Altair: Interactive Statistical Visualizations for Python

Jacob VanderPlas[1], **Brian E. Granger**[2], **Jeffrey Heer**[1], **Dominik Moritz**[1], **Kanit Wongsuphasawat**[1], **Eitan Lees**[3], **Ilia Timofeev**[4], **Ben Welsh**[5], **and Scott Sievert**[6]

1 University of Washington **2** California Polytechnic State University, San Luis Obispo **3** Florida State University **4** TTS Consulting **5** Los Angeles Times Data Desk **6** University of Wisconsin–Madison

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Software

- Review
- Repository
- Archive

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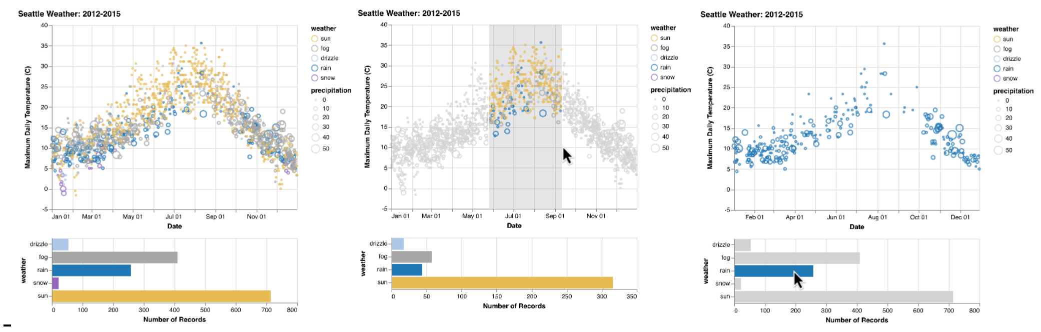
Summary

Altair is a declarative statistical visualization library for Python. Statistical visualization is a constrained subset of data visualization focused on the creation of visualizations that are helpful in statistical modeling. The constrained model of statistical visualization is usually expressed in terms of a visualization grammar (Wilkinson, 2005) that specifies how input data is transformed and mapped to visual properties (position, color, size, etc.).

Altair is based on the Vega-Lite visualization grammar (Satyanarayan, Moritz, Wongsuphasawat, & Heer, 2017), which allows a wide range of statistical visualizations to be expressed using a small number of grammar primitives. Vega-Lite implements a view composition algebra in conjunction with a novel grammar of interactions that allow users to specify interactive charts in an few lines of code. Vega-Lite is declarative; visualizations are specified using JSON data that follows the Vega-Lite JSON schema. As a Python library, Altair provides an API oriented towards scientists and data scientists doing exploratory data analysis (Tukey, 1977). Altair's Python API emits Vega-Lite JSON data, which is then rendered in a user-interface such as the Jupyter Notebook, JupyterLab, or nteract using the Vega-Lite JavaScript library. Vega-Lite JSON is compiled to a full Vega specification (Satyanarayan, Russell, Hoffswell, & Heer, 2016), which is then parsed and executed using a reactive runtime that internally makes use of D3.js (Bostock, Ogievetsky, & Heer, 2011).

The declarative nature of the Vega-Lite visualization grammar (Wilkinson, 2005, Satyanarayan et al. (2017)), and its encoding in a formal JSON schema, provide Altair with a number of benefits. First, much of the Altair Python code and tests are generated from the Vega-Lite JSON schema, ensuring strict conformance with the Vega-Lite specification. Second, the JSON data produced by Altair and consumed by Vega-Lite provides a natural serialization and file format for statistical visualizations. This is leveraged by JupyterLab, which provides built-in rendering of these files. Third, the JSON data provides a clean integration point for non-programming based visualization user-interfaces such as Voyager (Wongsuphasawat et al., 2016,Wongsuphasawat et al. (2017)).

In addition to static documentation, Altair includes a set of Jupyter Notebooks with examples and an interactive tutorial. These notebooks can be read by anyone with only a web-browser through binder.



The example above is an interactive Altair visualization of the weather in Seattle. The plot on the *left* shows the initial state: a scatterplot showing the temperature and dominant weather type between January and December, and a bar chart showing the counts grouped by weather type. The plot in the *middle* shows a brush that the user has drawn to focus on the summers; which are dominantly sunny. In the last plot on the *right*, the user has clicked on the a bar to filter the scatterplot.

These interactions are achieved through two selections: an interval selection on the scatterplot and a multi selection on the bar chart. The selections drive filters in the other plot. The code for this and other examples is in the Altair gallery.

Acknowledgements

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