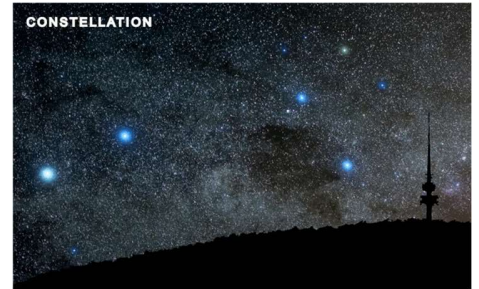


****READ FIRST****

Learning Module - a quick guide to using Constellation

This learning module should be read first before the other modules in Exercise 2. It includes instructions on:

1. Downloading and installing Constellation
2. Read the PDF user reference guide
3. Basic graph functionality: opening graphs, movement, selection, node/transaction counts, views
4. Intermediate graph functionality: hops, blazes, invert selection, induced subgraphs, copying graph elements



After this module you should have basic familiarity with using Constellation as a tool. You'll then be able to move on to the other learning modules in this exercise, and then to the questions.



1. Download and install Constellation

You can download Constellation from the website: <https://www.constellation-app.com/download>. After downloading, extract the .zip file into your desired location (eg. C:\Program Files\Constellation). Double-click the bin/constellation64.exe for Windows, or run the bin/constellation shell script for Linux/Mac.

Note: as of 19/5/2020, the most recent version of Constellation (in Beta) can be found at: <https://github.com/constellation-app/constellation/releases/tag/v2.0.0-beta4>



2. Read the Constellation PDF user reference guide


Before you start using Constellation, it is recommended that you download and read through the PDF 'Constellation Quick Start Guide.pdf', which is located in the Exercise 2 folder. This PDF gives a good introduction to some core concepts of Constellation, and serves as a user guide for many of the common tools and functions. It is worth keeping as a reference guide for future modules.



3. Basic graph functionality: opening graphs, movement, selection, node/transaction counts, views



Opening graphs

Open Constellation. To create a new graph, click the  symbol just below the File menu (or Ctrl+N). To open an existing graph, click File > Open > graphname.star (or Ctrl+O). In this module we'll use the 'Greg and Sarah Network.star' graph, so go ahead and open it up. Constellation graphs use the .star file format. You can use the graph to follow along with the rest of this module, practising the different tools within Constellation as they come up.

Basic graph movement and selection

To move around a graph, click and hold the right mouse button (RMB). To select a node or transaction, use the left mouse button (LMB); clicking and dragging with the LMB will let you box a selection, which works for both nodes and transactions. If you want to add to your selection, hold Ctrl when selecting an additional graph element. Using the mouse scroll wheel will allow you to zoom in or out on your graph.


Ctrl + Z can be used to 'undo' anything in Constellation, including selecting/deselecting elements, which can be useful if you accidentally drop your selection.

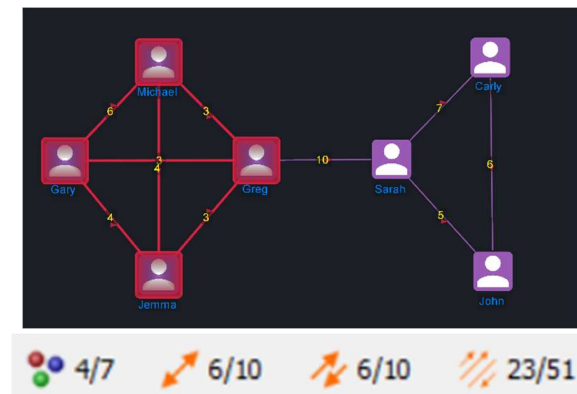
Graph Element counts

Down the bottom right of the application, you should see values showing the number of different elements you have on the graph: Nodes, Links, Edges, and Transactions.



For the distinction between Links, Edges, and Transactions, see the PDF user reference guide.

If you select elements on your graph, say for example four nodes and their connecting transactions, you'll see the values update to reflect how many elements of the total you have selected. If you do this on our graph, you'll see the values for nodes update to 4/7, meaning 4 of the total 7 nodes on the graph have been selected. If you box-selected and also highlighted the interconnecting transactions, the  symbol will show you how many individual transactions from the total have been selected as well.



This can be useful to get a quick overview of the size of the data on your graph, to check that everything has loaded as you expected, and on larger graphs to check you have made more advanced selections as you intended to.



Searching your graph


If you would like to search for a node or transaction on your graph, you can use the search function in the top right hand corner of the window (or Ctrl+i). This will search all attributes on the graph for the value you input, and is particularly helpful for finding specific nodes on large graphs easily.



By clicking on a search result, it will add that node\transaction to your selection.

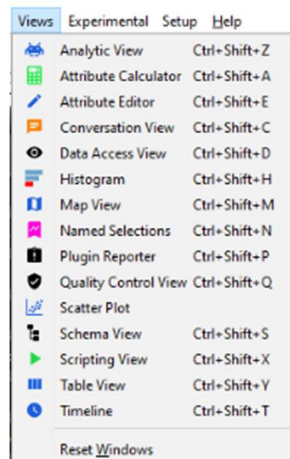


Zoom to selection

To zoom the graph to what you currently have selected, use the  icon (or Ctrl+up arrow key). This will change the view of your graph to include everything you have in your selection; if it isn't zooming in very much, you might have nodes selected on disparate parts of the graph: the zoom to selection function will try to fit them all into your vision.

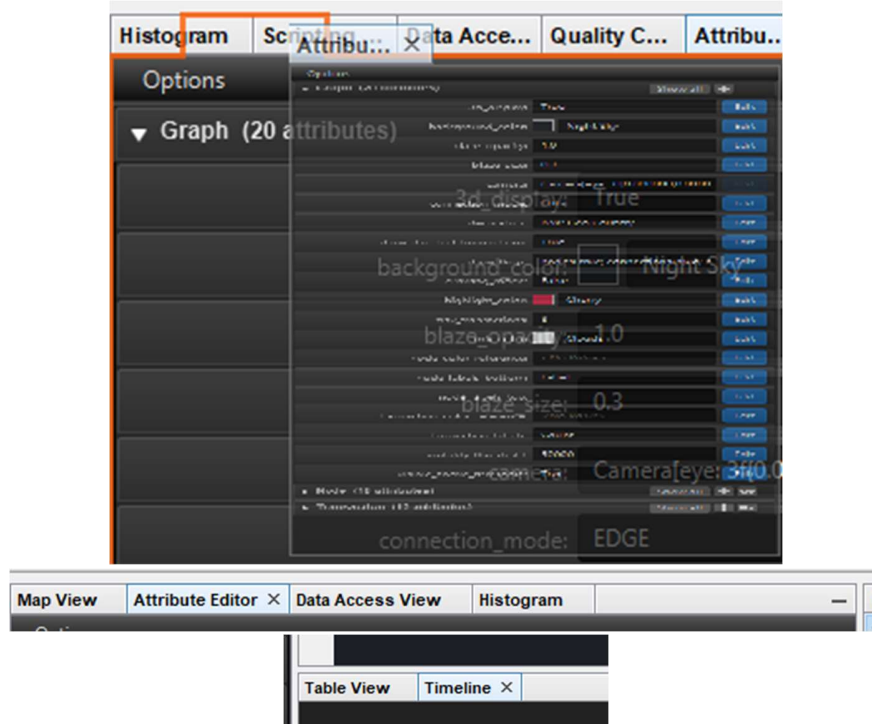
Views

Constellation is a modular program, easily thought of as one large tool with many smaller tools contained within it. The smaller tools are called 'views'. To open a view, click the 'Views' button in the menu bar. The views are listed in alphabetical order.



Some of the more common views you will use are the Attribute Editor, Data Access View, Histogram, Map View, Table View, and Timeline. If you open a view, it will add it to your viewing pane on the left of your screen. Multiple views can be added and reorganised as you prefer. Some views, like the table view and timeline view, will open in a new viewing pane on the bottom, as they are easier to use 'horizontally' rather than 'vertically'.

Open some of the views and practice moving them around into different positions. If you are clicking and dragging a view to another position, look for the orange box for where the view will land. You can have multiple windows open as well - such as dragging the map view to a second window if you have two computer monitors.



4. Intermediate graph functionality: hops, blazes, invert selection, induced subgraphs, copying graph elements

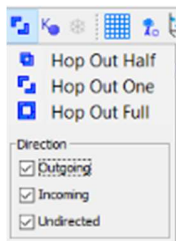


Hops

An extremely important element of graph-based analysis is the concept of 'hops', because it lets us make selections on the graph based on what is connected to our current selection. The hop

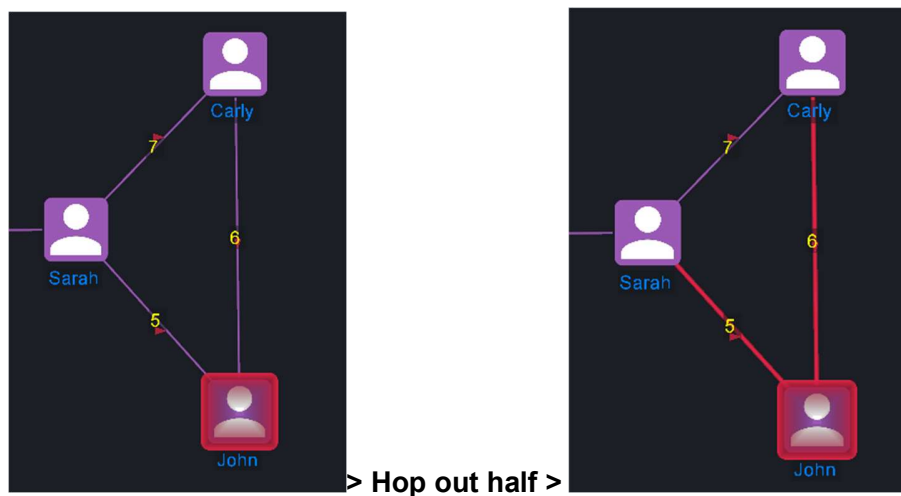
function can be found in the toolbar at the top under the symbol of the blue brackets:

You'll see there are several options, which we will work our way through:



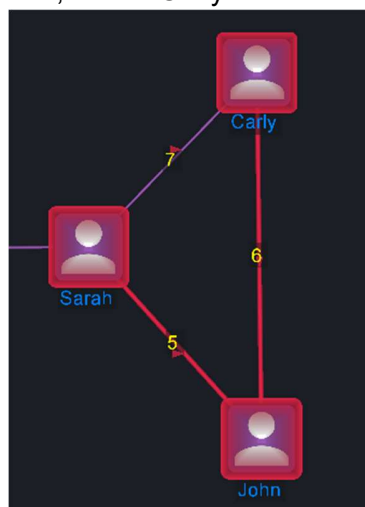
As noted, hops let us select graph elements connected to our existing selection. The first option in the hops menu is 'half hop'. If you picture two nodes on a graph connected by a transaction, those nodes would be said to be 'one hop' from each other. If you have one node selected, a 'half hop' would select the transaction connected to that node, but not the node on the other end of the transaction. Let's see what this looks like in practice on our Greg and Sarah graph.

Starting with John selected, we can see that Carly and Sarah are both connected to John at a distance of one hop. If we use the 'half hop' function, this will select the transactions linked to John, but not the Carly and Sarah nodes.



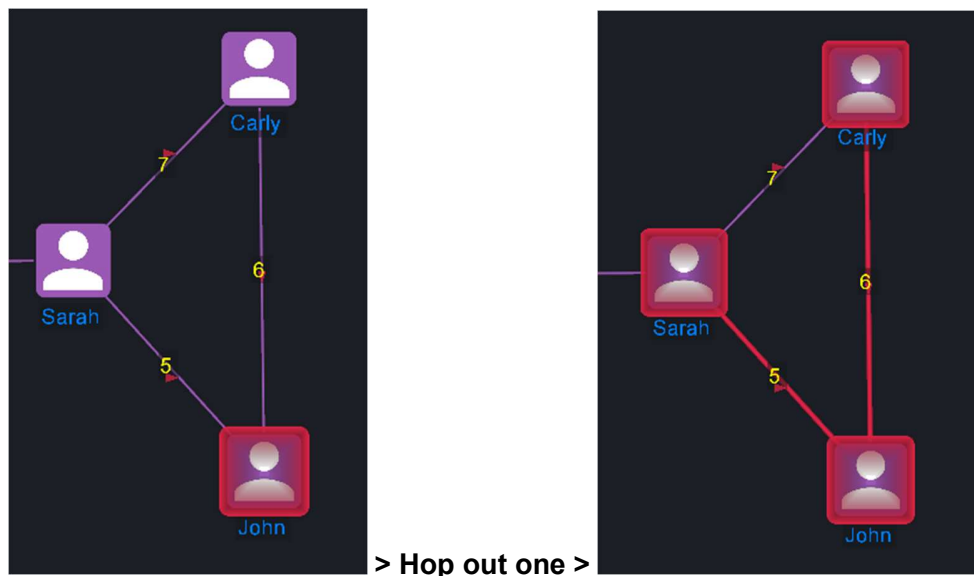
We might want to do this if we were interested in information that was stored on the transactions connected to one or more nodes, but didn't want to select any additional nodes that we weren't interested in.

As we now have the transaction selected, if we 'half hop' again, we will select the graph elements directly connected to our transactions, ie: the Carly and Sarah nodes.



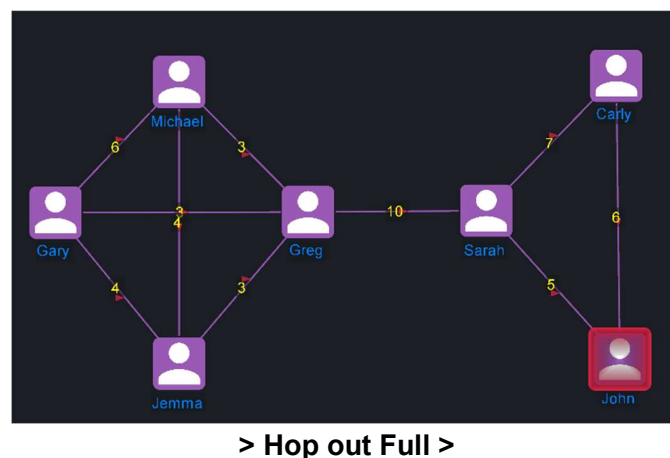
Note the connection between Carly and Sarah is still not selected. As you have seen, you can start with a selection of either nodes or transactions, and half hop to the next graph element out from them.

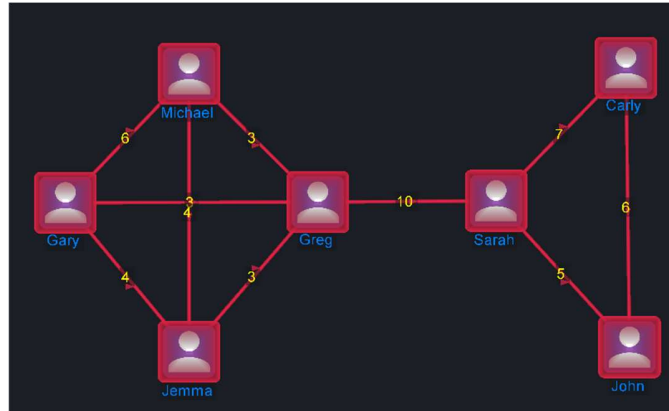
The next function is the 'one hop'. If you start by selecting only the John node, then 'hop out one', you'll add anything connected to John at 'one hop', which in this case is the Carly and Sarah nodes, as well as the transactions that connect them.



This is helpful for answering questions like 'which people are directly connected to this node/these nodes?' This is incredibly useful on larger graphs, where you can no longer use visual analysis alone to select elements of interest.

The last hop option is a 'full hop'. This will select everything on the graph that is connected in any way to your existing connection. If we start by selecting John, using a full hop will select the entirety of the graph, as all elements of this graph are connected in some way. This isn't always true for more complex graphs.






Start by selecting Greg, then hop out one. Who else has been selected now? How many nodes of the total 7 have been selected?

In this graph, we don't have any data that is 'directional', as in each case the pairs of individuals are meeting with each other (ie. 'undirected'). An example of a directed transaction might be one person contacting another, or a person or vehicle visiting a location. If we have this data, we might have questions like 'which people has John contacted', or 'which dates did John visit the Blue Duck cafe', where we want to only select data going in one direction.

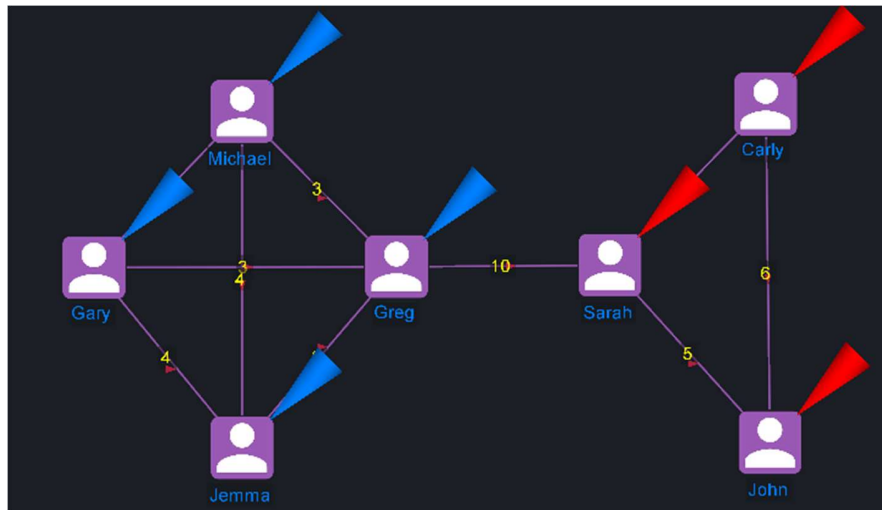
To do this, the three Direction options of 'outgoing', 'incoming', and 'undirected' are available in the hop function menu to allow you to toggle when you select different types of directed relationships with hops. If you use this function, it's a good idea to reset the tick boxes afterwards, as it can confuse future selections you make using the hop tool.

Blazes

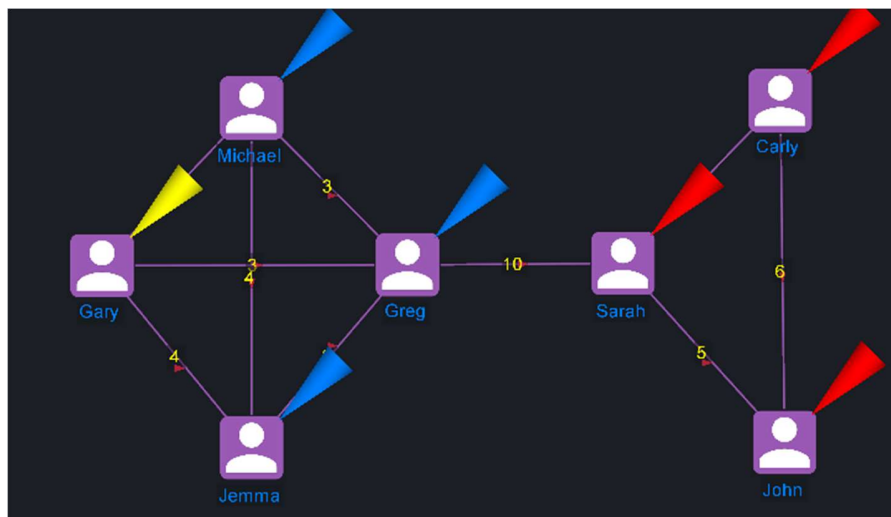
Sometimes when working on complex graphs, you need a way to mark certain selections of nodes so that you can come back to them later, while moving on to other selections in the meantime. Blazes can be used for this, as they create a visual coloured marker on the graph. This can be used to both visually identify selections of interest, and as we will see in later modules, as an attribute to allow re-selection on a larger scale.

To blaze a node or nodes, simply highlight them, click the drop-down blaze icon from the toolbar , and choose the colour you want for that selection. Blue, red, and yellow are the default quick-set options, however you can use custom blaze colours if you need more than three.




On our Greg and Sarah Network graph, we have two lunch groups joined by the relationship between Greg and Sarah. Let's blaze all of the people on Greg's side of the network in blue, and all the people on Sarah's side of the network in red.



Now change the colour of Gary's blaze to yellow. You do this by just setting the new colour; the graph will override the previous blaze colour with the new one. Remember, if you want to undo this you can with Ctrl+Z.




With the different networks blazed, even if the graph is rearranged, we can still easily see where each part of the network is. One way you can auto-rearrange the graph is the 'trees' layout, using

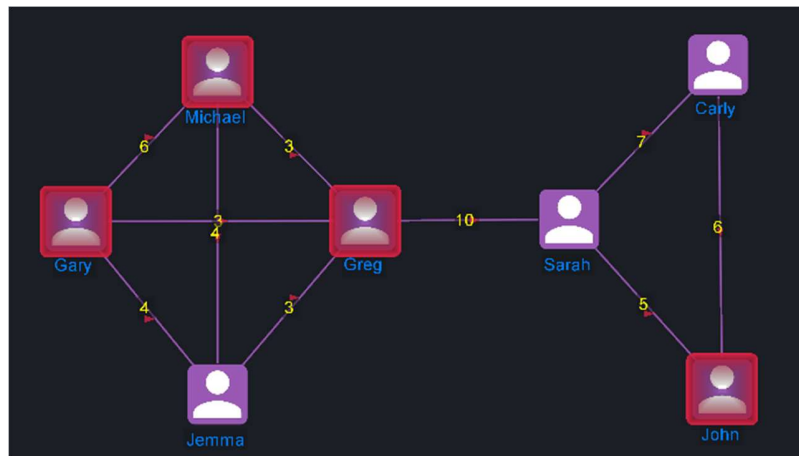
the  button (or Ctrl+T), or the grid layout using the  button (or Ctrl+G). Try both different layouts and see if you can still find the original networks, then press Ctrl+Z until the layout is back to its original form. You can remove the blazes by highlighting blazed nodes, and selecting the 'remove blazes' button from the blaze tool .

As you can see, the blaze feature is very helpful to find previous selections again. This becomes increasingly important with larger graphs.

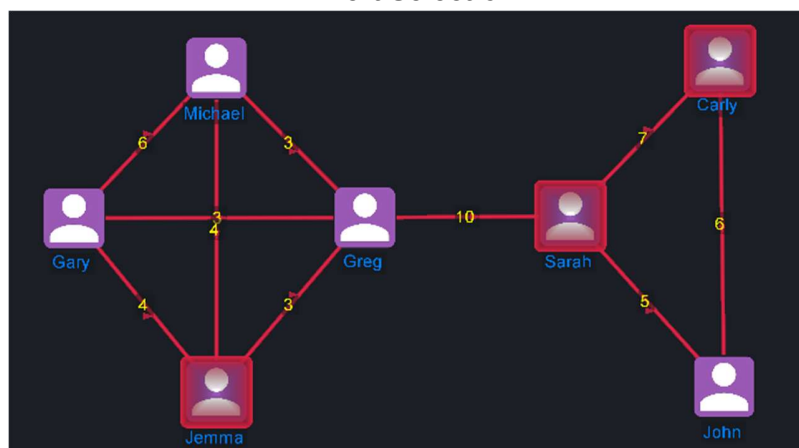
Invert Selection

Sometimes you may have a question where the easiest way to answer it is by selecting the graph elements you *aren't* interested in, and then reversing that selection. You can do this using the Invert Selection tool in the toolbar . This will simply take your existing selection, select everything that wasn't previously selected, and deselect anything that was selected.

On our graph, start by selecting all the males: Greg, Michael, Gary, and John. Press the invert selection button, and you'll see all the females become selected instead. You'll also notice all the transactions will now be selected; that is because they were not previously selected, so inverting changed this.



> Invert Selection >



Induced subgraphs

There are two types of induced subgraphs you can use in Constellation: the 'half hop', and the 'one hop' induced subgraphs. This sounds confusing, but it is really helping you to answer two simple questions:

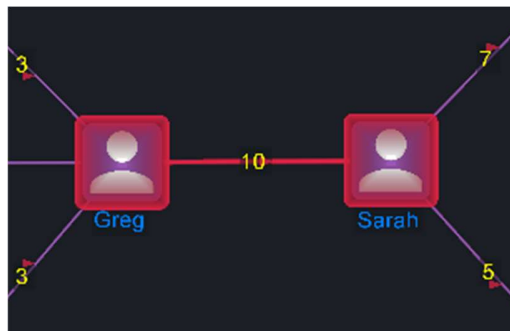
- Half-hop subgraph: are the nodes I have selected directly connected to each other?
- One-hop subgraph: do my selected nodes have any common nodes connected to them at a distance of one hop?

We'll use our Greg and Sarah Network graph to practice. The small size of this graph makes answering the questions easy, so you might need to imagine a situation where the lunch network had 7000 members instead of 7, making visual selection far more difficult.

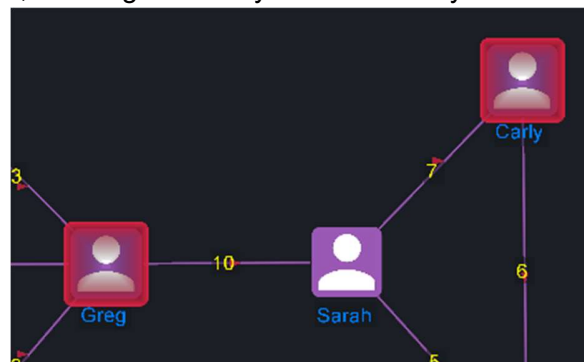
Start by selecting both Greg and Sarah. Click the 'select half hop induced subgraph' button



from the toolbar. As Greg and Sarah are directly connected, Constellation will select the transactions between them.



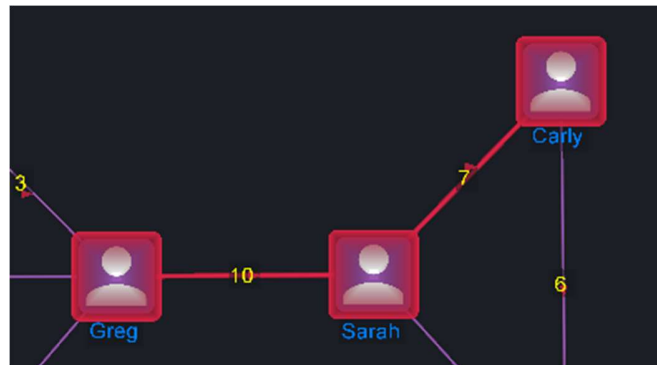
Try setting your selection to Greg and Carly. Using the half hop subgraph function won't add anything to your selection, as Greg and Carly are not directly connected to each other.



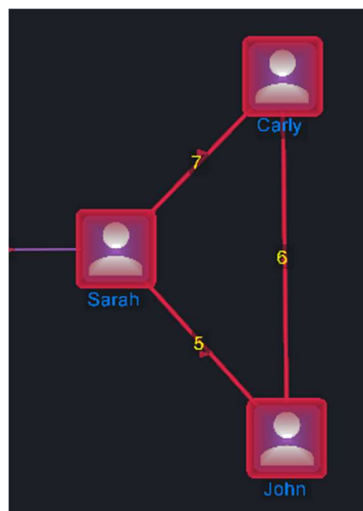
Let's see if Greg and Carly have any common nodes connected to them at a distance of one hop (imagine you can't just use your eyes for this). Using the 'select one hop induced subgraph button



, Constellation will select the common node between Greg and Carly: Sarah (as well as the transactions linking them together).



This also works for nodes that are directly connected. Start by selecting Sarah and Carly, then using the one hop subgraph function. Constellation will select the transactions connecting Carly and Sarah, but it will also select John, as the only common node connected to both Sarah and Carly at one hop.



Understanding how, and when, to use the different induced subgraph functions is a critical skill for performing analysis on larger graphs, so it is very important to learn these skills.

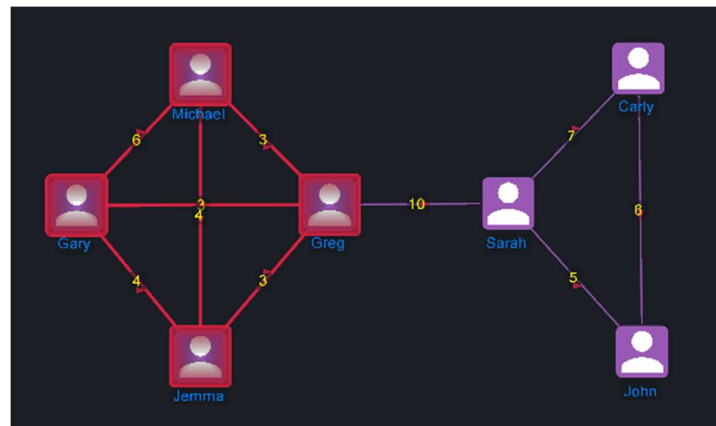
Copying graph elements

When doing analysis on larger graphs, sometimes the easiest way to answer your questions will be to take a subset of the graph elements that you are interested in, and copy them to a new graph. There are two ways to do this:

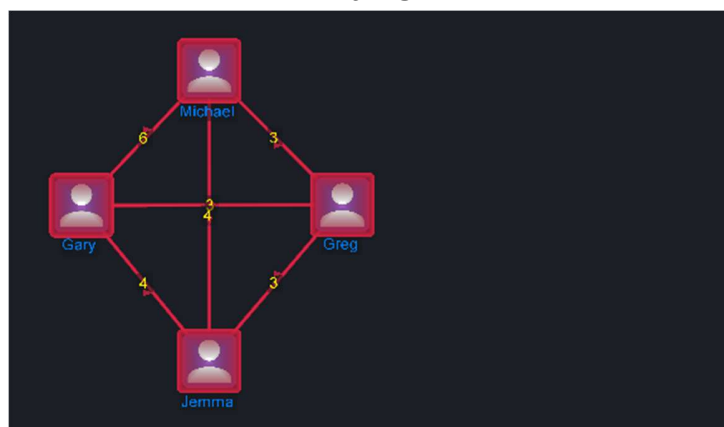
- Ctrl+U (or Edit > Copy to New Graph): this will create a new graph with everything you currently have selected copied across.
- Ctrl+C: this will copy anything you have selected. You can then open a new graph, or switch your selection to an existing graph, and Ctrl+V to paste the selection into that graph. Ctrl+X is also an option for cutting a selection from a graph for pasting elsewhere.

An important note about copying: for transactions to exist on the graph, they need to have a node at both ends of the transaction. If you copy transaction data without the corresponding nodes, Constellation will just drop the data.

In the Greg and Sarah Network graph, let's say we want to have a closer look at the Greg side of the network. Box-select Greg and his lunch network, then press Ctrl+U to move this selection to a new graph.



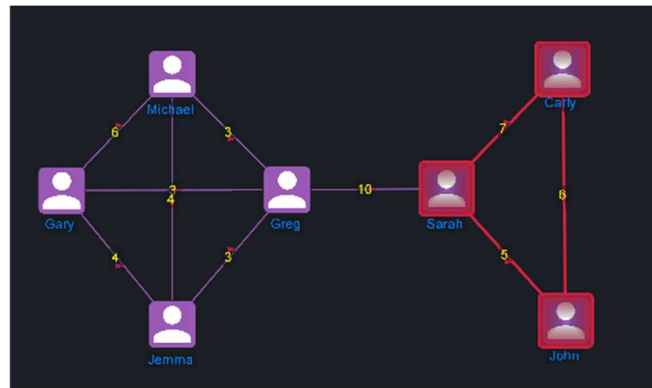
> Ctrl+U >



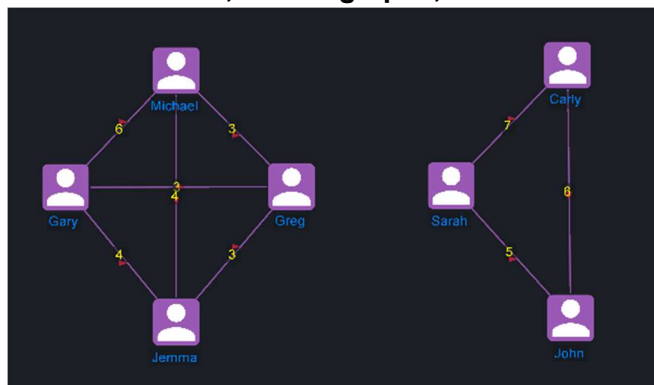
We now have a new graph with only the Greg network on it, making answering questions about Greg's network easier. This is usually preferable to deleting the data you don't want, because we can still go back to our original graph later if it turns out we needed that data.



Let's go back to the original graph, and copy the Sarah side of the network with Ctrl+C. Switch again to the new graph you created, and Ctrl+V to paste the data over.



> **Ctrl+C, switch graphs, Ctrl+V** >



We now have a graph with both networks. You'll notice there are no transactions between Greg and Sarah: this is because we didn't include those transactions in our selection when copying from one graph to the other.

When you copy elements from one graph to another, all of the relevant attributes are copied with it. If that element already exists on the new graph, any non-key (ie. grey or blue) attributes will copy over the top, overriding any existing attributes that were there. Let's see how this works.

In your second graph you created, put a red blaze on Sarah. Switch to your original graph, and put a blue blaze on Sarah. Select Sarah on the blue graph and Ctrl+C to copy the node, then switch to the second graph and Ctrl+V to paste the node. You'll see the blue blaze will override the red one, as the attribute of 'blaze' has been copied from one graph to another.

If you want to understand more about which attributes will override, which will merge, and which will cause an entirely new node to appear, refer to the 'Attributes' section of the Constellation PDF user reference guide.