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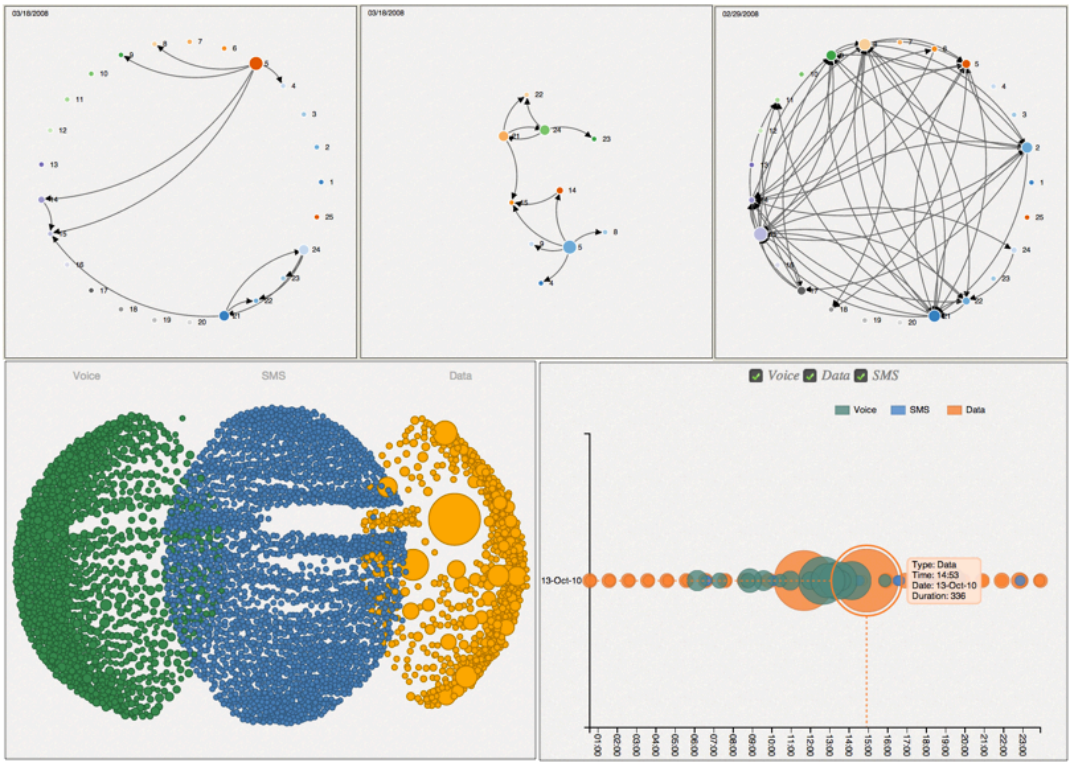
CS Senior Project



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Overview

Purpose

The purpose of this project is to visualize large datasets using:

- HTML
- JavaScript
- JQuery
- D3
- DimpleJS

Datasets

Two datasets are used, both from Crawdad:

1. ctu/personal dataset

Mobile phone records of Czech Ph.D. student Michal Ficek.

2. st_andrews/sassy dataset

Encounter records of a group of participants carrying sensor motes

Visualizations

I have created 3 visualizations:

1. Animated bubble chart for the ctu/personal dataset

This visualization displays all the records in the dataset with some grouping options. The user can group the bubbles by month, type, and direction.

2. Coordinated bubble chart for the ctu/personal dataset

This visualization gives the user a day by day analysis of the records by allowing the user to filter out the data based on the date and the type of data.

3. A network graph for the st_andrews/sassy dataset

This visualization consists of nodes and links that illustrate the architecture of the network. Two Layouts are used: forced directed layout and circular layout. The visualization has an animation feature that allows the user to select a range of dates and a duration for each graph. The respective graphs will then be displayed one by one.

Structure

Organization

I created 3 visualizations. I made sure that each visualization is independent from the others by organizing the associate files for each visualization in a separate folder. Although some visualization might use some shared files, I created separate copies of these files for each visualization. Hence, changes can be done to any visualization without affecting the rest of the visualizations.

File Format

The following file formats are used:

- .html

Hyper Text Markup Language file layouts the webpage and its elements: paragraphs, buttons, checkboxes, etc. It has links to other files .css and .js. It can also have a JavaScript code inclosed in the script tag.

```
<script type="text/javascript">

// JavaScript code

</script>
```

- .js

JavaScript file contains the source code. For some visualizations, the source code is divided into multiple .js files while in others, all the source code is placed within the .html file.

- .css

Cascading Styling Sheet file holds the styling instructions for the elements like: font size and color, position, size, etc. Some of the styling sheets are provided by some developers and are linked in the .html file.

- .csv

Comma Separated Values file hold the data. This file is downloaded for Crawdad website; however, I edited the file by adding more fields and changing the format for some data items.

- .json

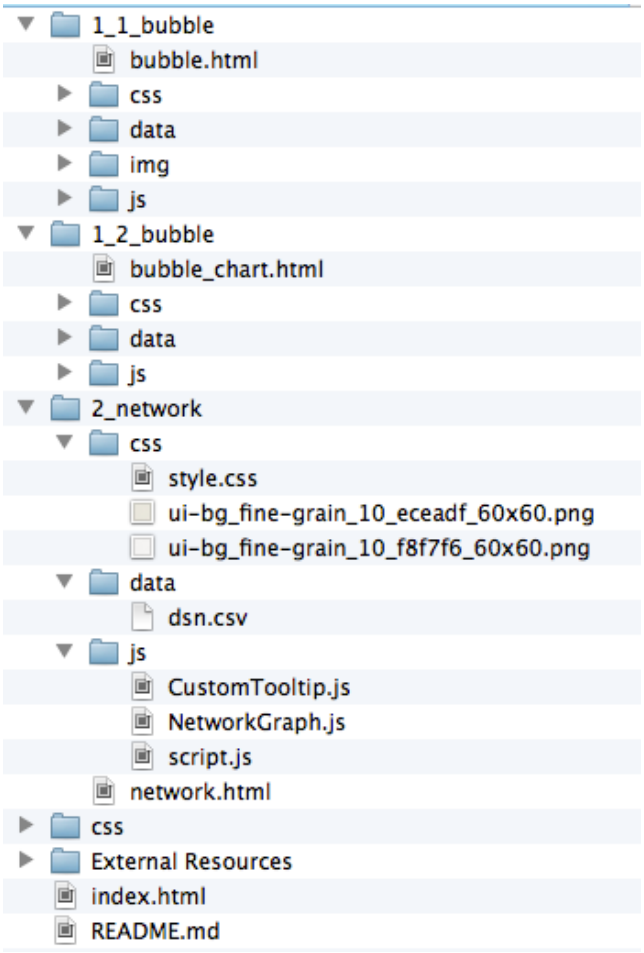
JavaScript Object Notation file also holds data. I used an online tool to convert the .csv file into a .json file because in one of the visualization it was easier to read the data in object notation.

- .png

Portable Network Graphics file is an image file that is used to load a picture to the webpage.

- .md

Markdown file holds README information.



The Structor of the project folder with the network visualization folder expanded

External Sources

As I mentioned above, some of the .css, and .js files are linked in the .html file. These files contains the entire source code of the libraries/packages I used. As these files can be updated, (e.g. I'm currently using the third version of D3), you can replace the link in the .html file to the new version if necessary.

For safety measures—just in case if the website hosting these files is down or if the webpage is no longer available—I included copies of these files in a folder called External Resources. This folder has no affect on the visualizations; you can delete the folder and the visualizations will run the same.

How to Run the Visualizations?

The project is currently hosted online using `github`. Visit the following URL to run the visualizations:

http://lajamilr.github.io/

If you want to edit the visualizations and run them locally on your computer, you will need to host your files. If you have Python installed on your computer, you can use the Terminal/ Command Line as follow:

1. Change the directory to your project directory

Use the `cd` command followed by the path of your project. For example:

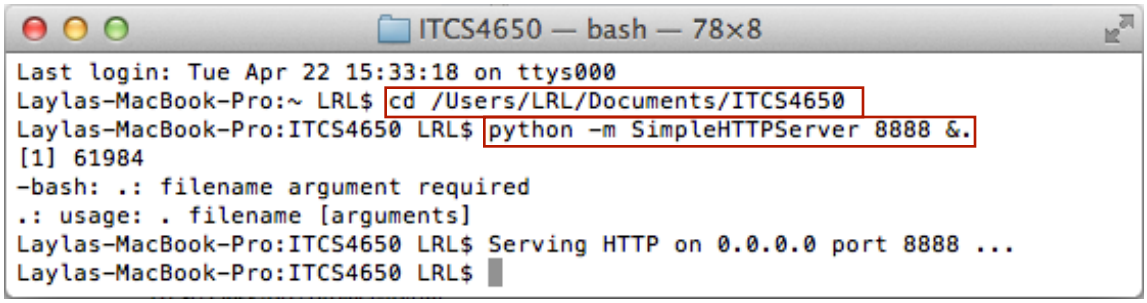
```
cd /Users/LRL/Documents/ITCS4650
```

2. Type the following command

```
python -m SimpleHTTPServer 8888 &.
```

3. Visit the following URL

http://localhost:8888/.



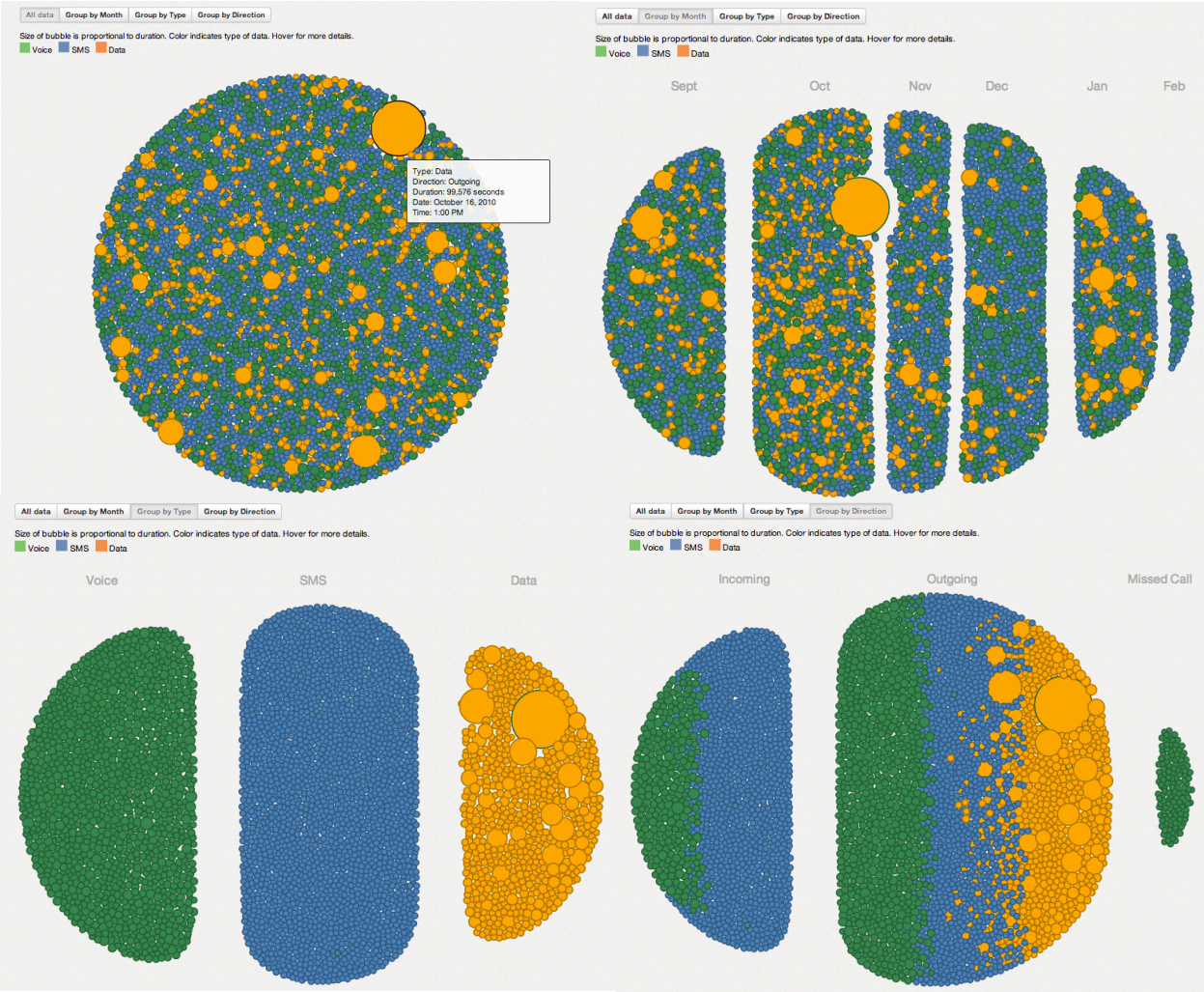
Home Page

Important Files

- `index.html` creates the home page of the project. It basically displays the project information along with links to the visualizations.
- `style.css` has the formatting styles for index.html

Animated Bubble Chart

Overview



This visualization is created following Jim Vallandingham's tutorial for creating an animated bubble chart *(see References)*. The visualization displays all the records of the dataset (more than 4000 records) as bubbles. The visualization provides grouping options; the user can group the data by month, type, and direction. Upon hovering, a tooltip is shown displaying additional information. The visualization features nice organic animations, and smooth transitions that add a lot of visual appeal to the graphic.

Dataset

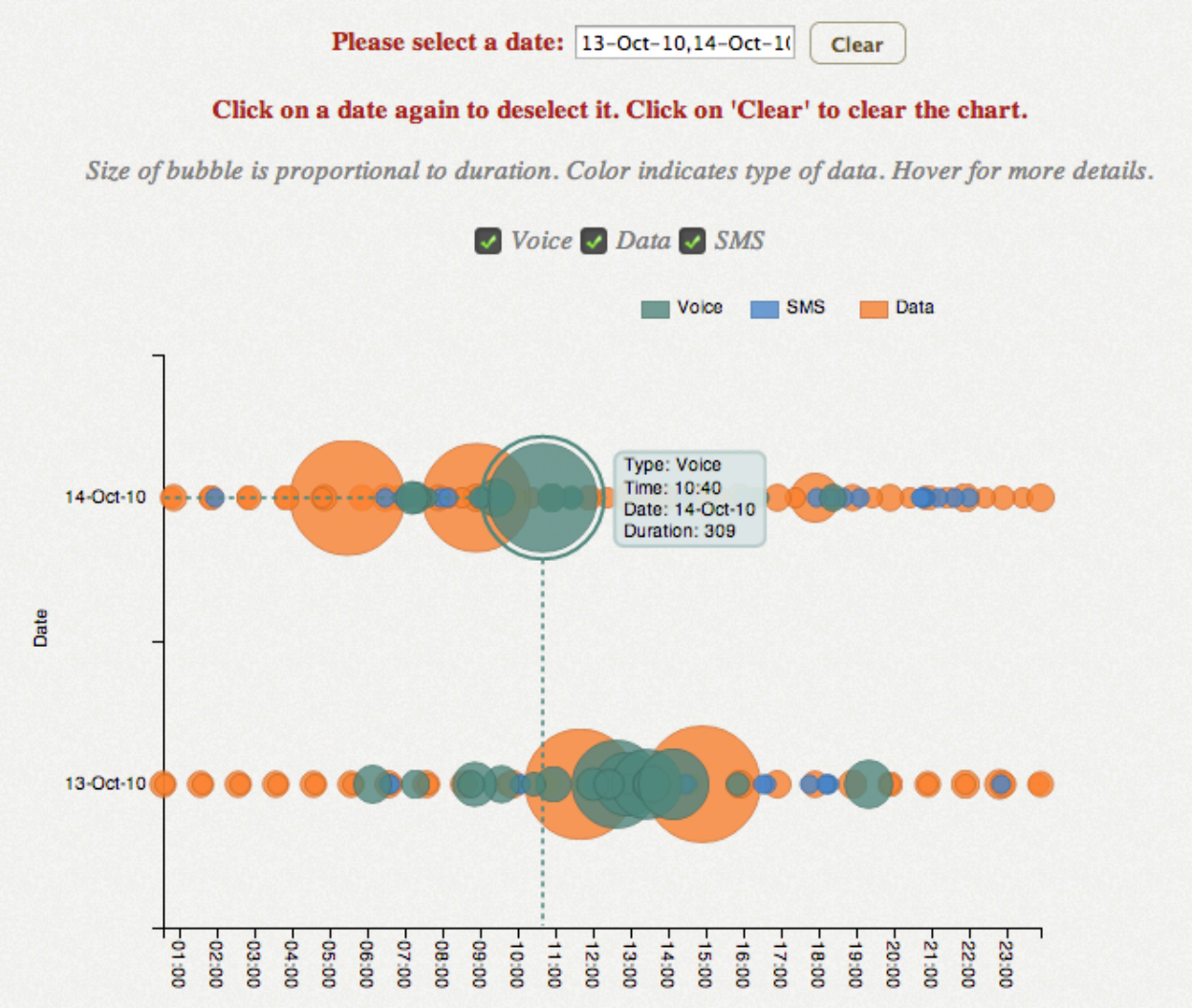
ctu/personal dataset: mobile phone records of Czech Ph.D. student Michal Ficek.

Important Files

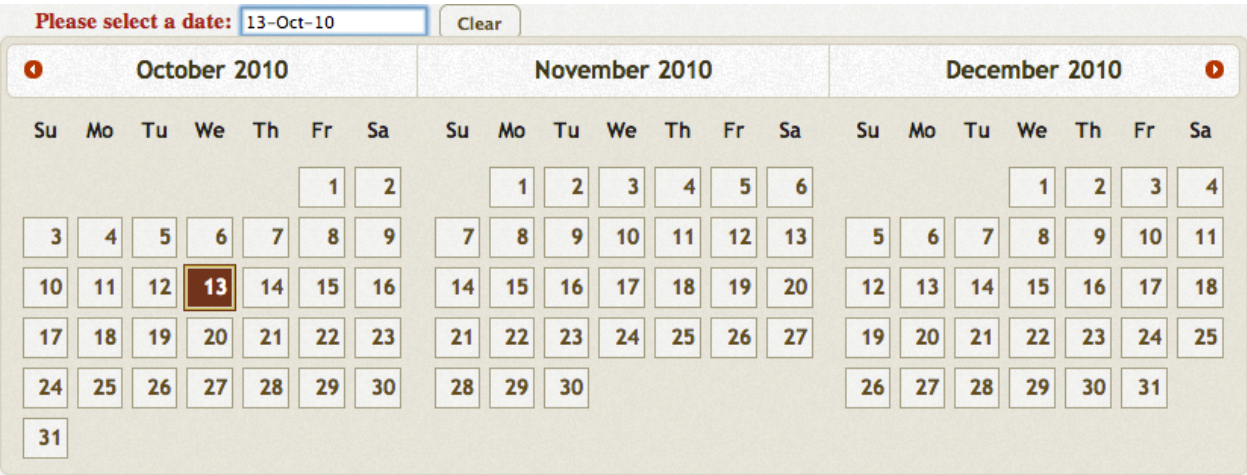
- `bubble.html` creates the layout of the page for the animated bubble chart. It does not contain any JavaScript code (it has links to other scripts).
- `bubblechart.js` reads the data and creates the custom bubble chart by calling the corresponding function form `bubble.js`
- `bubble.js` contains JavaScript source code for creating the animated bubble chart
- `CustomTooltip.js` contains functions that create a custom tooltip. it is provided by Nai Saevang.
- `script.js` has a function that adds commas to large number. It is provided by Nai Saevang.
- `plugins.js` has some functions that set up the window, log history, etc. It is provided by Nai Saevang.
- `bootstran.css` has formatting styles for navigation components like buttons, links, etc.
- `style.css` has the formatting styles for the animated bubble chart

Coordinated Bubble Chart

Overview



This visualization allows the user to filter the data by date and type. It uses a jQuery widget called Multi Dates Picker that enables the user to select multiple dates. The user can select the date again to deselect it. Furthermore, a 'Clear' button is provided that deselect all the dates and clears out the visualization. The visualization also provides 3 checkboxes that filter the data by type: voice, SMS, and data.



Multi Dates Picker View

Dataset

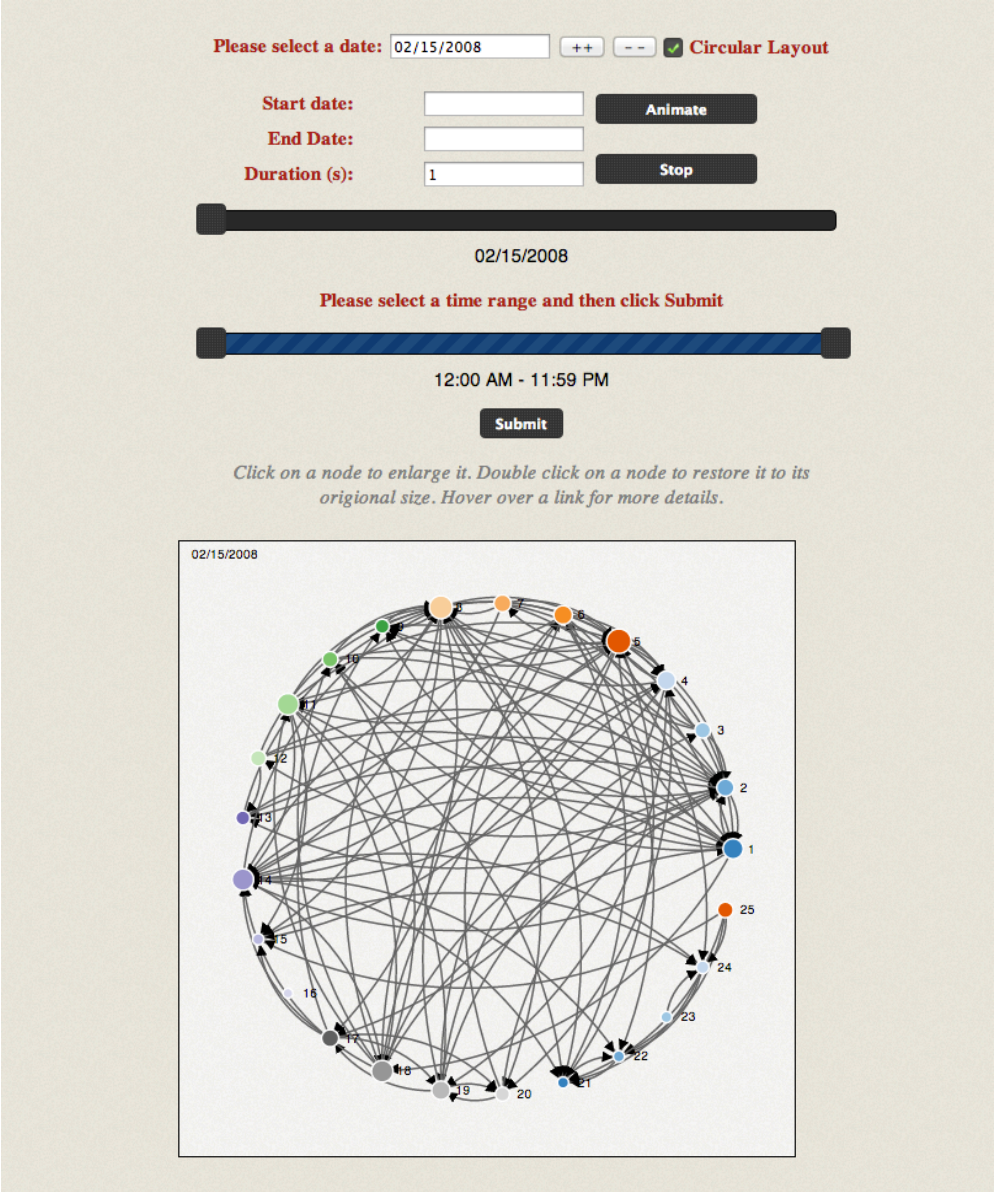
ctu/personal dataset: mobile phone records of Czech Ph.D. student Michal Ficek.

Important Files

- `bubble_chart.html` creates a bubble chart visualization placed on an x and y coordinates representing date and time. This file contains both html elements and JavaScript source code. This visualization uses DimpleJS instead of D3. Dimple is an object-oriented API for business analytics powered by D3. It allows the user to create beautiful visualizations with minimal code.
- `jquery-ui.multidatespicker.js` is the source code for the multi date picket jQuery widget. It is provided by the developers.
- `style.css` has the formatting styles for the bubble chart
- `mdp.css, pepper-ginder-custom.css` have formatting styles for the multi date picker. They are provided by the developers as well.

Network Graph

Overview



This visualization uses nodes and links to illustrate the structure of the network. The user can pick a date via the jQuery date picker widget and the respective nodes and links will be displayed. The visualization provides the user with other options to select a date. The user can update the date by using date slider, or the ++/--, buttons which move the date forward or backward by one day. The user can further filters out the data by specifying a time range through a time slider. The user can also toggles the layout between a circular and forced-directed layout via a checkbox.

Circular Layout

For the circular layout, the nodes are distributed equally on the circumference of a circle with radius of 200. To achieve this, I used the basic trigonometry formulas: `x = r cos(θ); y = r sin(θ)`. However, since D3 uses the upper left corner as the origin (0,0), Some transformation and projections are used to center the circle in the visualization area. To transform the Cartesian coordinates to the upper left corner convention, the x-coordinate is translated one unit upward before it is multiplied by the radius. The y-coordinates is also translated one unit upward, but it is also reflected with respect to the y-axis. Both x and y coordinates are translated 50 pixels to the right so that the circle will be centered in the 400X400 pixel view box. So, the final formulas are as follow:

```
x = (radius * ( cos(θ) + 1) )+ 50;

y = (radius * (-sin(θ) + 1) )+ 50;
```

The angle theta (θ) is incremented by a fixed value of (360°/25 = 14.4°) where 25 is the total number of nodes.

Animation

The visualization supports animation. The user needs to supply a starting date, ending date, and a duration for each graph. A sequence of graphs will be displayed each lasting for few seconds before its replaced by the next one. The visualization also provides a tooltip showing detailed information for both links and nodes.

Dataset

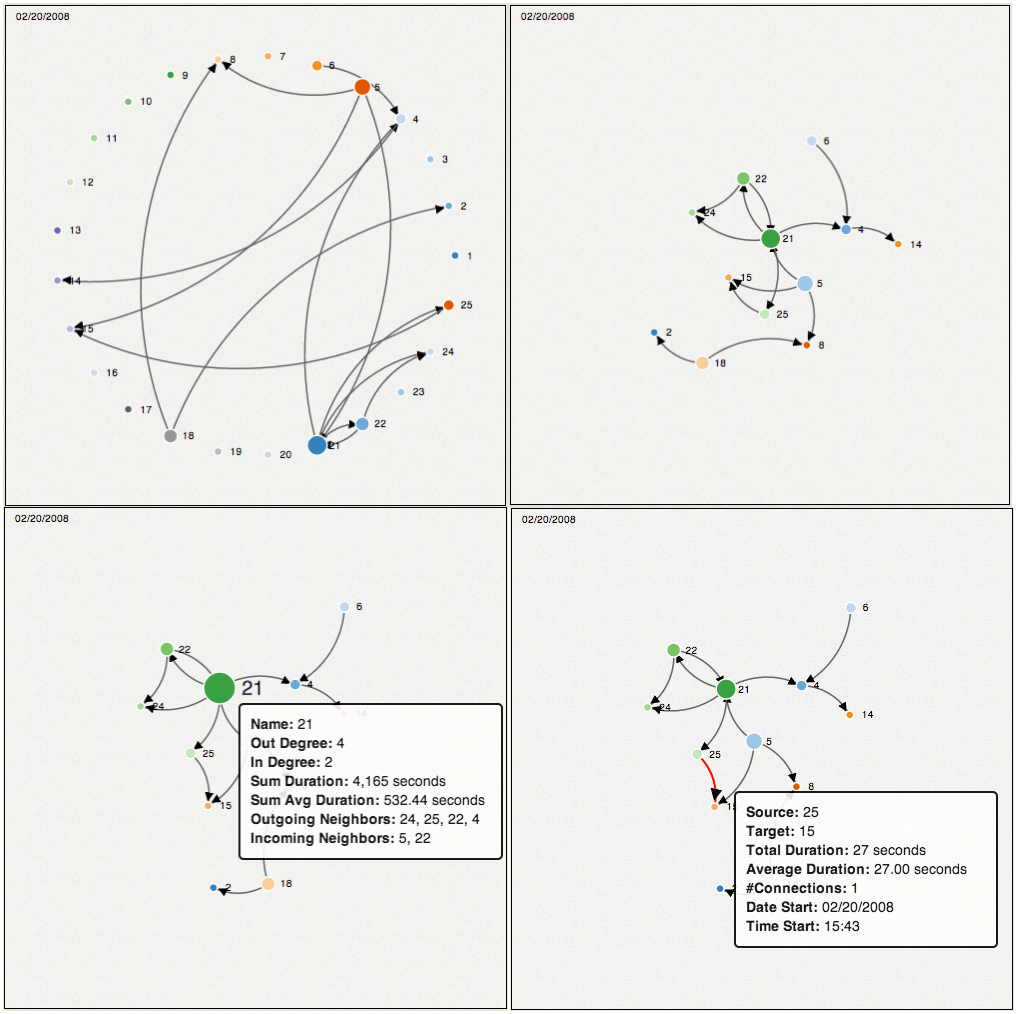
st_andrews/sassy dataset: encounter records of a group of participants carrying sensor motes

Important Files

- `network.html` creates the layout of the page for the network graph. It sets up the jQuery widgets (date picker, date slider, and time slider) and other html elements (text fields, checkboxes, and buttons). The animate feature is imbedded in this file.
- `NetworkGraph.js` contains JavaScript source code for creating the network graph
- `CustomTooltip.js` contains functions that create a custom tooltip. it is provided by Nai Saevang.
- `script.js` has a function that adds commas to large number. It is provided by Nai Saevang.
- `style.css` has the formatting styles for the network graph

Other views

Date Picker View



Different views of the visualization showing circular and forced-directed layout along with the tooltip for the nodes and links.

Acknowledgment

This project is created by **Layla R. Lajami** under the supervision of **Dr. Yu Wang** and his PhD Student **Chao Zhang** at The University of North Carolina at Charlotte.

- If you have any question, please contact me at http://layla-r-lajami.weebly.com/contact-me.html
- Source code can be downloaded from: https://github.com/lajamilr/lajamilr.github.io

References

- Jim Vallandingham's tutorial "Creating Animated Bubble Charts in D3": http://vallandingham.me/bubble_charts_in_d3.html
- Nai Saevang "Unemployment Visualization": https://github.com/naisaevang/unemploymentVis
- DimpleJS "Time Bubble Lines": http://dimplejs.org/advanced_examples_viewer.html?id=advanced_time_axis
- D3noob's blocks "Directional Force Layout Diagram with node colouring": http://bl.ocks.org/d3noob/8043434
- Bootstrap: http://getbootstrap.com/css/
- Sourceforge.net Multi Dates Picker: http://multidatespickr.sourceforge.net/
- jQuery Datepicker Widget: http://api.jqueryui.com/datepicker/
- jQery Slider Widget: http://api.jqueryui.com/slider/
- Marc Neuwirth "Using a jQuery UI Slider to Select a Time Range": http://marcneuwirth.com/blog/2010/02/21/using-a-jquery-ui-slider-to-select-a-time-range/
- Crawdad "The ctu/personal dataset": http://crawdad.cs.dartmouth.edu/ctu/personal/
- Crawdad "The st_andrews/sassy dataset" http://crawdad.cs.dartmouth.edu/st_andrews/sassy/