DC3: Evaluating Student's Grades

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Website: cs page (http://pages.cs.wisc.edu/~spehlmann/cs765/main.html)
Source: github (https://github.com/cramja/cs765-project)

Task Analysis

The purpose of this visualization tool is to help instructors understand overall class performance.

Supported Tasks

Heat Map

Many of the tasks listed on the problem description involved seeing trends in student submissions. Things like, "find student who improves mid-term" or "find a student who does consistently well" are essentially supported by displaying the base data without any aggregation. To this end, I felt that a heatmap suited the task. To track a trend across a single student/assignment, one need only scan across a row/column.

The interactive component to the Heat Map enables the user to try out different sort orders and display different stats. In my experience, I found the instantaneousness of this feature to be hugely helpful in visualizing the data. It allows for quick exploration.

The heatmap includes an `AVG` column for both key attributes. This enables the user to get an idea of how well the student or assignment performed overall.

Chart

I also wanted to support the task of seeing all of a student's data at once. Essentially, this meant seeing a single row in a database. To support this task I added a chart view of the cleaned data. Because seeing data in a static table is of limited use, I also added sorting functionality so that when a user clicks on a table header, the data will sort on that column. This allows the user to see a list of the actual numeric ordering of data. Another bonus, is that they can copy/paste the table into Excel and then do a more complicated analysis.

Limitations

Lack of Correlations

One of the main limitations of this approach was that it does not allow for finding correlations between stats. That is, the heatmap is good at displaying 1 stat well, but, if the user wanted to see the relationship between `numPosts` and `score` , they would have a hard time.

To support this correlations-finding task, a scatter plot or scatter plot matrix could be used. If implemented with the ability to brush and link while highlighting selected rows in the Chart, this would be a powerful tool.

Data Transformation

I used the JSON data to populate the visualization. This required doing some data cleaning and re-arrangement so that it could easily be handled by the visualizations. I place this in the limitations section because, after cleaning, the user has less information than before, however it also allows for visualization so this has a silver lining. I discuss the transforms below in the **Software Design** section.

To-do list

Regretfully, I did not have time to implement all the tasks which I wanted to. In order of importance, and perceived difficulty to implement (scale 1-5, 5 is hardest).

1. Add ability to **sort by average stat** on the heat map. I.E. the behavior would be, user clicks on the `AVG` keyword on the heatmap and then the heatmap sorts the data on that axis based on the average values.
   Goal: This would allow the user to compare between similar performers. *Note: I may implement this in the next day and update my website if that's the case.*
   Difficulty: 2

2. Add ability to **drag and drop** to re-order columns in the heatmap.
   Goal: This would allow precise comparisons. For example, it could support the task of finding a student who (suspiciously) has exactly the same scores of another (though

average sorting would do the same thing, in this case).
Difficulty: 5

3. Add **selection highlights** linked between the Chart and Heatmap. If a user clicks on a square in the heatmap, it should cause the chart to scroll and highlight the corresponding row in the Chart.
   Goal: This would quickly allow the user to find the source tuple associated with the view.
   Difficulty: 2

4. Add **correlations scatterplot matrix**. As discussed above, this would allow the user to compare measures.
   Difficulty: 4

5. Detailed **subview tiles** for the heat map.
   Goal: This would be useful for seeing post (list) data displayed on the heatmap without aggregating.
   Difficulty: 3

Task Reflection

Originally, I tried implementing a box plot view. For each assignment, a box plot of its stats would be displayed. The user would select a student and that student's score would then be highlighted in the box plot. This design was good for a one-all relationship view, but it was harder to track trends this way so I did not go through with this design.

Overall, I felt that the heatmap was the simplest design that hit on the majority of the tasks listed in the description.

Software Design

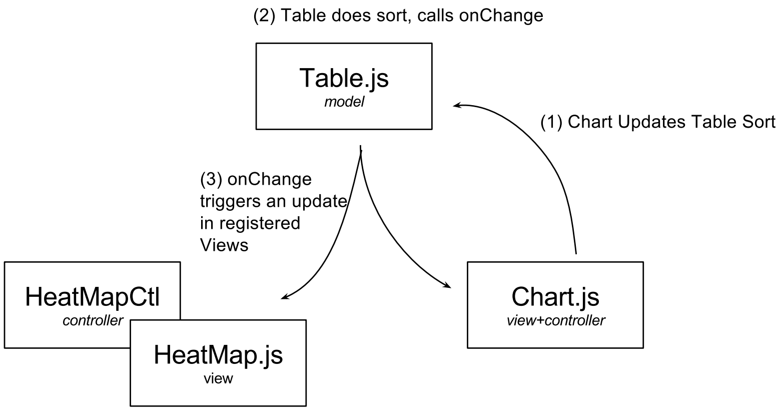
Data Transforms

To make the software design easier, I wanted a single source of data: a single, denormalized table. This adds redundancy, but made it so that I only had to do a join operation at load time.

There were many stats which could easily be extracted from the JSON without transformations. These included `score` and `lateness` . However, to nicely fit the single table structure which I implemented, other stats had to be derived from list attributes. For example, `avgPostLen` is the average length of the posts which a student submitted for an assignment. This had to be coupled with `totalPostLen` to give a complete picture of how many words a student submitted. A limitation here is that we lose information about the individual posts. I added a column to the chart, `posts` , which shows a list of the posts' individual lengths to help remedy this, though it's a primitive form of visualization.

MVC

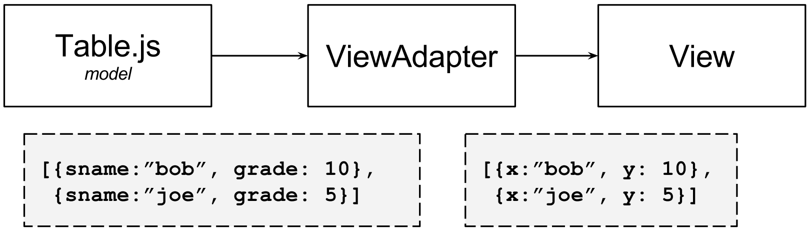
I wanted to support operations where one graphical element applies a transformation to the data, and its update triggers an update in a graphical element which is displaying the same base data. While D3 provides an excellent abstraction for binding/updating data with a single DOM element, it's left up the the user to decide how to do shared data transforms. To this end, I implemented a simple Model-View-Controller scheme. Outlined below is the basic interaction.



The abstraction became fuzzy with the chart because I combined control elements with view elements. I am unsure if it really matters for my purposes, I would need more practice implementing these kinds of frameworks if I were to have a strong opinion between a short, spaghetti-code style implementation versus a verbose but organized MVC style of design.

Reuse

I tried designing my classes in such a way as to be generic. This meant that the View classes expected data to come in a rigid, but generic format. For example the HeatMap expects tuples in a list like `[{x:NumericValue, y:NumericValue, z:NumericValue}, ...]` . This rigidity makes the view adaptable, but also requires another component to marshal the data between the `Model` format to the `View` format. I call this the `ViewAdapter` and I wrote them inside of the files which contained the views.



```
[{sname:”bob”, grade: 10},
 {sname:”joe”, grade: 5}]
```

```
[{x:”bob”, y: 10},
 {x:”joe”, y: 5}]
```

Commentary

It was very easy to get "lost in the weeds" with the implementation details. After understanding D3, I still had to figure out what was the proper way to structure the program. This was actually quite a lot of fun! Though I realize that the time spent on design and implementation was time not spent exploring different visualization possibilities.