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Interactive Curricular Roadmaps

1. Goals

The goal of my project is to create a platform to visualize the different paths that students typically pursue in course 6. I want to build a platform where students can ask questions about what classes they should take, both to "balance" their semester and to find similar themes in advanced classes, all backed by the history of previous course 6 students.

I wanted to design a project in order to give back to the younger generations of Course 6 students. My idea is to provide a new tool that they can use to help themselves make more educated decisions about what they study. I found my transition to Computer Science difficult and hopefully with this tool, students will be able to define a clearer path for themselves.

I would like to first discover what sort of patterns there are in students' course roads and then design a corresponding website to display these discoveries interactively. Part of this discovery will rely on what sort of interesting questions can this data shed light on? I aim to answer questions like: how to balance a semester? what courses should I take my senior year? and hopefully others. Once I have discovered what questions I can meaningful answer, I will design and implement a platform to convey these results in the most effective way. Currently, I think statistical roadmaps and selective filtering could be useful tools to students, but I am very open to all sorts of new designs.

2. Previous Work

Currently three websites aim to help make selecting classes easier for students Course Picker (picker.mit.edu), CourseRoad (courseroad.mit.edu), and HKN Underground GUide (hkn.mit.edu) for course 6 students. Course Picker allows you to select classes and then visually displays them in a calendar format to help students pick classes that do not overlap or find recitation times that fit in their schedule. CourseRoad allows you to create different curricular roadmaps and ensure that you are meeting all of your graduation requirements for any given major and minor configuration. HKN Underground Guide aggregates student surveys and course evaluations to create reports on each course 6 class that include metrics like how many hours a week the class really is, what is "cool" and "uncool" about the class, and recommended prerequisites.

My platform will be slightly different from Course Picker, CourseRoad, and HKN because it has the benefit of accessing historical data to help students decide which classes will be the most beneficial to take and in what order. Additionally, I envision my platform as more of a learning tool where students benefit from how former students have completed their degrees rather than just a planning tool similar to Course Picker or CourseRoad.

I will discuss the full implementation later, but I incorporated a couple packages in my project including Bootstrap and the D3 visualization library. These packages are the foundation

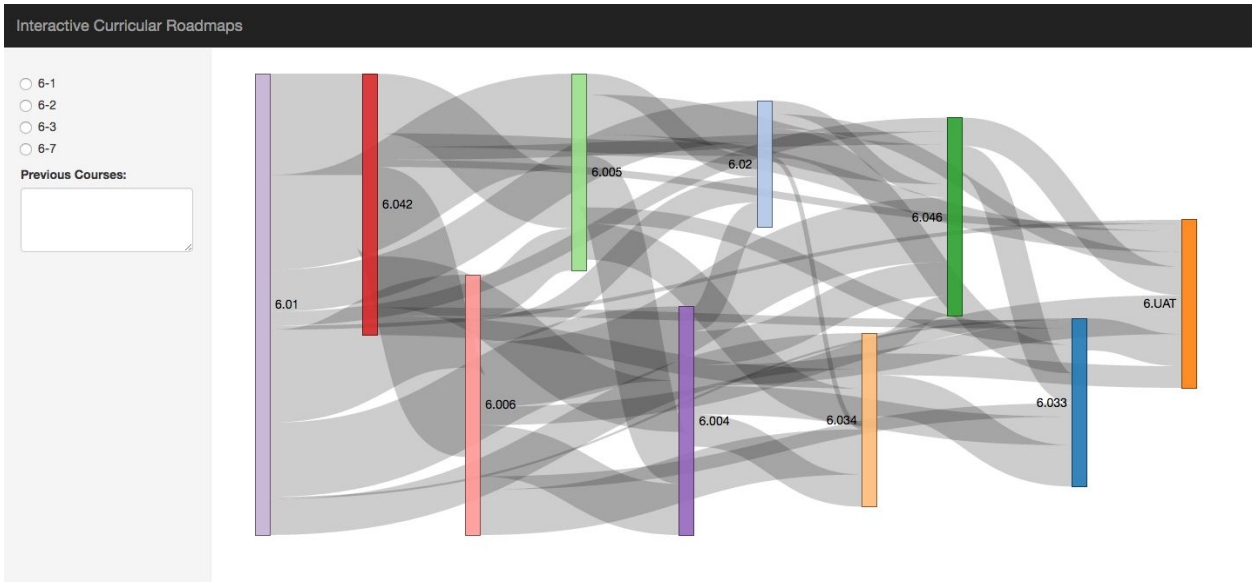
for my front end. In the references section, I cite where I received my inspiration and implementations from.

3. Description

The first step in my project was to clean my data. Professor Terman gave me access to the complete courseroads of all course 6 students. All of the data is anonymized and only provides the curricular roadmap and major (6-1, 6-2, 6-3, etc.). Out of the thousands of students, I did some filtering. I only looked at students who started after Fall of 2008 and if their major was listed as either "6-P3", "6-P2", "6-P1", "6-P7", "6-7", "6-2", "6-3", "6-1". The “P” represents that the student went on the Meng; I merged these groups so that all the students were labeled as either "6-P7", "6-7", "6-2", "6-3", "6-1". My final student count is 1905 students. The next step involved making the the labelling semester useful. Originally, each course number was listed with the absolute corresponding calendar year semester it was taken in e.g. (“6.004”, 20148). I modified all the data so that the course number would map to the sequential semester the class was taken in. For example, I took 6.004 in my Junior Fall or 5th semester, so it would be listed as (“6.004”, 5). This allows me to compare the ordering students take courses in more effectively.

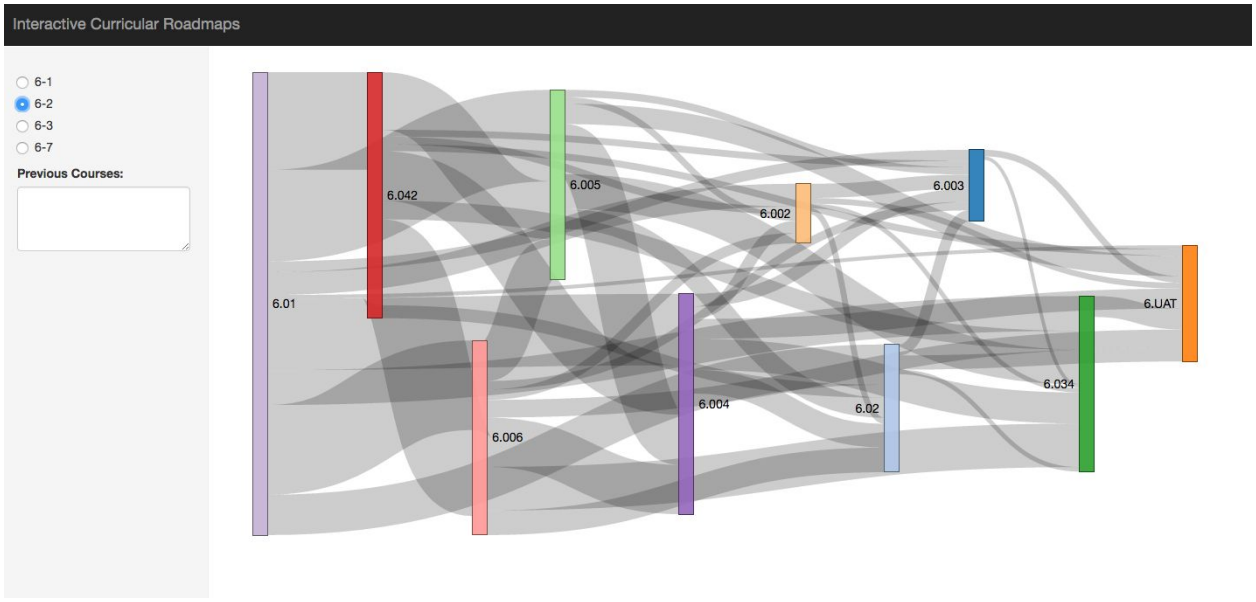
User interface is a rather simple design that includes just a title, a sidebar for limited customization, and the main panel containing a sankey diagram of curricular roadmaps. A sankey diagram display a flow network style of how students go from one class to another. When the page first opens, all of the students are aggregated, and I display a sankey diagram of the 10 most popular course 6 classes for all of the course 6 students.

<u>Displaying all students:</u>

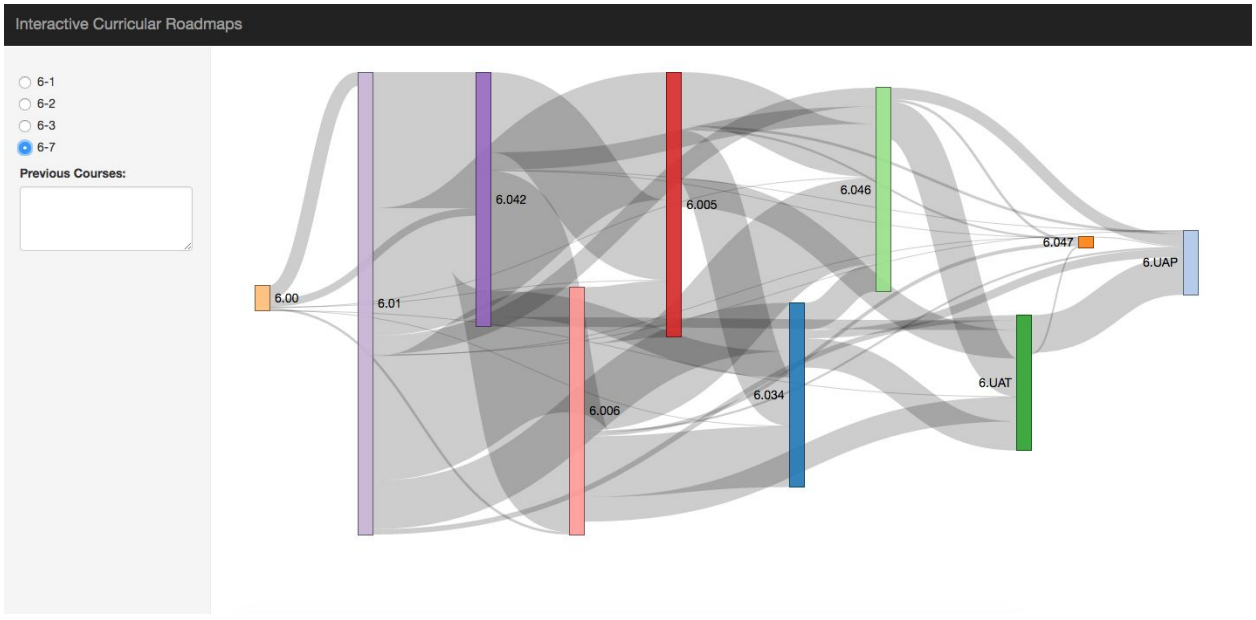


Using the sidebar, users can select certain majors that becomes a filter, so only students majoring in “6-2” are used in the sankey diagram. The goal of this platform is to help students make more educated decisions about what classes they want to take at MIT. Filtering by major and then even specific classes allows for greater customization of the roadmap.

Displaying 6-2 students:

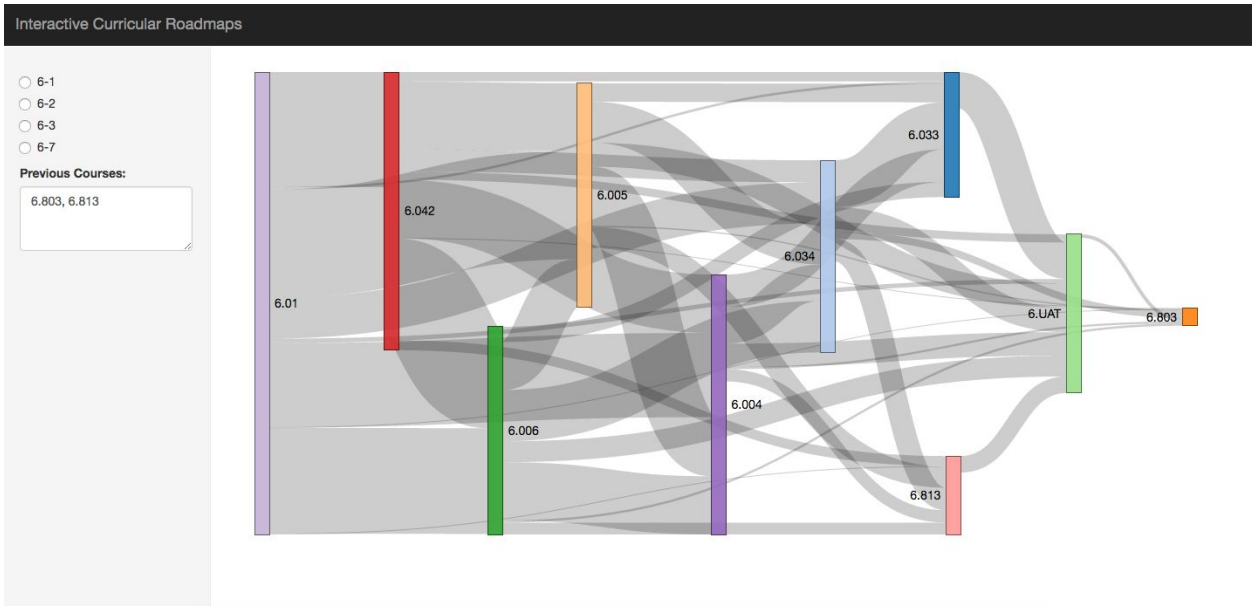


Displaying 6-7 students:

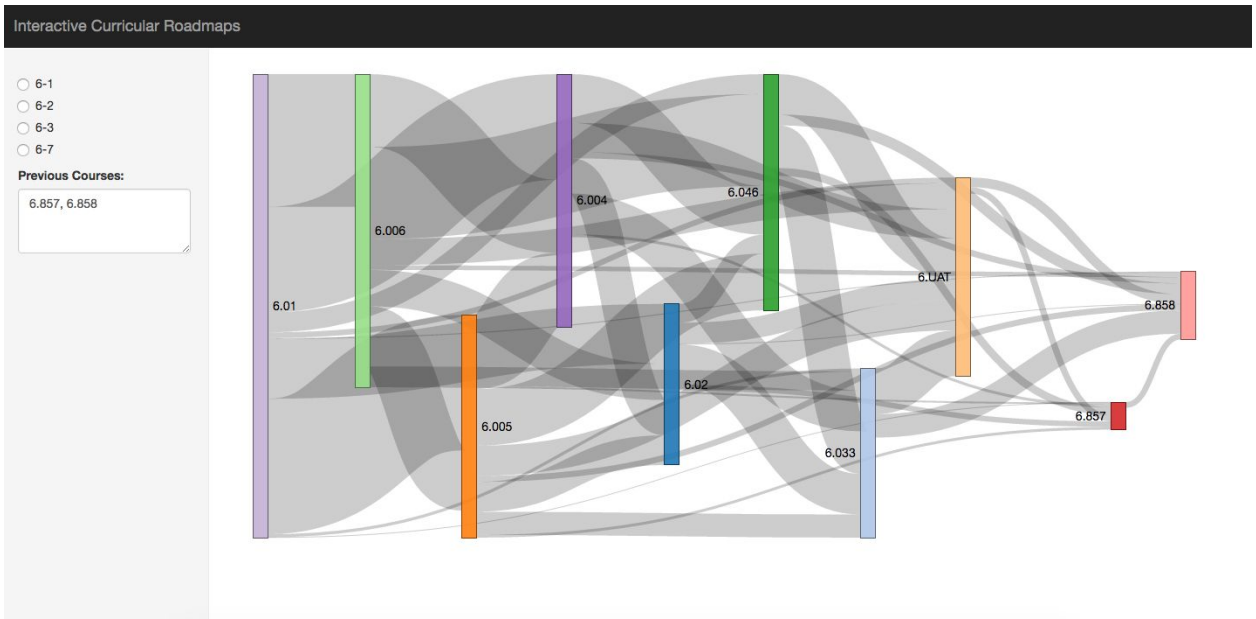


Additionally users can enter any number of courses in the Previous Courses textbox. If courses are entered in here then the user will only view a sankey diagram of students who took those classes. Below I selected 2 examples of how to filter for specific classes. I believe that the most useful classes to filter by are the ones that fewer people take rather than the stated requirements. It is interesting to know that new information can be recognized. For example in the 6.803 and 6.813 sample, 6.813 and 6.033 are both only offered in the spring and following that there was no predominant group of students who did not take the classes simultaneously.

Displaying students who took 6.813 and 6.803:



Displaying students who took 6.857 and 6.858:



My platform is entirely client-side written in JavaScript and using an apache server. To begin I precomputed the mappings required for the sankey diagram in python and then hard coded them into the HTML along with the JS.

4. User Feedback

I wanted to get some feedback from my largest two target groups: freshmen or younger students and older course 6 students trying to specialize their roadmap and education. First I spoke to a freshmen planning on majoring in course 6. She immediately understood that she was looking at a course 6 roadmap and that this is most likely what order people take classes. She noticed how the length of the bars corresponded to the number of students who took that

course; therefore, she could infer which ones were the most common. Additionally, she intuitively understood that the selecting a major from the radio buttons would show her only those students and that by typing courses into the textbox, students were also filtered using those parameters. She believed that this would be very helpful for freshmen because it is extremely easy to interpret “what classes are my friends taking?” which is an important and realistic question most young students ask themselves and each other.

The freshmen also had some suggestions of what could have made the viewing and learning experience better. Students new to course 6 have yet to master all of the different course numbers, so while they are easily understood by upperclassmen, freshmen don’t always remember the difference between 6.004 and 6.005. Along with potentially including the full class name, she thought that it might be helpful to include the number of units for each class because then it eases in planning out one’s own roadmap. Similarly, she wanted to know more about prereqs for specific classes, and her suggestions included listing them as you hovered over the bar or not allowing full flexibility in rearranging the nodes [ie you couldn’t pull one class in front of the other if the latter was a prereq to the first class]. She also thought it would be cool if she could select different paths and export those into a courseroad.mit.edu type platform to view her entire roadmap. Especially because all of the paths become very busy on the screen and it can be difficult to see how one particular flow over an entire course 6 education. Finally, she felt like the diagram was a little chaotic and overwhelming in the beginning and suggested either condensing classes/nodes based on requirements they fulfill and or removing insignificant paths between classes.

Likewise I interviewed a junior in 6-2 who is trying to decide what AUS classes she wants to take next year. She immediately understood the main objective of the sankey diagram and site as a whole. Her first suggestion was that she wanted to be able to add or remove classes from the diagram she was looking at, so that then it could be more tailored to what she wanted rather than just showing the required course 6 classes. She also wanted to know the opposite direction in some cases so including the statistics for that would be helpful in the hover for each node. She did not like or understand the color chosen for each node. She felt that there should be some meaning behind the colors as in all foundation classes are shades of green and headers are blue. Additionally, she would like whatever path way she was looking at to be a different color because sometimes it can be difficult to tell where different paths lead. I think the most interesting insight she had was when she dragged all of the introduction classes to the left so that they were all stacked on top of each other and then she could view the few classes that was trying to decide to take.

5. Conclusions

My project frames a different solution to the age old question of “What classes should I take?” All the resources out there, as helpful as they are, rely on the user to figure out what should be the best option for them. At MIT, we strongly encourage relationships with upperclassmen because they are really the ones who get you through those first two years. I envision this platform as a way to ensure that every freshman or sophomore has access to the “learned wisdom” of upperclassmen. Younger students constantly ask older students for help

deciding which classes and when, so while my project will certainly not, nor does it intend to, replace this relationship, I hope that every student can learn from the paths of those before him.

There are a couple significant flaws in my project that should be resolved. First, the D3 code should be in a separate JS file instead of with the HTML where I can also filter the displayed students after one JSON call. Currently, I precompute the mapping for the sankey diagram and hardcode it into the HTML. However, this not flexible or practical. Second, the sankey diagram implementation is limited in three ways: it can not handle more than 10 nodes or classes, shows classes only immediately after each other in one direction, and runs indefinitely under some filters. Due to the extensive flexibility students have in design their roadmap, it is not enough to just view the classes taken in order. Additionally, it would be very help to view the diagram by semesters. In the second link in my references section, the sankey diagram has groupings. It would be interesting to see what would happen if we grouped by semesters that expanded first and then created pathways. For the last point, the page will not load because the D3 diagram can't fully load. My theory is that for certain filters, the visualization cannot find the proper proportions for the visualization, and therefore never finishes. Finally, due to the small number of classes I can display, the diagram only shows course 6 classes. I think it would be very interesting to see what are the most popular concentrations or passions students have outside of course 6.

Some aesthetic changes that would improve learnability include grouping the node colors to reflect what the represented in the degree requirements, changing what it says when you hover over a node or pathway to something more informative (see notes from freshman interview), spreading the bars out for easier interpretation (now all of the bars are centered on a horizontal middle line), and potentially adding more filtering options or options to export to other roadmap sites like courseroad.mit.edu.

6. References

https://bost.ocks.org/mike/sankey/ - description of sankey diagram and an implmentation that might be the best to use
http://bl.ocks.org/Neilos/584b9a5d44d5fe00f779 - a example of a bidirectional sankey diagram. I think that it would be really interesting to make the roadmap bidirectional because so many course 6 students take classes "out of order" and then the diagram is less limited in general.
http://jsfiddle.net/VividD/CeAZQ/ - the implementation that I used in my project

All of my code is available at https://github.com/aerixxon/curricular-roadmaps