# Installation

[](https://visualstudio.microsoft.com/thank-you-downloading-visual-studio/?sku=Community&rel=16)The first step in installing VisCanvas is installing Visual Studio. The current version of Visual Studio being used to develop and run VisCanvas is Visual Studio 2019. You can install Visual Studio 2019 by clicking on the image or link below,

[Click Here!](https://visualstudio.microsoft.com/thank-you-downloading-visual-studio/?sku=Community&rel=16)

The next step is to install the correct packages needed to run and edit VisCanvas. After downloading and running the VisualStudio.exe you will be greeted by the Visual Studio Installer,

Graphical user interface, application

Description automatically generated

From here you will want to click ‘Install’. This will bring you to another page where you can install different workloads and customize what specific build tools you need for your project.

Graphical user interface, text, application

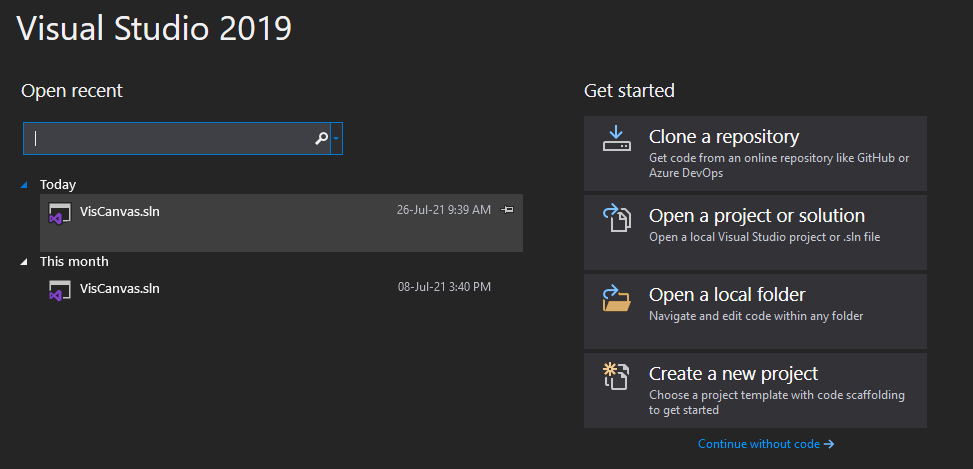
Description automatically generated

From here, select ‘Individual components’ and scroll down to find “C++/CLI support for v142 build tools (14.27). Make sure it is selected and then click ‘Install’ on the bottom right.

After Visual Studio is finished installing, follow the link below and clone the VisCanvas Repository to your machine.

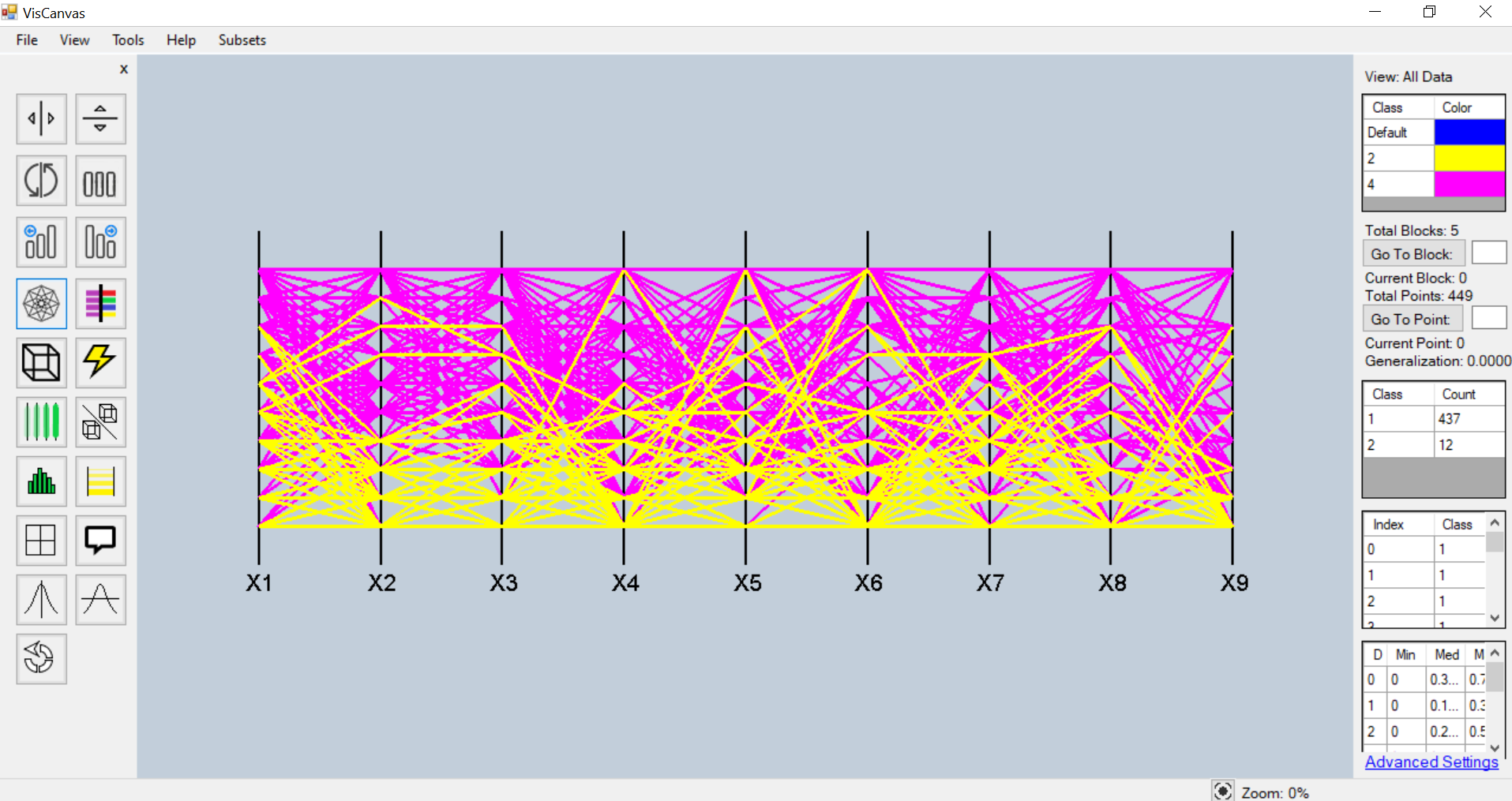
[VisCanvas Repository](https://github.com/SamShissler/VisCanvas2.0)

After cloning the repository, open Launch Visual Studio and you will be greeted with this screen,



Click ‘Open a project or solution’ And navigate to the cloned repository. Inside of the VisCanvas folder you will find a file called “VisCanvas.sln”. Select this file and click ‘Open’. Now your setup is complete!

# Overview



The VisCanvas UI has 5 main areas. The first of which is the menu bar at the top of the screen. The next two are the toolbars on the left and right side of the screens. There is also a small bar at the bottom of the screen that allows for zoom functionality. The main area is the data visualization itself in the center of the screen. The following sections describe these areas in more detail.

# Menu Bar

Graphical user interface

Description automatically generated

The first drop-down menu in the menu bar is the file menu. This has five options open, save, edit data, options, and exit. The *open* option opens a file explorer window where the user can select a .csv file to load into the software for visualization. The *save* option also opens a file explorer window where the user can select a destination and name the save file. The save file stores all of the data alongside any hypercubes or hyper-blocks that were made by the user. The *edit data* option allows the user to open a csv file and edit its values.

Graphical user interface, application

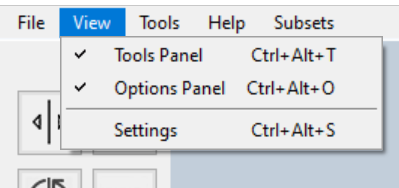
Description automatically generated

The options option opens an options window where the user can change various settings. There is a tab for hyperblock settings where the user can define the threshold value for defining hypercubes and whether or not they want to use the mean of hypercubes. There is also a button for applying these settings.

Graphical user interface, text, application

Description automatically generated

There is also an options tab where the user can define the format of the csv file that they will be loading into the software for visualization. Next to that is an option of whether to display the dimension names and where to display them. There is also space for a color picker to be implemented so that the user can choose what color they want their selector line to be and for a button to apply these changes. The selector line is a line the user can navigate through the data with. If they press the arrow keys they have the capability to select different lines to use with features like hyperblock creation.



The second drop-down menu is under the view tab. This drop-down has three options. The first of which set whether to display the left and right-side toolbar panels. A checkmark will be displayed if they are currently displayed. The third option is settings which opens a settings window.

Graphical user interface, text, application

Description automatically generated

The first tab in the settings window allows the user to modify classes. Classes can be selected via their name in the corresponding dropdown menu. They can then be deleted with the x or have their name changed with the change name field. There are also RGBA selectors to allow the user to define custom colors for different classes. There is also room for an apply button that would set these settings.

A picture containing graphical user interface

Description automatically generated

The next tab is the *class case* tab. This allows the user to select a class by name using the class name drop down. After a class is selected the user can click and drag to select a subset of n-D points (cases) to be displayed, rather than displaying all n-D points (cases) in that class. This is defined as the visible set of n-D points (cases). There is also room for an apply button that would set these settings.

Graphical user interface, application

Description automatically generated

The third tab is the *case* tab. They can change the n-D points’ (cases’) name using the change name field or change what class the point belongs to by using the class assignment drop down. There is also room for an apply button that would set these settings.

Graphical user interface, application

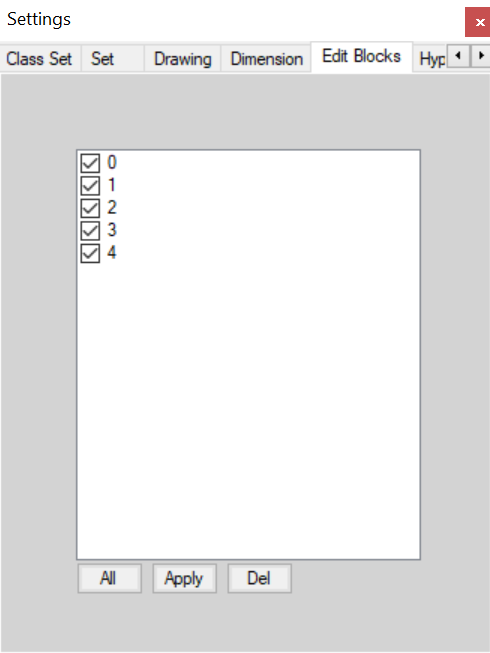
Description automatically generated

The fourth tab is the drawing tab. This tab controls what is drawn when viewing hyperblocks. Clicking a checkbox will set the relevant item to be displayed or to be hidden. The minimum, center, and maximum lines are the borders and median of the currently selected hyperblock. The selector line is the user-controlled line that is used to navigate the data. The background option controls whether the data is drawn on a white background or not.

Graphical user interface

Description automatically generated

The next tab is the *coordinate(attribute)* tab. This tab allows the user to change *coordinates (attributes)* by selecting them from the name drop down. The *coordinate’s* label can be changed from the change name field. There are also options to see all values for each n-D point (case) in this dimension and to alter how it is scaled. Below that is a check box that allows the user to reduce *coordinates* by removing them from view. There is also room for an apply button that would set these settings.

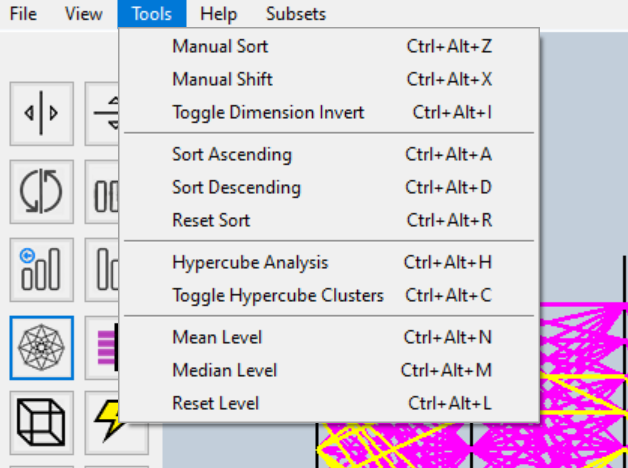


Next to this tab is the edit blocks tab. This tab allows control over hyper-blocks and hypercubes. Any hypercube or hyper-block that is created will be available to view here. Clicking in the white space will load the list of blocks and checking them controls whether they are viewed or not. The all button selects/de-selects all blocks. The apply button makes sets the current check marks. The del button will delete all selected blocks.

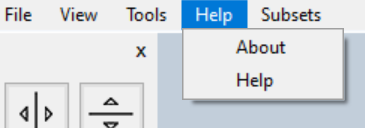
Graphical user interface, application

Description automatically generated

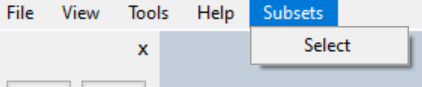
The final tab is the *hyberblock* cluster tab. This tab allows the user to select a *hyperblock* from the name drop down. They can then delete a chosen *hyperblock* by clicking the *x*. They can also change the name or color of the *hyperblock* using the corresponding fields. There is also room for an apply button that would set these settings.



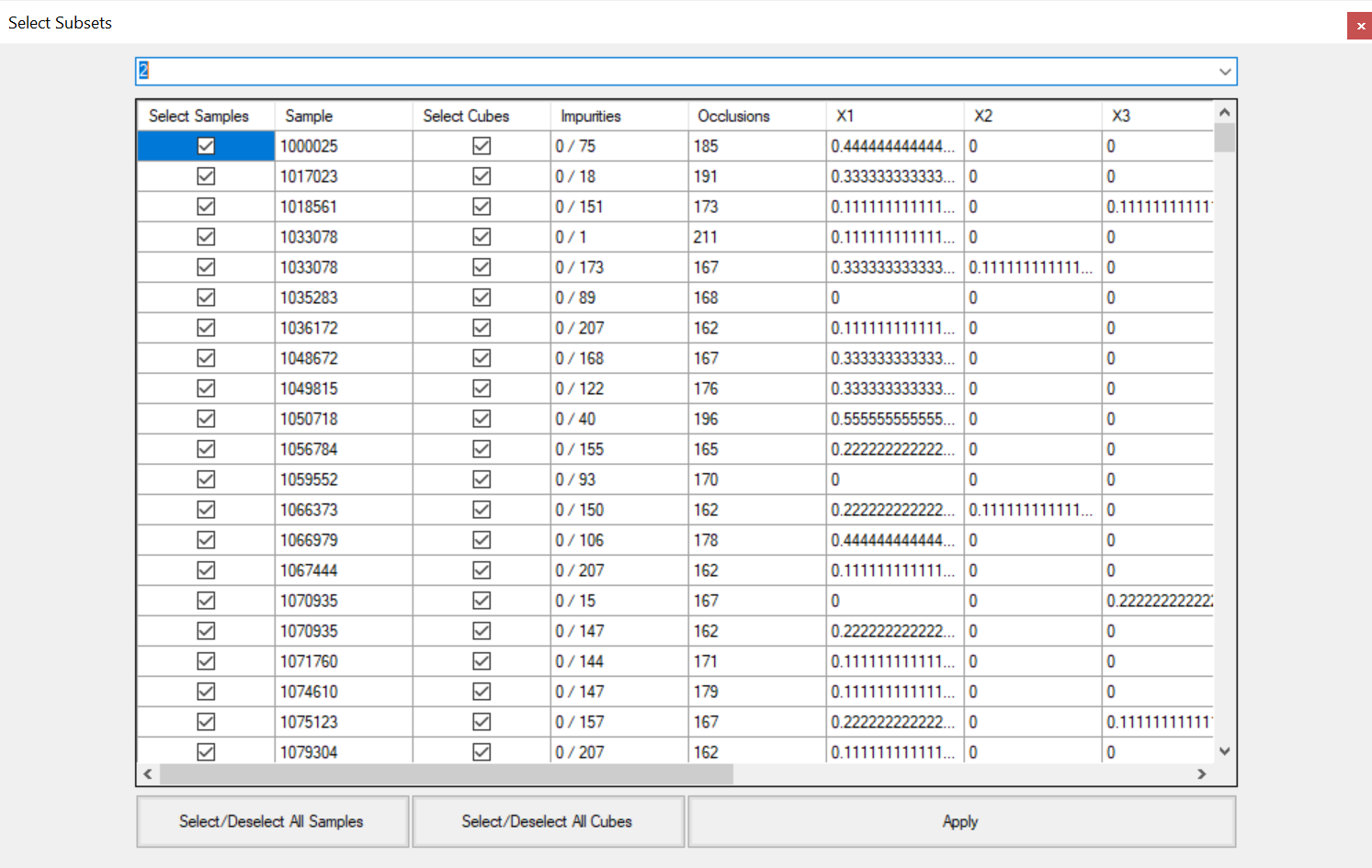
The tools drop-down menu in the bar allows users another route to using the functionality of the program without using the buttons or the hotkeys.



The help drop-down menu has two options where the user can find information about the software. The about option displays the names of the authors and the help function has a link to the pdf manual.



The final option in the menu bar is the subsets option. This option allows the user to gain more insight into the data and to select subsets of it.



The user can select a class from the dropdown at the top of the window. The select samples column allows users to define a subset of n-D points (cases) in the selected class by displaying only those that are checked. The sample column displays the name of the n-D point (case). The select cubes column allows users to see context around any given point by switching to a context view that displays these cubes. Only those that are checked will be displayed, and this allows users to gain insight into the region around a n-D point (case) of interest. The impurities column displays how many n-D points (cases) of opposite classes exist in these context cubes. The occlusion column displays how many other n-D points (cases) a given sample visually overlaps. The following columns contain the values of each dimension for each n-D point (case). The buttons allow for selecting/de-selecting all samples/cubes and to set current selections.

# Function Bar

The function bar on the left side of the software contains buttons that control the main functionality of the software. Each buttons description is listed after its image.



This button toggles a mode that allows the user to move dimensional lines left or right, swapping them.



This button toggles a mode that allows the user to move dimensional lines up or down.



This button inverts the values of a dimension.



This button resets all dimensional lines to their default position.



This button sorts dimensional lines in ascending order.



This button sorts dimensional lines descending order.



This button toggles the viewing mode to be hypercubes or all of the data.



This button toggles which coloring scheme to use when drawing data.



This button creates a hypercube around the currently selected n-D point using the threshold set in the options window.



This button automatically creates hyper-blocks.



This button compares all hyper-blocks pair wise and highlights areas that separate them in each dimension.



This button reduces the dimensions of two selected hyper-blocks to those where they do not overlap.



This button toggles a visualization mode that shows histograms based on frequency.



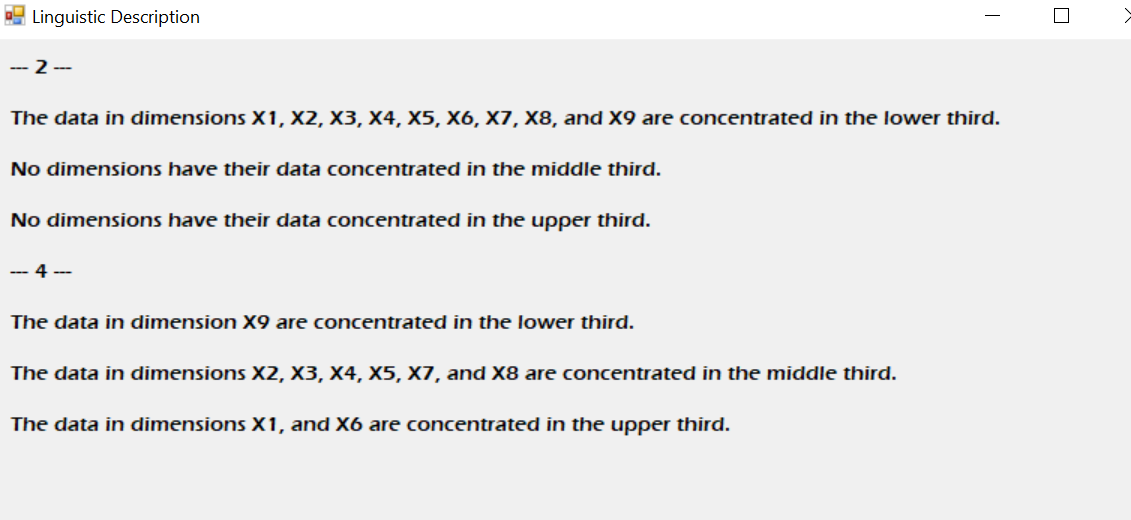
This button toggles a visualization mode that scales line width and alpha based on frequency.



This button creates a new window that displays each hyper-block side by side.



This button creates a window with a linguistic description of the currently viewed data.





This button shifts the dimensional lines according to the mean of the currently selected line.



This button shifts the dimensional lines according to the average of the currently selected line.

A picture containing text, picture frame

Description automatically generated

This button opens up the Dominant Nominal Sets operation for the selected data; more on this later.



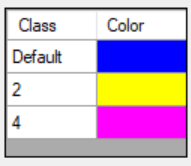
This button resets all shifted lines.

# Data Bar

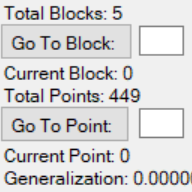
The data bar on the right side of the software contains tabular data describing the current visualization.



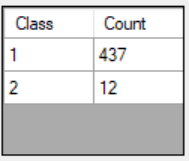
This component shows whether all data or hyper-blocks are being viewed.



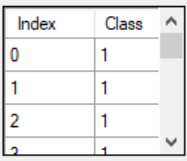
This table shows the color of each class in the data set.



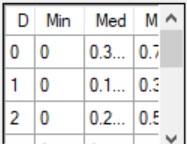
This component shows which point is currently being selected, and how many points there are. It also shows how many hyper-blocks there are, and which one is selected.



This table shows the distribution of classes within the currently selected hyper-block.



This table shows the index and class of each point within the currently selected hyper-block.



This table shows the minimum, median, and maximum of each dimension for the currently selected hyper-block.



This link opens the settings window.

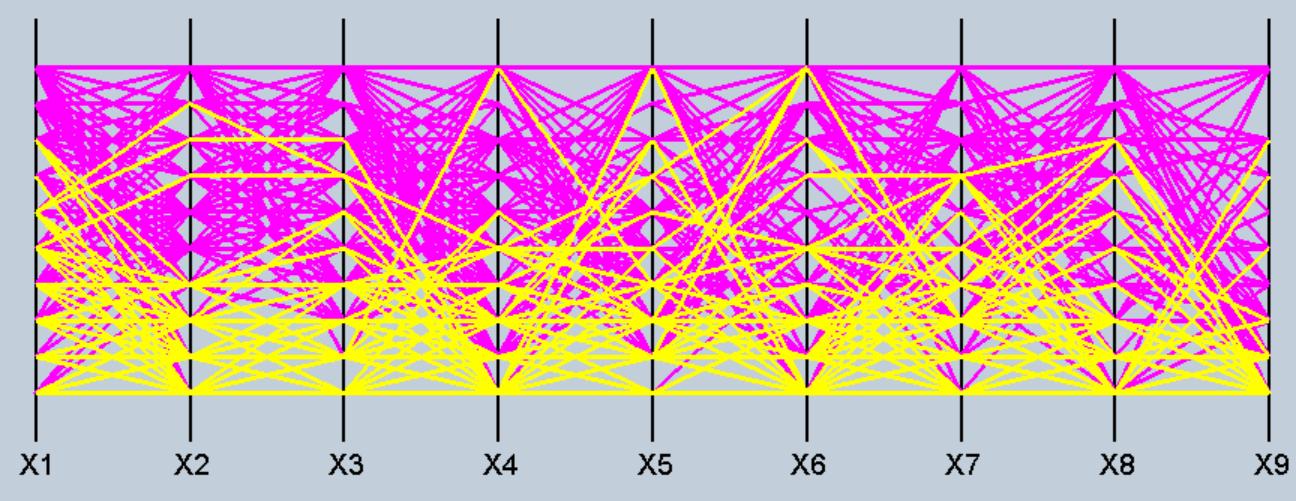
# Zoom Bar

The zoom bar at the bottom of the screen shows the current zoom level and has a button that resets the zoom level.

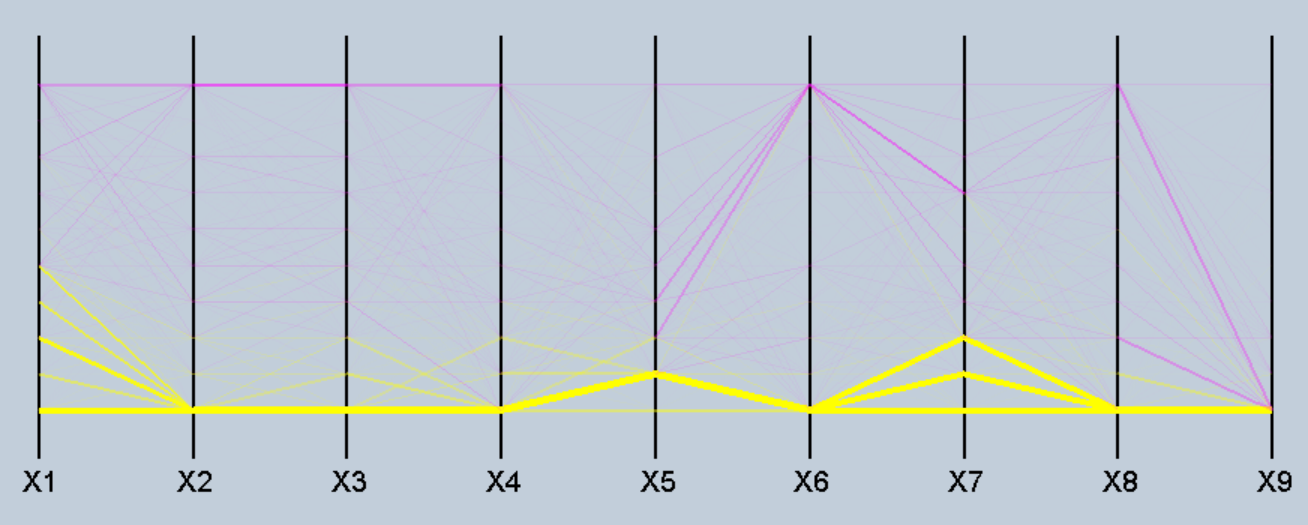


# Visualization

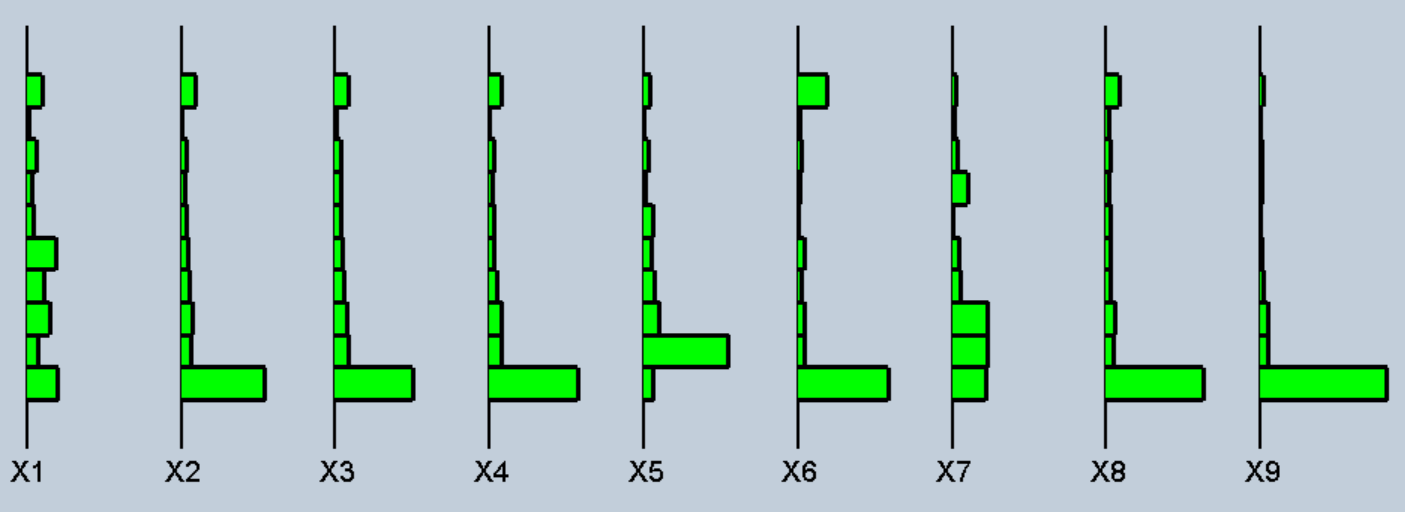
There are many different visualization modes within VisCanvas that are viewed in different ways. A description for each follows the image of it.



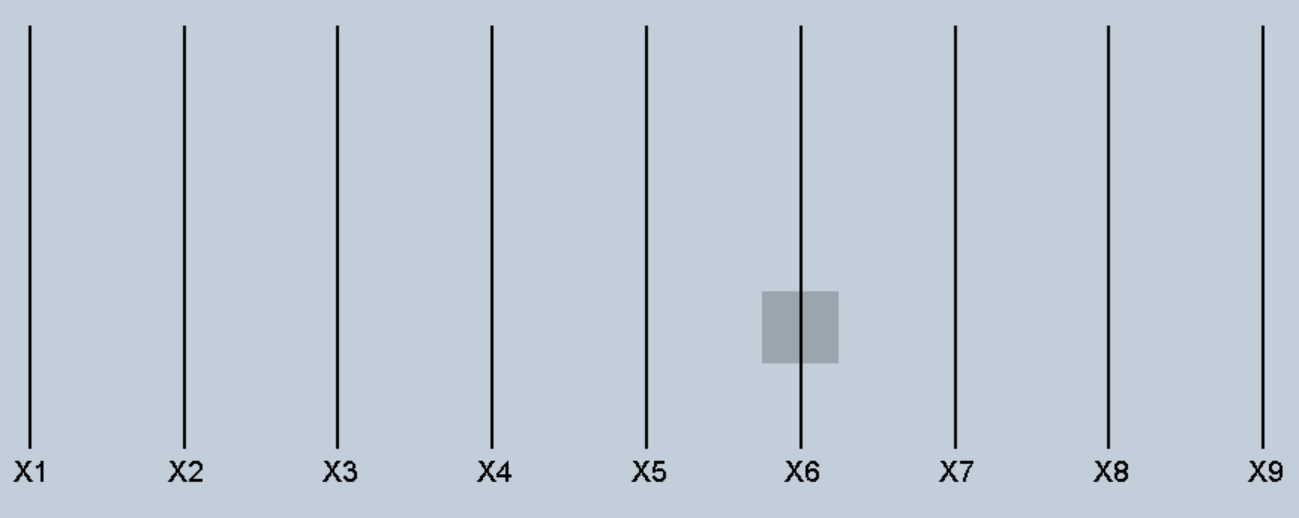
This is the default visualization which shows all n-D points.



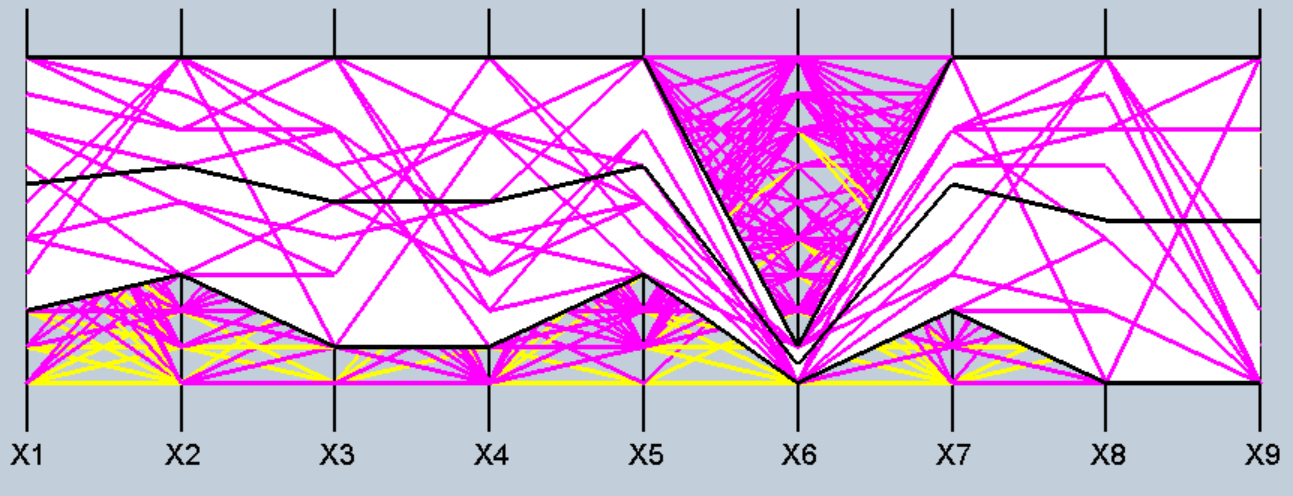
This is a visualization of all data using line width and alpha scaling to illustrate frequency.



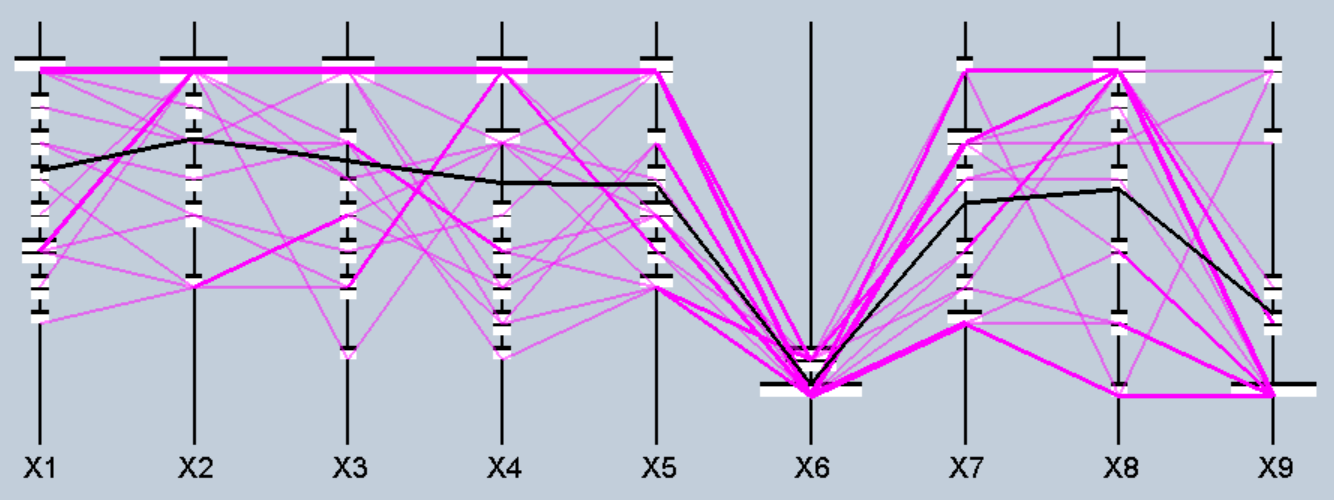
This is a visualization using histograms to view frequency.



This is a visualization that highlights areas where pairs of hyper-blocks do not overlap.



This is a visualization of hyper-blocks using minimum, median, and maximum lines with a background.

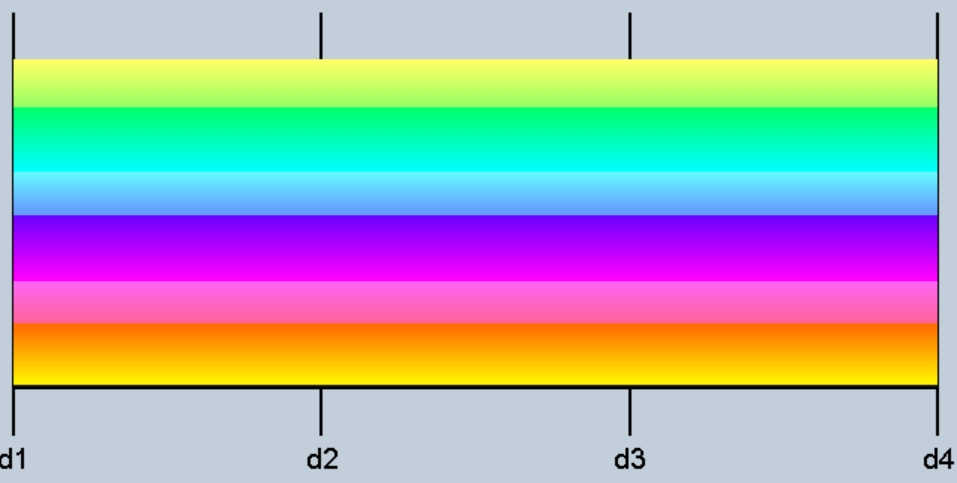


This is a visualization that uses histograms, line width, and line alpha to illustrate frequency of hyper-blocks.

A picture containing diagram

Description automatically generated

This is a visualization that uses Dominant Nominal sets; more on this later.



There is a feature that auto colors classes when loaded into the software. The above visualization illustrates this with 100 lines all of a different class.

# Dominant Nominal Sets

To briefly describe Dominant Nominal Sets, they are sets which represent data with nominal coordinates (attributes). For example color, name, taste.

The dominant nominal set contains its own functions and depictions. First will be covered the visualization and then some of the unique functions in the Function bar of the dominant nominal set.

## Visualization

Diagram

Description automatically generated

This is the visualization of the Simple Mushroom Data Set. Let’s talk about it. Let’s **first** discuss the coordinates (attributes). Each coordinate (attribute) is divided by blocks which are divided by black horizontal lines. Each block is composed of a unique value in the data. For example, if one coordinate (attribute; that is one column in the data) contains the values: *1, 2, 1, 3, 2, 2*, then its correpsonding visual coordinate (attribute) would then be divided into 3 blocks. The colors on each block represent the dominant class in that block. Since there can be more than two classes, the rest of the block is grey. **Second** let’s discuss the many lines you see connecting coordinates (attributes). They represent all of the n-D points (cases; in the data that is rows) in the data. Each indivudal line will extend from the first coordinate (attribute), unto every coordinate (attribute), all the way until the last coordinate (attribute). Each line’s color represents its class. It’s class will stay the same—meaning that the line will stay the same color across the visualization. The thicker lines you see mean that there are many n-D points (cases) near that case. **Third** let’s discuss the blocks which are outlined in green. Those blocks have a class dominance of over 95%, meaning that the cases in those blocks make up more than 95% of the block. **Fourth** Let’s discuss the text at the bottom of the visualization. When you hover over a coordinate (attribute) with your mouse, this text will automatically update to represent the number of cases in each block of that coordinate (attribute).

Next we will discuss the function Bar of the dominant nominal set

## Function Bar



This is the  *group* function. It allows you to select which coordinates (attributes) will have generated rules:

Shape

Description automatically generated

The form, *Coordinate Grouping*, is opened when you select the *group* function. The *generalize* button is not currently working. The *create group* button does work:

Graphical user interface, text, application

Description automatically generated

The *Group to Create* form is what is displayed when you press *create group* button*.* You can name the group anything (but you must name it something).

Table

Description automatically generated

Upon clicking *confirm* in the *Group to Create* form, you are presented with a the *Dimension Selection* form. Here you can select which coordinates (attributes) you would like to use in your current group. It is important the you mark the attribute with an uppercase *X* as seen above. When you are done, press confirm.

Graphical user interface, application, Word

Description automatically generated

Going back to the *Coordinate Grouping* form, we can see that our new group is displayed. You can create as many groups as you want—although be aware that, currently, every group must have a unique coordinate (attribute). This means that the maximum number of groups are the number of coordinates (attributes). To be clear, you do not need to use every coordinate (attribute) in your groups however those coordinates (attributes) will not be considered in the generated rules. Upon clicking *confirm* in the *coordinate grouping* form, the rules will be generated. This may take some time.



The next logical function to cover is the *Linguistic Analysis* function. This function will deliver your generated rules in a user-friendly text.

Graphical user interface, text, application, Word

Description automatically generated

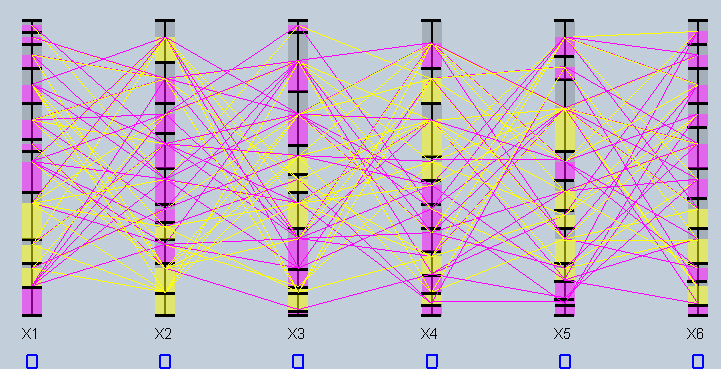
This is the text file that is generated. It contains the rules for every precision threshold(defined in the *config* file), it contains data about what is being displayed in the dominant nominal set, and it contains the same data found in the *Linguistic Analysis* found on the front page: information about where coordinates (attributes) are congregated.



Im not sure about this function



When you click this function, you will see a small blue outlined square underneath each coordinate (attribute) like so:



You may click any of the squares at which point they will be filled in blue. When you are re-click the button, and all the attributes but the ones which you clicked under will dissapear. If you click none of the squares, then all of the attributes will dissapear. In any csae to get the hidden attributes to reappear, you currently have to restart the program.



This function adjusts the transparency of the n-D points (cases). **Needs more**



Im not sure about this function



This function hypothetically allows you to change the Dominance threshold of the block outlined in green. It does not seem to be working yet.

# The config File

Text

Description automatically generated

A *config.txt* file is located insinde of *OpenGL\_on\_a\_Windows\_Form*, but a shortcut is listed within the main *VisCanvas2.0* file, as can be seen above. The layout of the config file is as follows:

variableName1 varValue1 varValue2 varValueN ; //comments

variableName2 varValue1 varValue2 varValueN ; //comments

variableNameN varValue1 varValue2 varValueN ; //comments

The config file right now has two different variables which can be modified: the Preceision Thresholds, and the minumim class-n-D point (case) line cut off. Both apply to the Dominant Nominal Sets.

The Precision Thresholds, or in the config file: *PrecisionThresholds* lists the different Precision Thresholds desireable for the rules.

The minimum class-case line cut off, or in the config file: *MinClassCaseLineDrawCutOff* has only one value. This value represents at the minimum required n-D points (cases) in a class in order for its n-D points to be drawn as lines on the dominant nominal sets visualization. The higher you make this number, the thicker the lines become. Going above 25 causes visual issues. 15 is a good value in most cases it seems.