Visualization of Flight Connections

The airports data was combined together from two separate sources:
https://datahub.io/core/airport-codes
https://datahub.io/core/country-list

The purpose of the application is to provide a visualization tool that allows pandemic experts to analyze flights among airports, countries and groups of countries, including number of flights, direction and origins and destinations. The two views are Flight map and Node Trix.

Shared Interactivity

Uploading data

When the page is visited the first time, it will show a very limited amount of flight data from 1st of January, 2019. This allows the user to try out the app without using their own data. The user can use their own data from: https://zenodo.org/record/4737390#.ZFq2uXZByUm

Adding and deleting window

The state of the windows are completely separated. One can show flights from January, while the other shows flights from February. Their dates can be filtered separately, they can show different groups or countries, directions, path distances, views, etc. When adding a window, it will copy the settings of the previous one. So if any time the user wants to sync the second window with the first one, they can always just delete it and add a new one that copies over the settings of the first window. Technically adding more than two windows is supported, but not recommended except on very large screens as it leaves less room for each visualization.

Switching orientation of windows

The windows can either be next to each other (vertical orientation) or under (horizontal orientation).

Active window

There is always an active window. The user can select an active window by clicking on it (the first window is selected by default). The settings in the user interface will reflect the settings of the active window.

Toggling user interface

The user can close and open the user interface to have more space for the visualization after setting the parameters.

Date picker

The user can select a date range, and it will filter to flights that happened under the selected period.

Collections and the active items selector

The application uses two collections. By clicking on the Add/Remove button between the collections in the standard UI, a more comprehensive interface (compared to the immediate, limited one) will show up for working with the collections. The active items selector component is a dropdown menu where multiple countries can be selected at once. The user can add (or replace) countries or groups of countries to both collections with it. They can be added either separately (as countries) or as a group. The selector contains default groups (countries in continents), but the user can create their own groups by selecting countries, providing a group name and adding them as an active group to one of the collections. After that the user can see in the selector group options their own group and their countries. These option groups can be deleted, collapsed, or by clicking on their name, the countries associated with the group can all be added to the dropdown selection at once.
In the collections themselves the user can see active countries and groups (by switching between Countries and Groups in the collection header). Countries that are in a group (in either of the collections) will be shown as turquoise, and their group name will be visible. The countries and groups can be deleted from the collections one by one. Alternatively, all countries can be deleted at the same time by emptying the active items selector and replacing the countries in the collection.
The visualizations by default will consider flights that had an origin in one collection and a destination from the other. If a country is not in either of the groups, it will not be shown and its flights will not be considered in any calculations.

Direction

The user can also change the direction. If it is directed from the first collection to the second collection, it will only consider flights that have an origin country from the first collection, and a destination in the second one. It is the same the other way around. The default option is that it is directed both ways. When directed in only one direction, it also enables the path distance setting.

Setting path distance

If the direction is only one way between the collections, the user can set a path distance. It is particularly useful if there is only one country in one of the collections, and more in the other one. With path distance zero, it will draw in the direct edges, but if the user increases the distance, it will also draw in nodes and edges that are a part of a path to that one country with the set distance amount of nodes between at most.

Coloring edges based on number of flights

The user can set two numbers that influence how the edges are colored. If the number of flights between two nodes is more than the higher number, it will show the edge as red. If it is between the two numbers, or equal to one of them, it will show the edge as yellow. If it is less than the lower number, it will show the edge as blue. This makes three categories: red for danger, yellow for warning, blue for safe (in case of a pandemic research at least). The numbers automatically change place so the higher number is always at the top. It also increases the top number by one if they are equal, so they cannot be the same.

Toggle between airports and countries

It is possible to toggle between airports and countries. It will show the nodes as either airports or countries (when airports are selected it will be more clustered naturally, as there are a lot more airports). It is worth mentioning that in the Flight map, airports will not connect to a group node, but they will still be colored differently if they are in a group (turquoise instead of pink). See Flight map > Groups.

Views

The user can select between two views: NodeTrix and Flight map.

Highlighting between views

By clicking on the label of the pins in the Flight map, they will get highlighted. When opening the active items selector, these highlighted items will automatically be selected. It works the other way around too: By selecting countries in the selector, it will show the pin labels as highlighted if they are displayed (The label will have an under and overline). These highlighted nodes will be highlighted (shown in magenta) in the NodeTrix as well.

Flight map

Camera

The user can select between two camera views: Roam and Orbit.

The Orbit camera is the default camera, which allows easy and fast exploring. The user can click and drag to move the camera around the visualization, and using the mouse wheel they can adjust the zoom level.
The Roam camera will enable a first person view which allows the user to navigate in the visualization more freely to see the visualization from any point of view. Using WASD for moving forward, backward, left and right respectively, Space to move up, C to move down, and holding Shift makes the movement faster.

Note: There is a bug when toggling between the camera views. It will cause errors if it is done more than one time.

Groups

When there are active groups and the pins are by countries (and not airports), a group node will appear above the pins, and all of the pins under the group will connect to the group node only (the color of the edge is based on the sum of their flight numbers with the countries outside the group). The outside countries and groups will have connections only with the group node and not their countries directly (again, correctly summed for the sake of edge colors). This allows a less clustered visualization. Both the group nodes and their pins are turquoise instead of the default pink, making it easier to differentiate between pins in a group and individual ones. If the pins are by airports, they will still be colored, indicating they are in a group, but there will not be a group node.

Edges under groups

These edges show how the outside edges connected to the group node are distributed between the group and their countries. The user can choose between hiding and showing edges between countries and their groups. For example, if a group called SwNo consists of Sweden and Norway, it is possible to hide the edges between the countries and their group node, but other edges of the group node will still be visible.

NodeTrix

Opening NodeTrix

The user can change their view to view the NodeTrix implementation by clicking the NodeTrix radio button.

It is also possible to view it in a new window by first adding a new window, selecting it as active and then clicking NodeTrix. Now the user can view both visualizations at once.

Adding groups

If there are no groups made by the user yet then there will only be one matrix.

Users need to add groups through the Add/remove button, see (Collections and the active items selector). The only way to split off groups from the starting matrix is to add countries to the collection as groups. If the countries are added separately then they are added to the matrices, and not split off into an own group. Then the groups added in the first collection will be in blue and the groups in the second collection will be red.

The way to read the matrices is that the rows represent the origins and the columns represent the destinations.

Interactivity

The user can click each individual cell in the matrix to get more information about how many connections there are between the source and the target. It is also possible to click edges between the matrices however this can be a bit hard when the edges overlap.

The user can also click the “Change edge sides” in the top left to change where the edges between groups can come out of, it goes from bottom->left->top->right and bottom again. It will change what side the edges come out from in all the matrices.

The user can also drag the matrices around the view by clicking and dragging.

Run the app
Preferred IDE: Visual studio Code

- Download and setup Node.js.
- Open terminal at root folder in IDE.
- Write in the terminal: npm i
- Write in the terminal: npm start

Alternatively:
Visit https://flights-1f2a3.web.app/