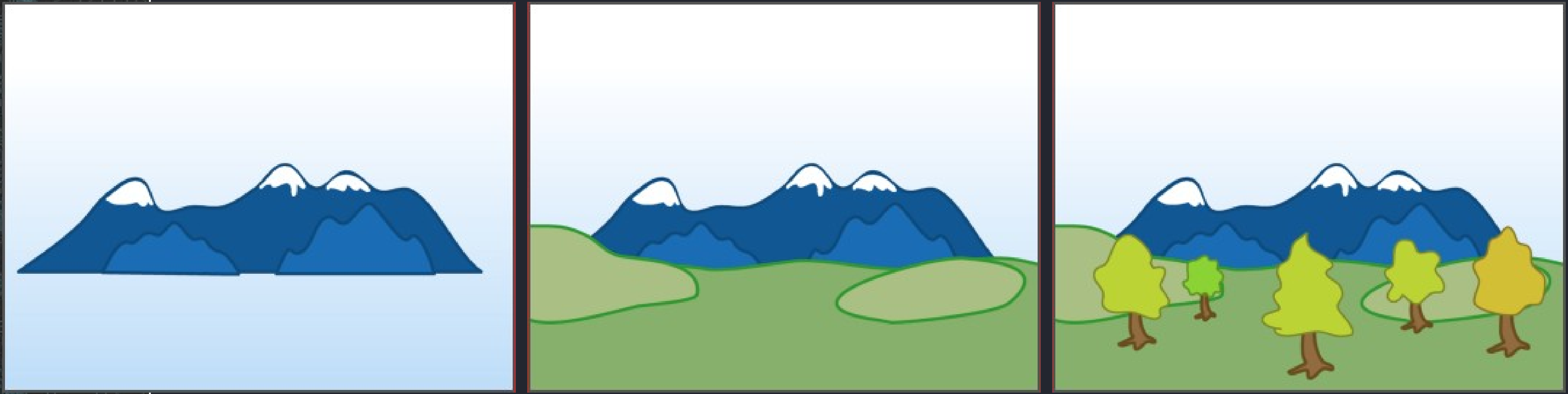
Type constraints

Layer ordering

Inlined data?

Styled Layer Descriptor: Painter's Model

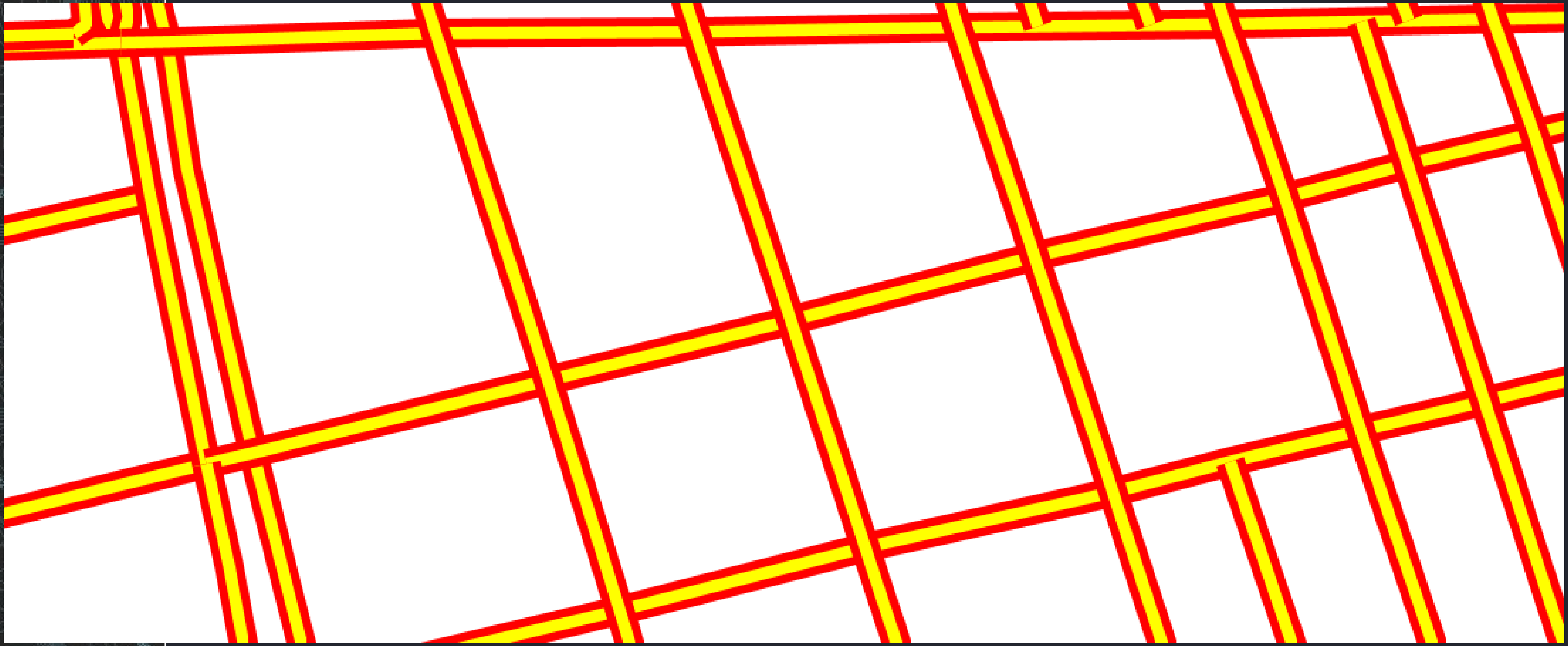
- Render each rule entirely
- Last rule wins



Road with Outline

Rule: features like X
- LineSymbolizer
  - Stroke – red, thick
- LineSymbolizer
  - Stroke – yellow, thin

Styled Layer Descriptor – Painter's Model



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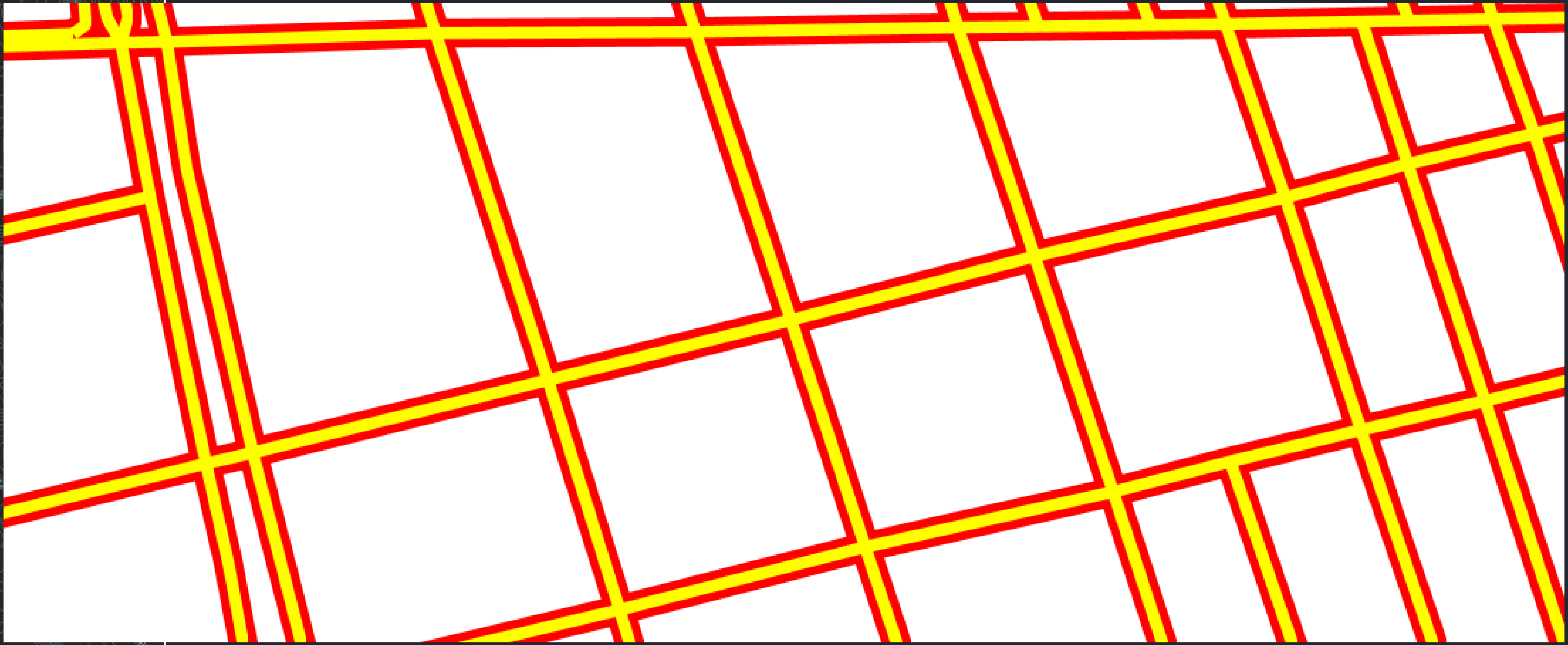
- FeatureTypeStyle
  - Rule: **features like X**
    - LineSymbolizer
      - Stroke – red, thick
- FeatureTypeStyle
  - Rule: **features like X**
    - LineSymbolizer
      - Stroke – yellow, thin

Styled Layer Descriptor – Painter's Model



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Cascading Style Sheets: Specialized syntax

- Filter/Property pairs
- No boilerplate

```
* {
  stroke: black;
}
```

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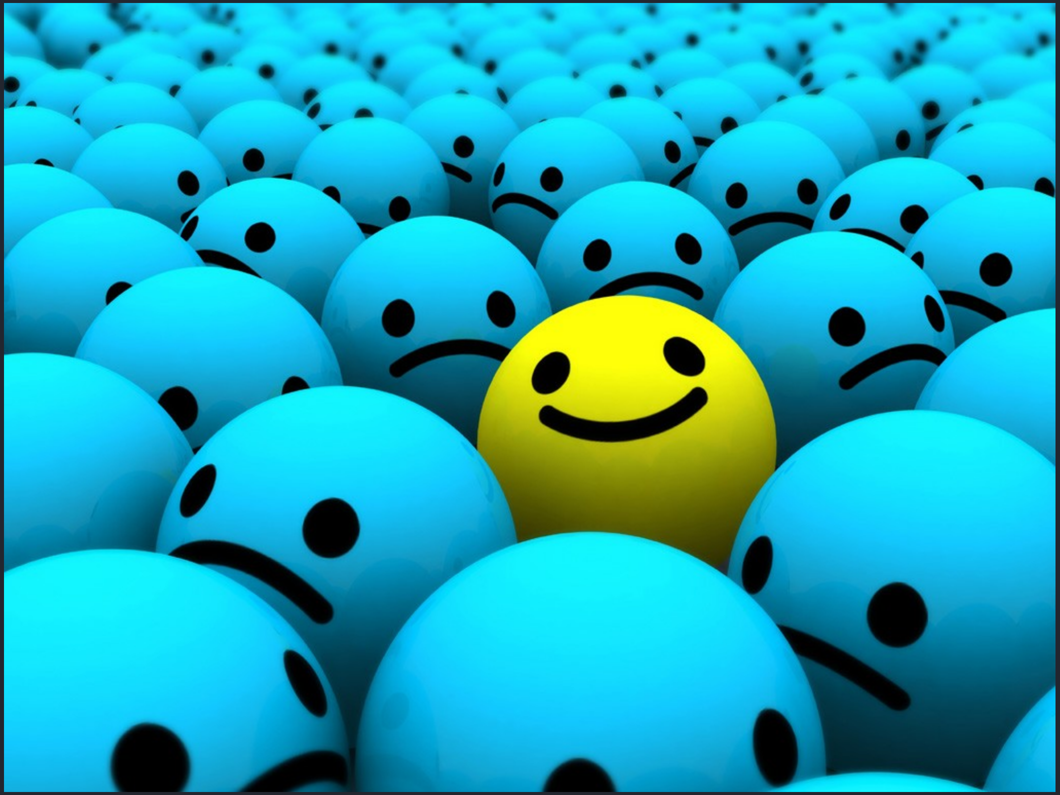
Cascading Style Sheets: Feature Set

Cascading Style Sheets: Cascading Model

- Combine *properties*
- Most *specific* rule wins



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Cascading Style Sheets: Existing user base

- Every web developer
- Cascadenik, Cartagen, Halcyon...

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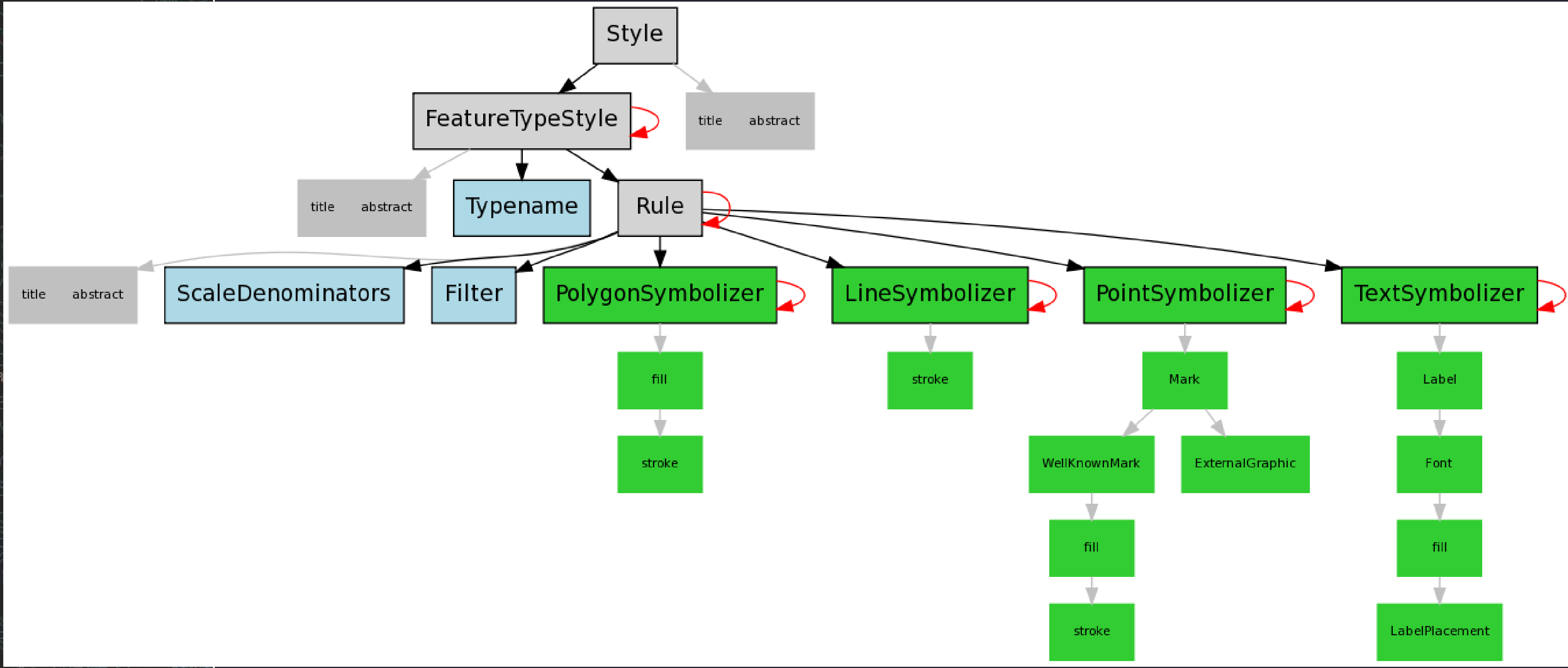
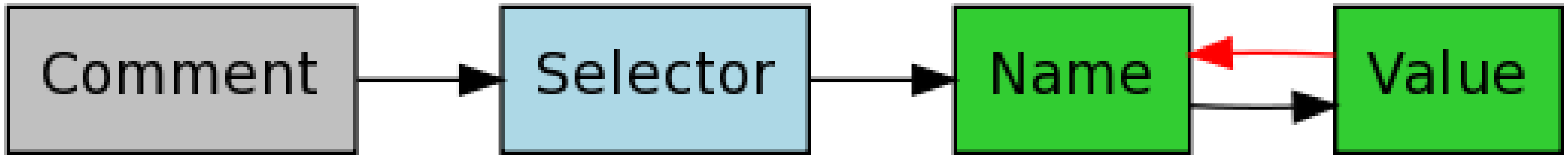
Recap

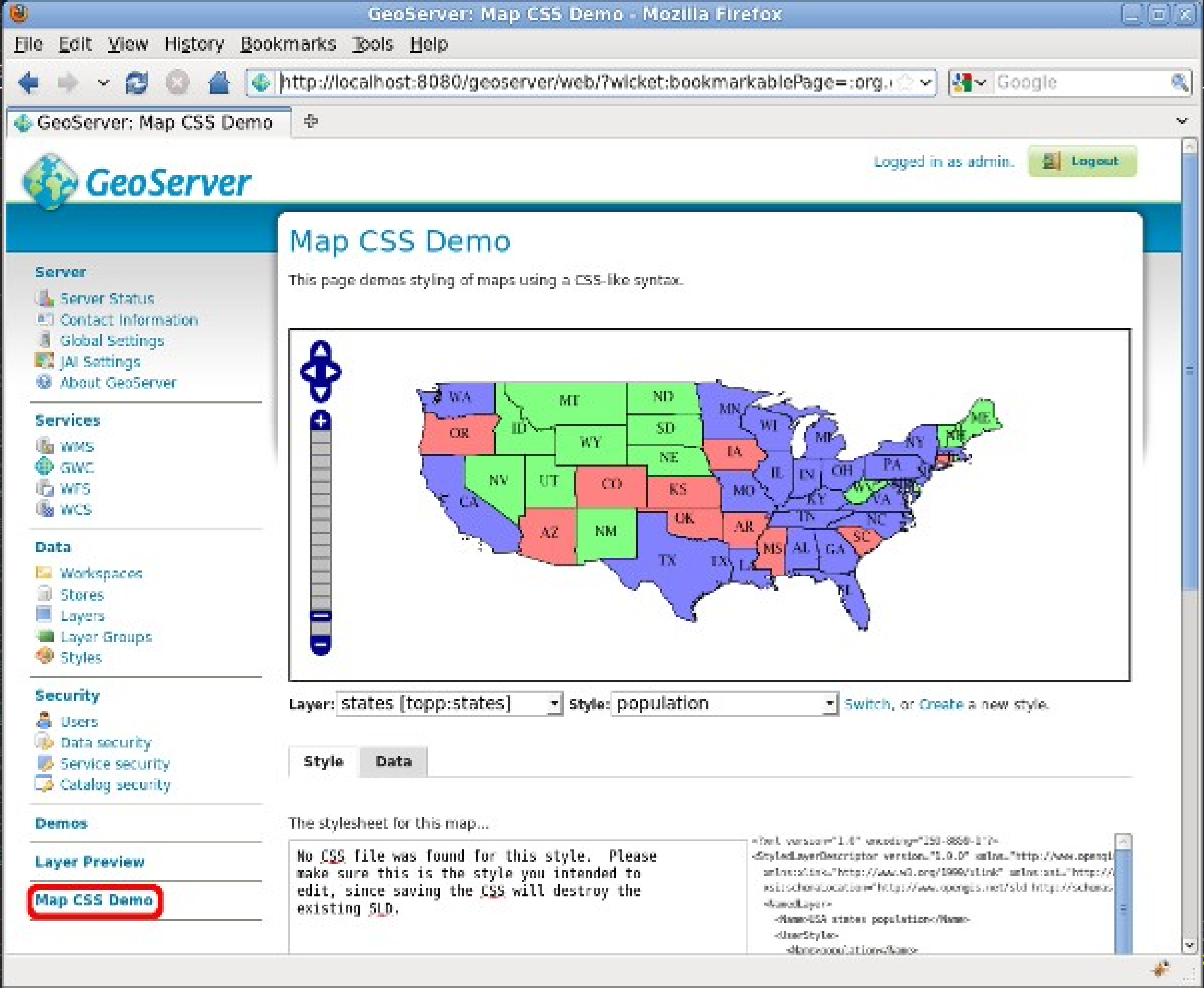
SLD	CSS
XML	Custom-tailored
Part of WMS	Styling only
Painter's Model	Cascading inheritance
Resolves Rules	Resolves properties
OGC Services	In wide, general use


Style
FeatureTypeStyle
title
abstract
title
abstract
Typename
Rule
title
abstract
ScaleDenominators
Filter
PolygonSymbolizer
LineSymbolizer
PointSymbolizer
TextSymbolizer
fill
stroke
stroke
Mark
WellKnownMark
ExternalGraphic
fill
stroke
Label
Font
fill
LabelPlacement


Comment
Selector
Name
Value

How do you use it? Translator

- reuse existing infrastructure
- avoid deploying experimental software in production
- easier comparison of functionality



Map CSS Demo

This page demos styling of maps using a CSS-like syntax.

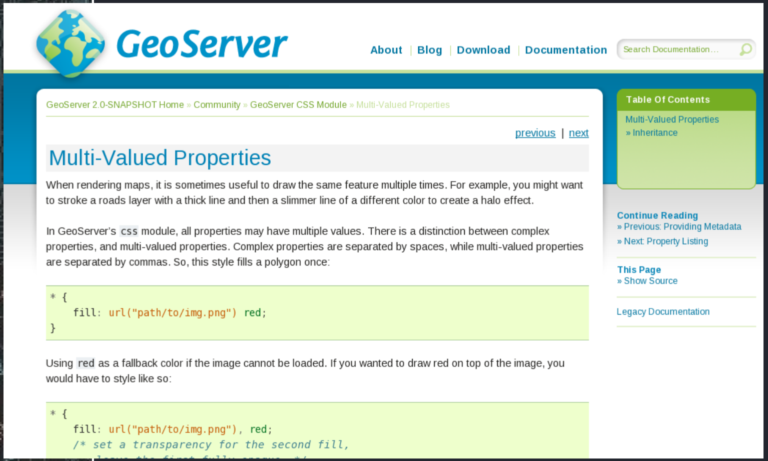
Layer: states [topp:states] **Style:** population Switch, or Create a new style.

The stylesheet for this map...

```
No CSS file was found for this style.  Please
make sure this is the style you intended to
edit, since saving the CSS will destroy the
existing SLD.
```

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<StyledLayerDescriptor version="1.0.0" xmlns="http://www.opengi
  xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xsi="http://
  xsi:schemaLocation="http://www.opengis.net/sld http://schemas
  <NamedLayer>
    <Name>USA states population</Name>
    <UserStyle>
      <Name>population</Name>
```

Documentation



GeoServer

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Multi-Valued Properties

When rendering maps, it is sometimes useful to draw the same feature multiple times. For example, you might want to stroke a roads layer with a thick line and then a slimmer line of a different color to create a halo effect.

In GeoServer's `css` module, all properties may have multiple values. There is a distinction between complex properties, and multi-valued properties. Complex properties are separated by spaces, while multi-valued properties are separated by commas. So, this style fills a polygon once:

```
* {
    fill: url("path/to/img.png") red;
}
```

Using `red` as a fallback color if the image cannot be loaded. If you wanted to draw red on top of the image, you would have to style like so:

```
* {
    fill: url("path/to/img.png"), red;
    /* set a transparency for the second fill,
```

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Multi-Valued Properties
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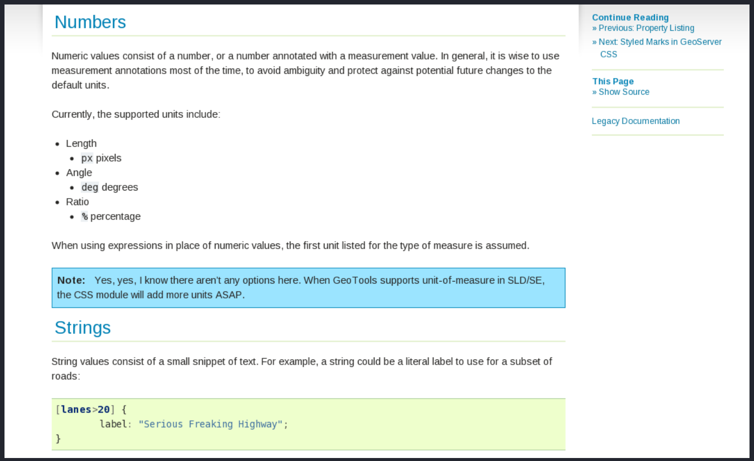
Legacy Documentation



Numbers

Numeric values consist of a number, or a number annotated with a measurement value. In general, it is wise to use measurement annotations most of the time, to avoid ambiguity and protect against potential future changes to the default units.

Currently, the supported units include:

- Length
  - `px` pixels
- Angle
  - `deg` degrees
- Ratio
  - `%` percentage

When using expressions in place of numeric values, the first unit listed for the type of measure is assumed.

Note: Yes, yes, I know there aren't any options here. When GeoTools supports unit-of-measure in SLD/SE, the CSS module will add more units ASAP.

Strings

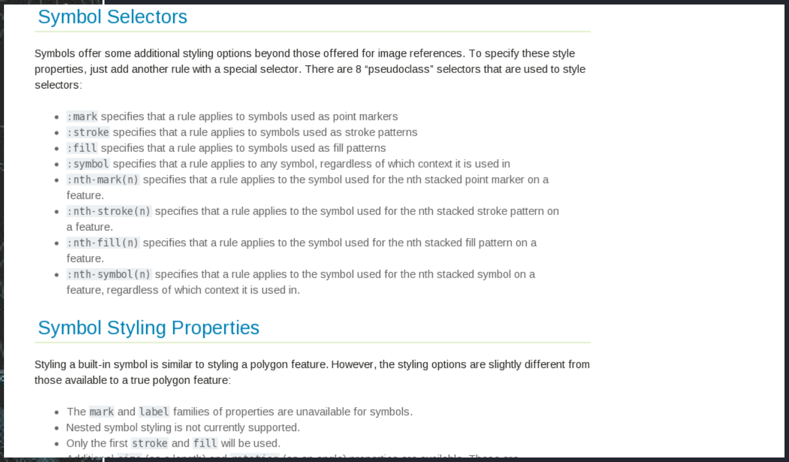
String values consist of a small snippet of text. For example, a string could be a literal label to use for a subset of roads:

```
[lanes>20] {
        label: "Serious Freaking Highway";
}
```

Continue Reading
» Previous: Property Listing
» Next: Styled Marks in GeoServer CSS

This Page
» Show Source

Legacy Documentation



Symbol Selectors

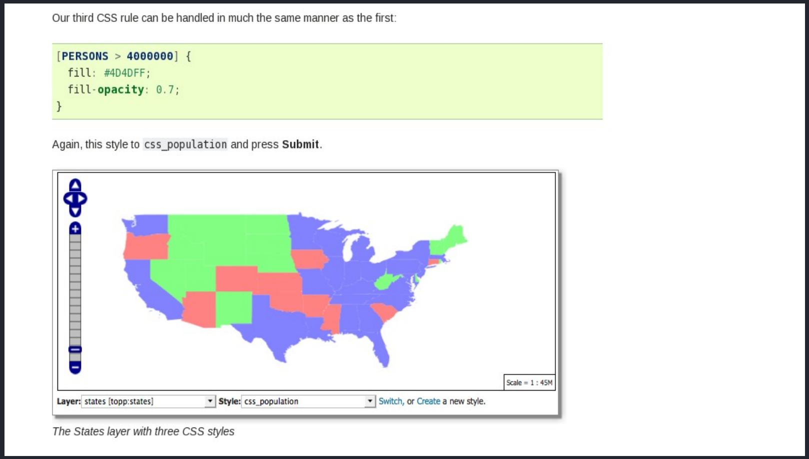
Symbols offer some additional styling options beyond those offered for image references. To specify these style properties, just add another rule with a special selector. There are 8 "pseudoclass" selectors that are used to style selectors:

- `:mark` specifies that a rule applies to symbols used as point markers
- `:stroke` specifies that a rule applies to symbols used as stroke patterns
- `:fill` specifies that a rule applies to symbols used as fill patterns
- `:symbol` specifies that a rule applies to any symbol, regardless of which context it is used in
- `:nth-mark(n)` specifies that a rule applies to the symbol used for the nth stacked point marker on a feature.
- `:nth-stroke(n)` specifies that a rule applies to the symbol used for the nth stacked stroke pattern on a feature.
- `:nth-fill(n)` specifies that a rule applies to the symbol used for the nth stacked fill pattern on a feature.
- `:nth-symbol(n)` specifies that a rule applies to the symbol used for the nth stacked symbol on a feature, regardless of which context it is used in.

Symbol Styling Properties

Styling a built-in symbol is similar to styling a polygon feature. However, the styling options are slightly different from those available to a true polygon feature:

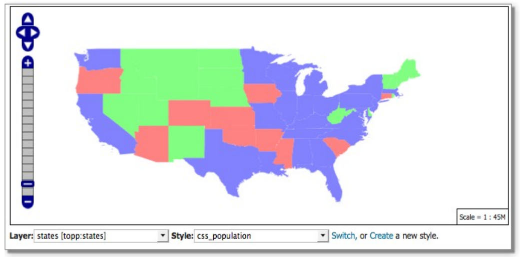
- The `mark` and `label` families of properties are unavailable for symbols.
- Nested symbol styling is not currently supported.
- Only the first `stroke` and `fill` will be used.



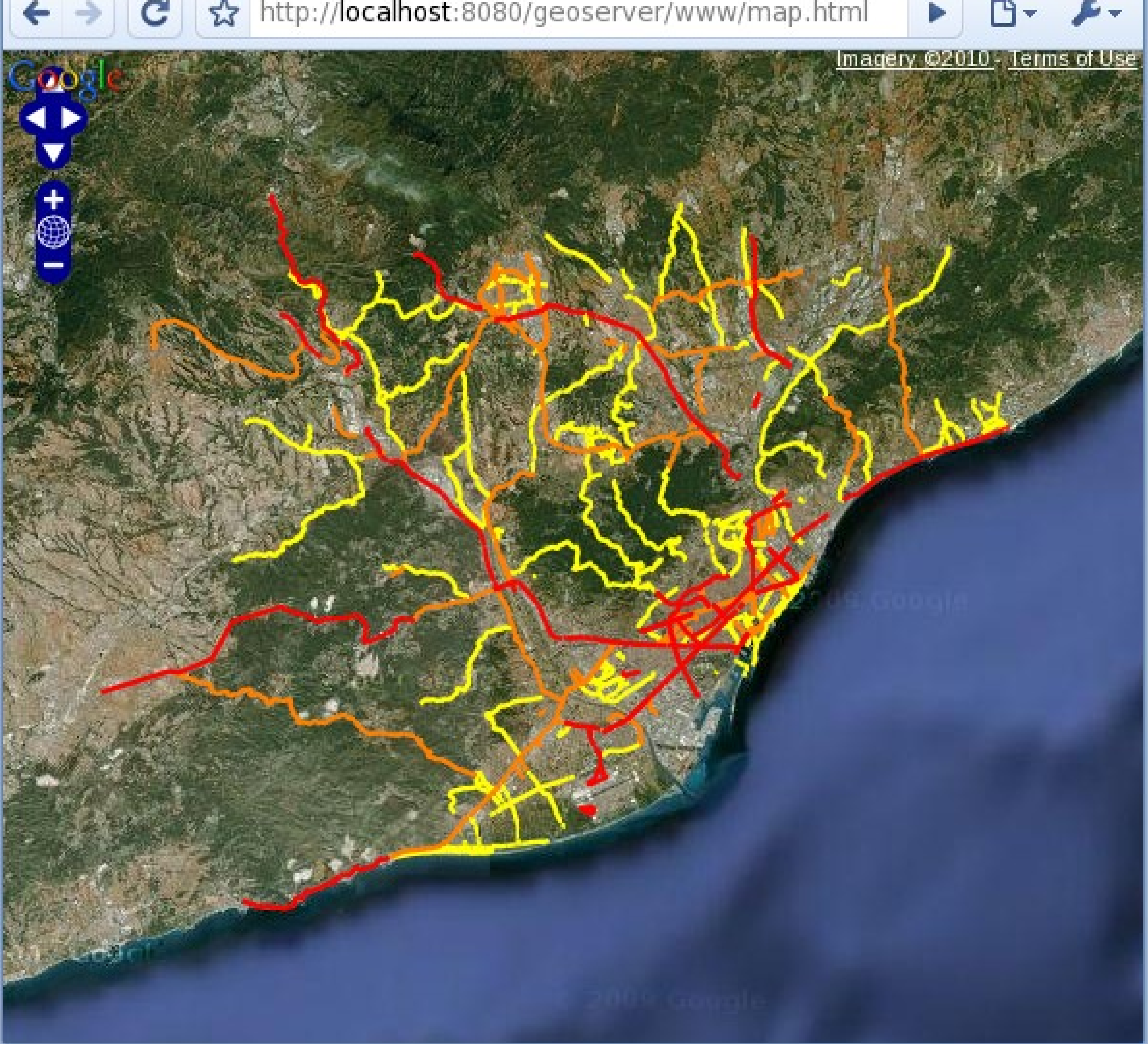
Our third CSS rule can be handled in much the same manner as the first:

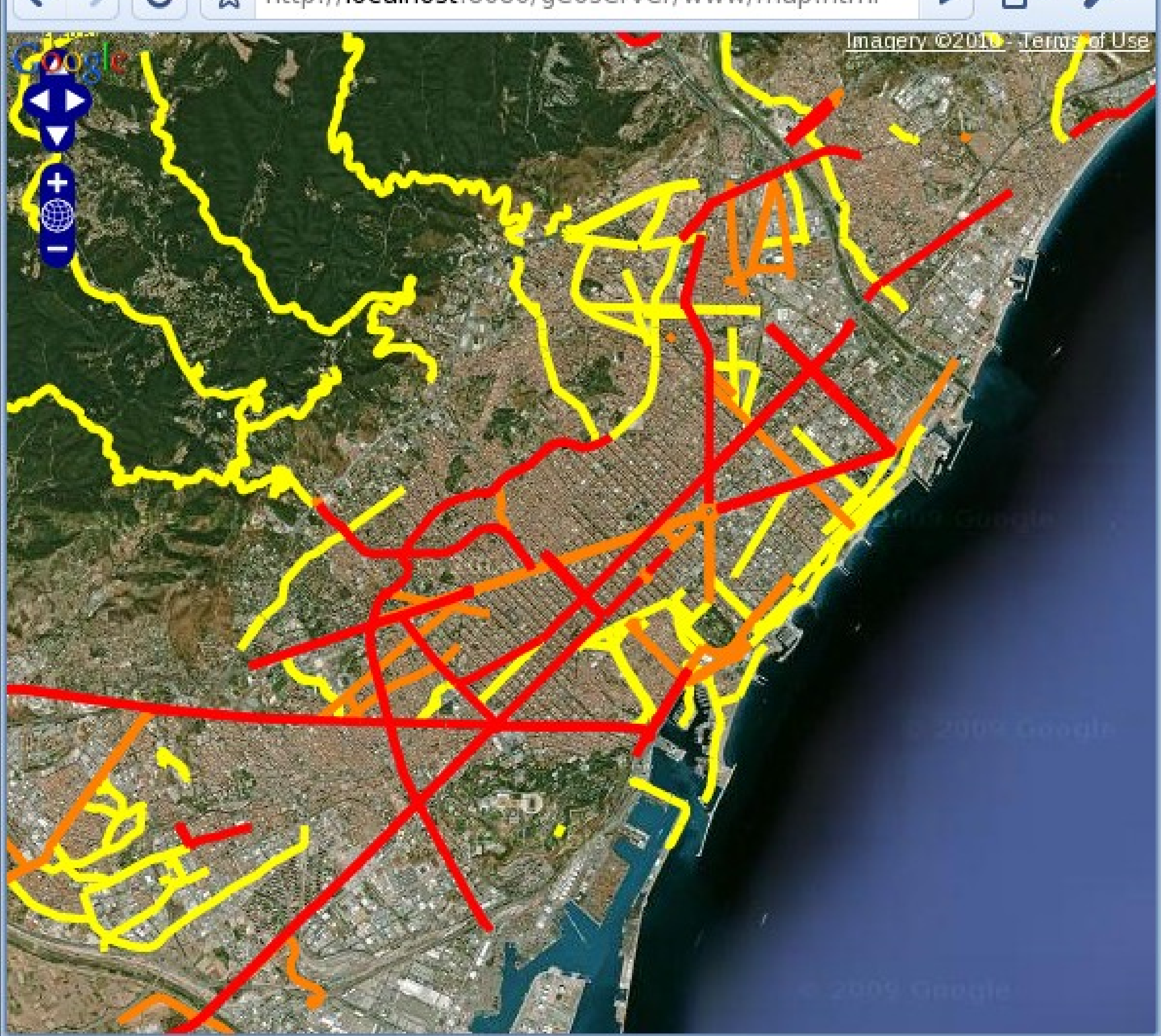
```
[PERSONS > 4000000] {
  fill: #4D4DFF;
  fill-opacity: 0.7;
}
```

Again, this style to `css_population` and press **Submit**.



The States layer with three CSS styles


http://localhost:8080/geoserver/www/map.html
Google
Imagery ©2010 - Terms of Use
©2009 Google
©2009 Google


Imagery ©2010 - Terms of Use
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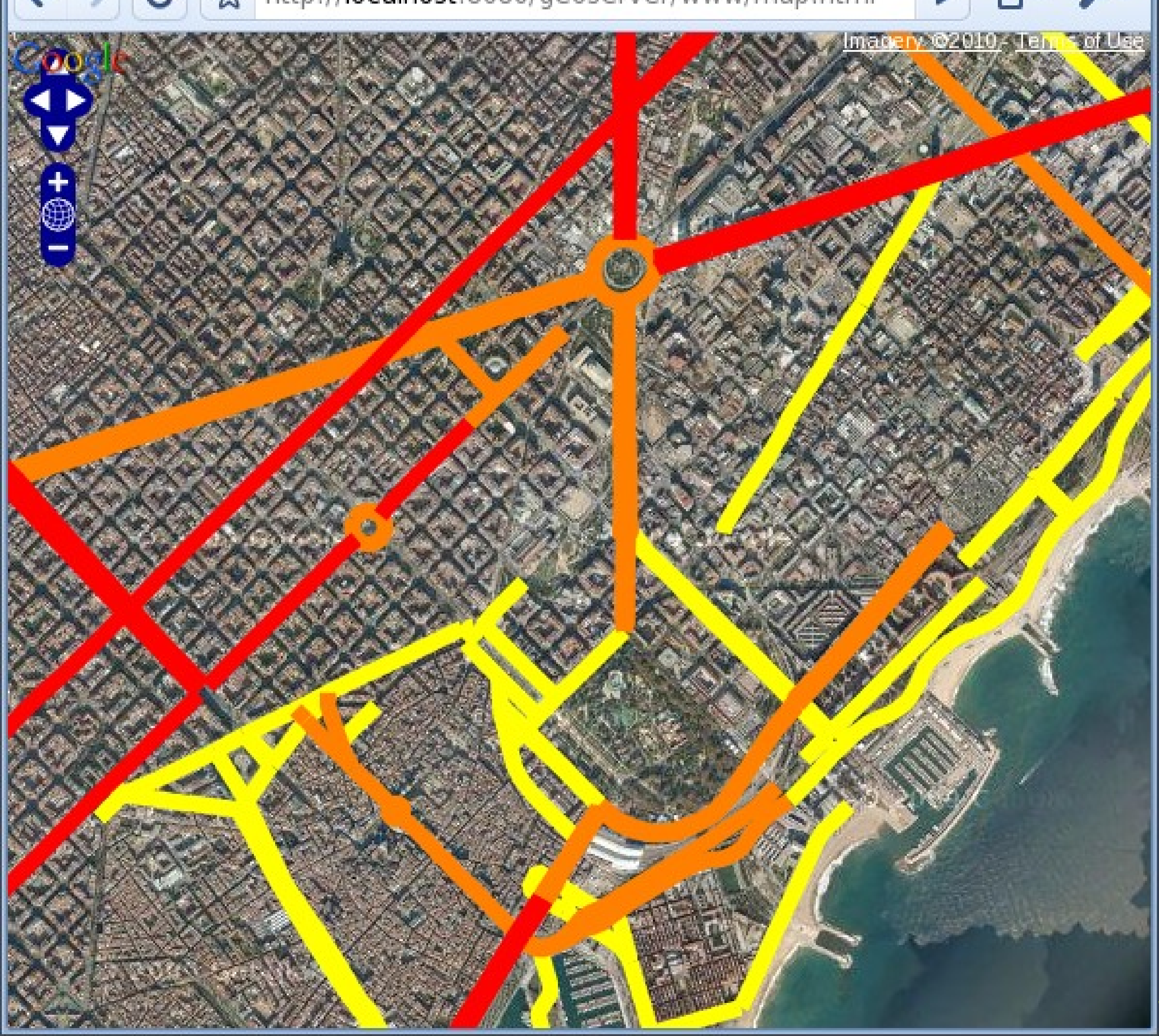
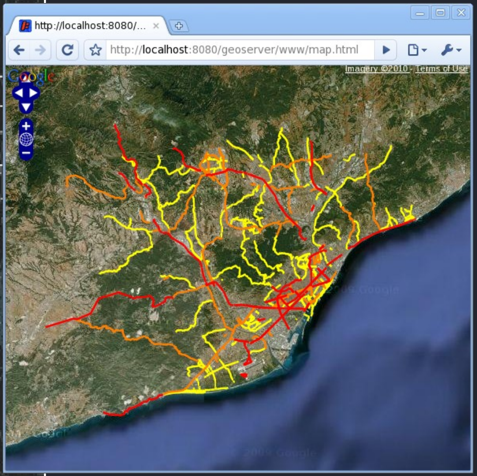
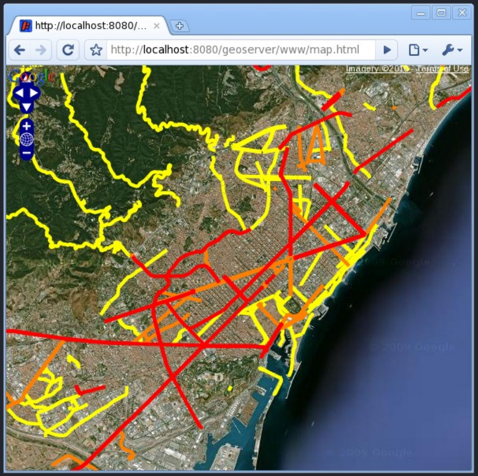
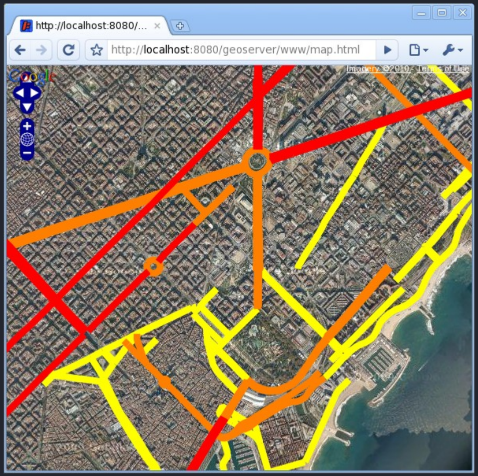
© 2009 Google
© 2009 Google


Google
Imagery ©2010 - Terms of Use

Example: Styling Roads

- Vary color with type
- Vary stroke-width with scale


http://localhost:8080/...
http://localhost:8080/geoserver/www/map.html
Imagery ©2010 · Terms of Use

http://localhost:8080/...
http://localhost:8080/geoserver/www/map.html

http://localhost:8080/...
http://localhost:8080/geoserver/www/map.html

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SLD

```
<sld:CssParameter name="stroke">#ffff00</sld:CssParameter>
<sld:CssParameter name="stroke-width">2</sld:CssParameter>
```

SLD

```
<sld:Stroke>
  <sld:CssParameter name="stroke">#ffff00</sld:CssParameter>
  <sld:CssParameter name="stroke-width">2</sld:CssParameter>
</sld:Stroke>
```

SLD

```
<sld:LineSymbolizer>
  <sld:Stroke>
    <sld:CssParameter name="stroke">#ffff00</sld:CssParameter>
    <sld:CssParameter name="stroke-width">2</sld:CssParameter>
  </sld:Stroke>
</sld:LineSymbolizer>
```

SLD

```
<sld:MinScaleDenominator>300000.0</sld:MinScaleDenominator>
<sld:LineSymbolizer>
  <sld:Stroke>
    <sld:CssParameter name="stroke">#ffff00</sld:CssParameter>
    <sld:CssParameter name="stroke-width">2</sld:CssParameter>
  </sld:Stroke>
</sld:LineSymbolizer>
```

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SLD

```
<ogc:Filter>
  <ogc:PropertyIsEqualTo>
    <ogc:PropertyName>type</ogc:PropertyName>
    <ogc:Literal>tertiary</ogc:Literal>
  </ogc:PropertyIsEqualTo>
</ogc:Filter>
<sld:MinScaleDenominator>300000.0</sld:MinScaleDenominator>
<sld:LineSymbolizer>
  <sld:Stroke>
    <sld:CssParameter name="stroke">#ffff00</sld:CssParameter>
    <sld:CssParameter name="stroke-width">2</sld:CssParameter>
  </sld:Stroke>
</sld:LineSymbolizer>
```

SLD

```
<sld:Rule>
  <ogc:Filter>
    <ogc:PropertyIsEqualTo>
      <ogc:PropertyName>type</ogc:PropertyName>
      <ogc:Literal>tertiary</ogc:Literal>
    </ogc:PropertyIsEqualTo>
  </ogc:Filter>
  <sld:MinScaleDenominator>300000.0</sld:MinScaleDenominator>
  <sld:LineSymbolizer>
    <sld:Stroke>
      <sld:CssParameter name="stroke">#ffff00</sld:CssParameter>
      <sld:CssParameter name="stroke-width">2</sld:CssParameter>
    </sld:Stroke>
  </sld:LineSymbolizer>
</sld:Rule>
```

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```
</sld:Rule>
<sld:Rule>
  <ogc:Filter>
    <ogc:PropertyIsEqualTo>
      <ogc:PropertyName>type</ogc:PropertyName>
      <ogc:Literal>tertiary</ogc:Literal>
    </ogc:PropertyIsEqualTo>
  </ogc:Filter>
  <sld:MinScaleDenominator>100000.0</sld:MinScaleDenominator>
  <sld:MaxScaleDenominator>300000.0</sld:MaxScaleDenominator>
  <sld:LineSymbolizer>
    <sld:Stroke>
      <sld:CssParameter name="stroke">#ffff00</sld:CssParameter>
      <sld:CssParameter name="stroke-width">4</sld:CssParameter>
    </sld:Stroke>
  </sld:LineSymbolizer>
</sld:Rule>
<sld:Rule>
  <ogc:Filter>
    <ogc:PropertyIsEqualTo>
      <ogc:PropertyName>type</ogc:PropertyName>
      <ogc:Literal>secondary</ogc:Literal>
    </ogc:PropertyIsEqualTo>
  </ogc:Filter>
  <sld:MinScaleDenominator>300000.0</sld:MinScaleDenominator>
  <sld:LineSymbolizer>
    <sld:Stroke>
      <sld:CssParameter name="stroke">#ffa500</sld:CssParameter>
      <sld:CssParameter name="stroke-width">2</sld:CssParameter>
    </sld:Stroke>
  </sld:LineSymbolizer>
</sld:Rule>
<sld:Rule>
  <ogc:Filter>
    <ogc:PropertyIsEqualTo>
      <ogc:PropertyName>type</ogc:PropertyName>
      <ogc:Literal>secondary</ogc:Literal>
    </ogc:PropertyIsEqualTo>
  </ogc:Filter>
  <sld:MaxScaleDenominator>100000.0</sld:MaxScaleDenominator>
  <sld:LineSymbolizer>
    <sld:Stroke>
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  </sld:LineSymbolizer>
</sld:Rule>
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      <ogc:PropertyName>type</ogc:PropertyName>
      <ogc:Literal>secondary</ogc:Literal>
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      <sld:CssParameter name="stroke-width">4</sld:CssParameter>
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  </sld:LineSymbolizer>
</sld:Rule>
<sld:Rule>
  <ogc:Filter>
    <ogc:PropertyIsEqualTo>
      <ogc:PropertyName>type</ogc:PropertyName>
      <ogc:Literal>primary</ogc:Literal>
    </ogc:PropertyIsEqualTo>
  </ogc:Filter>
  <sld:MinScaleDenominator>300000.0</sld:MinScaleDenominator>
  <sld:LineSymbolizer>
    <sld:Stroke>
      <sld:CssParameter name="stroke">#ff0000</sld:CssParameter>
      <sld:CssParameter name="stroke-width">2</sld:CssParameter>
```

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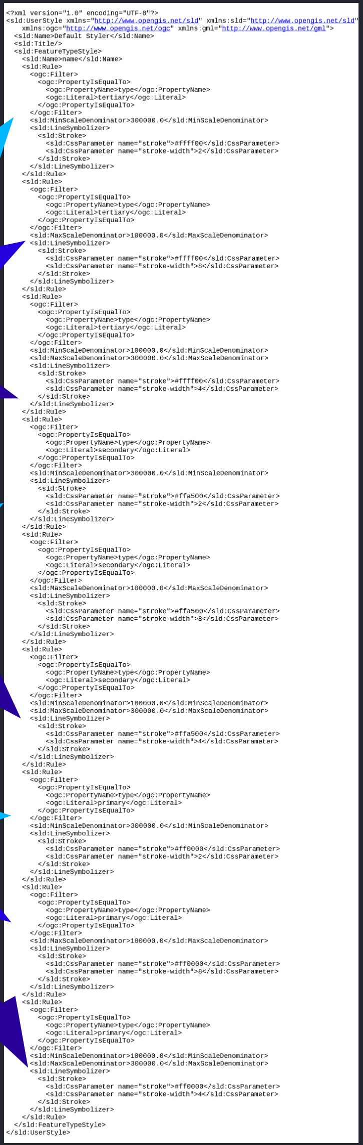

```
<?xml version="1.0" encoding="UTF-8"?>
<sld:UserStyle xmlns="http://www.opengis.net/sld" xmlns:sld="http://www.opengis.net/sld"
    xmlns:ogc="http://www.opengis.net/ogc" xmlns:gml="http://www.opengis.net/gml">
  <sld:Name>Default Styler</sld:Name>
  <sld:Title/>
  <sld:FeatureTypeStyle>
    <sld:Name>name</sld:Name>
    <sld:Rule>
      <ogc:Filter>
        <ogc:PropertyIsEqualTo>
          <ogc:PropertyName>type</ogc:PropertyName>
          <ogc:Literal>tertiary</ogc:Literal>
        </ogc:PropertyIsEqualTo>
      </ogc:Filter>
      <sld:MinScaleDenominator>300000.0</sld:MinScaleDenominator>
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        <sld:Stroke>
          <sld:CssParameter name="stroke">#ffff00</sld:CssParameter>
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    <sld:Rule>
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          <sld:CssParameter name="stroke">#ffff00</sld:CssParameter>
          <sld:CssParameter name="stroke-width">8</sld:CssParameter>
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    <sld:Rule>
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        </ogc:PropertyIsEqualTo>
      </ogc:Filter>
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    <sld:Rule>
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          <ogc:Literal>primary</ogc:Literal>
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      </ogc:Filter>
      <sld:MaxScaleDenominator>100000.0</sld:MaxScaleDenominator>
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          <ogc:Literal>primary</ogc:Literal>
        </ogc:PropertyIsEqualTo>
      </ogc:Filter>
      <sld:MinScaleDenominator>100000.0</sld:MinScaleDenominator>
      <sld:MaxScaleDenominator>300000.0</sld:MaxScaleDenominator>
      <sld:LineSymbolizer>
        <sld:Stroke>
          <sld:CssParameter name="stroke">#ff0000</sld:CssParameter>
          <sld:CssParameter name="stroke-width">4</sld:CssParameter>
        </sld:Stroke>
      </sld:LineSymbolizer>
    </sld:Rule>
  </sld:FeatureTypeStyle>
</sld:UserStyle>
```

CSS

```
<sld:Rule>
  <ogc:Filter>
    <ogc:PropertyIsEqualTo>
      <ogc:PropertyName>type</ogc:PropertyName>
      <ogc:Literal>tertiary</ogc:Literal>
    </ogc:PropertyIsEqualTo>
  </ogc:Filter>
  <sld:MinScaleDenominator>300000.0</sld:MinScaleDenominator>
  <sld:LineSymbolizer>
    <sld:Stroke>
      <sld:CssParameter name="stroke">#ffff00</sld:CssParameter>
      <sld:CssParameter name="stroke-width">2</sld:CssParameter>
    </sld:Stroke>
  </sld:LineSymbolizer>
</sld:Rule>
```

CSS

```
<sld:Rule>
  <ogc:Filter>
    <ogc:PropertyIsEqualTo>
      <ogc:PropertyName>type</ogc:PropertyName>
      <ogc:Literal>tertiary</ogc:Literal>
    </ogc:PropertyIsEqualTo>
  </ogc:Filter>
  <sld:MinScaleDenominator>300000.0</sld:MinScaleDenominator>
  <sld:LineSymbolizer>
    <sld:Stroke>
                           stroke: #ffff00;
                           stroke-width: 2;
    </sld:Stroke>
  </sld:LineSymbolizer>
</sld:Rule>
```

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CSS

```
<sld:Rule>
  <ogc:Filter>
    <ogc:PropertyIsEqualTo>
      <ogc:PropertyName>type</ogc:PropertyName>
      <ogc:Literal>tertiary</ogc:Literal>
    </ogc:PropertyIsEqualTo>
  </ogc:Filter>
  <sld:MinScaleDenominator>300000.0</sld:MinScaleDenominator>
  {

                                                stroke: #ffff00;
                                                stroke-width: 2;


  }
</sld:Rule>
```

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CSS

```
<sld:Rule>
  <ogc:Filter>
    <ogc:PropertyIsEqualTo>
      <ogc:PropertyName>type</ogc:PropertyName>
      <ogc:Literal>tertiary</ogc:Literal>
    </ogc:PropertyIsEqualTo>
  </ogc:Filter>
  [@scale > 300000.0]
  {

                                                        stroke: #ffff00;
                                                        stroke-width: 2;


  }
</sld:Rule>
```

CSS

```
<sld:Rule>


      [type = 'tertiary']




  [@scale > 300000.0]
  {


                              stroke: #ffff00;
                              stroke-width: 2;


  }
</sld:Rule>
```

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CSS

```
    [type = 'tertiary']


[@scale > 300000.0]
{
                                   stroke: #ffff00;
                                   stroke-width: 2;

}
```

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CSS

```
[type = 'tertiary'] [@scale > 300000.0] {
    stroke: #ffff00;
    stroke-width: 2;
}
```

```
[type = 'tertiary'] [@scale > 300000.0] {
    stroke: #ffff00;
    stroke-width: 2;
}

[type = 'tertiary'] [@scale > 100000.0] [@scale < 300000.0] {
    stroke: #ffff00;
    stroke-width: 4;
}

[type = 'tertiary'] [@scale < 100000.0] {
    stroke: #ffff00;
    stroke-width: 8;
}

[type = 'secondary'] [@scale > 300000.0] {
    stroke: #ffa500;
    stroke-width: 2;
}

[type = 'secondary'] [@scale > 100000.0] [@scale < 300000.0] {
    stroke: #ffa500;
    stroke-width: 4;
}

[type = 'secondary'] [@scale < 100000.0] {
    stroke: #ffa500;
    stroke-width: 8;
}

[type = 'primary'] [@scale > 300000.0] {
    stroke: #ff0000;
    stroke-width: 2;
}

[type = 'primary'] [@scale > 100000.0] [@scale < 300000.0] {
    stroke: #ff0000;
    stroke-width: 4;
}

[type = 'primary'] [@scale < 100000.0] {
    stroke: #ff0000;
    stroke-width: 8;
}
```

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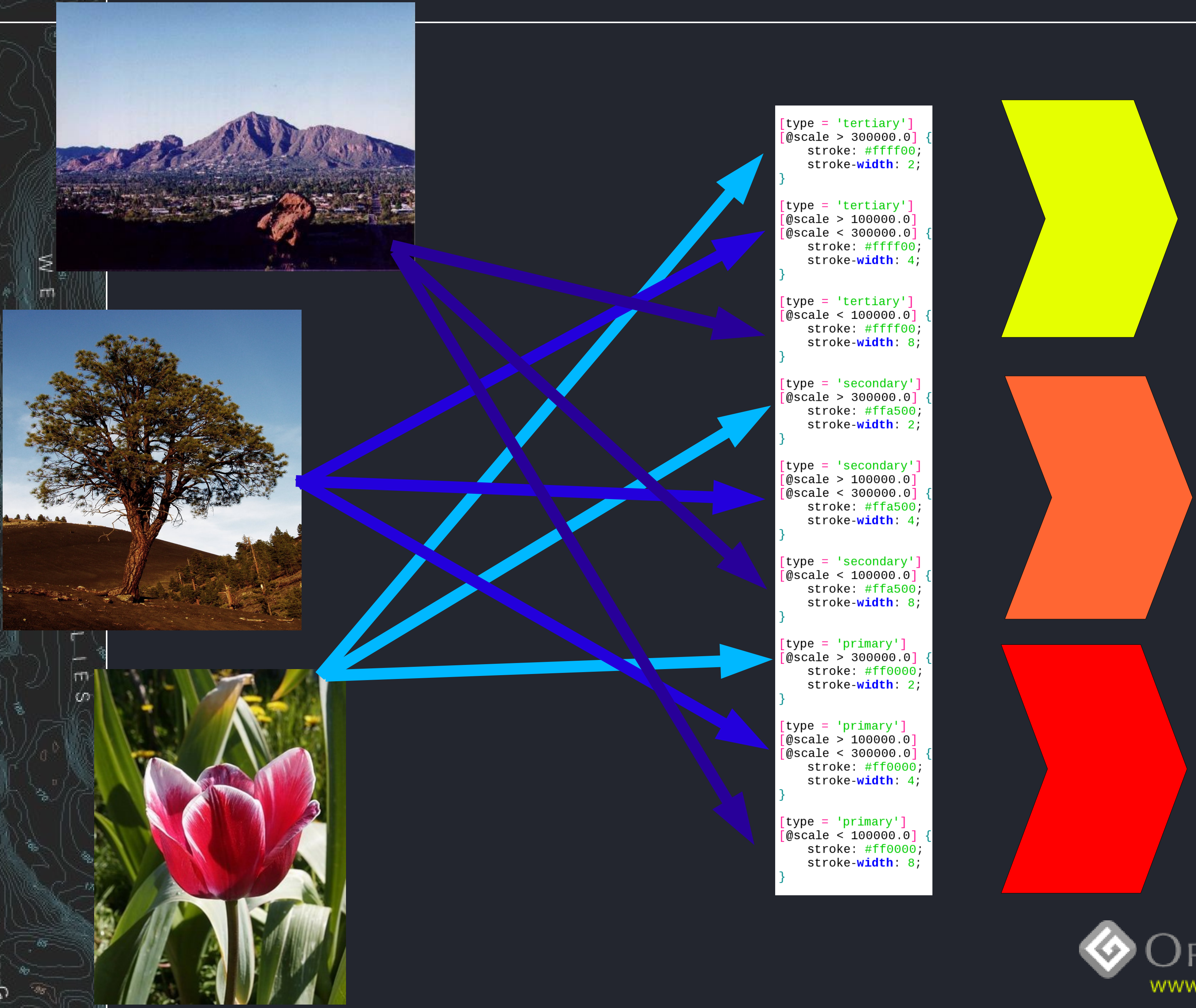
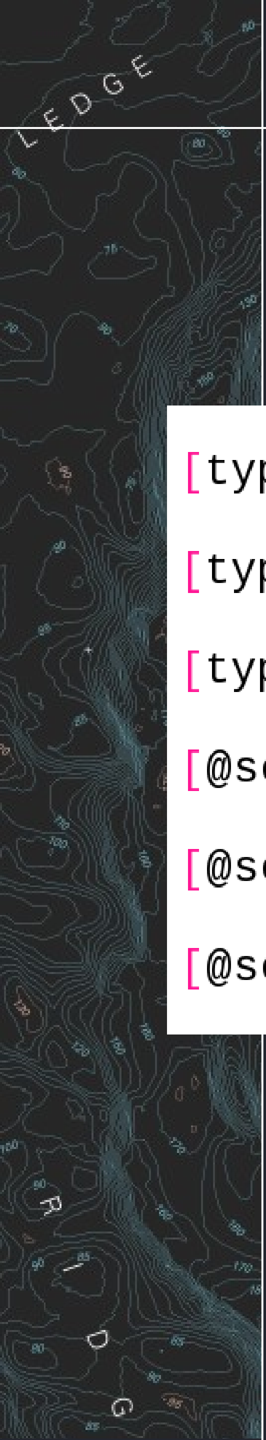


```
[type = 'tertiary']
[@scale > 300000.0] {
    stroke: #ffff00;
    stroke-width: 2;
}

[type = 'tertiary']
[@scale > 100000.0]
[@scale < 300000.0] {
    stroke: #ffff00;
    stroke-width: 4;
}

[type = 'tertiary']
[@scale < 100000.0] {
    stroke: #ffff00;
    stroke-width: 8;
}

[type = 'secondary']
[@scale > 300000.0] {
    stroke: #ffa500;
    stroke-width: 2;
}

[type = 'secondary']
[@scale > 100000.0]
[@scale < 300000.0] {
    stroke: #ffa500;
    stroke-width: 4;
}

[type = 'secondary']
[@scale < 100000.0] {
    stroke: #ffa500;
    stroke-width: 8;
}

[type = 'primary']
[@scale > 300000.0] {
    stroke: #ff0000;
    stroke-width: 2;
}

[type = 'primary']
[@scale > 100000.0]
[@scale < 300000.0] {
    stroke: #ff0000;
    stroke-width: 4;
}

[type = 'primary']
[@scale < 100000.0] {
    stroke: #ff0000;
    stroke-width: 8;
}
```



```
[type = 'tertiary'] { stroke: #ffff00; }

[type = 'secondary'] { stroke: #ffa500; }

[type = 'primary'] { stroke: #ff0000; }

[@scale > 300000.0] { stroke-width: 2; }

[@scale > 100000.0] [@scale < 300000.0] { stroke-width: 4; }

[@scale < 100000.0] { stroke-width: 8; }
```

```
* { stroke: #ffff00; stroke-width: 2; }

[type = 'secondary'] { stroke: #ffa500; }

[type = 'primary'] { stroke: #ff0000; }

[@scale > 100000.0] [@scale < 300000.0] { stroke-width: 4; }

[@scale < 100000.0] { stroke-width: 8; }
```

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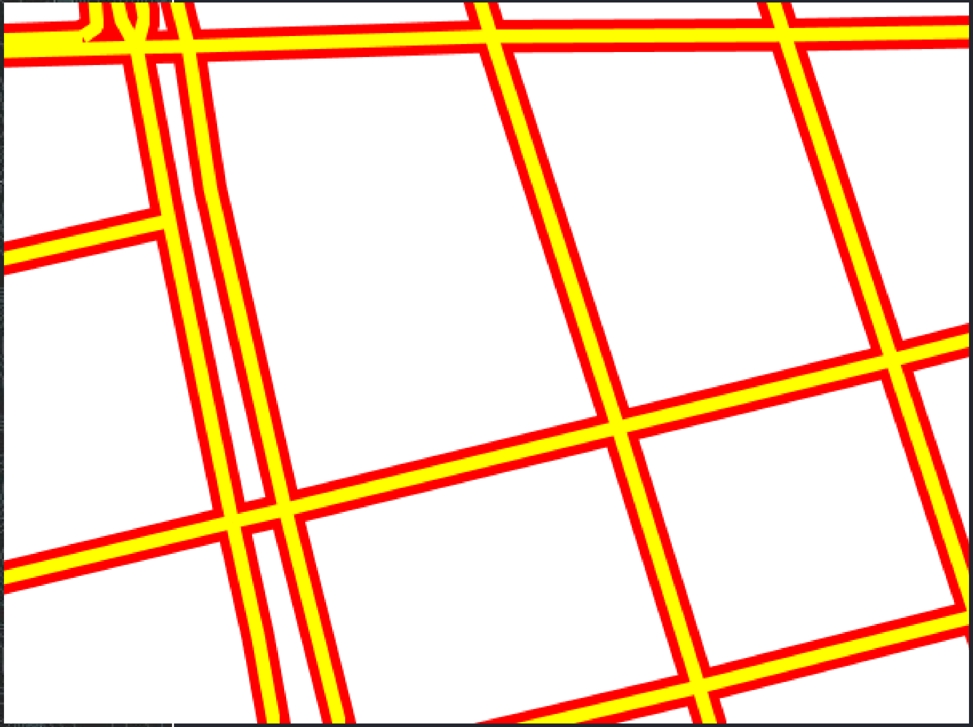
CSS <> SLD: Filters

- `[att='value']`
- `featuretype`
- `#id`
- `[@scale]`
- Unified all constraints

CSS <> SLD: Repeated rendering

```
* {
 stroke:        red,  yellow;
 stroke-width: 20px, 8px;
 z-index:       0,    10;
}
```

CSS <> SLD: Repeated rendering



```
* {
  stroke:
   red, yellow;
  stroke-width:
   20px, 8px;
  z-index:
   0, 10;
}
```

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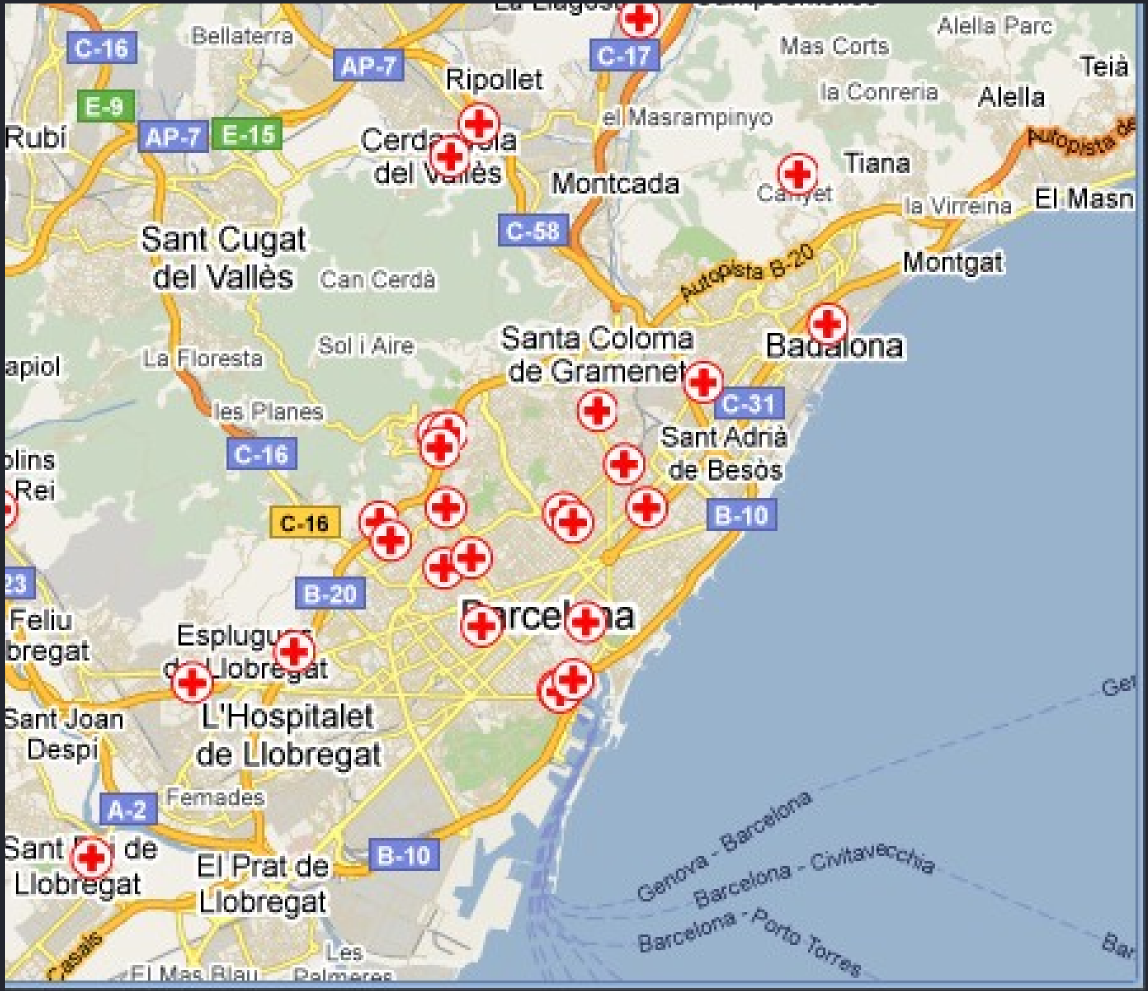
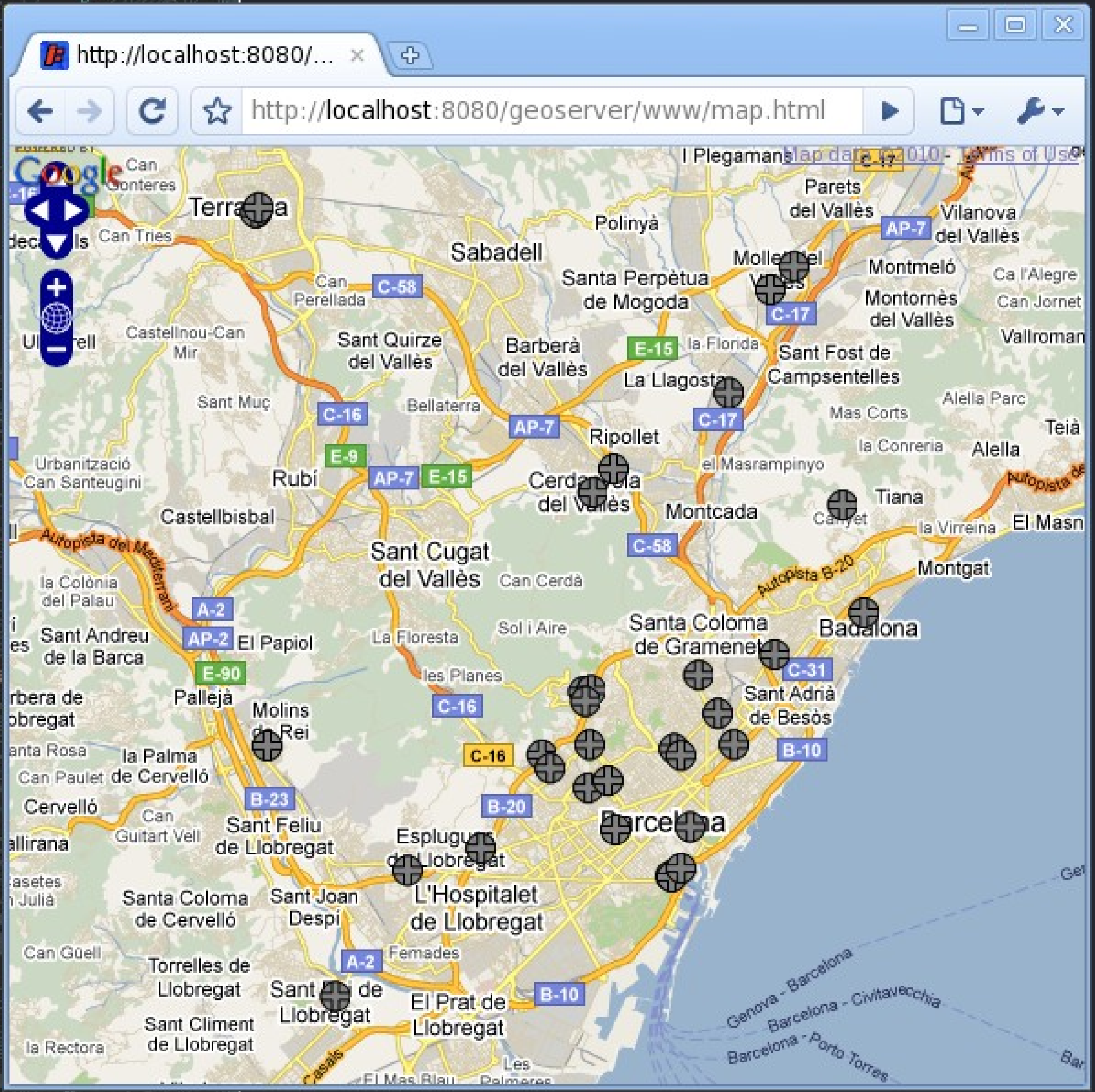
CSS <> SLD: Styled marks

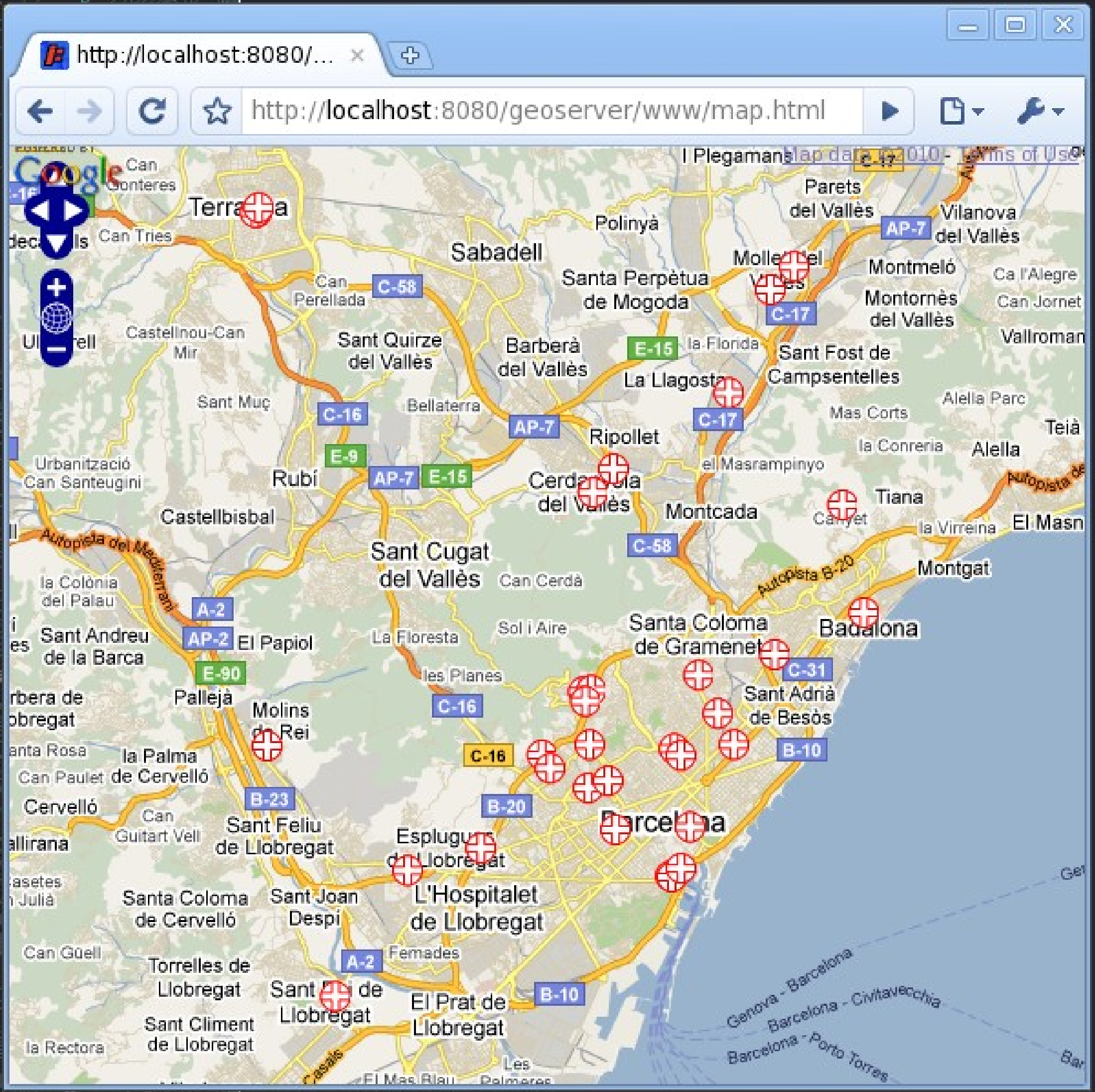


CSS <> SLD: Styled marks


http://localhost:8080/...
http://localhost:8080/geoserver/www/map.html
Sabadell
Sant Cugat del Vallès
Badalona
Barcelona
L'Hospitalet de Llobregat
Map data ©2010 - Terms of Use

```
[type='hospital'] {
  mark:
    symbol(circle),
    symbol(cross);
}
```

CSS <> SLD: Styled marks


http://localhost:8080/geoserver/www/map.html

```
[type='hospital']
{ ... }

[type='hospital']
:mark {
  fill: white;
  stroke: red;
}
```

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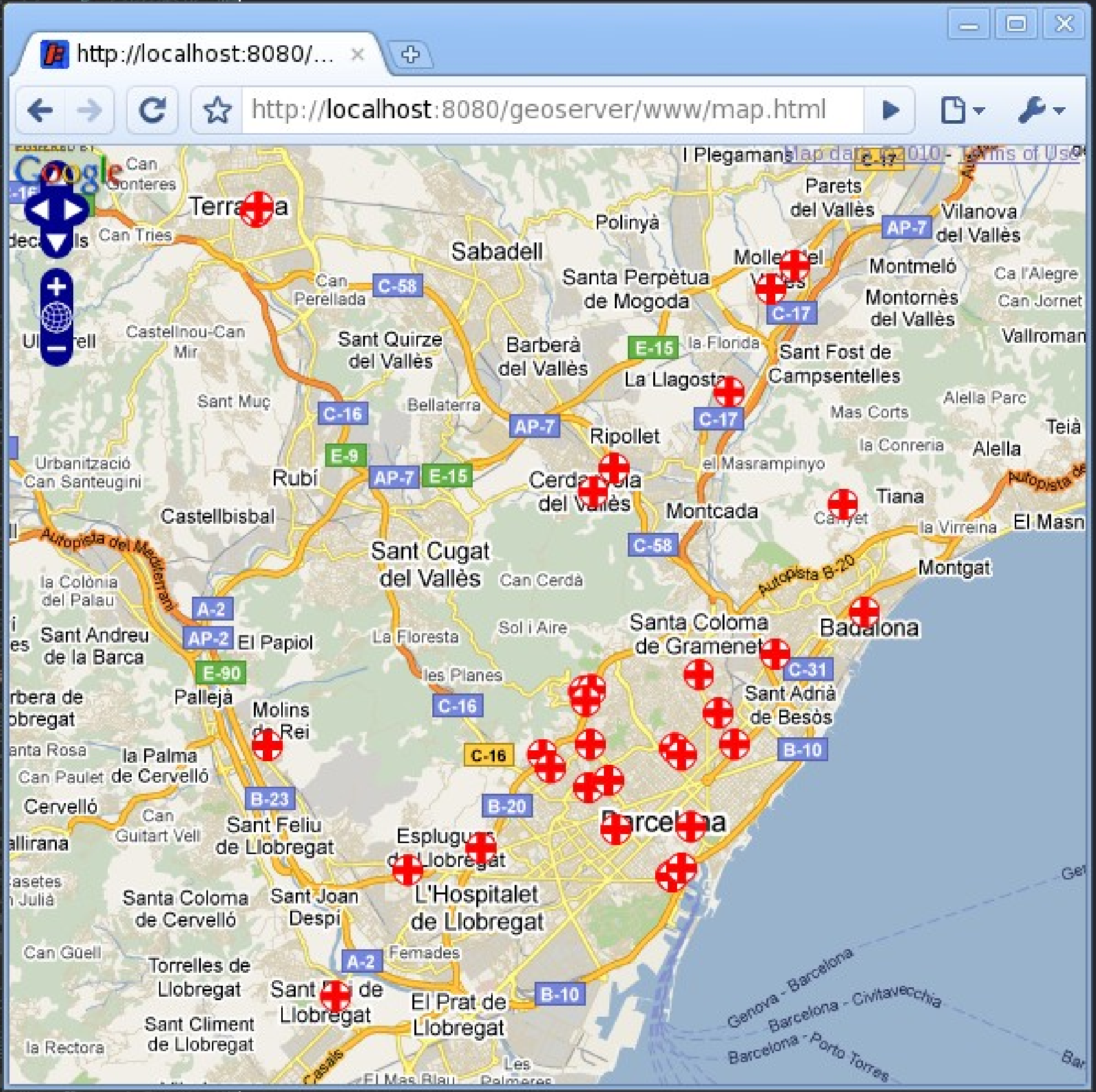
CSS <> SLD: Styled marks


http://localhost:8080/...
http://localhost:8080/geoserver/www/map.html
Map data ©2010 - Terms of Use

```
[type='hospital']
{ ... }
[type='hospital']
:mark { ... }

[type='hospital']
:nth-mark(2) {
  fill: red;
}
```

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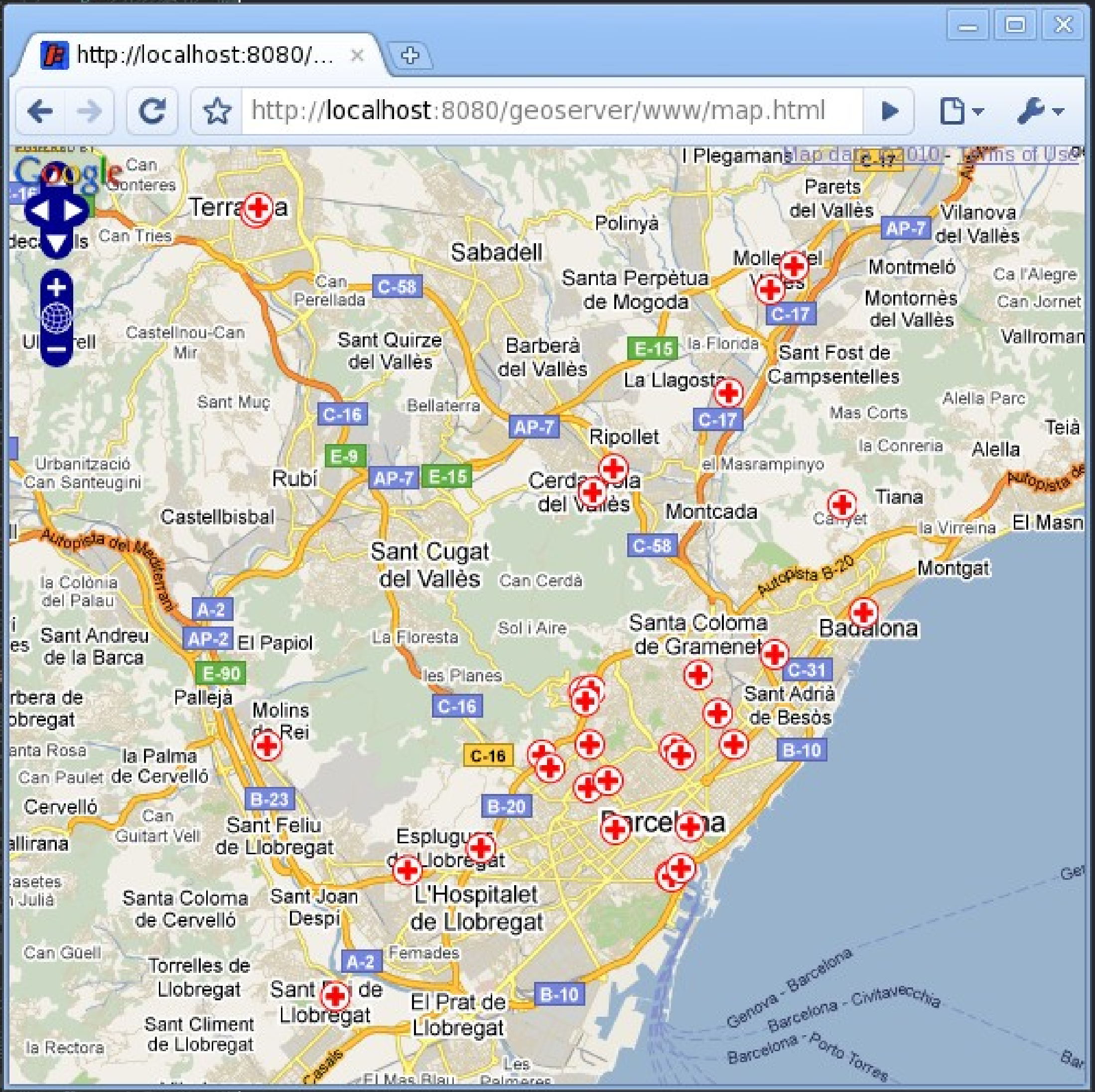
CSS <> SLD: Styled marks


http://localhost:8080/...
http://localhost:8080/geoserver/www/map.html
Map data ©2010 - Terms of Use
Sabadell
Terrassa
Sant Cugat del Vallès
Barcelona
Badalona
L'Hospitalet de Llobregat

```
[type='hospital'] {
  mark:
   symbol(circle),
   symbol(cross);
  mark-size:
   16px, 10px;
}

[type='hospital']
:mark { ... }

[type='hospital']
:nth-mark(2){ ... }
```

Potential Directions

- SLD → CSS translator
- `@import`
- CSS + WMS
- CSS-aware editor
- Standardized Map CSS
- Raster styling

SLD → CSS Translator

- Naive (wrong) version would be easy
- Important details
  - Combine rules from stacked FeatureTypeStyles
  - “factor out” commonalities
  - Title/Abstract metadata

@import(base.css)

- Share common definitions between multiple styles
- Not possible in SLD; relies on per-property rule combination to be useful

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CSS + WMS

- Integrate CSS into WMS the way SLD is now
- `<UserStyle` **`type="text/css"`**`>` in SLD?
- GetMap&**css_body=**...
- “refine” named styles from server

CSS-aware editor

- Syntax highlighting
- “palettes”
  - Fonts
  - Colors
  - Marks
  - Properties
- <Your idea here>

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Standardized Map CSS

- Existing tools
  - Mapnik
  - Cartagen
  - OSM (Halcyon)
- Each has different dialect with different model
- Sharing would be cool

Raster Styling

- Only “gap” left
- Not sure what it will look like yet

The Backend

- First “serious” project in Scala
- Zero “adapter” code
- Functional features – data transforms
- Parsing library

Scala

- Scala is to Java as CSS is to SLD
- “Just another library” at runtime
- Highly reduced boilerplate during development

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Scala in GeoServer

- Just add ~~water~~ scala-library.jar
- Loaded like any other extension

Scala Collections

```
val nums = List.make(1, 10)
val (odds, evens) =
  nums.partition(_ % 2 != 0)
val pairs =
  for (i <- nums; j <- nums)
    yield (i, j)
```

Parsing in Scala

```
private val literal =
  percentage | measure |
  number | string | color
```

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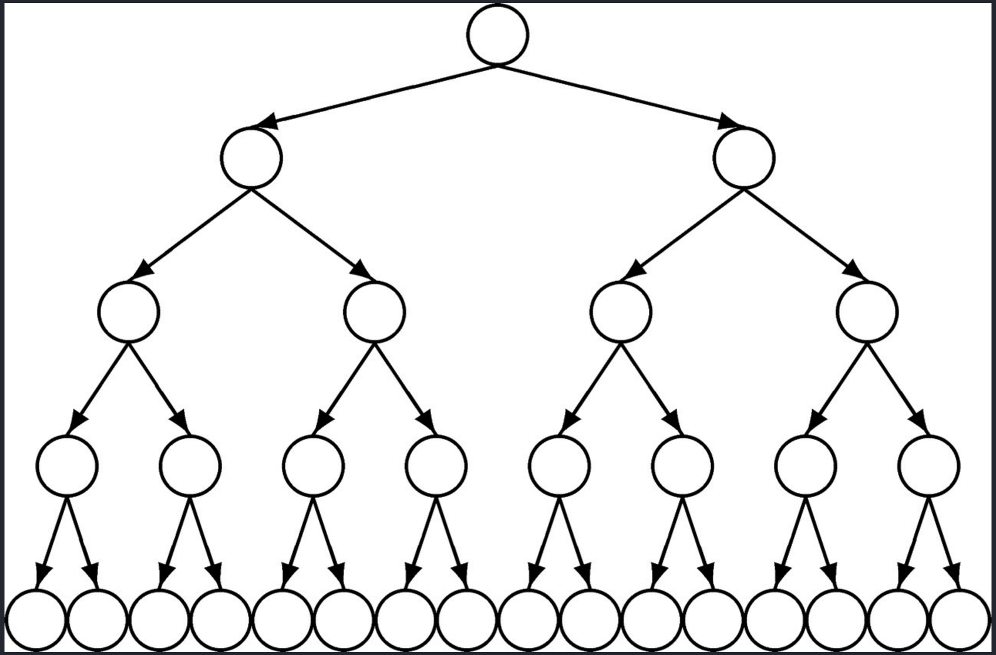
CSS <> SLD: Painter's Model to Cascading

- Exhaustive search
- Filter analysis (for speed)



Questions?

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