Data Visualization: Principles and Techniques

Rene Rubalcava

slides: https://git.io/Je0yD
Principles
Audience

- Who are your users?
- Public
- Internal
- Engineers
- Know your customers
Visual Contrast

• How map features and page elements contrast
• Distinguish between objects and features
Legibility

- the ability to be seen and understood
- Selecting symbols
- Appropriate sizes
Figure-Ground Organization

- Spontaneous separation of the figure in the foreground from an “amorphous” background
- Where should viewer focus
Hierarchical Organization

- Separate meaningful characteristics and to portray likenesses
- Visual separation of your map into layers
- Levels of importance
Balance

- Organization of map and elements
- Print media varies from Web media
Interactivity

- Provide clarity
- Try not to confuse
Visualization
What can we visualize?

• Where?
• What?
• When?
• Multivariate
Symbols

- Based on geometry type
- Points
  - SimpleMarkerSymbol, PictureMarkerSymbol, WebStyleSymbol, CIMSymbol
- Lines
  - SimpleLineSymbol
- Polygon
  - SimpleFillSymbol, PictureFillSymbol
var marker = new SimpleMarkerSymbol({
  style: "diamond",
  outline: {
    width: 1.75,
    color: [76, 115, 0, 0.75]
  },
  color: [170, 255, 0, 1]
});

var fill = new SimpleFillSymbol({
  outline: {
    width: 1.75,
    color: 0x00000000
  }
});
Data

- FeatureCollection
- FeatureLayer
- MapImageLayer
- CSVLayer
- GeoJSONLayer
- StreamLayer
Data-driven

- Field value(s)
  - TOTAL_POP

- Arcade expression
  - Round( ($feature.BACHELOR + $feature.MASTER) / $feature.POP_25UP) );
Renderers

SimpleRenderer

```javascript
layer.renderer = new SimpleRenderer(
    symbol: createSymbol("#ff002e")
);
```

ClassBreaksRenderer

```javascript
var renderer = new ClassBreaksRenderer(
    field: "population",
    classBreakInfos: [
        { minValue: 0, maxValue: 2500, symbol: createSymbol("#f8e3c2", 3) },
        { minValue: 2500, maxValue: 15000, symbol: createSymbol("#e5998c", 6) },
        { minValue: 15000, maxValue: 75000, symbol: createSymbol("#d86860", 12) },
        { minValue: 75000, maxValue: 1000000, symbol: createSymbol("#9b3557", 22) }
    ]
);
```

UniqueValueRenderer

```javascript
var renderer = new UniqueValueRenderer(
    valueExpression: `var parties = [$feature.MP06025a_B, $feature.MP06024a_B, $feature.MP06026a_B];
return Decode( Max(parties), $feature.MP06025a_B, 'republican', $feature.MP06024a_B, 'democrat', $feature.MP06026a_B, 'independent', 'n/a');`,
    valueExpressionTitle: "Election Winner",
    uniqueValueInfos: [
        { value: "democrat", symbol: createSymbol("#0033ff"), label: "Democrat" },
        { value: "republican", symbol: createSymbol("#ff002e"), label: "Republican" },
        { value: "independent", symbol: createSymbol("#fa5f5d"), label: "Independent/other party" }
    ]
);
```
Visual Variables

- For numeric data-driven continuous visualizations
  - Color
  - Size
  - Opacity
  - Rotation
Renderers
Visual Variables

```javascript
var strengthArcade = document.getElementById("strength").text;
renderer.visualVariables = [{
  type: "opacity",
  valueExpression: strengthArcade,
  valueExpressionTitle: "Share of registered voters",
  stops: [
    { value: 33, opacity: 0.05, label: "< 33%" },
    { value: 44, opacity: 1.0, label: "> 44%" }
  ]
}];
```
Smart Mapping
Age in years, from INSPECTION_DATE to 2/25/2019:

- > 13
- 6.8
- < 4.4
- Other
Relationship
Predominance
Data Exploration

- Demo
Client-Side

- Client-side queries
- Fast visual variable updates
- Heatmap
const dotDensityRenderer = new DotDensityRenderer({
  dotValue: 100,
  outline: null,

  referenceScale: 577790, // 1:577,790 view scale
  legendOptions: { unit: "people" },
  attributes: [
    {
      field: "B03002_003E",
      color: "#f23c3f",
      label: "White (non-Hispanic)"
    },
  ]
})
2D WebStyles (CIM)
// Update renderer with new web style symbol

```javascript
function updateRenderer() {
  let renderer = layer.renderer.clone;
  var cb = renderer.classBreakInfos[0];
  cb.symbol = new WebStyleSymbol({
    name: "school",
    styleName: "Esri2DPointSymbolsStyle"
  });
  layer.renderer = renderer;
  map.add(layer);
}
```
new DictionaryRenderer(
  url: url,
  fieldMap: {
    fuel_type: "Fuel_Type_Code",
    connector_types: "EV_Connector_Types",
    network: "EV_Network",
    name: "Station_Name"
  },
  config: {
    show_label: "true"
  }
)
Resources

• Design principles for cartography
• Make your histogram legendary
Please take our survey on the app.

1. Download the Esri Events app and find your event.
2. Select the session you attended.
3. Scroll down to find the feedback section.
4. Complete answers and select “Submit”.

Esri European Developer Summit
November 4-6, 2019
Hilton Berlin, Germany

Esri Ocean and Atmospheric GIS Forum
November 5-7, 2019
New Orleans, Louisiana

Esri Mid-Atlantic User Conference
November 7-8, 2019
New Orleans, Louisiana

ArcGIS Runtime SDKs: Using Augmented Reality (AR)
Salon Humboldt

The title and description were consistent with the content. (*)
1. Poor
2. Average
3. Excellent

The presentation was well organized and clear. (*)
1. Poor
2. Average
3. Excellent

How was the presenter's public speaking skills? (*)
1. Poor
2. Average
3. Excellent

The content of the workshop was relevant to my work. (*)
1. No
2. Yes

The workshop provided information or techniques I can apply to my work right away. (*)
1. Poor
2. Average
3. Excellent