Visualization Systems & Toolkits

8803DV CS/MGT
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Systems/tools that help people create visualizations or use visualizations to help people explore and analyze data.

Toolkits are components/libraries/packages that help developers/designers build these visualization systems.
Data Exploration and Analysis Tools

Visualization Authoring Tools

Toolkits and Grammars
Data Exploration and Analysis Tools

Visualization Authoring Tools

Toolkits and Grammars
Automated exploratory analysis tools

Semi-automated visual analysis tools
Automated exploratory analysis tools

Semi-automated visual analysis tools
Microsoft Power BI

Video
Microsoft Power BI

- Naturalistic data analysis
- Support complex workflows
- Integrate multiple data sources
- Automatic dashboards
Exploratory visualizations to start with

Recommendations of attributes and charts

Great for EDA
Ecoxight

Video
Ecoxight

Network visualizations

Beyond node-link diagrams (time, geo, etc.)
Automated exploratory analysis tools

Semi-automated visual analysis tools
Interactive Data Exploration and Analysis Tools
Data Exploration and Analysis Tools

Visualization Authoring Tools

Toolkits and Grammars
Customization & Control?

Data Exploration and Analysis Tools

Visualization Authoring Tools

Toolkits and Grammars

Vega & Vega-Lite
Data Exploration and Analysis Tools

Visualization Authoring Tools

Toolkits and Grammars

INFOVIS
iVisDesigner

- Programming free custom visualizations
- Drawing tool style interactions
- Supports tons of visualizations
Data-Driven Guides

Infographics (remember them?)

Incorporating data into images enables new levels of customization

Photoshop like interaction
Data Exploration and Analysis Tools

Visualization Authoring Tools

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Interaction & Reproducibility?

Toolkits and Grammars
Data Exploration and Analysis Tools

Visualization Authoring Tools

Toolkits and Grammars
Fine-grained building blocks for constructing visualizations

Includes layout algorithms, navigation and interaction techniques

Java-based

Laid the foundation for other toolkits (e.g., Flare) and several visualization systems (e.g., DOI Trees (AVI '04), Vizster (InfoVis '05))
Protovis is no longer under active development.

The final release of Protovis was v3.3.1 (4.7 MB). The Protovis team is now developing a new visualization library, D3.js, with improved support for animation and interaction. D3 builds on many of the concepts in Protovis; for more details, please read the introduction and browse the examples.

This project was led by Mike Bostock and Jeff Heer of the Stanford Visualization Group, with significant help from Vadim Ogievetsky. We welcome your comments and suggestions.

Updates

June 28, 2011 - Protovis is no longer under active development. We recommend switching to D3.js!
New toolkit following a *declarative model*

- Focus on the “what” more than the “how”

Simple grammar of graphical primitives called *marks*
**D3.js** is a JavaScript library for manipulating documents based on data. **D3** helps you bring data to life using HTML, SVG, and CSS. D3's emphasis on web standards gives you the full capabilities of modern browsers without tying yourself to a proprietary framework, combining powerful visualization components and a data-driven approach to DOM manipulation.

Uses explicitly of web standards such as Scalable Vector Graphics (SVG) rather than a proprietary “marks” graphics set

Not just an InfoVis toolkit

TONS of examples and very well documented!!
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https://d3js.org/
D3.js in action

<table>
<thead>
<tr>
<th>Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedan</td>
<td>50</td>
</tr>
<tr>
<td>SUV</td>
<td>20</td>
</tr>
<tr>
<td>Sports</td>
<td>30</td>
</tr>
<tr>
<td>Minivan</td>
<td>100</td>
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D3.js in action

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Vega – A Visualization Grammar

Vega is a visualization grammar, a declarative language for creating, saving, and sharing interactive visualization designs. With Vega, you can describe the visual appearance and interactive behavior of a visualization in a JSON format, and generate web-based views using Canvas or SVG.

Vega provides basic building blocks for a wide variety of visualization designs: data loading and transformation, scales, map projections, axes, legends, and graphical marks such as rectangles, lines, plotting symbols, etc. Interaction techniques can be specified using reactive signals that dynamically modify a visualization in response to input event streams.

A Vega specification defines an interactive visualization in a JSON format. Specifications are parsed by Vega’s JavaScript runtime to generate both static images or interactive web-based views. Vega provides a convenient representation for computational generation of visualizations, and can serve as a foundation for new APIs and visual analysis tools.

To get started with Vega, take a look at the tutorials, example gallery, and usage guide, or read about the project’s goals. To create common statistical graphics in a more concise form, check out Vega-Lite, a higher-level language built on top of Vega.

Vega – A Visualization Grammar

```json
{
  "width": 400,
  "height": 200,
  "padding": {"top": 10, "left": 30, "bottom": 30, "right": 10},
  "data": [
    {
      "name": "table",
      "values": [
        {"x": 1, "y": 28}, {"x": 2, "y": 55},
        {"x": 3, "y": 43}, {"x": 4, "y": 91},
        {"x": 5, "y": 81}, {"x": 6, "y": 53},
        {"x": 7, "y": 19}, {"x": 8, "y": 87},
        {"x": 9, "y": 52}, {"x": 10, "y": 48},
        {"x": 11, "y": 24}, {"x": 12, "y": 49},
        {"x": 13, "y": 87}, {"x": 14, "y": 66},
        {"x": 15, "y": 17}, {"x": 16, "y": 27},
        {"x": 17, "y": 68}, {"x": 18, "y": 16},
        {"x": 19, "y": 49}, {"x": 20, "y": 15},
        ...
      ],
      "scales": [...
        {
          "name": "x",
          "type": "ordinal",
          "range": "width",
          "domain": {"data": "table", "field": "x"}
        },
        ...
      ],
      "axes": [{
        "type": "x", "scale": "x"},
        "type": "y", "scale": "y"
      }
    },
    "marks": [
      {
        "type": "rect",
        "from": {"data": "table"},
        "properties": {
          "enter": {
            "x": {"scale": "x", "field": "x"},
            "width": {"scale": "x", "band": true, "offset": -1},
            "y": {"scale": "y", "field": "y"},
            "y2": {"scale": "y", "value": 0}
          },
          "update": {
            "fill": {"value": "steelblue"}
          },
          "hover": {
            "fill": {"value": "red"}
          }
        }
      }
    ]
  }
}
```

A Vega specification defines an interactive visualization in a JSON format. Specifications are parsed by Vega-Lite, a set of convenient visualizations, and can serve as a foundation for new APIs and visual analysis tools.

For more information, read the specification, take a look at the tutorials, examples gallery, and demo gallery, or read about the design and implementation of Vega. To use Vega-Lite in a more concise form, check out Vega-CD, a higher-level language built on top of Vega.
Vega – A Visualization Grammar

Less “programming” more “specification”

Very verbose
A simple bar chart with embedded data.

```
{
  "description": "A simple bar chart with embedded data.",
  "data": {
    "values": [
      {"a": "A", "b": 28}, {"a": "B", "b": 55}, {"a": "C", "b": 43},
      {"a": "D", "b": 91}, {"a": "E", "b": 81}, {"a": "F", "b": 53},
      {"a": "G", "b": 19}, {"a": "H", "b": 87}, {"a": "I", "b": 52}
    ],
  },
  "mark": "bar",
  "encoding": {
    "x": {"field": "a", "type": "ordinal"},
    "y": {"field": "b", "type": "quantitative"}
  }
}
```
{  
"description": "A simple bar chart with embedded data.",
"data": {
  "values": [
    {"a": "A", "b": 28}, {"a": "B", "b": 55}, {"a": "C", "b": 43},
    {"a": "D", "b": 91}, {"a": "E", "b": 81}, {"a": "F", "b": 53},
    {"a": "G", "b": 19}, {"a": "H", "b": 87}, {"a": "I", "b": 52}
  
  ],
  "mark": "bar",
  "encoding": {
    "x": {"field": "a", "type": "ordinal"},
    "y": {"field": "b", "type": "quantitative"}
  }
}
Toolkits targeting specific components
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- Visualization Recommendation engines

COMPASS is a visualization recommendation engine. Given user query, it suggests visualizations, ranked by both data properties and perceptual principles.
Toolkits targeting specific components

- Re-ordering layouts

Toolkits targeting specific components

- Natural language interaction (Shameless plug)

**NL4DV: Toolkit for Natural Language Driven Data Visualization**

Arjun Srinivasan*  
John Stasko†  
Georgia Institute of Technology

Video

Srinivasan, Arjun, and John Stasko. "NL4DV: Toolkit for Natural Language Driven Data Visualization."
Toolkits targeting specific components

- Visualization Recommendation engines
- Re-ordering layouts
- Natural language interaction

... and much more
Data Exploration and Analysis Tools

Visualization Authoring Tools

Toolkits and Grammars
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Visualization Authoring Tools

Need programming

Toolkits and Grammars
Data Exploration and Analysis Tools

Visualization Authoring Tools

Toolkits and Grammars
Customization

Visualization Authoring Tools

Toolkits and Grammars

INFOVIS
Visualization Systems & Toolkits