

# Web-based Visualization with D3

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## 1 Current Visualization Approaches and D3

Visual representation of complex data reveals the motifs and patterns which cannot be easily understood by basic statistical approaches. However, in case of the analysis of real data, the phenomenon of interest usually involves many parameters and a researcher needs many different plots to visualize the diverse aspects of analysis results. In addition, current paradigm of visualization is based on displaying static images on a 2D surface. It might be a computer screen, a wall, a piece of paper, or any kind of material that provides a support for the image.

A solution for displaying complex data visualizations is to make visualization interactive through a computer or a smart device. This gives the user much more flexibility for looking at different aspects of the data with little effort. There are many standalone tools for specific visualization purposes such as Cytoscape and Gephi for network visualization whereas standalone software has some serious limitations for interaction flexibility and sharing the visualizations. Web technologies provide a great deal of opportunity for interactive data visualization and among many JavaScript library alternatives, D3 is well ahead [1]. D3 is a JavaScript library [2] that allows programmers to modify and transform any part of a web page and associate HTML elements with data. This results in interactive and dynamic graphs with a very wide range of layout options through a modern browser.

### 1.1 Visual consistency of D3

Another advantage of using D3 is object constancy. Usually, when you generate a plot with different elements, positions of each object are calculated from scratch using a built-in algorithm. This independent nature of calculations prevents continuity of the graph in response to a change of a parameter in underlying data. This is a counterintuitive approach regarding our cognitive expectations. The visual continuity is achieved through animated transitions. There are examples showing how visual continuity helps the user to easily follow changes in response to a parameter change [3].

A suitable example for displaying the results of calculations of graph element positions without considering visual continuity is a BLOSUM network using specific BLOSUM matrices. Consider the network graphs below in Figure 1, with different BLOSUM matrices of 62% and 45% similarities, respectively.

On the graphs shown in Figure 1, when the matrix parameters change, positions of each node are calculated from the beginning. However, when you generate the initial network with D3 and enable the user to select the new matrix to be displayed, user can easily follow the changes in visualization as animations such as the introduction of new edges and smooth movement of nodes in a force-directed graph. Interactive version of this graph can be found at <http://ahmetrasit.com/blosum/>. User can move the mouse over an amino acid and get a detailed information about its molecular weight, frequency, codons, a brief information and chemical representation of the molecule at the bottom-right corner of the page. The user can also change BLOSUM identity value using the slider on the top-left, change substitution score threshold to change the network structure using the second slider on the top, change node color to represent different chemical properties

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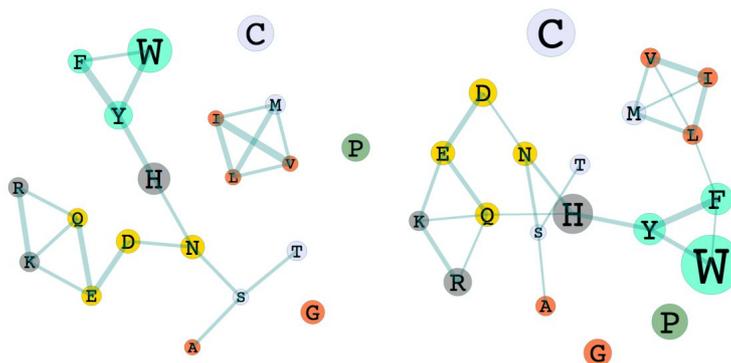


Figure 1: Network representations of BLOSUM62 (left) and BLOSUM45 (right) matrices.

of amino acids (horizontal bars on the center-right side is the color map of selected chemical properties), and lastly, change node size to represent different numerical properties of each amino acid according to the categories listed on the top-right side.

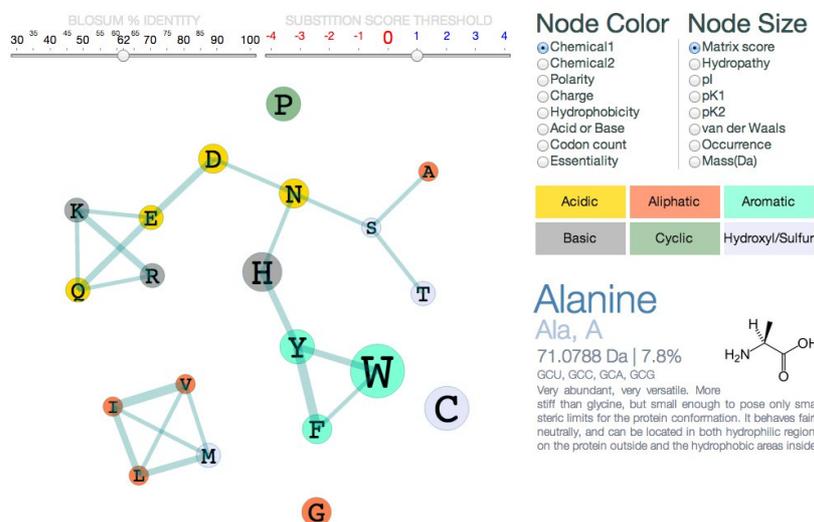


Figure 2: Screenshot of the Interactive BLOSUM Graph GUI available at <http://ahmetrasit.com/blosum/>

## 1.2 Content of the Workshop

In this talk, I will give some examples of how visualization helps us understand the story behind the data and I will demonstrate how to manipulate HTML elements using D3. Finally, I will introduce basic interactive graphs created with D3 and show how to manipulate a single graph layout with different data.

## References

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