Vega-Lite

A Grammar of Interactive Graphics

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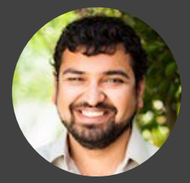
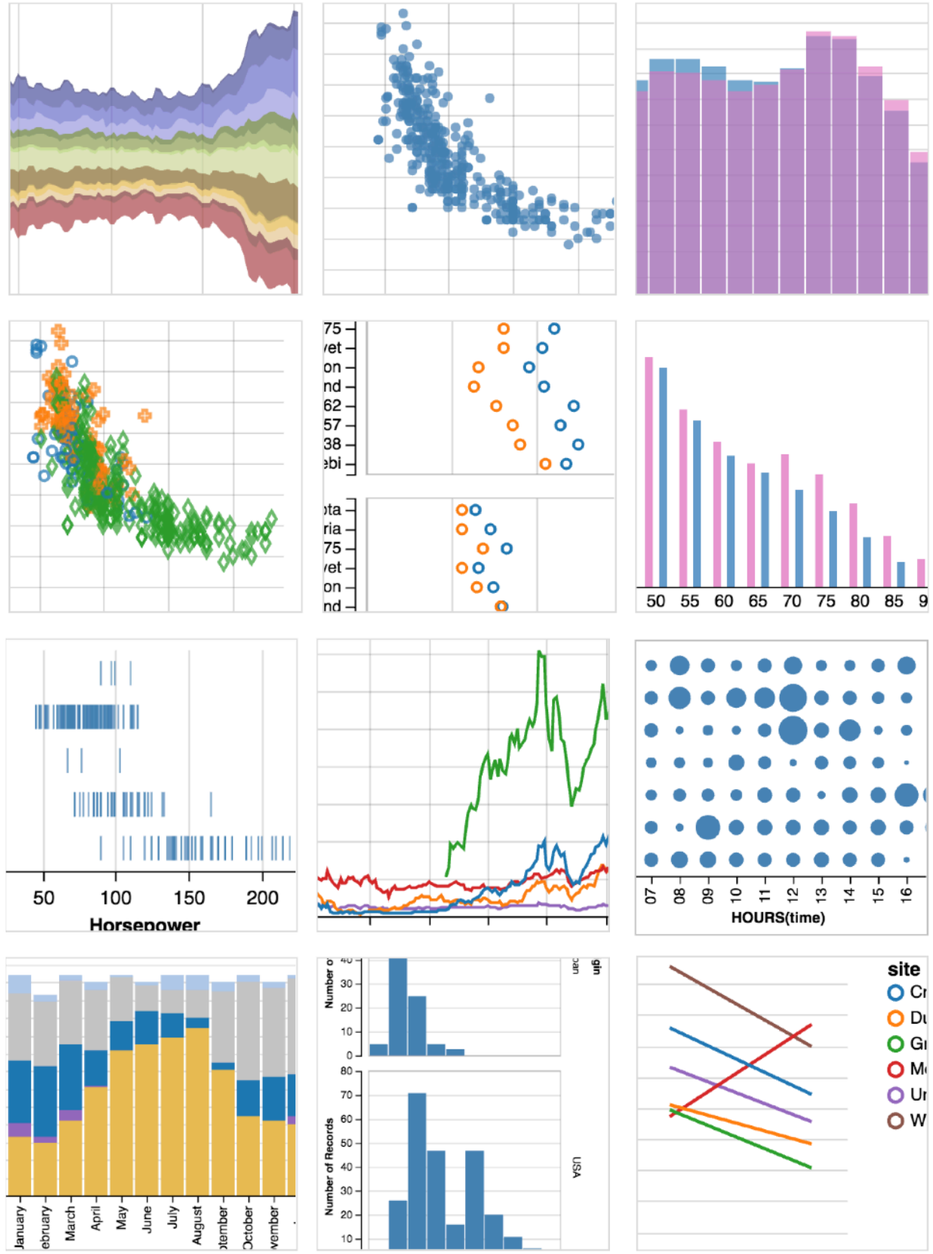
Dominik Moritz @domoritz
Arvind Satyanarayan @arvindsatya1
Jeffrey Heer @jeffrey_heer



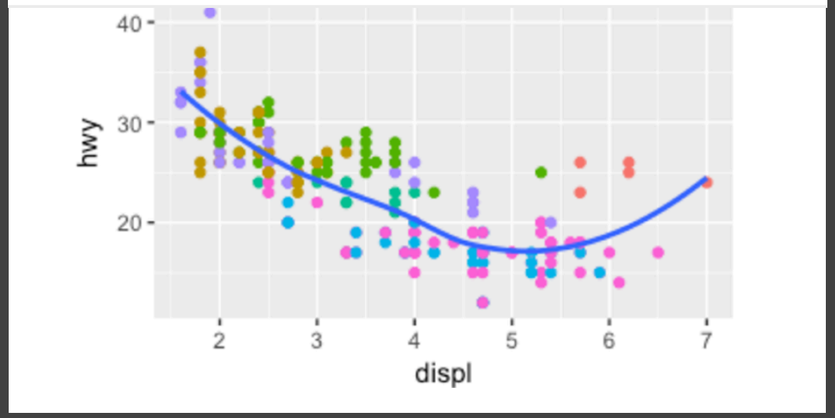



Interactive Data Lab @uwdata
University of Washington

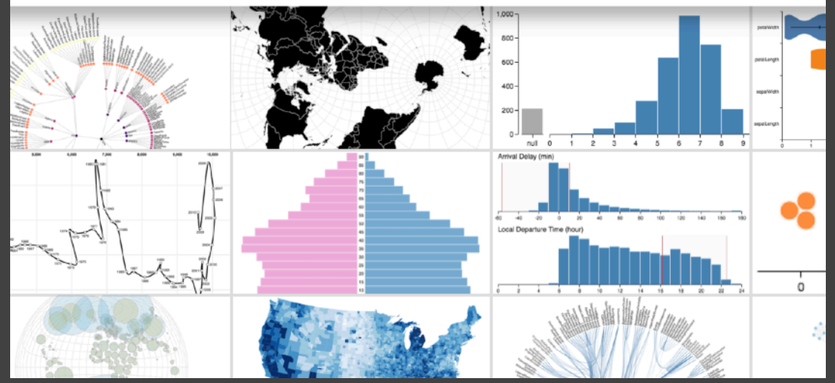


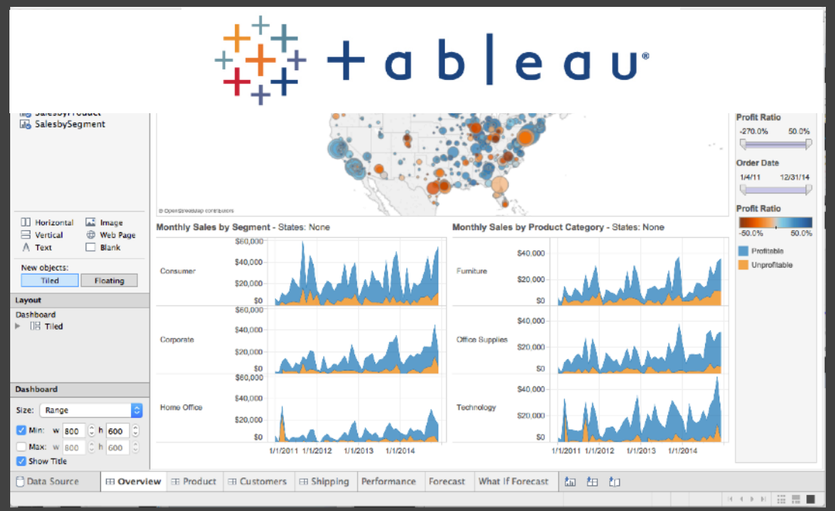
Data-Driven Documents

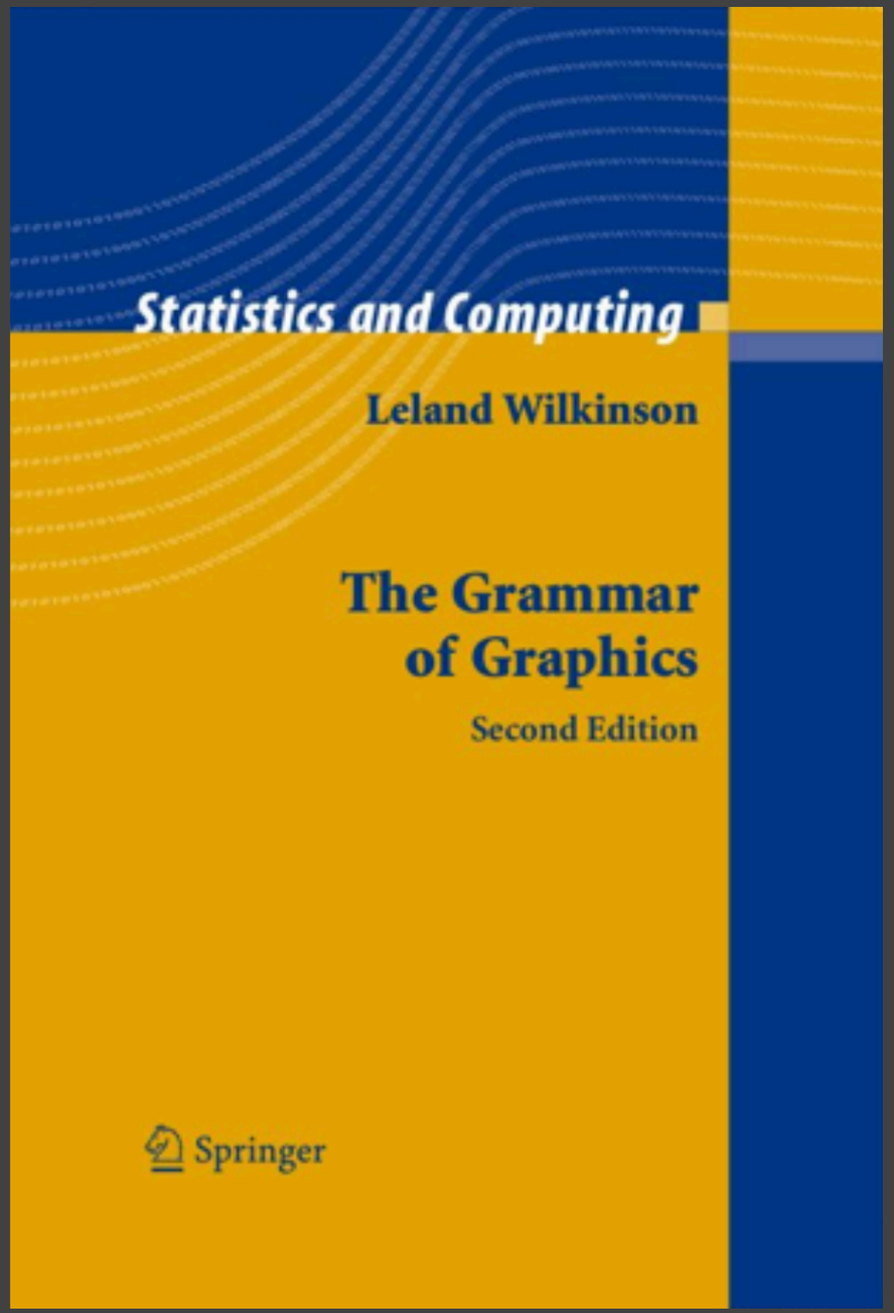
ggplot2 part of the tidyverse

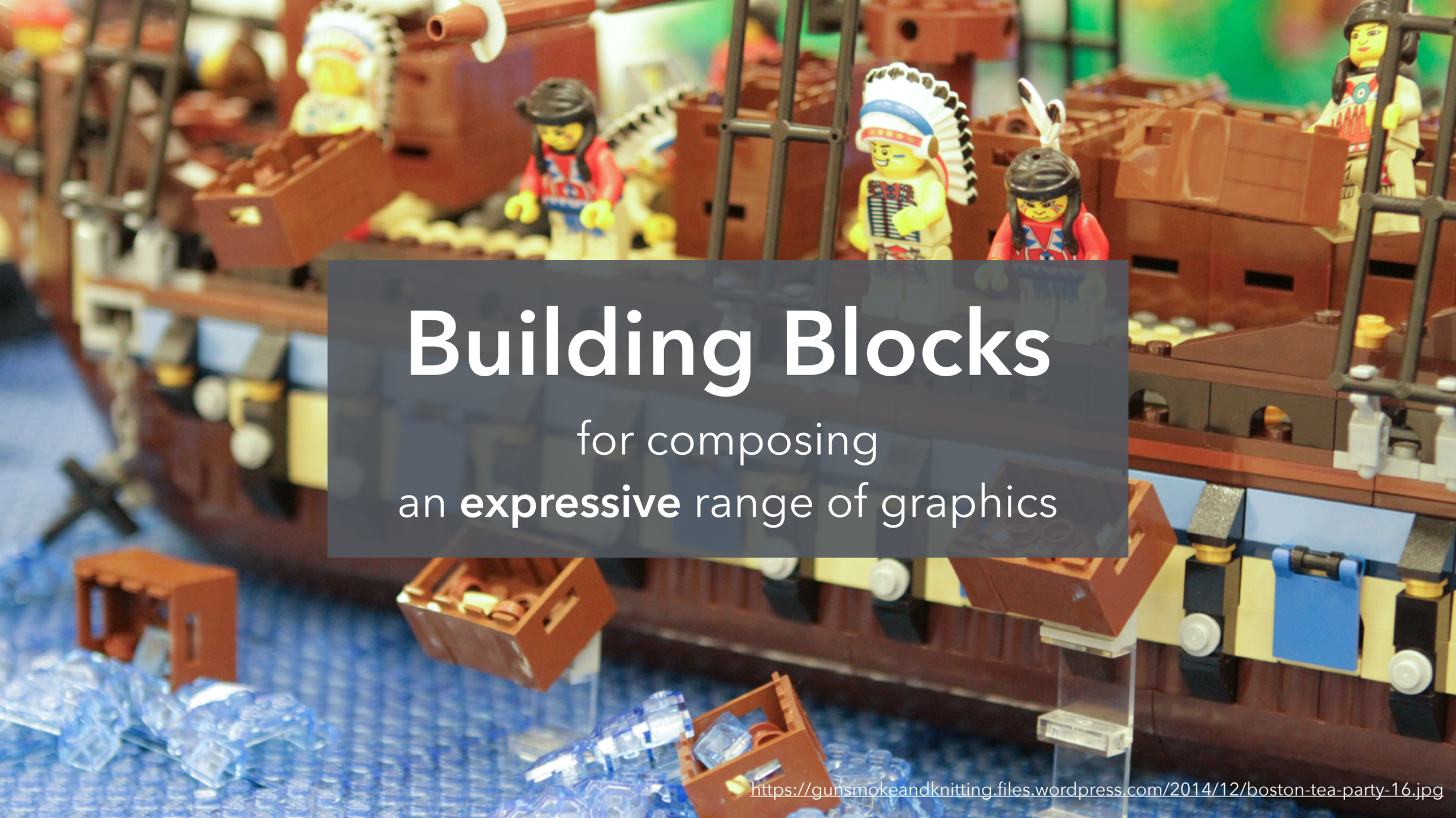


Vega – A Visualization Grammar






Statistics and Computing
Leland Wilkinson
The Grammar of Graphics
Second Edition
Springer



Building Blocks

for composing
an **expressive** range of graphics

https://gunsmokeandknitting.files.wordpress.com/2014/12/boston-tea-party-16.jpg

Grammar of Graphics

Grammar of Graphics

Data Input data source to visualize.

Grammar of Graphics

Data	Input data source to visualize.
Transform	Filter, aggregation, binning, etc.

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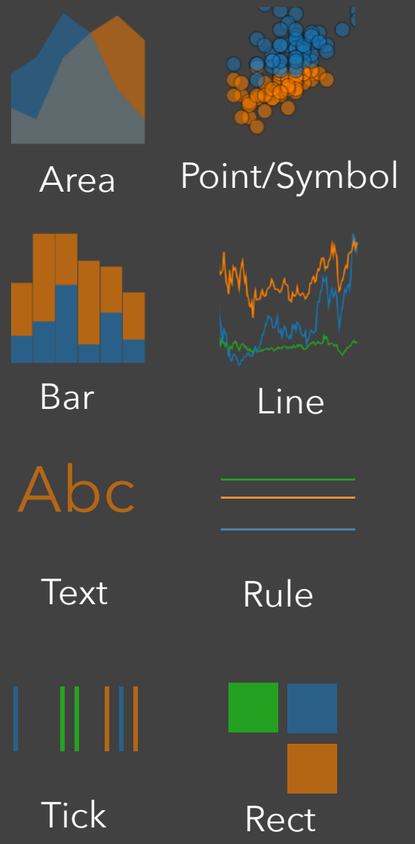
Mark Data-representative graphics.



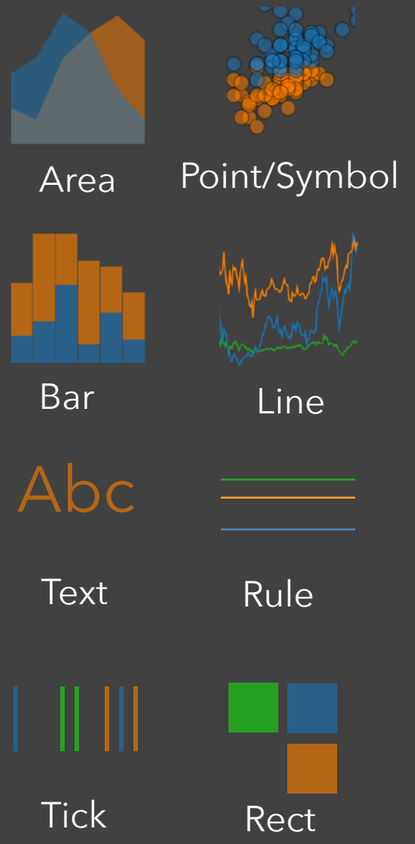
Grammar of Graphics

Data Input data source to visualize.

Transform Filter, aggregation, binning, etc.

Mark Data-representative graphics.

Encoding Mapping between data and mark properties.



Grammar of Graphics

Data Input data source to visualize.

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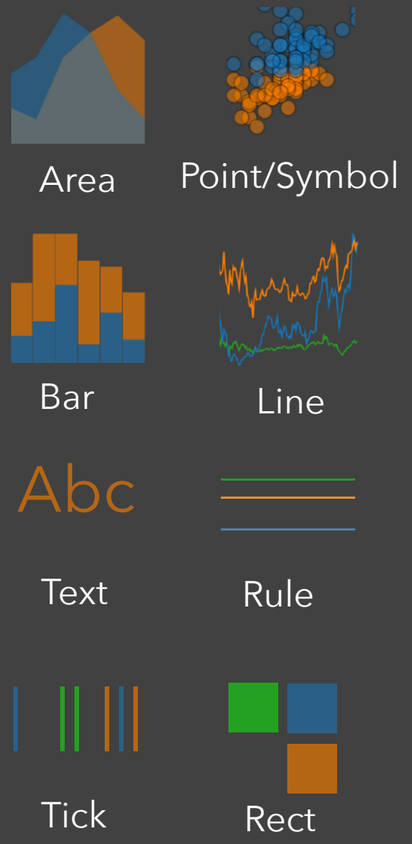
Encoding Mapping between data and mark properties.

Scale Functions that map data values to visual values.



Grammar of Graphics

Data Input data source to visualize.

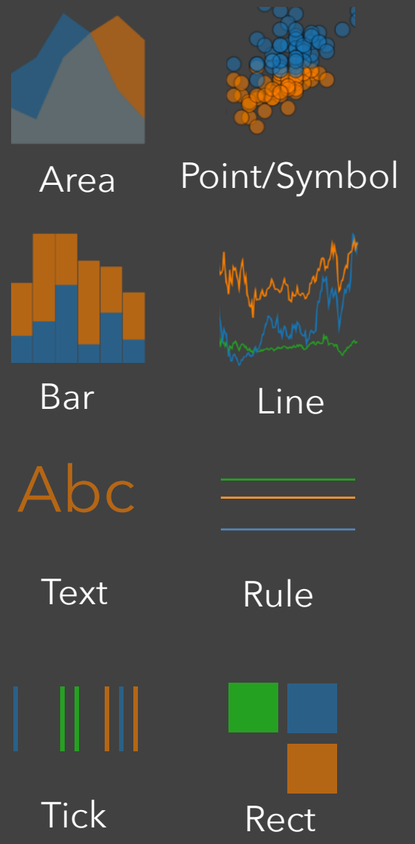
Transform Filter, aggregation, binning, etc.

Mark Data-representative graphics.

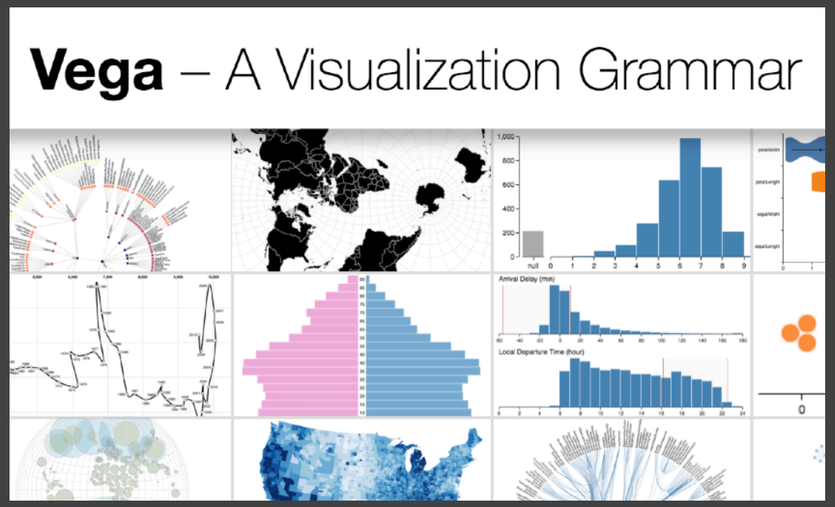
Encoding Mapping between data and mark properties.

Scale Functions that map data values to visual values.

Guides Axes & legends that visualize scales.



Grammar of Graphics *for Customized Designs*



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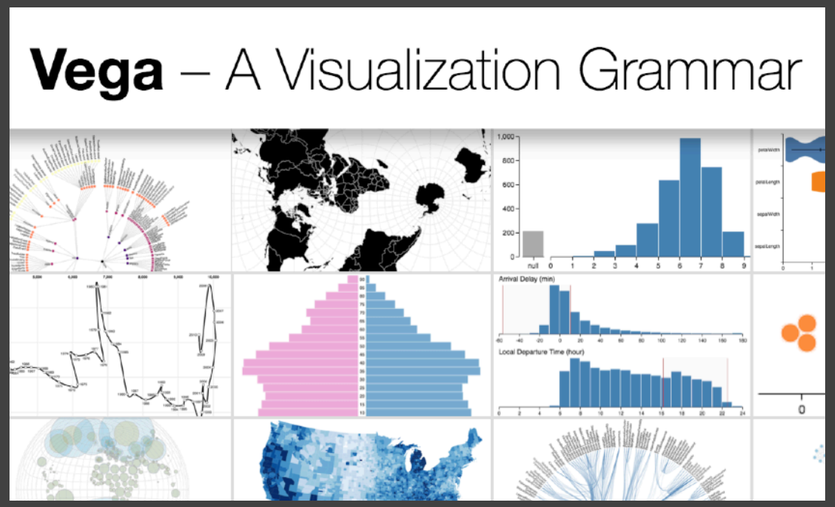
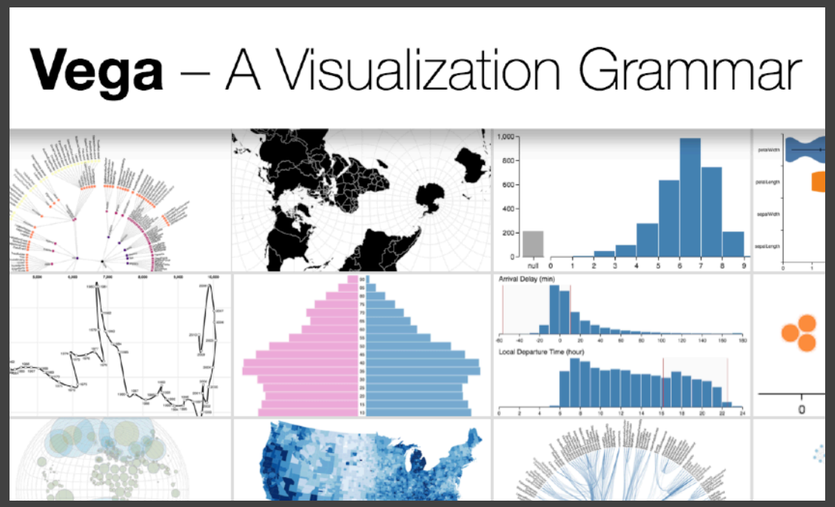


Offer **fine-grained control** for composing interactive graphics.

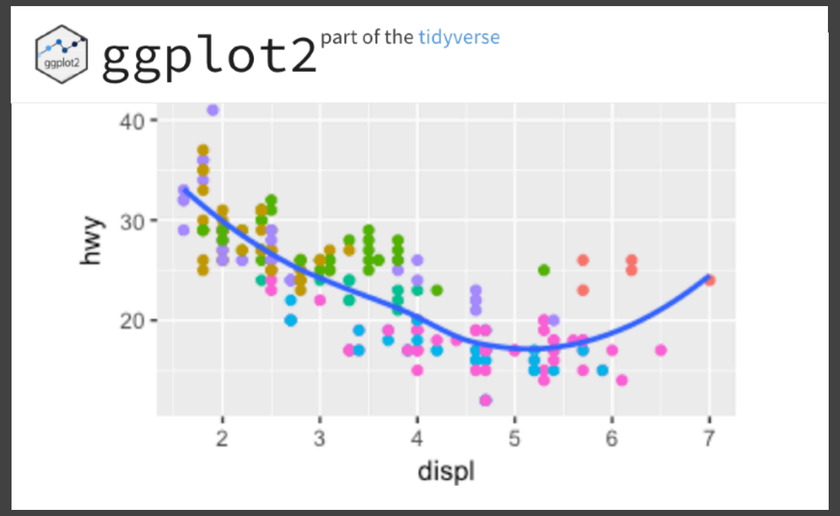
Grammar of Graphics *for Customized Designs*

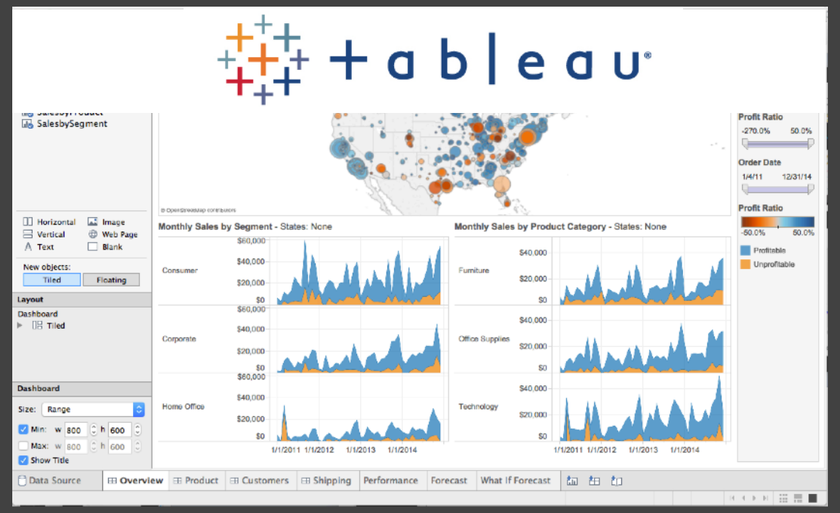


Offer **fine-grained control** for composing interactive graphics.

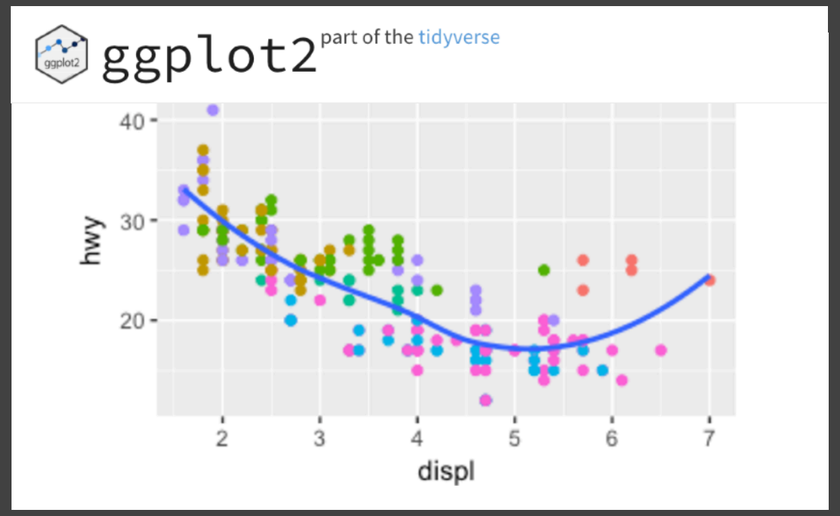
But require **verbose** specifications and technical expertise.

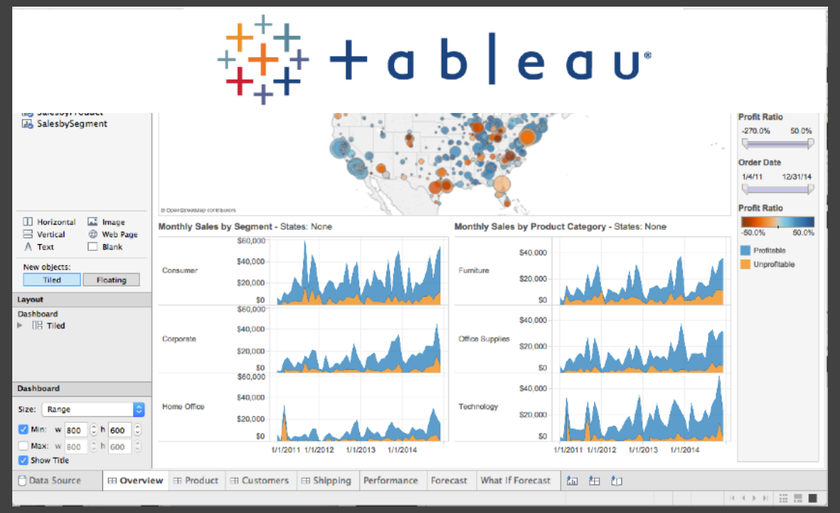
Grammar of Graphics *for Exploration*





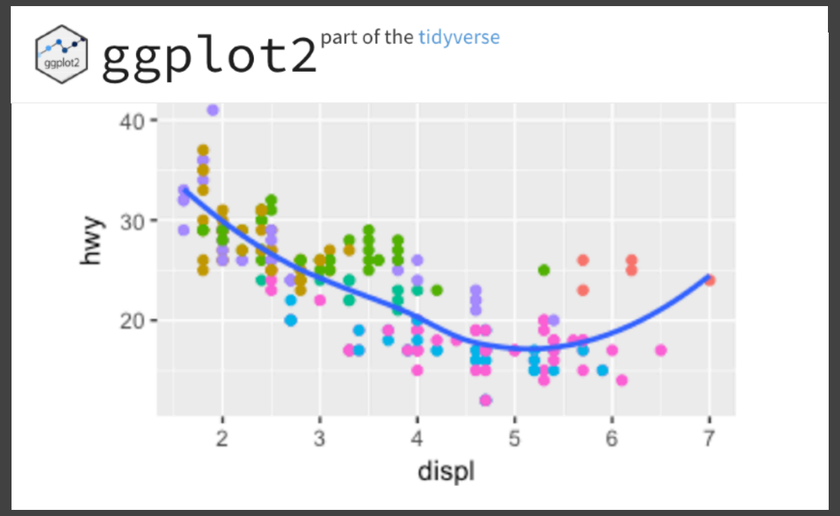
Grammar of Graphics *for Exploration*

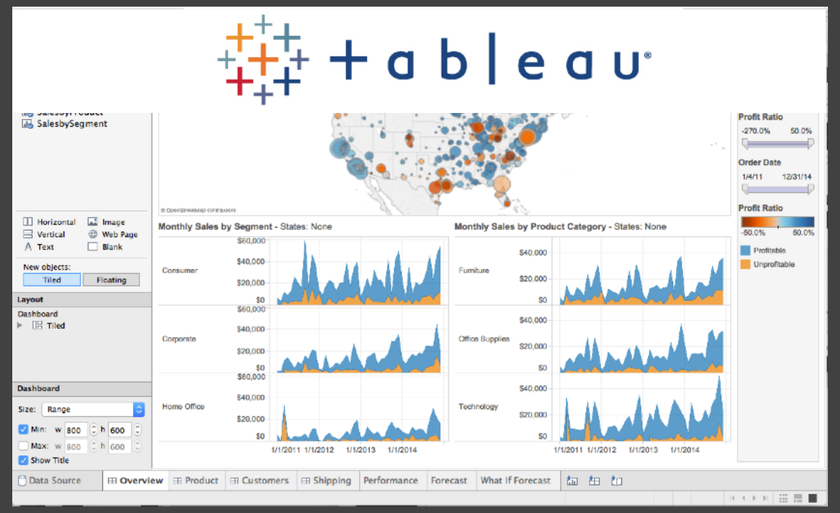




Facilitate **rapid exploration** with **concise** specifications by omitting low-level details.

Grammar of Graphics *for Exploration*

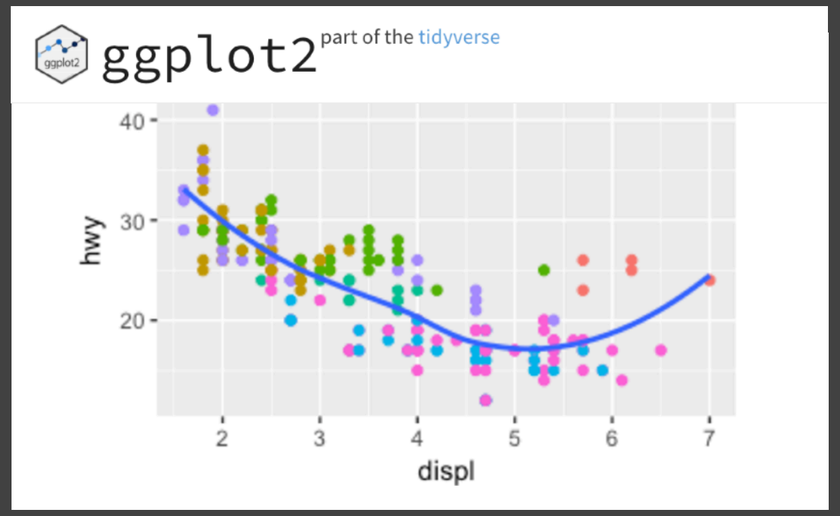


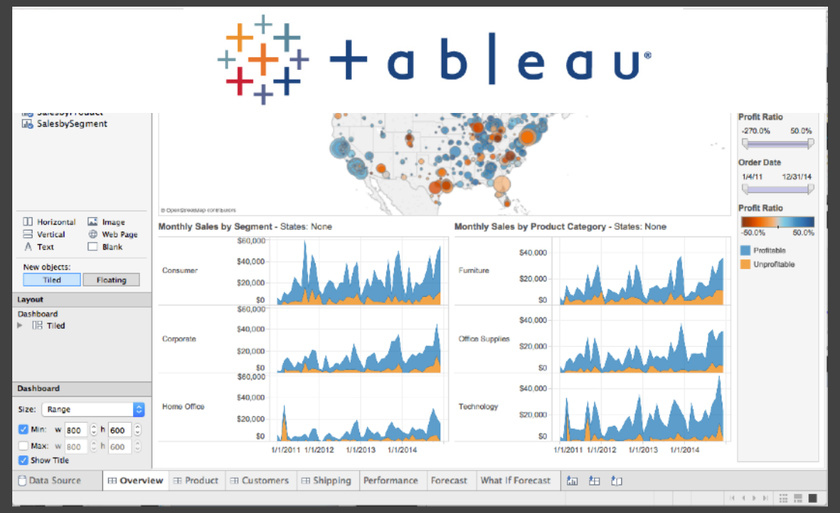


Facilitate **rapid exploration** with **concise** specifications by omitting low-level details.

Infer **sensible defaults** and allow customization by overriding defaults.

Grammar of Graphics *for Exploration*





Facilitate **rapid exploration**
with **concise** specifications
by omitting low-level details.

Infer **sensible defaults** and
allow customization
by overriding defaults.

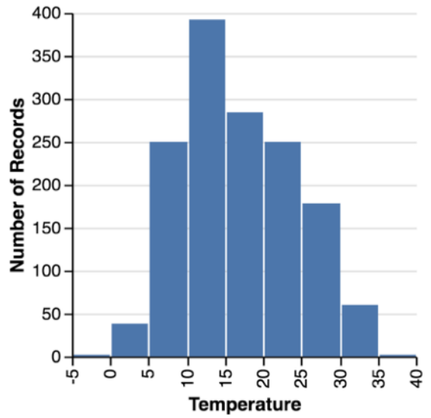
But **limited** support for **interactions.**

Vega-Lite's Mission

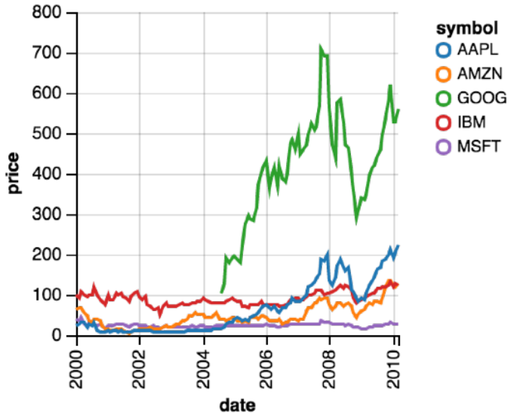
Facilitate exploratory data analysis
with an ***expressive*** yet ***concise*** language
to specify ***interactive multi-view graphics***

Vega-Lite: a Grammar of Graphics

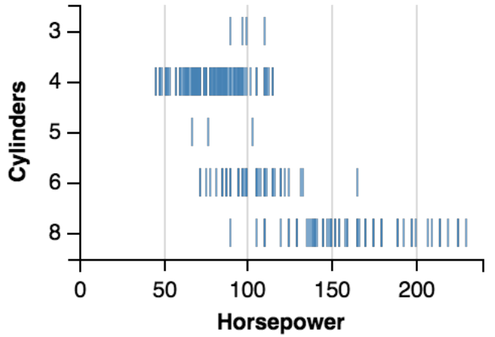
Histogram



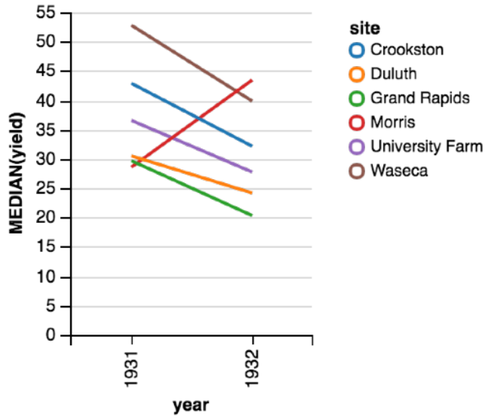
Multi-series Line Chart



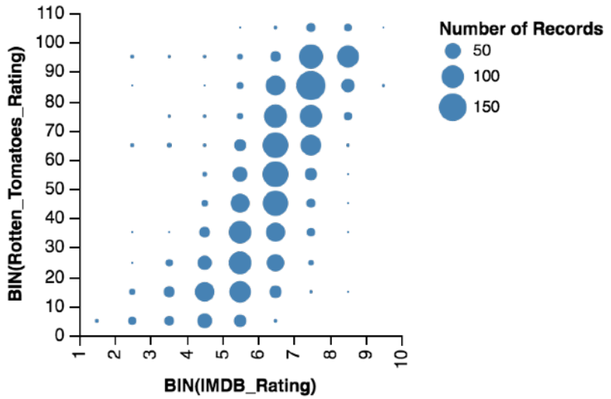
Stripplot



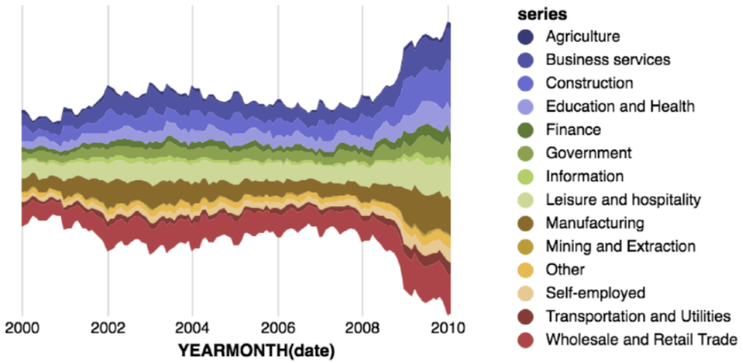
Slope Graph



Binned Scatterplot

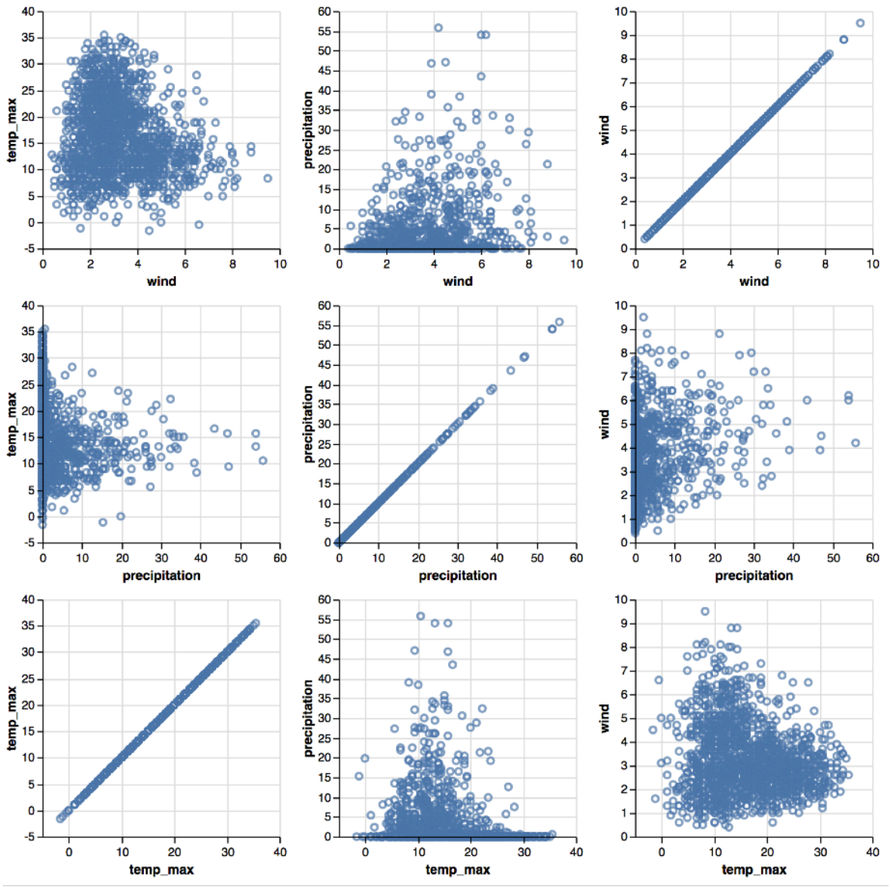


Area Chart

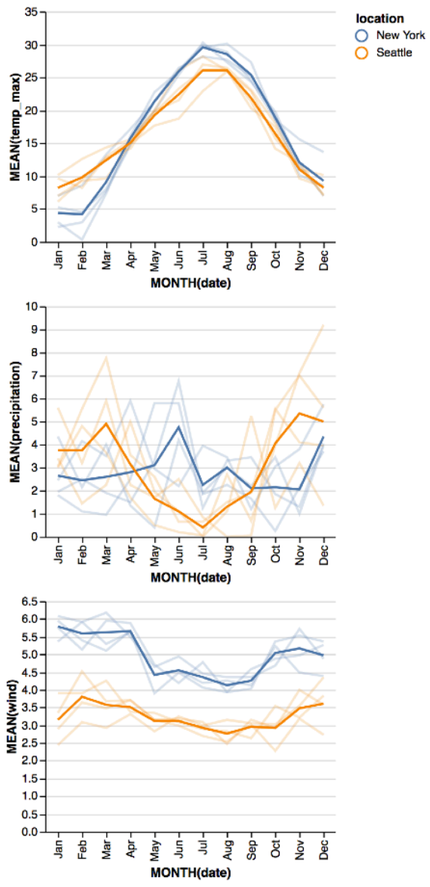


Vega-Lite: a Grammar of Multi-View Graphics

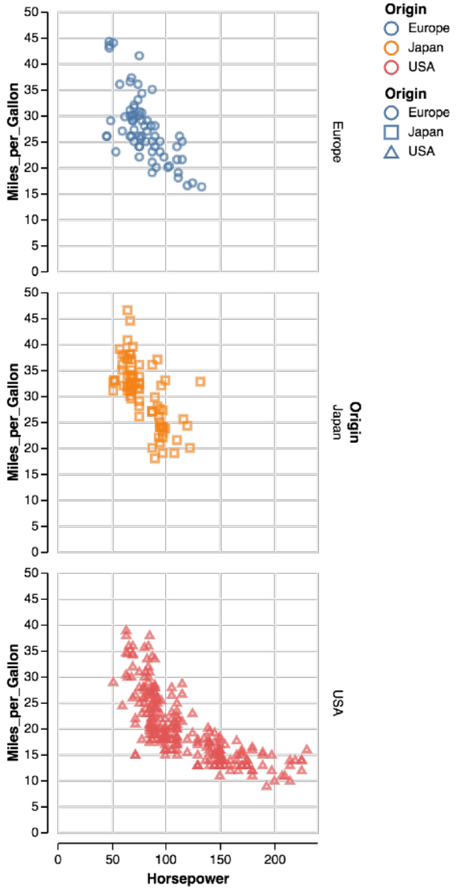
Scatterplot Matrix



Concatenated & Layered View

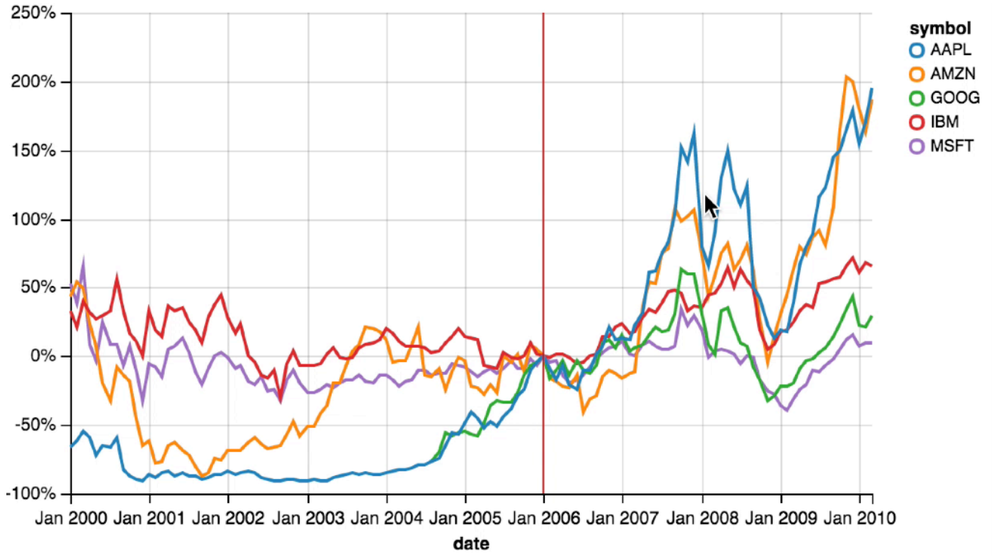


Faceted View

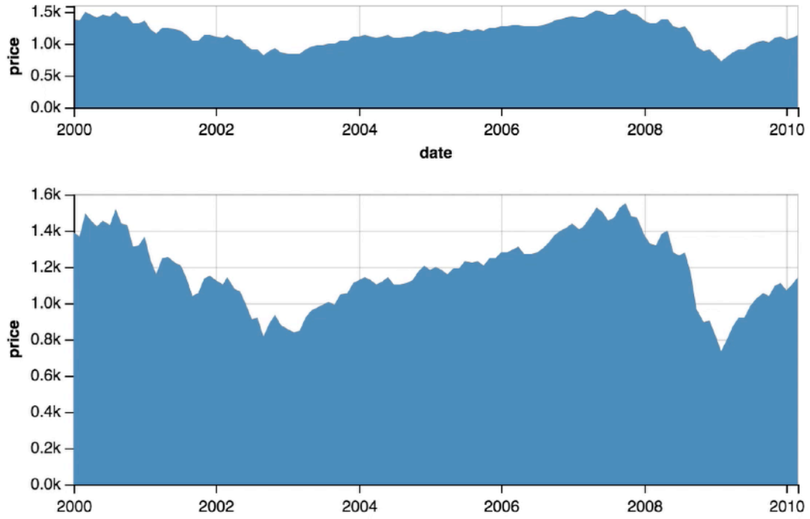


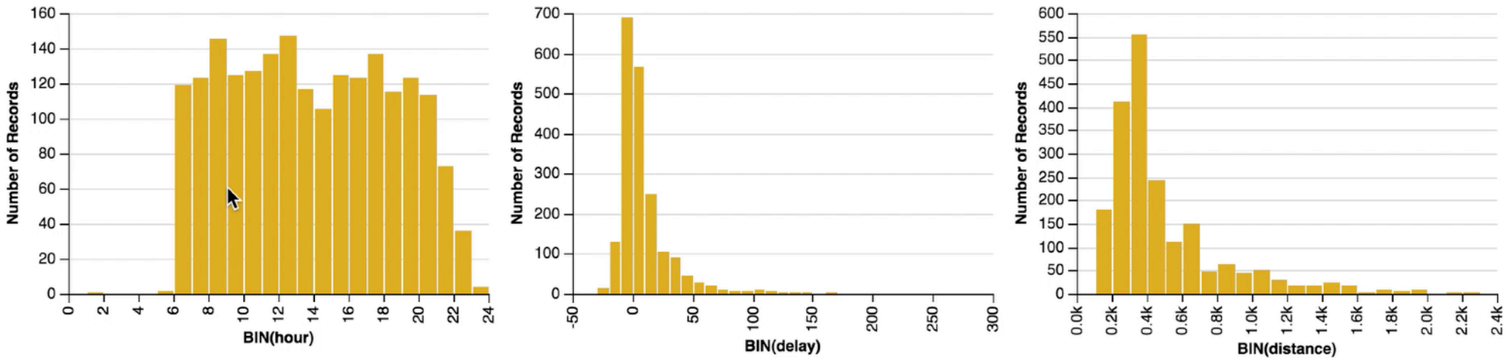
Vega-Lite: a Grammar of Interactive Multi-View Graphics

Indexed Chart



Focus+Context





Cross-filtering

Vega-Lite: a Grammar of Interactive Multi-View Graphics

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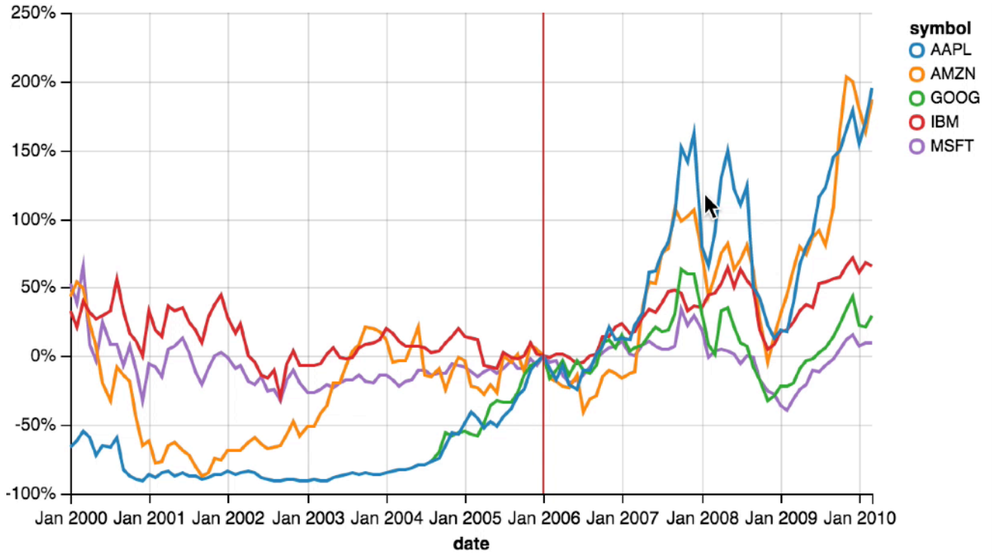

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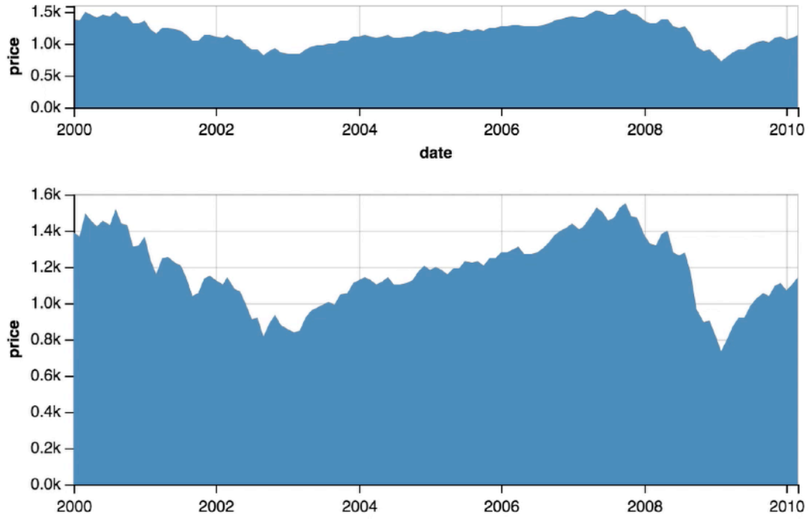

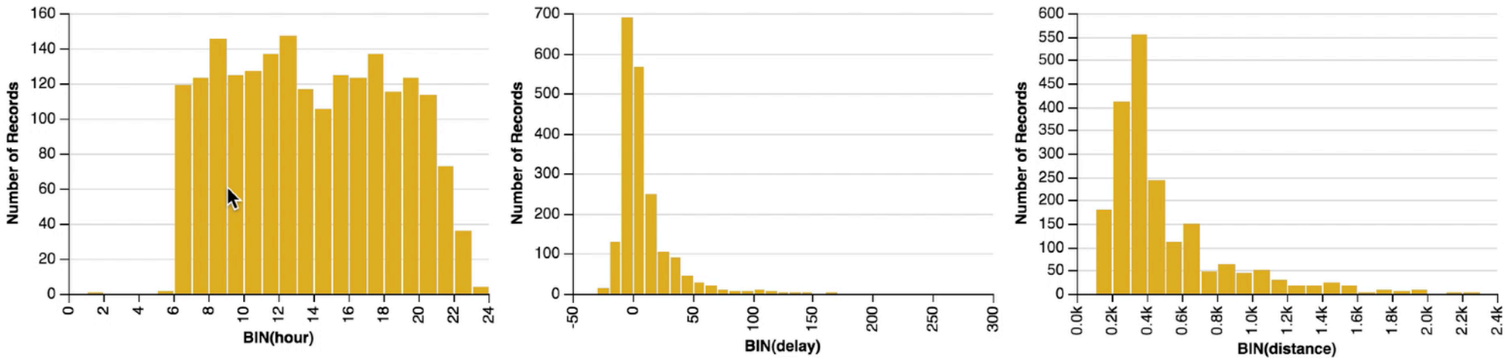

Cross-filtering

Vega-Lite: a Grammar of Interactive Graphics

The Design of Vega-Lite

Single View Specification

Layered and **Multi-view** Composition

Interactions with Selections

Using Vega-Lite

Programming with Vega-Lite

Higher-level **Tools** and **Recommendations**

Vega-Lite: a Grammar of Interactive Graphics

The Design of Vega-Lite

- **Single View** Specification
- **Layered** and **Multi-view** Composition
- **Interactions** with Selections

Using Vega-Lite

- **Programming** with Vega-Lite
- Higher-level **Tools** and **Recommendations**

Specifying Single Views

Specifying Single Views

Abstract Data

Specifying Single Views

Abstract Data  Visual Representation

Specifying Single Views

Abstract Data → Visual Representation

Weather Data for Seattle

date	temperature	precipitation	weather
1/1	10.6	10.9	"rain"
1/2	11.7	0.8	"drizzle"
1/3	12.2	10.2	"rain"
…	…	…	…

Specifying Single Views

Abstract Data → Visual Representation

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1/1	10.6	10.9	"rain"
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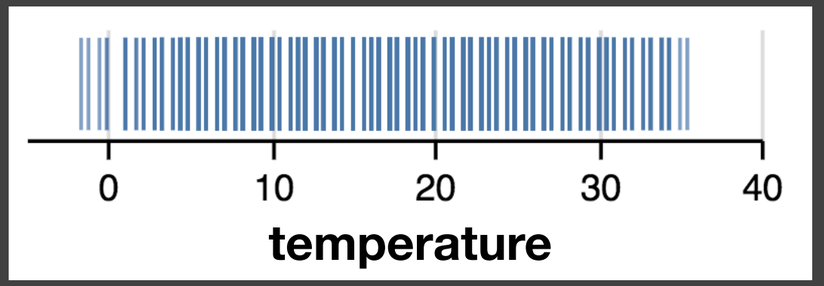
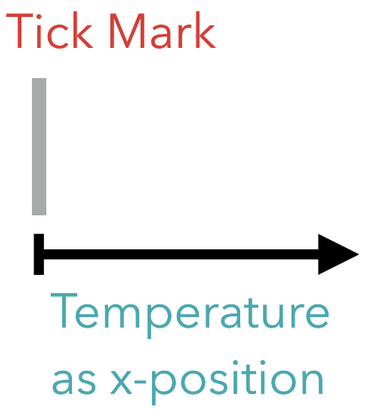
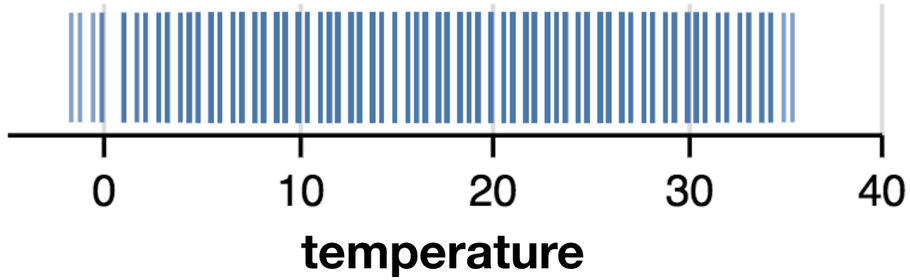
…	…	…	…

Strip Plot of Temperature



Strip Plot = (Tick with x=field)

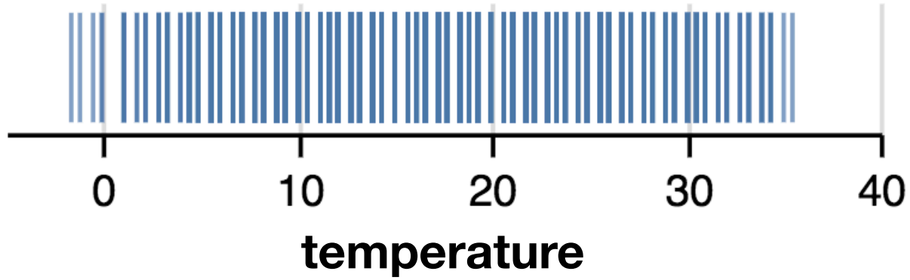




Strip Plot = (Tick with x=field)

Tick Mark

Temperature
as x-position
(Quantitative)

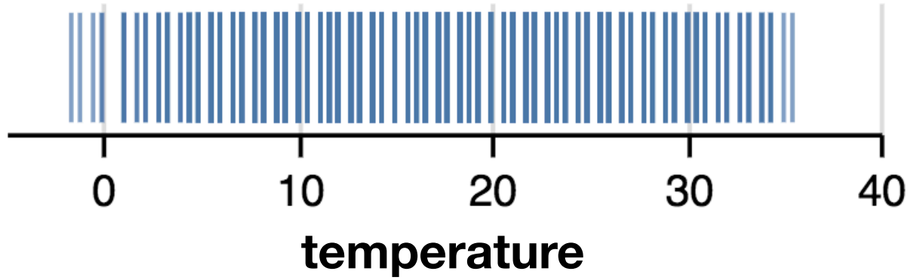


Strip Plot = (Tick with x=field)

Tick Mark

Temperature
as x-position
(Quantitative)

```
{
  data: {url: "weather-seattle.json"},
```



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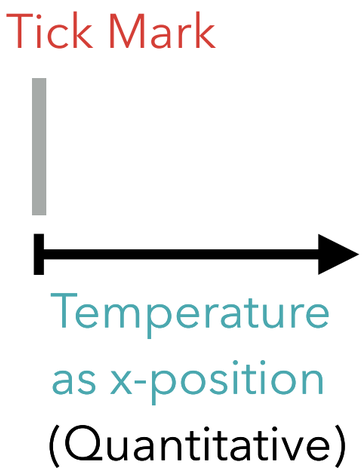


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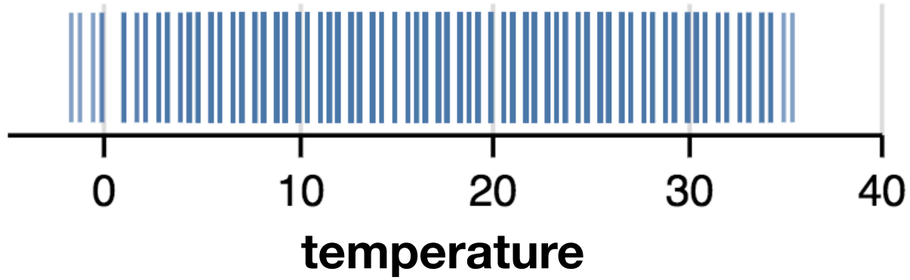

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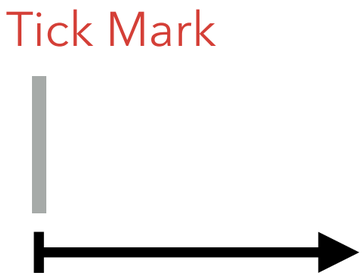


```
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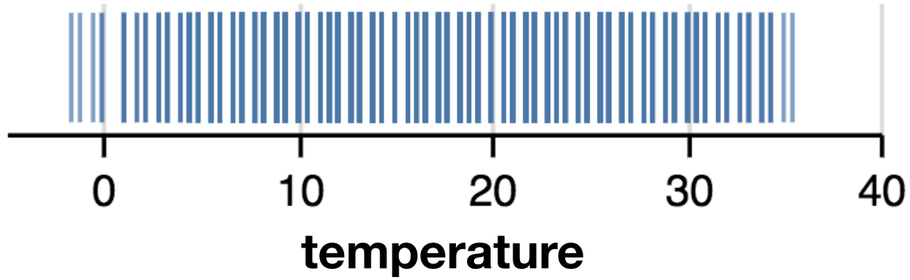
}
```



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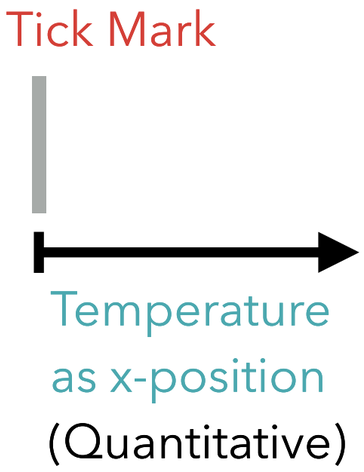


```
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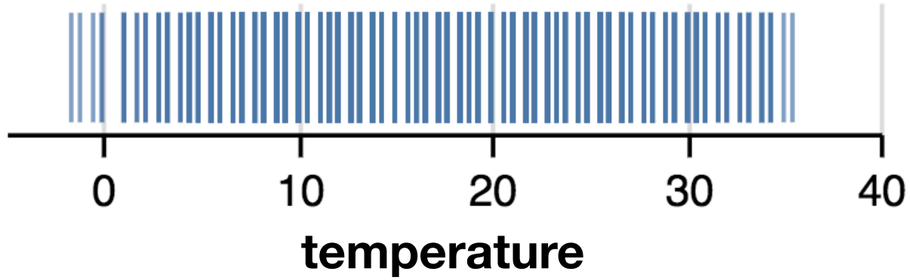
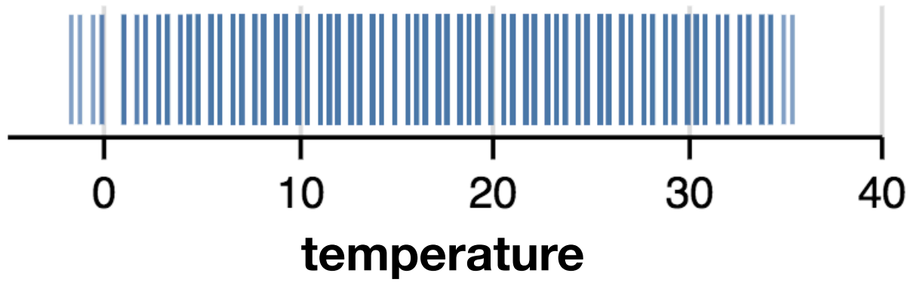
  }
}
```



Vega-Lite is portable JSON specification

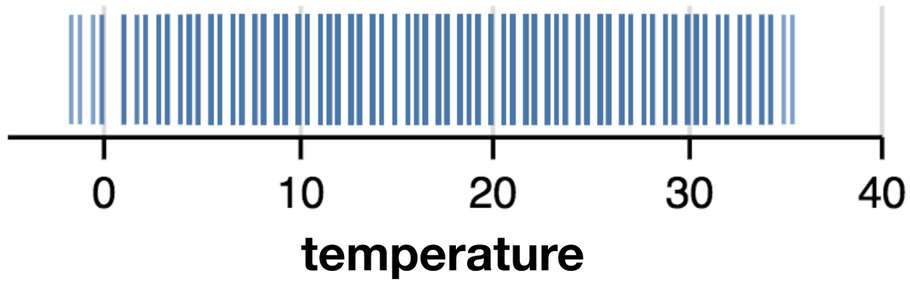
Strip Plot = (Tick with x=field)

```
{
  data: {url: "weather-seattle.json"},
  mark: "tick",
  encoding: {
    x: {
      field: "temperature",
      type: "quantitative"
    }
  }
}
```



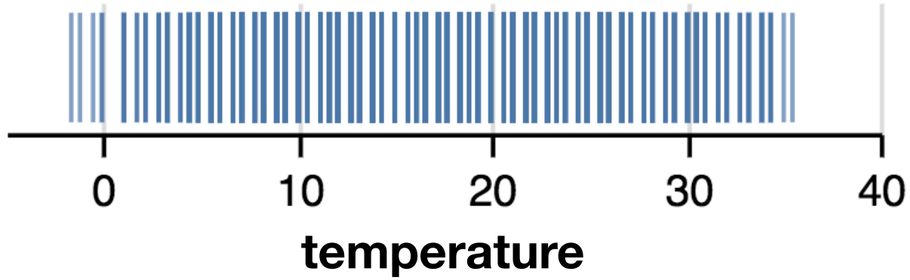
Strip Plot: Default Scales and Axes

```
{
  data: {url: "weather-seattle.json"},
  mark: "tick",
  encoding: {
    x: {
      field: "temperature",
      type: "quantitative",
      scale: {type: "linear", domain: [0, 8], ...}
      axis: {title: "temp", grid: true, ...}
    }
  }
}
```



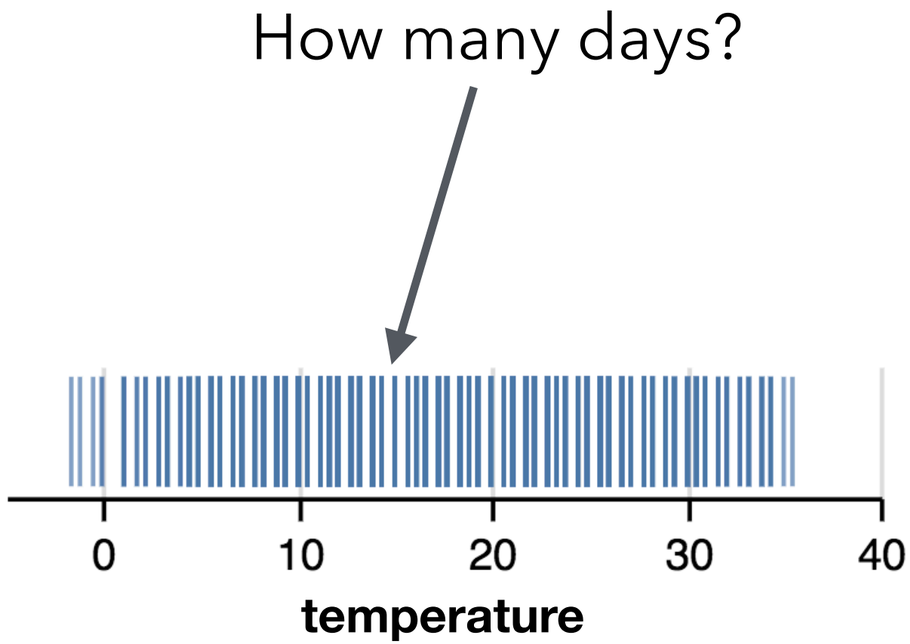
Strip Plot

```
{
  data: {url: "weather-seattle.json"},
  mark: "tick",
  encoding: {
    x: {
      field: "temperature",
      type: "quantitative"
    }
  }
}
```



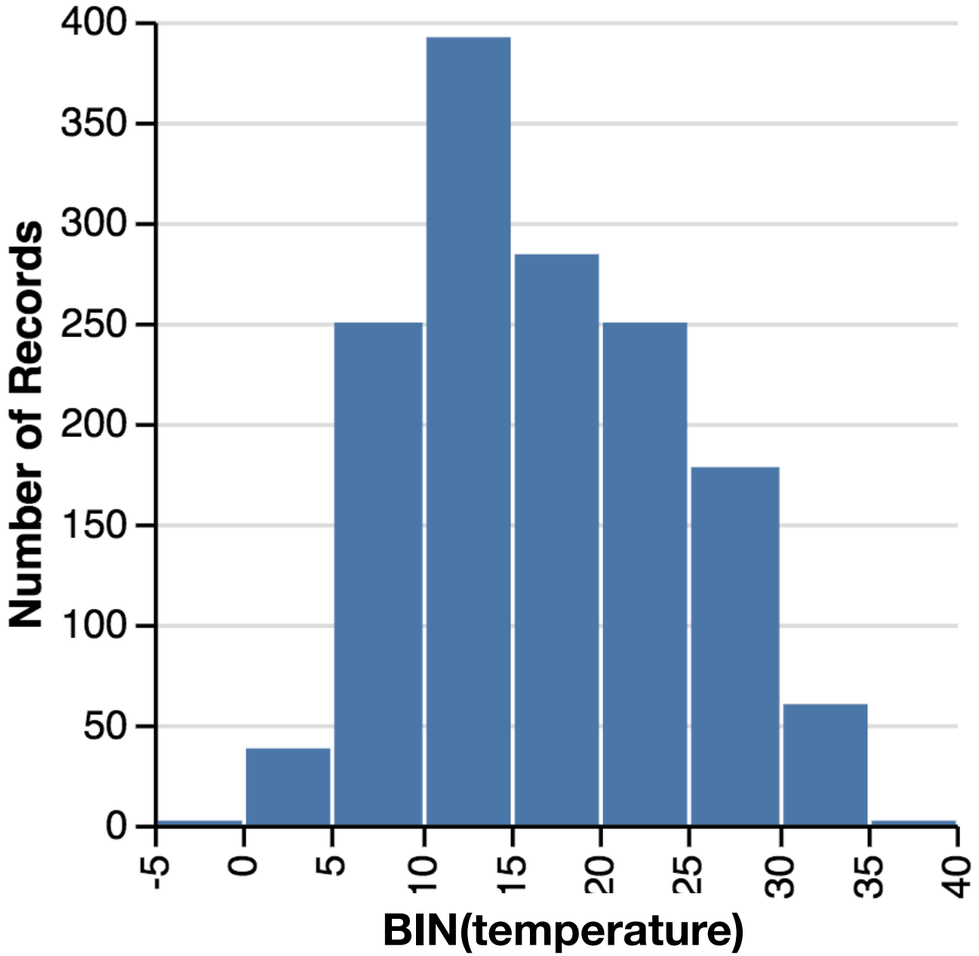
Strip Plot

```
{
  data: {url: "weather-seattle.json"},
  mark: "tick",
  encoding: {
    x: {
      field: "temperature",
      type: "quantitative"
    }
  }
}
```



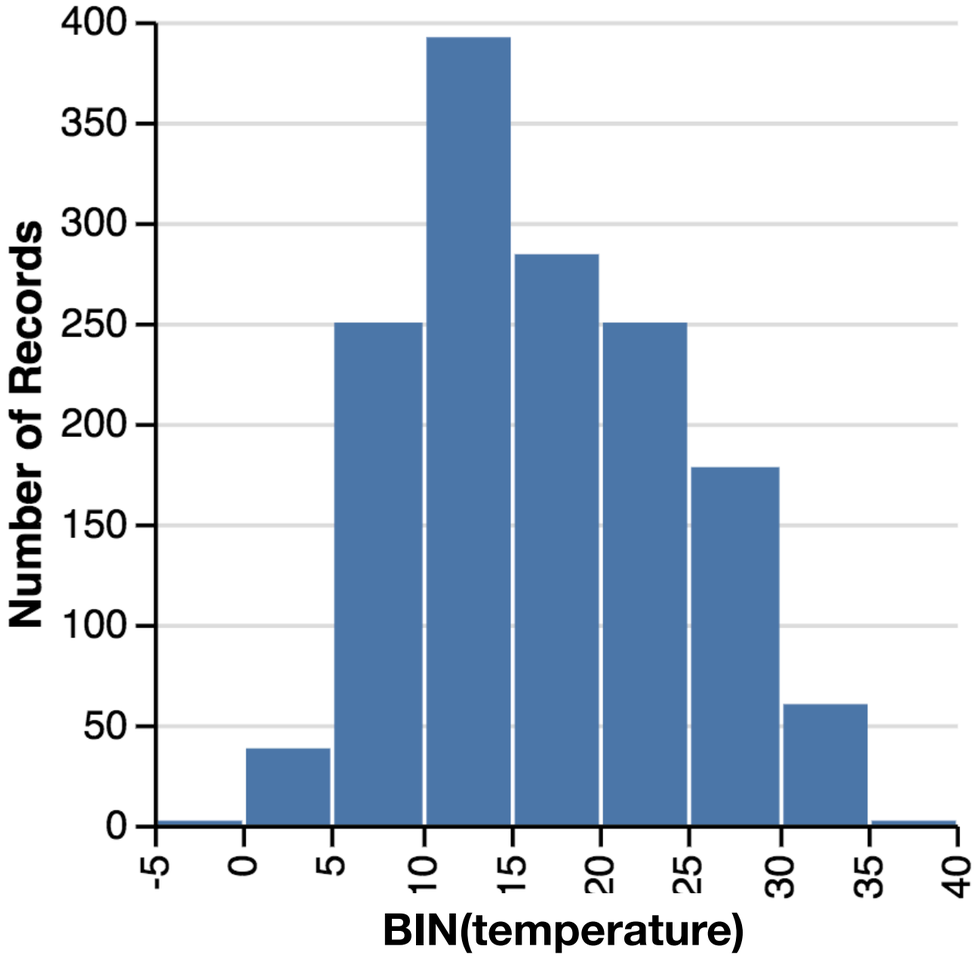
Histogram

Goal



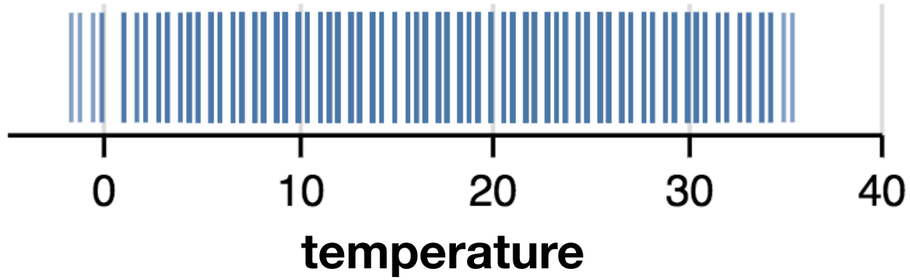
Histogram = (Bar with x=binned field, y=count)

Goal



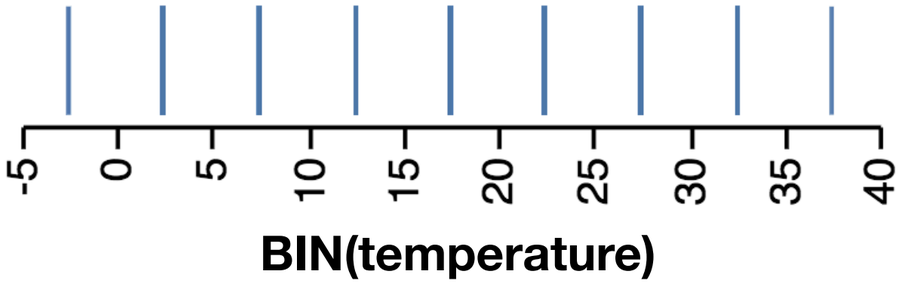
Histogram = (Bar with x=binned field, y=count)

```
{
  data: {url: "weather-seattle.json"},
  mark: "tick",
  encoding: {
    x: {
      field: "temperature",
      type: "quantitative"
    }
  }
}
```



Histogram = (Bar with x=binned field, y=count)

```
{
  data: {url: "weather-seattle.json"},
  mark: "tick",
  encoding: {
    x: {
      bin: true,
      field: "temperature",
      type: "quantitative"
    }
  }
}
```

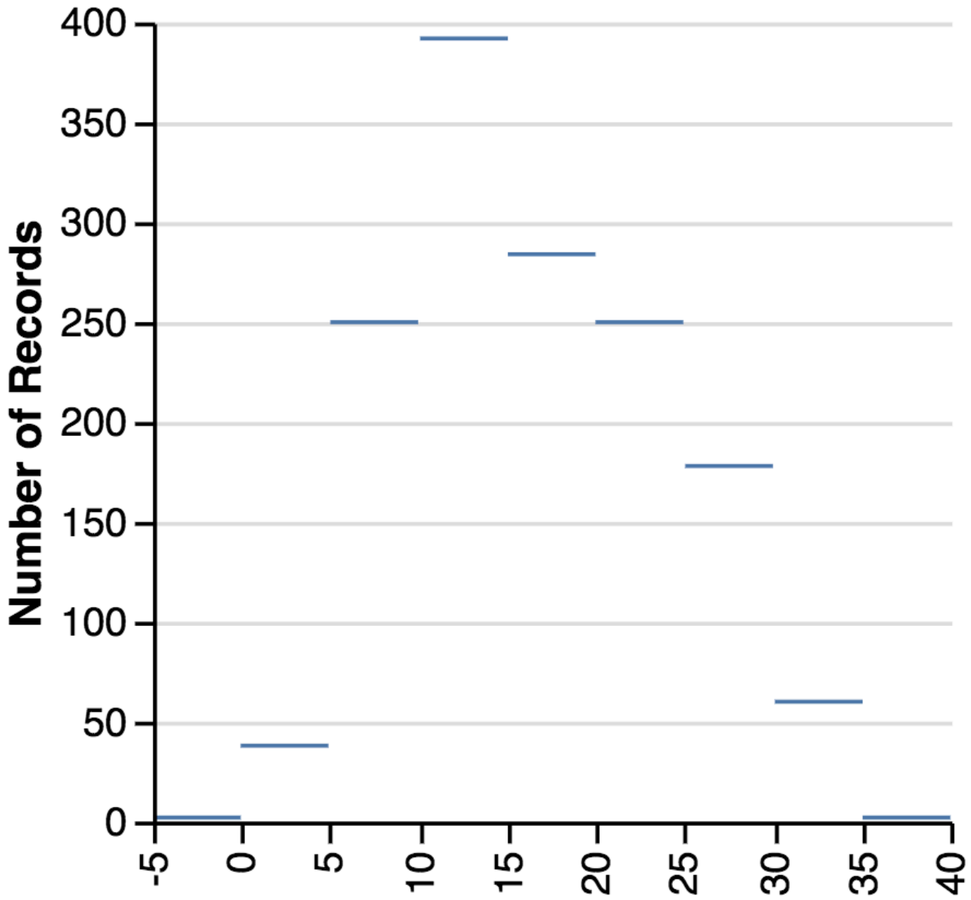


Histogram = (Bar with x=binned field, y=count)

```
{
  data: {url: "weather-seattle.json"},
  mark: "tick",
  encoding: {
    x: {
      bin: true,
      field: "temperature",
      type: "quantitative"
    }
  }
}
```

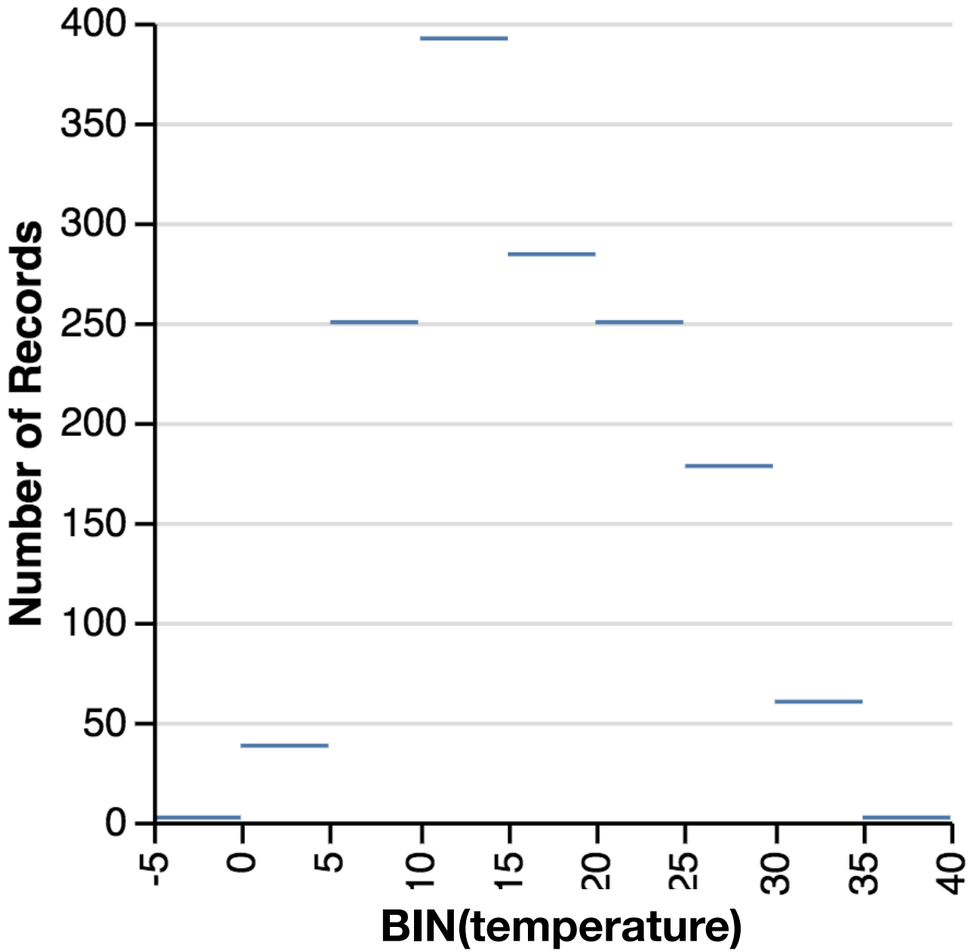
Histogram = (Bar with x=binned field, y=count)

```
{
  data: {url: "weather-seattle.json"},
  mark: "tick",
  encoding: {
    x: {
      bin: true,
      field: "temperature",
      type: "quantitative"
    },
    y: {
      aggregate: "count",
      type: "quantitative"
    }
  }
}
```



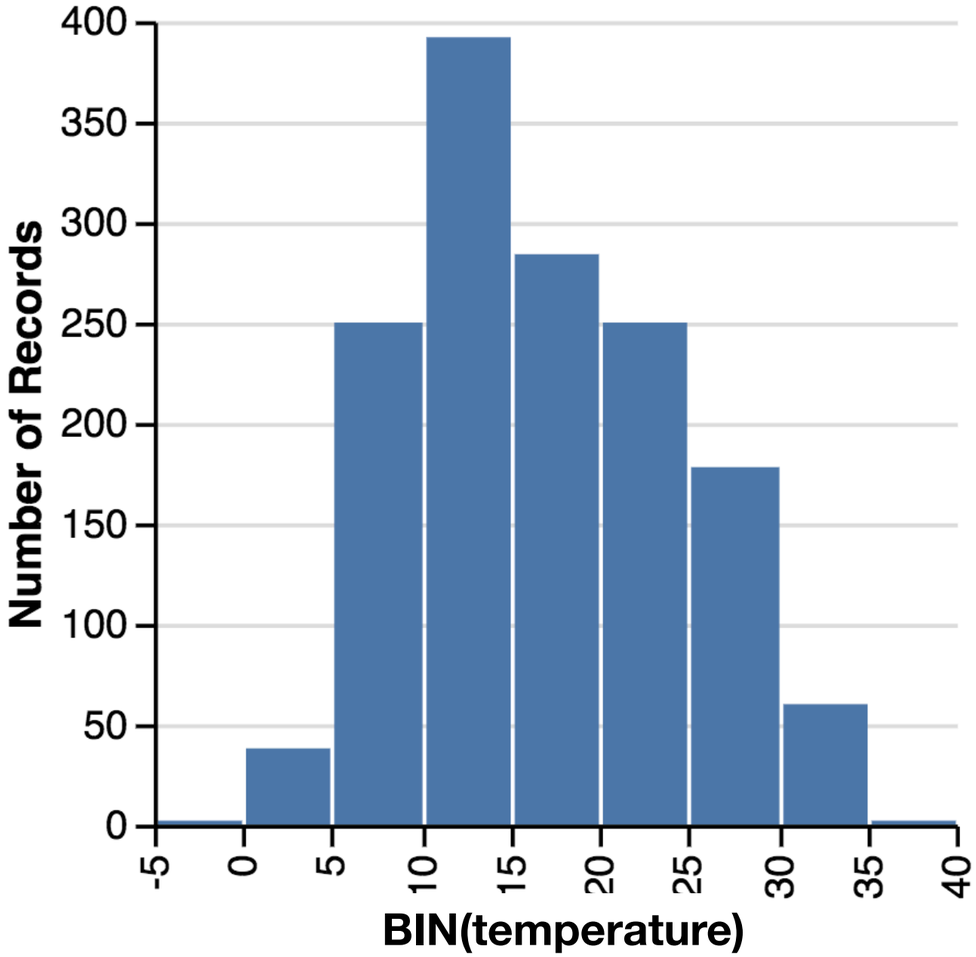
Histogram = (Bar with x=binned field, y=count)

```
{
  data: {url: "weather-seattle.json"},
  mark: "tick",
  encoding: {
    x: {
      bin: true,
      field: "temperature",
      type: "quantitative"
    },
    y: {
      aggregate: "count",
      type: "quantitative"
    }
  }
}
```



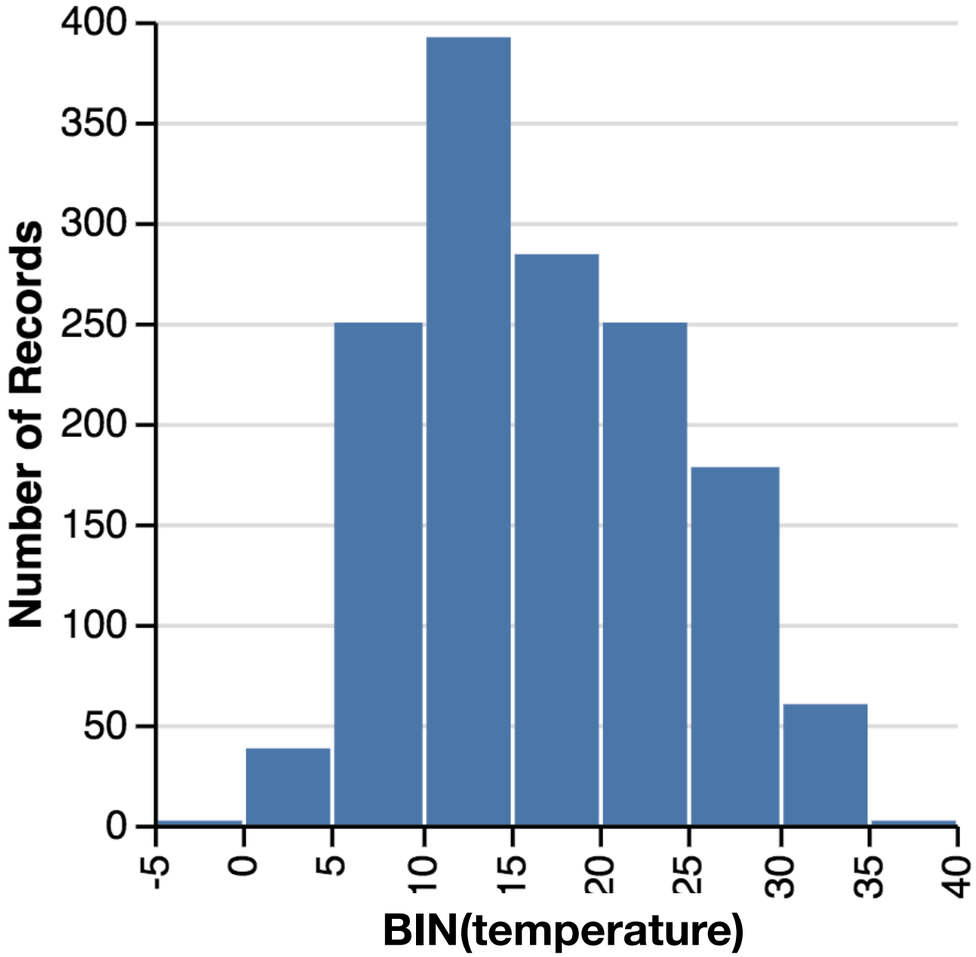
Histogram = (Bar with x=binned field, y=count)

```
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {
      bin: true,
      field: "temperature",
      type: "quantitative"
    },
    y: {
      aggregate: "count",
      type: "quantitative"
    }
  }
}
```



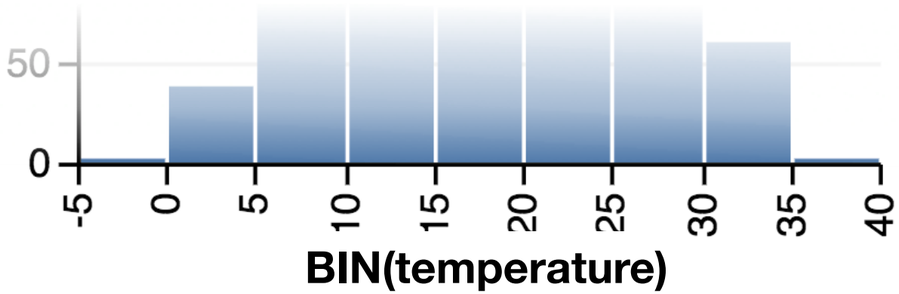
Histogram = (Bar with x=binned field, y=count)

```
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {
      bin: true,
      field: "temperature",
      type: "quantitative"
    },
    y: {
      aggregate: "count",
      type: "quantitative"
    }
  }
}
```



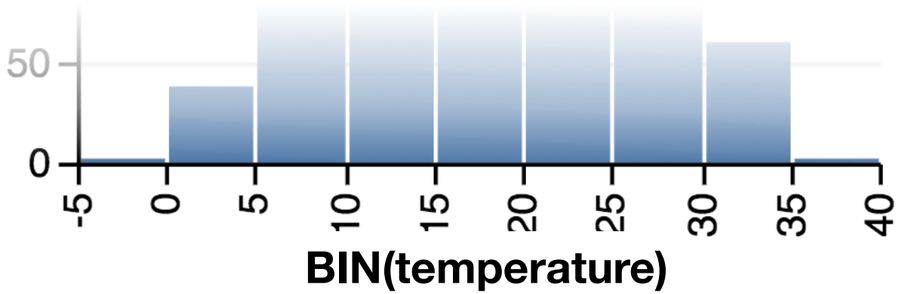
Sensible Defaults for Binning

Channel determines guide and bin parameters



Sensible Defaults for Binning

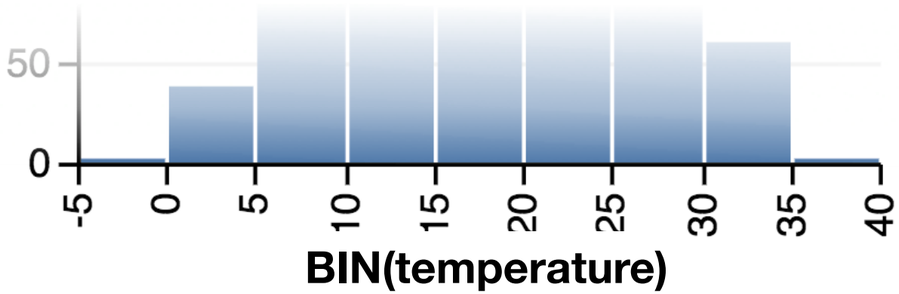
Channel determines guide and bin parameters

		Position
Guide		
# of Bins		

Sensible Defaults for Binning

Channel determines guide and bin parameters

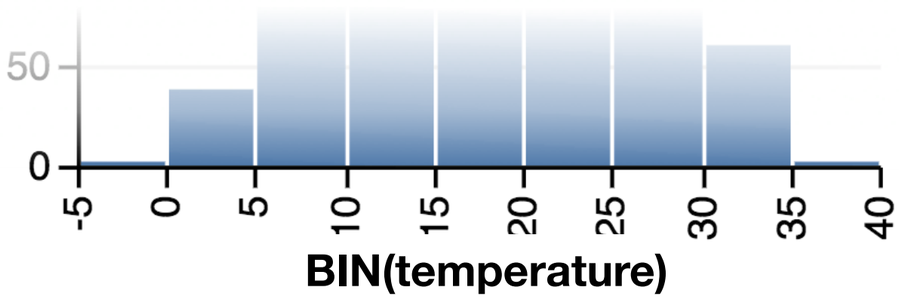
		Position
Guide		Quantitative axis
# of Bins		



Sensible Defaults for Binning

Channel determines guide and bin parameters

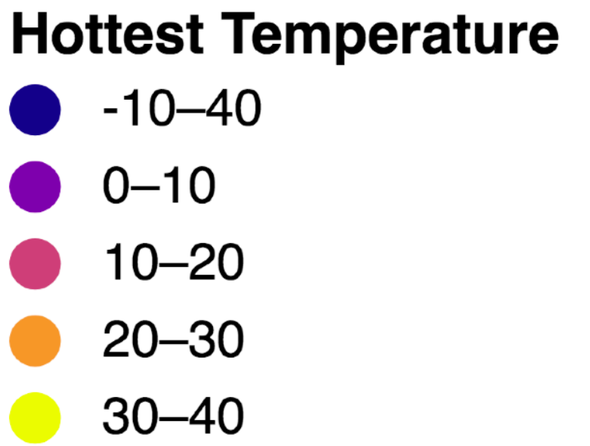
		Position
Guide		Quantitative axis
# of Bins		More bins

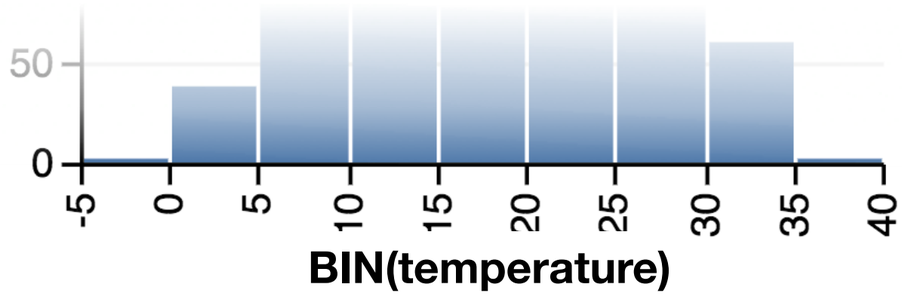


Sensible Defaults for Binning

Channel determines guide and bin parameters

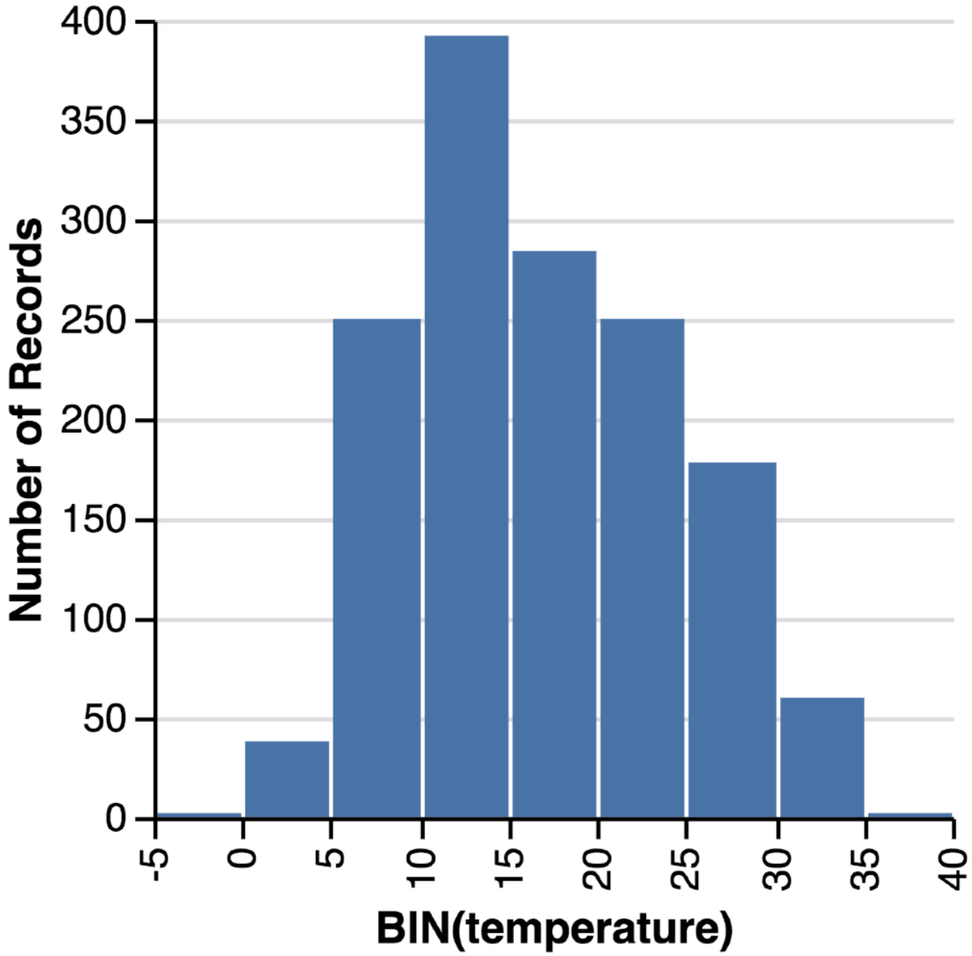
	Color/Opacity/Shape	Position
Guide	Legend with range labels	Quantitative axis
# of Bins	Fewer bins	More bins





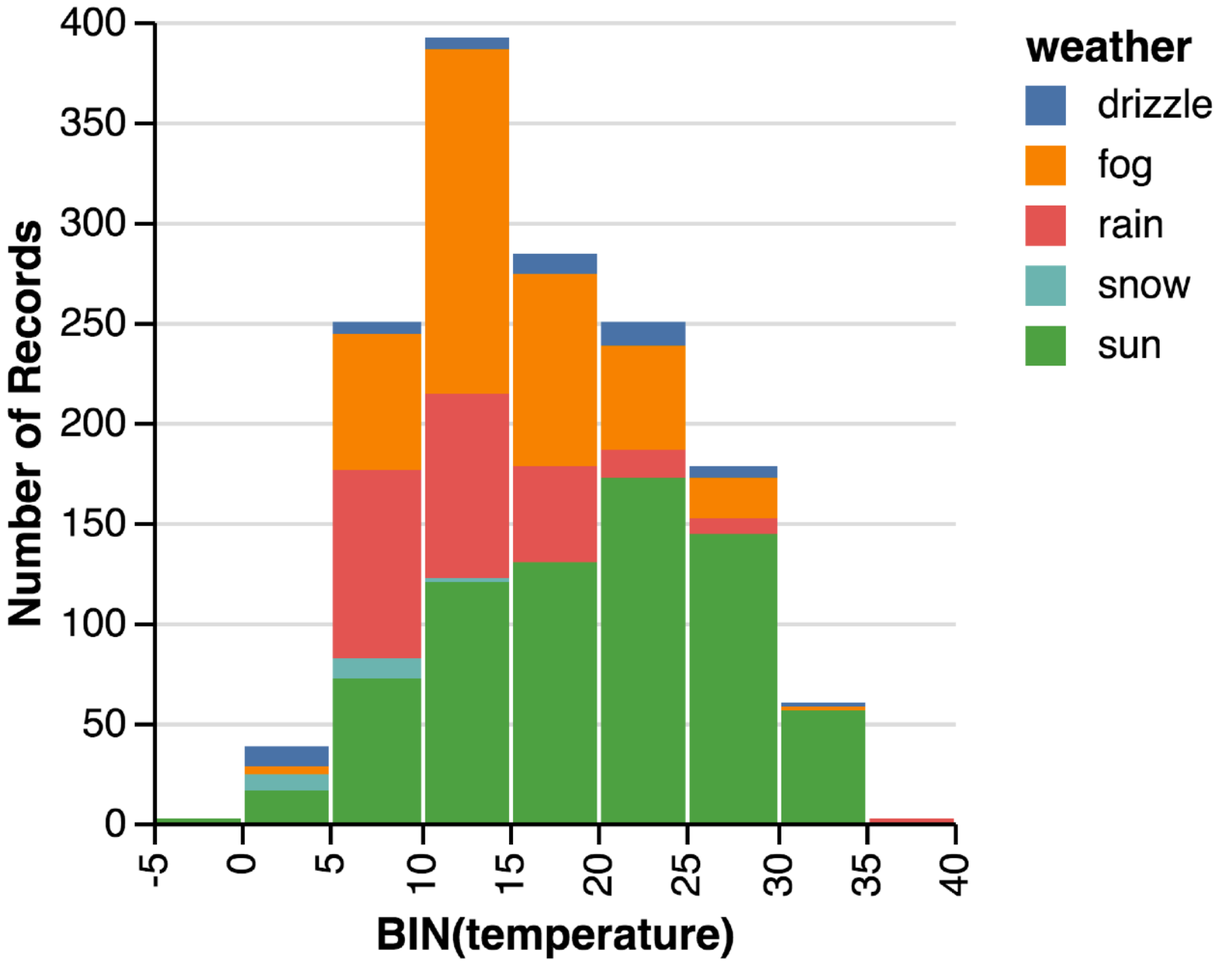
Histogram

```
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {
      bin: true,
      field: "temperature",
      type: "quantitative"
    },
    y: {
      aggregate: "count",
      type: "quantitative"
    }
  }
}
```



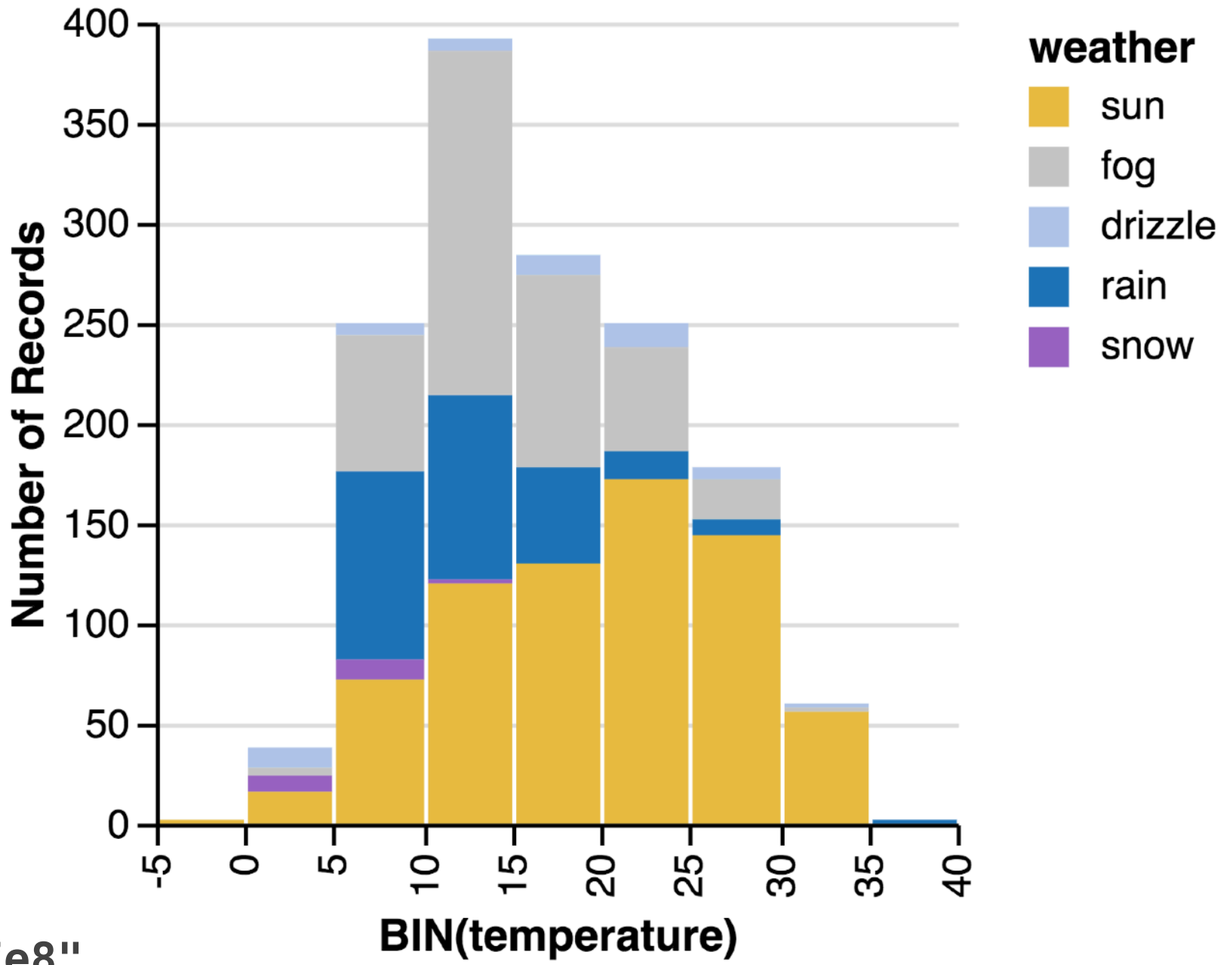
Histogram + Color

```
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {
      bin: true,
      field: "temperature",
      type: "quantitative"
    },
    y: {
      aggregate: "count",
      type: "quantitative"
    },
    color: {
      field: "weather",
      type: "nominal"
    }
  }
}
```



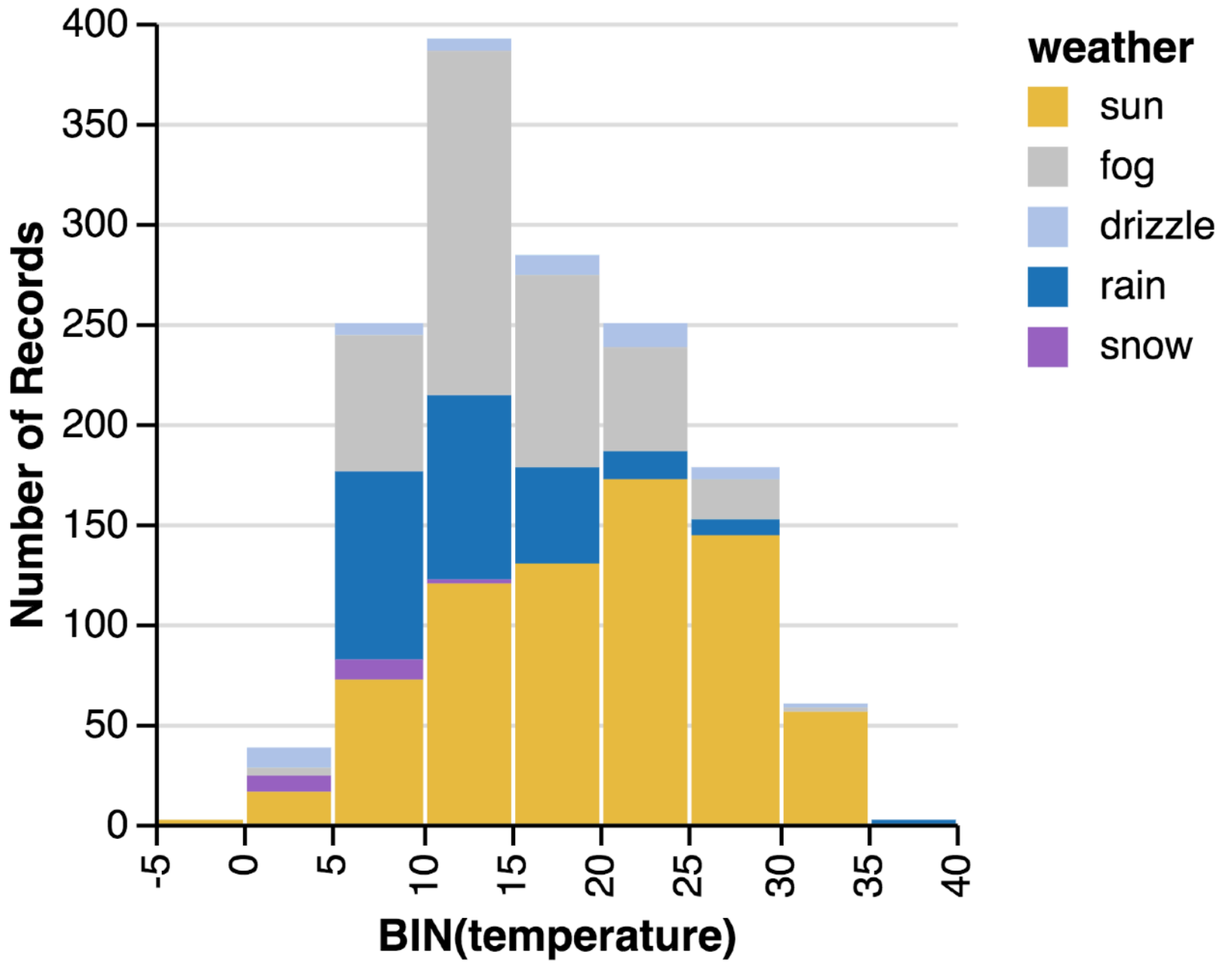
Histogram + Color

```
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {
      bin: true,
      field: "temperature",
      type: "quantitative"
    },
    y: {
      aggregate: "count",
      type: "quantitative"
    },
    color: {
      field: "weather",
      type: "nominal",
      "scale": {
        "domain": ["sun","fog","drizzle",
                   "rain","snow"],
        "range": ["#e7ba52","#c7c7c7","#aec7e8",
                  "#1f77b4","#9467bd"]
      }
    }
```



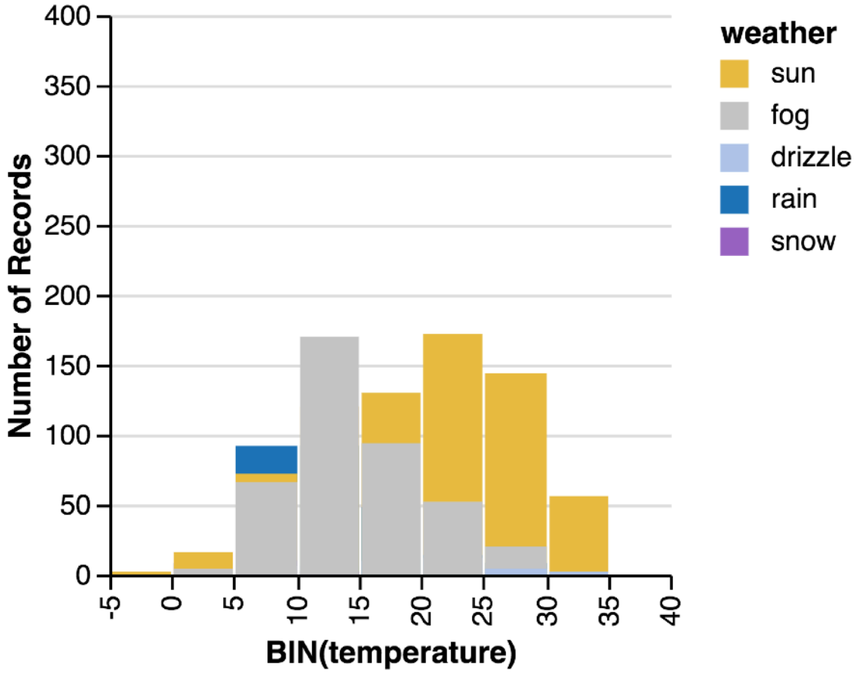
Histogram + Color = Stacked Histogram

```
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {
      bin: true,
      field: "temperature",
      type: "quantitative"
    },
    y: {
      aggregate: "count",
      type: "quantitative"
    },
    color: {
      field: "weather",
      type: "nominal",
      ...
      }
    }
  }
}
```

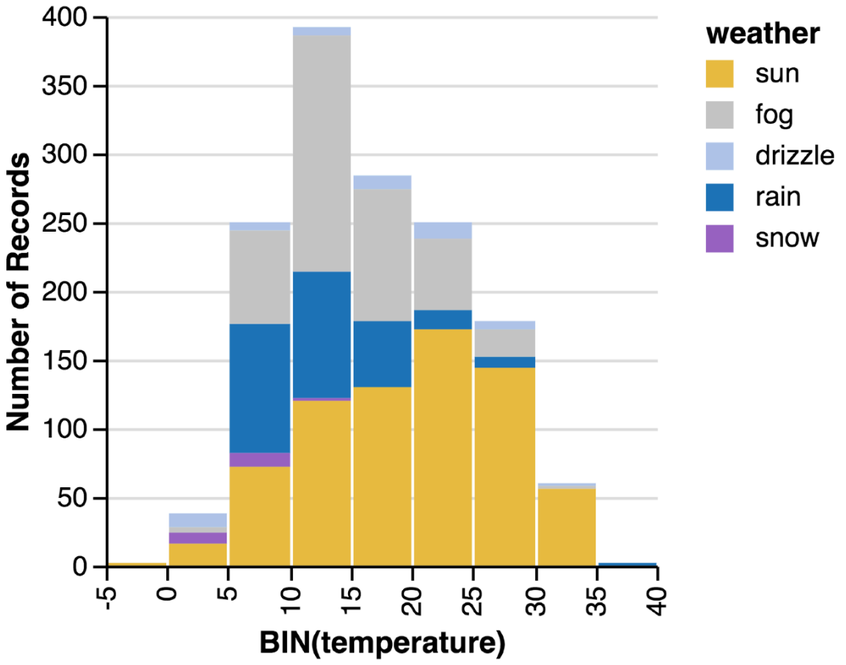


Stacked Histogram: Sensible Defaults

no stack



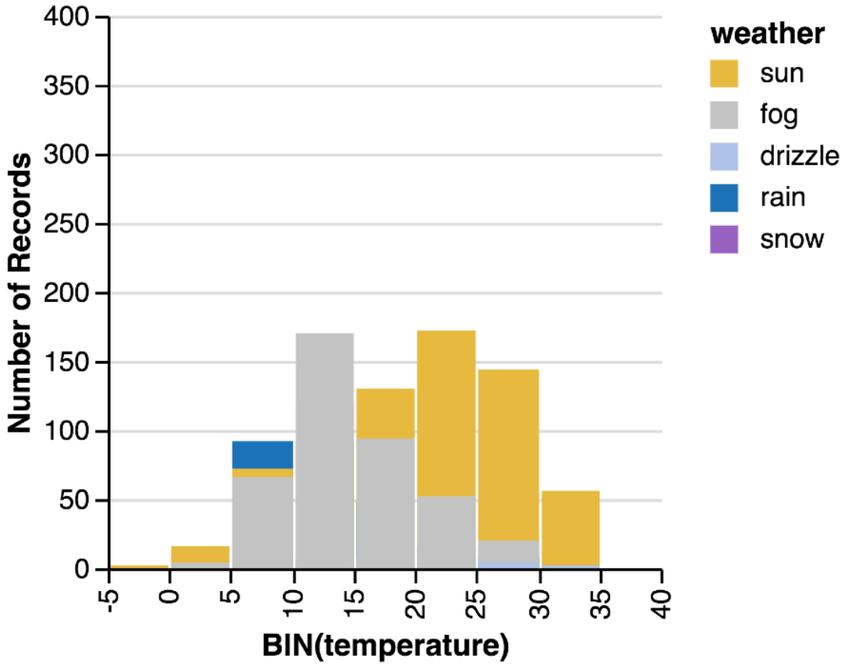
stack (default)



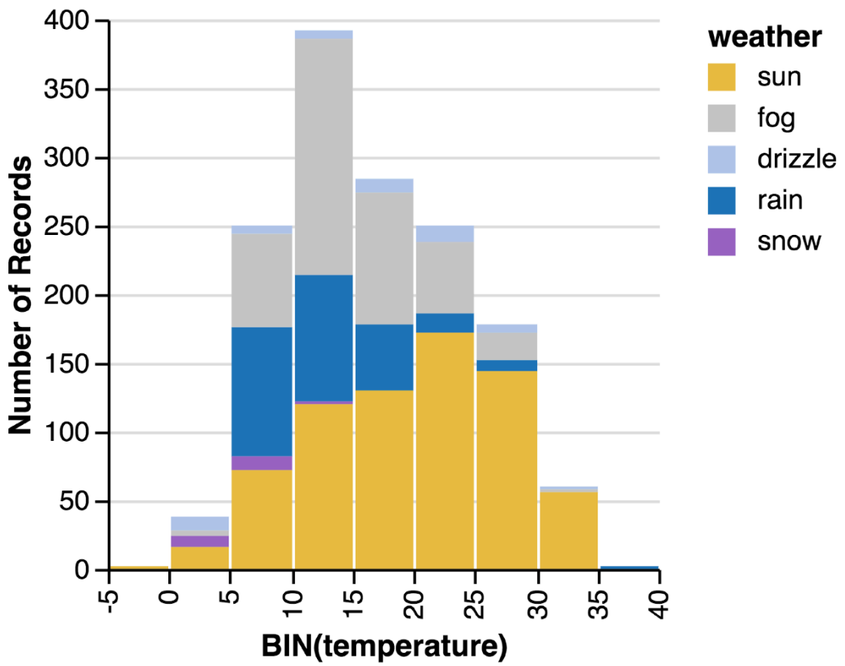
Stacked Histogram: Sensible Defaults

Channel (color) + Mark (bar) automatically enables stacking: a layout transform.

no stack



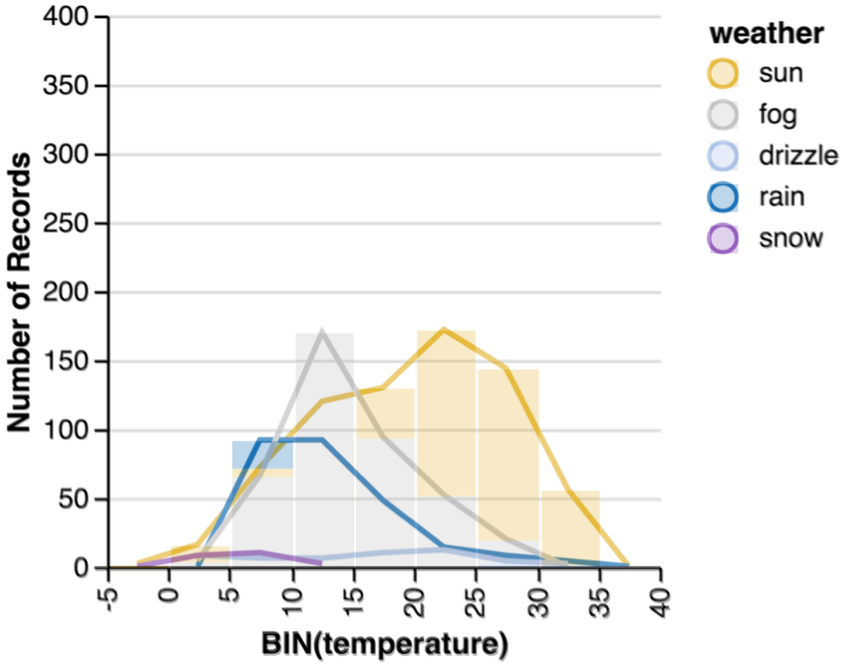
stack (default)



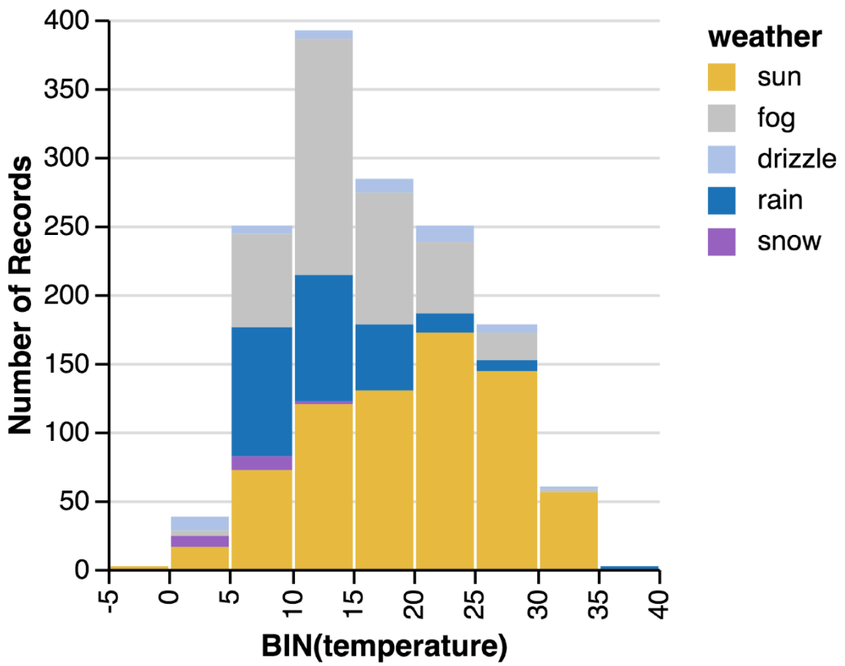
Stacked Histogram: Sensible Defaults

Channel (color) + Mark (bar) automatically enables stacking: a layout transform.

no stack → overlap

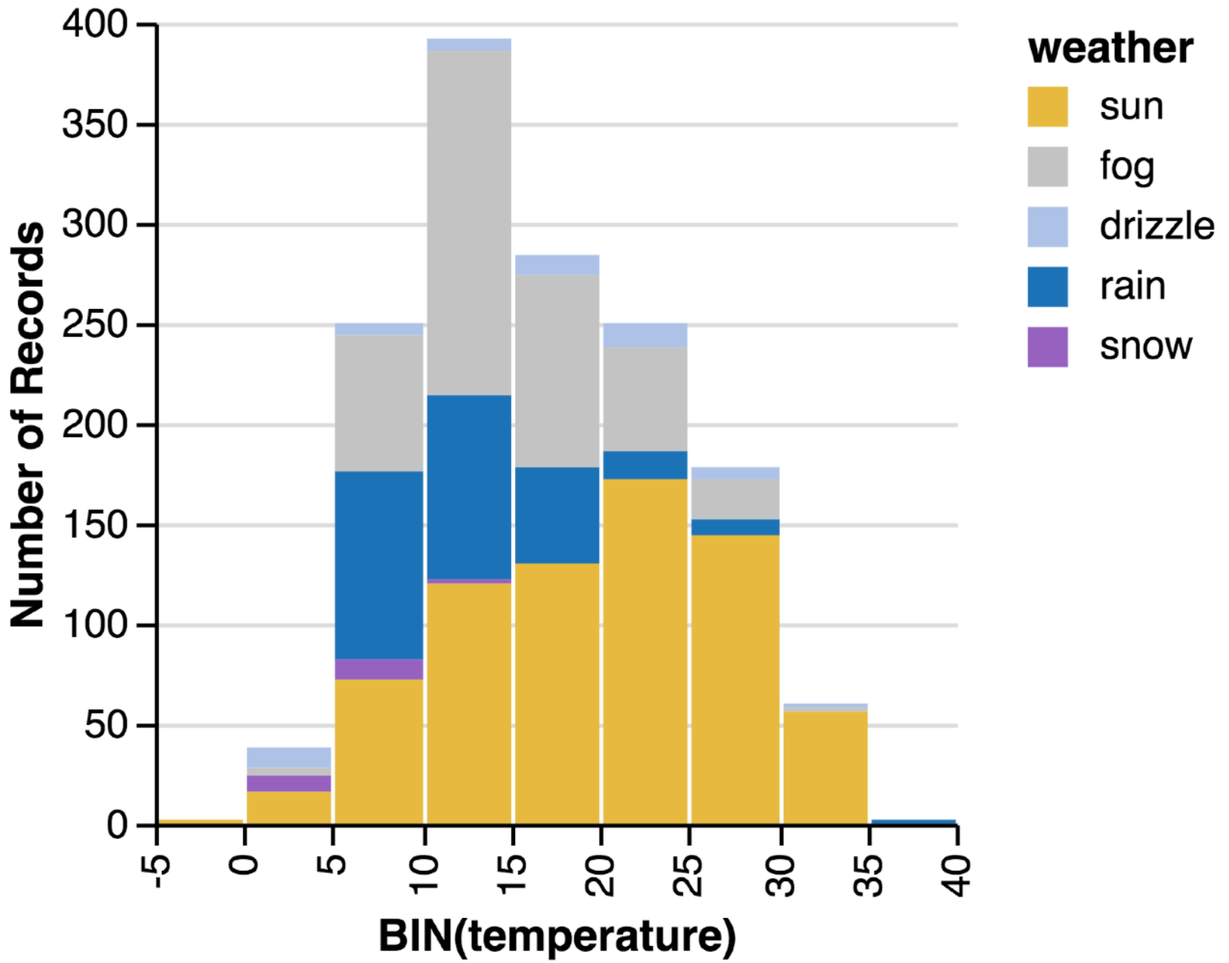


stack (default)



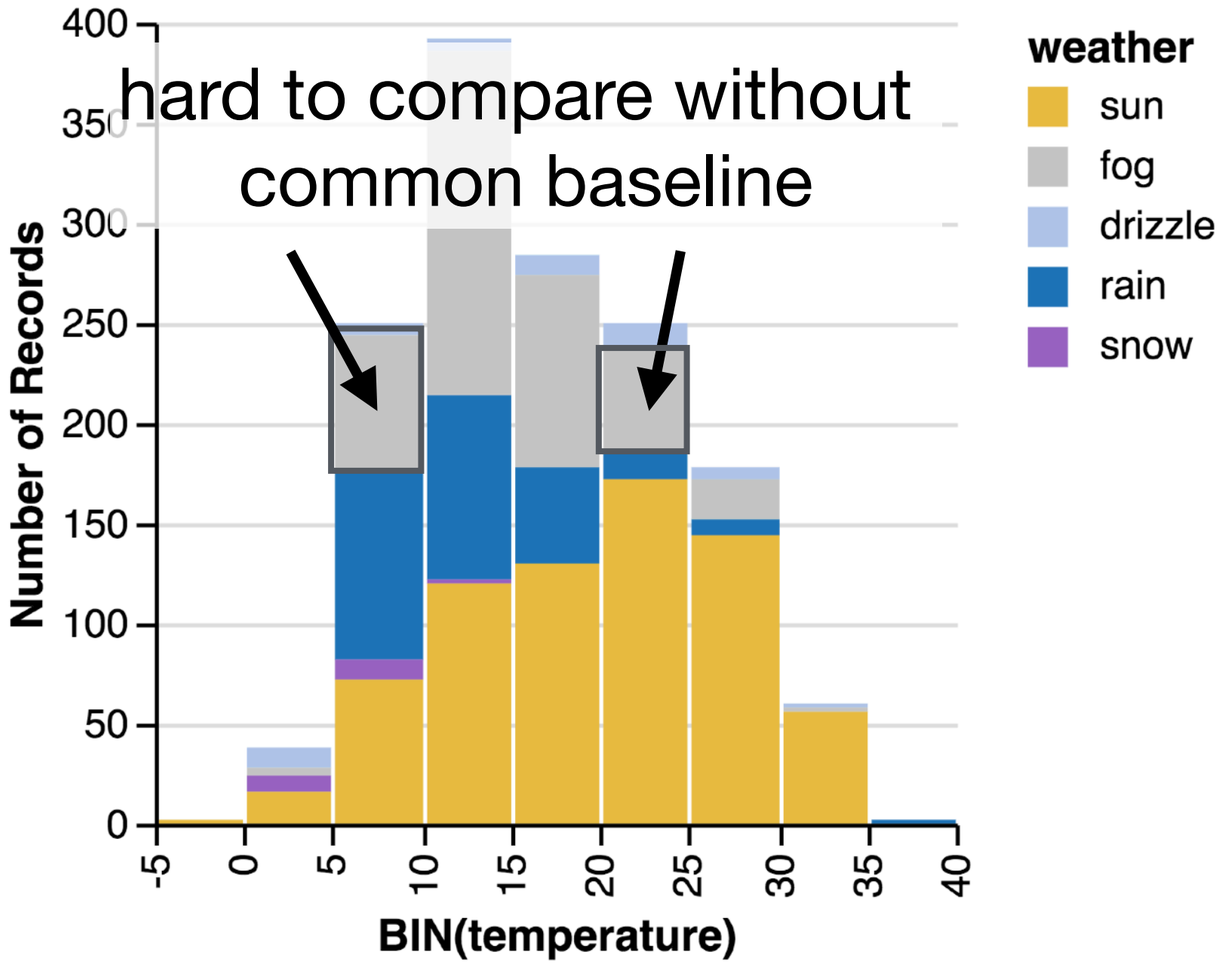
Histogram + Color = Stacked Histogram

```
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {
      bin: true,
      field: "temperature",
      type: "quantitative"
    },
    y: {
      aggregate: "count",
      type: "quantitative"
    },
    color: {
      field: "weather",
      type: "nominal"
    }
  }
}
```



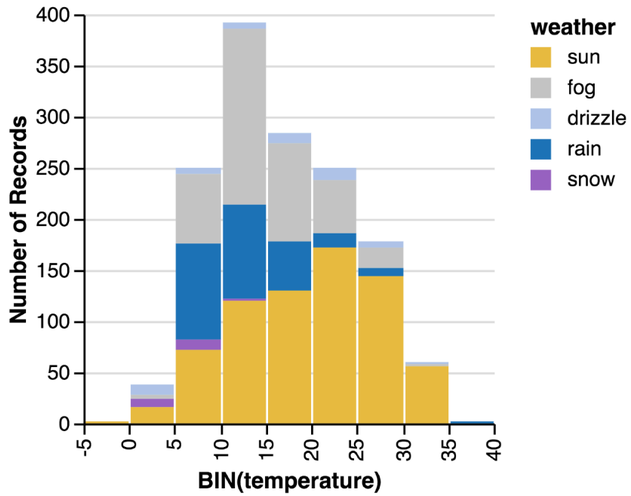
Histogram + Color = Stacked Histogram

```
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {
      bin: true,
      field: "temperature",
      type: "quantitative"
    },
    y: {
      aggregate: "count",
      type: "quantitative"
    },
    color: {
      field: "weather",
      type: "nominal"
    }
  }
}
```



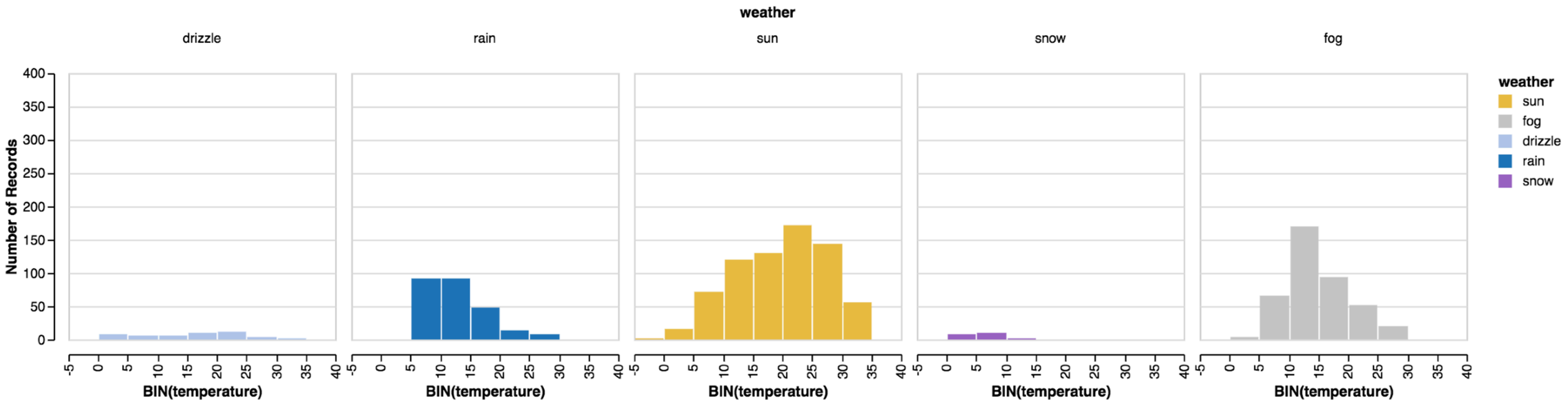
Histogram + Color = Stacked Histogram

```
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {bin: true, field: "temperature", type: "quantitative"},
    y: {aggregate: "count",              type: "quantitative"},
    color: {       field: "weather",     type: "nominal"}
  }
}
```



Histogram + Column = Trellis Histogram

```
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {bin: true, field: "temperature", type: "quantitative"},
    y: {aggregate: "count",              type: "quantitative"},
    column: {      field: "weather",     type: "nominal"}
  }
}
```



Vega-Lite: a Grammar of Interactive Graphics

The Design of Vega-Lite

- **Single View** Specification
- **Layered** and **Multi-view** Composition
- **Interactions** with Selections

Using Vega-Lite

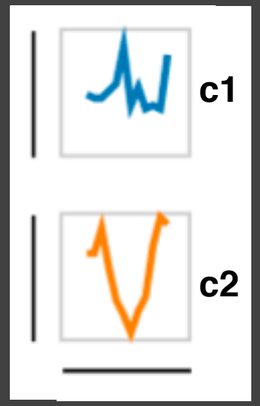
- **Programming** with Vega-Lite
- Higher-level **Tools** and **Recommendations**

View Composition Operators

View Composition Operators

facet row: C

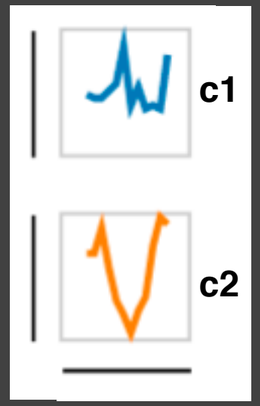
=



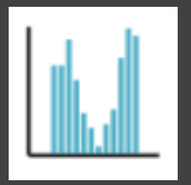
View Composition Operators

facet row: C

=



layer: [



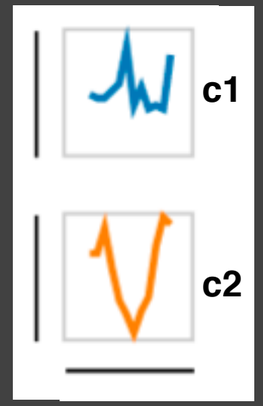
,

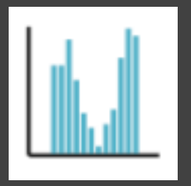
] =

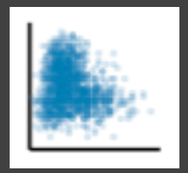
View Composition Operators

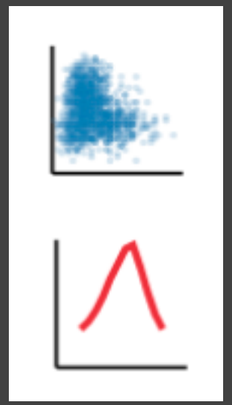
facet row: C

=



layer: [ , ] =

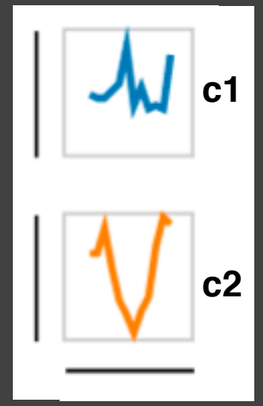
vconcat: [ , ] =

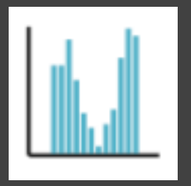


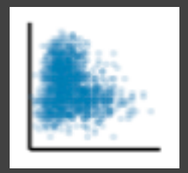
View Composition Operators

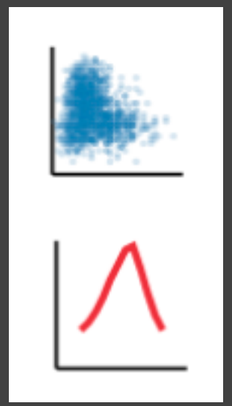
facet row: C

=

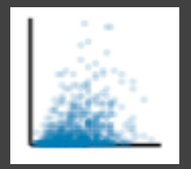


layer: [ , ] =

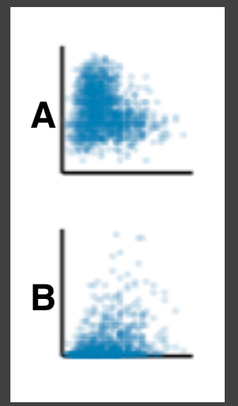
vconcat: [ , ] =



repeat row: [A,B]

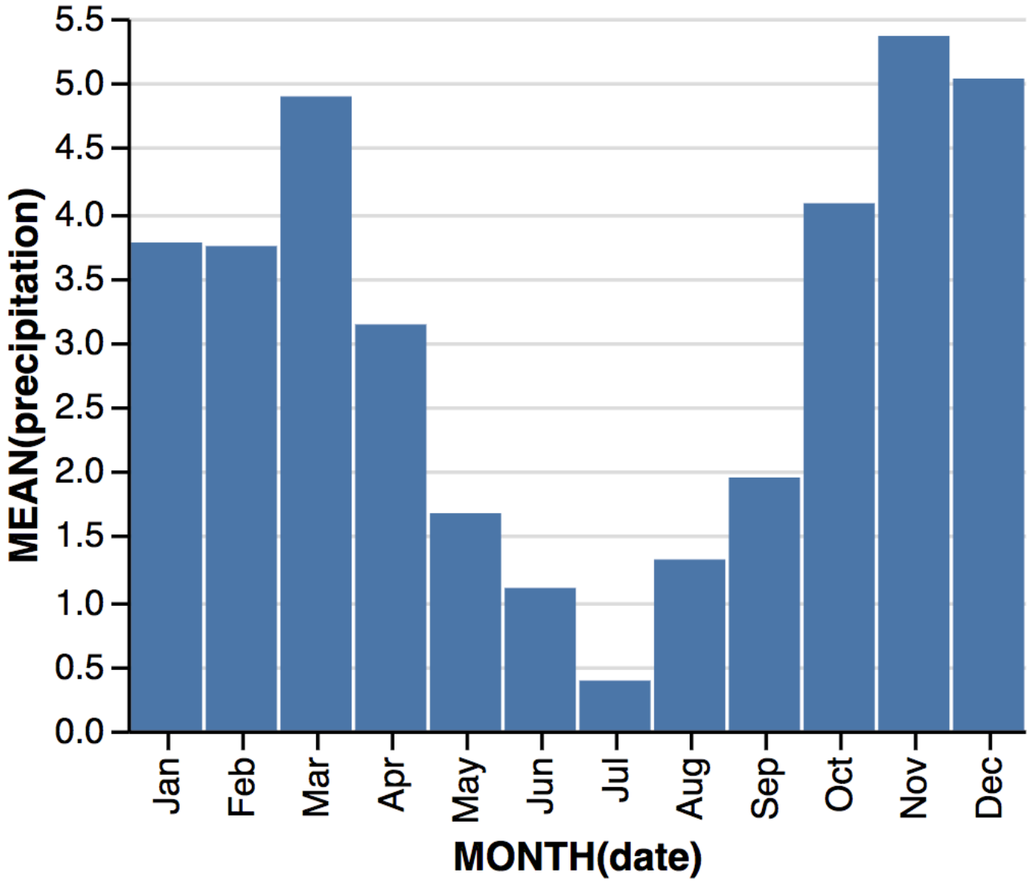


=



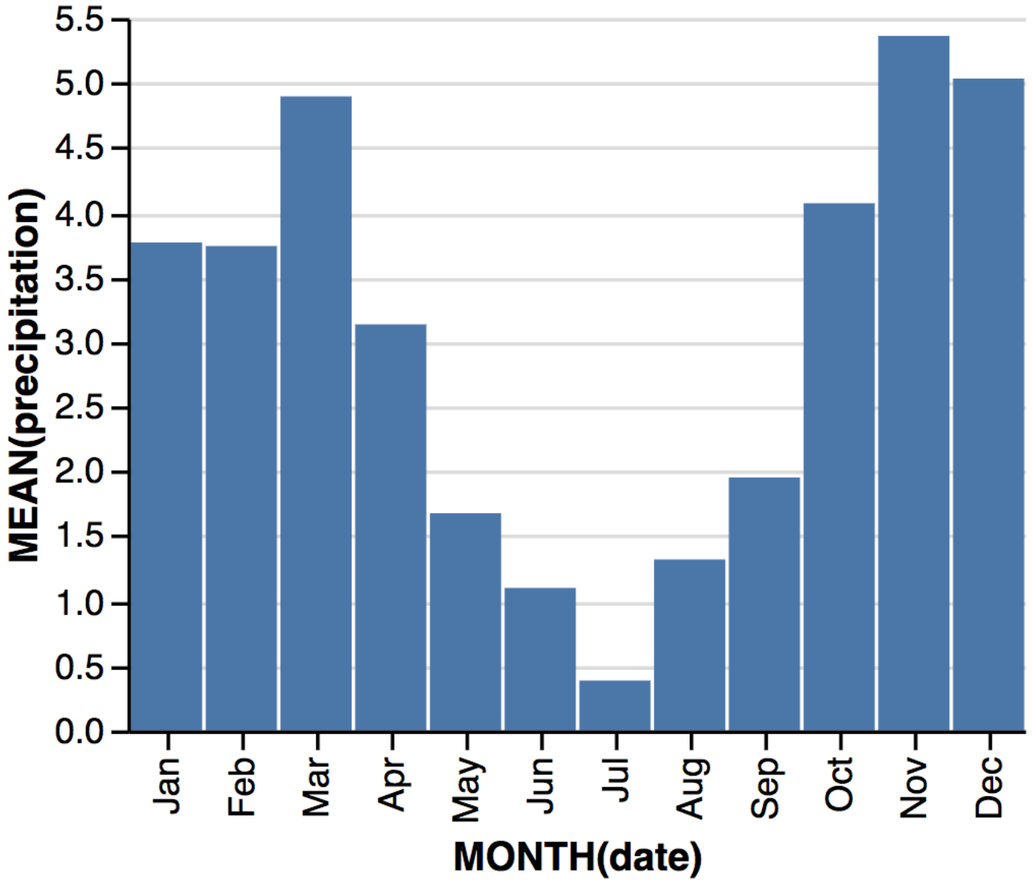
Monthly Precipitation

```
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {
      timeUnit: "month",
      field: "date",
      type: "quantitative"
    },
    y: {
      aggregate: "mean",
      field: "precipitation",
      type: "quantitative"
    }
  }
}
```



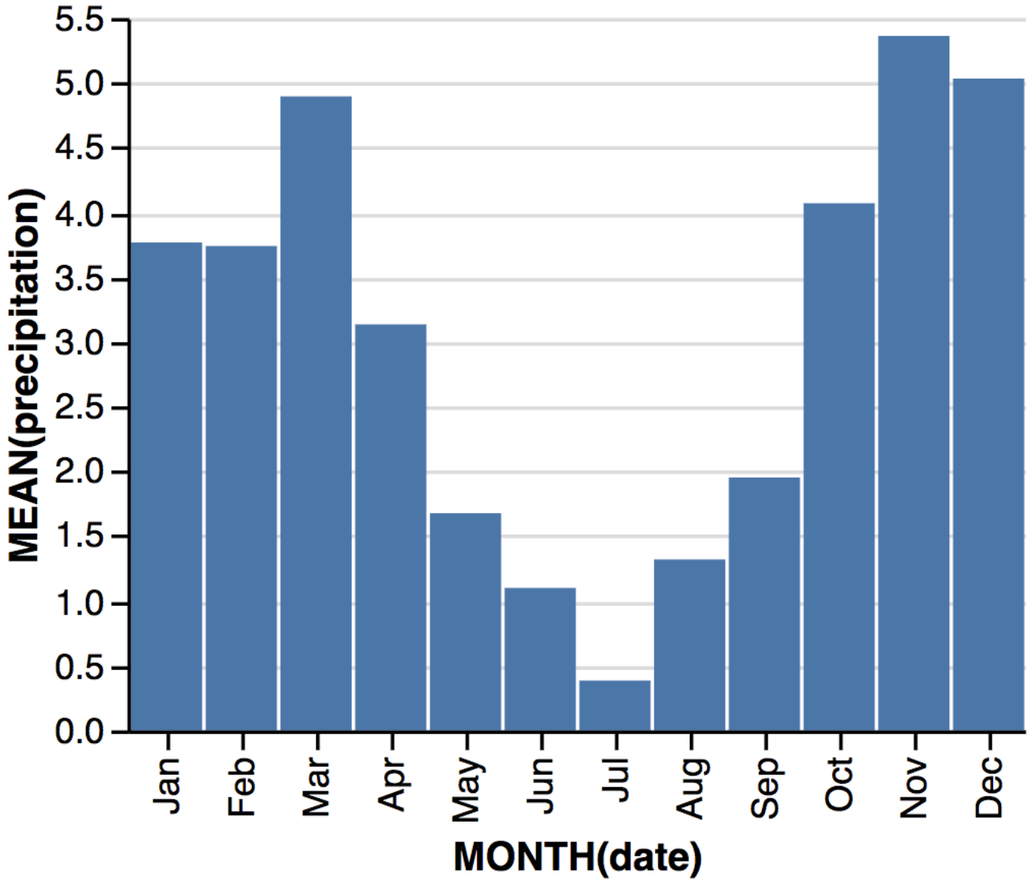
Monthly Precipitation

```
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {
      timeUnit: "month",
      field: "date",
      type: "quantitative"
    },
    y: {
      aggregate: "mean",
      field: "precipitation",
      type: "quantitative"
    }
  }
}
```



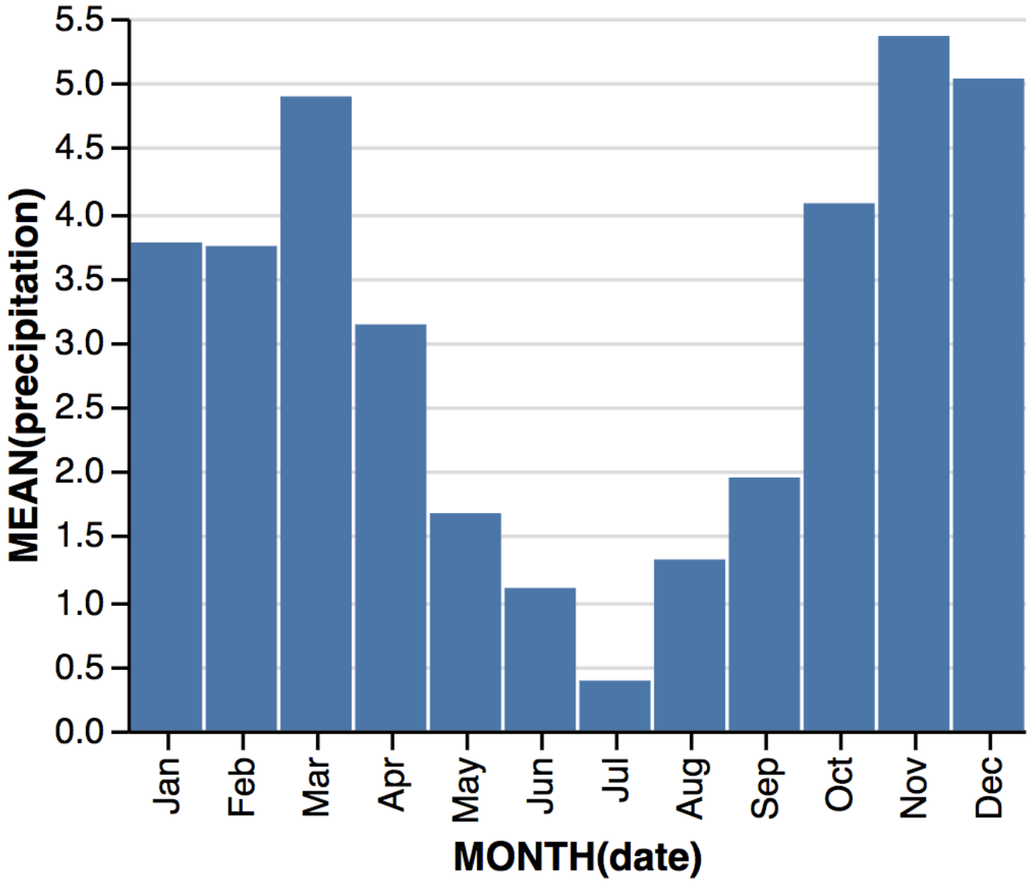
Monthly Precipitation

```
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {
      timeUnit: "month",
      field: "date",
      type: "quantitative"
    },
    y: {
      aggregate: "mean",
      field: "precipitation",
      type: "quantitative"
    }
  }
}
```



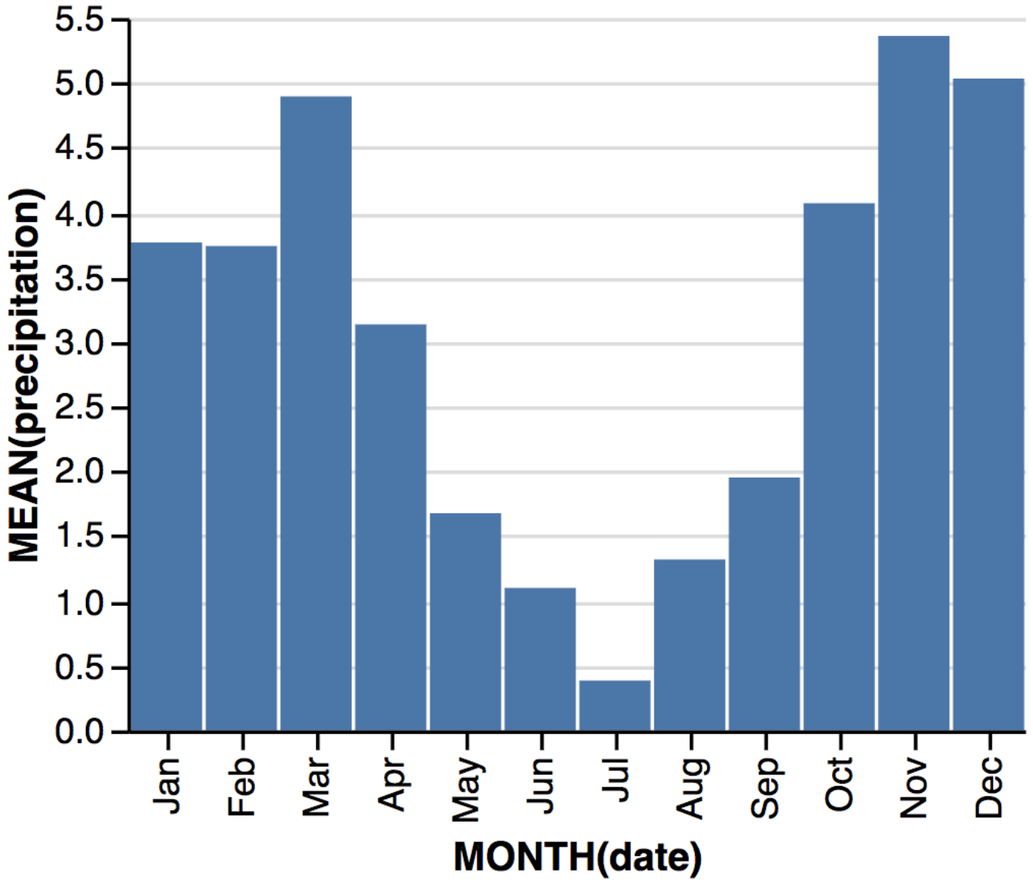
Layering

```
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {
      timeUnit: "month",
      field: "date",
      type: "quantitative"
    },
    y: {
      aggregate: "mean",
      field: "precipitation",
      type: "quantitative"
    }
  }
}
```



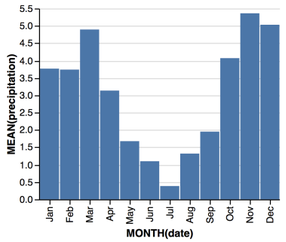
Layering

```
{
  data: {url: "weather-seattle.json"},
  layer: [{
    mark: "bar",
    encoding: {
      x: {
        timeUnit: "month",
        field: "date",
        type: "quantitative"
      },
      y: {
        aggregate: "mean",
        field: "precipitation",
        type: "quantitative"
      }
    }
  }
  ]
}
```

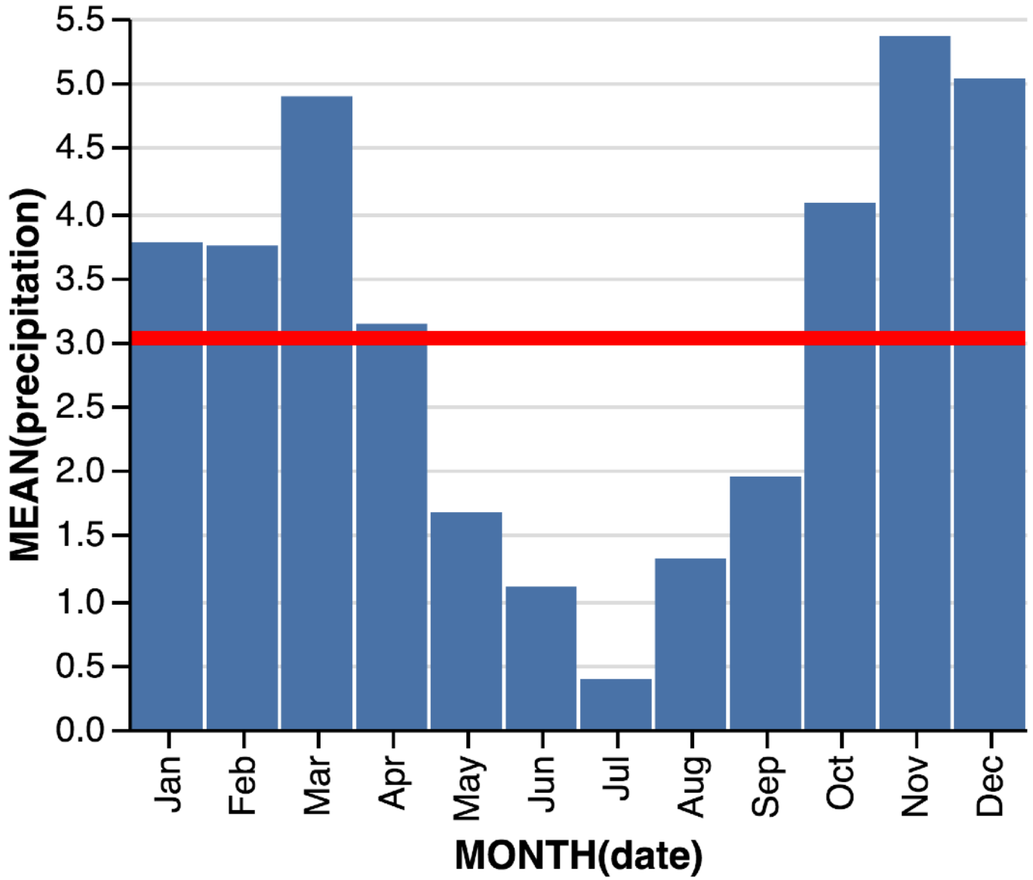


Layering

```
{
  data: {url: "weather-seattle.json"},
  layer: [{
```

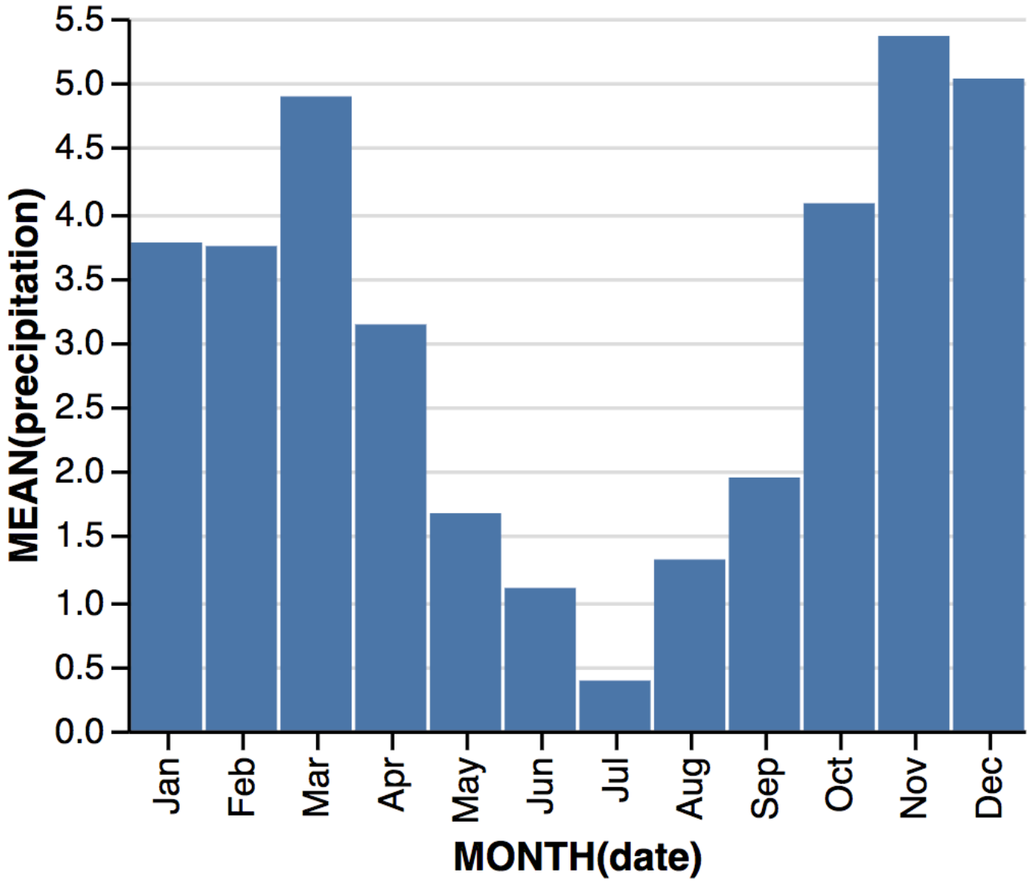



```
  }, {
    mark: "rule",
    encoding: {
      y: {
        aggregate: "mean",
        field: "precipitation",
        type: "quantitative"
      }
    }]
}
```



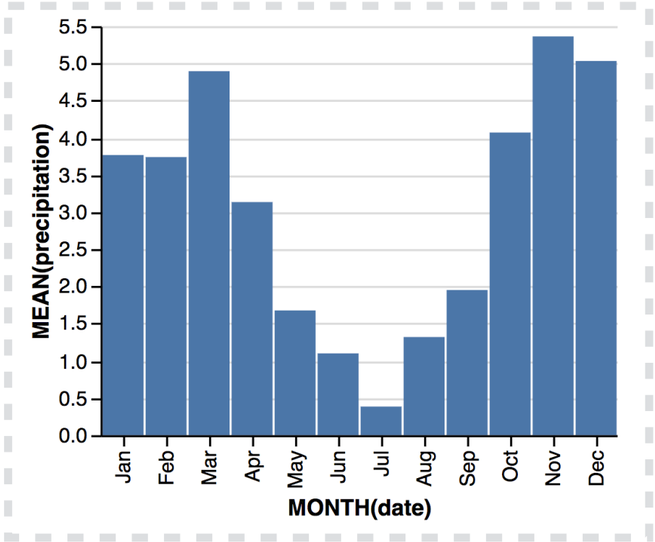
Concat

```
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {
      timeUnit: "month",
      field: "date",
      type: "quantitative"
    },
    y: {
      aggregate: "mean",
      field: "precipitation",
      type: "quantitative"
    }
  }
}
```



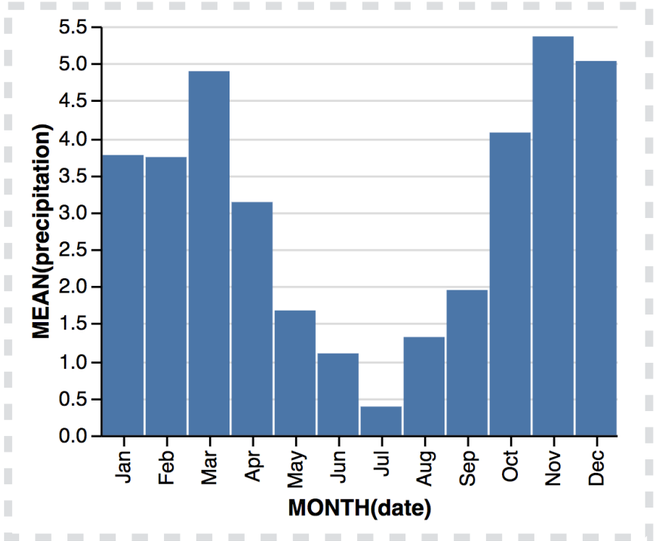
Concat

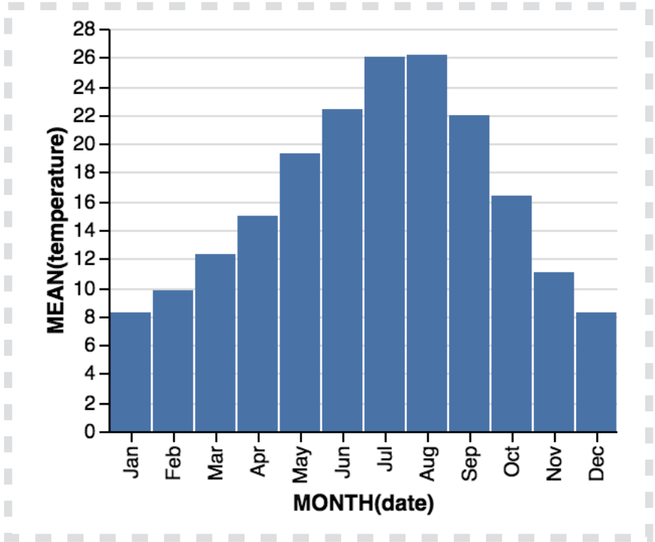
```
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {
      timeUnit: "month",
      field: "date",
      type: "quantitative"
    },
    y: {
      aggregate: "mean",
      field: "precipitation",
      type: "quantitative"
    }
  }
}
```



Concat

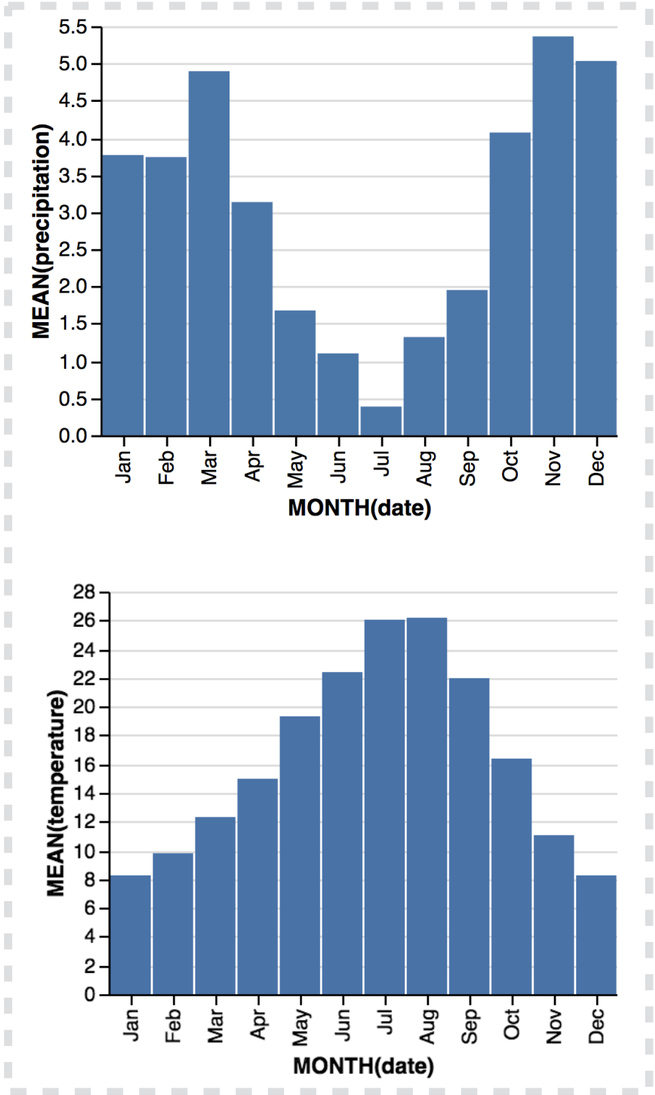
```
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {
      timeUnit: "month",
      field: "date",
      type: "quantitative"
    },
    y: {
      aggregate: "mean",
      field: "precipitation",
      type: "quantitative"
    }
  }
}
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {
      timeUnit: "month",
      field: "date",
      type: "quantitative"
    },
    y: {
      aggregate: "mean",
      field: "temperature",
      type: "quantitative"
    }
  }
}
```





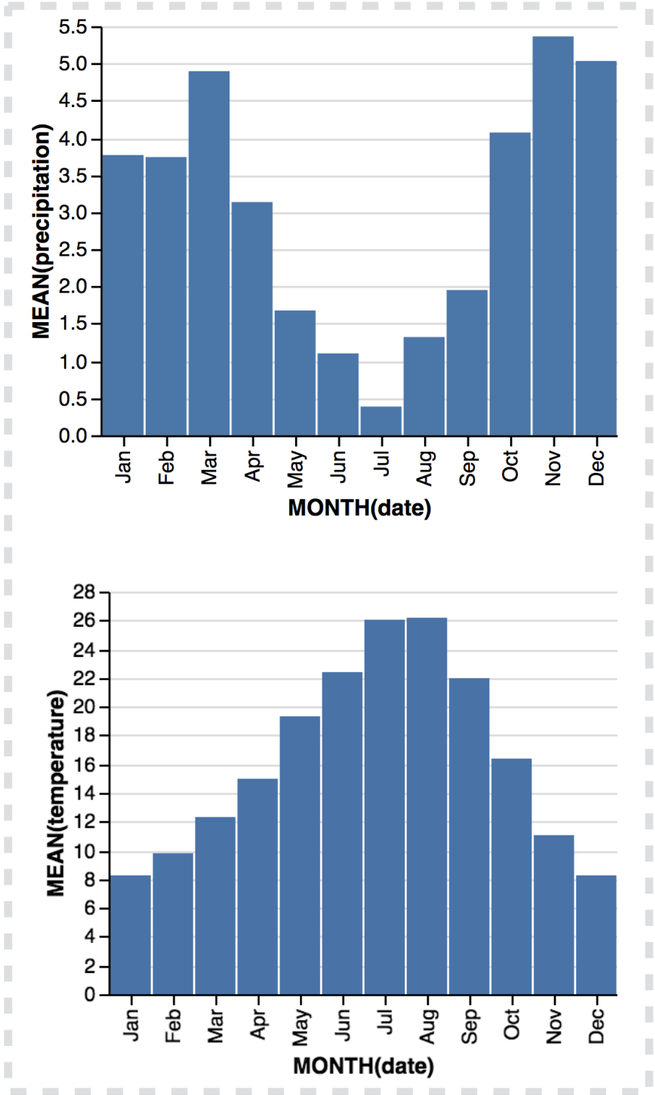
Concat

```
{
  vconcat: [{
    data: {url: "weather-seattle.json"},
    mark: "bar",
    encoding: {
      x: {
        timeUnit: "month",
        field: "date",
        type: "quantitative"
      },
      y: {
        aggregate: "mean",
        field: "precipitation",
        type: "quantitative"
      }
    }
  },
  {
    data: {url: "weather-seattle.json"},
    mark: "bar",
    encoding: {
      x: {
        timeUnit: "month",
        field: "date",
        type: "quantitative"
      },
      y: {
        aggregate: "mean",
        field: "temperature",
         type: "quantitative"
      }
    }
  }]
}
```



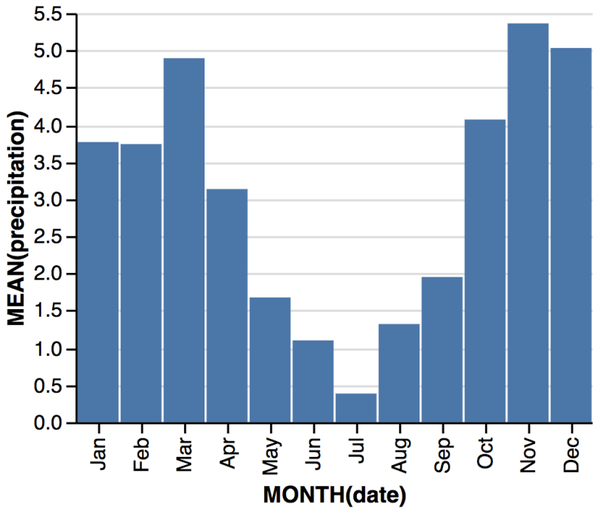
Concat

```
{
  vconcat: [{
    data: {url: "weather-seattle.json"},
    mark: "bar",
    encoding: {
      x: {
        timeUnit: "month",
        field: "date",
        type: "quantitative"
      },
      y: {
        aggregate: "mean",
        field: "precipitation",
        type: "quantitative"
      }
    }
  },
  {
    data: {url: "weather-seattle.json"},
    mark: "bar",
    encoding: {
      x: {
        timeUnit: "month",
        field: "date",
        type: "quantitative"
      },
      y: {
        aggregate: "mean",
        field: "temperature",
         type: "quantitative"
      }
    }
  }]
}
```



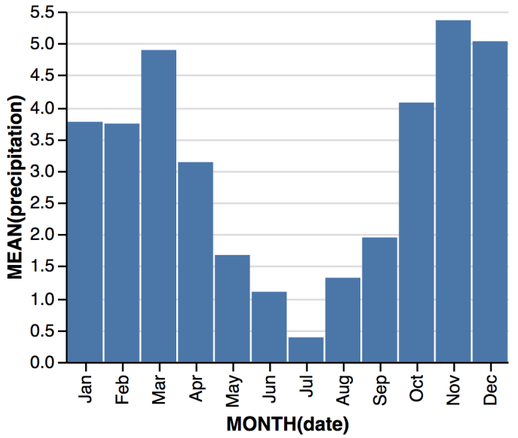
Repeat

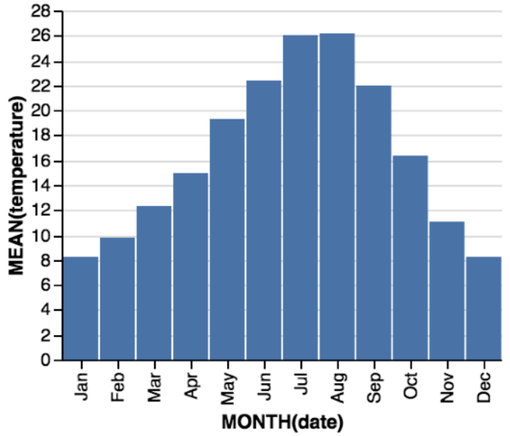
```
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {
      timeUnit: "month",
      field: "date",
      type: "quantitative"
    },
    y: {
      aggregate: "mean",
      field: "precipitation",
      type: "quantitative"
    }
  }
}
```

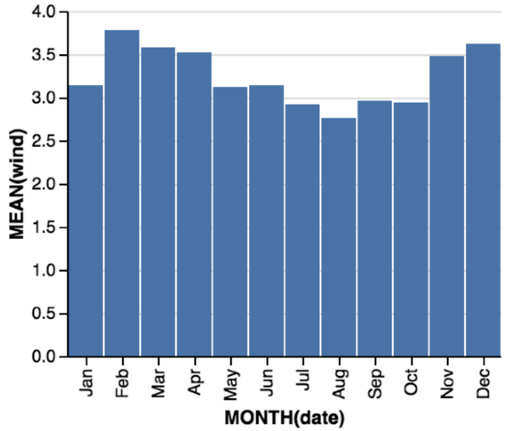


Repeat

```
{
  repeat: {
    column: ["precipitation", "temperature", "wind"]
  },
  spec: {
    data: {url: "weather-seattle.json"},
    mark: "bar",
    encoding: {
      x: {
        timeUnit: "month",
        field: "date",
        type: "quantitative"
      },
      y: {
        aggregate: "mean",
        field: {repeat: "column"},
        type: "quantitative"
      }
    }
  }
}
```

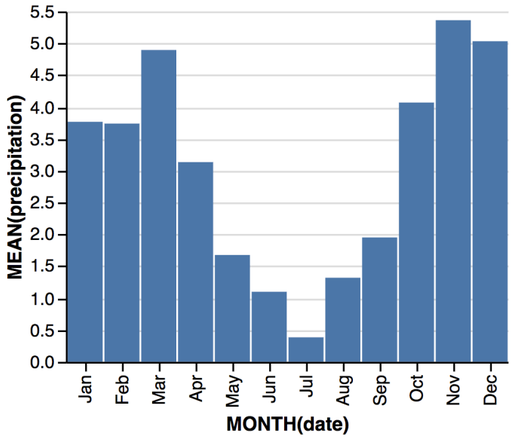


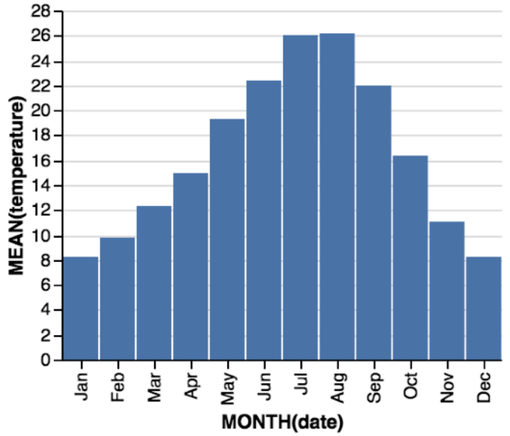


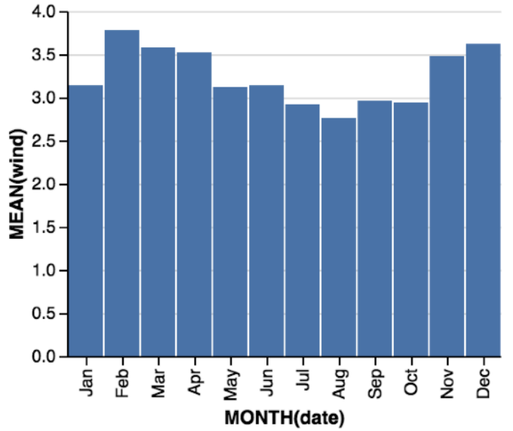


Repeat

```
{
  repeat: {
    column: ["precipitation", "temperature", "wind"]
  },
  spec: {
    data: {url: "weather-seattle.json"},
    mark: "bar",
    encoding: {
      x: {
        timeUnit: "month",
        field: "date",
        type: "quantitative"
      },
      y: {
        aggregate: "mean",
        field: {repeat: "column"},
        type: "quantitative"
      }
    }
  }
}
```

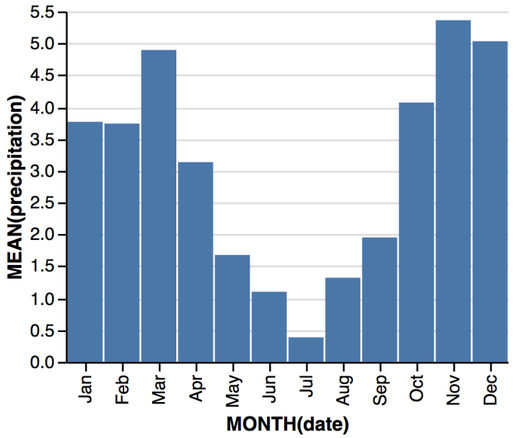


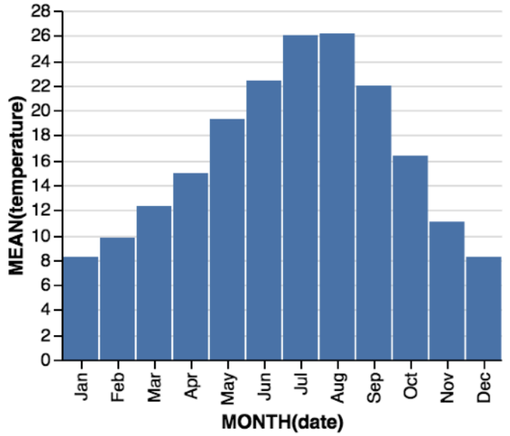


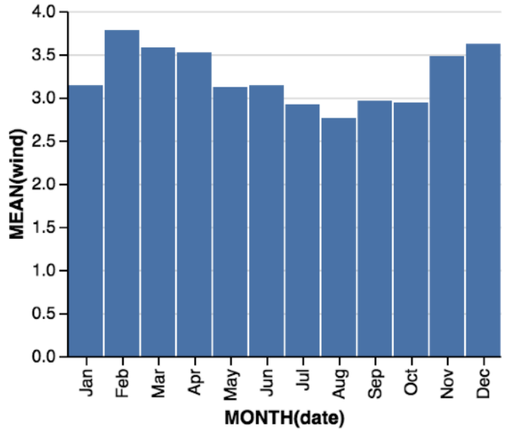


Repeat

```
{
  repeat: {
    column: ["precipitation", "temperature", "wind"]
  },
  spec: {
    data: {url: "weather-seattle.json"},
    mark: "bar",
    encoding: {
      x: {
        timeUnit: "month",
        field: "date",
        type: "quantitative"
      },
      y: {
        aggregate: "mean",
        field: {repeat: "column"},
        type: "quantitative"
      }
    }
  }
}
```

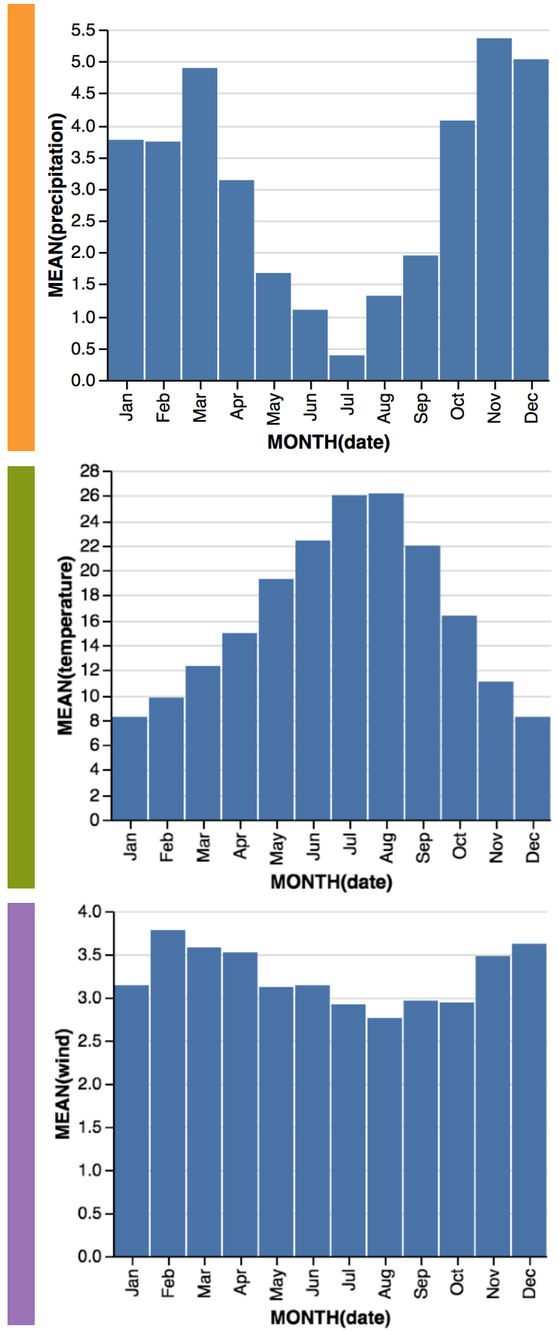






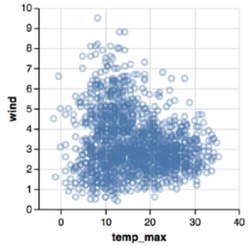
Concat

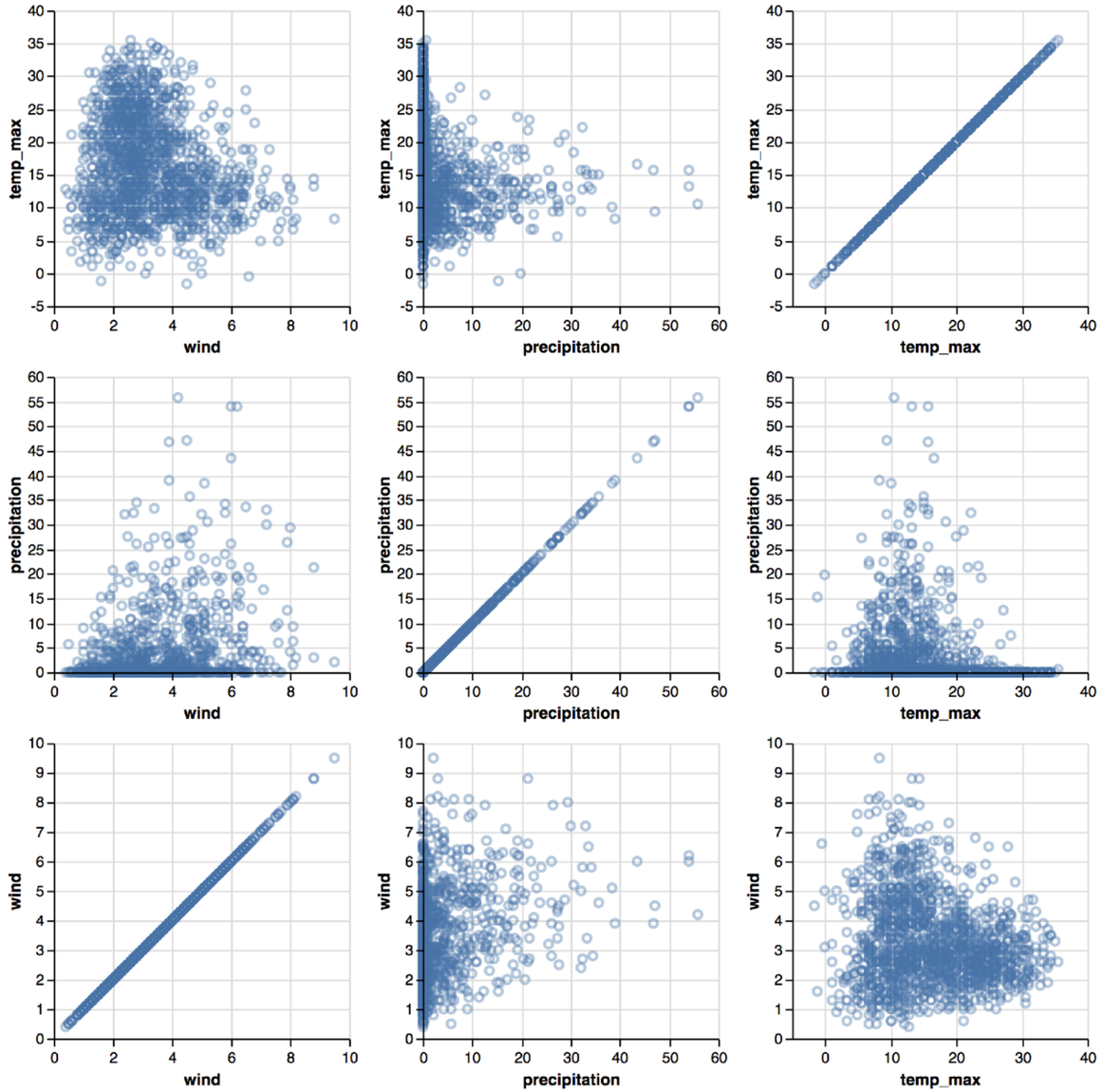
```
{
  repeat: {
    column: ["precipitation", "temperature", "wind"]
  },
  spec: {
    data: {url: "weather-seattle.json"},
    mark: "bar",
    encoding: {
      x: {
        timeUnit: "month",
        field: "date",
        type: "quantitative"
      },
      y: {
        aggregate: "mean",
        field: {repeat: "column"},
        type: "quantitative"
      }
    }
  }
}
```



Repeat

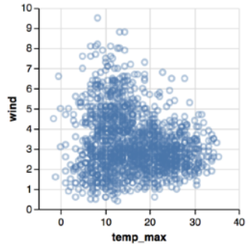
```
{
  repeat: {
    column: [
     "temperature"
     "precipitation",
     "wind"],
    row: [
      "wind",
      "precipitation",
      "temperature",
    ]
  },
  spec: {
    ...
  }
}
```

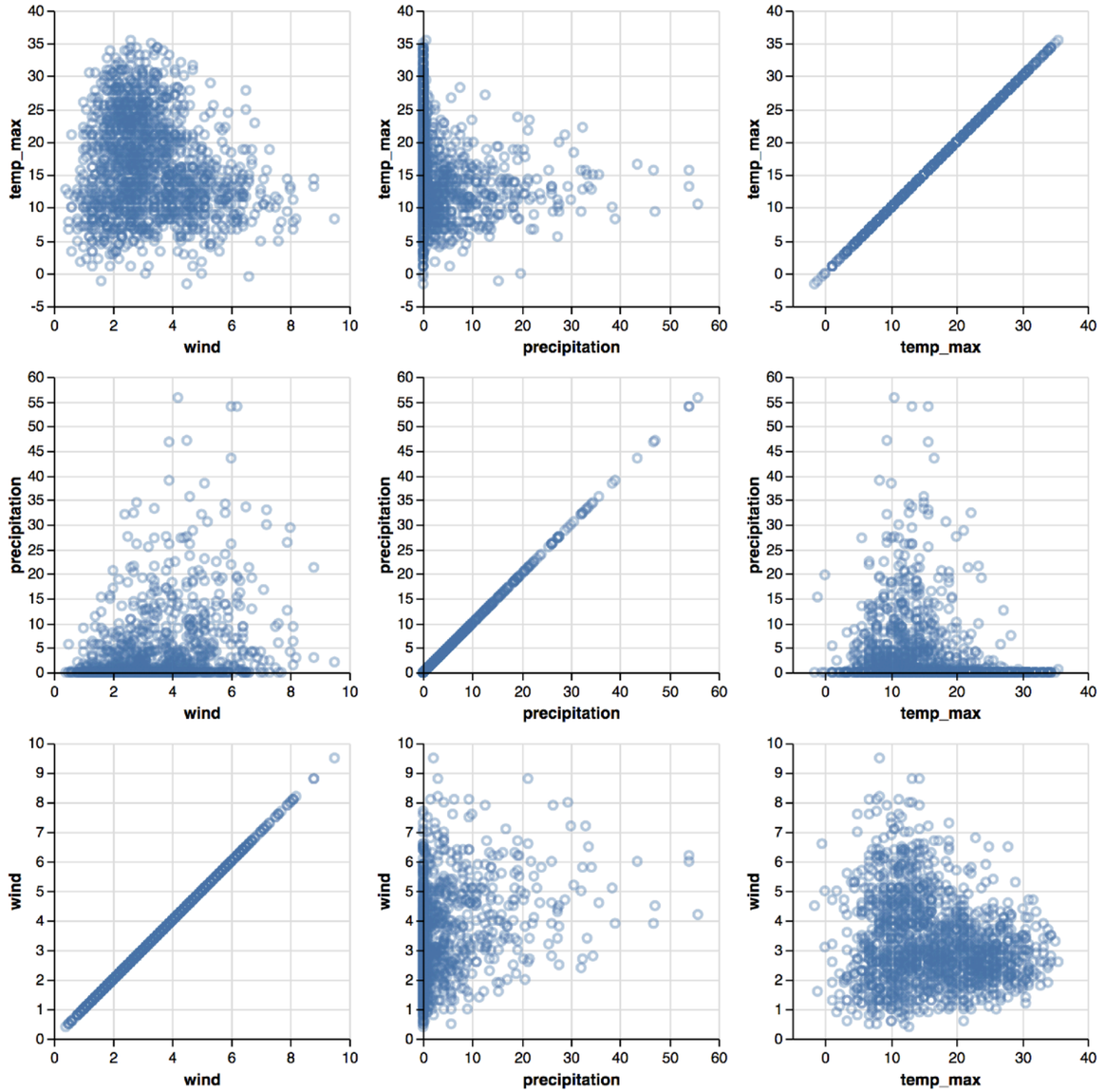


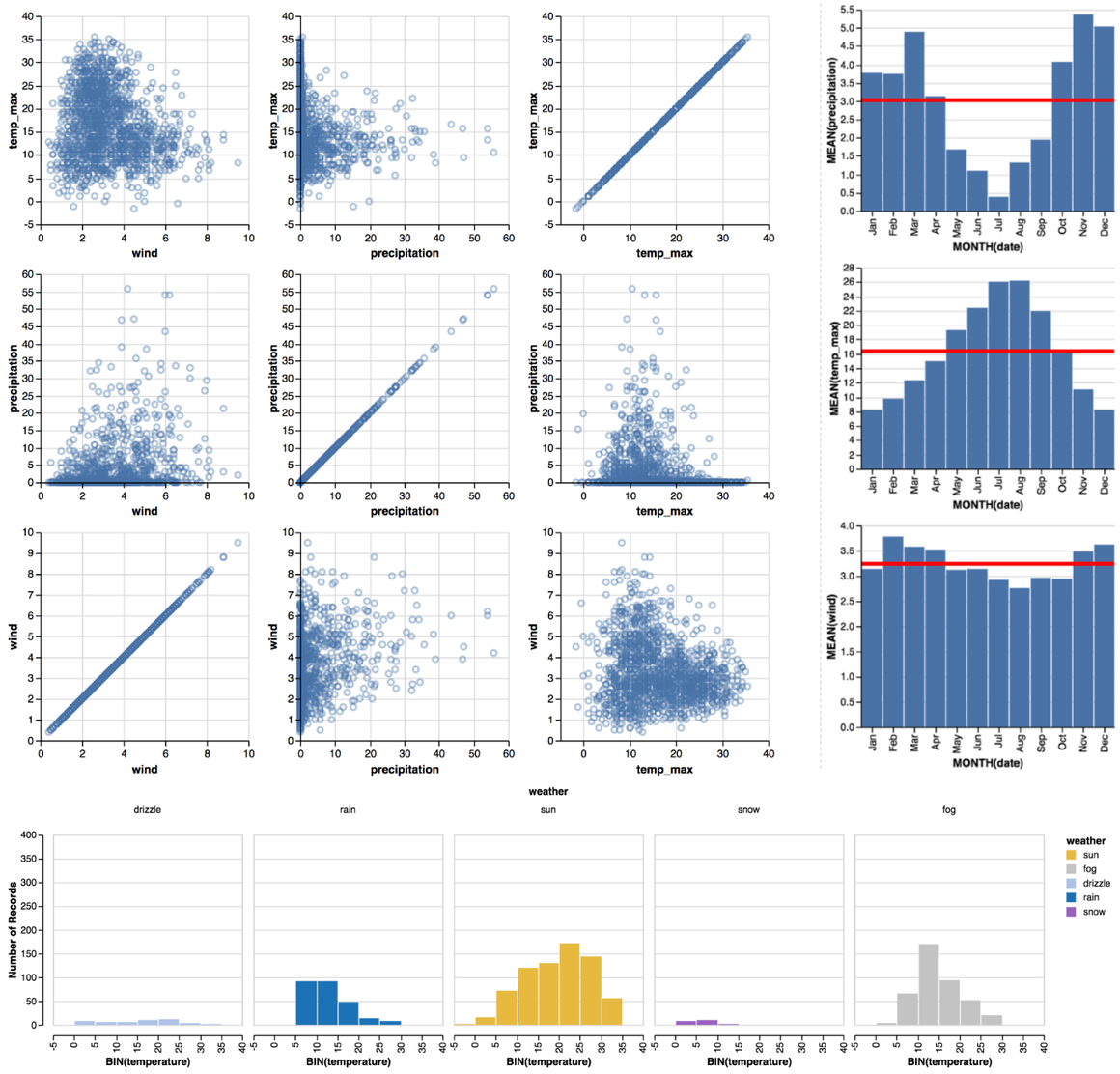


Repeat: SPLOM

```
{
  repeat: {
    column: [
     "temperature"
     "precipitation",
     "wind"],
    row: [
      "wind",
      "precipitation",
      "temperature",
    ]
  },
  spec: {
    ...
  }
}
```



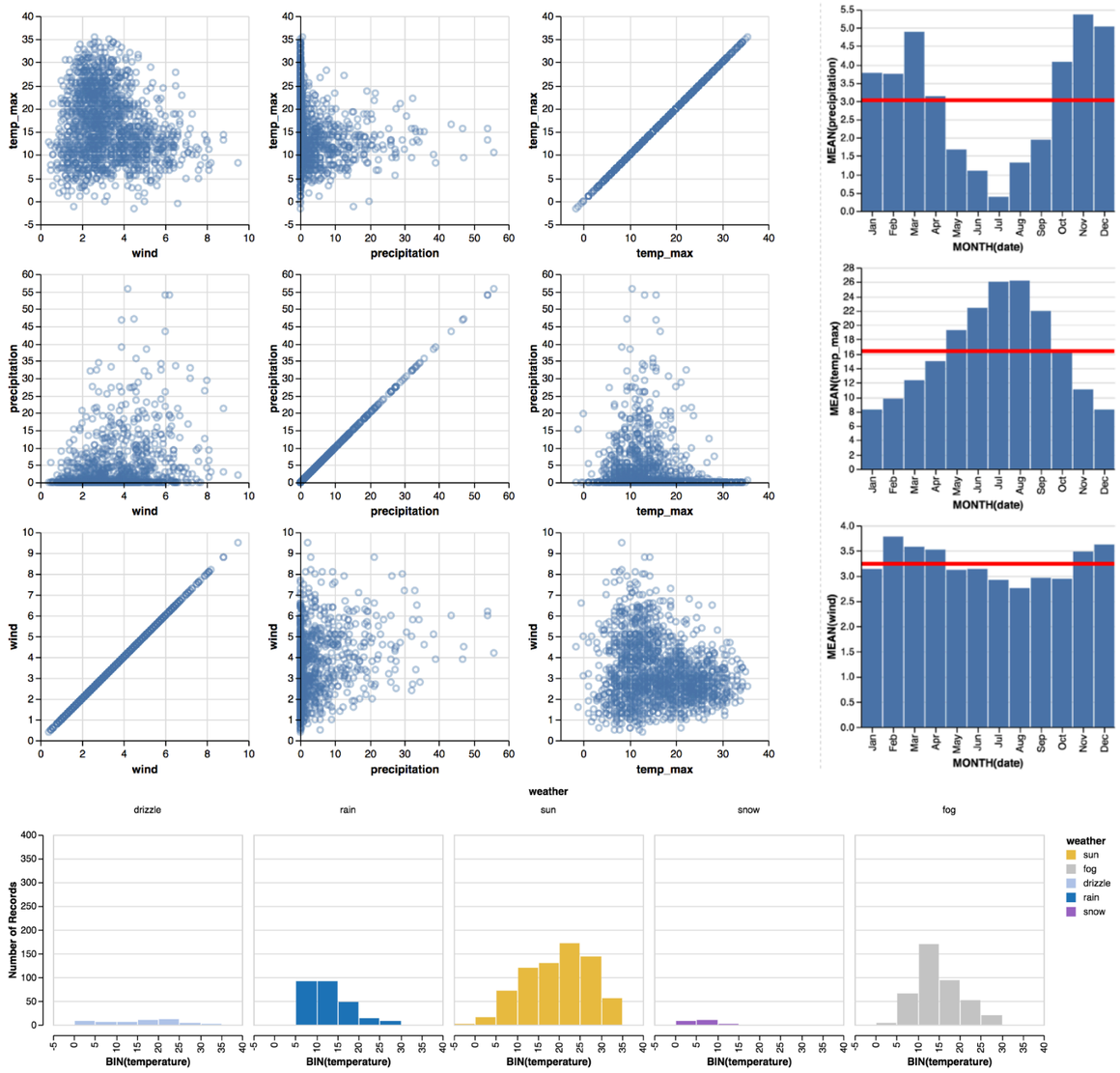




Dashboards

Many views, some of them composed

Manual data, and view management

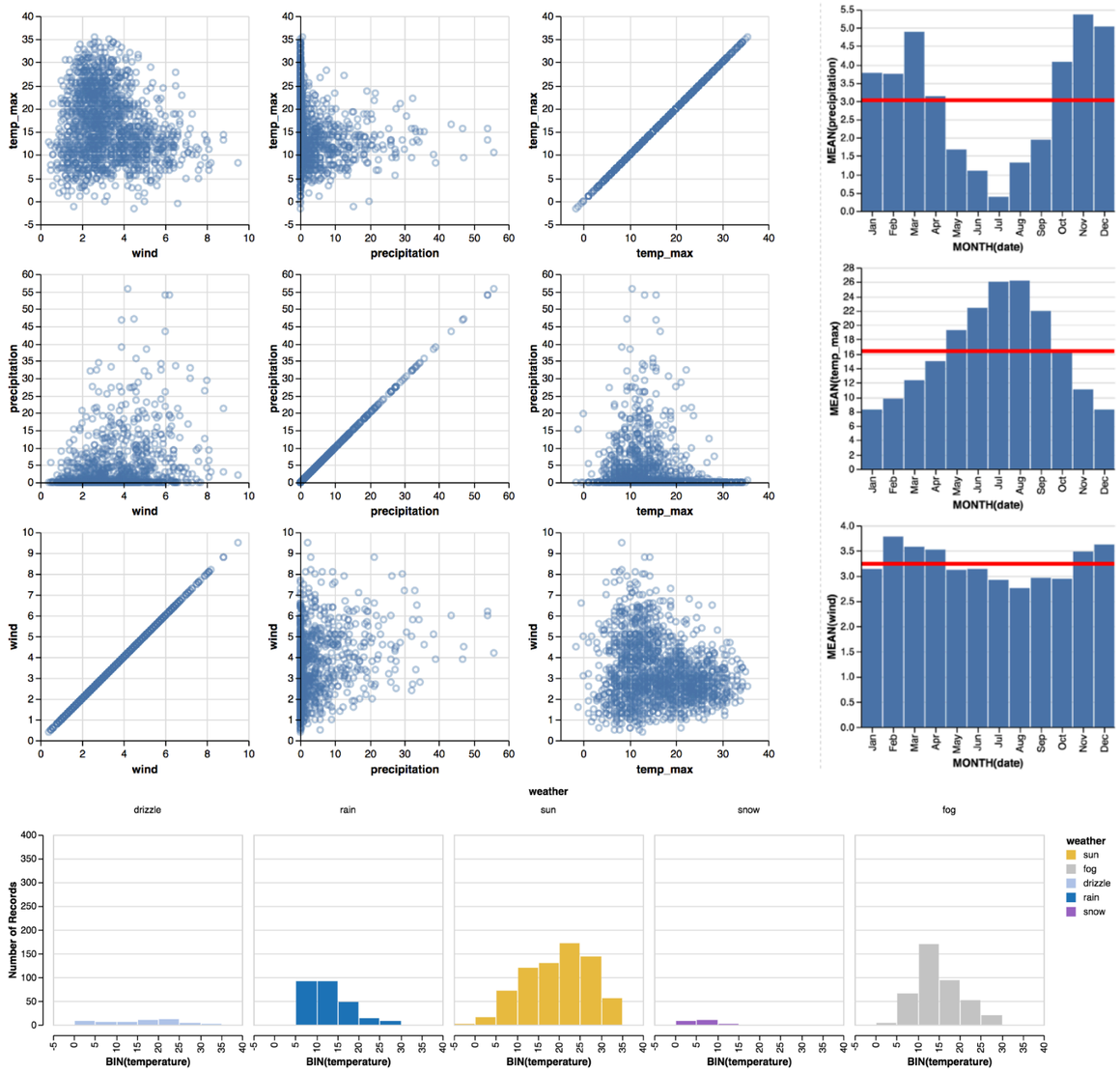


Dashboards

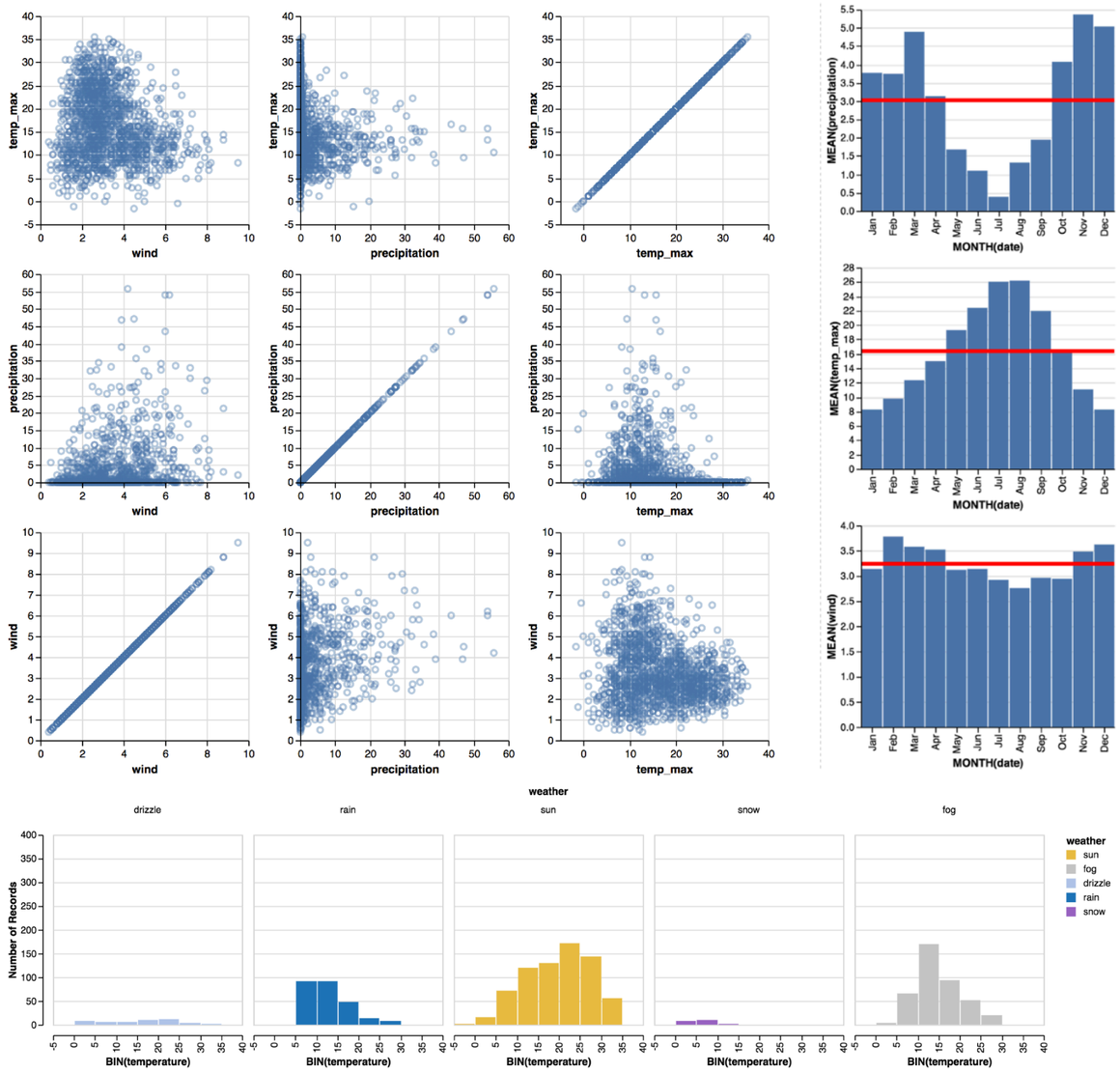
Many views, some of them composed

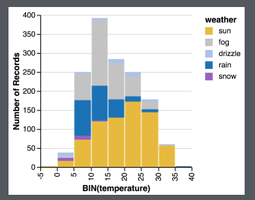
Manual data, and view management

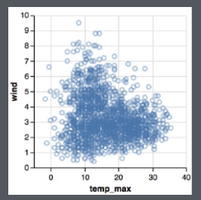
Composition

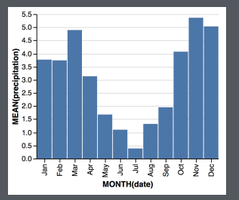


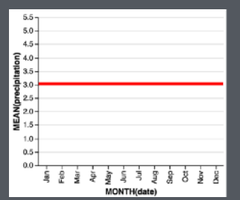
Composition



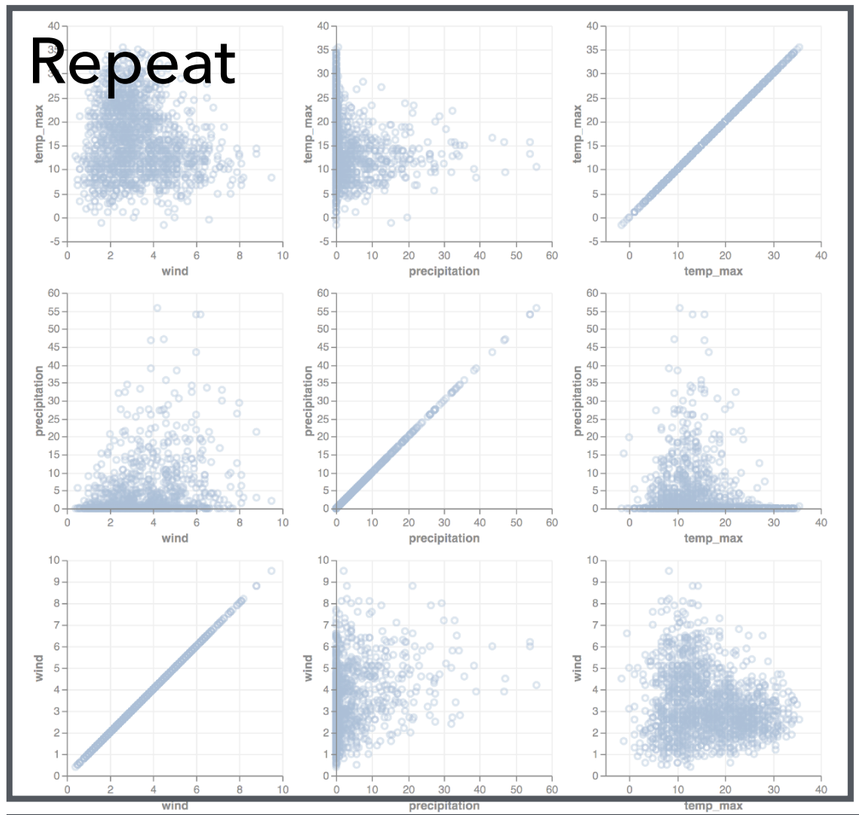


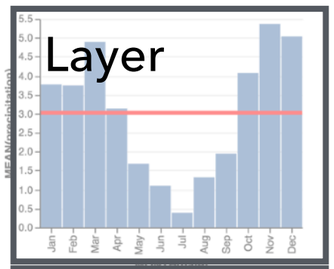


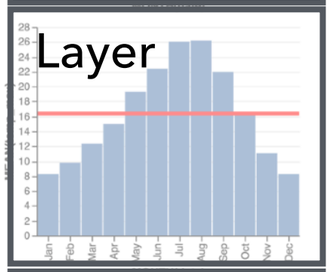


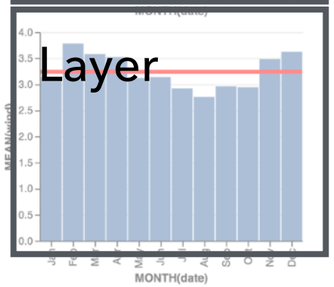


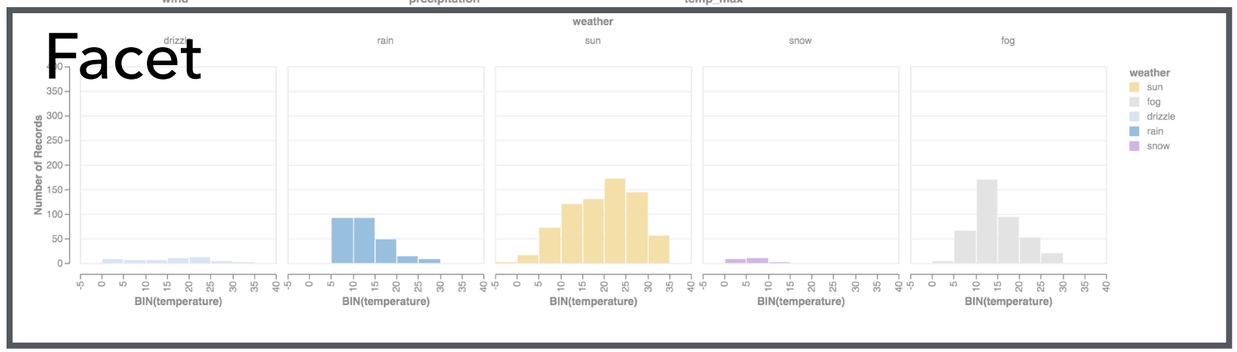
Composition

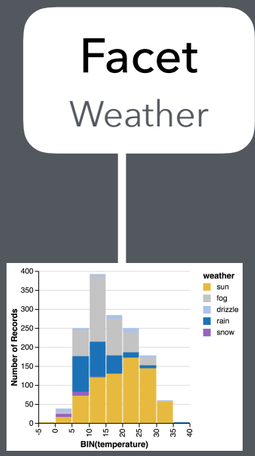


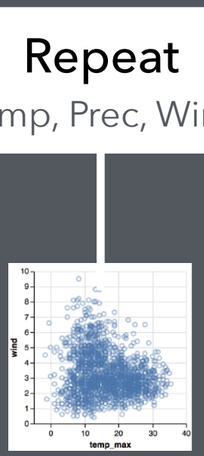


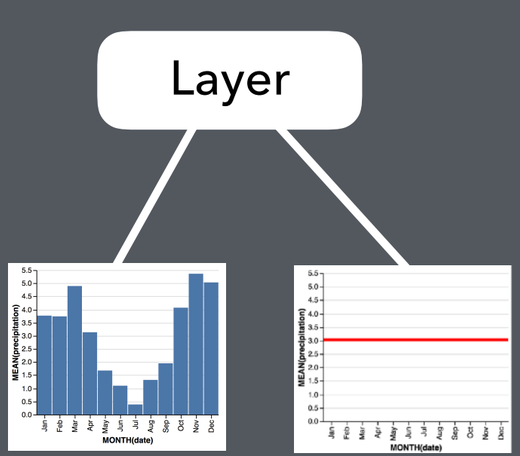


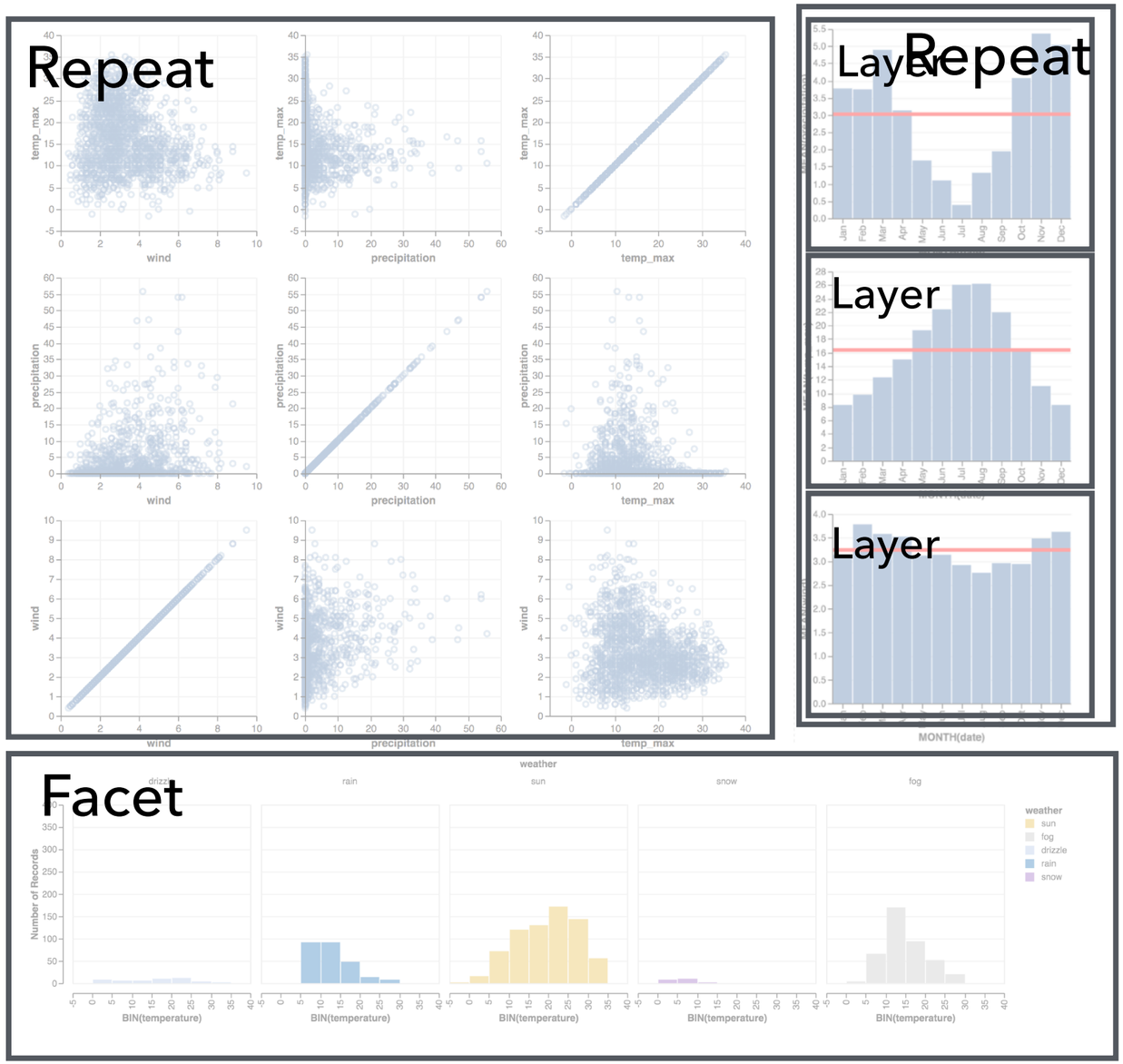




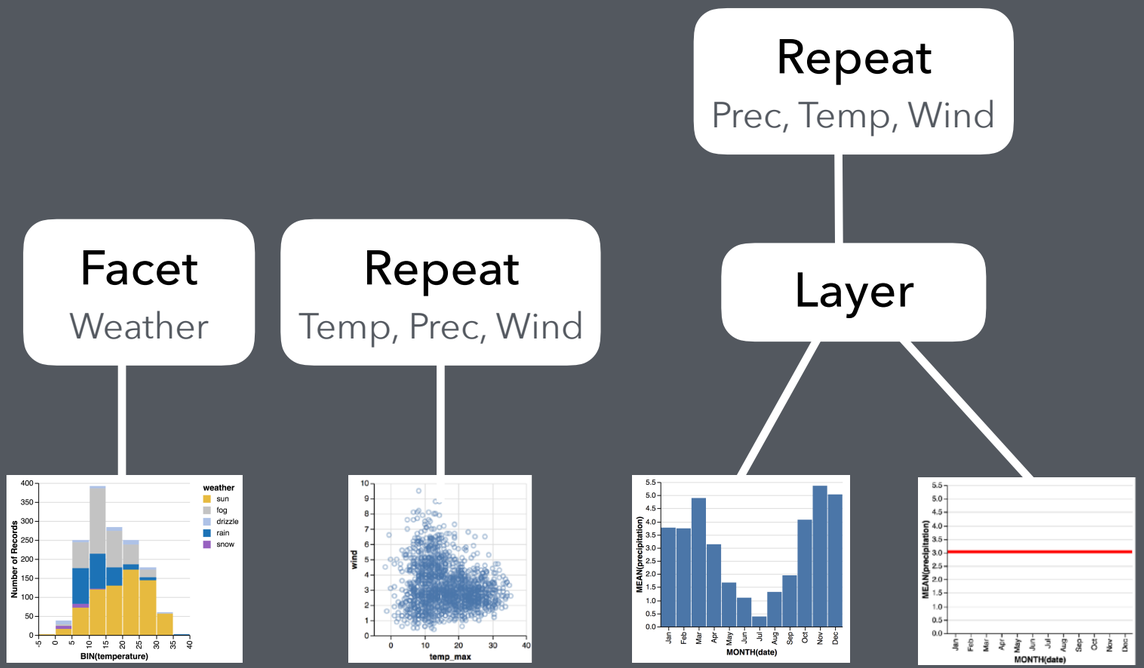




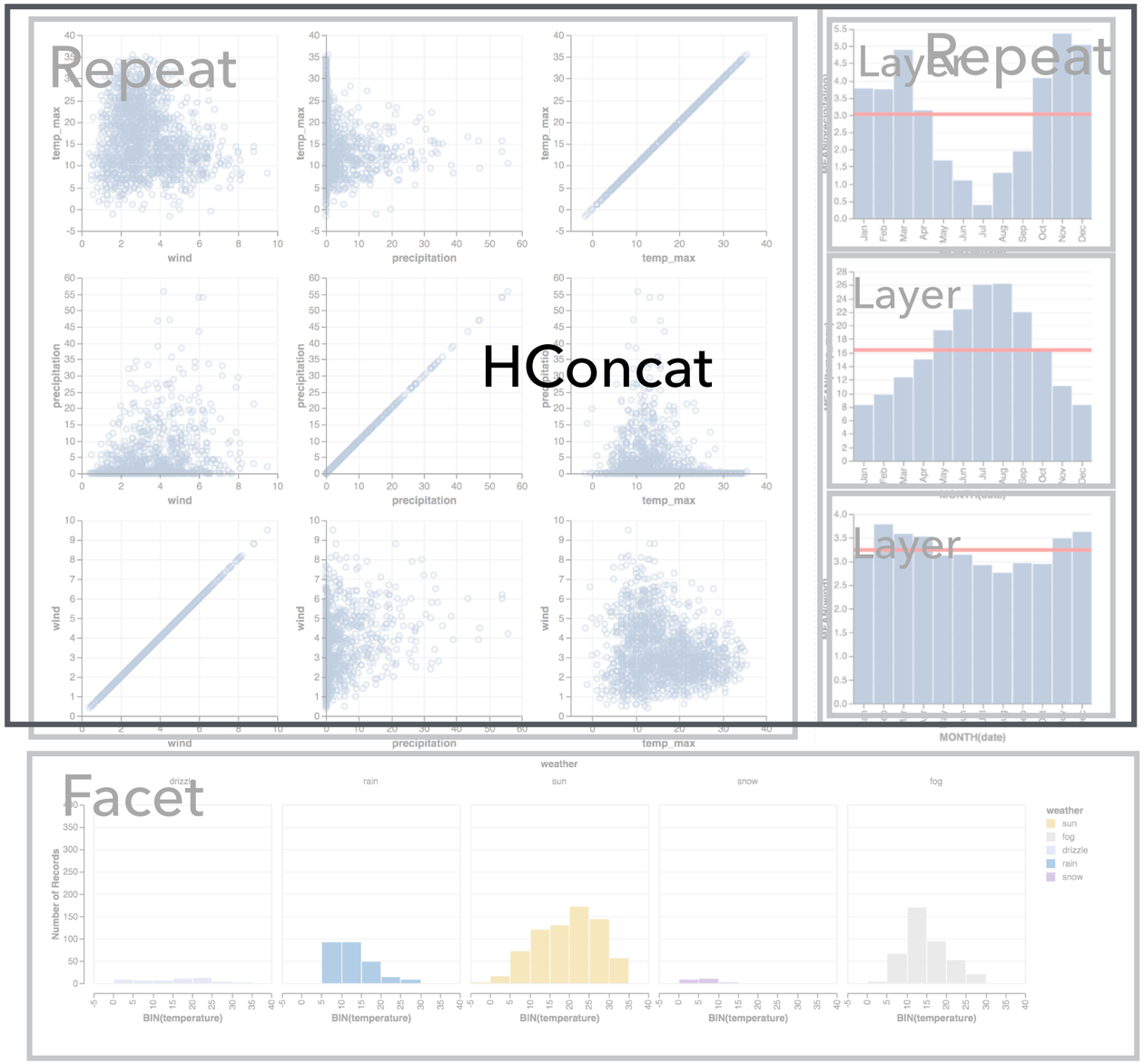


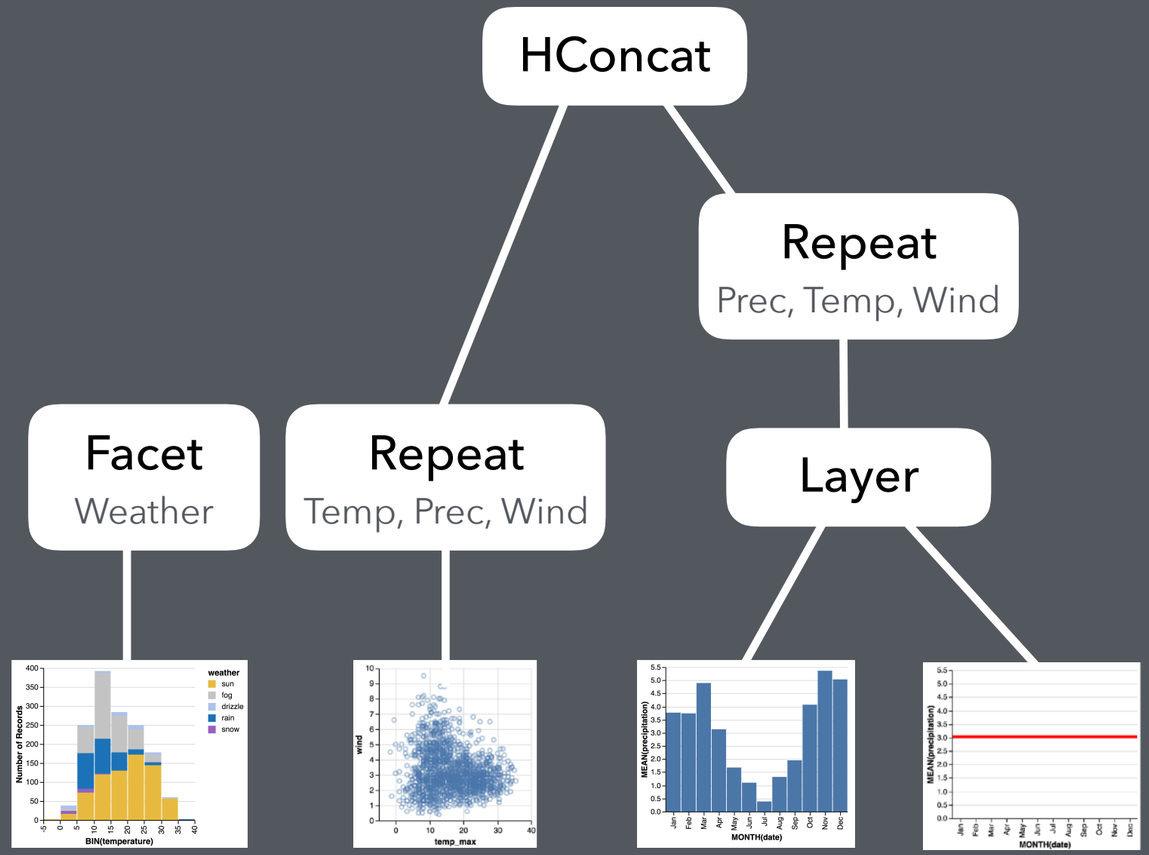


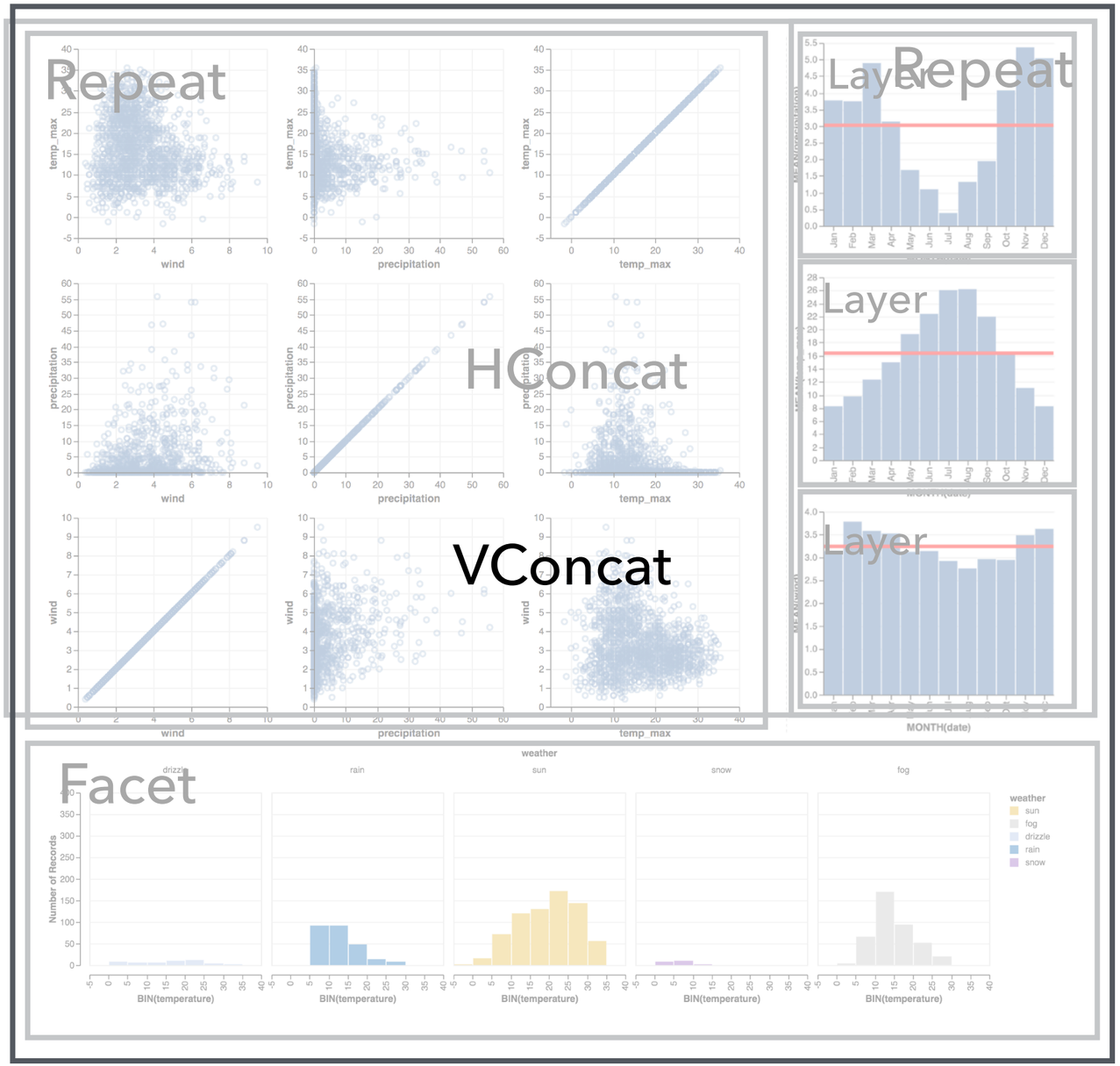
Hierarchical View Composition



Hierarchical View Composition







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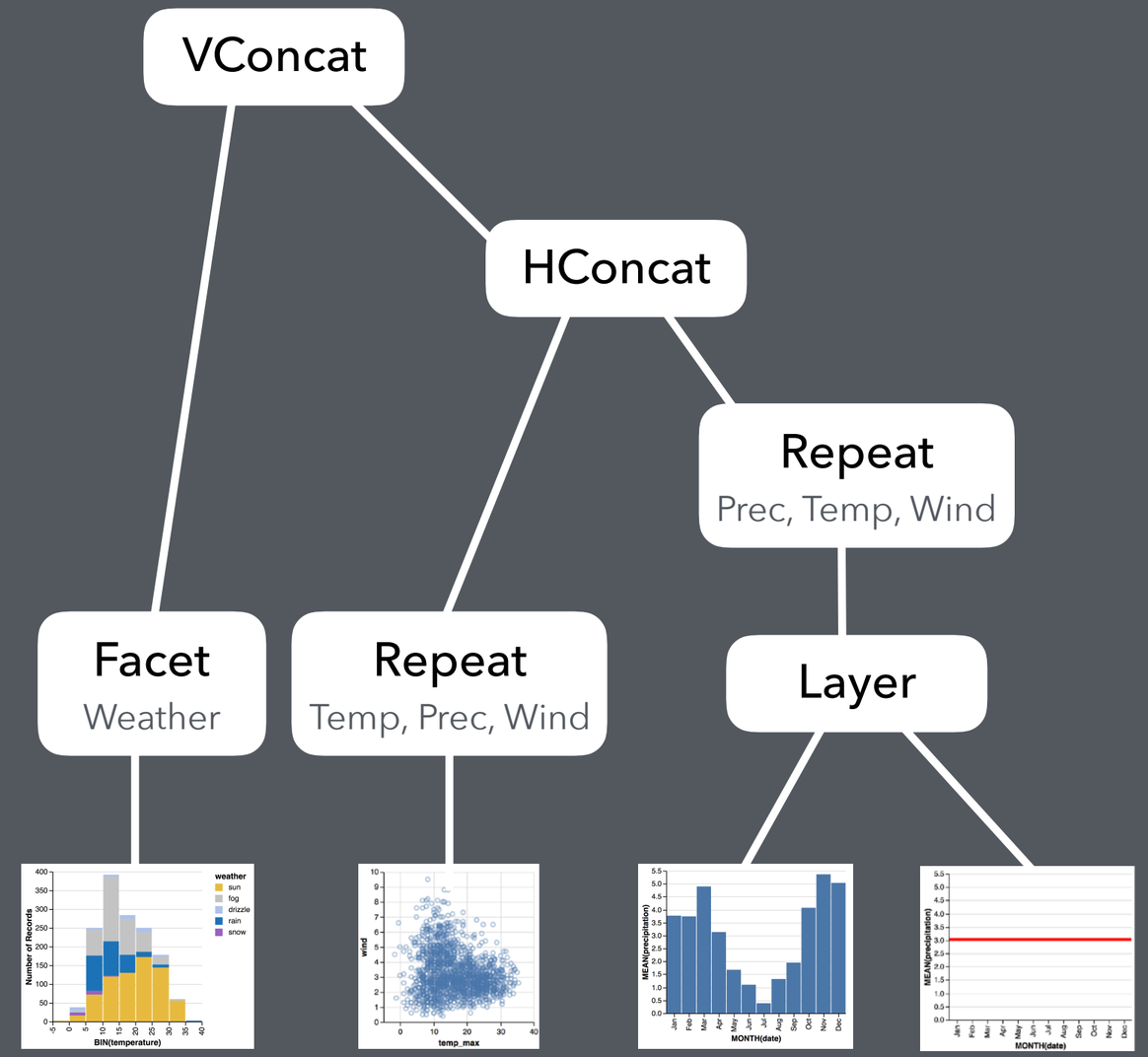

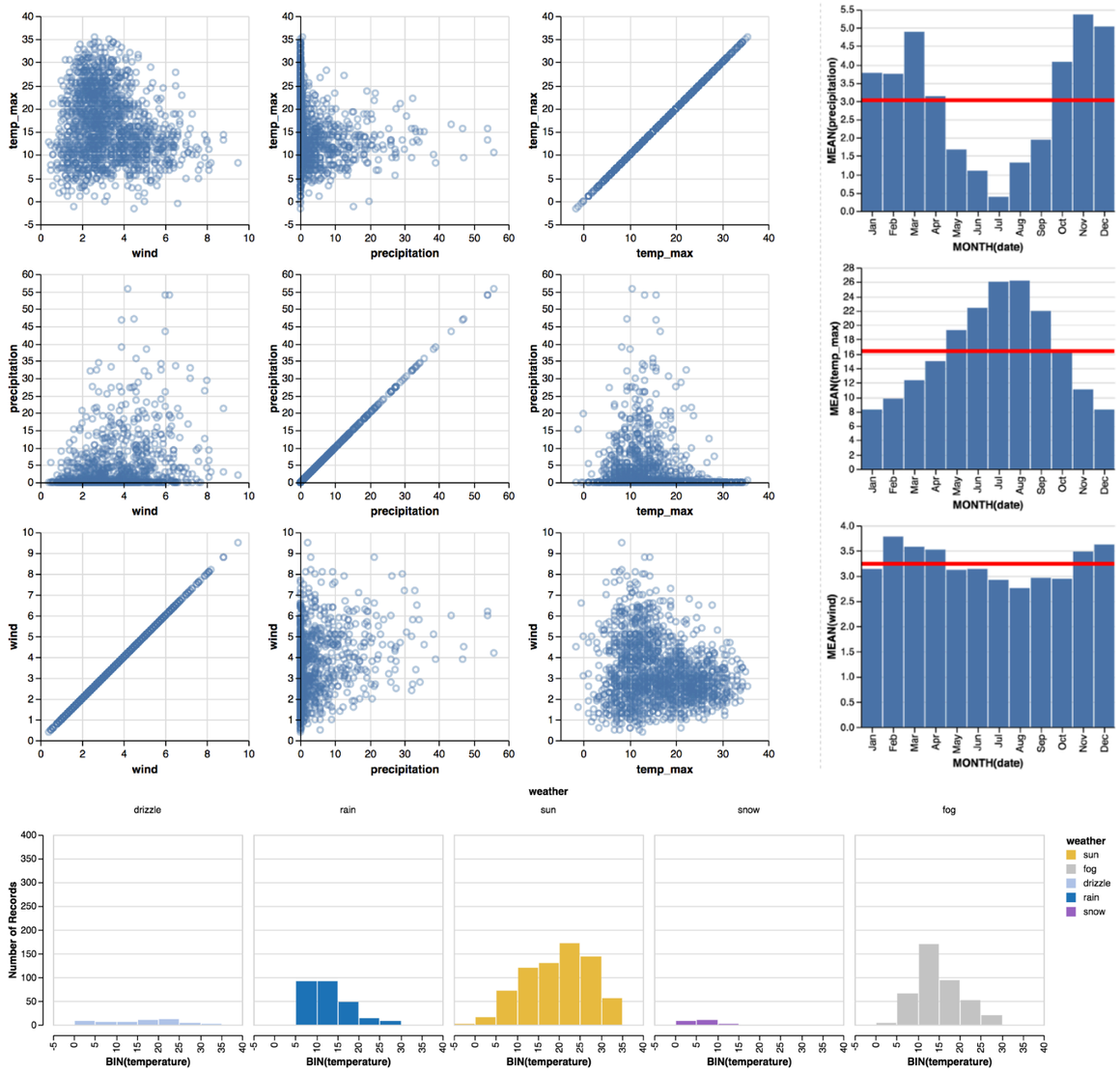

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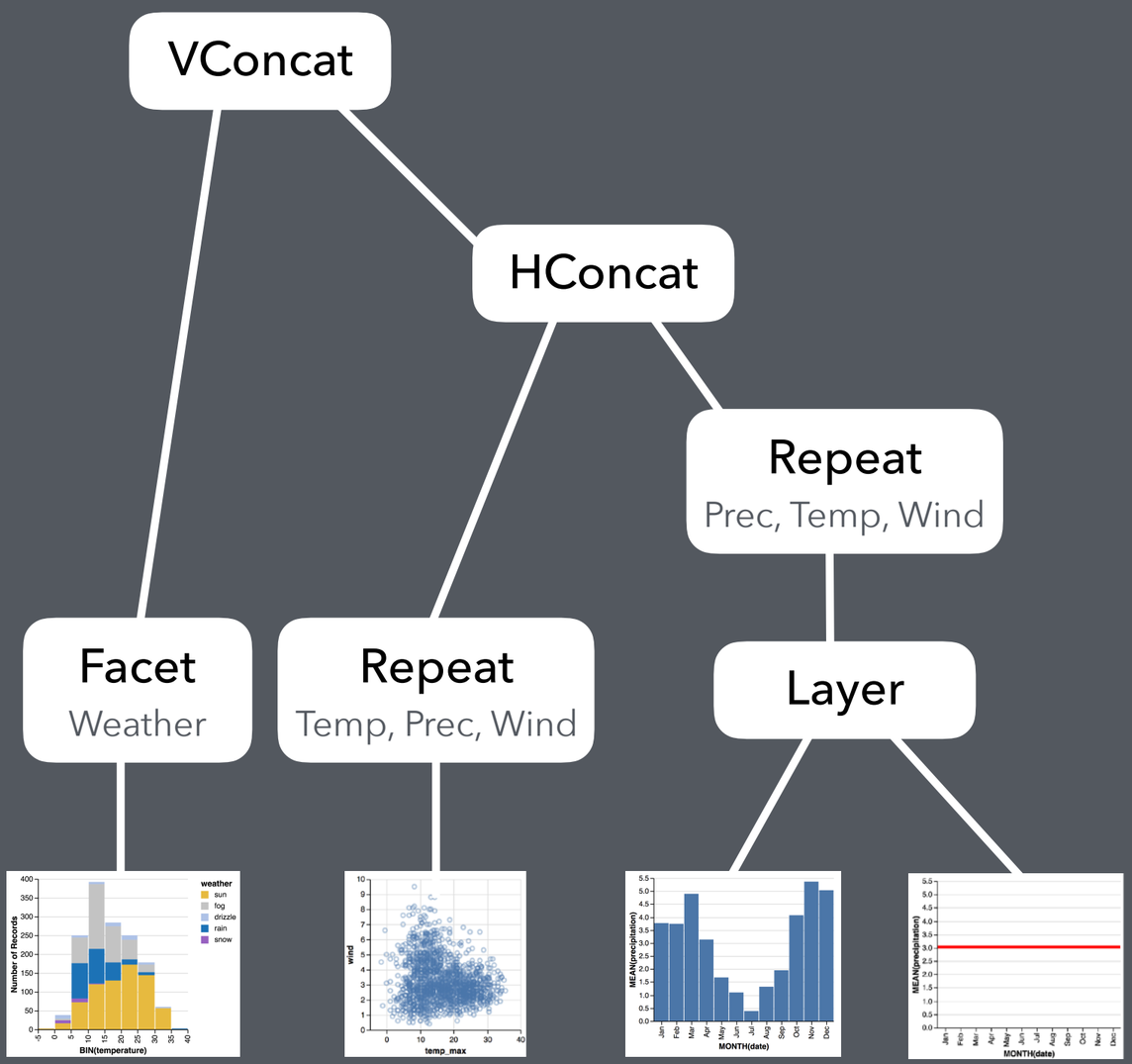
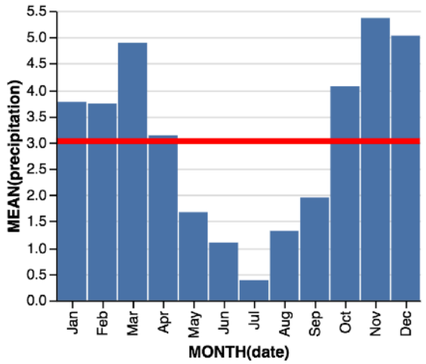
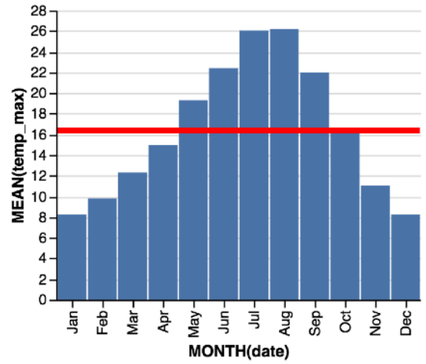
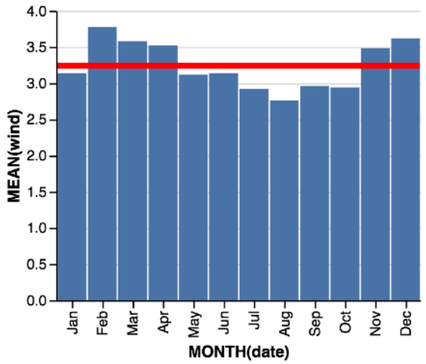


Layer + Repeat







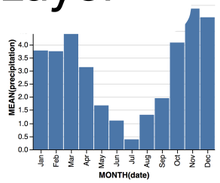

```
{
```

Repeat

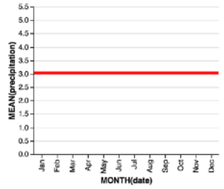
Prec, Temp, Wind `'precipitation", "temperature", "wind"]`

```
  },
  spec: {
```

Layer

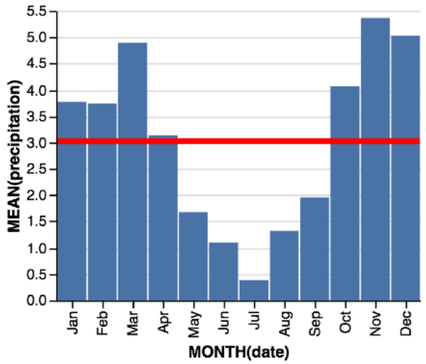


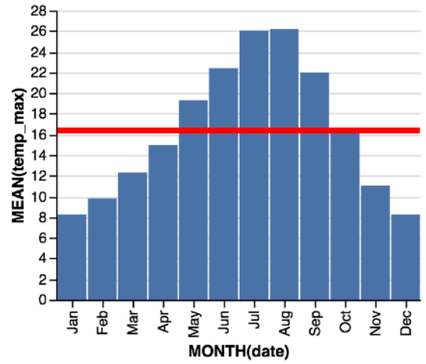

```
    ,
```

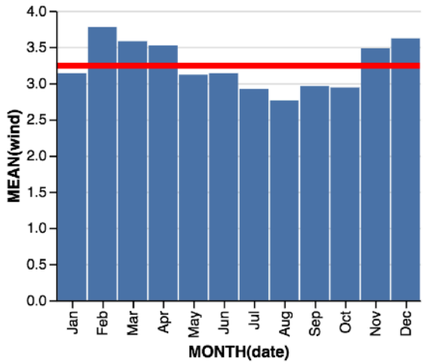


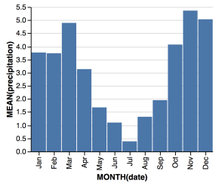
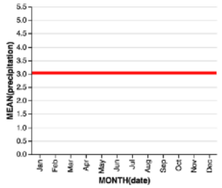

```
    ]
  }
}
```

Layer + Repeat








```
{
  repeat: {
    column: ["precipitation", "temperature", "wind"]
  },
  spec: {
    layer: [
      
      ,
      
    ]
  }
}
```

Vega-Lite: a Grammar of Interactive Graphics

The Design of Vega-Lite

- **Single View** Specification
- **Layered** and **Multi-view** Composition
- **Interactions** with Selections -> *We'll discuss this next lecture!*

Using Vega-Lite

- **Programming** with Vega-Lite
- Higher-level **Tools** and **Recommendations**

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Higher-level **Tools** and **Recommendations**

Using Vega-Lite

Using Vega-Lite

Compile to Vega and
use Vega's runtime

Using Vega-Lite

Compile to Vega and use Vega's runtime

{ Retarget to different renderers (Web-based/Server, Canvas/SVG)

Using Vega-Lite

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- Retarget to different renderers (Web-based/Server, Canvas/SVG)
- Support streaming data

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Declarative
JSON Syntax

Using Vega-Lite

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Declarative JSON Syntax

- Serve as file format

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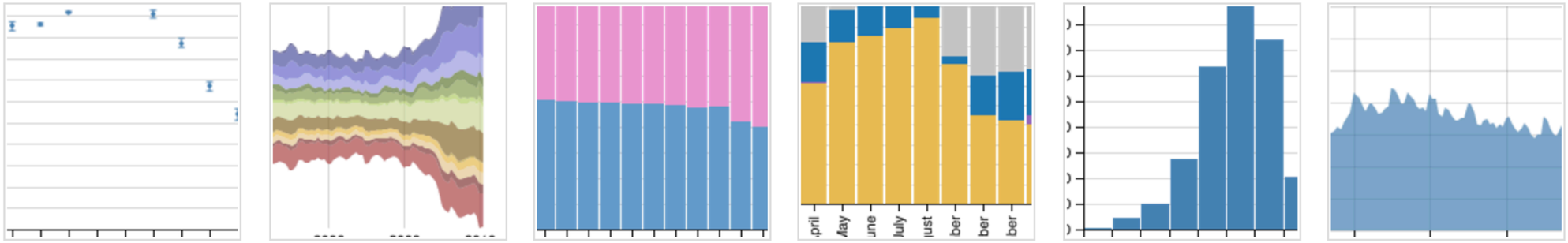
- Retarget to different renderers (Web-based/Server, Canvas/SVG)
- Support streaming data

Declarative JSON Syntax

- Serve as file format
- Bindings for different languages

Declarative Visualization in Python



Altair is a declarative statistical visualization library for Python, based on **Vega-Lite**.

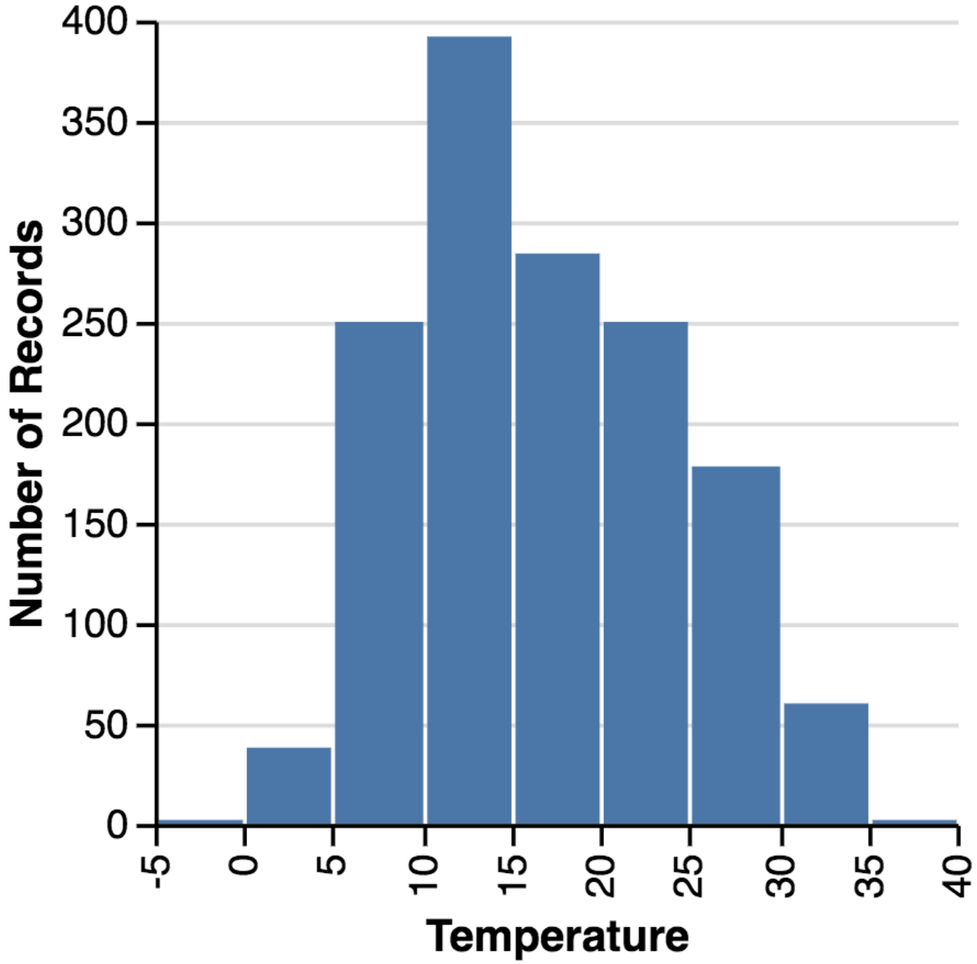
With Altair, you can spend more time understanding your data and its meaning. Altair's API is simple, friendly and consistent and built on top of the powerful **Vega-Lite** visualization grammar. This elegant simplicity produces beautiful and effective visualizations with a minimal amount of code.

Altair: Vega-Lite in Python

Led by Brian Granger and Jake VanderPlas.

Histogram in Altair

```
{
  data: {url: "weather-seattle.json"},
  mark: "bar",
  encoding: {
    x: {
      bin: true,
      field: "Temperature",
      type: "quantitative"
    },
    y: {
      aggregate: "count",
      type: "quantitative"
    }
  }
}
```



altair-viz.github.io

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from altair import Chart, expr

data_weather = expr.DataFrame('data/weather-
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Chart(data_weather)
```

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Chart(data_weather)
  .mark_bar()
```

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      type: "quantitative"
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      type: "quantitative"
    }
  }
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```
from altair import Chart, expr

data_weather = expr.DataFrame('data/weather-
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  .mark_bar()
  .encode(
     x=X(bin=True, field='Temperature'),
     y=Y(aggregate='count')
  )
```

altair-viz.github.io

Histogram in Altair

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```

Altair's API is automatically generated from the Vega-Lite JSON schema.

altair-viz.github.io

“It is this type of 1:1:1 mapping between thinking, code, and visualization that is my favorite thing about [Altair]”

– Dan Saber.

https://dansaber.wordpress.com/2016/10/02/a-dramatic-tour-through-pythons-data-visualization-landscape-including-ggplot-and-altair/

“We see this portion of the effort as much bigger than Altair itself: the Vega and Vega-Lite specifications are perhaps the best existing candidates for a principled lingua franca *of data visualization”* – Altair Team.

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Voyager

Augment manual specification with recommendation to **promote breadth** & **reduce tedium** in exploration.

Use Vega-Lite to **recommend** data and visual encodings.

https://github.com/vega/voyager

datavoyager

Bookmarks (0) Undo Redo

Data

Cars Change

Fields

- Cylinders
- Name
- Origin
- Year
- Acceleration
- Displacement
- Horsepower
- Miles per Gallon
- Weight in lbs
- COUNT

Wildcards

- Categorical Fields
- Temporal Fields
- Quantitative Fields

Debug · Report an issue

Encoding

Clear

x drop a field here
y drop a field here
column drop a field here
row drop a field here

Marks

auto

size drop a field here
color drop a field here
shape drop a field here
detail drop a field here
text drop a field here

any drop a field here

Filter

Filter invalid numbers

Specified View

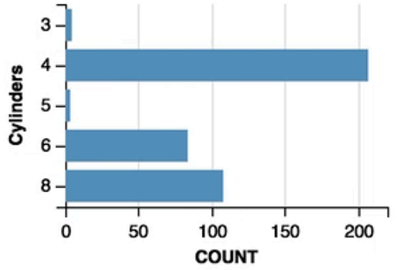
No specified visualization yet. Start exploring by dragging a field to encoding pane on the left or examining univariate summaries below.

Related Views

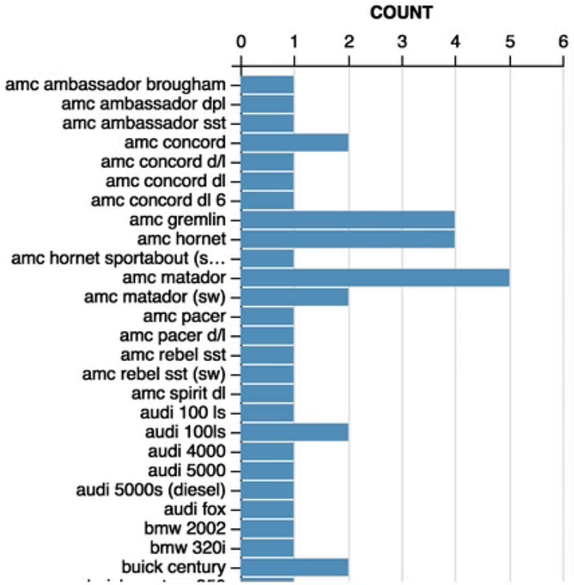
Univariate Summaries Hide

Univariate Summaries

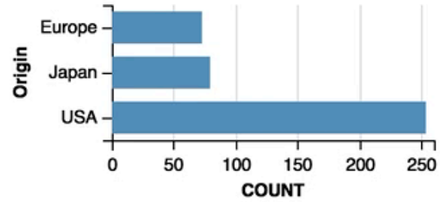
Cylinders # COUNT



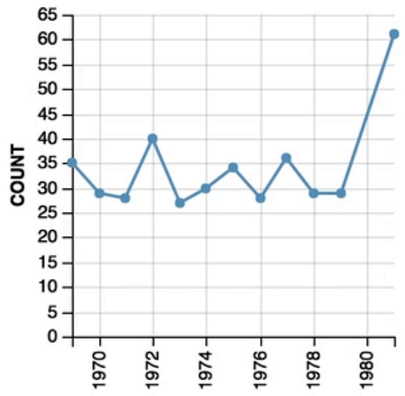
Name # COUNT



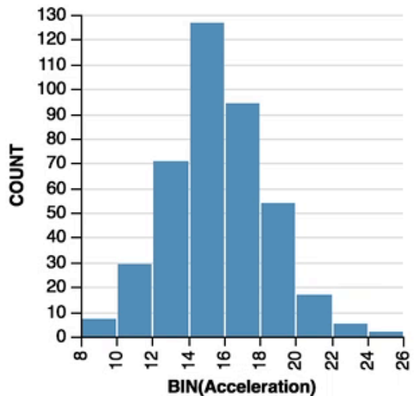
Origin # COUNT



YEAR (Year) # COUNT



BIN (Acceleration) # COUNT



datavoyager

Bookmarks (0) Undo Redo

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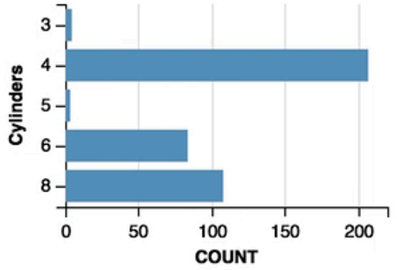

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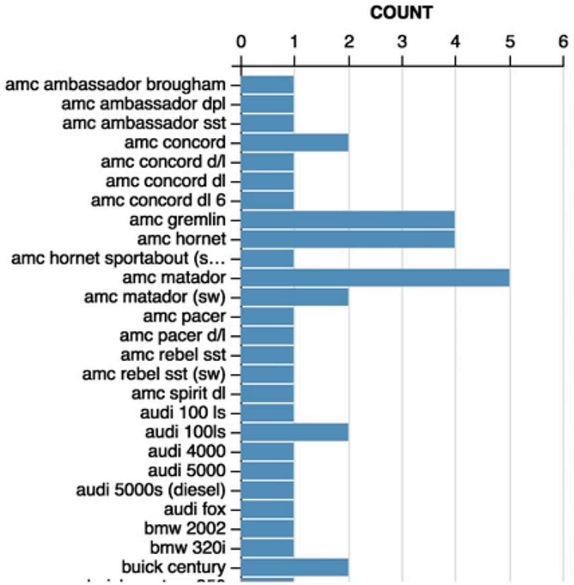

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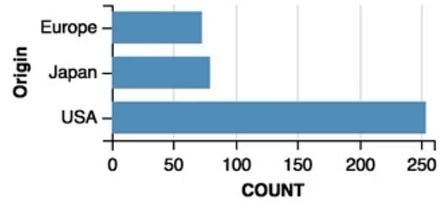

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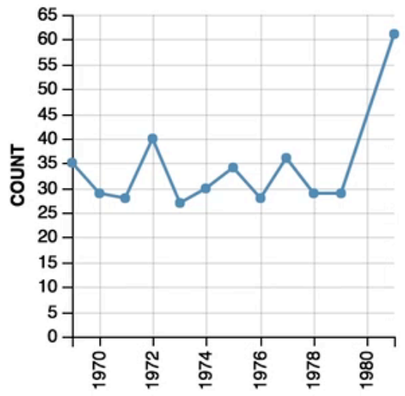
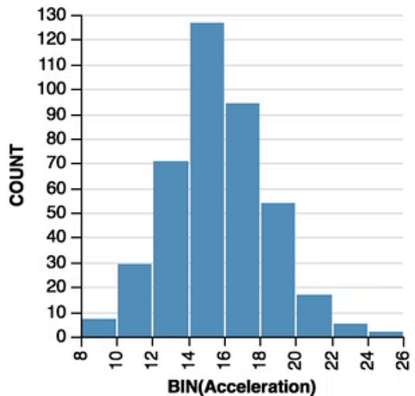
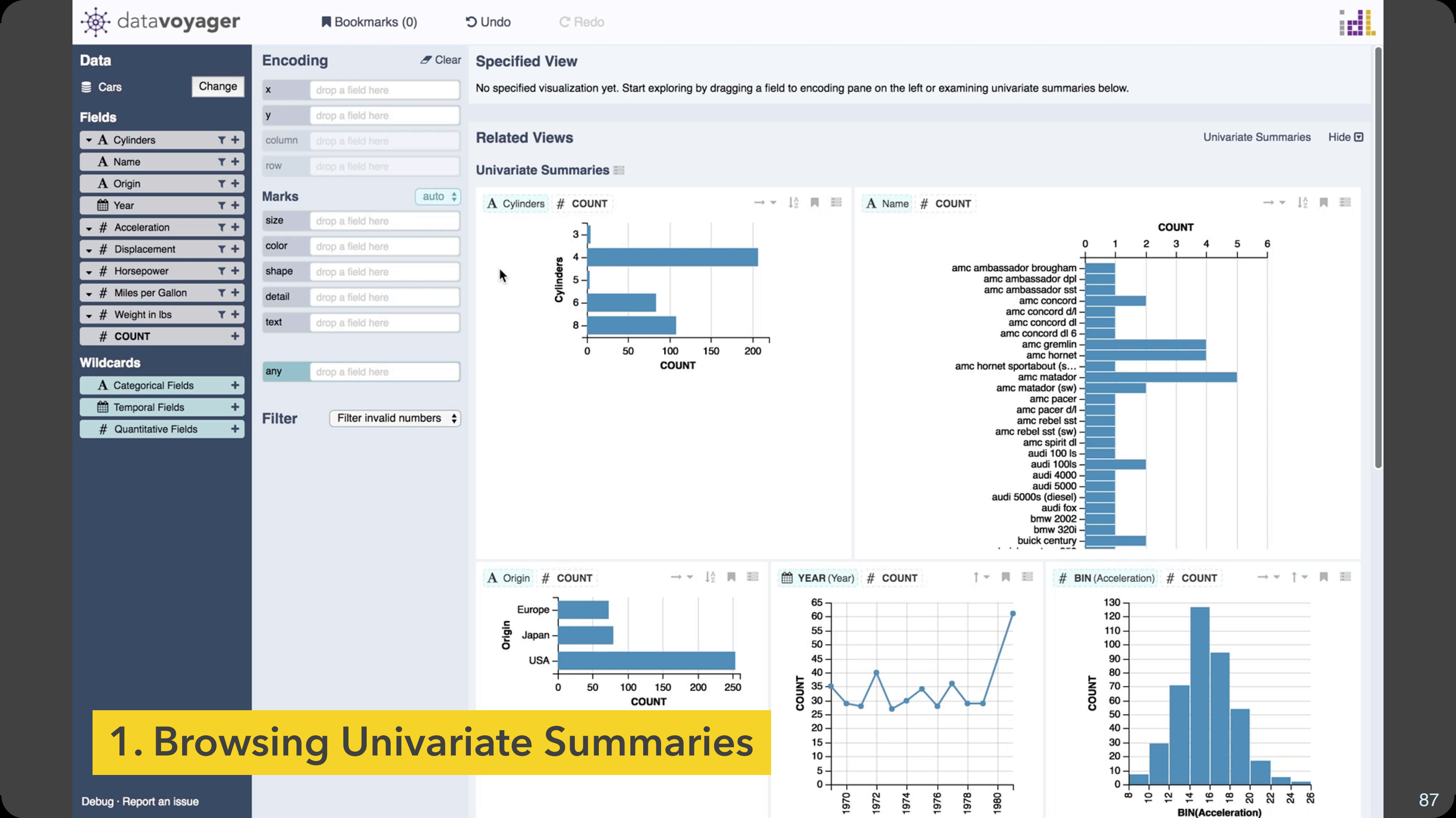
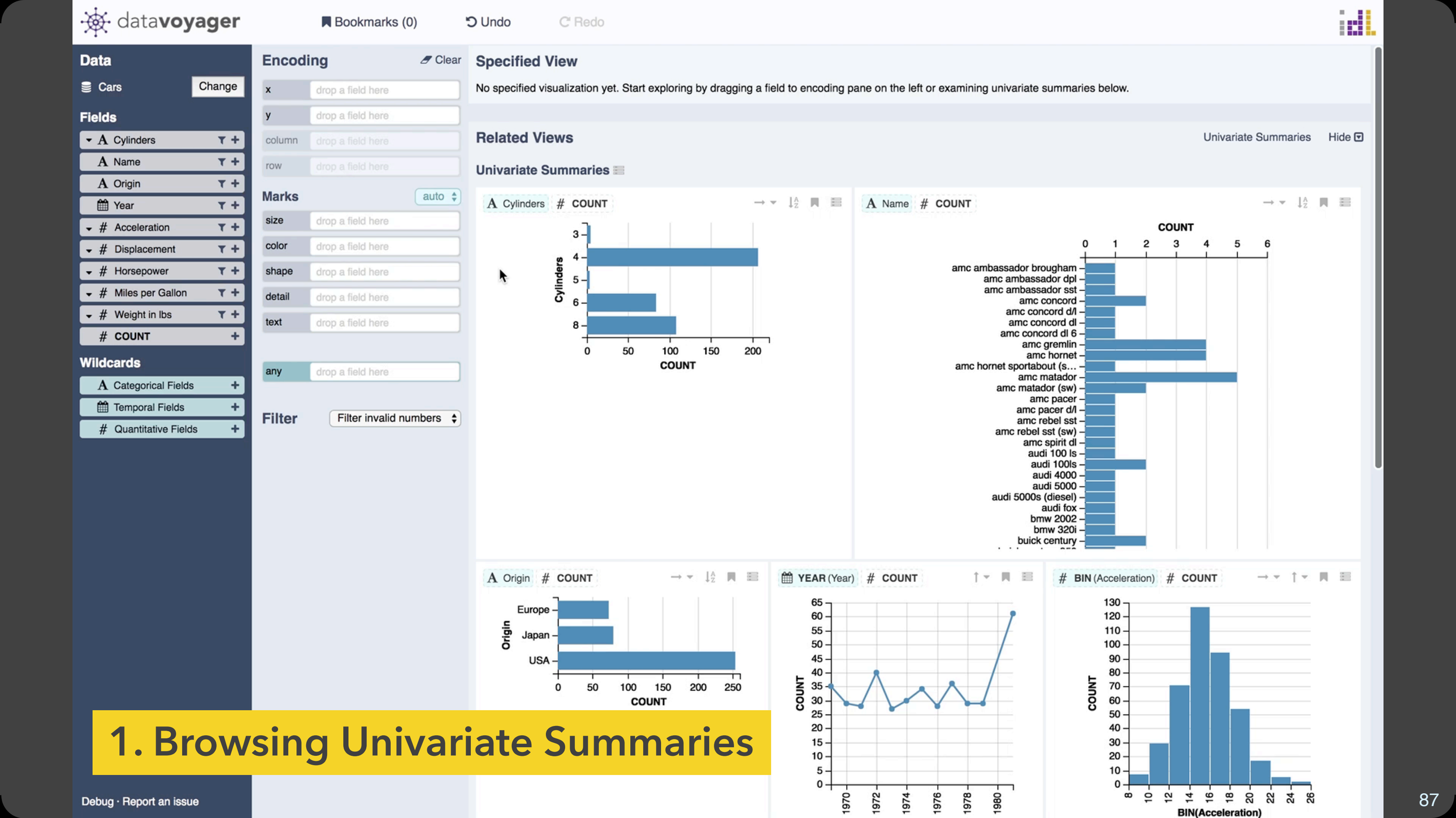


BIN (Acceleration) # COUNT




datavoyager
Bookmarks (0)
Undo
Redo
Data
Cars
Change
Fields
Cylinders
Name
Origin
Year
Acceleration
Displacement
Horsepower
Miles per Gallon
Weight in lbs
COUNT
Wildcards
Categorical Fields
Temporal Fields
Quantitative Fields
Encoding
Clear
x
y
column
row
Marks
auto
size
color
shape
detail
text
any
drop a field here
Filter
Filter invalid numbers
Specified View
No specified visualization yet. Start exploring by dragging a field to encoding pane on the left or examining univariate summaries below.
Related Views
Univariate Summaries
Hide
Univariate Summaries
Cylinders # COUNT
Cylinders
COUNT
Name # COUNT
amc ambassador brougham
amc ambassador dpl
amc ambassador sst
amc concord
amc concord d/l
amc concord dl
amc concord dl 6
amc gremlin
amc hornet
amc hornet sportabout (s…
amc matador
amc matador (sw)
amc pacer
amc pacer d/l
amc rebel sst
amc rebel sst (sw)
amc spirit dl
audi 100 ls
audi 100ls
audi 4000
audi 5000
audi 5000s (diesel)
audi fox
bmw 2002
bmw 320i
buick century
Origin # COUNT
Europe
Japan
USA
Origin
COUNT
YEAR (Year) # COUNT
COUNT
BIN (Acceleration) # COUNT
COUNT
BIN(Acceleration)
1. Browsing Univariate Summaries
Debug · Report an issue


datavoyager
Bookmarks (0)
Undo
Redo
Data
Cars
Change
Fields
Cylinders
Name
Origin
Year
Acceleration
Displacement
Horsepower
Miles per Gallon
Weight in lbs
COUNT
Wildcards
Categorical Fields
Temporal Fields
Quantitative Fields
Encoding
Clear
x
y
column
row
Marks
auto
size
color
shape
detail
text
any
drop a field here
Filter
Filter invalid numbers
Specified View
No specified visualization yet. Start exploring by dragging a field to encoding pane on the left or examining univariate summaries below.
Related Views
Univariate Summaries
Hide
Univariate Summaries
Cylinders # COUNT
Cylinders
COUNT
Name # COUNT
amc ambassador brougham
amc ambassador dpl
amc ambassador sst
amc concord
amc concord d/l
amc concord dl
amc concord dl 6
amc gremlin
amc hornet
amc hornet sportabout (s…
amc matador
amc matador (sw)
amc pacer
amc pacer d/l
amc rebel sst
amc rebel sst (sw)
amc spirit dl
audi 100 ls
audi 100ls
audi 4000
audi 5000
audi 5000s (diesel)
audi fox
bmw 2002
bmw 320i
buick century
Origin # COUNT
Europe
Japan
USA
Origin
COUNT
YEAR (Year) # COUNT
COUNT
BIN (Acceleration) # COUNT
COUNT
BIN(Acceleration)
1. Browsing Univariate Summaries
Debug · Report an issue

datavoyager Bookmarks (0) Undo Redo

Data

Cars Change

Fields

- Cylinders
- Name
- Origin
- Year
- Acceleration
- Displacement
- Horsepower
- Miles per Gallon
- Weight in lbs
- COUNT

Wildcards

- Categorical Fields
- Temporal Fields
- Quantitative Fields

Encoding Clear

x: drop a field here
y: drop a field here
column: drop a field here
row: drop a field here

Marks auto

size: drop a field here
color: drop a field here
shape: drop a field here
detail: drop a field here
text: drop a field here

any: drop a field here

Filter Filter invalid numbers

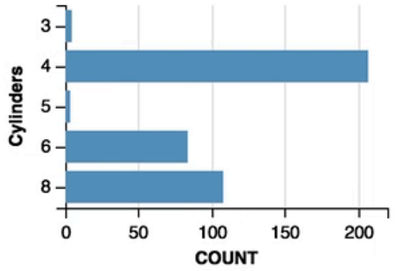
Specified View

No specified visualization yet. Start exploring by dragging a field to encoding pane on the left or examining univariate summaries below.

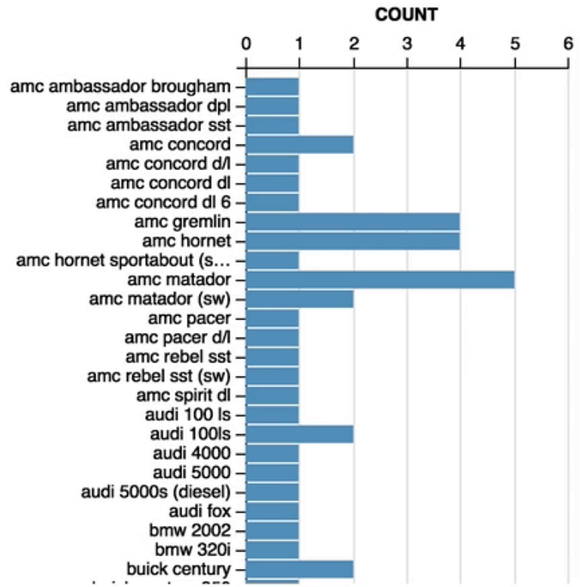
Related Views Univariate Summaries Hide

Univariate Summaries

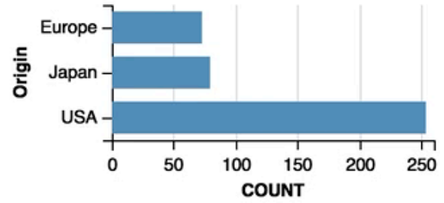
Cylinders # COUNT



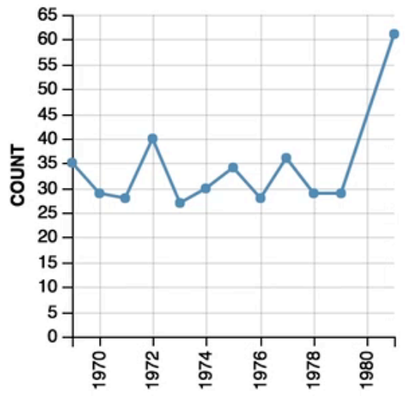
Name # COUNT



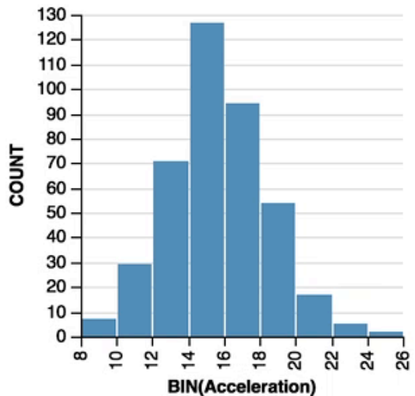
Origin # COUNT



YEAR (Year) # COUNT

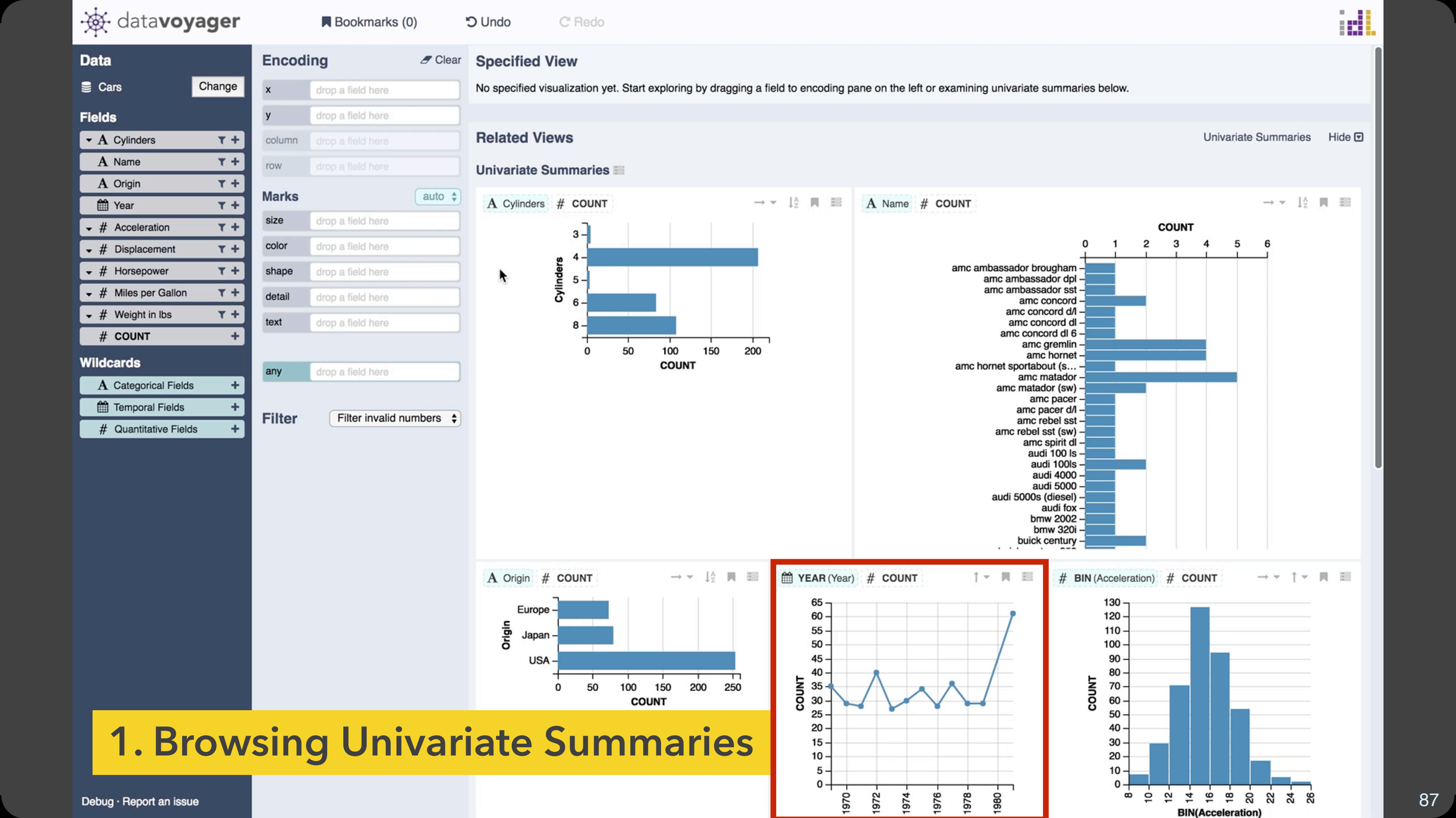


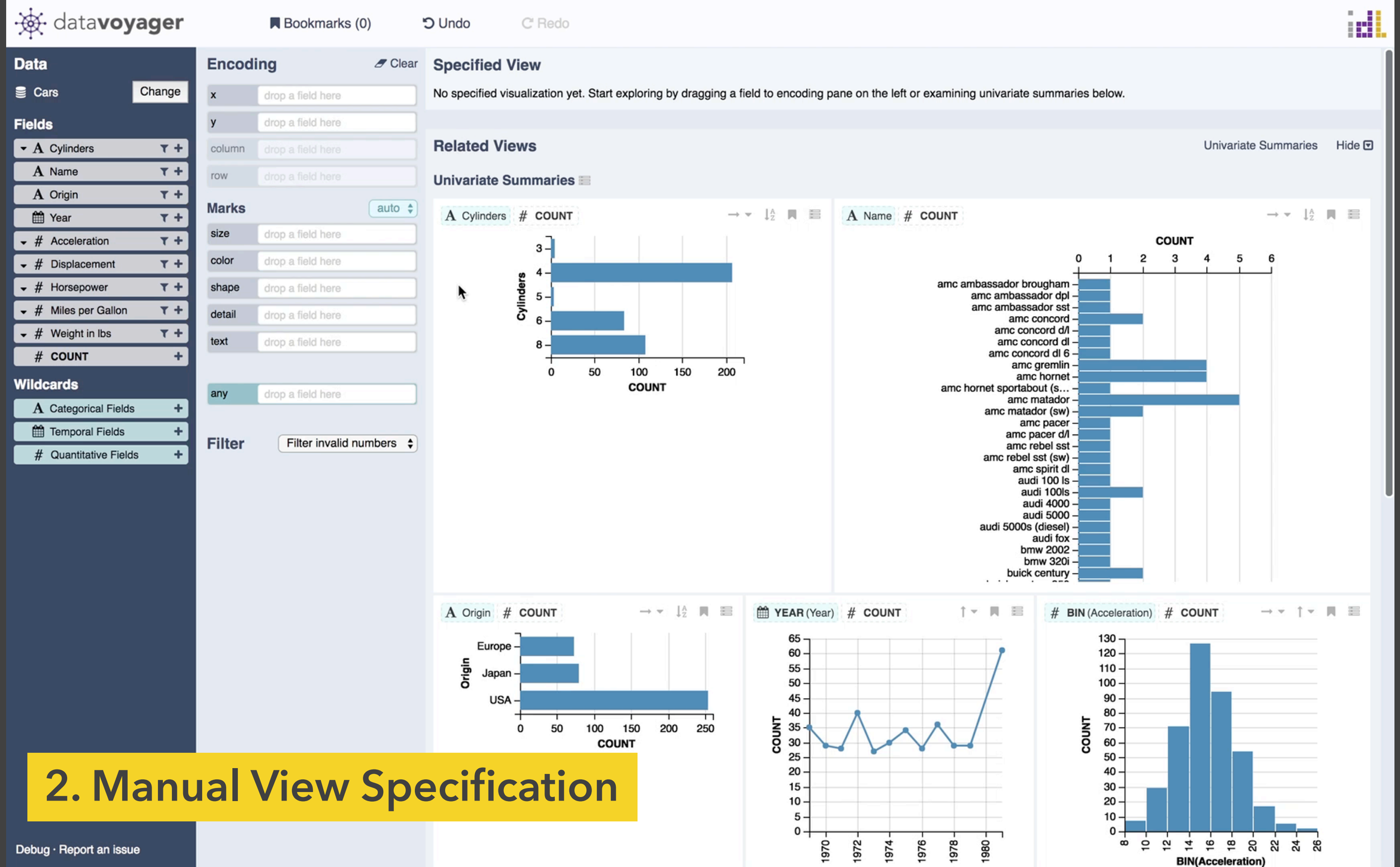
BIN (Acceleration) # COUNT



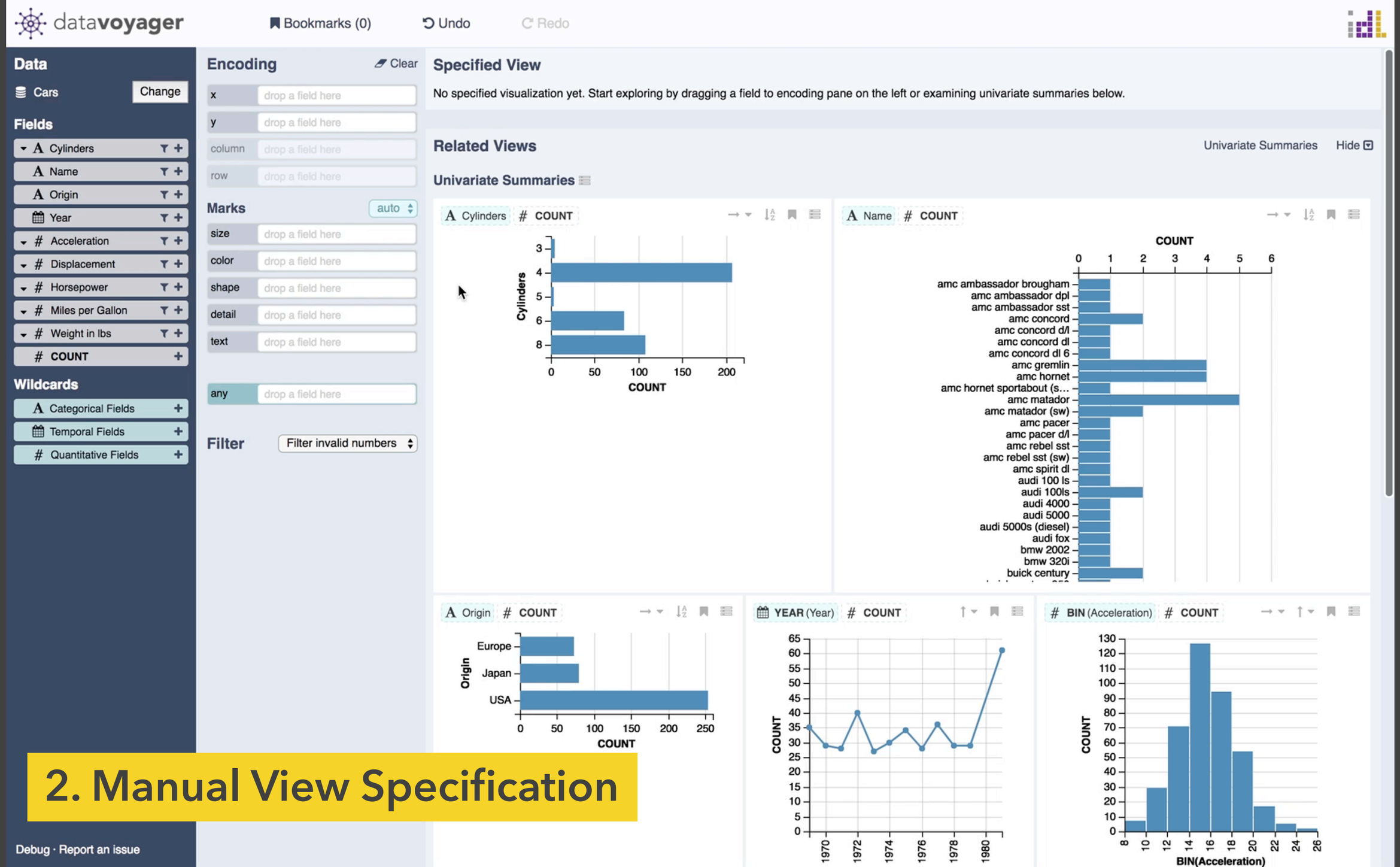
1. Browsing Univariate Summaries

Debug · Report an issue


datavoyager
Bookmarks (0)
Undo
Redo
Data
Cars
Change
Fields
Cylinders
Name
Origin
Year
Acceleration
Displacement
Horsepower
Miles per Gallon
Weight in lbs
COUNT
Wildcards
Categorical Fields
Temporal Fields
Quantitative Fields
Encoding
Clear
x
y
column
row
drop a field here
Marks
auto
size
color
shape
detail
text
any
Filter
Filter invalid numbers
Specified View
No specified visualization yet. Start exploring by dragging a field to encoding pane on the left or examining univariate summaries below.
Related Views
Univariate Summaries
Hide
Univariate Summaries
Cylinders # COUNT
Cylinders
COUNT
Name # COUNT
amc ambassador brougham
amc ambassador dpl
amc ambassador sst
amc concord
amc concord d/l
amc concord dl
amc concord dl 6
amc gremlin
amc hornet
amc hornet sportabout (s…
amc matador
amc matador (sw)
amc pacer
amc pacer d/l
amc rebel sst
amc rebel sst (sw)
amc spirit dl
audi 100 ls
audi 100ls
audi 4000
audi 5000
audi 5000s (diesel)
audi fox
bmw 2002
bmw 320i
buick century
Origin # COUNT
Europe
Japan
USA
Origin
COUNT
YEAR (Year) # COUNT
COUNT
BIN (Acceleration) # COUNT
COUNT
BIN(Acceleration)
1. Browsing Univariate Summaries
Debug · Report an issue



2. Manual View Specification



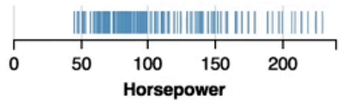
2. Manual View Specification

```
{
  mark: "tick",
  encoding: {
    x: {
      field: "Horsepower",
      type: "quantitative"
    }
  }
}
```

Undo Redo

Specified View

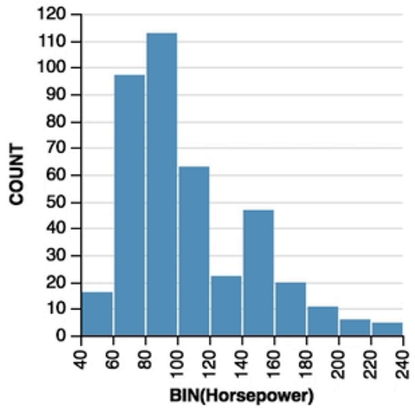
X-AXIS SWAP X/Y BOOKMARK



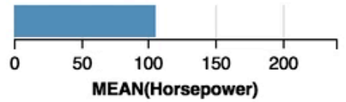
Related Views All Summaries Add Quantitative Field Add Categorical Field Add Temporal Field Hide

Summaries

BIN (Horsepower) # COUNT

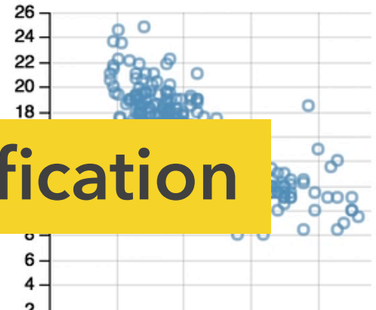


MEAN (Horsepower)

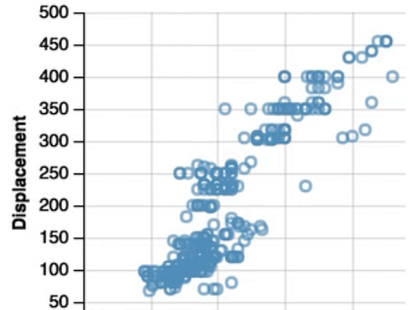


Add Quantitative Field

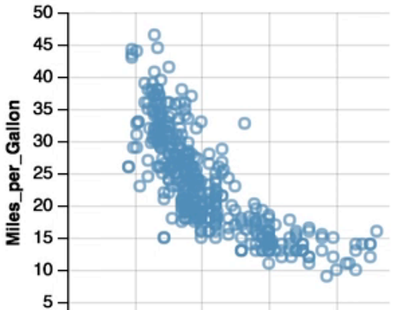
Horsepower # Acceleration



Horsepower # Displacement



Horsepower # Miles per Gallon



Miles per Gallon
Weight in lbs
COUNT

Wildcards

Categorical Fields
Temporal Fields
Quantitative Fields

detail drop a field here
text drop a field here
any drop a field here

Filter Filter invalid numbers

Debug · Report an issue

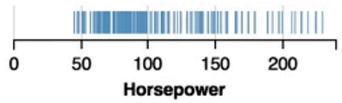
2. Manual View Specification

```
{
  mark: "tick",
  encoding: {
    x: {
      field: "Horsepower",
      type: "quantitative"
    }
  }
}
```

Undo Redo

Specified View

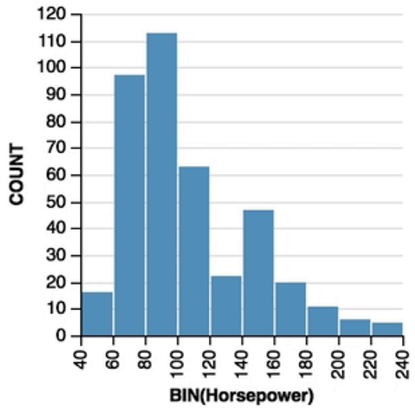
X-AXIS SWAP X/Y BOOKMARK



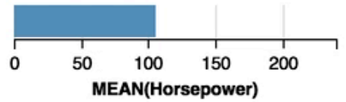
Related Views All Summaries Add Quantitative Field Add Categorical Field Add Temporal Field Hide

Summaries

BIN (Horsepower) # COUNT

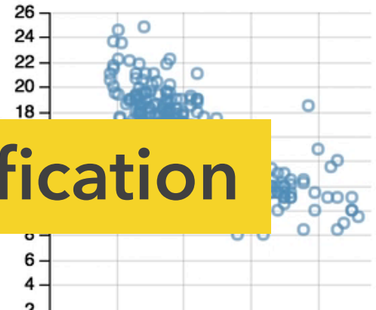


MEAN (Horsepower)

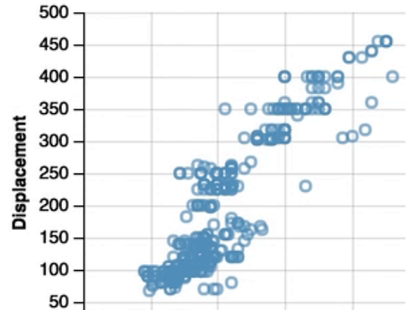


Add Quantitative Field

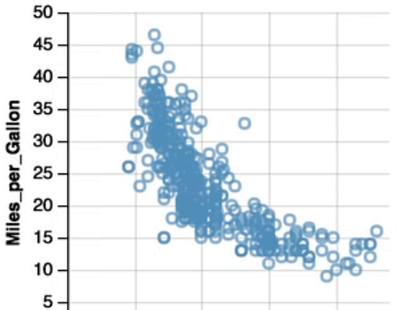
Horsepower # Acceleration



Horsepower # Displacement



Horsepower # Miles per Gallon



Miles per Gallon
Weight in lbs
COUNT

Wildcards

Categorical Fields
Temporal Fields
Quantitative Fields

detail drop a field here
text drop a field here
any drop a field here

Filter Filter invalid numbers

Debug · Report an issue

2. Manual View Specification

datavoyager Bookmarks (0) Undo Redo

Data

Cars Change

Fields

- Cylinders
- Name
- Origin
- Year
- Acceleration
- Displacement
- Horsepower
- Miles per Gallon
- Weight in lbs
- COUNT

Wildcards

- Categorical Fields
- Temporal Fields
- Quantitative Fields

Encoding Clear

x	Horsepower
y	drop a field here
column	drop a field here
row	drop a field here

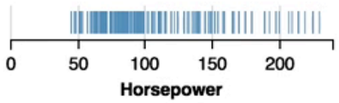
Marks auto

size	drop a field here
color	drop a field here
shape	drop a field here
detail	drop a field here
text	drop a field here
any	drop a field here

Filter Filter invalid numbers

Specified View

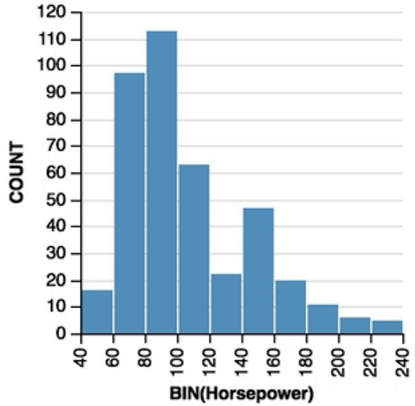
X-AXIS SWAP X/Y BOOKMARK



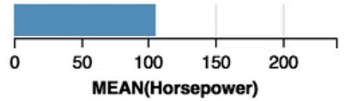
Related Views All Summaries Add Quantitative Field Add Categorical Field Add Temporal Field Hide

Summaries

BIN (Horsepower) # COUNT

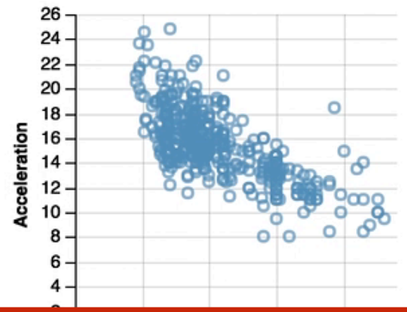


MEAN (Horsepower)

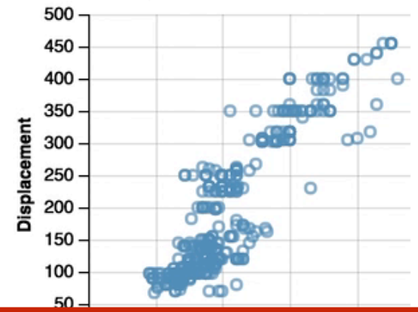


Add Quantitative Field

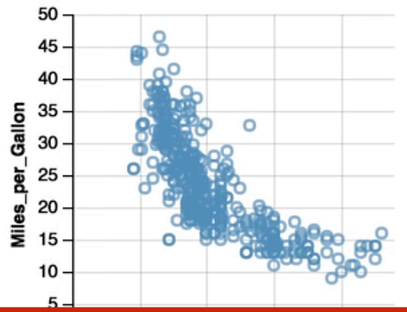
Horsepower # Acceleration



Horsepower # Displacement



Horsepower # Miles per Gallon



3. Related Views

Debug · Report an issue

datavoyager Bookmarks (0) Undo Redo

Data

Cars Change

Fields

- Cylinders
- Name
- Origin
- Year
- Acceleration
- Displacement
- Horsepower
- Miles per Gallon
- Weight in lbs
- COUNT

Wildcards

- Categorical Fields
- Temporal Fields
- Quantitative Fields

Encoding Clear

x	Horsepower
y	drop a field here
column	drop a field here
row	drop a field here

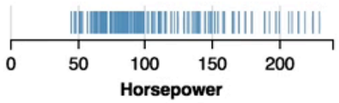
Marks auto

size	drop a field here
color	drop a field here
shape	drop a field here
detail	drop a field here
text	drop a field here
any	drop a field here

Filter Filter invalid numbers

Specified View

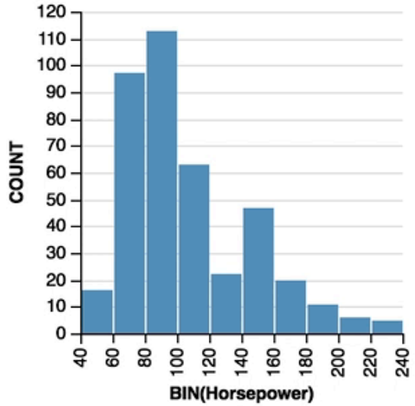
X-AXIS SWAP X/Y BOOKMARK



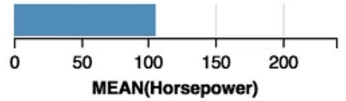
Related Views All Summaries Add Quantitative Field Add Categorical Field Add Temporal Field Hide

Summaries

BIN (Horsepower) # COUNT

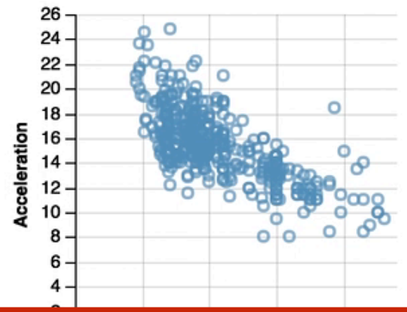


MEAN (Horsepower)

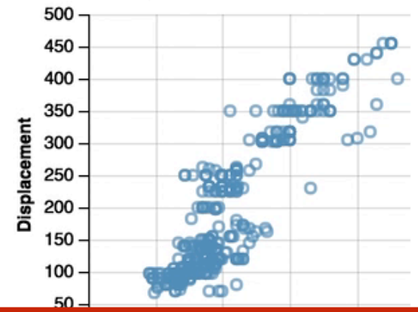


Add Quantitative Field

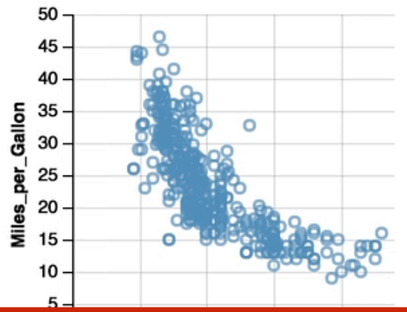
Horsepower # Acceleration



Horsepower # Displacement



Horsepower # Miles per Gallon



3. Related Views

Debug · Report an issue

datavoyager Bookmarks (0) Undo Redo

Data

Cars Change

Fields

- Cylinders
- Name
- Origin
- Year
- Acceleration
- Displacement
- Horsepower
- Miles per Gallon
- Weight in lbs
- COUNT

Wildcards

- Categorical Fields
- Temporal Fields
- Quantitative Fields

Encoding Clear

x: Horsepower
y: drop a field here
column: drop a field here
row: drop a field here

Marks auto

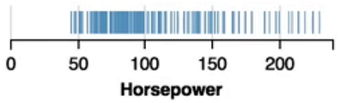
size: drop a field here
color: drop a field here
shape: drop a field here
detail: drop a field here
text: drop a field here

any: drop a field here

Filter Filter invalid numbers

Specified View

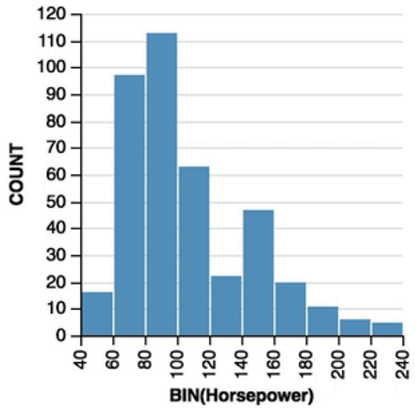
X-AXIS SWAP X/Y BOOKMARK



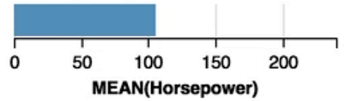
Related Views All Summaries Add Quantitative Field Add Categorical Field Add Temporal Field Hide

Summaries

BIN (Horsepower) # COUNT

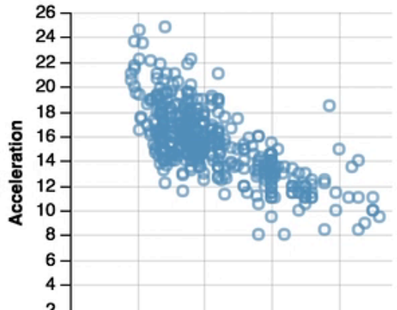


MEAN (Horsepower)

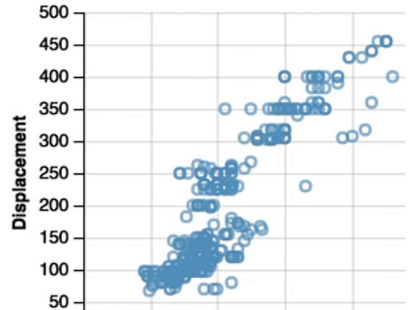


Add Quantitative Field

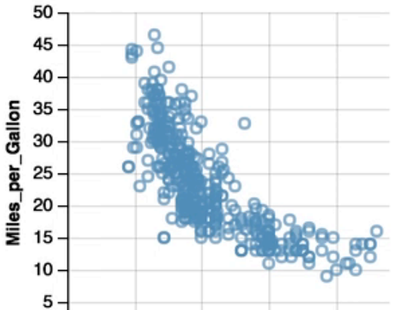
Horsepower # Acceleration



Horsepower # Displacement



Horsepower # Miles per Gallon



3. Related Views

Debug · Report an issue

datavoyager Bookmarks (0) Undo Redo

Data

Cars Change

Fields

- Cylinders
- Name
- Origin
- Year
- Acceleration
- Displacement
- Horsepower
- Miles per Gallon
- Weight in lbs
- COUNT

Wildcards

- Categorical Fields
- Temporal Fields
- Quantitative Fields

Encoding Clear

x: Horsepower
y: drop a field here
column: drop a field here
row: drop a field here

Marks auto

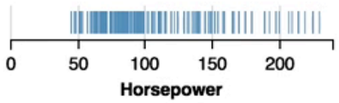
size: drop a field here
color: drop a field here
shape: drop a field here
detail: drop a field here
text: drop a field here

any: drop a field here

Filter Filter invalid numbers

Specified View

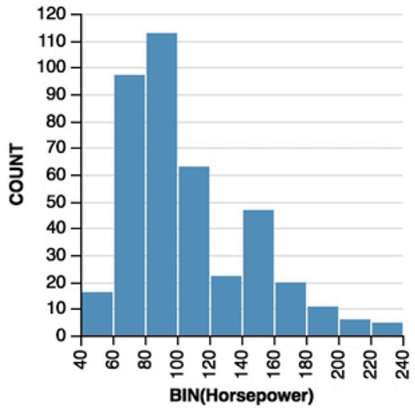
X-AXIS SWAP X/Y BOOKMARK



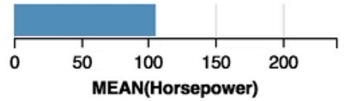
Related Views All Summaries Add Quantitative Field Add Categorical Field Add Temporal Field Hide

Summaries

BIN (Horsepower) # COUNT

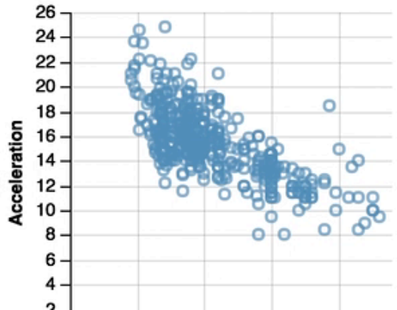


MEAN (Horsepower)

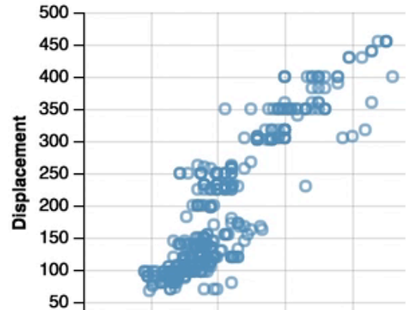


Add Quantitative Field

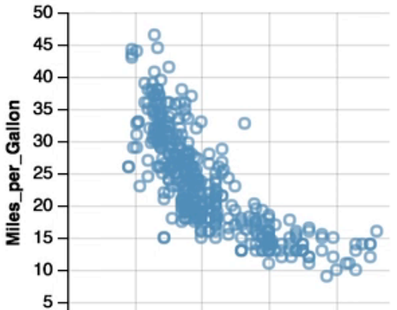
Horsepower # Acceleration



Horsepower # Displacement



Horsepower # Miles per Gallon



3. Related Views

Debug · Report an issue

datavoyager Bookmarks (0) Undo Redo

Data

Cars Change

Fields

- Cylinders
- Name
- Origin
- Year
- Acceleration
- Displacement
- Horsepower
- Miles per Gallon
- Weight in lbs
- COUNT

Wildcards

- Categorical Fields
- Temporal Fields
- Quantitative Fields

Encoding Clear

x	# Horsepower
y	drop a field here
column	drop a field here
row	drop a field here

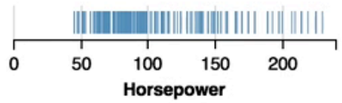
Marks auto

size	drop a field here
color	drop a field here
shape	drop a field here
detail	drop a field here
text	drop a field here
any	drop a field here

Filter Filter invalid numbers

Specified View

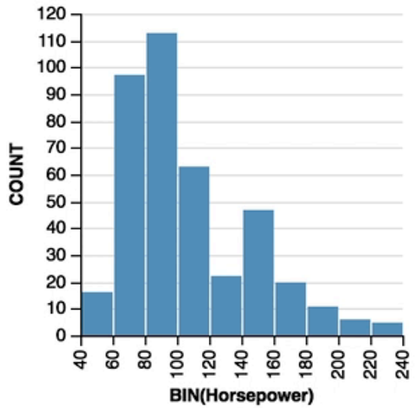
X-AXIS SWAP X/Y BOOKMARK



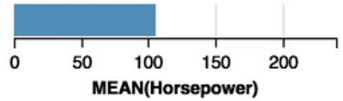
Related Views All Summaries Add Quantitative Field Add Categorical Field Add Temporal Field Hide

Summaries

BIN (Horsepower) # COUNT

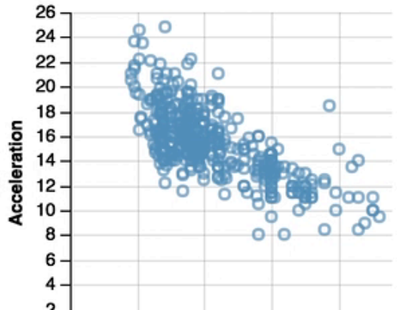


MEAN (Horsepower)

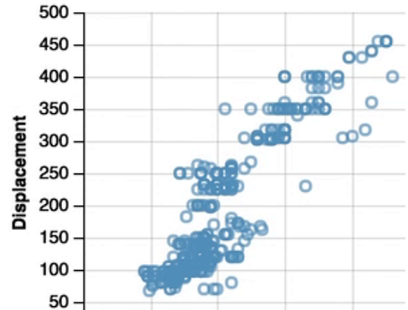


Add Quantitative Field

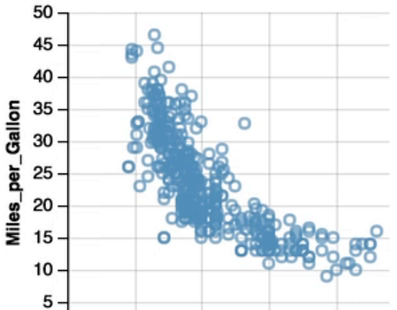
Horsepower # Acceleration



Horsepower # Displacement



Horsepower # Miles per Gallon



3. Related Views

Debug · Report an issue

datavoyager Bookmarks (0) Undo Redo

Data

Cars Change

Fields

- Cylinders
- Name
- Origin
- Year
- Acceleration
- Displacement
- Horsepower
- Miles per Gallon
- Weight in lbs
- COUNT

Wildcards

- Categorical Fields
- Temporal Fields
- Quantitative Fields

Encoding Clear

x	# Horsepower
y	drop a field here
column	drop a field here
row	drop a field here

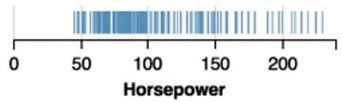
Marks auto

size	drop a field here
color	drop a field here
shape	drop a field here
detail	drop a field here
text	drop a field here
any	drop a field here

Filter Filter invalid numbers

Specified View

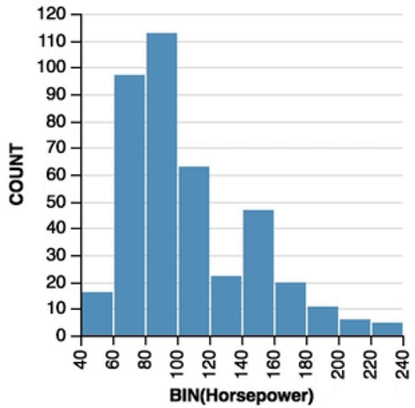
X-AXIS SWAP X/Y BOOKMARK



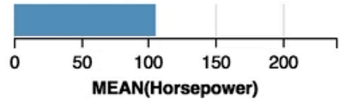
Related Views All Summaries Add Quantitative Field Add Categorical Field Add Temporal Field Hide

Summaries

BIN (Horsepower) # COUNT

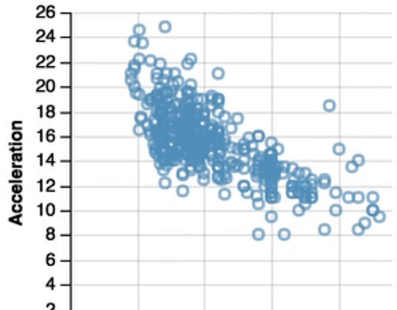


MEAN (Horsepower)

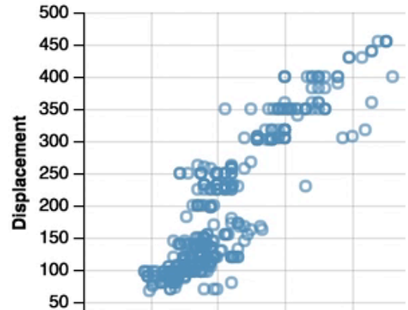


Add Quantitative Field

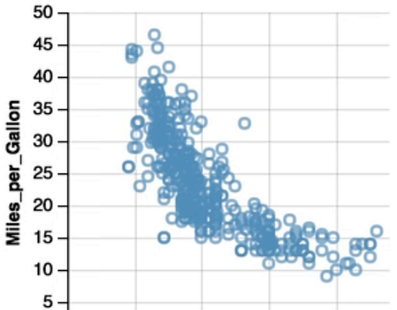
Horsepower # Acceleration



Horsepower # Displacement



Horsepower # Miles per Gallon



3. Related Views

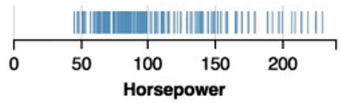
Debug · Report an issue

```
{
  mark: "tick",
  encoding: {
    x: {
      field: "Horsepower",
      type: "quantitative"
    }
  }
}
```

Undo Redo

Specified View

X-AXIS SWAP X/Y BOOKMARK

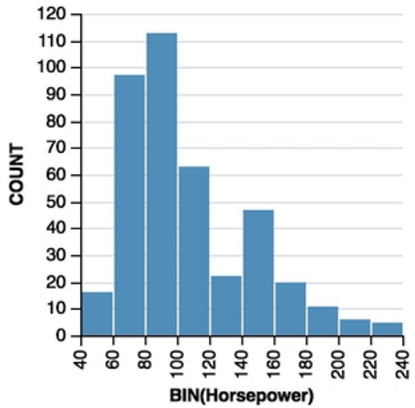


Related Views

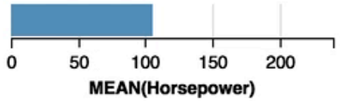
All Summaries Add Quantitative Field Add Categorical Field Add Temporal Field Hide

Summaries

BIN (Horsepower) # COUNT

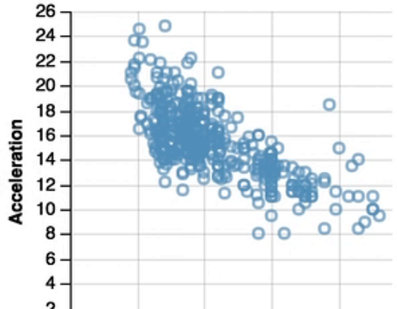


MEAN (Horsepower)

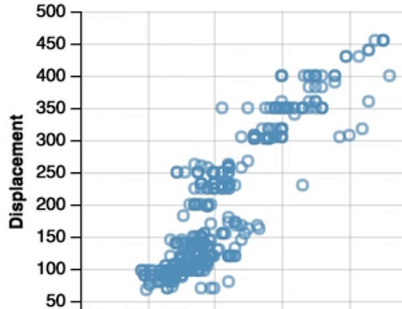


Add Quantitative Field

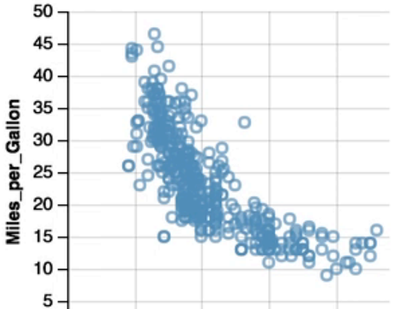
Horsepower # Acceleration



Horsepower # Displacement



Horsepower # Miles per Gallon



Miles per Gallon
Weight in lbs
COUNT

Wildcards

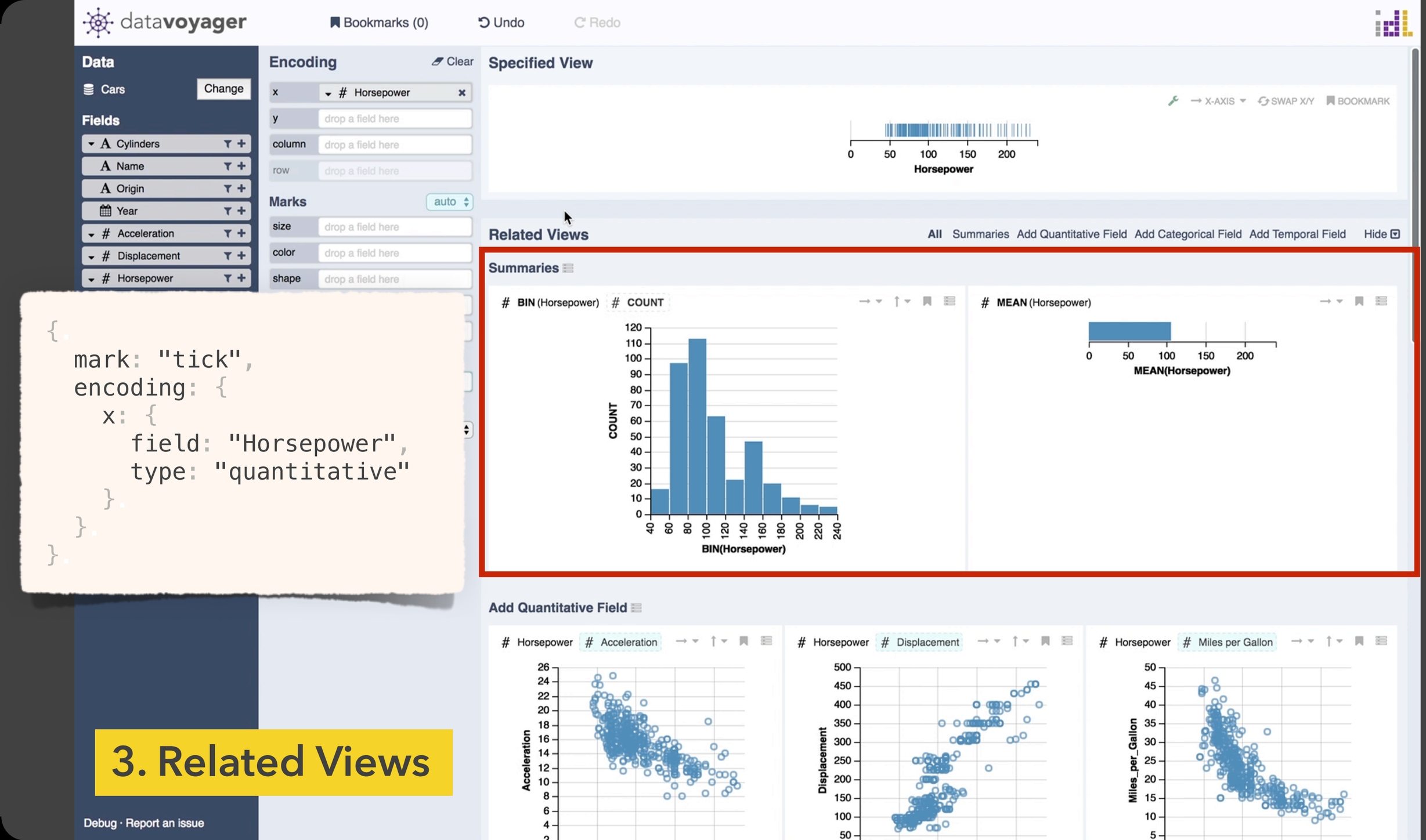
Categorical Fields
Temporal Fields
Quantitative Fields

detail drop a field here
text drop a field here
any drop a field here

Filter Filter invalid numbers

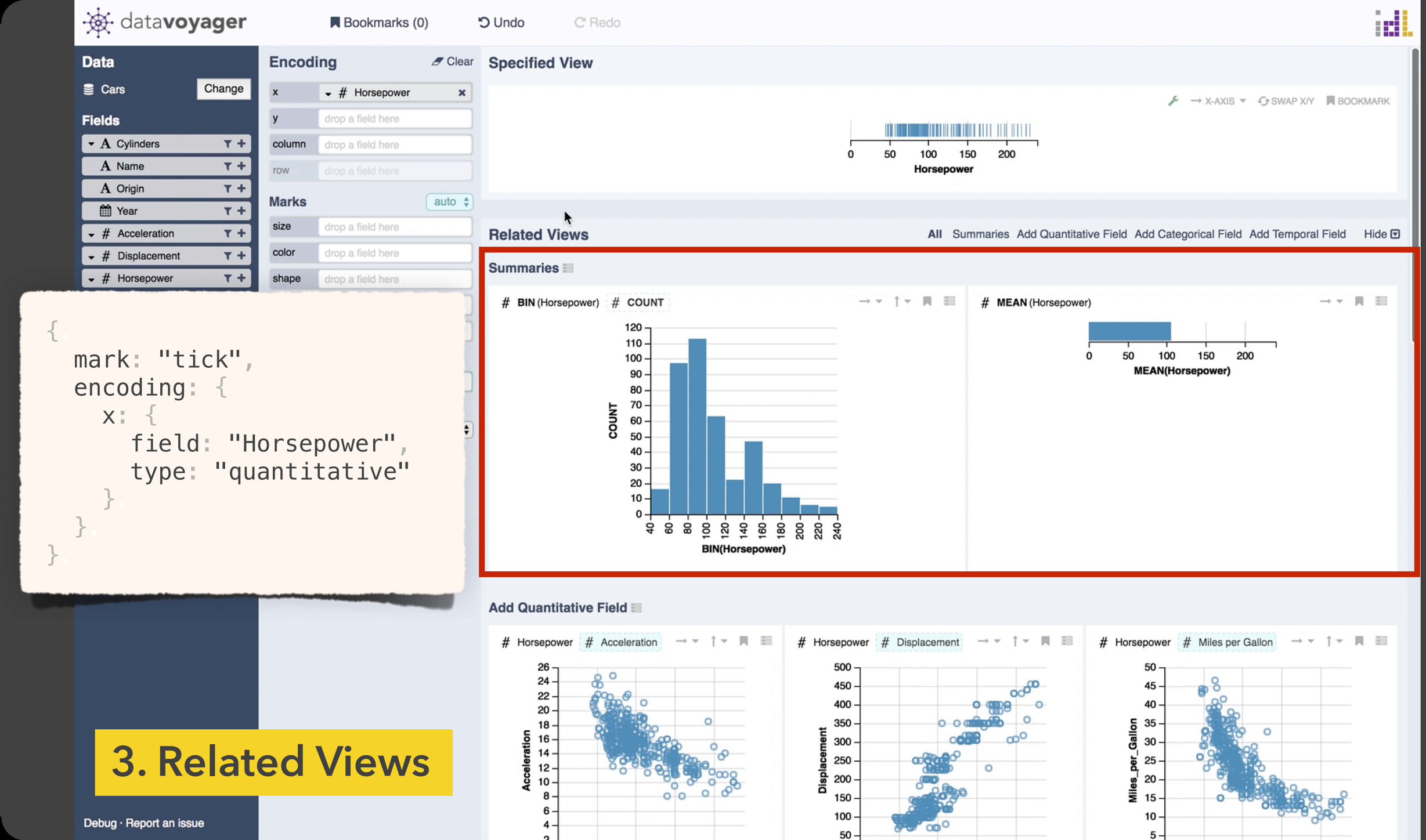
Debug · Report an issue

3. Related Views



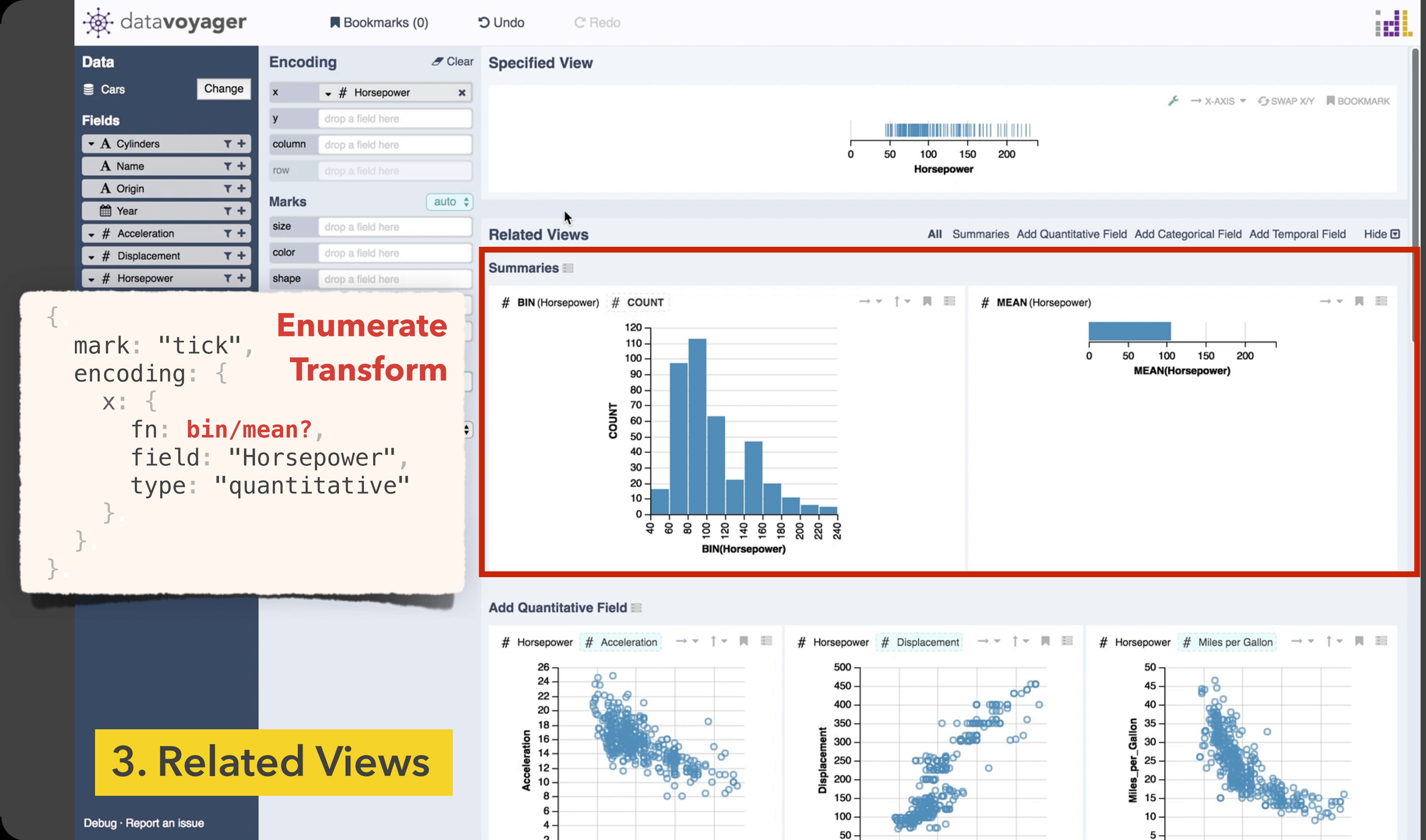

```
{
  mark: "tick",
  encoding: {
    x: {
      field: "Horsepower",
      type: "quantitative"
    }
  }
}
```

3. Related Views




```
{
  mark: "tick",
  encoding: {
    x: {
      field: "Horsepower",
      type: "quantitative"
    }
  }
}
```

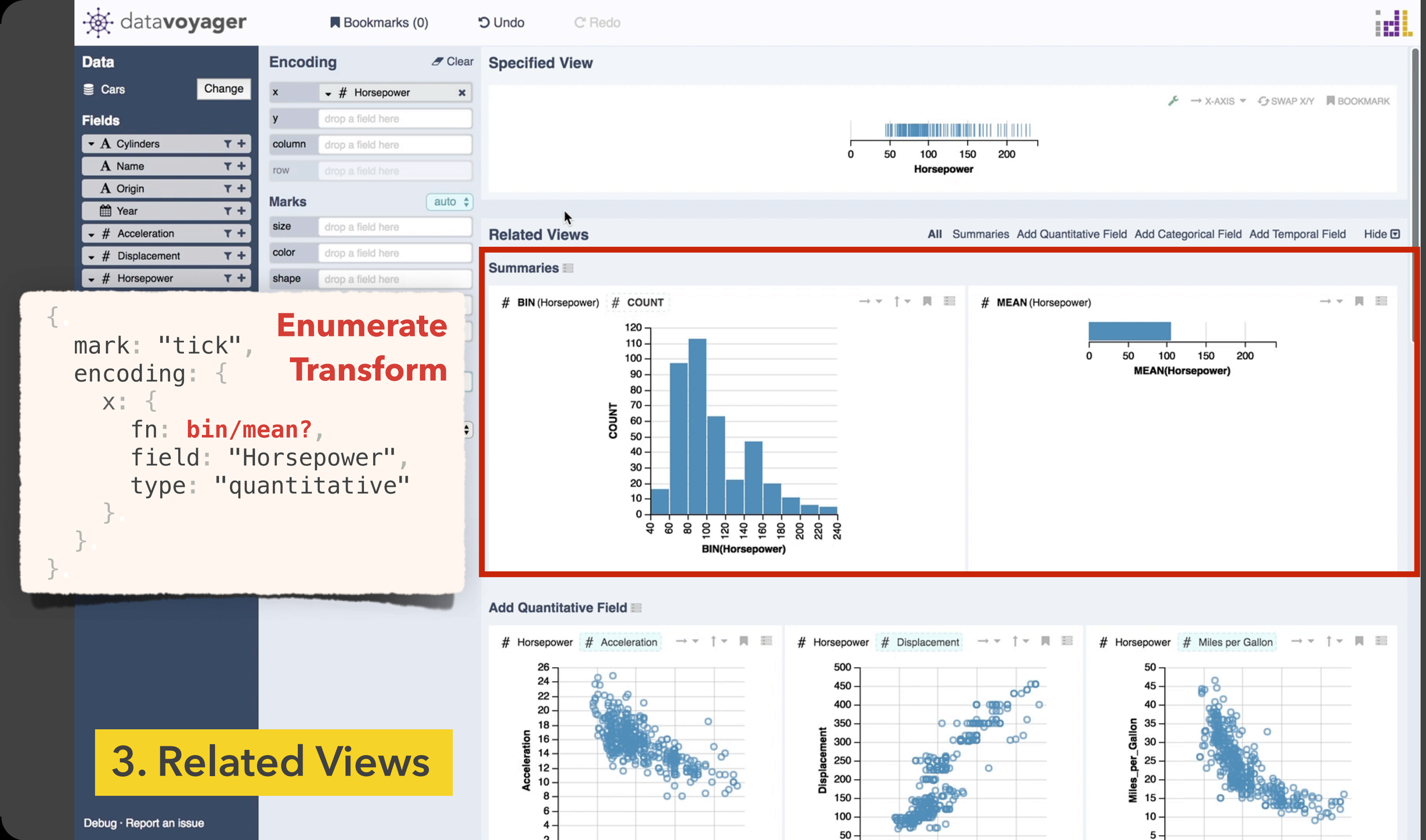
3. Related Views




```
{
  mark: "tick",
  encoding: {
    x: {
      fn: bin/mean?,
      field: "Horsepower",
      type: "quantitative"
    }
  }
}
```

Enumerate Transform

3. Related Views




```
{
  mark: "tick",
  encoding: {
    x: {
      fn: bin/mean?,
      field: "Horsepower",
      type: "quantitative"
    }
  }
}
```

Enumerate Transform

3. Related Views

datavoyager

Bookmarks (0) Undo Redo

Data

Cars Change

Fields

- Cylinders
- Name
- Origin
- Year
- Acceleration
- Displacement
- Horsepower

Encoding Clear

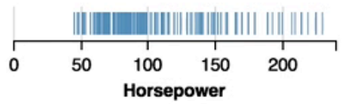
- x: Horsepower
- y: drop a field here
- column: drop a field here
- row: drop a field here

Marks auto

- size: drop a field here
- color: drop a field here
- shape: drop a field here

Specified View

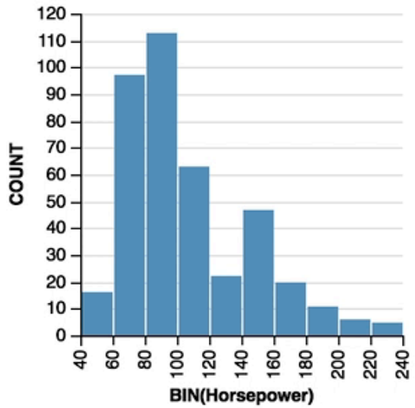
X-AXIS SWAP X/Y BOOKMARK



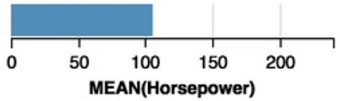
Related Views All Summaries Add Quantitative Field Add Categorical Field Add Temporal Field Hide

Summaries

BIN (Horsepower) # COUNT

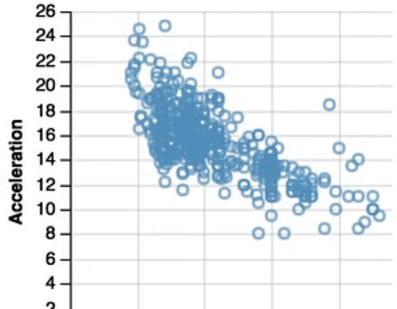


MEAN (Horsepower)

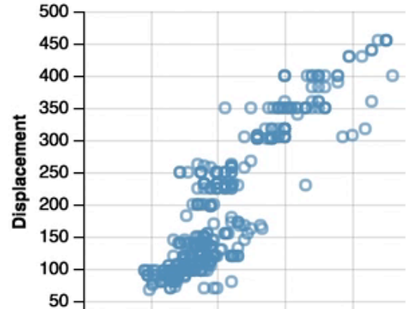


Add Quantitative Field

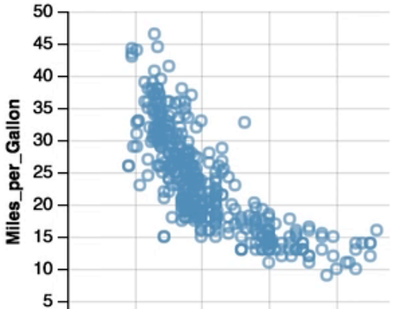
Horsepower # Acceleration



Horsepower # Displacement



Horsepower # Miles per Gallon




```
{
  mark: "tick",
  encoding: {
    x: {
      fn: "bin",
      field: "Horsepower",
      type: "quantitative"
    }
  }
}
```

3. Related Views

Debug · Report an issue

datavoyager

Bookmarks (0) Undo Redo

Data

Cars Change

Fields

- Cylinders
- Name
- Origin
- Year
- Acceleration
- Displacement
- Horsepower

Encoding Clear

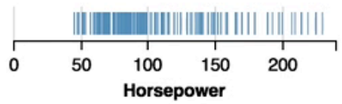
- x: Horsepower
- y: drop a field here
- column: drop a field here
- row: drop a field here

Marks auto

- size: drop a field here
- color: drop a field here
- shape: drop a field here

Specified View

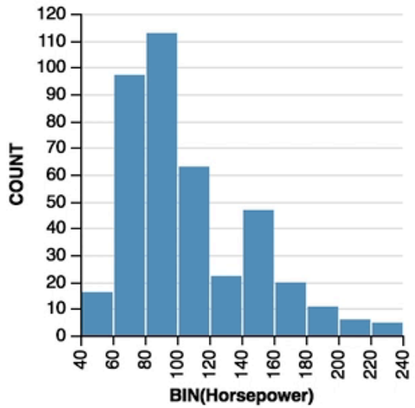
X-AXIS SWAP X/Y BOOKMARK



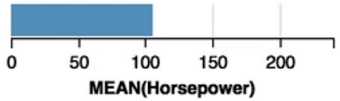
Related Views All Summaries Add Quantitative Field Add Categorical Field Add Temporal Field Hide

Summaries

BIN (Horsepower) # COUNT

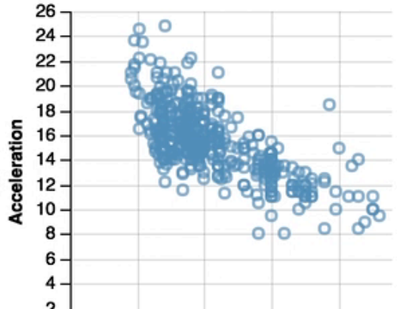


MEAN (Horsepower)

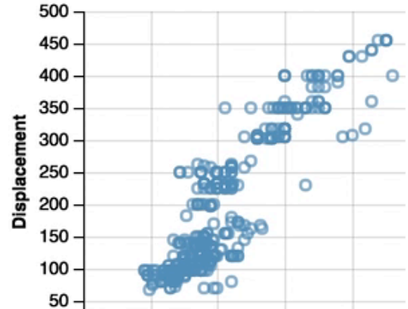


Add Quantitative Field

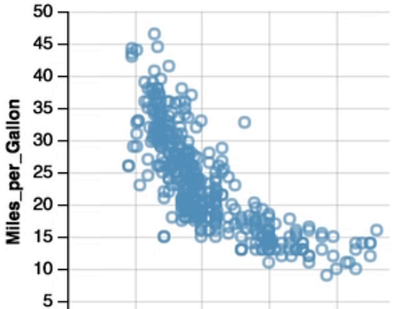
Horsepower # Acceleration



Horsepower # Displacement



Horsepower # Miles per Gallon

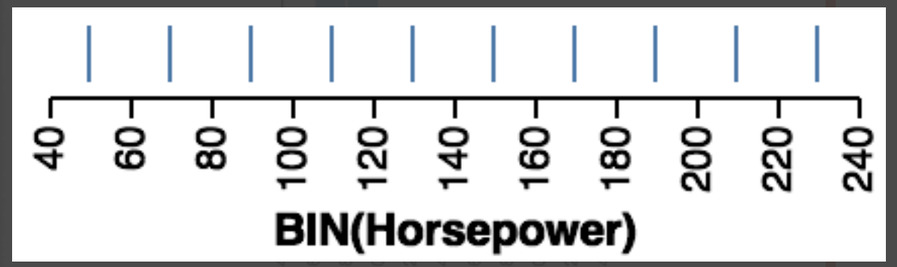



```
{
  mark: "tick",
  encoding: {
    x: {
      fn: "bin",
      field: "Horsepower",
      type: "quantitative"
    }
  }
}
```

3. Related Views

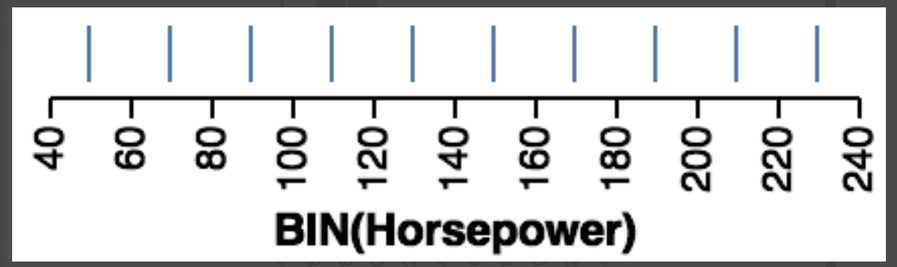
Debug · Report an issue

```
{
  mark: "tick",
  encoding: {
    x: {
      fn: "bin",
      field: "Horsepower",
      type: "quantitative"
    }
  }
}
```



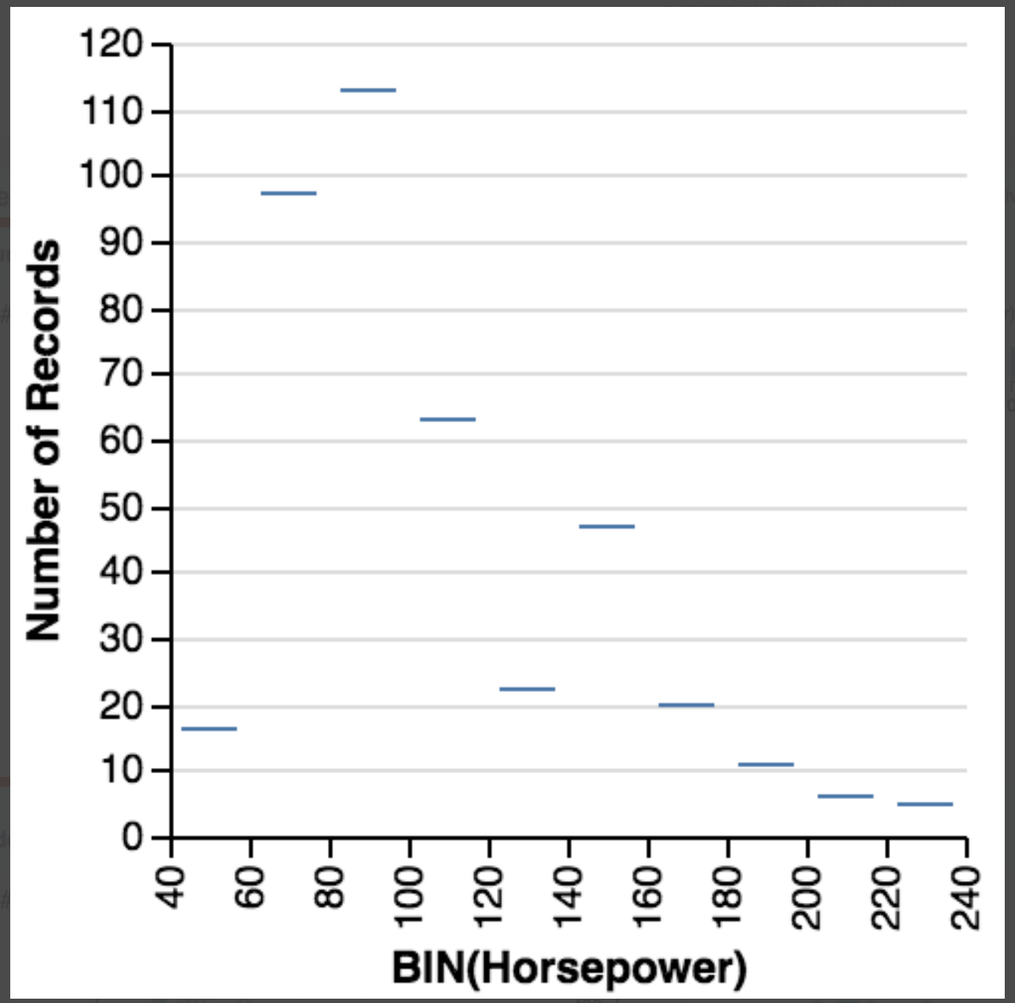
3. Related Views

```
{
  mark: "tick",
  encoding: {
    x: {
      fn: "bin",
      field: "Horsepower",
      type: "quantitative"
    }
  }
}
```



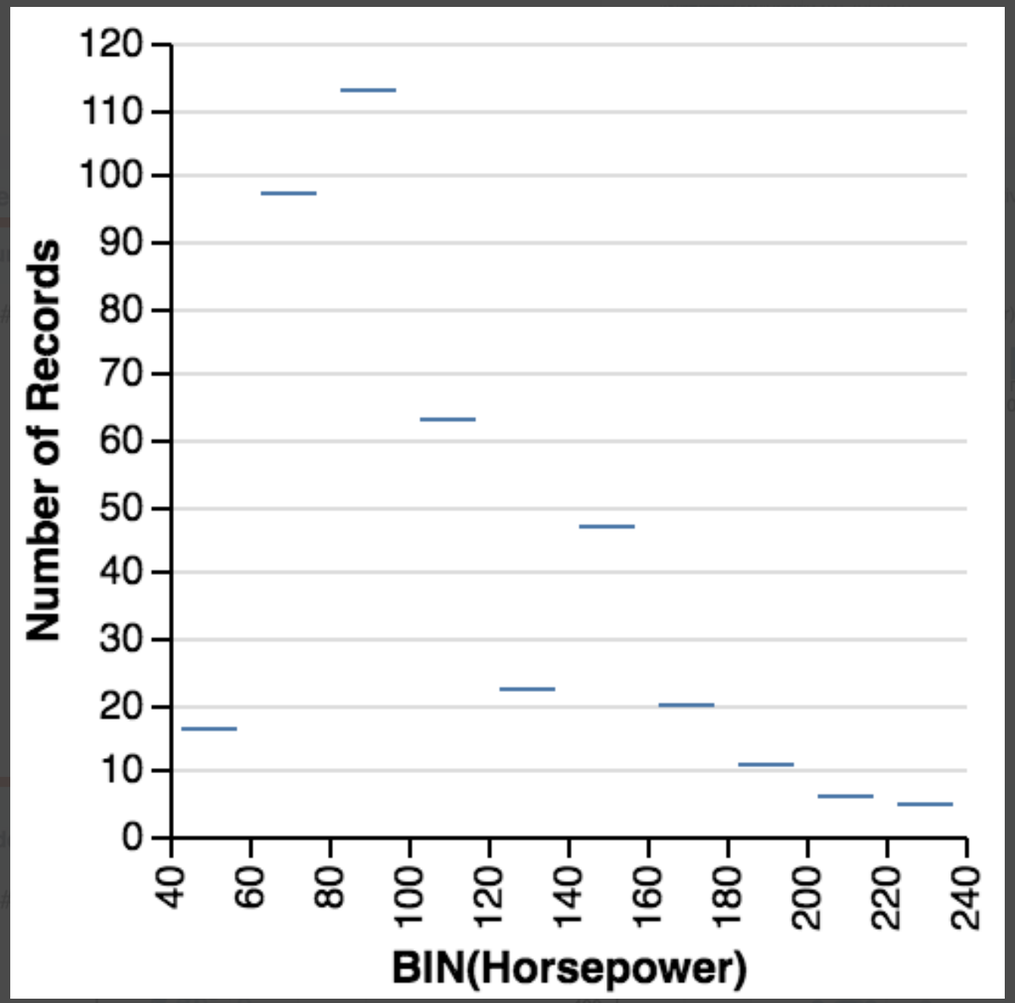
3. Related Views

```
{
  mark: "tick",
  encoding: {
    x: {
      fn: "bin",
      field: "Horsepower",
      type: "quantitative"
    },
    y: {
      aggregate: "count",
      type: "quantitative"
    }
  }
}
```



3. Related Views

```
{
  mark: "tick",
  encoding: {
    x: {
      fn: "bin",
      field: "Horsepower",
      type: "quantitative"
    },
    y: {
      aggregate: "count",
      type: "quantitative"
    }
  }
}
```



3. Related Views


```
{
  mark: ?,
  encoding: {
    x: {
      fn: "bin",
      field: "Horsepower",
      type: "quantitative"
    },
    y: {
      aggregate: "count",
      type: "quantitative"
    },
  },
}
```

Enumerate & Rank Encodings

3. Related Views

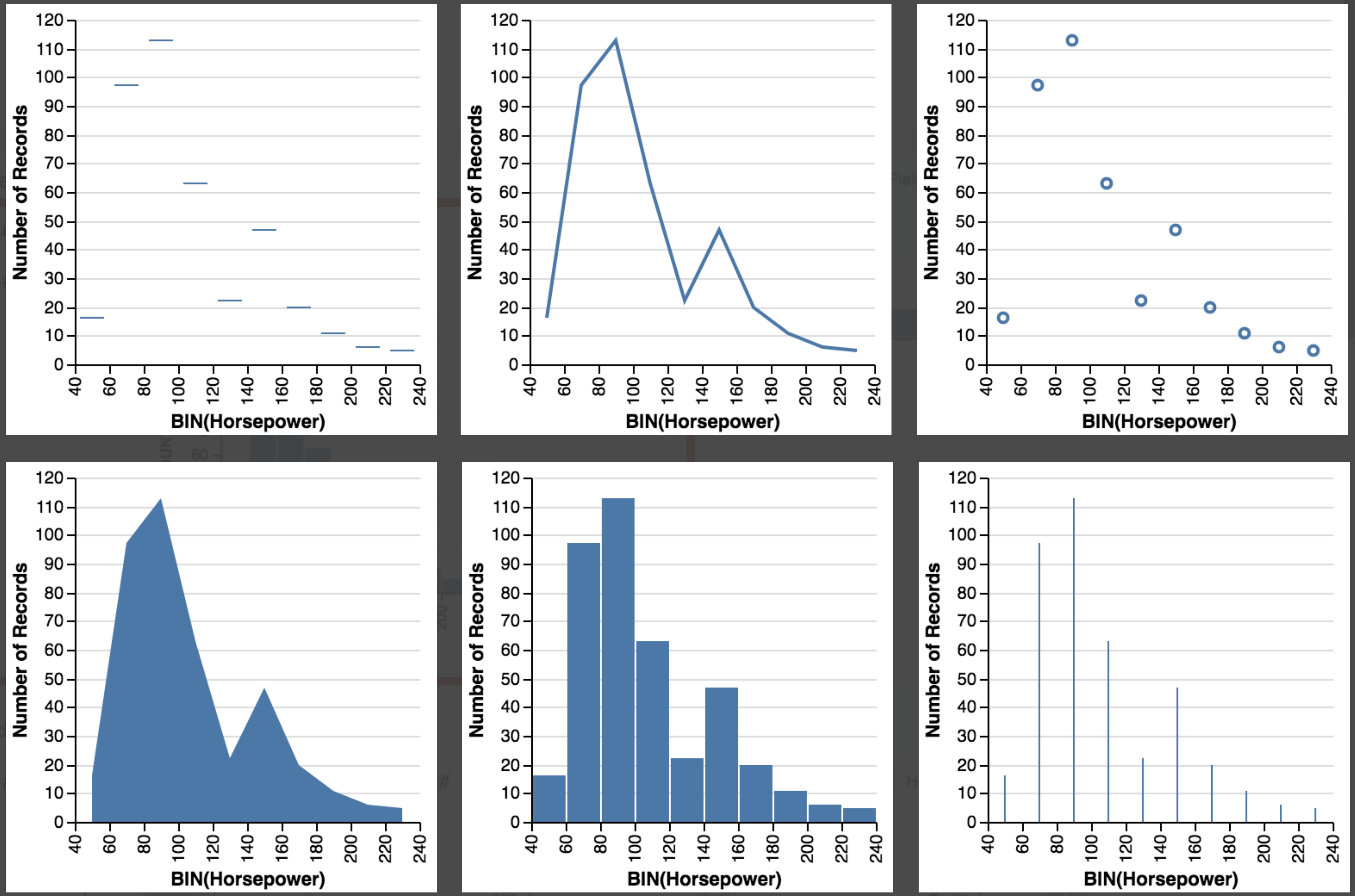

```
{
  mark: ?,
  encoding: {
    x: {
      fn: "bin",
      field: "Horsepower",
      type: "quantitative"
    },
    y: {
      aggregate: "count",
      type: "quantitative"
    },
  },
}
```

Enumerate & Rank Encodings

3. Related Views

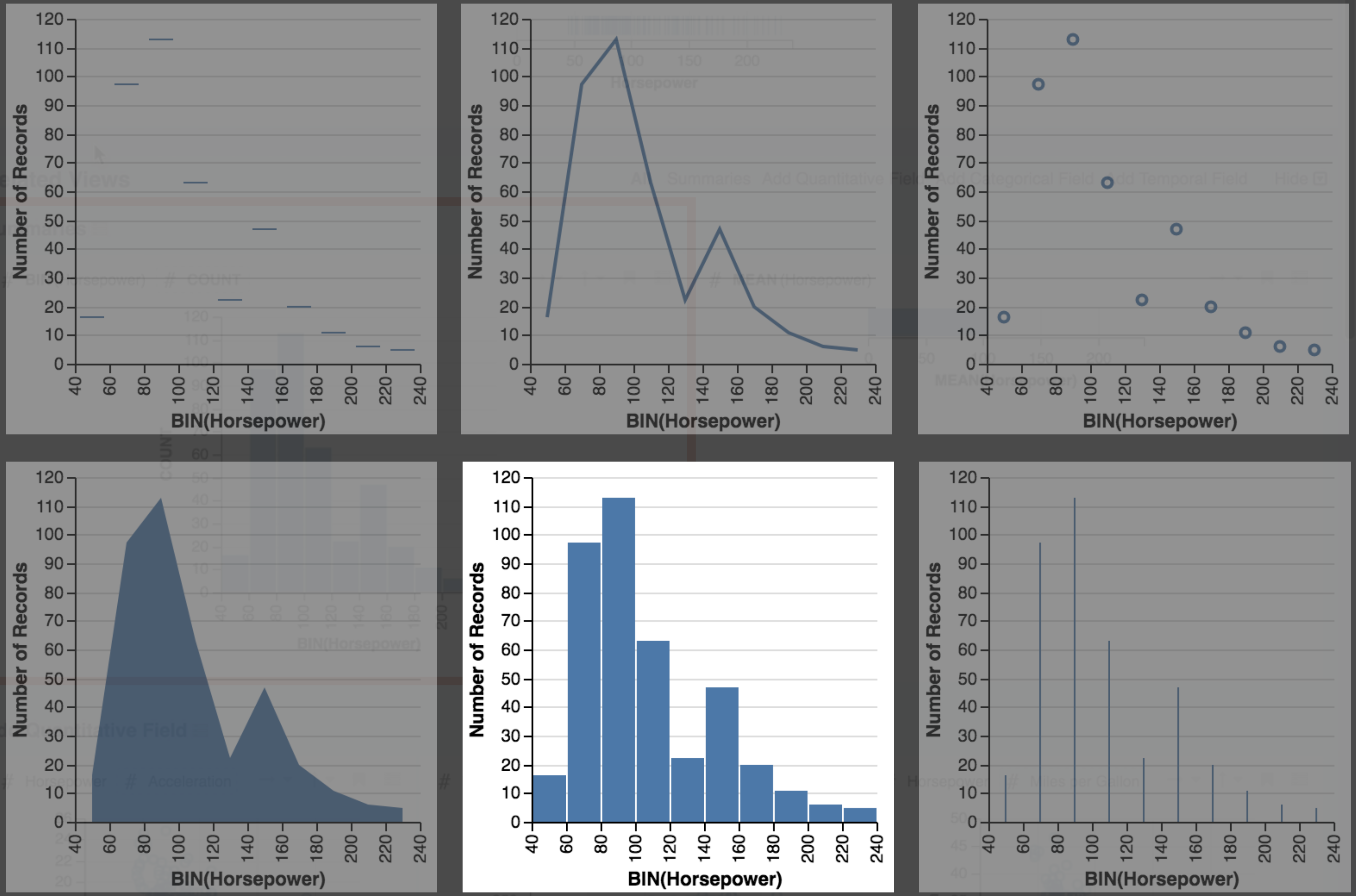
Enumerate & Rank Encodings

```
{
  mark: ?,
  encoding: {
    x: {
      fn: "bin",
      field: "Horsepower",
      type: "quantitative"
    },
    y: {
      aggregate: "count",
      type: "quantitative"
    }
  }
}
```



Enumerate & Rank Encodings

```
{
  mark: ?,
  encoding: {
    x: {
      fn: "bin",
      field: "Horsepower",
      type: "quantitative"
    },
    y: {
      aggregate: "count",
      type: "quantitative"
    }
  }
}
```




Enumerate & Rank Encodings
{
mark: ?,
encoding: {
x: {
fn: "bin",
field: "Horsepower",
type: "quantitative"
},
y: {
aggregate: "count",
type: "quantitative"
}
}
}
Number of Records
BIN(Horsepower)
0 10 20 30 40 50 60 70 80 90 100 110 120
40 60 80 100 120 140 160 180 200 220 240
datavoyager
3. Related Views

datavoyager Bookmarks (0) Undo Redo

Data

Cars Change

Fields

- Cylinders
- Name
- Origin
- Year
- Acceleration
- Displacement
- Horsepower
- Miles per Gallon
- Weight in lbs
- COUNT

Wildcards

- Categorical Fields
- Temporal Fields
- Quantitative Fields

Encoding Clear

x: Horsepower
y: drop a field here
column: drop a field here
row: drop a field here

Marks auto

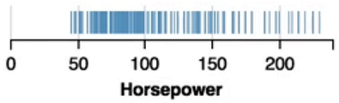
size: drop a field here
color: drop a field here
shape: drop a field here
detail: drop a field here
text: drop a field here

any: drop a field here

Filter Filter invalid numbers

Specified View

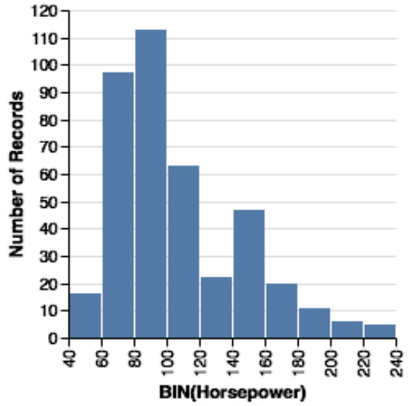
X-AXIS SWAP X/Y BOOKMARK



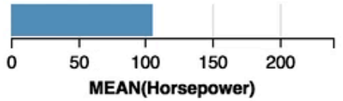
Related Views All Summaries Add Quantitative Field Add Categorical Field Add Temporal Field Hide

Summaries

BIN (Horsepower) # COUNT

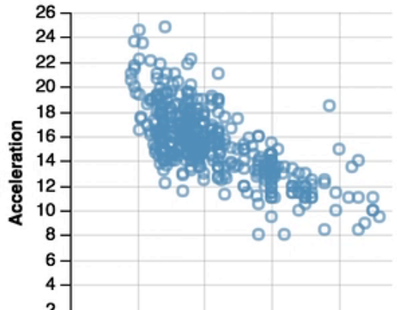


MEAN (Horsepower)

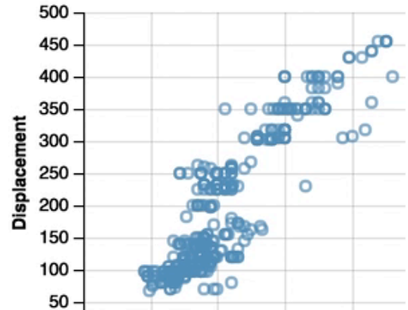


Add Quantitative Field

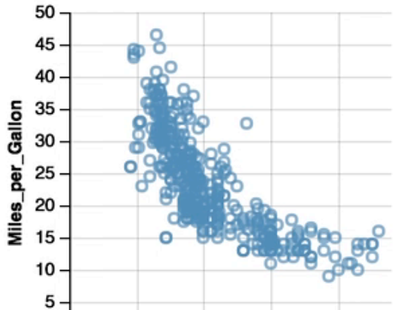
Horsepower # Acceleration



Horsepower # Displacement



Horsepower # Miles per Gallon



3. Related Views

Debug · Report an issue

datavoyager Bookmarks (0) Undo Redo

Data

Cars Change

Fields

- Cylinders
- Name
- Origin
- Year
- Acceleration
- Displacement
- Horsepower
- Miles per Gallon
- Weight in lbs
- COUNT

Wildcards

- Categorical Fields
- Temporal Fields
- Quantitative Fields

Encoding Clear

x: Horsepower
y: drop a field here
column: drop a field here
row: drop a field here

Marks auto

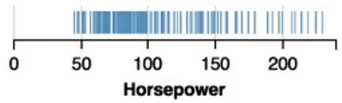
size: drop a field here
color: drop a field here
shape: drop a field here
detail: drop a field here
text: drop a field here

any: drop a field here

Filter Filter invalid numbers

Specified View

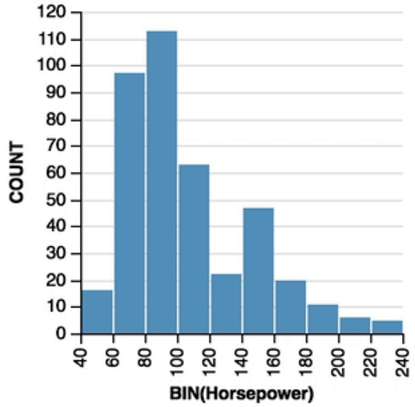
X-AXIS SWAP X/Y BOOKMARK



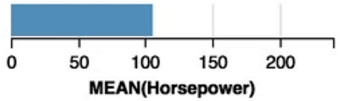
Related Views All Summaries Add Quantitative Field Add Categorical Field Add Temporal Field Hide

Summaries

BIN (Horsepower) # COUNT

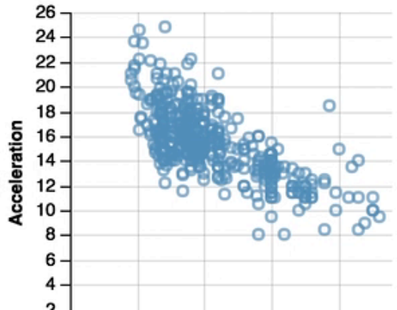


MEAN (Horsepower)

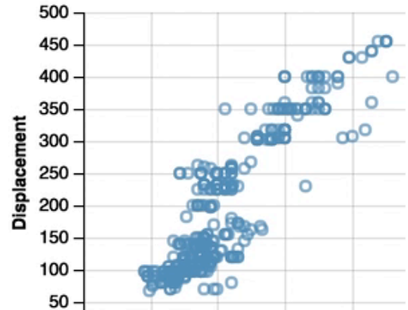


Add Quantitative Field

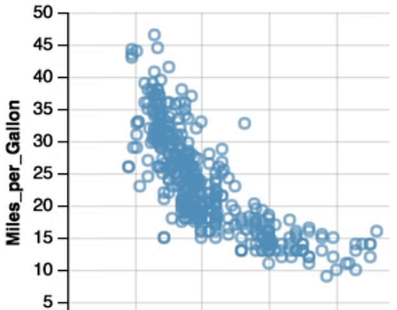
Horsepower # Acceleration



Horsepower # Displacement



Horsepower # Miles per Gallon



3. Related Views

Debug · Report an issue

datavoyager Bookmarks (0) Undo Redo

Data

Cars Change

Fields

- Cylinders
- Name
- Origin
- Year
- Acceleration
- Displacement
- Horsepower
- Miles per Gallon
- Weight in lbs
- COUNT

Wildcards

- Categorical Fields
- Temporal Fields
- Quantitative Fields

Encoding Clear

x	Horsepower
y	drop a field here
column	drop a field here
row	drop a field here

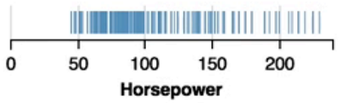
Marks auto

size	drop a field here
color	drop a field here
shape	drop a field here
detail	drop a field here
text	drop a field here
any	drop a field here

Filter Filter invalid numbers

Specified View

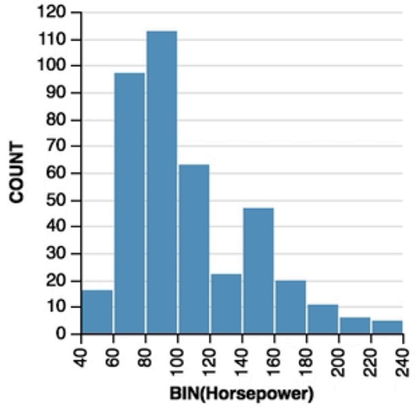
X-AXIS SWAP X/Y BOOKMARK



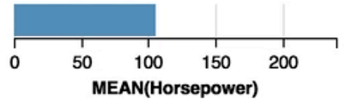
Related Views All Summaries Add Quantitative Field Add Categorical Field Add Temporal Field Hide

Summaries

BIN (Horsepower) # COUNT

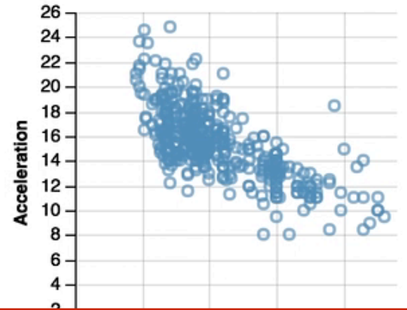


MEAN (Horsepower)

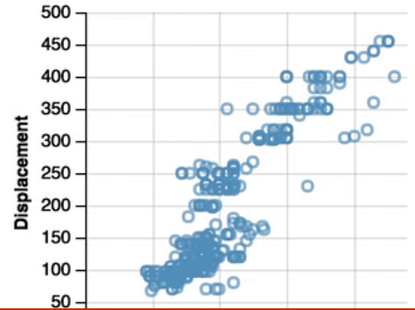


Add Quantitative Field

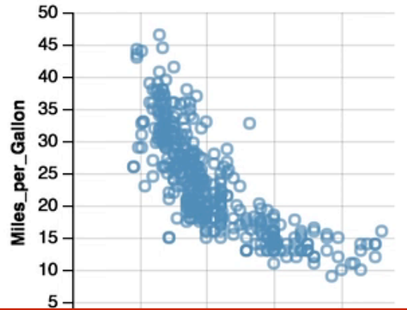
Horsepower # Acceleration



Horsepower # Displacement



Horsepower # Miles per Gallon



3. Related Views

Debug · Report an issue

datavoyager Bookmarks (0) Undo Redo

Data

Cars Change

Fields

- Cylinders
- Name
- Origin
- Year
- Acceleration
- Displacement
- Horsepower
- Miles per Gallon
- Weight in lbs
- COUNT

Wildcards

- Categorical Fields
- Temporal Fields
- Quantitative Fields

Encoding Clear

x	Horsepower
y	drop a field here
column	drop a field here
row	drop a field here

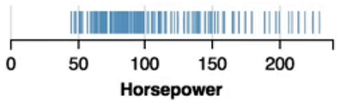
Marks auto

size	drop a field here
color	drop a field here
shape	drop a field here
detail	drop a field here
text	drop a field here
any	drop a field here

Filter Filter invalid numbers

Specified View

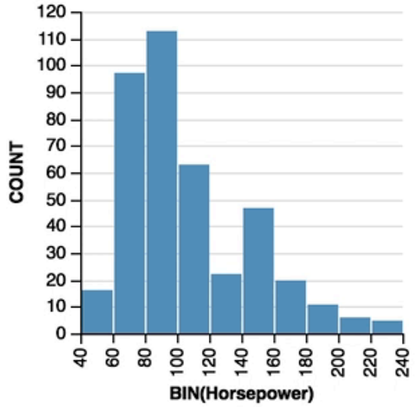
X-AXIS SWAP X/Y BOOKMARK



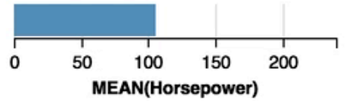
Related Views All Summaries Add Quantitative Field Add Categorical Field Add Temporal Field Hide

Summaries

BIN (Horsepower) # COUNT

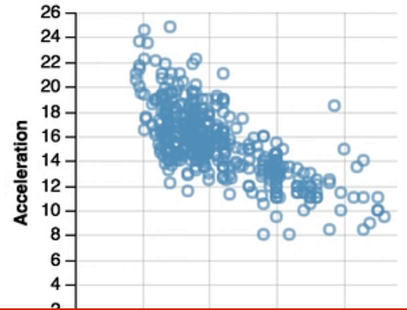


MEAN (Horsepower)

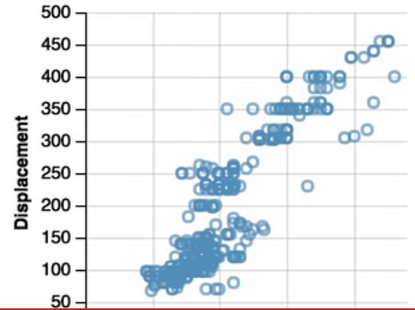


Add Quantitative Field

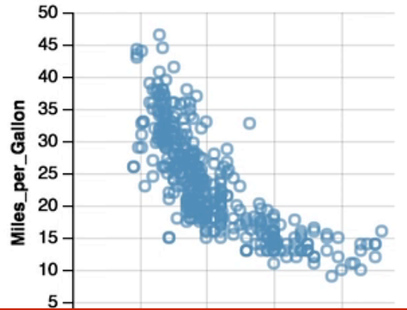
Horsepower # Acceleration



Horsepower # Displacement



Horsepower # Miles per Gallon



3. Related Views

Debug · Report an issue

datavoyager Bookmarks (0) Undo Redo

Data

Cars Change

Fields

- Cylinders
- Name
- Origin
- Year
- Acceleration
- Displacement
- Horsepower
- Miles per Gallon
- Weight in lbs
- COUNT

Wildcards

- Categorical Fields
- Temporal Fields
- Quantitative Fields

Encoding Clear

x	Horsepower
y	drop a field here
column	drop a field here
row	drop a field here

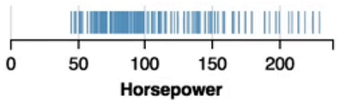
Marks auto

size	drop a field here
color	drop a field here
shape	drop a field here
detail	drop a field here
text	drop a field here
any	drop a field here

Filter Filter invalid numbers

Specified View

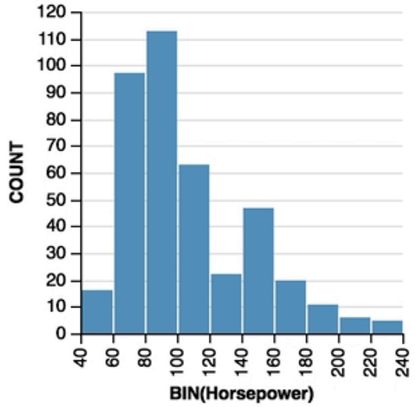
X-AXIS SWAP X/Y BOOKMARK



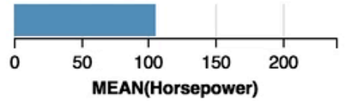
Related Views All Summaries Add Quantitative Field Add Categorical Field Add Temporal Field Hide

Summaries

BIN (Horsepower) # COUNT

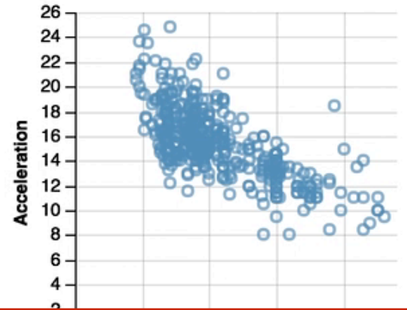


MEAN (Horsepower)

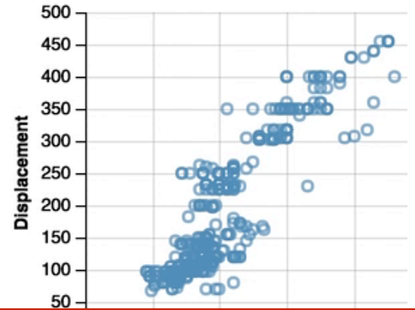


Add Quantitative Field

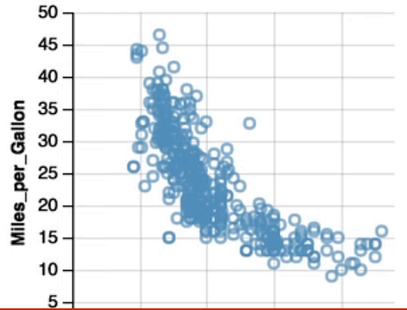
Horsepower # Acceleration



Horsepower # Displacement



Horsepower # Miles per Gallon



3. Related Views

Debug · Report an issue

datavoyager Bookmarks (0) Undo Redo

Data

Cars Change

Fields

- Cylinders
- Name
- Origin
- Year
- Acceleration
- Displacement
- Horsepower
- Miles per Gallon
- Weight in lbs
- COUNT

Wildcards

- Categorical Fields
- Temporal Fields
- Quantitative Fields

Encoding Clear

x	# Horsepower
y	drop a field here
column	drop a field here
row	drop a field here

Marks auto

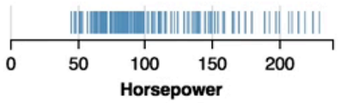
size	drop a field here
color	drop a field here
shape	drop a field here
detail	drop a field here
text	drop a field here

any	drop a field here

Filter Filter invalid numbers

Specified View

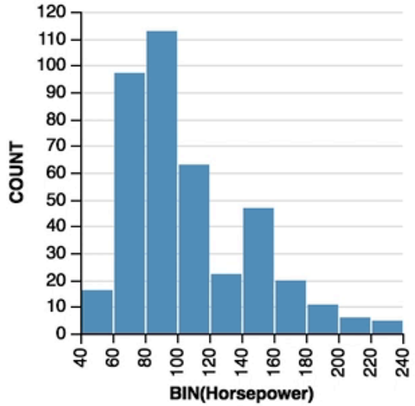
X-AXIS SWAP X/Y BOOKMARK



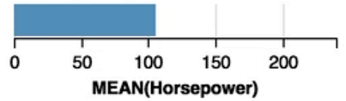
Related Views All Summaries Add Quantitative Field Add Categorical Field Add Temporal Field Hide

Summaries

BIN (Horsepower) # COUNT

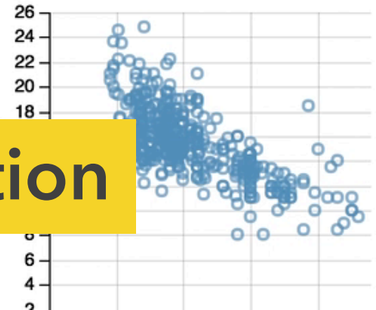


MEAN (Horsepower)

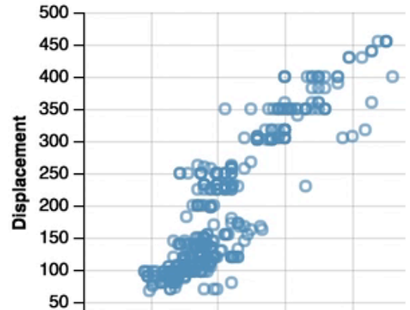


Add Quantitative Field

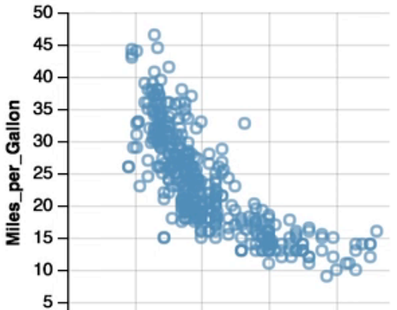
Horsepower # Acceleration



Horsepower # Displacement



Horsepower # Miles per Gallon



4. Wildcard Specification

Debug · Report an issue

datavoyager Bookmarks (0) Undo Redo

Data

Cars Change

Fields

- Cylinders
- Name
- Origin
- Year
- Acceleration
- Displacement
- Horsepower
- Miles per Gallon
- Weight in lbs
- COUNT

Wildcards

- Categorical Fields
- Temporal Fields
- Quantitative Fields

Encoding Clear

x	# Horsepower
y	drop a field here
column	drop a field here
row	drop a field here

Marks auto

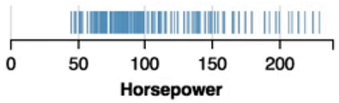
size	drop a field here
color	drop a field here
shape	drop a field here
detail	drop a field here
text	drop a field here

any	drop a field here

Filter Filter invalid numbers

Specified View

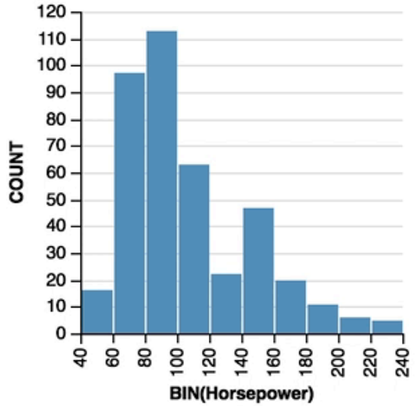
X-AXIS SWAP X/Y BOOKMARK



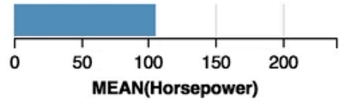
Related Views All Summaries Add Quantitative Field Add Categorical Field Add Temporal Field Hide

Summaries

BIN (Horsepower) # COUNT

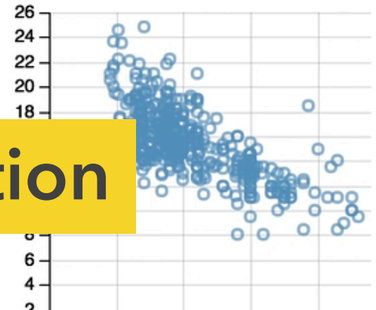


MEAN (Horsepower)

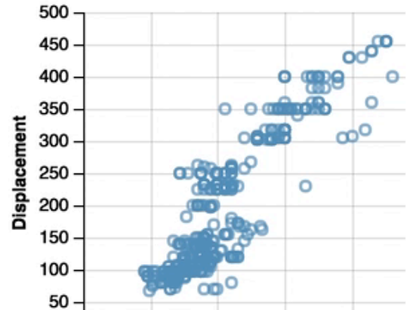


Add Quantitative Field

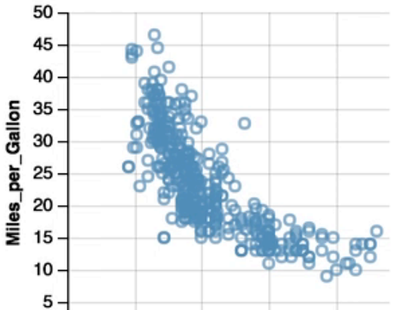
Horsepower # Acceleration



Horsepower # Displacement

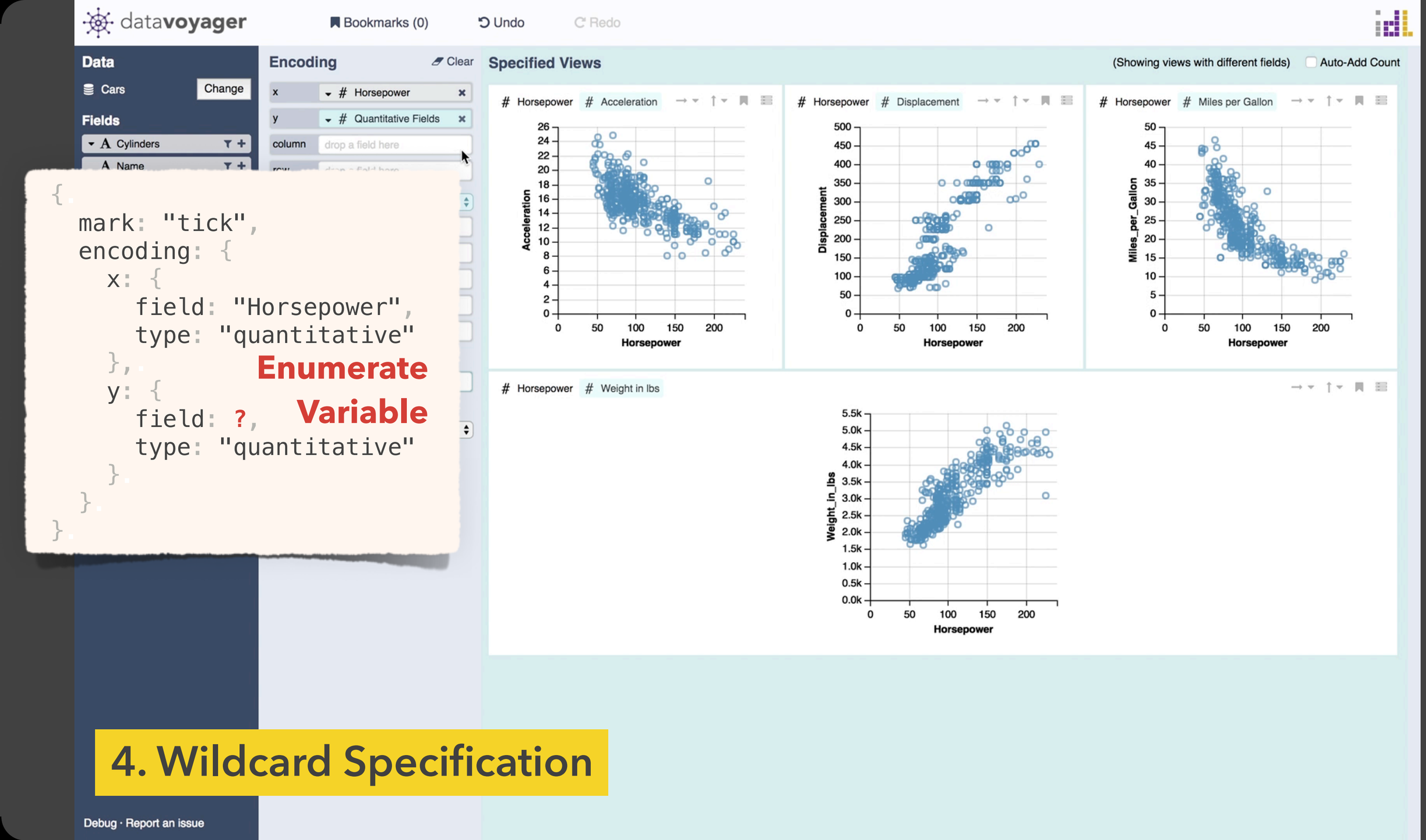


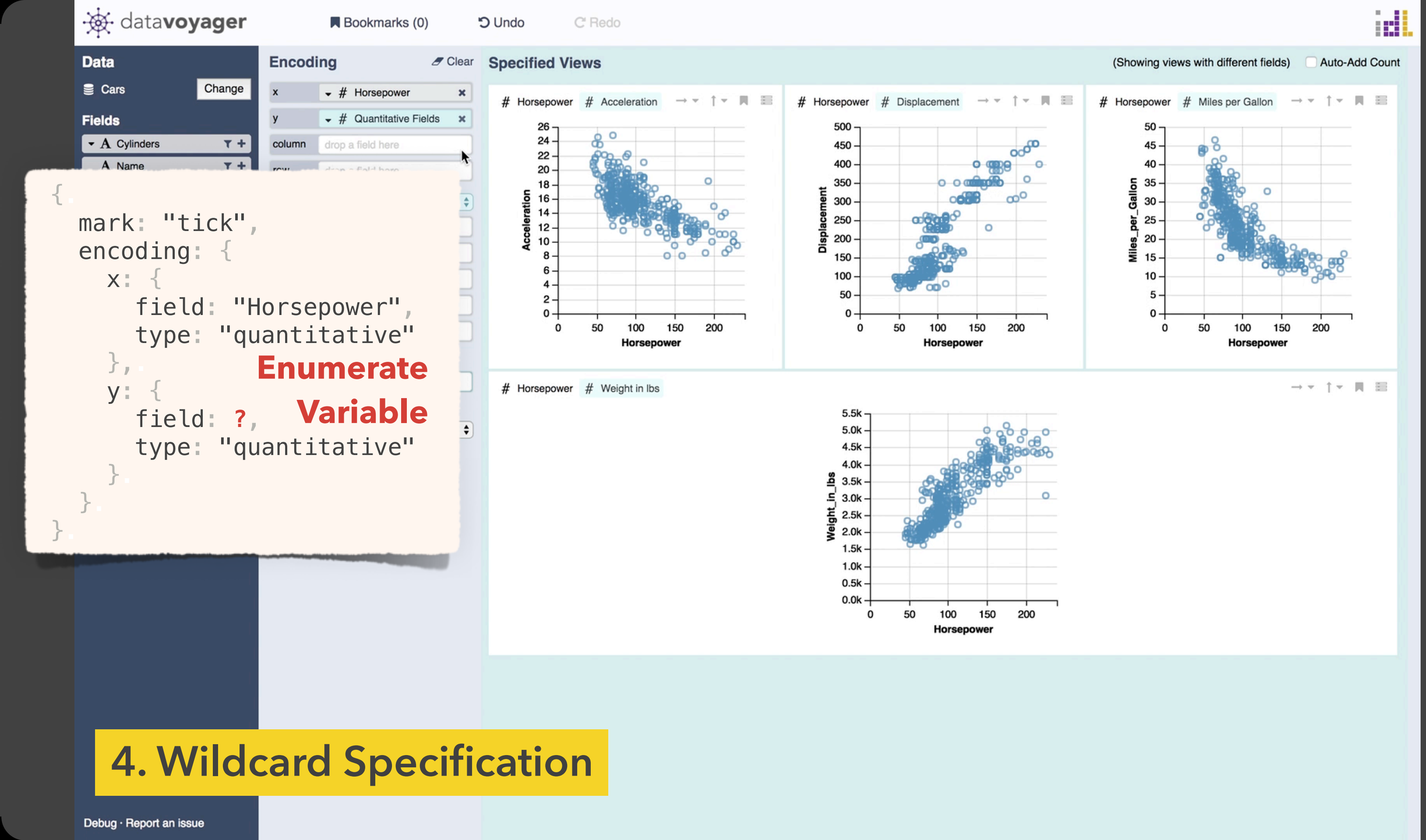
Horsepower # Miles per Gallon



4. Wildcard Specification

Debug · Report an issue


datavoyager
Bookmarks (0)
Undo
Redo
Data
Cars
Change
Fields
Cylinders
Name
Encoding
Clear
x
Horsepower
y
Quantitative Fields
column
drop a field here
Specified Views
(Showing views with different fields)
Auto-Add Count
Horsepower
Acceleration
Displacement
Miles per Gallon
Weight in lbs
Horsepower
Acceleration
Displacement
Miles_per_Gallon
Weight_in_lbs
{
mark: "tick",
encoding: {
x: {
field: "Horsepower",
type: "quantitative"
},
y: {
field: ?,
type: "quantitative"
}
}
}
Enumerate
Variable
4. Wildcard Specification
Debug · Report an issue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Miles per Gallon
Weight in lbs
Horsepower
Acceleration
Displacement
Miles_per_Gallon
Weight_in_lbs
{
mark: "tick",
encoding: {
x: {
field: "Horsepower",
type: "quantitative"
},
y: {
field: ?,
type: "quantitative"
}
}
}
Enumerate
Variable
4. Wildcard Specification
Debug · Report an issue

datavoyager Bookmarks (0) Undo Redo

Data

Cars Change

Fields

- Cylinders
- Name
- Origin
- Year
- Acceleration
- Displacement
- Horsepower
- Miles per Gallon
- Weight in lbs
- COUNT

Wildcards

- Categorical Fields
- Temporal Fields
- Quantitative Fields

Encoding Clear

- x: Horsepower
- y: Quantitative Fields
- column: drop a field here
- row: drop a field here

Marks auto

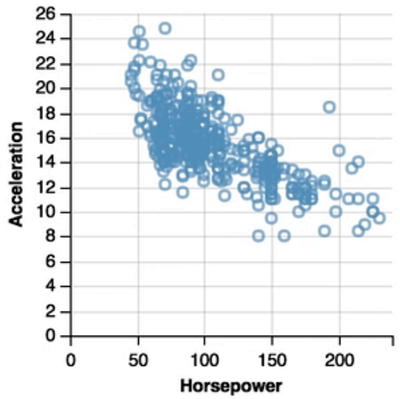
- size: drop a field here
- color: drop a field here
- shape: drop a field here
- detail: drop a field here
- text: drop a field here

any: drop a field here

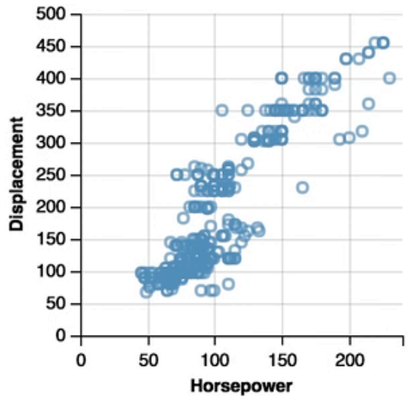
Filter Filter invalid numbers

Specified Views (Showing views with different fields) Auto-Add Count

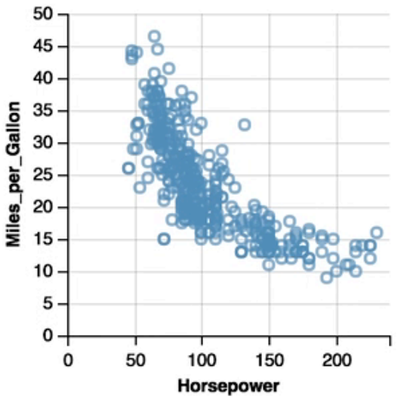
Horsepower # Acceleration



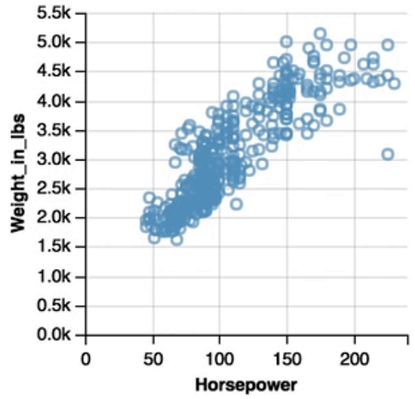
Horsepower # Displacement



Horsepower # Miles per Gallon



Horsepower # Weight in lbs



4. Wildcard Specification

Debug · Report an issue

datavoyager Bookmarks (0) Undo Redo

Data

Cars Change

Fields

- Cylinders
- Name
- Origin
- Year
- Acceleration
- Displacement
- Horsepower
- Miles per Gallon
- Weight in lbs
- COUNT

Wildcards

- Categorical Fields
- Temporal Fields
- Quantitative Fields

Encoding Clear

- x: Horsepower
- y: Quantitative Fields
- column: drop a field here
- row: drop a field here

Marks auto

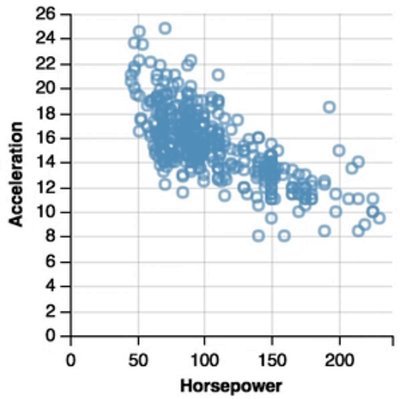
- size: drop a field here
- color: drop a field here
- shape: drop a field here
- detail: drop a field here
- text: drop a field here

any: drop a field here

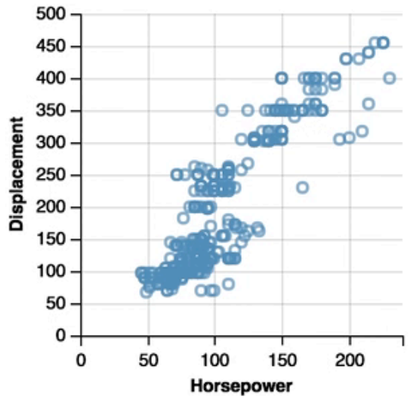
Filter Filter invalid numbers

Specified Views (Showing views with different fields) Auto-Add Count

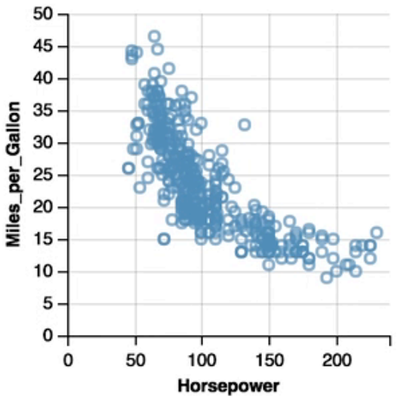
Horsepower # Acceleration



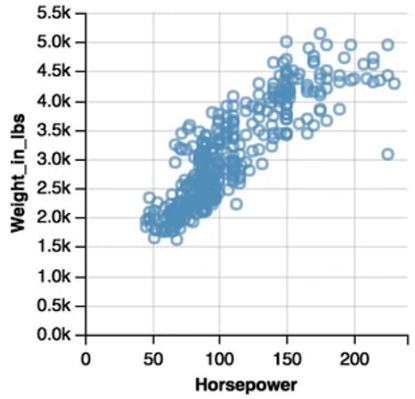
Horsepower # Displacement



Horsepower # Miles per Gallon



Horsepower # Weight in lbs



4. Wildcard Specification

Debug · Report an issue

Voyager

Augment manual specification with recommendation
to **promote breadth** & **reduce tedium** in exploration

Use Vega-Lite to **recommend** data and visual encodings.

https://github.com/vega/voyager

Vega-Lite: a Grammar of Interactive Graphics

The Design of Vega-Lite

Single View Specification

Layered and **Multi-view** Composition

Interactions with Selections

Using Vega-Lite

Programming with Vega-Lite

Higher-level **Tools** and **Recommendations**

Exploring Data

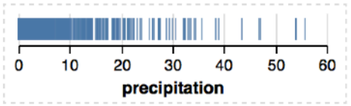
In this tutorial, you'll learn a few more techniques for creating visualizations in Vega-Lite. If you are not fa
Lite, please read the getting started tutorial first.

For this tutorial, we will create visualizations to explore weather data for Seattle, taken from NOAA. The d
file with columns for the temperature (in Celsius), precipitation (in centimeter), wind (in meter/second), an
We have one row for each day from January 1st, 2012 to December 31st, 2015.

To load the CSV file with Vega-Lite, we need to provide a URL and set the format type in the data sectio
specification.

```
"data": {"url": "data/seattle-weather.csv"}
```

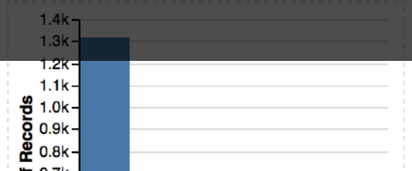
Let's start by looking at the precipitation. Precipitation is a quantitative variable. Let's use a tick mark to s
distribution of precipitation.



Open in Vega Editor

```
{
  "$schema": "https://vega.github.io/schema/vega-lit
  "data": {"url": "data/seattle-weather.csv"},
  "mark": "tick",
  "encoding": {
    "x": {"field": "precipitation", "type": "quantit
  }
}
```

It looks as though precipitation is skewed towards lower values; that is, when it rains, it usually doesn't r
better see this, we can create a histogram of the precipitation data. For this, we have to add an encoding
that uses a special field `*` that is aggregated with `count`. It is difficult to see patterns across continuou
can therefore discretize the temperature values by binning using `bin`.




```
{
  "$schema": "https://vega.github.io/schema/vega-lit
  "data": {"url": "data/seattle-weather.csv"},
  "mark": "bar",
  "encoding": {
    "x": {
```


Overview

Edit this page

Vega-Lite is a high-level visualization grammar. It provides a concise JSON syntax for supporting rapid generation of visualizations to support analysis. Vega-Lite can serve as a declarative format for describing and creating data visualizations. Vega-Lite specifications can be compiled to a lower-level, more detailed Vega specifications and rendered using Vega's compiler.

This documentation describes the JSON specification language and how to use Vega-Lite visualizations in a web application.

Table of Contents

Below is an overview of the documentation for Vega-Lite properties. See below for an overview of Vega-Lite specifications.

Tutorials & Documentations

vega.github.io/vega-lite

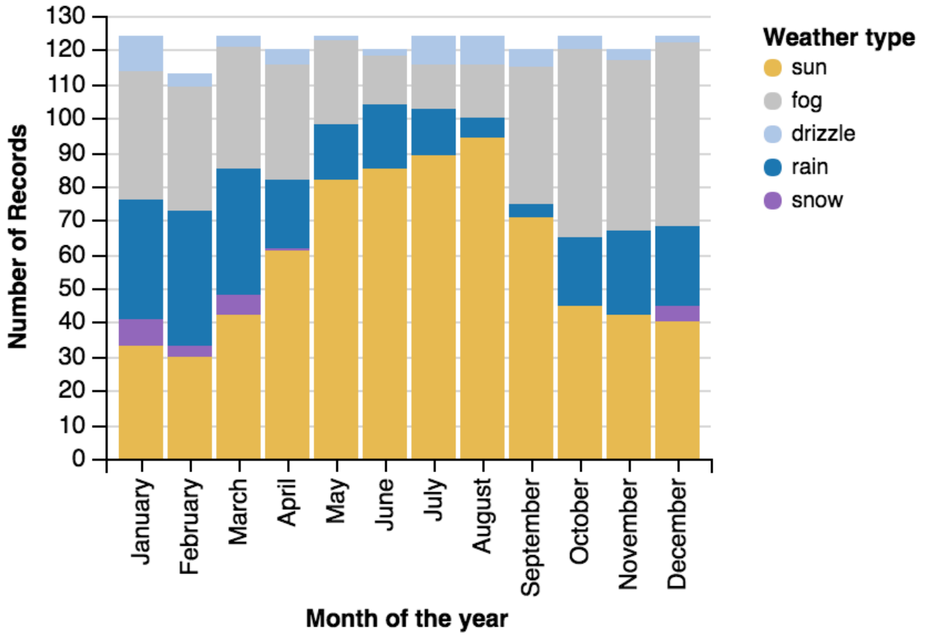
Vega-lite | Stacked Bar Chart | Format | Parse

```
{
  "data": {"url": "data/seattle-weather.csv","format": {"type": "csv"}},
  "mark": "bar",
  "encoding": {
    "x": {
      "field": "date",
      "type": "temporal",
      "timeUnit": "month",
      "axis": {"title": "Month of the year"}
    },
    "y": {
      "field": "*",
      "type": "quantitative",
      "aggregate": "count"
    },
    "color": {
      "field": "weather",
      "type": "nominal",
      "scale": {
        "domain": ["sun","fog","drizzle","rain","snow"],
        "range": ["#e7ba52","#c7c7c7","#aec7e8","#1f77b4","#9467bd"]
      },
      "legend": {
        "title": "Weather type"
      }
    }
  }
}
```

Vega compiled from Vega-Lite (read-only) | Edit Vega spec

```
{
  "width": 1,
  "height": 1,
  "padding": "auto",
  "data": [
    {
      "name": "source_0",
      "url": "data/seattle-weather.csv",
      "format": {"type": "csv","parse": {"date": "date"}},
      "transform": [
        {
          "type": "filter",
          "test": "datum[\"date\"] !== null && !isNaN(datum[\"date\"])"
```

Visualization | Renderer: Canvas | Export



Online Editor

vega.github.io/editor

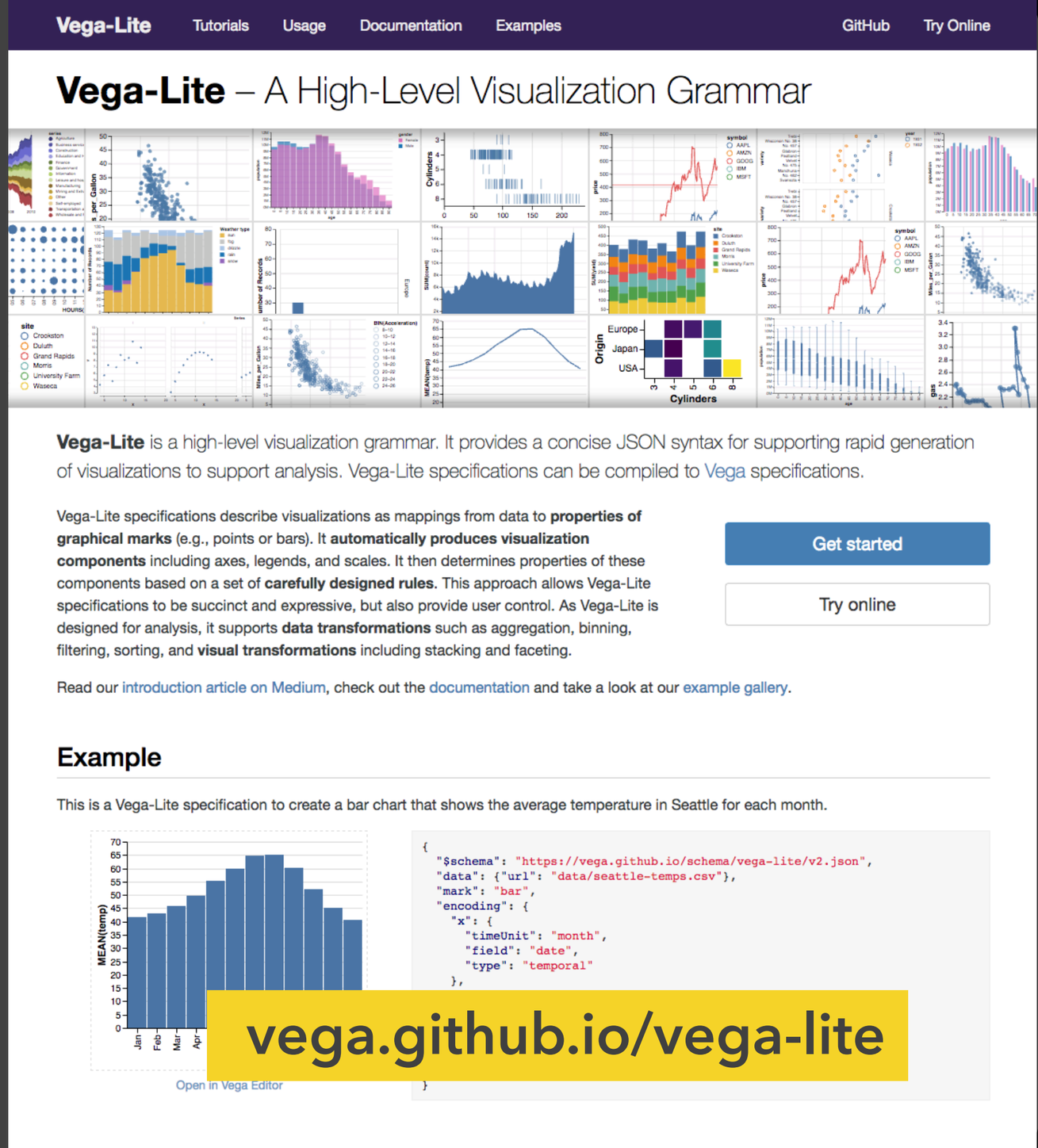



Kanit "Ham" Wongsuphasawat @kanitw
Dominik Moritz @domoritz
Arvind Satyanarayan @arvindsatya1
Jeffrey Heer @jeffrey_heer

Interactive Data Lab @uwdata
University of Washington







vega.github.io/vega-lite