

Advanced cartographic map rendering in GeoServer

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Overview



- Who we are
- Example map
- Raster styling
- Scale dependent rules
- Hatches, patterns and dashes
- Point Symbolology
- Labeling
- Transformations
- Cross layer filtering

GeoSolutions

- Founded in Italy in late 2006
- Expertise
 - Image Processing, GeoSpatial Data Fusion
 - Java, Java Enterprise, C++, Python
 - JPEG2000, JPIP, Advanced 2D visualization
- Supporting/Developing FOSS4G projects
 - GeoTools, GeoServer
 - GeoBatch, GeoNetwork
- Clients
 - Public Agencies
 - Private Companies
- <http://www.geo-solutions.it>

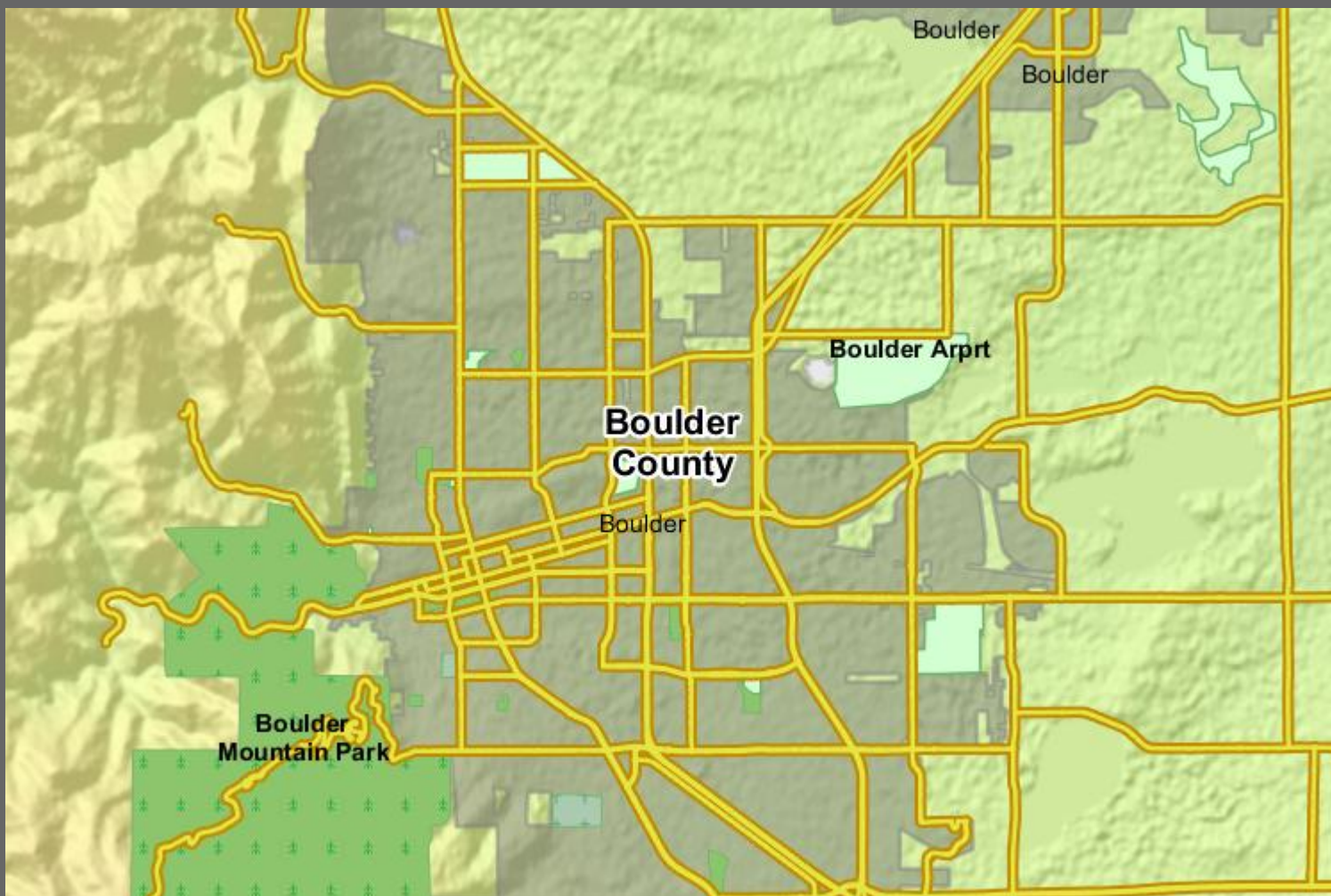


The example map

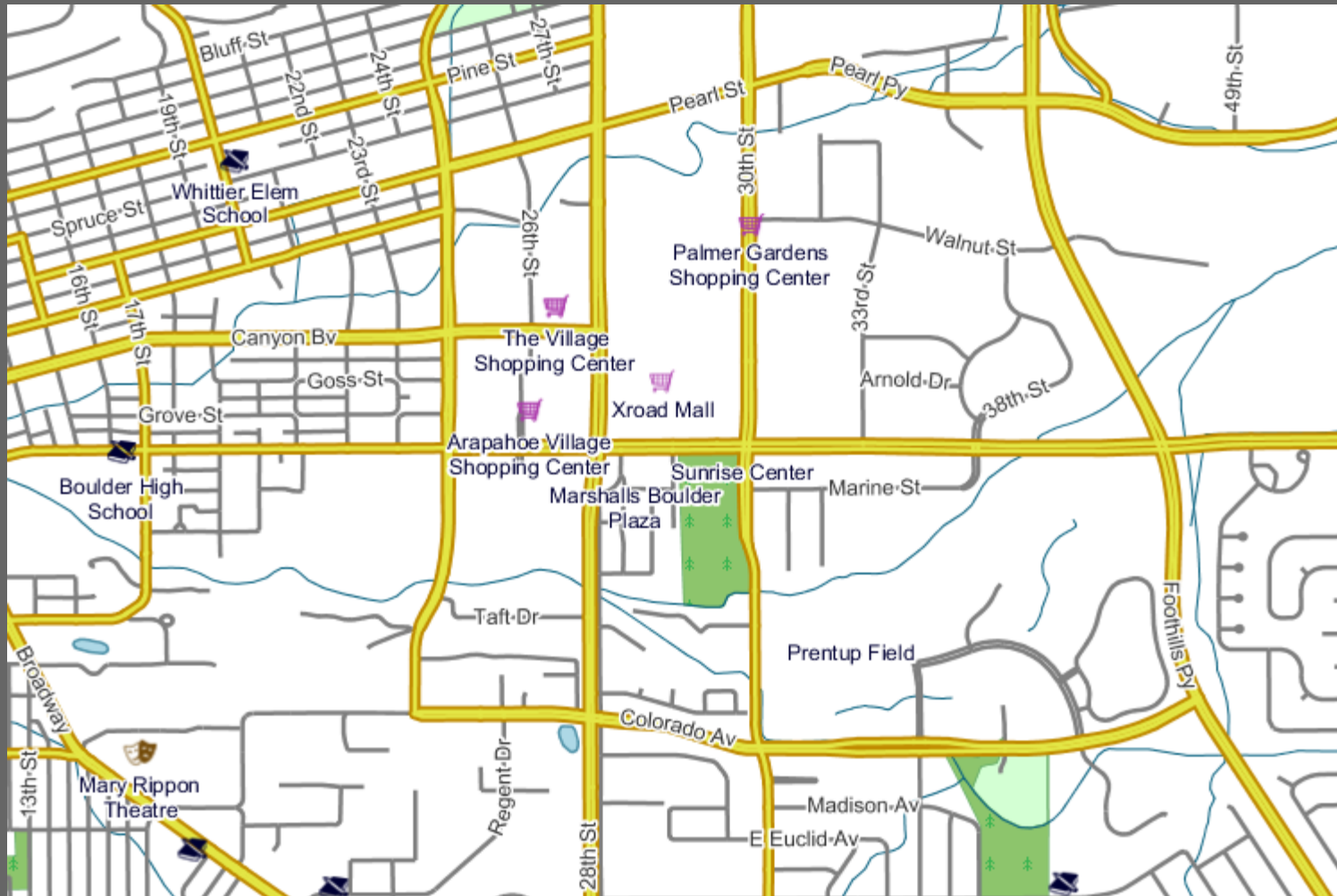
Example map



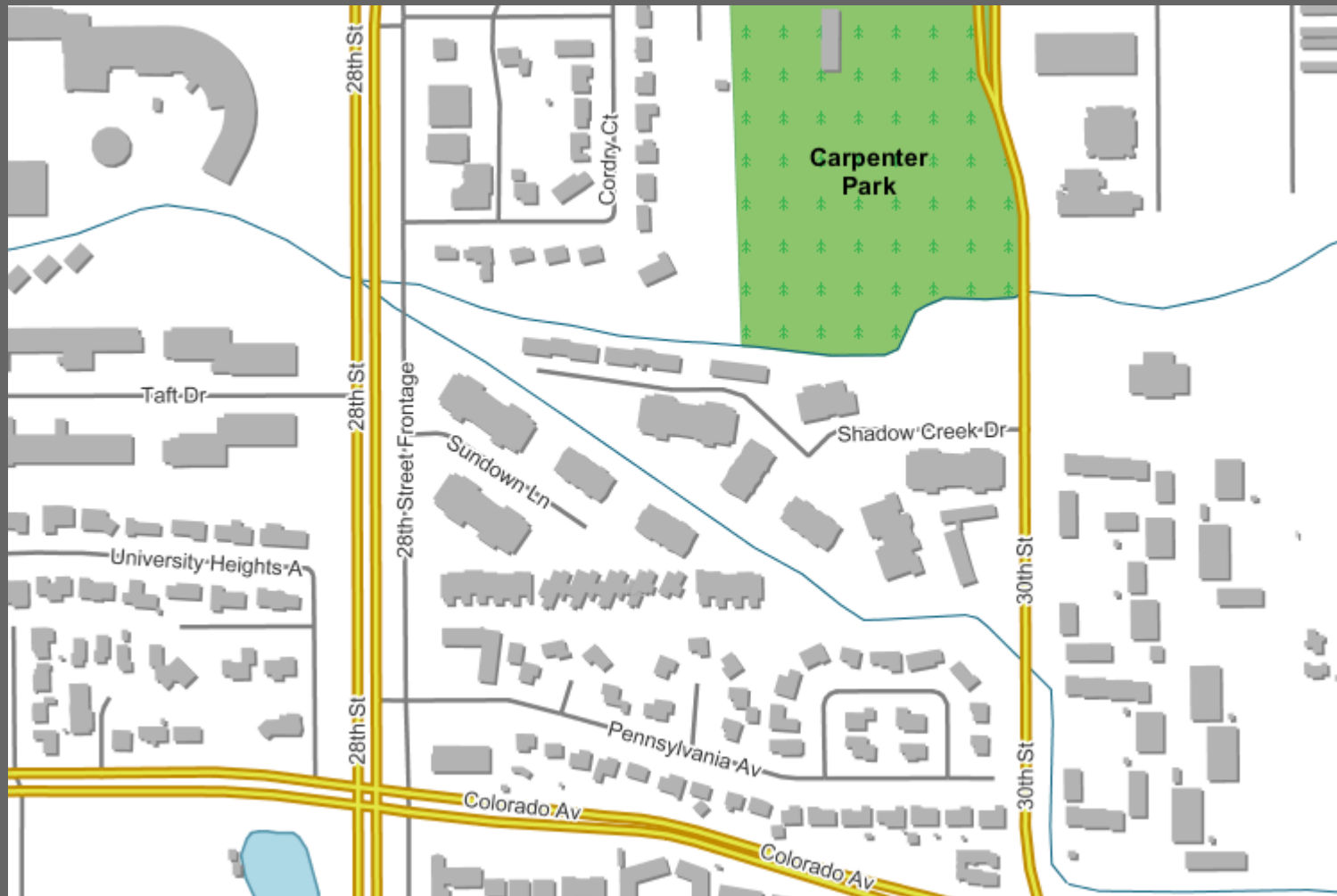
Example map



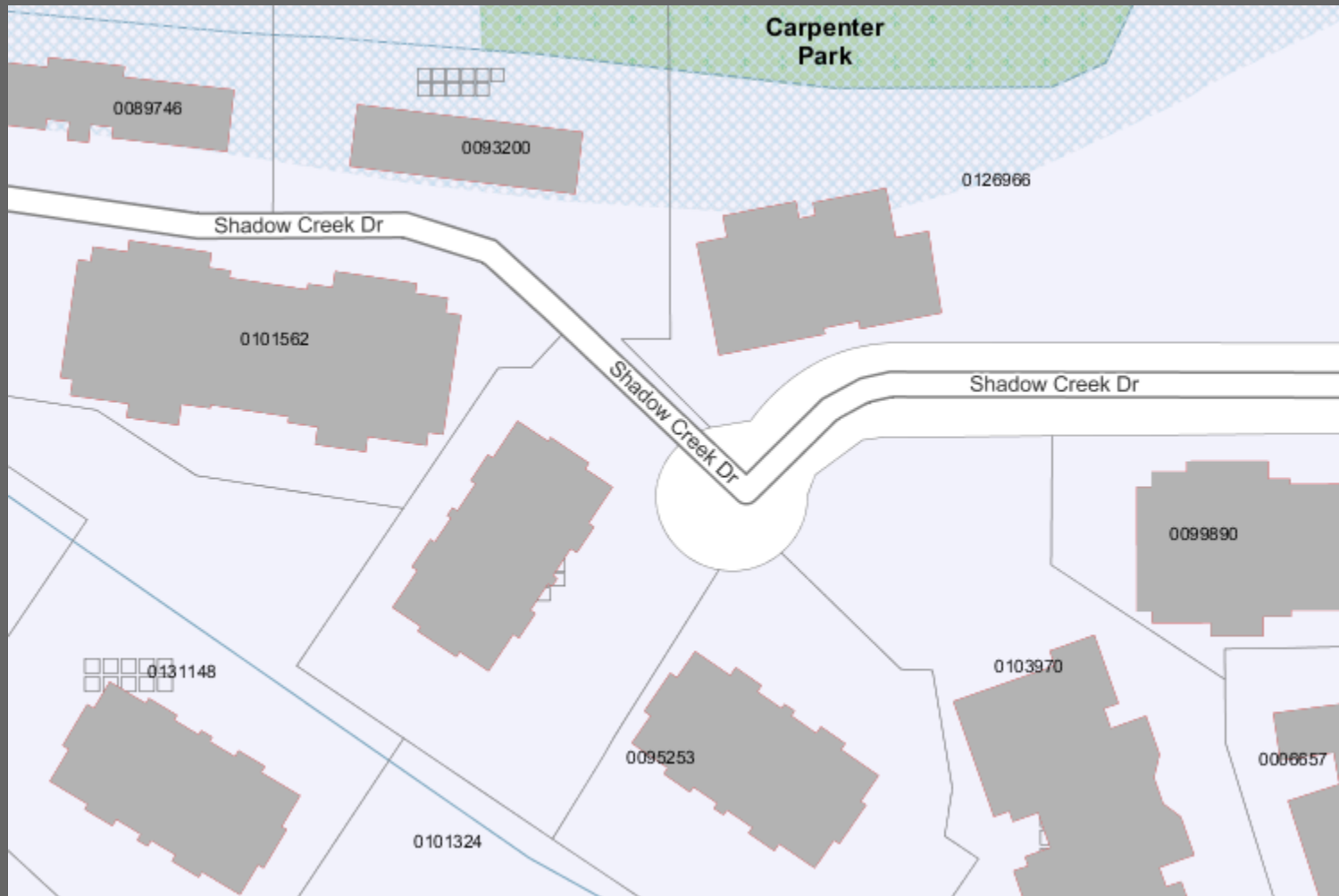
Example map



Example map



Example map

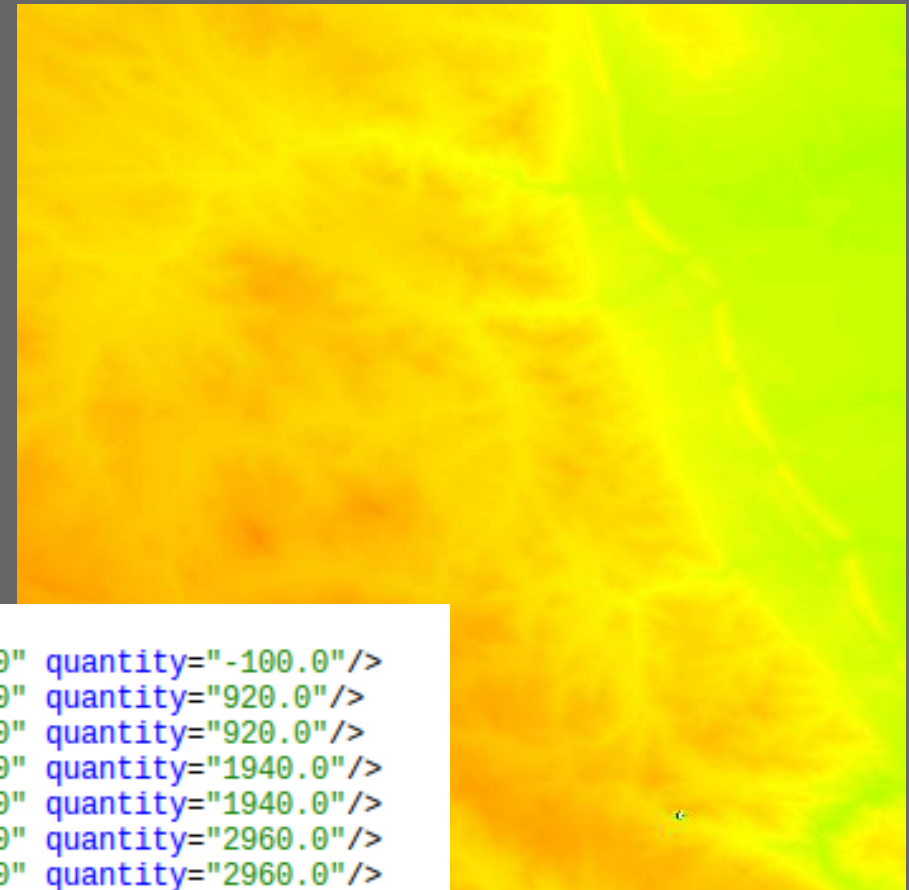


Raster styling

A DEM and a color map



- SRTM from USGS
- Standard color map
- Just avoid the nodata values with opacity=0
- A bit dull...



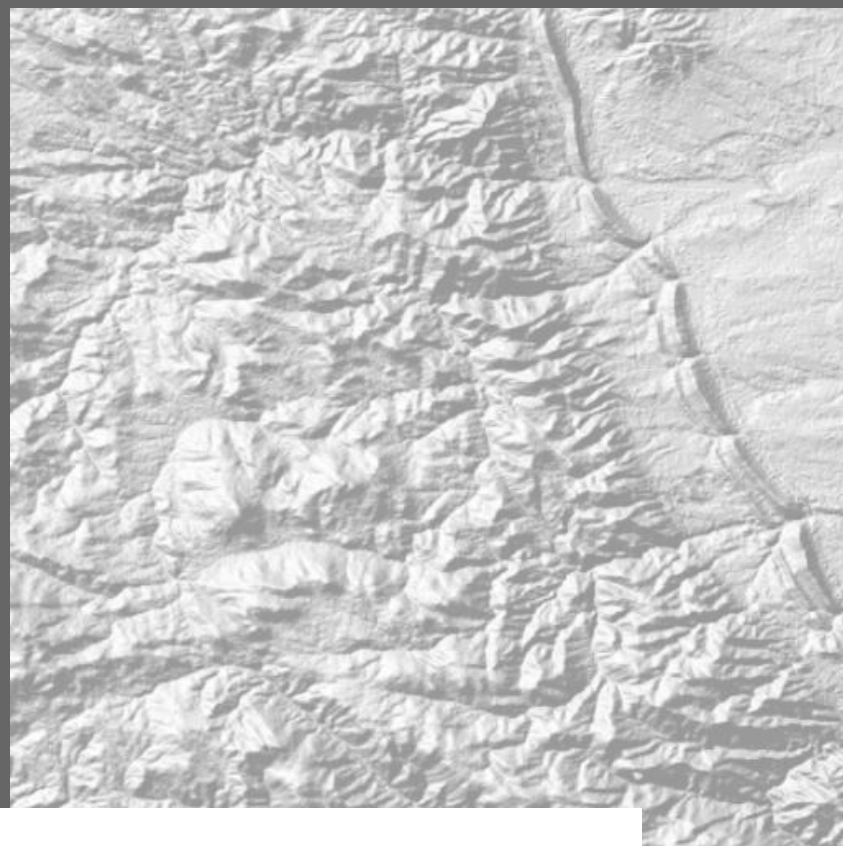
```
<sld:ColorMap>
  <sld:ColorMapEntry color="#00BFBF" opacity="0.0" quantity="-100.0"/>
  <sld:ColorMapEntry color="#00FF00" opacity="0.0" quantity="920.0"/>
  <sld:ColorMapEntry color="#00FF00" opacity="1.0" quantity="920.0"/>
  <sld:ColorMapEntry color="#FFFF00" opacity="1.0" quantity="1940.0"/>
  <sld:ColorMapEntry color="#FFFF00" opacity="1.0" quantity="1940.0"/>
  <sld:ColorMapEntry color="#FF7F00" opacity="1.0" quantity="2960.0"/>
  <sld:ColorMapEntry color="#FF7F00" opacity="1.0" quantity="2960.0"/>
  <sld:ColorMapEntry color="#BF7F3F" opacity="1.0" quantity="3980.0"/>
  <sld:ColorMapEntry color="#BF7F3F" opacity="1.0" quantity="3980.0"/>
  <sld:ColorMapEntry color="#141514" opacity="1.0" quantity="5000.0"/>
</sld:ColorMap>
```

Add hillshade



- GeoServer cannot do hillshade on its own now
- gdaldem to the rescue:

```
gdaldem hillshade -z 5 -s
111120 srtm_boulder.tiff
srtm_boulder_hs.tiff -co
tiled=yes
```



- Partially transparent

```
<sld:ColorMap>
  <sld:ColorMapEntry color="#000000" opacity="0.0" quantity="0.0"/>
  <sld:ColorMapEntry color="#999999" opacity="0.75" quantity="1.0"/>
  <sld:ColorMapEntry color="#FFFFFF" opacity="0.75" quantity="256.0"/>
</sld:ColorMap>
```

Overlay the two



Scale dependent rules

Scale dependent rules



- Too often forgotten or little used, yet very important:
 - Hide layers when too zoomed in (raster/vector example)
 - Progressively show details
 - Add more expensive rendering when there are less features
- Key to any high performance / good looking map

Example



Hide as you zoom in



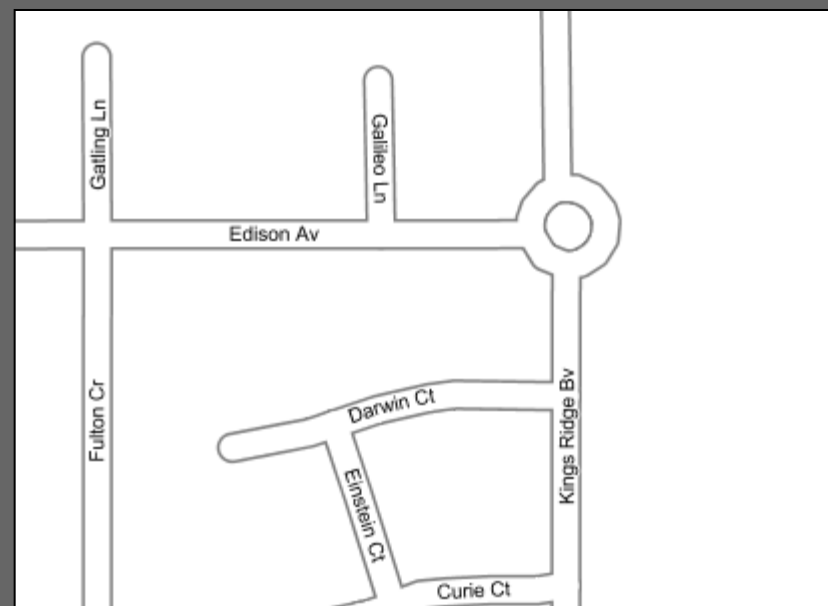
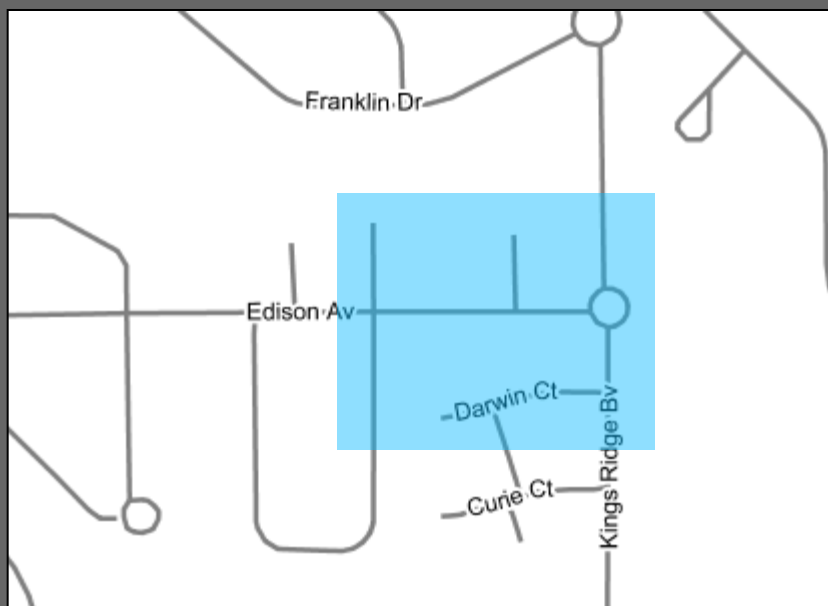
- Add a MinScaleDenominator to the rule
- This will make the layer disappear at 1:75000 (towards 1:1)

```
<sld:Rule>
  <sld:MinScaleDenominator>75000</sld:MinScaleDenominator>
  <sld:PolygonSymbolizer>
    <sld:Stroke>
      <sld:CssParameter name="stroke-width">4.0</sld:CssParameter>
    </sld:Stroke>
  </sld:PolygonSymbolizer>
  <sld:TextSymbolizer>
    <sld:Label>
      <ogc:PropertyName>NAMELSAD10</ogc:PropertyName>
    </sld:Label>
    <sld:Font>
      <sld:CssParameter name="font-family">Arial</sld:CssParameter>
      <sld:CssParameter name="font-size">20.0</sld:CssParameter>
      <sld:CssParameter name="font-style">normal</sld:CssParameter>
      <sld:CssParameter name="font-weight">bold</sld:CssParameter>
    </sld:Font>
  </sld:TextSymbolizer>
</sld:Rule>
```

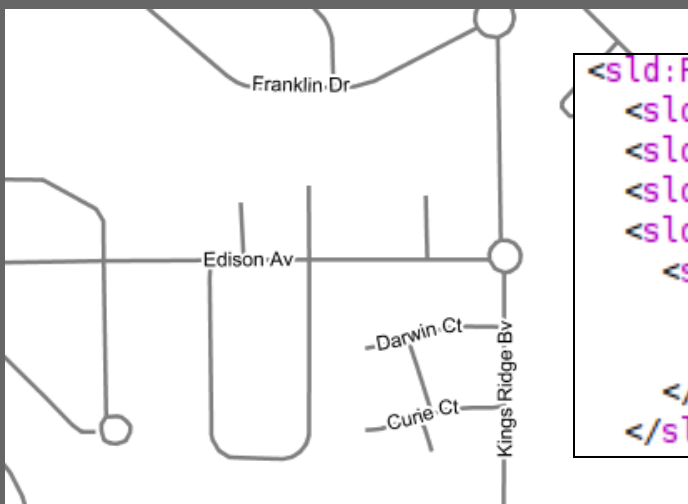
Alternative rendering



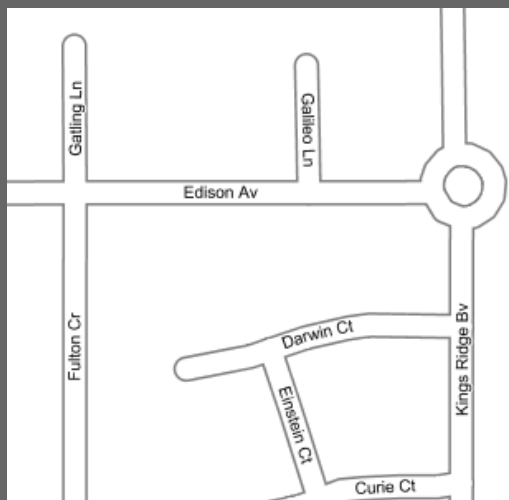
- Simple rendering at low scale (up to 1:2000)
- More complex rendering when zoomed in (1:1999 and above)



Alternative rendering



```
<sld:Rule>
  <sld:Name>Simple</sld:Name>
  <sld:MinScaleDenominator>10000.0</sld:MinScaleDenominator>
  <sld:MaxScaleDenominator>75000</sld:MaxScaleDenominator>
  <sld:LineSymbolizer>
    <sld:Stroke>
      <sld:CssParameter name="stroke">#7F7F7F</sld:CssParameter>
      <sld:CssParameter name="stroke-width">2.0</sld:CssParameter>
    </sld:Stroke>
  </sld:LineSymbolizer>
</sld:Rule>
```

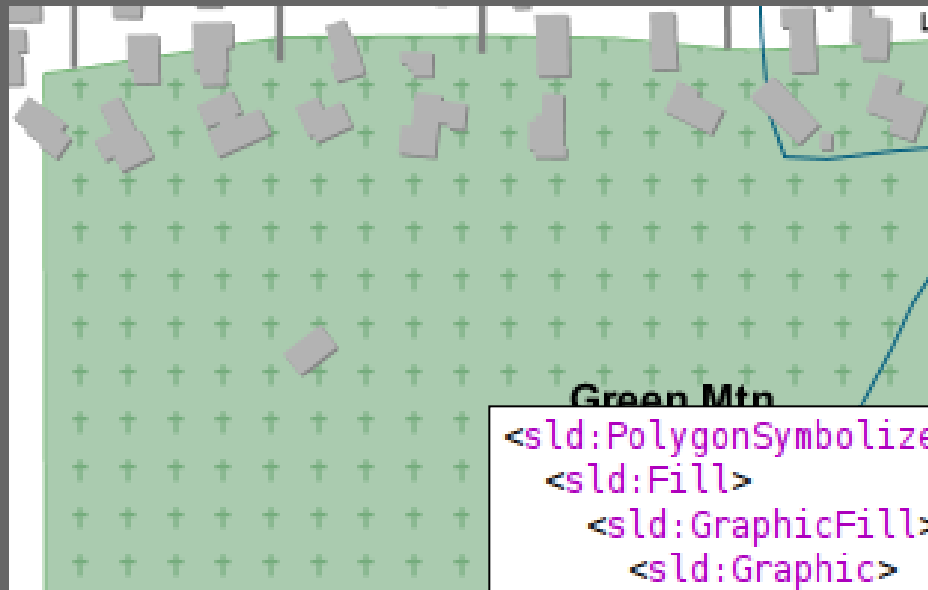


```
<sld:Rule>
  <sld:Name>Inner</sld:Name>
  <sld:MaxScaleDenominator>10000.0</sld:MaxScaleDenominator>
  <sld:LineSymbolizer>
    <sld:Stroke>
      <sld:CssParameter name="stroke">#FFFFFF</sld:CssParameter>
      <sld:CssParameter name="stroke-linecap">round</sld:CssParameter>
      <sld:CssParameter name="stroke-linejoin">round</sld:CssParameter>
      <sld:CssParameter name="stroke-width">12.0</sld:CssParameter>
    </sld:Stroke>
  </sld:LineSymbolizer>
</sld:Rule>
```

```
<sld:Rule>
  <sld:Name>Outer</sld:Name>
  <sld:MaxScaleDenominator>10000.0</sld:MaxScaleDenominator>
  <sld:LineSymbolizer>
    <sld:Stroke>
      <sld:CssParameter name="stroke">#7F7F7F</sld:CssParameter>
      <sld:CssParameter name="stroke-linecap">round</sld:CssParameter>
      <sld:CssParameter name="stroke-linejoin">round</sld:CssParameter>
      <sld:CssParameter name="stroke-width">15.0</sld:CssParameter>
    </sld:Stroke>
  </sld:LineSymbolizer>
</sld:Rule>
```

Hatches, patterns and dashes

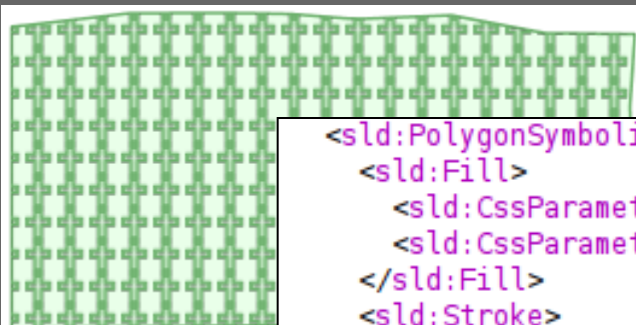
Filling with patterns



```
<sld:PolygonSymbolizer>
  <sld:Fill>
    <sld:GraphicFill>
      <sld:Graphic>
        <sld:ExternalGraphic>
          <sld:OnlineResource xlink:type="simple"
            xlink:href="./img/landmarks/area/grave_yard.png" />
          <sld:Format>image/png</sld:Format>
        </sld:ExternalGraphic>
      </sld:Graphic>
    </sld:GraphicFill>
  </sld:Fill>
</sld:PolygonSymbolizer>
```



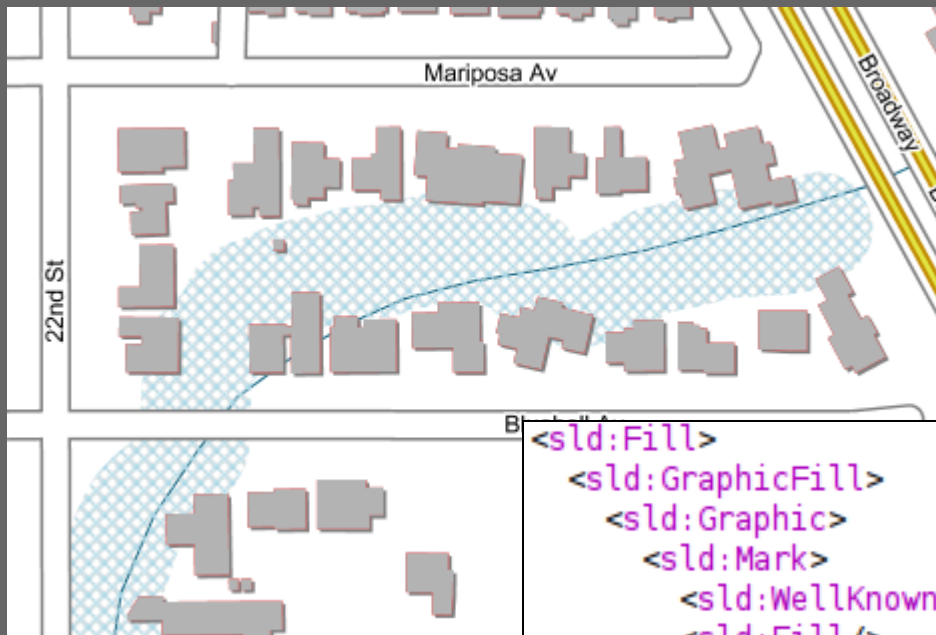
Filling with TTF fonts



```
<sld:PolygonSymbolizer>
  <sld:Fill>
    <sld:CssParameter name="fill">#D3FFD3</sld:CssParameter>
    <sld:CssParameter name="fill-opacity">0.5</sld:CssParameter>
  </sld:Fill>
  <sld:Stroke>
    <sld:CssParameter name="stroke">#6DB26D</sld:CssParameter>
  </sld:Stroke>
</sld:PolygonSymbolizer>
<sld:PolygonSymbolizer>
  <sld:Fill>
    <sld:GraphicFill>
      <sld:Graphic>
        <sld:Mark>
          <sld:WellKnownName>ttf://Wingdings#0x0055</sld:WellKnownName>
          <sld:Stroke>
            <sld:CssParameter name="stroke">#6DB26D</sld:CssParameter>
          </sld:Stroke>
        </sld:Mark>
        <sld:Size>16</sld:Size>
      </sld:Graphic>
    </sld:GraphicFill>
  </sld:Fill>
</sld:PolygonSymbolizer>
```

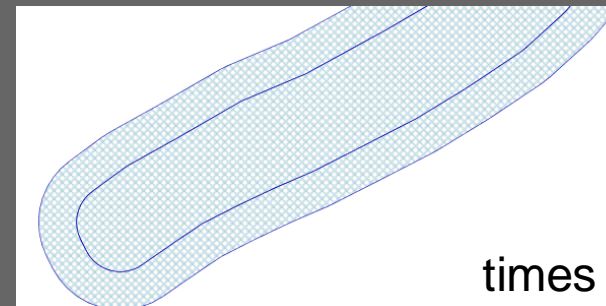
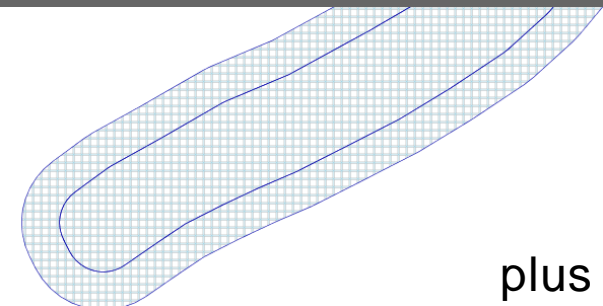
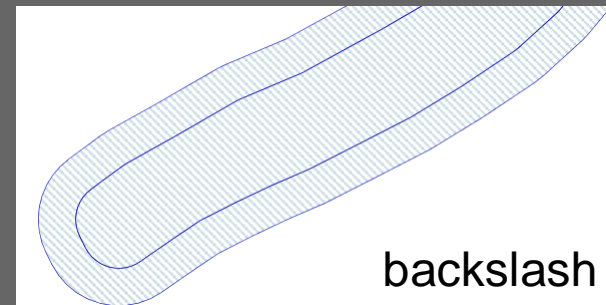
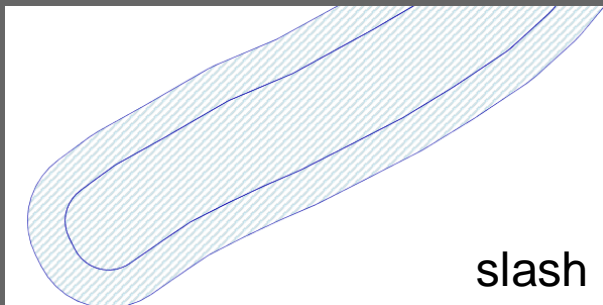
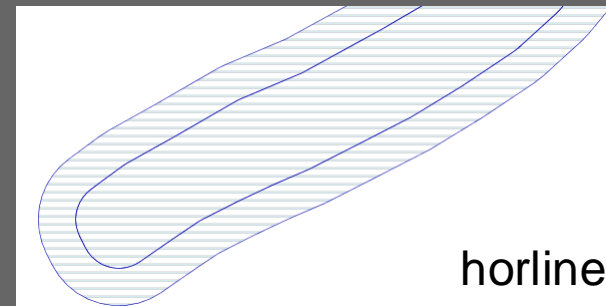
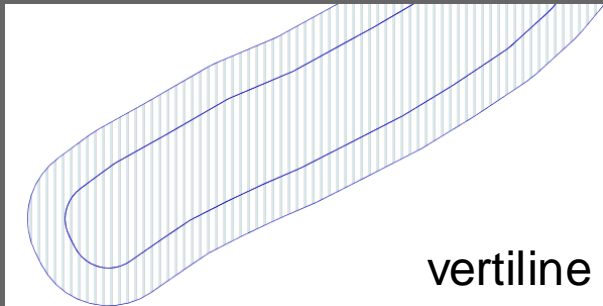
ttf:///<fontname>#<hexcode>

Hatches

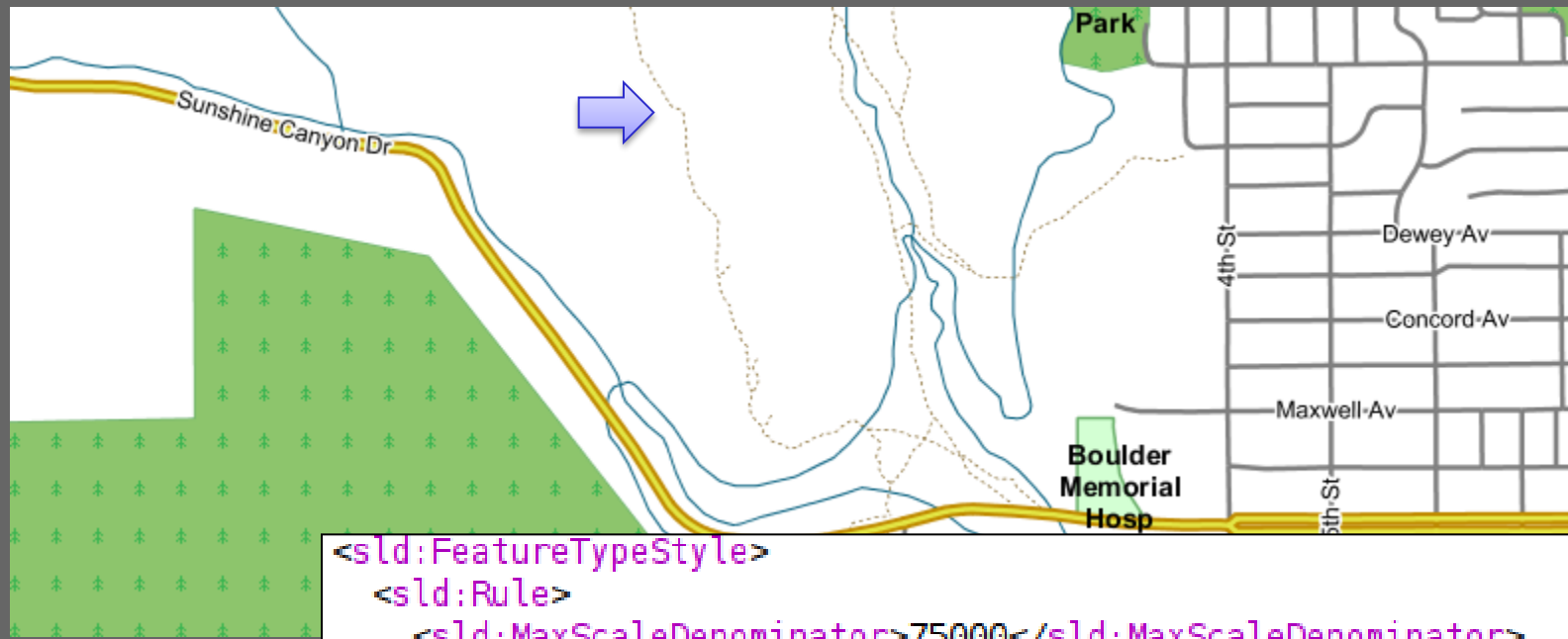


```
<sld:Fill>
  <sld:GraphicFill>
    <sld:Graphic>
      <sld:Mark>
        <sld:WellKnownName>shape://times</sld:WellKnownName>
        <sld:Fill/>
        <sld:Stroke>
          <sld:CssParameter name="stroke">#ADD8E6</sld:CssParameter>
          <sld:CssParameter name="stroke-width">1.0</sld:CssParameter>
        </sld:Stroke>
      </sld:Mark>
      <sld:Size>
        <ogc:Literal>8.0</ogc:Literal>
      </sld:Size>
    </sld:Graphic>
  </sld:GraphicFill>
</sld:Fill>
```


Hatches

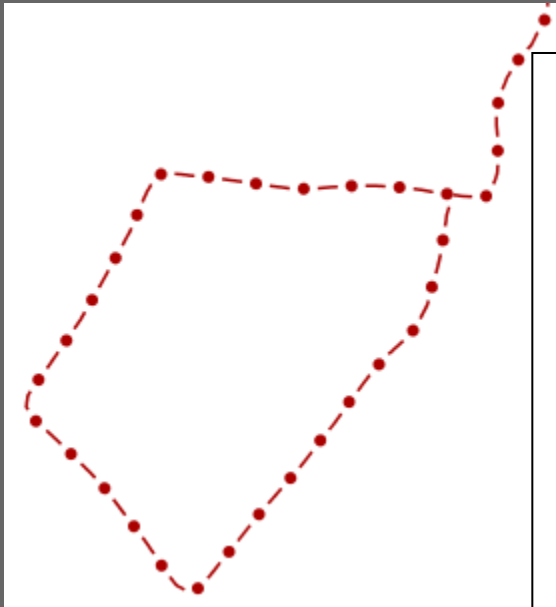


Dashes



```
<sld:FeatureTypeStyle>
  <sld:Rule>
    <sld:MaxScaleDenominator>75000</sld:MaxScaleDenominator>
    <sld:LineSymbolizer>
      <sld:Stroke>
        <sld:CssParameter name="stroke">#6B4900</sld:CssParameter>
        <sld:CssParameter name="stroke-width">0.1</sld:CssParameter>
        <sld:CssParameter name="stroke-dasharray">2.0</sld:CssParameter>
      </sld:Stroke>
    </sld:LineSymbolizer>
  </sld:Rule>
</sld:FeatureTypeStyle>
```

Dashes



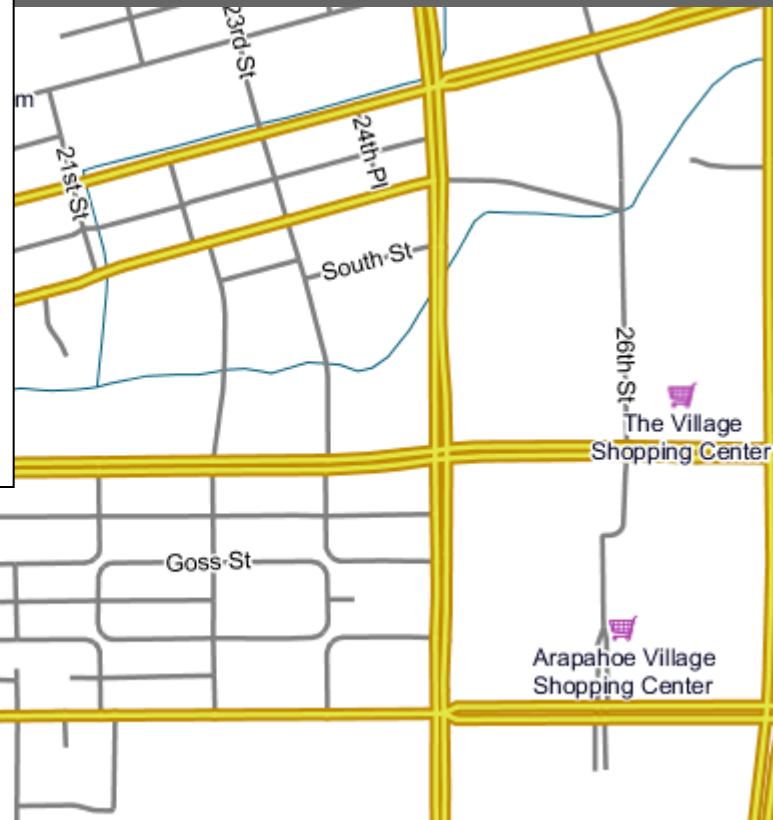
```
<sld:LineSymbolizer>
  <sld:Stroke>
    <sld:GraphicStroke>
      <sld:Graphic>
        <sld:Mark>
          <sld:WellKnownName>circle</sld:WellKnownName>
          <sld:Fill>
            <sld:CssParameter name="fill">#AA0000</sld:CssParameter>
          </sld:Fill>
        </sld:Mark>
        <sld:Size>
          <ogc:Literal>6</ogc:Literal>
        </sld:Size>
      </sld:Graphic>
    </sld:GraphicStroke>
    <sld:CssParameter name="stroke-dasharray">6 18</sld:CssParameter>
  </sld:Stroke>
</sld:LineSymbolizer>
<sld:LineSymbolizer>
  <sld:Stroke>
    <sld:CssParameter name="stroke">#AA0000</sld:CssParameter>
    <sld:CssParameter name="stroke-dasharray">10 14</sld:CssParameter>
    <sld:CssParameter name="stroke-dashoffset">14</sld:CssParameter>
  </sld:Stroke>
</sld:LineSymbolizer>
```

Point Symbolology

Point symbols



```
<sld:Name>shopping</sld:Name>
<ogc:Filter>
  <ogc:And>
    <ogc:PropertyIsEqualTo>
      <ogc:PropertyName>MTFCC</ogc:PropertyName>
      <ogc:Literal>C3081</ogc:Literal>
    </ogc:PropertyIsEqualTo>
    <ogc:PropertyIsLike wildCard="*" singleChar="#" escape="!">
      <ogc:PropertyName>FULLNAME</ogc:PropertyName>
      <ogc:Literal>*Shopping*</ogc:Literal>
    </ogc:PropertyIsLike>
  </ogc:And>
</ogc:Filter>
<sld:MaxScaleDenominator>75000</sld:MaxScaleDenominator>
<sld:PointSymbolizer>
  <sld:Graphic>
    <sld:ExternalGraphic>
      <sld:OnlineResource xlink:type="simple"
        xlink:href="./img/landmarks/shop_supermarket.p.16.png" />
      <sld:Format>image/png</sld:Format>
    </sld:ExternalGraphic>
  </sld:Graphic>
</sld:PointSymbolizer>
```



- 600 loc for 6 different points types
- Painful...

Prepare data

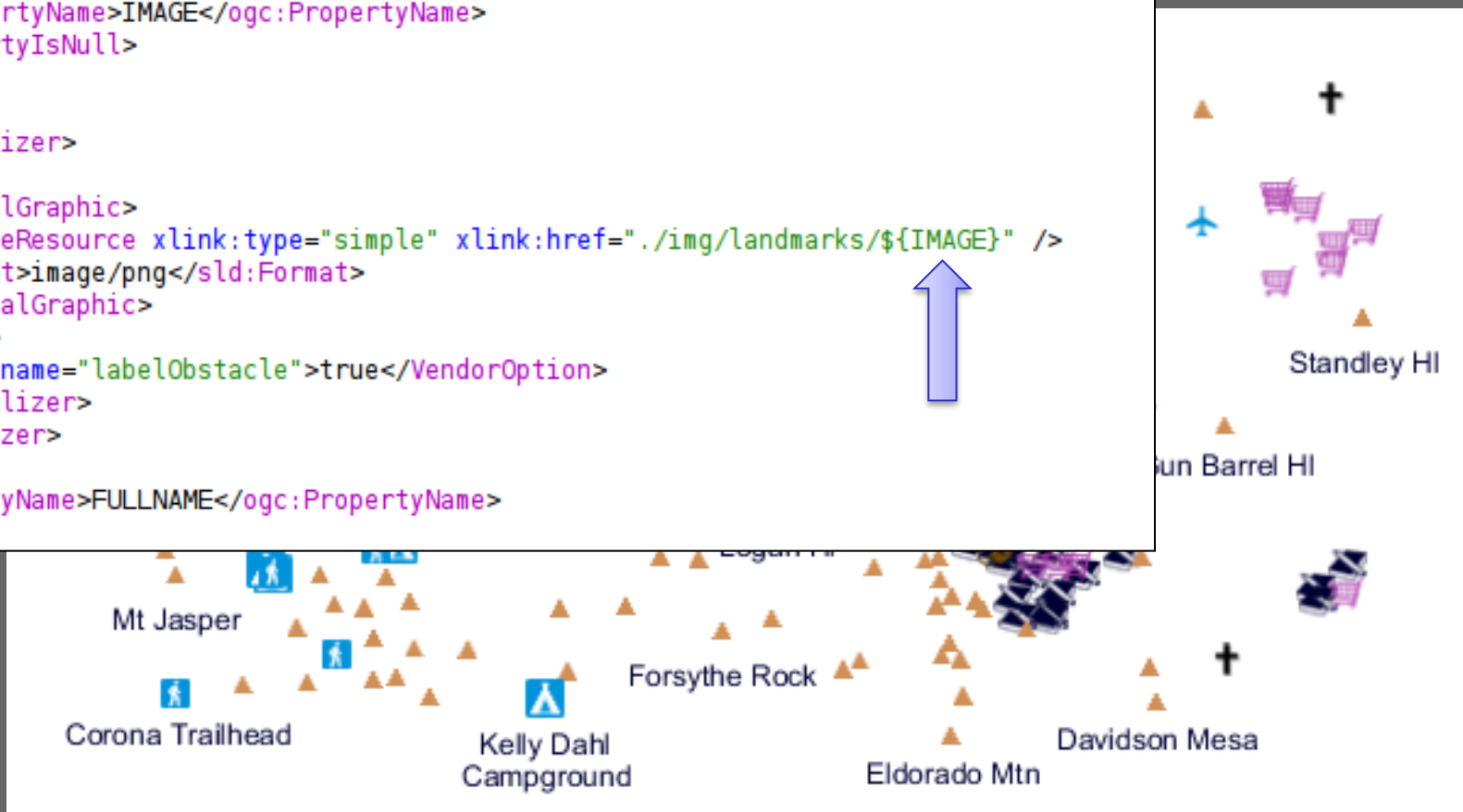


- `alter table pointlm add column image varchar;`
- `update pointlm set image = 'shop_supermarket.p.16.png' where MTFCC = 'C3081' and (FULLNAME like '%Shopping%' or FULLNAME like '%Mall%');`
- `update pointlm set image = 'peak.png' where MTFCC = 'C3022'`
- `update pointlm set image = 'amenity_prison.p.20.png' where MTFCC = 'K1236';`
- `update pointlm set image = 'museum.p.16.png' where MTFCC = 'K2165';`
- `update pointlm set image = 'airport.p.16.png' where MTFCC = 'K2451';`
- `update pointlm set image = 'school.png' where MTFCC = 'K2543';`
- `update pointlm set image = 'christian3.p.14.png' where MTFCC = 'K2582';`
- `update pointlm set image = 'gate2.png' where MTFCC = 'K3066';`

Dynamic symbolizers

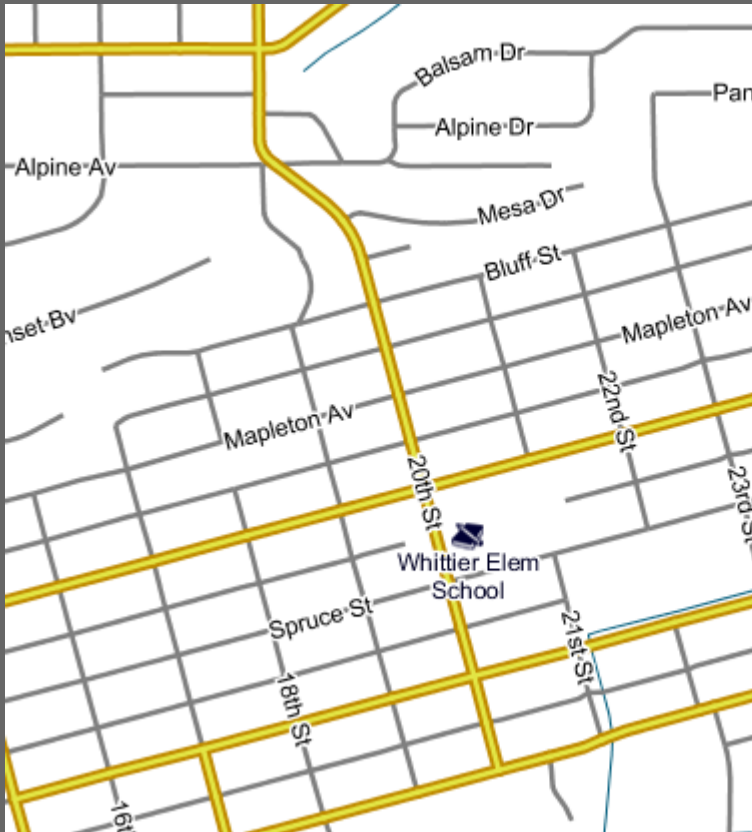


```
<sld:FeatureTypeStyle>
  <sld:Rule>
    <sld:Name>landmarks</sld:Name>
    <ogc:Filter>
      <ogc:Not>
        <ogc:PropertyIsNull>
          <ogc:PropertyName>IMAGE</ogc:PropertyName>
        </ogc:PropertyIsNull>
      </ogc:Not>
    </ogc:Filter>
    <sld:PointSymbolizer>
      <sld:Graphic>
        <sld:ExternalGraphic>
          <sld:OnlineResource xlink:type="simple" xlink:href="./img/landmarks/${IMAGE}" />
          <sld:Format>image/png</sld:Format>
        </sld:ExternalGraphic>
      </sld:Graphic>
      <VendorOption name="labelObstacle">true</VendorOption>
    </sld:PointSymbolizer>
    <sld:TextSymbolizer>
      <sld:Label>
        <ogc:PropertyName>FULLNAME</ogc:PropertyName>
      </sld:Label>
    </sld:TextSymbolizer>
  </sld:Rule>
</sld:FeatureTypeStyle>
```



Labeling

Line labels



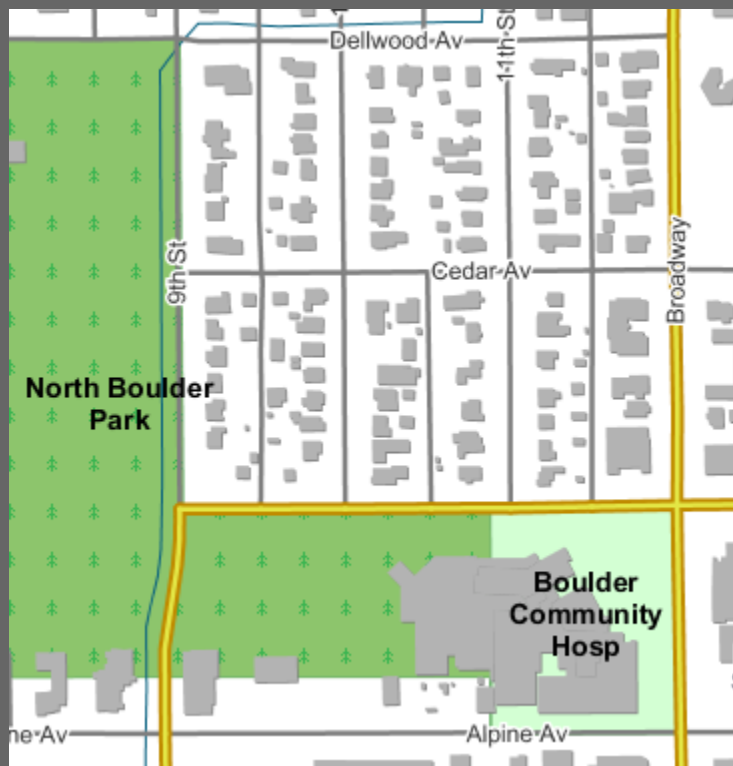
```
<sld:TextSymbolizer>
  <sld:Label>
    <ogc:PropertyName>LABEL_NAME</ogc:PropertyName>
  </sld:Label>
  <sld:Font>
    <sld:CssParameter name="font-family">Arial</sld:CssParameter>
    <sld:CssParameter name="font-size">12.0</sld:CssParameter>
    <sld:CssParameter name="font-style">normal</sld:CssParameter>
    <sld:CssParameter name="font-weight">normal</sld:CssParameter>
  </sld:Font>
  <sld:LabelPlacement>
    <sld:LinePlacement/>
  </sld:LabelPlacement>
  <sld:Halo>
    <sld:Radius>
      <ogc:Literal>1.5</ogc:Literal>
    </sld:Radius>
    <sld:Fill>
      <sld:CssParameter name="fill">#FFFFFF</sld:CssParameter>
    </sld:Fill>
  </sld:Halo>
  <sld:Fill>
    <sld:CssParameter name="fill">#000000</sld:CssParameter>
  </sld:Fill>
  <sld:Priority>500</sld:Priority>
  <sld:VendorOption name="followLine">true</sld:VendorOption>
  <sld:VendorOption name="repeat">250</sld:VendorOption>
  <sld:VendorOption name="group">yes</sld:VendorOption>
  <sld:VendorOption name="maxDisplacement">100</sld:VendorOption>
</sld:TextSymbolizer>
```

Point labels



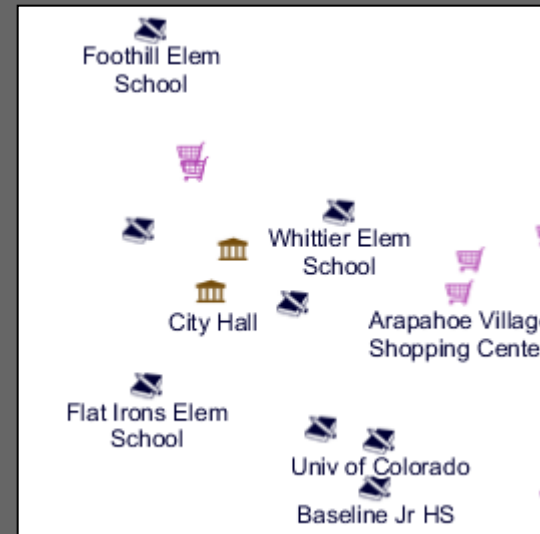
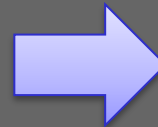
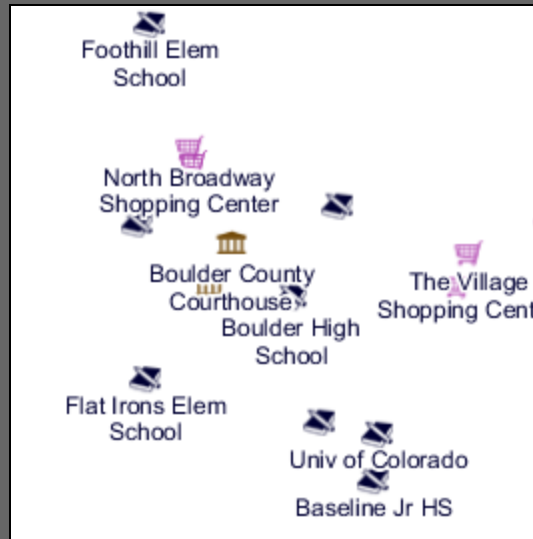
```
<sld:TextSymbolizer>
  <sld:Label>
    <ogc:PropertyName>FULLNAME</ogc:PropertyName>
  </sld:Label>
  <sld:Font>
    <sld:CssParameter name="font-family">Arial</sld:CssParameter>
    <sld:CssParameter name="font-size">12.0</sld:CssParameter>
    <sld:CssParameter name="font-style">normal</sld:CssParameter>
    <sld:CssParameter name="font-weight">normal</sld:CssParameter>
  </sld:Font>
  <sld:LabelPlacement>
    <sld:PointPlacement>
      <sld:AnchorPoint>
        <sld:AnchorPointX>0.5</sld:AnchorPointX>
        <sld:AnchorPointY>1.0</sld:AnchorPointY>
      </sld:AnchorPoint>
      <sld:Displacement>
        <sld:DisplacementX>0.0</sld:DisplacementX>
        <sld:DisplacementY>-10.0</sld:DisplacementY>
      </sld:Displacement>
    </sld:PointPlacement>
  </sld:LabelPlacement>
  <sld:Halo>
    <sld:Radius>1.5</sld:Radius>
    <sld:Fill>
      <sld:CssParameter name="fill">#FFFFFF</sld:CssParameter>
    </sld:Fill>
  </sld:Halo>
  <sld:Fill>
    <sld:CssParameter name="fill">#000033</sld:CssParameter>
  </sld:Fill>
  <sld:Priority>200000</sld:Priority>
  <sld:VendorOption name="autoWrap">100</sld:VendorOption>
</sld:TextSymbolizer>
```

Polygon labels



```
<sld:Label>
  <ogc:PropertyName>FULLNAME</ogc:PropertyName>
</sld:Label>
<sld:Font>
  <sld:CssParameter name="font-family">Arial</sld:CssParameter>
  <sld:CssParameter name="font-size">14.0</sld:CssParameter>
  <sld:CssParameter name="font-style">normal</sld:CssParameter>
  <sld:CssParameter name="font-weight">bold</sld:CssParameter>
</sld:Font>
<sld:LabelPlacement>
  <sld:PointPlacement>
    <sld:AnchorPoint>
      <sld:AnchorPointX>0.5</sld:AnchorPointX>
      <sld:AnchorPointY>0.5</sld:AnchorPointY>
    </sld:AnchorPoint>
  </sld:PointPlacement>
</sld:LabelPlacement>
<sld:Fill>
  <sld:CssParameter name="fill">#000000</sld:CssParameter>
</sld:Fill>
<sld:Priority>50000</sld:Priority>
<sld:VendorOption name="autoWrap">100</sld:VendorOption>
<sld:VendorOption name="maxDisplacement">200</sld:VendorOption>
<sld:VendorOption name="goodnessOfFit">0.9</sld:VendorOption>
```


Label Obstacles



```
<sld:PointSymbolizer>
  <sld:Graphic>
    <sld:ExternalGraphic>
      <sld:OnlineResource xlink:type="simple" xlink:href="./img/landmarks/shop_supermarket.p.16.png" />
      <sld:Format>image/png</sld:Format>
    </sld:ExternalGraphic>
  </sld:Graphic>
  <VendorOption name="labelObstacle">true</VendorOption>
</sld:PointSymbolizer>
```

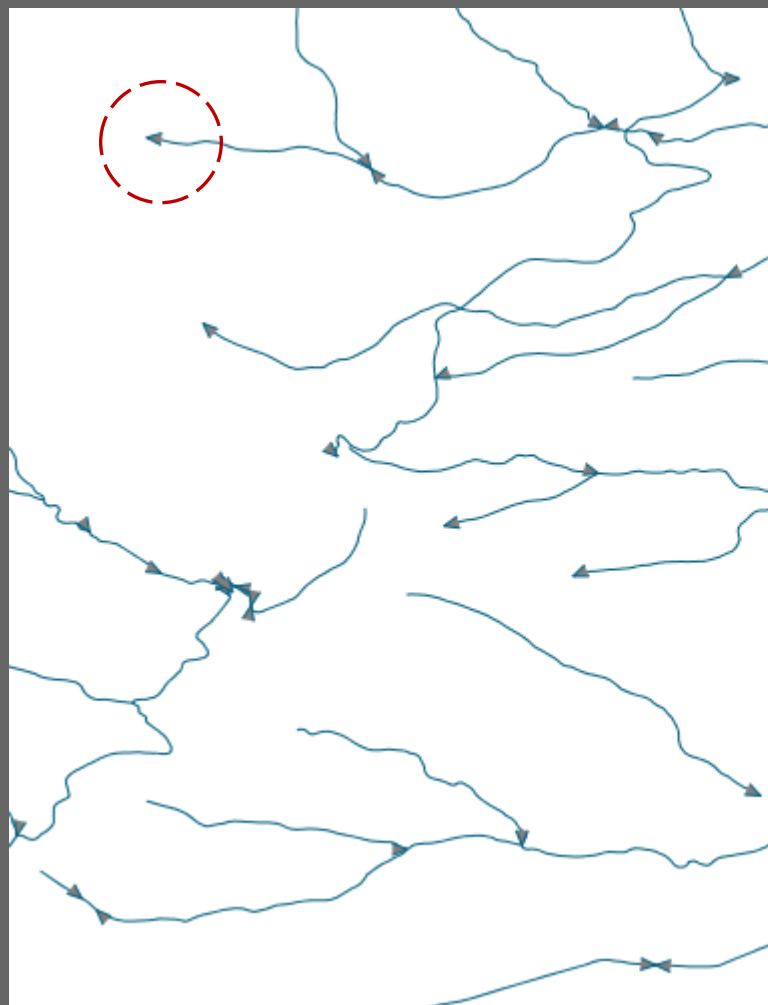
Transformations

Geometry transformations



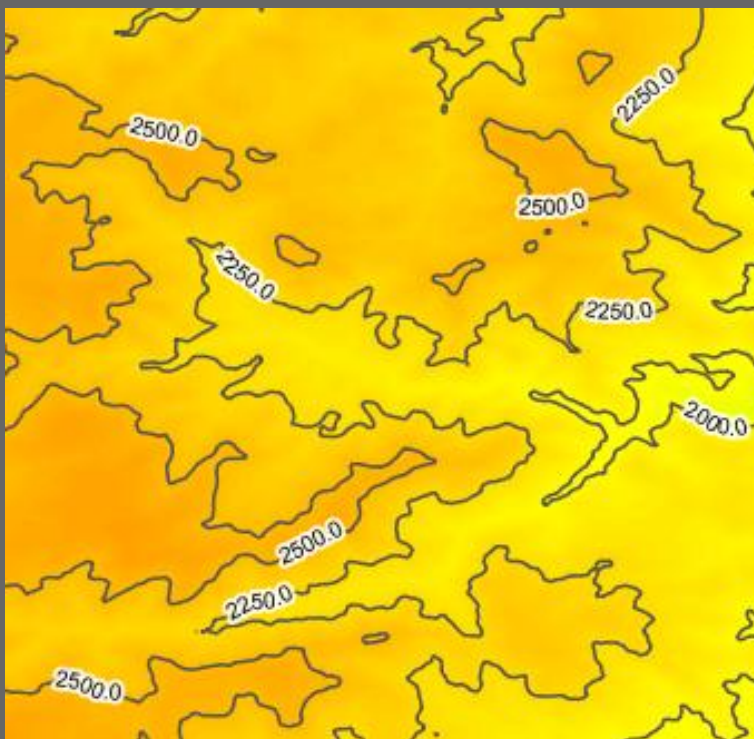
```
<sld:FeatureTypeStyle>
  <sld:Rule>
    <sld:Name>Shadow</sld:Name>
    <sld:MinScaleDenominator>5000.0</sld:MinScaleDenominator>
    <sld:MaxScaleDenominator>15000.0</sld:MaxScaleDenominator>
    <sld:PolygonSymbolizer>
      <sld:Geometry>
        <ogc:Function name="offset">
          <ogc:PropertyName>the_geom</ogc:PropertyName>
          <ogc:Literal>3.0</ogc:Literal>
          <ogc:Literal>-3.0</ogc:Literal>
        </ogc:Function>
      </sld:Geometry>
      <sld:Fill/>
    </sld:PolygonSymbolizer>
  </sld:Rule>
</sld:FeatureTypeStyle>
<sld:FeatureTypeStyle>
  <sld:Rule>
    <sld:Name>Fill</sld:Name>
    <sld:MaxScaleDenominator>25000.0</sld:MaxScaleDenominator>
    <sld:PolygonSymbolizer>
      <sld:Fill>
        <sld:CssParameter name="fill">#B3B3B3</sld:CssParameter>
      </sld:Fill>
    </sld:PolygonSymbolizer>
  </sld:Rule>
</sld:FeatureTypeStyle>
```

Geometry transformations



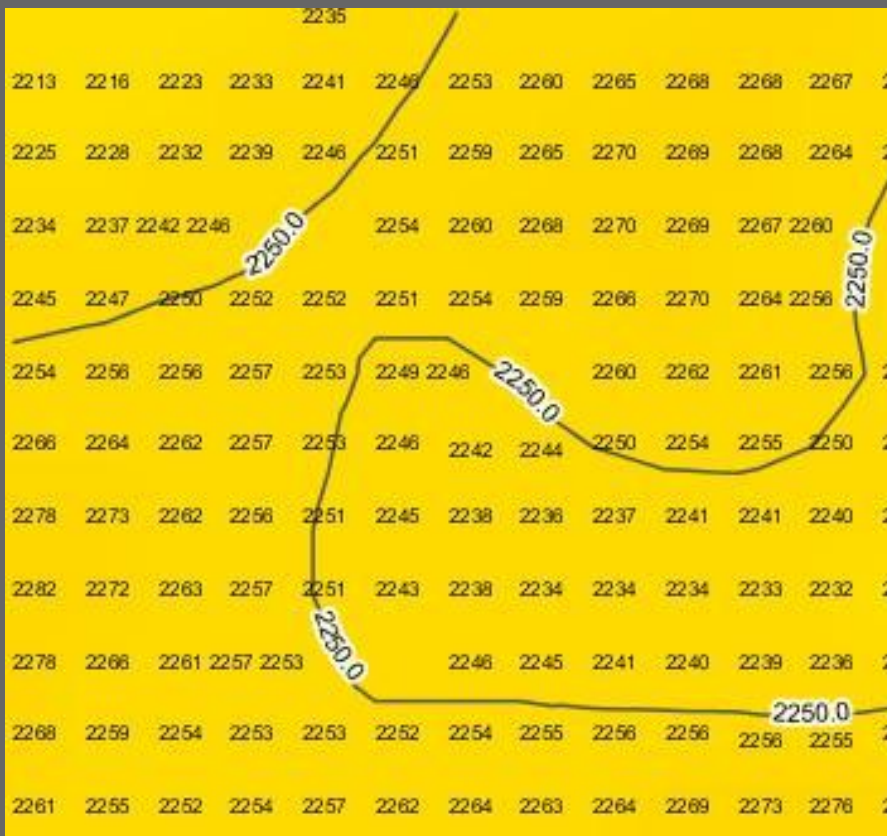
```
<PointSymbolizer>
  <Geometry>
    <ogc:Function name="endPoint">
      <ogc:PropertyName>the_geom</ogc:PropertyName>
    </ogc:Function>
  </Geometry>
  <Graphic>
    <Mark>
      <WellKnownName>shape://oarrow</WellKnownName>
      <Fill />
      <Stroke>
        <CssParameter name="stroke-width">1</CssParameter>
        <CssParameter name="stroke">#06607F</CssParameter>
      </Stroke>
    </Mark>
    <Size>15</Size>
    <Rotation>
      <ogc:Function name="endAngle">
        <ogc:PropertyName>the_geom</ogc:PropertyName>
      </ogc:Function>
    </Rotation>
  </Graphic>
</PointSymbolizer>
```

Rendering transformations



```
<FeatureTypeStyle>
  <Transformation>
    <ogc:Function name="gs:Contour">
      <ogc:Function name="parameter">
        <ogc:Literal>data</ogc:Literal>
      </ogc:Function>
      <ogc:Function name="parameter">
        <ogc:Literal>levels</ogc:Literal>
        <ogc:Literal>1000</ogc:Literal>
        <ogc:Literal>1250</ogc:Literal>
        <ogc:Literal>1500</ogc:Literal>
        <ogc:Literal>1750</ogc:Literal>
        <ogc:Literal>2000</ogc:Literal>
        <ogc:Literal>2250</ogc:Literal>
        <ogc:Literal>2500</ogc:Literal>
        <ogc:Literal>2750</ogc:Literal>
        <ogc:Literal>3000</ogc:Literal>
        <ogc:Literal>3250</ogc:Literal>
        <ogc:Literal>3500</ogc:Literal>
      </ogc:Function>
    </ogc:Function>
  </Transformation>
  <Rule>
    <Name>Contour</Name>
    <LineSymbolizer>
      <Stroke>
        <CssParameter name="stroke">#555555</CssParameter>
      </Stroke>
    </LineSymbolizer>
    <TextSymbolizer>
```

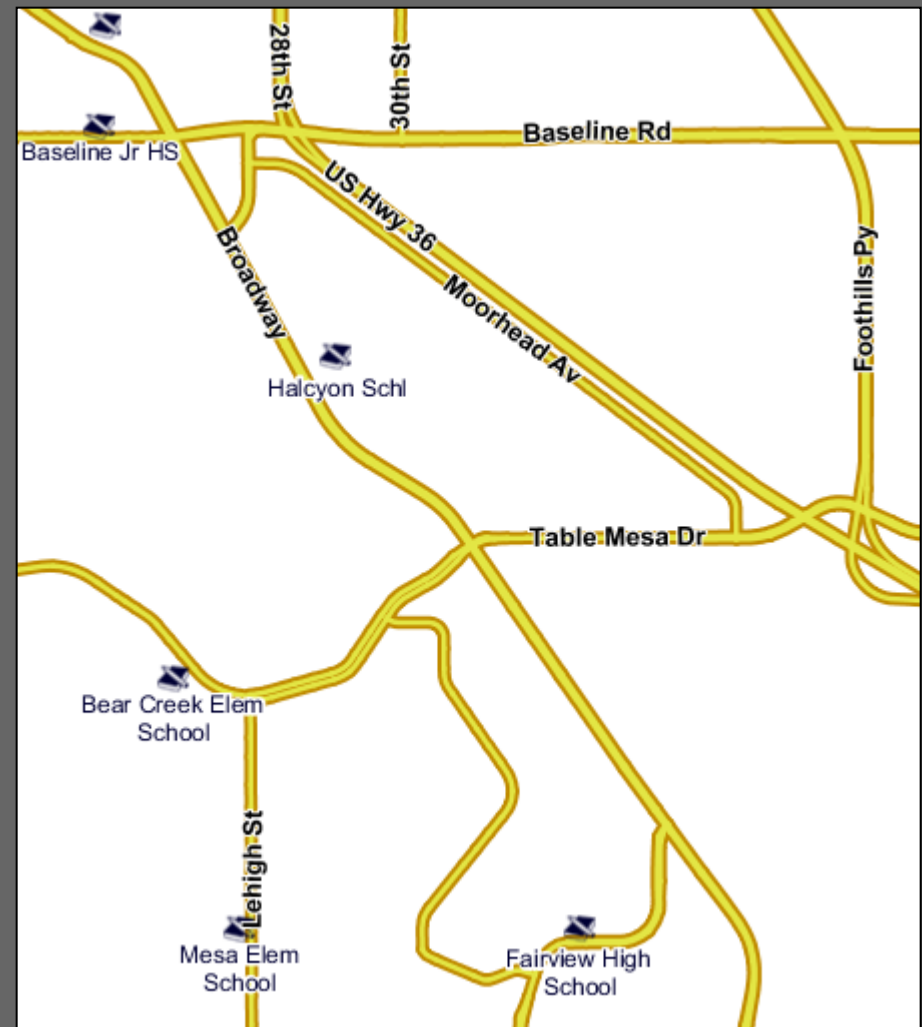

Rendering transformations



```
<FeatureTypeStyle>
  <Transformation>
    <ogc:Function name="gs:RasterAsPointCollection">
      <ogc:Function name="parameter">
        <ogc:Literal>data</ogc:Literal>
      </ogc:Function>
    </ogc:Function>
  </Transformation>
  <Rule>
    <maxScaleDenominator>4000</maxScaleDenominator>
    <TextSymbolizer>
      <Label>
        <ogc:PropertyName>GRAY_INDEX</ogc:PropertyName>
      </Label>
      <Font>
        <CssParameter name="font-family">Arial</CssParameter>
        <CssParameter name="font-style">Normal</CssParameter>
        <CssParameter name="font-size">8</CssParameter>
      </Font>
      <Fill>
        <CssParameter name="fill">#000000</CssParameter>
      </Fill>
    </TextSymbolizer>
  </Rule>
</FeatureTypeStyle>
```


Cross layer filtering

Cross layer filtering



Get all schools close at less than 200m from a main road

Cross layer filtering



- Get all the main roads
- Turn then into a single geometry
- Get all the schools within 500 meters from the geometry just created

```
CQL_FILTER =  
  MTFCC='K2543' AND  
    DWITHIN(the_geom,  
      collectGeometries(  
        queryCollection('foss4g:Mainrd',  
          'the_geom', 'INCLUDE')),  
      500, meters)
```

Demo and styles



- Demo of most these examples here:
 - <http://demo1.geo-solutions.it/playground/wms/reflect?layers=boulder&format=application/openlayers>
 - http://demo1.geo-solutions.it/playground/wms/reflect?layers=boulder_dem_tx&format=application/openlayers
- Full data, styles and configuration, ready to use:
 - http://demo.geo-solutions.it/share/foss4g_data_dir.tar.gz
- Get the slides: <http://geo-solutions.blogspot.com/>

The End



Questions?

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