

<b>Overview</b>	<b>2</b>
<b>Data</b>	<b>3</b>
Sources	3
1) Main Data Source	3
2) Sprites	4
3) Type Advantages / Disadvantages	4
4) Background for Innovative View	5
Preprocessing Pipeline	5
1) Main Data Source	5
2) Sprites	5
3) Type Advantages / Disadvantages	5
<b>Goals and Tasks</b>	<b>6</b>
<b>Visualization</b>	<b>6</b>
Scatterplot (1)	6
Bar Chart (2)	7
Radial Chart (3)	7
Pokemon Stadium / Innovative View (4)	8
Overview of Linking of Views	8
<b>Reflection</b>	<b>10</b>
Changes Made between M1 (Proposal) and M2	10
Changes Made between M2 and M3	11
Remaining Reflection	11
<b>Team Assessment</b>	<b>12</b>
Work Breakdown prior to M3	12
Work Breakdown for M3	12
Write-Up	12
Programming	12

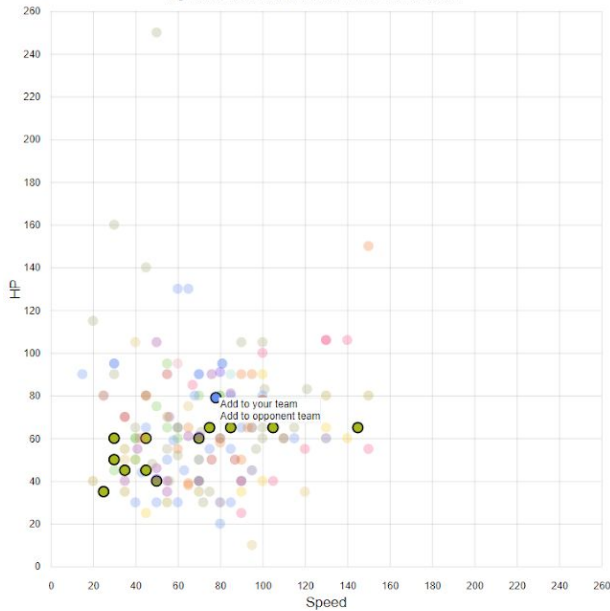
# Overview

## PokeStats: Pokemon Trainer Guide

Stat 1:  Stat 2:  Generation

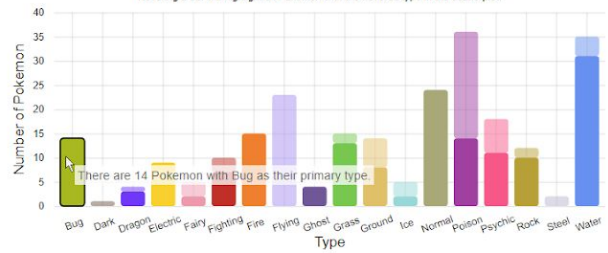
### HP vs. Speed

This scatterplot compares Pokemon from the currently selected generation based on the currently selected stats. Choose which stats to compare and which generation to view using the dropdowns and slider above. Hovering over a Pokemon will highlight other Pokemon with the same primary or secondary type. Left click to select a Pokemon, view its in the radial chart, and follow it as you view different stats. Right click to add a Pokemon to a team in the Pokemon Stadium.



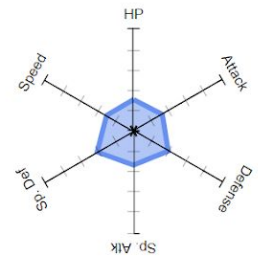
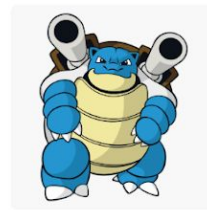
### Number of Pokemon by Type

This bar chart shows the distribution of Pokemon across types for the selected generation. Hovering over a bar will highlight all Pokemon with the hovered type in the scatterplot.



### Blastoise's Stats

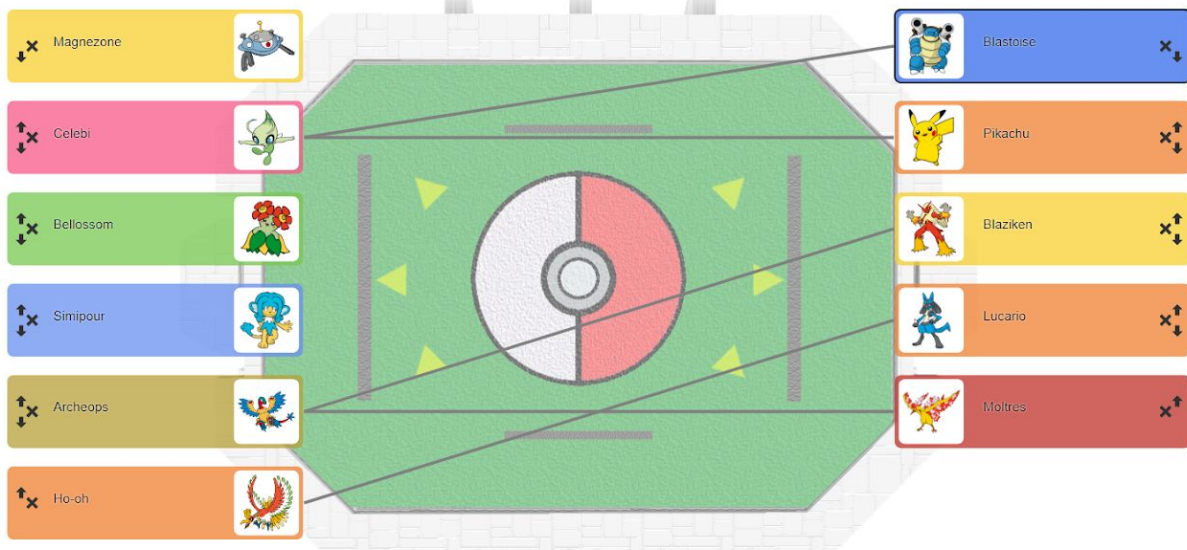
This radial chart breaks down the stats of the currently selected Pokemon. Select a Pokemon by clicking it in the scatterplot or its image in the Pokemon Stadium.



## Pokemon Stadium

Create your own Pokemon teams and see how they match up against your opponents' teams. Add Pokemon to either team using the dropdown and buttons below or by using the context menu in the scatterplot by right clicking a Pokemon. Each line between two Pokemon indicates that the Pokemon on your side is a good matchup against the Pokemon on the opponent's side. Left click a Pokemon's image to select it and its generation.

Pokemon:  Add to:



Pokemon is one of the world's best selling video game franchises. Almost everyone is a Pokemon trainer at some point in their life. In spite of this, outside of fanatics, most fans of the franchise never take the time to explore the relationships between their beloved Pokemons' types, generations, and stats. Furthermore, the few who do end up struggling with it because the game doesn't facilitate the task well, if at all. To address this and give Pokemon fans the chance to see their favourite Pokemon in a different light, we have built a data visualization that allows Pokemon lovers, casual and crazy alike, to visually explore a dataset of Pokemon and their stats.

Our visualization shows the distribution of Pokemon across different stats (user chosen) on a scatterplot and across types on a bar chart, and allows filtering by generation. Users can see the exact stats of a Pokemon on a radial chart and can even simulate battles between 2 teams of 6 Pokemon with our innovative view, which provides recommendations for matchups based on type advantages and total stats. Furthermore, many of the views are linked for easy navigation.

By playing with the visualization, users can answer questions such as:

- Are there 2 stats that can be used to determine the type of a Pokemon?
- Are water type Pokemon generally slower than fire type Pokemon?
- What are the stats of my favourite Pokemon?
- What's the best way to use my Pokemon team to defeat the other team?

## Data

### Sources

#### 1) Main Data Source

<https://www.kaggle.com/abcsds/pokemon> [Pokemon.csv]

This is a table type dataset with 800 items (Pokemon).

Each Pokemon has 13 associated attributes that describe it:

- **#:** ID of the Pokemon
  - categorical, 721 levels
  - not 800 levels because variations of a Pokemon, such as Venasaur and Mega Venasaur, have the same #
- **Name:** Name of the Pokemon (unique)
  - categorical, 800 levels
- **Type 1:** Each Pokemon has a type, which determines its weakness/resistance to attacks
  - categorical, 18 levels
- **Type 2:** Some Pokemon are dual type and have 2
  - categorical, 18 levels
- **Total:** Sum of all stats (general indicator of a Pokemon's strength)

- quantitative, range is [0, 1530]
  - range indicates what is possible, not what Pokemon stat totals actually exist
- **HP:** Hit points, or health, is how much damage the Pokemon can endure before fainting
  - quantitative, range is [0, 255]
- **Attack:** The base modifier for normal attacks (eg. Scratch, Tackle)
  - quantitative, range is [0, 255]
- **Defense:** The base damage resistance against normal attacks
  - quantitative, range is [0, 255]
- **Sp. Atk:** Special attack, the base modifier for special attacks (eg. Fire Blast, Bubble Beam)
  - quantitative, range is [0, 255]
- **Sp. Def:** The base damage resistance against special attacks
  - quantitative, range is [0, 255]
- **Speed:** Determines which Pokemon attacks first each round
  - quantitative, range is [0, 255]
- **Generation:** Which generation the Pokemon belongs to
  - ordinal, 6 levels
- **Legendary:** 'True' if the Pokemon is legendary, else 'False'
  - categorical, 2 levels

## 2) Sprites

<https://www.youtube.com/watch?v=17SjD0eJSks> (download link in description)

We use these sprites to display in our innovative view.

## 3) Type Advantages / Disadvantages

[https://github.com/veekun/pokedex/blob/master/pokedex/data/csv/type\\_efficacy.csv](https://github.com/veekun/pokedex/blob/master/pokedex/data/csv/type_efficacy.csv)  
[type\_efficacy.csv]

This is a table type dataset with 324 items (type matchups).

Each type matchup has 3 attributes:

- **damage\_type\_id:** the type of the attack being used
  - categorical, 18 levels (not including unknown and shadow)
- **target\_type\_id:** the type of the Pokemon being targeted
  - categorical, 18 levels (not including unknown and shadow)
- **damage\_factor:** the percent of regular damage the target takes
  - quantitative, range is [50, 200]
  - taking the regular amount of damage would correspond to a value of 100

<https://github.com/veekun/pokedex/blob/master/pokedex/data/csv/types.csv> [types.csv]

This is a table type dataset with 18 type items (excluding unknown and shadow).

Each type has 4 attributes:

- **id:** unique ID for a type
  - categorical, 18 levels

- **identifier**: name of the type
  - categorical, 18 levels
- **generation\_id**: the generation the type was introduced
  - ordinal, 3 levels
- **damage\_class\_id**: the class of the damage
  - categorical, 2 levels

#### 4) Background for Innovative View

[https://res.cloudinary.com/dmsuvanyj/image/upload/v1478619334/14uanx2\\_zclwui.png?fbclid=IwAR17IU9yFvvq\\_hYPVi15fw7M-bO37QpyCyTY-4EmKHP8fWMIInCY7Xrn0oO8](https://res.cloudinary.com/dmsuvanyj/image/upload/v1478619334/14uanx2_zclwui.png?fbclid=IwAR17IU9yFvvq_hYPVi15fw7M-bO37QpyCyTY-4EmKHP8fWMIInCY7Xrn0oO8)

## Preprocessing Pipeline

### 1) Main Data Source

1. Load the main data source in.
2. Change strings to numbers for numeric properties such as Attack.
3. Change 'True' and 'False' strings to booleans for the Legendary property.
4. Get a list of all the unique types, for use in the bar chart (categories for the x axis).
5. Filter the data by the currently selected generation. This is what gets used by the scatterplot and radial chart. We only allow the selection of generations 1 through 5. The innovative view uses the unfiltered data, as does the radial chart for the special case when a Pokemon is selected from the innovative view.
6. For the selected generations data, calculate how many Pokemon there are of each type. This is the data used by the bar chart visualization.

### 2) Sprites

1. Grab all of the pokemon names from the main data source.
2. Create a regex parser that will take the name as an input and return the filename and path of the sprite image.

### 3) Type Advantages / Disadvantages

1. Load types.csv and type\_efficacy.csv in.
2. Change strings to numbers for all numeric properties.
3. Load data from types.csv into an array.
4. Grab columns id and identifier from types.csv. The id is the foreign key used to find the name of \*\_type\_id in type\_efficacy.csv.
5. Place the type names (identifier column) into an array with id as index for future access.
6. Load data from type\_efficacy.csv into a 2d array
7. Each row from type\_efficacy.csv contains a type\_id pair and the value associated with the type\_id pair.

8. Every possible combination pair of type\_id's has a value. Store the value into the 2d array at [damage\_type\_id][target\_type\_id].

## Goals and Tasks

The goal was to give users an easy to use Pokemon visualization that effectively visualizes the stat information of all of the Pokemon from most of the generations. This visualization allows users to visualize Pokemon in many ways. They can [identify] Pokemon from each generation with the best stats. This allows users to optimize their Pokemon teams in their games. They can [explore] Pokemon data from each of the 5 generations in the scatterplot to [discover] Pokemon with high stats they never knew about before. They might not care just about stats, so they can [compare] Pokemon by their stats and type to decide what they should prioritize. If users aren't sure about what stats they want but know that they are looking for a Pokemon of a specific type, they can [browse] Pokemon of specific types and choose between those.

With the combination of the scatterplot, bar chart, radial chart, and the innovative "Pokemon Stadium" view, users are able to easily and intuitively discover and explore all of the Pokemon from this dataset in an enjoyable manner.

## Visualization

### Scatterplot (1)

To best visualize the Pokemon stat attributes, the scatterplot gives a 'Stat 1' vs. 'Stat 2' comparison, encoding the currently selected stats vertically and horizontally on a common scale. Each point mark on the scatterplot represents a Pokemon. We use a scatterplot since position is the best perceived encoding channel, so showing the stats of the Pokemon using the position channel is the best choice for easy recognition and understanding. Along with position encoding the quantitative stats of Pokemon, the types of the Pokemon are also encoded, using color hue. Some Pokemon have 'Type 1' and 'Type 2' (a primary and secondary type). Hovering over a Pokemon will highlight other Pokemon with the same primary or secondary type and bring up a tooltip with the Pokemon's name, number, and types (if the Pokemon is legendary, that will be indicated as well). Left click to select a Pokemon, view its stats in the radial chart, and follow it as you view different stats. Right click to add a Pokemon to a team in the Pokemon Stadium.

Throughout *all* of the views, the 'Type 1' attribute is encoded using color hue. There are 18 different color hues that encode the different Pokemon types. Although this is a lot of different color hues to encode, we think this is the correct decision. Our rationale for doing so is that users will be familiar with the color hues we use to encode the various types because the color hues we use are similar to those used in the games themselves.

Users can change what stats they visualize by selecting from the 'Stat 1' and 'Stat 2' dropdowns (1a). 'Stat 1' is on the y-axis, while 'Stat 2' is on the x-axis. They can also choose what data is shown by using the 'Generation' slider (1b). The slider controls the data shown in both the scatterplot and bar chart.

## Bar Chart (2)

The stacked bar chart shows the counts of all Pokemon within a specific generation (the currently selected one), broken down by types. The horizontal positions of the bars encodes type and the vertical height of the bars/line marks is the number of Pokemon with the specific type. Some bars will have stacks of 2, and this is because some Pokemon have 2 types. The stacked bar chart allows for both 'Type 1' and 'Type 2' to be visualized. The bottom, more opaque colored bar is the count of Pokemon with the specific type as 'Type 1' and the top, more transparent colored bar is the count of Pokemon with the specific type as 'Type 2'. The rationale for having the stacked bar chart is so all type information from the dataset is encoded, and to have a simple and effective overview of all Pokemon and their types by linking it with the scatterplot.

Users can hover over the bars to highlight them and see the precise number of Pokemon with the specific type (2a) in case there is any confusion in reading the vertical axis. The scatterplot and bar chart are linked to allow users to easily browse for Pokemon of certain types. For example, one use-case scenario is that a user wants to find a fire-type Pokemon that has both high attack and HP. The user could set those stats in the scatterplot, then hover over the fire bars in the bar chart to find the best compromise of both of these stats. Hovering the 'Type 1' bar will highlight Pokemon with fire as 'Type 1' in the scatterplot and hovering the 'Type 2' bar will highlight Pokemon with fire as their second type.

## Radial Chart (3)

The radial chart does not have much interaction but gives the user finer detail for their selected Pokemon. In the radial chart, the 6 quantitative stat attributes are visualized. The radial length encodes the stat value and the total area roughly encodes the total stats of the Pokemon. The radial position encodes which stat is being represented. The sum of the stat attributes gives a general idea of how powerful a Pokemon is, so the total area of the radial chart acts as a way of visualizing this.

If no Pokemon is selected, the radial chart will show the stats of an average Pokemon from the currently selected generation. This allows the user to view the 'power creep' of Pokemon over the generations (Pokemon having more and more total stats) by pressing the 'Play' button next to the generation slider (1b), which will automatically filter through the generations. Selecting a Pokemon in either the scatterplot (1d) or the Pokemon Stadium view (4c) will display the Pokemon in the radial chart. Hovering the radial chart area portion will bring up a tooltip with the exact numbers for each stat and more information.

## Pokemon Stadium / Innovative View (4)

For our innovative view, we wanted an interactive visualization that would recommend the most optimal way for you to utilise your team of Pokemon in battle against your opponent's. At an abstract level, the recommendations are created by taking two sets of data (your Pokemon objects and your opponent's Pokemon objects) and making recommendations based on parameters in each dataset object. Each Pokemon object is represented with a point mark. The color hue of the point encodes the Pokemon type. The horizontal position of the point mark encodes which team the Pokemon is on. The recommendation is represented with a connection line mark joining two points. The recommendation will recommend that the user attack with its Pokemon with the highest stats. If we don't account for type advantages, this would mean the strongest Pokemon will attack all of the opponent's team. However, our recommendation also takes type advantages into consideration. For example, Since water type has a 2x multiplier against fire type, the calculated attack stats being considered would double. This could potentially make a weaker water type Pokemon a better recommendation than a stronger Pokemon without a type advantage against fire types. The interactive components allow a user to add, delete, and reorder each dataset (4b), which allows the user to modify the datasets to obtain the data the user requires. In other words, the user can recreate his/her Pokemon team and the opponent's team exactly. Although the recommendation calculations are not influenced by the order of the datasets, the reason we allowed re-ordering of the datasets is for the user to match their own actual team's ordering in their Pokemon game.

The innovative view is linked to the scatterplot through the scatterplot's context menu, which appears if you right click on a Pokemon's point in the scatterplot. It allows you to add that Pokemon to your team or the opponent's team in the innovative view. This makes it easier for users to assemble teams from Pokemon whose stats they're visualizing in the scatterplot. The innovative view is also linked to the radial chart. If you select a Pokemon's image from the innovative view, the radial chart will display that Pokemon's stats. The rationale is identical to that of linking the scatterplot with the radial chart: this allows a detailed view of the Pokemon's stats and power level. Note that selecting a Pokemon in the innovative view will also change the currently selected generation to the generation of the selected Pokemon. This is to ensure the other views remain consistent in visualizing only the data of the currently selected generation.

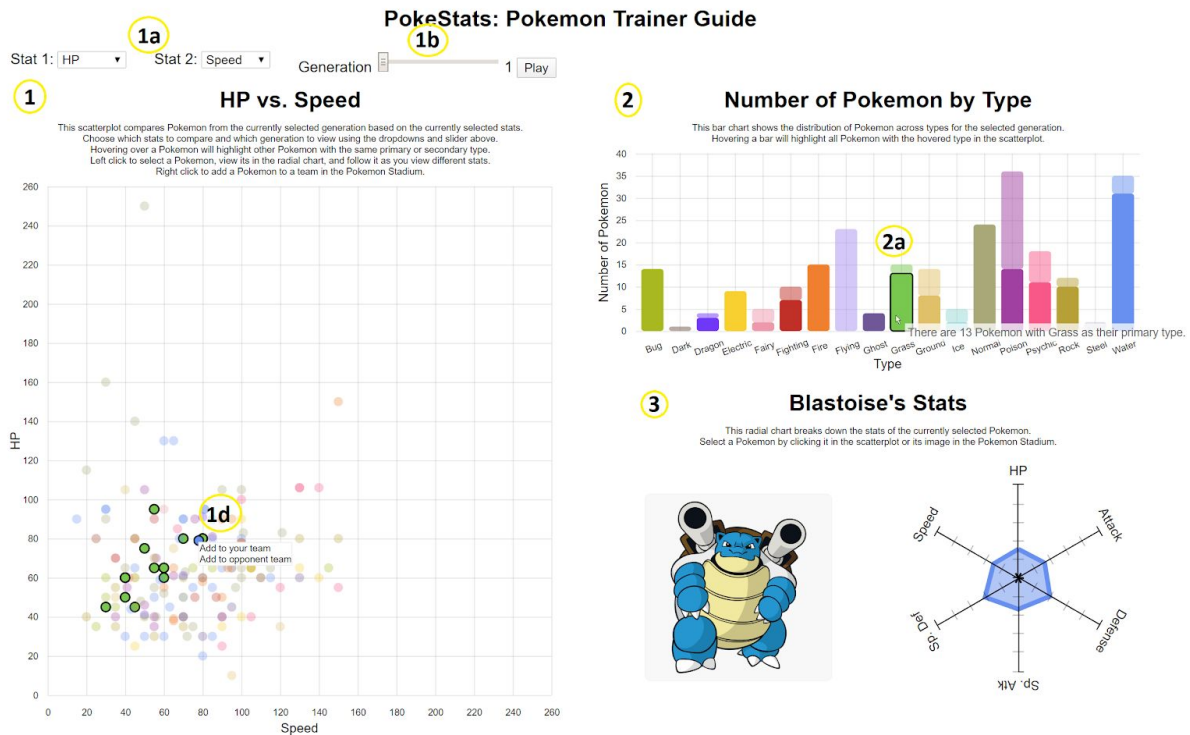
## Overview of Linking of Views

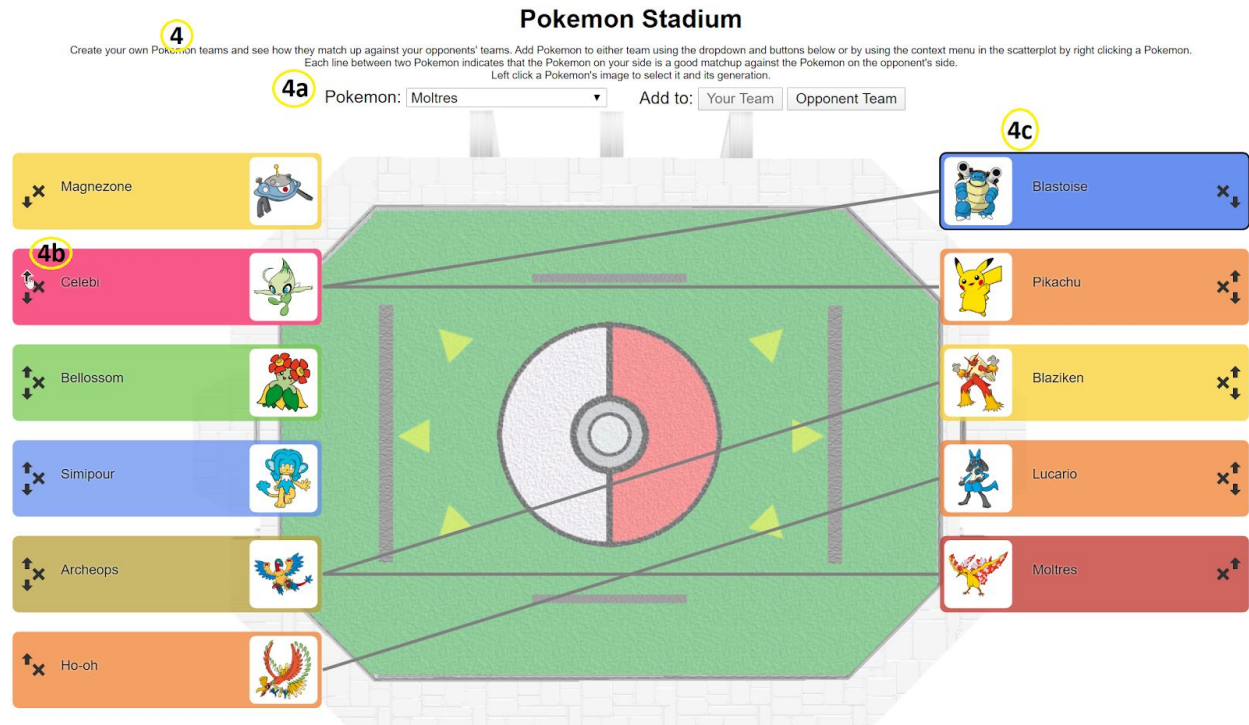
- The stat dropdowns (1a) and generation slider (1b) control the data displayed in the scatterplot and bar chart.
- The scatterplot and bar chart are bidirectionally linked. Highlighting the bars in the bar chart highlights the corresponding points in the scatterplot, and highlighting points in the scatterplot highlights up to 2 bars in the bar chart, depending on if the Pokemon has 1 or 2 types.
- The scatterplot, Pokemon Stadium view, and radial chart are all linked. Selecting a Pokemon in the innovative view will display it in the radial chart and select it in the



scatterplot. If the selected Pokemon belongs to a different generation, the selected generation data will automatically change and then select the Pokemon. Selecting the Pokemon in the scatterplot will only display it in the radial chart, and does not select it in the Pokemon Stadium view since it may not be in any teams, and there may be multiple of the Pokemon.

- Pokemon can be added in the Pokemon Stadium view using the dropdown and buttons (4a) or by right clicking a Pokemon in the scatterplot and using the context menu (1d).





## Reflection

Overall, our project was quite similar to our initial proposal. Most of the differences between the proposal and our final project were done to make the visualization more intuitive.

### Changes Made between M1 (Proposal) and M2

Scatterplot, Bar Chart, and Radial Chart:

- no changes

Innovative View:

- Changed the way a user would search for a specific Pokemon
  - User now uses one searchable (by typing) dropdown menu and selects which Pokemon team to add it to instead of having a blank template with an individual dropdown for each Pokemon
- Omitted the explanation of the matchup between 2 Pokemon
- Omitted the redundant "Fainted" feature
- Added the primary type as a background for the individual Pokemon
- Added the ability to click Pokemon and display stats on radial chart

Overall Layout of Visualization:

- Bar chart and radial chart were made smaller in size and moved to occupy one quadrant together
- The innovative view was made to be the width of the entire page

## Changes Made between M2 and M3

- Add selected Pokemon image next to radial chart (radial chart)
- Hovering over a scatterplot mark now displays both Pokemon with same Primary type and Secondary type (scatterplot)
- Disable “add to team” button if team has 6 (innovative view)
- Allow selecting of entire rectangle (innovative view)
- Make the bar chart a stacked bar chart, showing both primary type and secondary type counts (hover primary -> shows pokemon with that primary type in scatterplot, hover secondary -> shows pokemon with that secondary type in scatterplot) (Modify link between scatterplot and bar chart)
- Select in innovative changes selected generation and selects pokemon in scatterplot (Add link between innovative view and scatterplot)
- Improved descriptions of visualizations to make linking more obvious (Overall layout of visualization)
- Easter egg: 1 pokemon for each member of ELITE 3

## Remaining Reflection

Our visualization goals stayed relatively the same. Most of the visual changes we made were very small iterations and quality of life improvements to better achieve our goals.

Technically, we expanded the scope of our initial project. Initially, the bar chart, scatterplot, and radial chart were planned to be tightly integrated through hovering and clicking. The innovative view felt like a separate thing completely so we added all of the links such as being able to select a Pokemon from the innovative view and it will be displayed on the scatterplot and radial chart.

We knew our scatterplot, bar chart, and radial chart were possible in D3 because we've seen them done in D3 before. The one we weren't completely sure about was our innovative view, but we had a basic idea of how to implement it in D3 for the project. It was much more complex than the other charts but it was possible.

The one idea we did not implement was the tooltip for the innovative view. The original plan was to explain why the match was made but it was a bit complex to implement in terms of programming and the time required did not align with the benefit of having it. It was supposed to display if a type advantage existed (e.g. fire type beats grass type) but we decided that having the type colour of the Pokemon present was a suitable alternative that took much less time.

If we were to do this project again, we would definitely set up the initial charts to be more robust. The majority of our time spent was refactoring the initial charts to support linking between them and supporting the secondary types. It would have saved a lot of time if we were able to add

features easily. However, we were able to overcome this problem and the project was a success.

## Team Assessment

### Work Breakdown prior to M3

For the most part, everyone worked on what they indicated they would in the Work Breakdown from milestone 1. We believe that everyone contributed equally.

For programming, Andrew was responsible for part of the initial data preprocessing as well as the creation and linking of the 'standard' visualizations: scatterplot, bar chart, and radial chart. He also made the stat dropdown menus and generation slider and linked those to the aforementioned visualizations. On the write-up side, Andrew worked on 'Vision changes since proposal', 'Link to original data source', 'Data preprocessing pipeline', and editing/formatting.

For programming, Kevin was responsible for the adding ways to add Pokemon to the innovative view such as the dropdown and scatterplot context menu, most of the innovative view rendering, and the innovative view buttons such as the move up/down and remove. He also linked the innovative view to the radial chart as well, and created the tooltip that is used throughout. For the write-up side, Kevin and Mark worked together on "Rationale for design choices ...", "Does the visualization enable the tasks we set out ...", and adding screenshots of the current prototype.

For programming, Mark was responsible for the backend logic of the innovative view. He created the function for the battle logic (recommendations). He also found the sprite images source, and created the regex parsers and functions that would grab the proper sprite image from the local data. He also pre-processed type\_efficacy.csv and types.csv. He also created the function that formatted the name from the main dataset to the display name. See above for the write-up contributions.

### Work Breakdown for M3

#### Write-Up

Andrew worked on the 'Overview' and 'Data' sections.

Kevin worked on the 'Goals and Tasks' and 'Visualization' sections.

Mark worked on the 'Reflection' section.

We all contributed to the 'Team Assessment' section as well as editing and formatting.

#### Programming

Kevin & Mark did all the additional coding.

#### Kevin's Changes:

Previously, the Pokemon Stadium view was only linked to the radial chart. To further integrate the views together, selecting a Pokemon in the Pokemon Stadium view now changes the filtered data to the selected Pokemon's generation, and then selects the Pokemon in the scatterplot. Note that this will also change the bar chart view, as it will visualize the newly selected generation. Now, deselecting a Pokemon anywhere should deselect it from all views. Overall there can only be one selected Pokemon in the entire visualization. Also, now when the teams are full in the Pokemon Stadium, the buttons will be disabled so users aren't misled. Furthermore, the UI for the Pokemon Stadium was improved by allowing for the selection of a Pokemon by selecting anywhere on its point mark, rather than just the image. Kevin also added the easter egg (see if you can find it).

#### Mark's Changes:

After M2 was completed, there were a few things missing from our visualization. Our scatterplot and bar chart only displayed the primary type of the Pokemon and ignored the secondary type. It was also a little inconvenient to visually see which Pokemon was selected.

Mark added support for visualizing the secondary type (previously, only the primary type was visualized) by making the bar chart a stacked bar chart. By stacking the number of Pokemon with that type as their secondary type on top of the primary type bar, we are able to see the total number of Pokemon of that type. Hovering over a secondary type bar in the chart will highlight every Pokemon with that secondary type in the scatterplot.

Mark linked the updated bar chart with the scatterplot. When hovering over the scatterplot, both the primary type bar and the secondary type bar (if applicable) will highlight. In addition to the Pokemon in the scatterplot with the same primary type being highlighted, the Pokemon with the same secondary type are also highlighted now.

Mark added an image beside the radial chart to make it easier to visually identify which Pokemon was selected. Previously, the selected Pokemon was indicated by the radial chart's title and the highlighted scatterplot point which may not be visually explicit enough to make the selected Pokemon clear.

Andrew acted as QA (quality assurance) and updated documentation. Namely, he updated the descriptions accompanying the various visualizations to make the linking more obvious to users.