Project Proposal: by Mandy Tam

Fluorescent Antibody Panel Viewer

Background and Motivation.

I work in the field of cell biology for my day job. One important tool in cell biology is fluorescently labeled antibodies, which are routinely used to mark cells of interest and analyzed by flow cytometry and/or fluorescence microscopy. A panel of different fluorescent markers can be combined in a multi-parameter experiment. Designing a multicolor panel takes into lots of considerations: e.g. colors that are available, spectral overlap between the colors, detection limit of the instrument, cross-reactivity of the antibodies etc.. I believe many of these factors can be turned into visualizations, which can help researchers weigh the different factors in order to make a decision. Currently a typical workflow involves browsing through catalogs of antibodies, looking up excitation/emission spectra of fluorochromes, identifying those that work for a particular instrument configuration, and finding an antibody combination that have minimal spectral overlap. Usually, designing a multicolor antibody panel requires going back and forth between numerous charts and catalogs. I believe the decision process can be made more efficient and intuitive with a centralized and visually guided tool. My goal is to prototype such a tool to help streamline antibody panel design.

(I have emailed cs171 staff previously for permission to pursue the project solo. I have decided to do this as I have lots of personal interest in this topic and I would like to have more control on its direction. In practice, I can get actual feedback from the people I work with about my design so I will not be working in a vacuum.)

Project Objectives.

The visualization will help to answer these questions:

- What colors are available for the antibodies I want to use?
- Which antibody has the most/least color choices? (logic: start building the panel by picking a color for the antibody with the least choice)
- When an antibody is added to the panel, how does affect my options for the rest of the panel? (e.g., If I pick a green fluorescence for antibody A, I cannot choose green fluorescence for my other antibodies because they will overlap too much)
- Will my instrument be able to detect this antibody panel?
- How much fluorescence spectral overlap is there between my antibodies?

Benefits: these are questions we need to ask when we build an antibody panel. Currently, the answers of these questions are often scattered. When the number of antibodies in the panel increases, the process gets more and more difficult. That's why I think a tool that answers these questions centrally and visually will help with the decision process.

Data.

Antibody catalog: I have the permission to use the antibody catalog from BD Biosciences for this project. The catalog is only available in the web format so I will have to scrap the data.
http://www.bdbiosciences.com/ecat/Searchresults.do?sf=CATALOG_TYPE%3AAntibodies+-+Single+Color%2FPure&pgNum=1&pgSize=&cs=CATALOG_TYPE%3AAntibodies+-+Single+Color%2FPure&sort=SortOrderDef&key=*&mterms=true&tblView=dTable

Fluorescence spectra: spectra for fluorchromes in the catalog will be pulled out. Data is available in CSV format from: http://www.fluorophores.tugraz.at/substance/

Instrument configuration: I have those in csv format. I will pick one instrument to build the prototype. If time allows, I will add extra instruments.

Data Processing.

The antibody catalog will require web scraping but data is readily available and clean. However I expect substantial data integration.

1) Compute the color code for each antibody. This will be based on the emission spectrum of each antibody. The easier way is to identify the emission maximum and convert it a color in the visual spectrum. This will be good for the overview panels. More accurately, fluorescent emission comes in a spectrum of color and I will attempt to assign a spectrum of color as an optional goal if time allows.

2) Identify spectral overlap. Will have to find a way to quantify how much the different fluorescence spectra overlap.

3) Integrate instrument configuration data to antibody data. Based on the filter configuration, some antibodies will not be possible for us so we will need to integrate that data.

My idea of data organization is to store data in 3 main data lists (arrays) with these basic contents:

1) A list of antibody objects, each antibody object will have name, clone, format (i.e. fluoresecence) etc.. This comes directly from the antibody catalog
2) A list of fluorescence objects, each object will have fluorescence ID, spectrum (comes directly from the spectral data), computed overlap with other fluoresecence (will be used to filter out antibodies that aren't compatible), color code
3) A list of filter objects, each corresponds to an optical filter that lets light through. I will compute how much each filter overlaps with each fluorescence (info will be used to filter antibodies that work/don't work with this filter).

Visualization.

Please see sketch at the end of the document for some visuals.

There will be an overview section that allows users to view the whole catalog and pick out a subset of antibodies they are interested in. I would like to create a visual catalog: have a visual to show all the colors available for each antigen. Users will have the option to filter the catalog by selecting keyword, by "brushing" on the overview grid, and search by name. They can select the antibodies they want to show in the detailed view.

Detailed view section. Will show each selected antibody set in detail, also will have an instrument configuration/spectral viewer

Must-Have Features.

- Color coding overview/detailed view of antibodies
- Filtering by keyword and brushing option
- Spectral viewer with filters
- Interactively "dim" or eliminate the antibodies that are no longer compatible based on our previous choices

Optional Features.

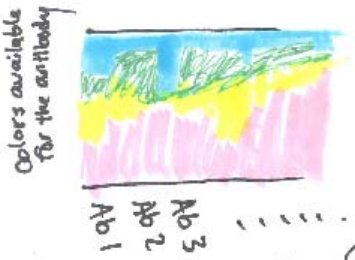
- Organize and allow users to select antibodies by biological significance
- Color code antibodies by color spectrum instead of a solid color
- Additional instrument configuration (given a panel, which instrument works?)

Project Schedule.

- Thursday March 20: Finish HW4, start focusing on project
- Thursday March 27: Data integration, get the color coding to work
- Thursday April 3: Antibody color grid, fluorescence spectrum/instrument config module
- Thursday April 10: (Prototype Due!) Interactive features: filter, brushing
- Thursday April 17: The week to deal with unresolved items and bugs from previous weeks
- Thursday April 24: Final touches: website styling, record screencast
- Thursday May 1: Project Due!

Overview selector

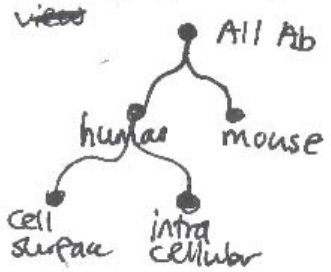
view of the catalog



selection tool:

① entry box [....]
type in Ab name & search

② organize catalog by hierachy (?? maybe?)



→ set up common trees to allow users to narrow down the category & find the antibody

Filter option (common categories)
list keywords that users can select to filter catalog

① by keywords: Human Mouse
Cell surface intracellular
immunology etc.

② brushing on graph

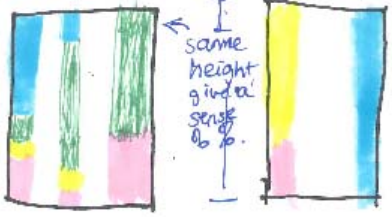
Detail View

Antibody panel

once Abs are selected, the detail view will be activated:

Antibody: CD4 CD44

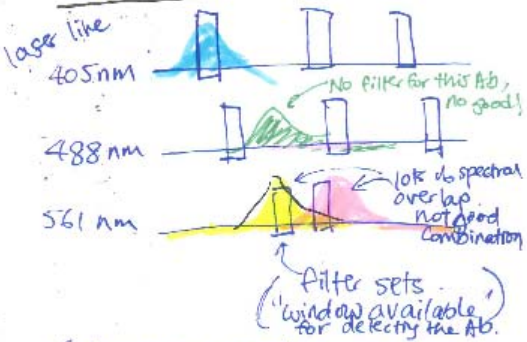
clone: Clone 1, Clone 2, Clone 3 | Clone 1, Clone 2



- What color is available?
- how many choices I have for this Ab?
- e.g. here, lots more choices for CD4 Ab than CD44 Ab.

& all the Ab's users select.

choose Ab, immediately show side by side with instrument configuration viewer



(color code everything according to the visual spectrum)