home

jhive - A Java GUI for Hive Plots

A 'hive plot' displays a network graph in a coordinate system where nodes are placed along linear axes.

Launch

Making hive plots with jhive is very easy. Follow our tutorial to learn more about jhive!

Navigation

Announcements

Version 0.3.0 and Java 8.0+

Ka Ming Nip posted on Apr 24, 2014

The Java Web Start link would launch the *pre-release* build of **jhive** version 0.3.0. The code was built with JDK 8.0.

This build has most of the bug-fixes and features of version 0.3.0. Please let me know if you have any issues or bugs.

If Java blocks the deployment of jhive, please lower your Java security settings to *medium*.

Edit

Launching jhive with Java Web Start

Ka Ming Nip posted on Jan 27, 2014

For latest updates and bug fixes, always launch jhive with this Java Web Start link:

Launch

If you have launched jhive from this link previously, then it will update your cached version automatically.

A desktop shortcut would be created for *offline* use. Launching from this shortcut does not check for updates.

Edit

New Wiki

Ka Ming Nip posted on Aug 02, 2013

The wiki for jhive is now public:

http://www.bcgsc.ca/wiki/display/jhive/

It is still under construction. Lots of content will be added soon.

Please check back for updates!

Edit

Quick Start

> jhive requires Java Runtime Environment (JRE) 6 or above.

To run jhive from the command line:

```
java -jar jhive.jar
```

Drag and drop a DOT file into the thumbnails list at lower left corner of the jhive window.

Voilà! A hive plot is created using the default settings.

Documentation

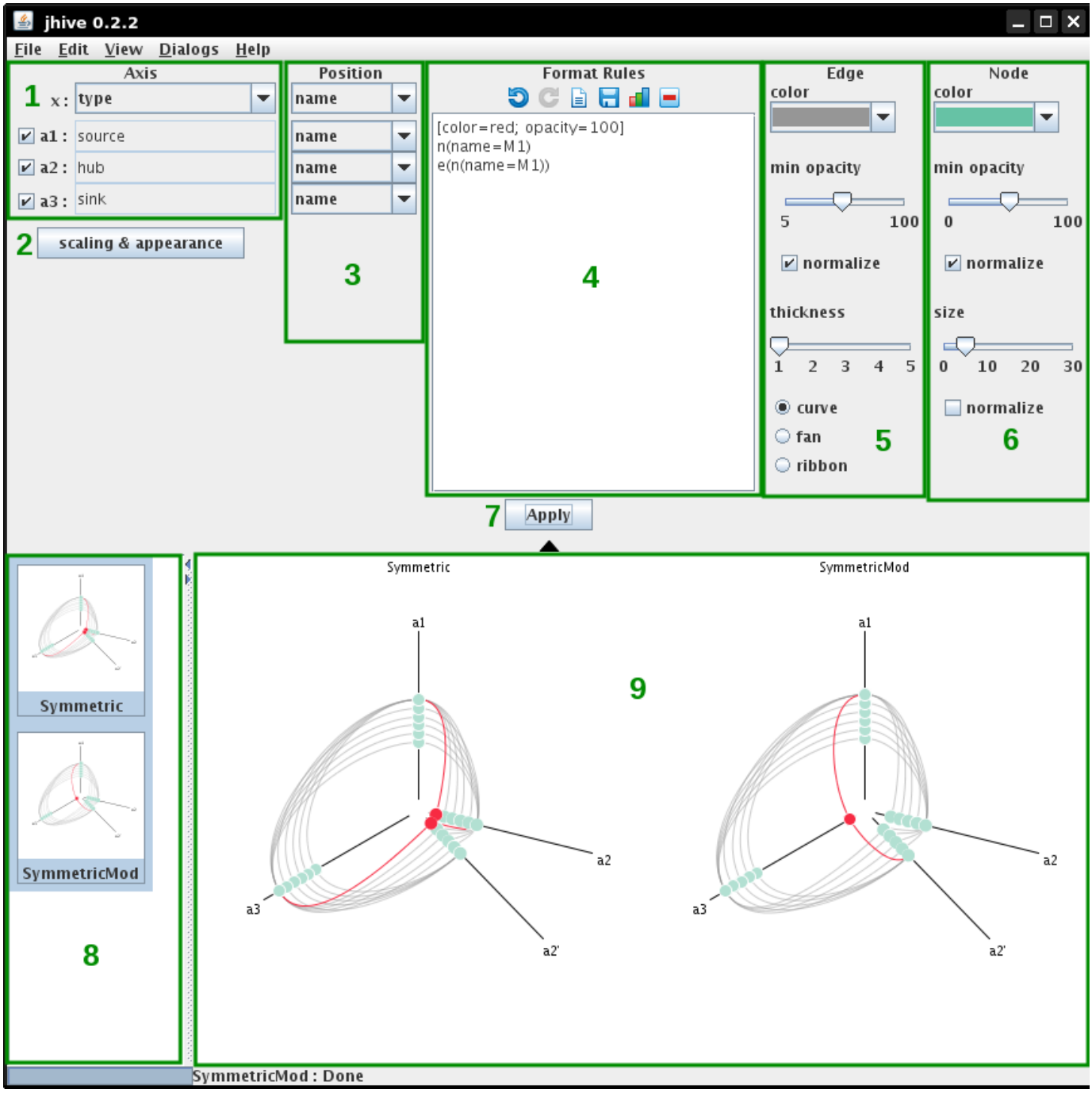
These pages document various features in jhive.

- The Graphical User Interface
- Input Format
- Axis Assignment
- Axis Scaling and Appearance
- Position Assignment
- Format Rules
- Multi-plot View
- Differential Hive Plot

The Graphical User Interface

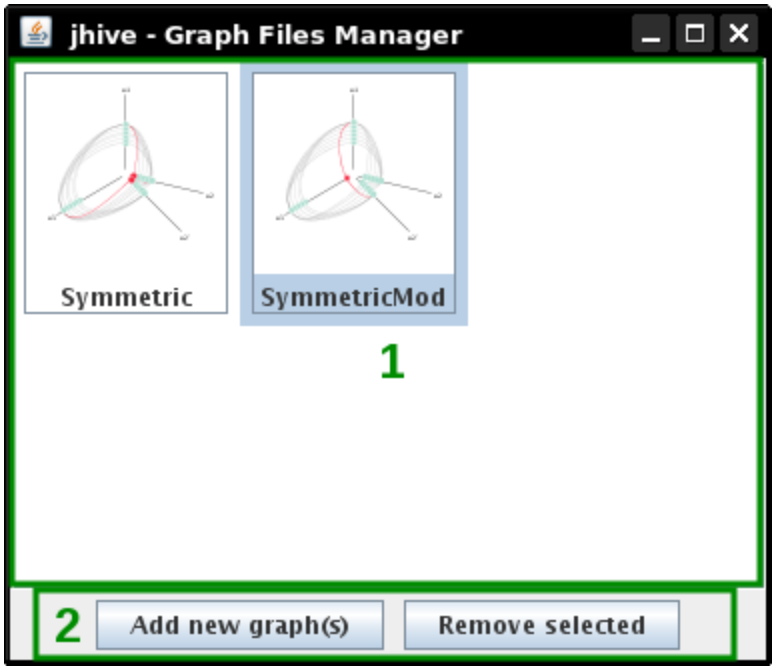
- Main Window
- Graph Files Manager
- Axis Scaling and Appearance
- Create Differential Hive Plot

Main Window



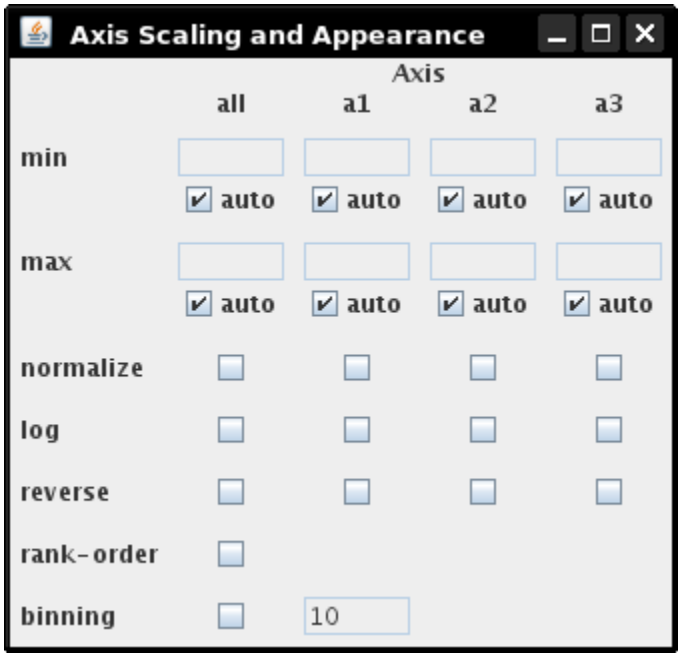
1. Axis Assignment Settings.
2. Axis Scaling and Appearance Settings
3. Position Assignment Settings.
4. Format Rules Editor (supports drag-and-drop of rules files)
5. Edge Appearance Settings
6. Node Appearance Settings
7. Apply Current Settings
8. Thumbnails List (supports drag-and-drop of graph files)
9. Hive Plots View

Graph Files Manager

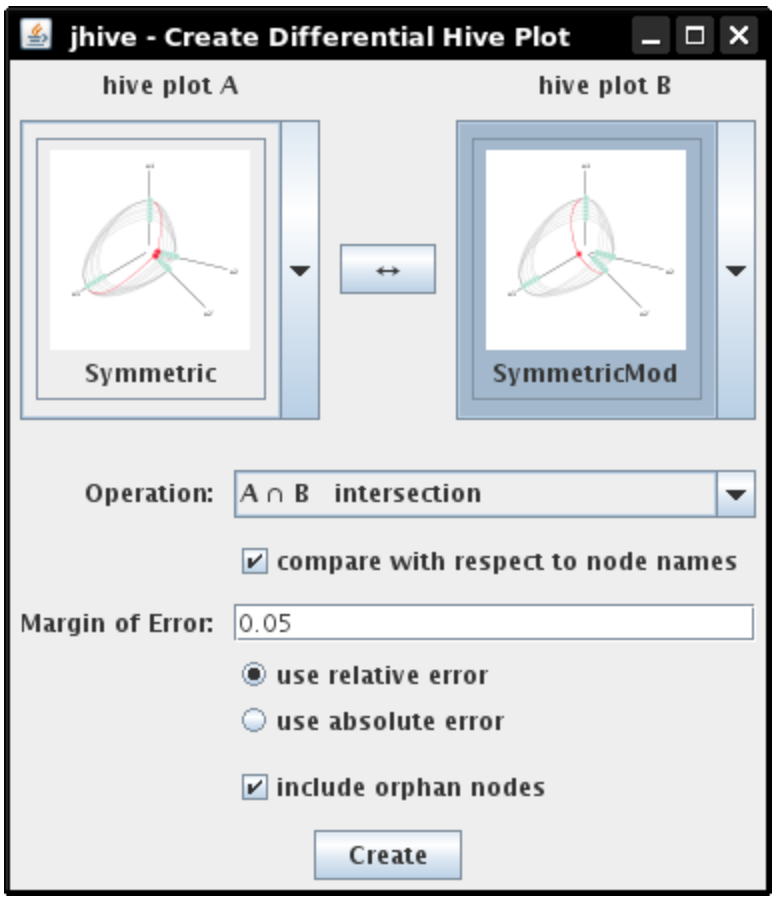


1. Thumbnails List (supports drag-and-drop of graph files). Also see Input Format.
2. Add/Remove Graph Files

Axis Scaling and Appearance



Create Differential Hive Plot



Input Format

The format of input graph files is a **subset** of the DOT format. A graph be either a directed graph or an undirected graph.

1. Directed Graph:

```
digraph graphName {
node1 [ attribute1=value1 attribute2=value2 ... ] #comments
"node 2" [ "attribute 1"="value 1" attribute2=value2 ... ] //comments
...
node1 -> "node 2" [ attribute1=value1 attribute2=value2 ... ] #comments
...
}
```

2. Undirected Graph:

```
graph graphName {
node1 [ attribute1=value1 attribute2=value2 ... ] #comments
"node 2" [ "attribute 1"="value 1" attribute2=value2 ... ] //comments
...
node1 -- "node 2" [ attribute1=value1 attribute2=value2 ... ] #comments
...
}
```

Nevertheless, the input graph can be a multigraph, where parallel edges are allowed.

You can find several example DOT files in the 'sample_graph' directory or download them here.

Names for graphs, nodes, edges, and attributes can be strings of any non-space characters except:

```
[]();#="
```

There are no escape characters.

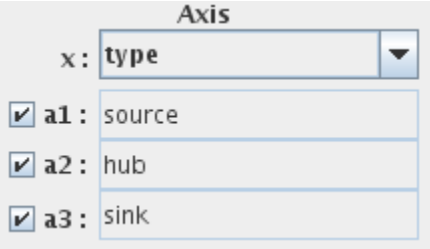
Space characters can be used by wrapping the string with double-quotes.

Comments can be added throughout the DOT file with either '#' or '//'; any trailing characters are ignored by the parser.

Axis Assignment

Each node can be assigned to one (or none) of the three axes in the hive plot.

The axis assignment criteria is based on either a node's property in the network or a node's attribute. The assignment criteria can be set with these controls in the first column of the settings panel:



1. A drop-down list to select either a property or an attribute for axis assignment. It defines variable 'x', which is used for some properties.
2. Text fields to define the rule for each axis. JavaScript syntax is used for some properties.
3. Check boxes to toggle assignment of nodes to each axe.

- If a node does not meet the assignment criteria or it qualifies to be assigned to more than one axes, then it will not be included in the hive plot.
- An empty text-field corresponds to the set of nodes *not assigned to the other two axes*.

Node Properties

available not available

Name	Variable 'x'	JavaScript	Description
type	−	−	A node can be one of the following types in the network: • '`source`' - the node has only outgoing edges. • '`hub`' - the node has both outgoing and incoming edges. • '`sink`' - the node has only incoming edges. Isolated nodes (ie. nodes without any edges) are not included in the hive plot. Incident nodes of undirected edges are hubs.
name	−	−	The name of the node. To be assign specific nodes to the axis, you must define either: • a substring of the node names, ie. '`app`' matches '`apple`', '`pineapple`' • a JavaScript regular expression pattern matching the node names, ie. '`node1\d*`' matches '`node1`', '`node12`', '`node123`'

betweeness			Betweeness centrality; the number of shortest paths that pass through a node.
branching (nn/n)			The number next-neighbors divided by the number of neighbors.
closeness			Closeness centrality; the average distance between a node and all others reachable from it.
clustering coefficient			The clustering coefficient of a node.
degree			Degree centrality; the number of incident edges of a node.
eccentricity			The maximum distance between a node and all others reachable from it.
eigenvector			Eigenvector centrality.
flow			The difference between numbers of outgoing edges and incoming edges.
PageRank			Google's variant of the eigenvector centrality.
reachability			The number of nodes that can reach a node. In a directed graph, this is the number of upstream nodes.

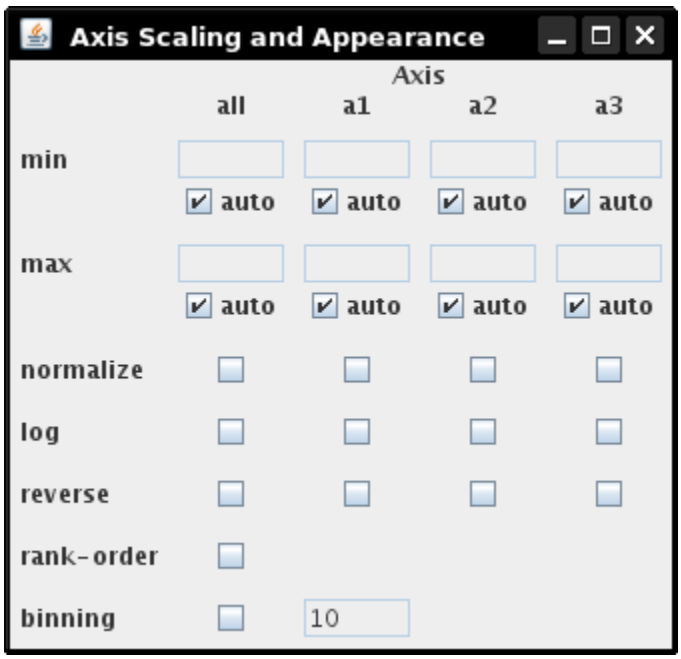
Node Attributes

As shown in Input Format, a node can be associated with attributes. Node attributes can be used in axis assignment.

In the drop-down list, the node attribute names would appear blue and are always prefixed with the dollar sign character '$', ie. **`$attribute1`**

Axis Scaling and Appearance

The scale and appearance of an axis can be set with the controls in this dialog:



This dialog can be launched from either the Dialogs menu or the 'Scaling & Appearance' button in the Axis column of the settings panel.

Functions

available not available

Function	All Axes	Individual Axis	Description
min	✓	✓	Sets the minimum position allowed. The 'auto' check-box or an empty text field would automatically find the minimum position for the corresponding axis.
max	✓	✓	Sets the maximum position allowed. The 'auto' check-box or an empty text field would automatically find the maximum position for the corresponding axis.
normalize	✓	✓	Scale the node positions to use the full length of axis.
log	✓	✓	Apply logarithmic transform on the node positions.
reverse	✓	✓	Reverse the assigned node positions.
rank-order	✓	−	Reassign each node a position based on its rank. No two nodes would have the same rank within one axis.
binning	✓	−	Distribute nodes into evenly spaced bins. The number of bins is defined in the text field.

Position Assignment

Each node has a specific position on the axis it was assigned.

Like axis assignment, positions are also defined based on either a node's property in the network or a node's attribute. The assignment criteria can be set with these controls in the second column of the settings panel:

1. A drop-down box to select the property/attribute for all 3 axes.
2. A drop-down box to select the property/attribute for axis a1.
3. A drop-down box to select the property/attribute for axis a2.
4. A drop-down box to select the property/attribute for axis a3.

Node Properties

As described in Axis Assignment, except 'type' is not available here.

Node Attributes

As shown in Input Format, a node can be associated with attributes. The node attributes can be used in position assignment.

In each drop-down box, node attribute names are blue and are always prefixed with the dollar sign character '$', ie. **$attribute**

Format Rules

Syntax

Each line can be one of the following. Comments can be made with either '#' or '//'; all trailing characters would be ignored.

Syntax	Description
`GC`	A General Command (GC) that affects the entire hive plot.
`[AM; ...]`	Set the default Appearance Modifiers (AM). Any format rules following this line will have these appearance modifiers unless overwritten otherwise.
`QNS [AM; ...]`	Apply appearance modifiers to the node(s) selected with a Quick Node Selector (QNS).
`QES [AM; ...]`	Apply appearance modifiers to the edge(s) selected with a Quick Edge Selector (QES).
`CNS [AM; ...]`	Apply appearance modifiers to the node(s) selected with a Complex Node Selector (CNS).
`CES [AM; ...]`	Apply appearance modifiers to the edge(s) selected with a Complex Edge Selector (CES).

General Command

Syntax	Description

`clear`	Hide all nodes and edges from the hive plot.
	
	This is shorthand for:
	
	`n() [show=no]`
	`e() [show=no]`
	
	or
	
	`.* [show=no]`
	`.* .* [show=no]`

Appearance Modifier

Syntax	Description
`thickness=int` `width=int`	Set the thickness of the edge(s) selected. `int` must be an integer 0.
`size=int` `radius=int`	Set the radius of the node(s) selected. `int` must be an integer 0.

`rgb=(int,int,int)`
`color=(int,int,int)`
`colour=(int,int,int)`
	Set the color of the item(s) selected with an RGB triplet (*r*, *g*, *b*).
	
	`int` must be an integer in range [0, 255].

`rgb=str`
`color=str`
`colour=str`
	Set the color of the item(s) selected with a name.
	
	`str` must be one of:
	
	• `optblue, optgreen, optyellow, optorange, optred, optviolet, optpurple`
	• `white`
	• `vvvvlgrey, vvvlgrey, vvlgrey, vlgrey, lgrey, grey, dgrey, vdgrey, vvdgrey, vvvdgrey, vvvvdgrey`
	• `black`
	• `vlred, lred, red, dred`
	• `vlgreen, lgreen, green, dgreen`
	• `vlblue, lblue, blue, dblue`
	• `vlpurple, lpurple, purple, dpurple`
	• `vlyellow, lyellow, yellow, dyellow`
	• `lime`
	• `vlorange, lorange, orange, dorange`

`rgb=int`
`color=int`
`colour=int`
	Set the color of the item(s) selected with an index of the color palette.
	
	`int` must be an integer 0.

`rgb=relation`
`color=relation`
`colour=relation`
	Set the color of the item(s) selected as a darker or brighter variant of the default color.
	
	`relation` must be one of:
	
	• `brighter`
	• `darker`

`depth=int`
`level=int`
`z=int`
`layer=int`
	Set the layer of the item(s) selected.
	
	All objects in the hive plot are in the default layer 0.
	
	All objects selected by a format rule are in the default layer 1.
	
	`int` must be an integer in range [-2^{31}-1, 2^{31}-1].

`opacity=int`	Set the opacity of the item(s) selected. `int` must be in an integer in range [0, 100].

`show=boolean`
`visible=boolean`
`appear=boolean`
	Show (or hide) the item(s) selected.
	
	`boolean` must be one of:
	
	• `yes, y, true, t`
	• `no, n, false, f`

`show`
`visible`
`appear`
	Show the items selected.

`autonode=boolean`	Set the visibility of nodes (not) to depend on the visibility of incident edges. `boolean` must be one of: • `yes, y, true, t` • `no, n, false, f`
`autonode`	Set the visibility of nodes to depend on the visibility of incident edges.

`label=boolean`	Show (or hide) the label of the node(s) selected. `boolean` must be one of: • `yes, y, true, t` • `no, n, false, f`
`label`	Show the label of the node(s) selected.

Quick Node Selector

Syntax	Description
`str`	Select a node with its name. `str` must be a valid node name.
`.*`	Select all nodes in the network.

Quick Edge Selector

Syntax	Description
`QNS QNS`	Select the edges from the first QNS to the second QNS.
`QNS QNS QNS`	Select the edges from the first QNS to the second QNS and the edges from the second QNS to the third QNS.

Complex Node Selector

Syntax	Description
`n()`	Select all nodes in the network.
`n(...)`	Select nodes that satisfy the conditions in `...` `...` must be one of, or a comma-separated list of AS or ICES. AS specifies the criteria of the nodes' attributes. ICES specifies the criteria of incident edges' attributes.
`!n(...)`	Complement of the set of nodes returned by `n(...)`

Complex Edge Selector

Syntax	Description
`e()`	Select all edges in the network.
`e(...)`	Select edges that satisfy the conditions in `...` `...` must be one of, or a comma-separated list of AS or ICNS. AS specifies the criteria of the edges' attributes. ICNS specifies the criteria of incident nodes' attributes.
`!e(...)`	Complement of the set of nodes returned by `e(...)`

Attribute Selector

Syntax	Description
`attr=val`	The item(s) has attribute `attr` with only one value and that value is `val`.
`attr~val`	The item(s) has attribute `attr` with one or more values and one of the values is `val`.
`attr~!val`	The item(s) has attribute `attr` with one or more values and one of the values is not `val`.
`attr>val`	The item(s) has numerical attribute `attr` greater than the value `val`.
`attr>=val`	The item(s) has numerical attribute `attr` greater than or equal to the value `val`.
`attr==val`	The item(s) has numerical attribute `attr` equal to the value `val`.
`attr<=val`	The item(s) has numerical attribute `attr` less than or equal to the value `val`.
`attr<val`	The item(s) has numerical attribute `attr` less than the value `val`.

Internal Complex Node Selector

Syntax	Description
`n(...)`	Specify the incident node(s). `...` as defined in CNS.
`n1(...)`	Specify the source node(s).
`n2(...)`	Specify the sink node(s).
`!n(...)`	Complement of set of nodes returned by `n(...)`
`!n1(...)`	Complement of set of nodes returned by `n1(...)`
`!n2(...)`	Complement of set of nodes returned by `n2(...)`

> In an undirected graph, `n1(...)` and `n2(...)` are treated the same way as `n(...)`

Internal Complex Edge Selector

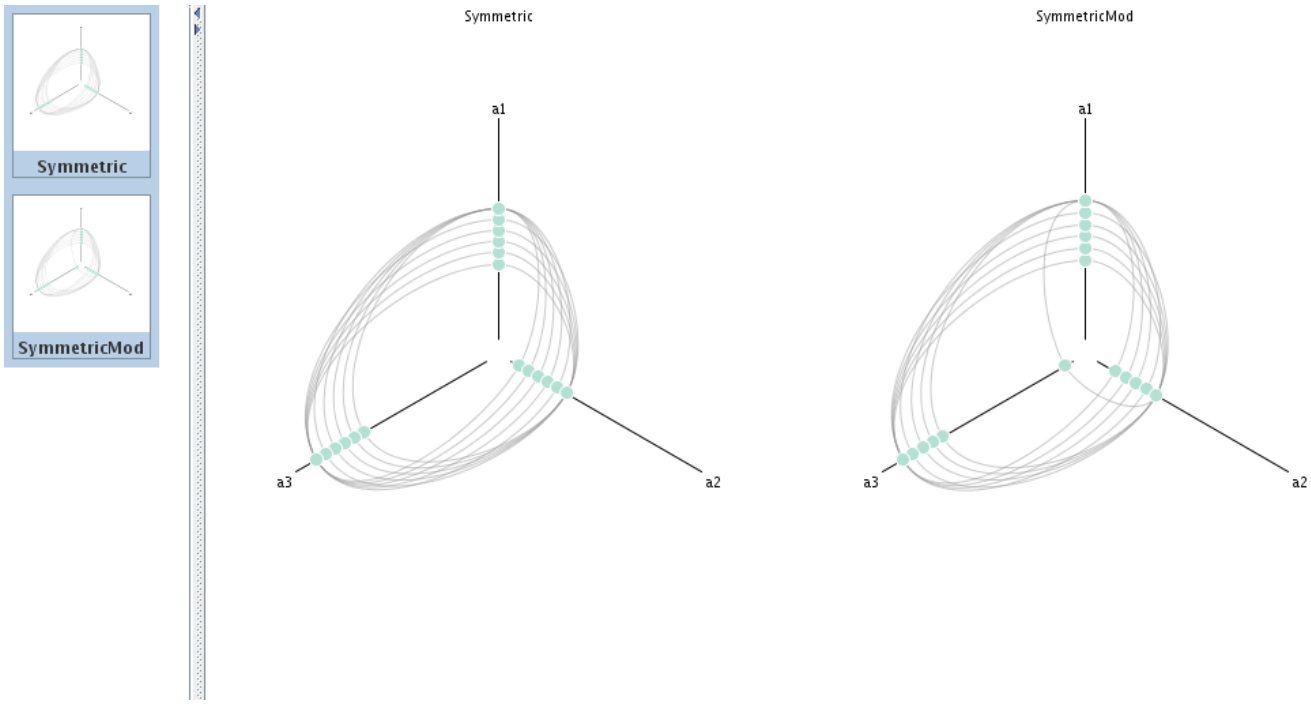
Syntax	Description
`e(...)`	Specify the incident edge(s). `...` as defined in CES.
`e1(...)`	Specify the incoming edge(s).
`e2(...)`	Specify the outgoing edge(s).

`!e(...)`	Complement of set of edges returned by `e(...)`
`!e1(...)`	Complement of set of edges returned by `e1(...)`
`!e2(...)`	Complement of set of edges returned by `e2(...)`

> In an undirected graph, `e1(...)` and `e2(...)` are treated the same way as `e(...)`

Multi-plot View

The selection of thumbnails (left of the divider) determines which hive plots are shown (right of the divider).



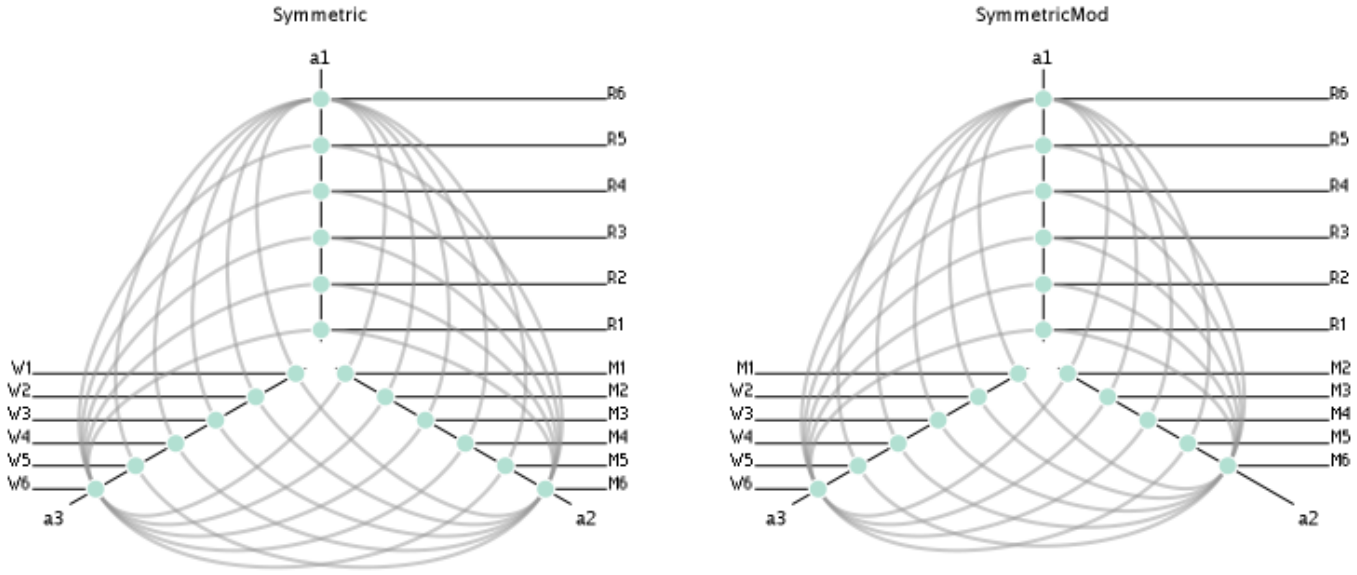
Any changes in current settings would be applied to all hive plots selected.

Conflicting settings between the selected hive plots would be greyed-out. Double-clicking would re-enable a greyed-out component.

Differential Hive Plot

Synopsis

Differences or similarities in networks are typically discovered in a side-by-side comparison.



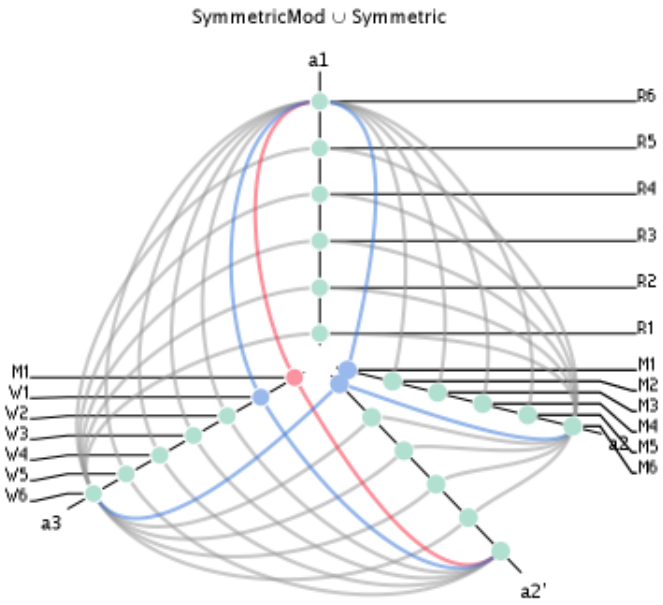
We can simplify this process by visualizing the differences or similarities between two hive plots as a differential hive plot.

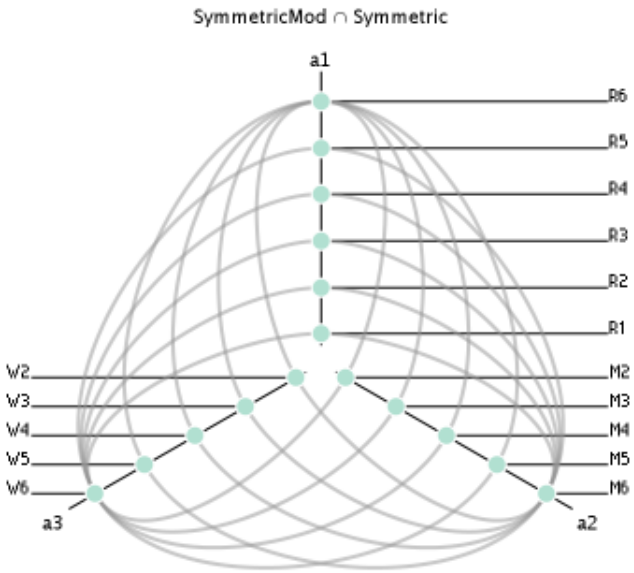
Set Operations

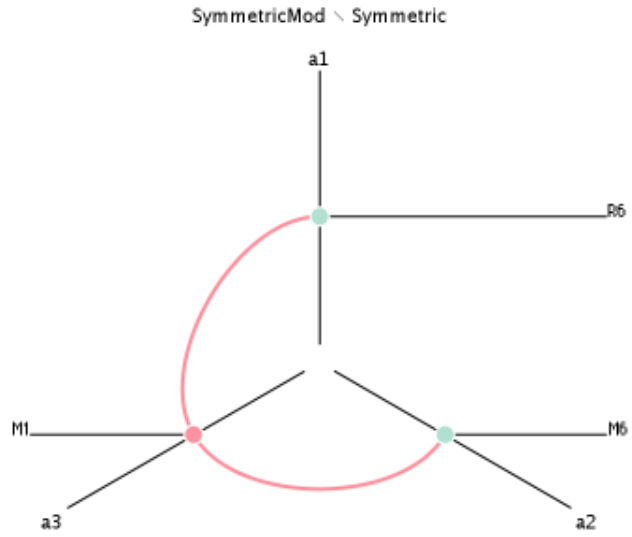
Differential hive plots can be constructed by performing a set operation on two given hive plots "A" and "B":

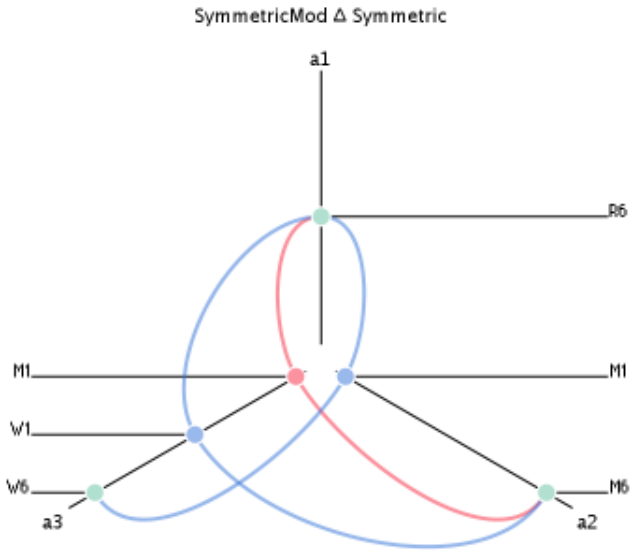
Operation	Denotation	Effect
intersection	A B	Select similar nodes and edges from "A" and "B".
relative complement	A B	Select nodes and edges from "A" that are not found in "B".
symmetric difference	A B	Select unique nodes and edges from each plot.
union	A B	Select all nodes and edges from "A" and "B". Equivalent to joining the results of intersection and symmetric difference.

Here are 4 different differential hive plots:









Definition of Similarness

Two edges are *similar* if all of the following are met:

- sources are on the same axis
- sinks are on the same axis
- directionality must agree for directed edges only
- positions of the sources are within the margin of error
- positions of the sinks are within the margin of error
- sources have the same name (optional)
- sinks have the same name (optional)

Margin of Error

The margin of error defines the degree of similarness. There are 2 types of error:

Type	Definition

Absolute Error	The difference in the original values used to define the node's position on the hive plot. Domain: same as the parameter chosen for node position assignment
Relative Error	The difference in the node's relative position on the axis. Domain: (0,1)

Attributes for Format Rules

Every node or edge in a differential hive plot is assigned a value for the **`src`** attribute:

Value	Definition
A	This item is unique to hive plot "A".
B	This item is unique to hive plot "B".
AB	This item is common to both hive plots "A" and "B".

In the 4 examples above, format rules were applied to assign colors based on the `src` attribute.

Nodes that are not *similar* are assigned a value for the **`diff`** attribute:

Value	Definition
`onaxis`	Nodes are on the same axis but no within the margin of error.
`offaxis`	Nodes are on different axis.
`offplot`	The node is not found in the other hive plot.

Tutorial

These lessons will teach you how to use jhive. Topics vary from basics for beginners to features for advanced users.

- Basics - Part 1
- Basics - Part 2

You would need our our sample network DOT files for these lessons.

Basics - Part 1

Consider a sample graph (|*V*|=4, |*E*|=3), '`sample_graphs/simple.dot`':

```
digraph Simple {
A [pos=4] # node 'A'
B [pos=8] # node 'B'
C [pos=16] # node 'C'
D [pos=2] # node 'D'
A -> B [cost=4] # edge from 'A' to 'B'
B -> C [cost=8] # edge from 'B' to 'C'
C -> D [cost=14] # edge from 'C' to 'D'
}
```

Create a hive plot with default settings

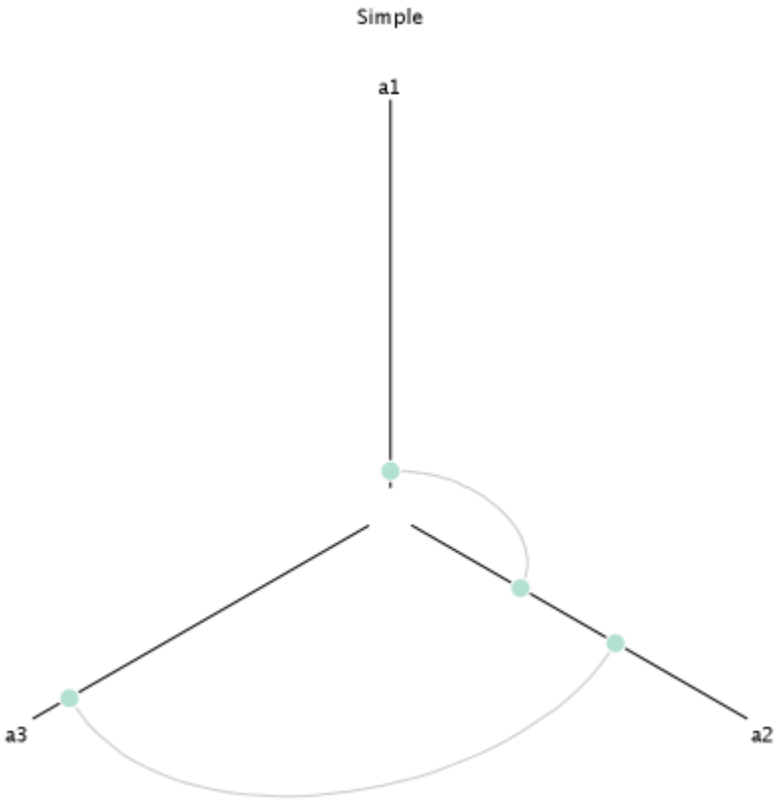
To visualize this network as a hive plot, load this DOT file into jhive by either:

- dragging the DOT file into the thumbnails list of the main window, or
- dragging the DOT file into the Graph Files Manager, or
- locating the DOT file from 'Open Graph Files...' in the 'File' menu.

The hive plot would be generated using the default coordinate system:

Axis	Position
type	name

This is the default hive plot:

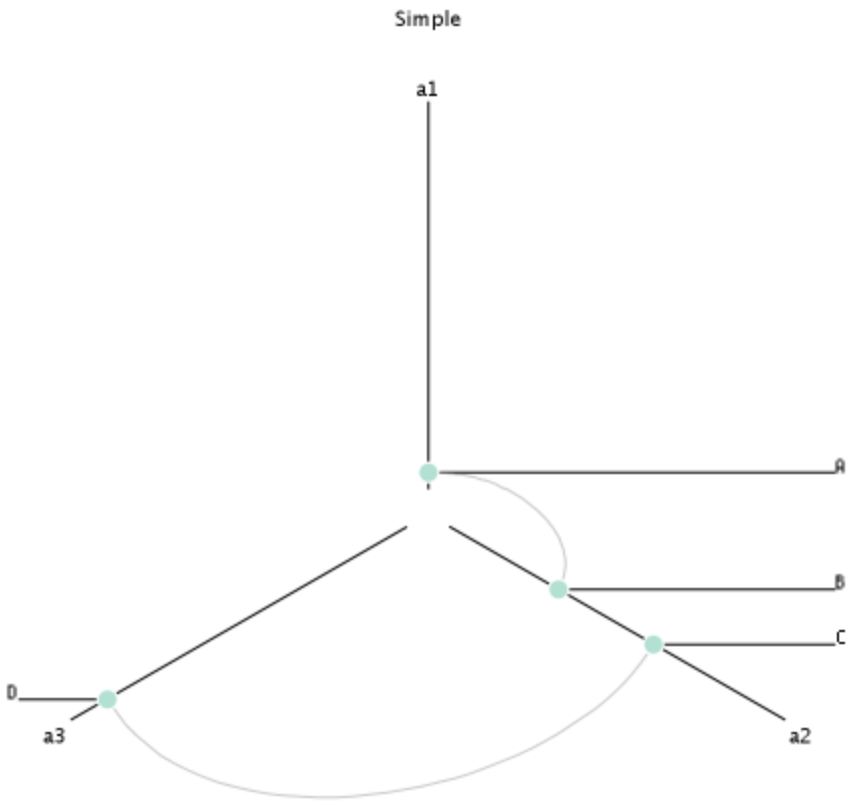


Label nodes on a hive plot

There are tooltips for node names as you hover the cursor over the node. If you like, you can label all nodes with the format rule:

```
n() [label]
```

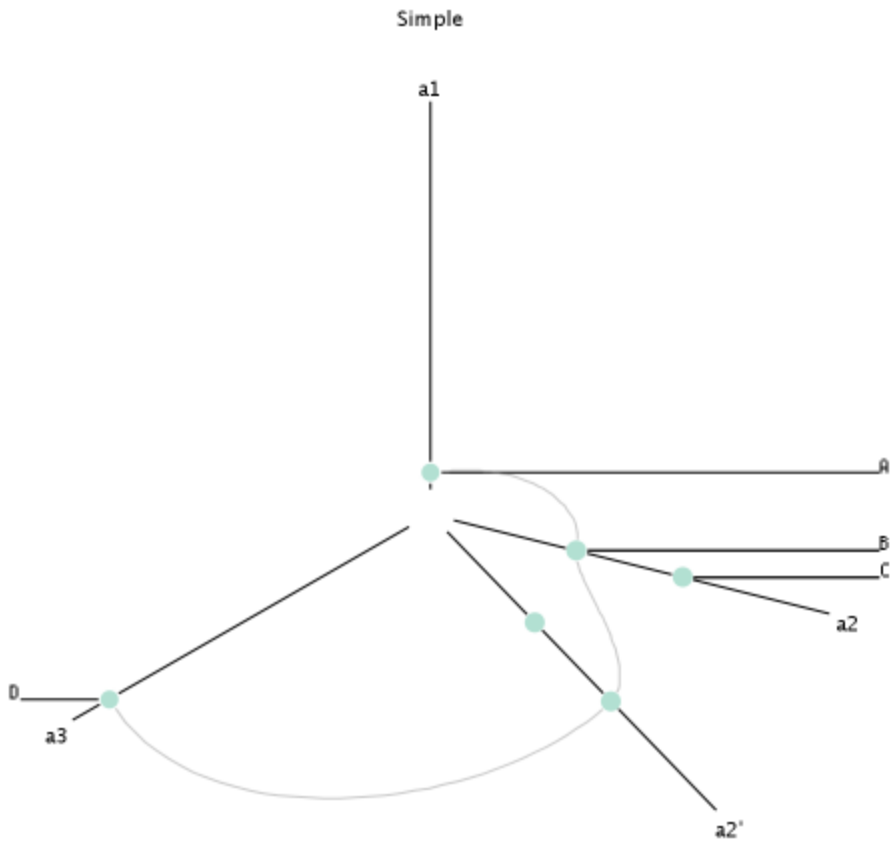
> Remember to click the "Apply" button after adding/removing format rules!



Clone an axis to reveal intra-axial edges

You see 4 nodes but only 2 edges here. So, where is the edge between nodes B and C?

By default, jhive only shows inter-axial edges. To reveal intra-axial edges, double-click the label for axis 2 "a2" to clone axis 2:



The edge between nodes B and C is revealed.

Double-click the axis labels, either "a2" or "a2'", to collapse the cloned axis.

Define a new coordinate system

You can define a new coordinate system using a completely different combination of node properties or attributes.

Let's use the node attribute `pos` for both axis and positions assignments.

> Node attributes are blue and have a dollar sign prefix in the Axis and Position drop-down lists.

In the Axis column, select `$pos` in the drop-down list and enter these conditions into the 3 textfields:

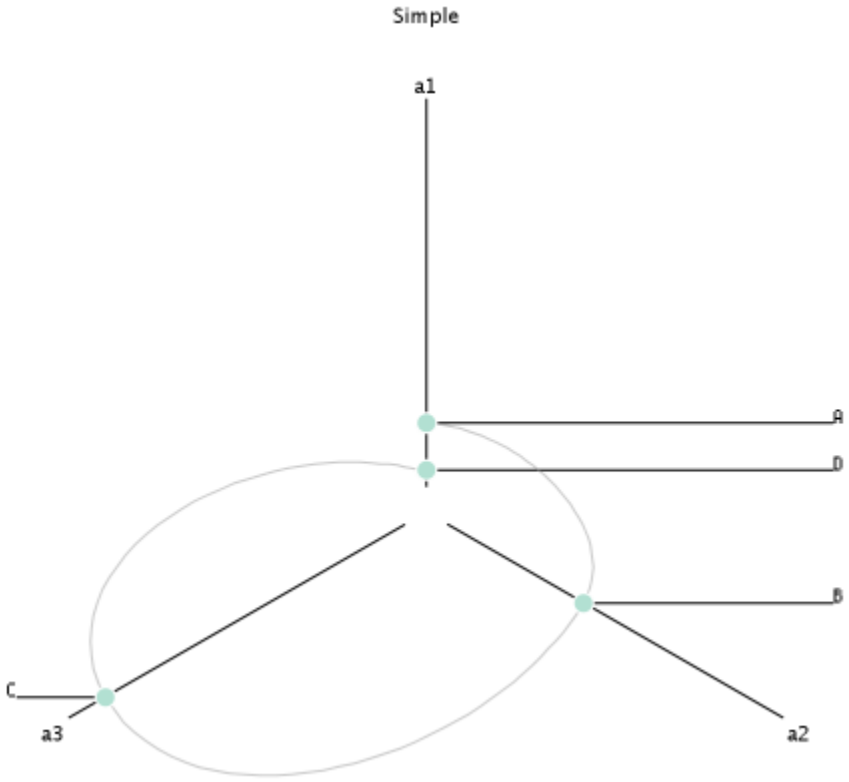
Axis	Condition
a1	`x<=5`
a2	`x>5 && x<=10`
a3	

> The blank a3 condition is intentional. It is equivalent to the condition "`x>10`".
>
> A blank condition is the wild card for nodes not satisfying the conditions for the other axes.

In the Position column, select `$pos` in the top-most drop-down list.

The other 3 drop-down lists are axis-specific. It is possible to assign a different parameter for each axis.

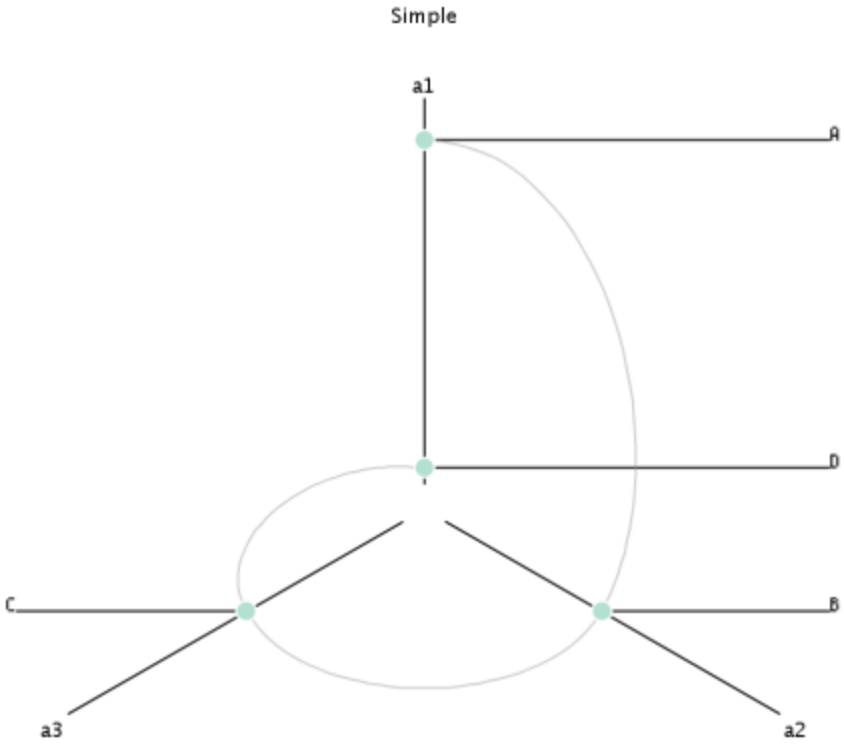
This is the resulting hive plot:



Normalize the scale of axes

By default, the 3 axes are in the same scale. Normalization would magnify each axis to the smallest non-disjoint interval that contains all nodes assigned to the axis.

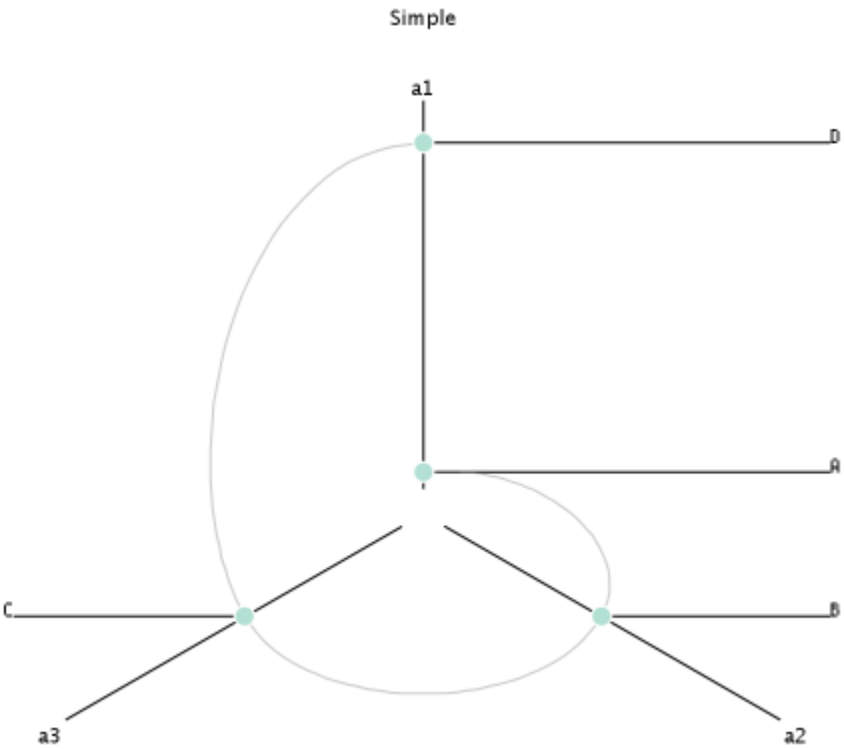
In the Position column, check the "normalize" checkbox. This is the resulting hive plot:



Reverse the axis orientation

Like a Cartesian coordinate system, position values increase as moving away from the origin, regardless of which node property/attribute was chosen for each axis. The axis orientation can be reversed.

In the Reverse column, check the top-most checkbox. This is the resulting hive plot:

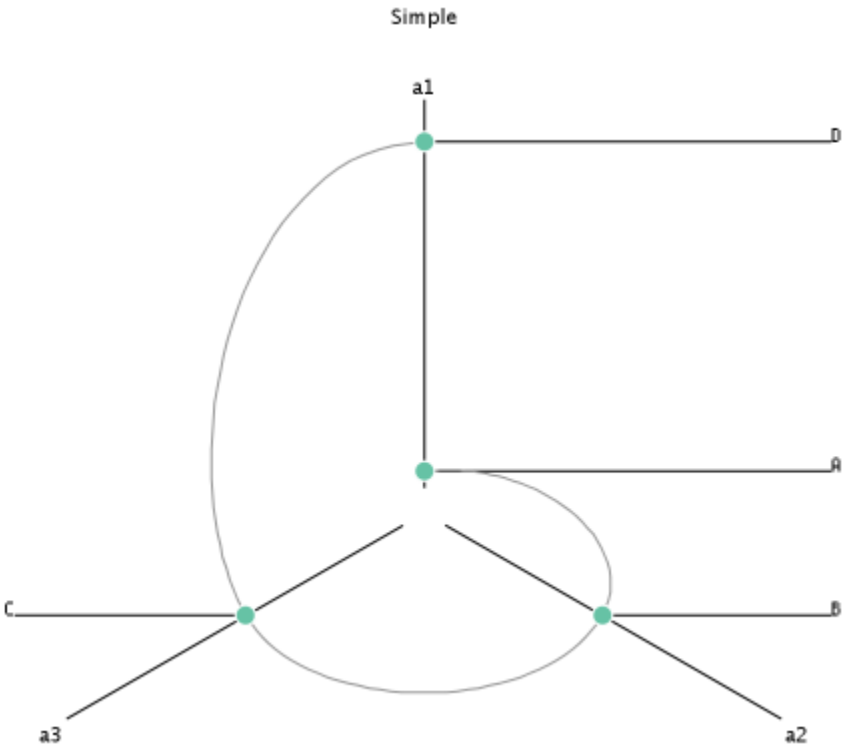


Notice here that nodes A and D have swap their positions.

Change the opacity of nodes and edges

The default opacity for nodes and edges is 50%. The opacity for *all* nodes and edges in the hive plot can be set with the "min opacity" sliders under the Edge and Node columns.

Let's set the opacity of all nodes and edges to 100%:



Notice that the colors appear more saturated now.

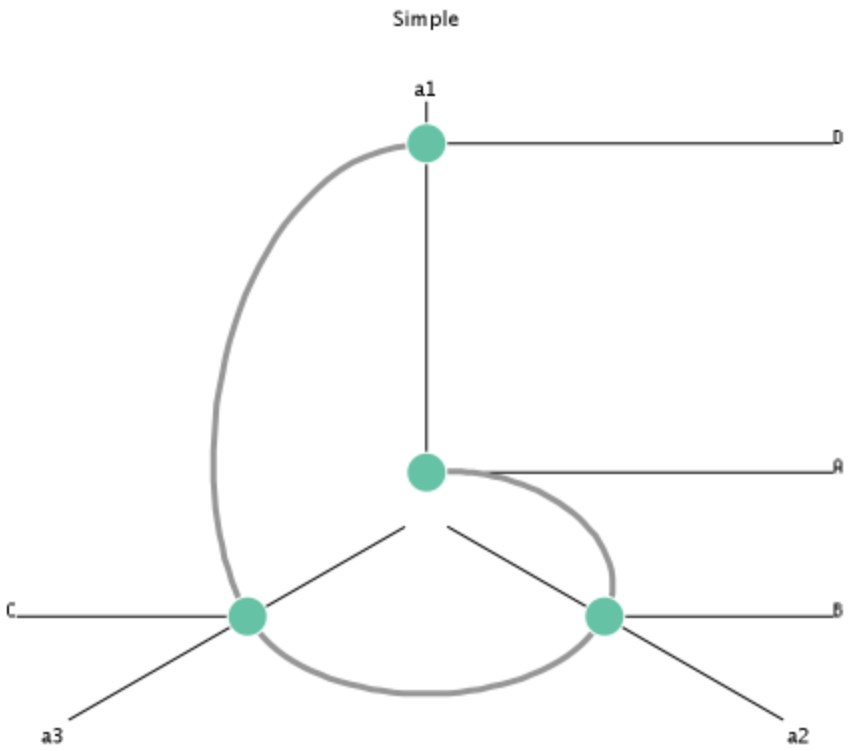
Change the thickness of edges and size of nodes

Edges have a default thickness of 1 pixel and nodes have a default radius of 5 pixels.

The thickness for all edges can be set with the "thickness" slider.

The radius of all nodes can be set with the "size" slider.

Let's set the edge thickness to 3 pixels and the node radius to 10 pixels:



Change the color of edges, nodes, and the background

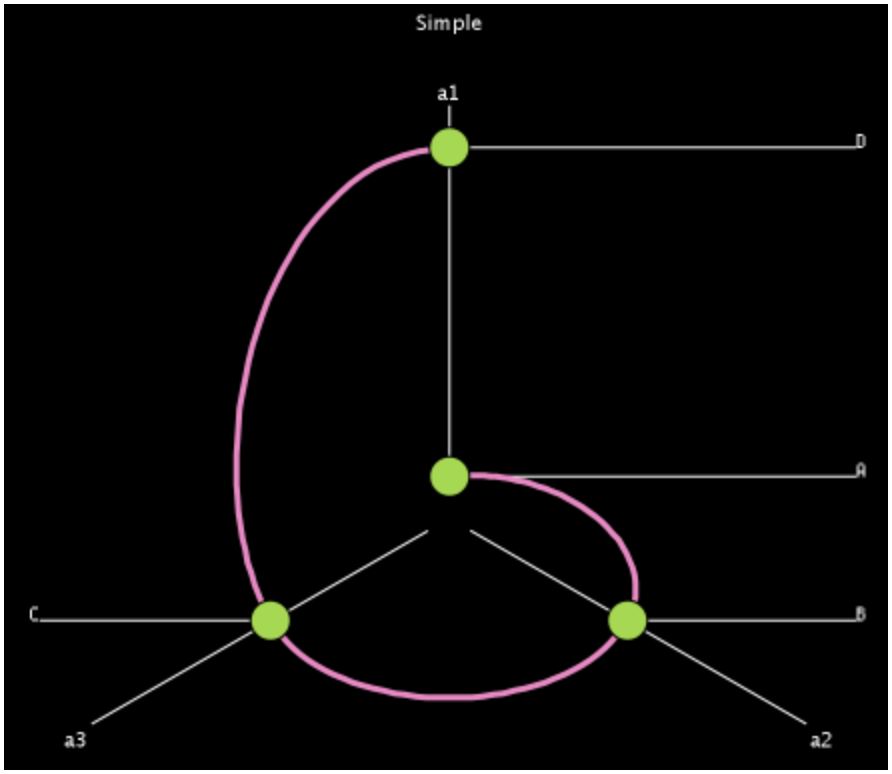
Item	Default Color
edges	gray
nodes	teal
background	white

The color of all edges can be set with the Edge "color" drop-down list.

The color of all nodes can be set with the Node "color" drop-down list.

The background color can be reversed (black) by checking from "Reverse background color" checkbox in the "View" menu.

Example:



Notice the color of axes, labels, and the graph name is white when the background color is reversed.

Basics - Part 2

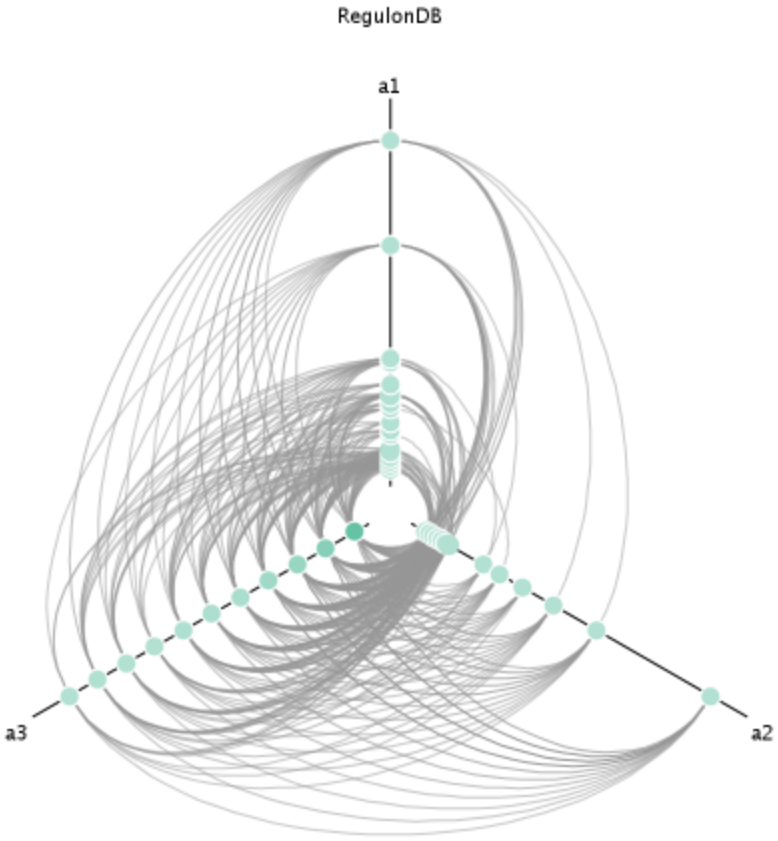
Let's look at a much larger sample graph (|*V*|=1695, |*E*|=3889), '`sample_graph/regulondb.dot`'.

- Normalize opacity of nodes and edges
- Normalize node size
- Fan out edges

Create a hive plot with these changes to the default settings:

- use "degree" to assign node positions
- normalize node positions

> Refer to Basics - Part 1 if you don't remember how to configure the settings to create an hive plot.



Notice that the color of some nodes/edges are more saturated than others?

Their positions are just more popular than others!

Normalize opacity of nodes and edges

The normalized opacity of an item indicates the popularity of the item's position.

For example, the most opaque items are at the most popular position while the least opaque items are at the least popular position.

By default, the opacity values for both nodes and edges are normalized between 50% (the minimum opacity set by the sliders) to 100% (the maximum possible opacity).

Without normalization, opacity of stacking items would simply add up until it is maxed out at 100%. For example, it would only take 2 stacking items to max out the opacity when the minimum opacity is set to 50%.

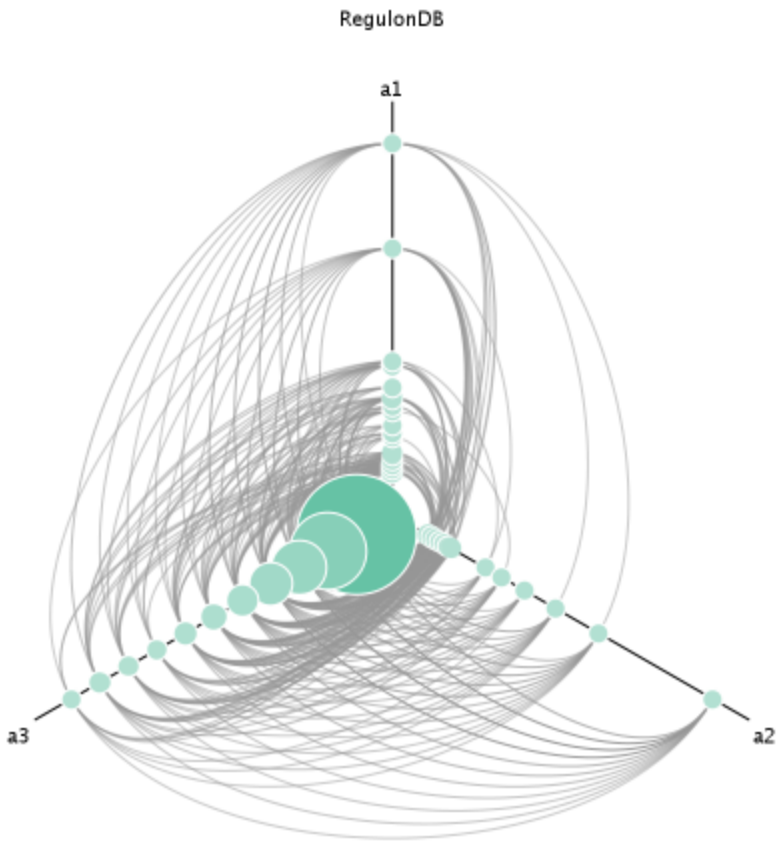
Normalize node size

The normalized node size indicates the popularity of the node's position.

For example, largest nodes (radius of 30 pixels) are at the most popular position while smallest nodes (radius set by the slider) are at the least popular position.

By default, node sizes are *not* normalized.

Let's normalize the node size:



Since node opacity is normalized, the largest node is the most opaque.

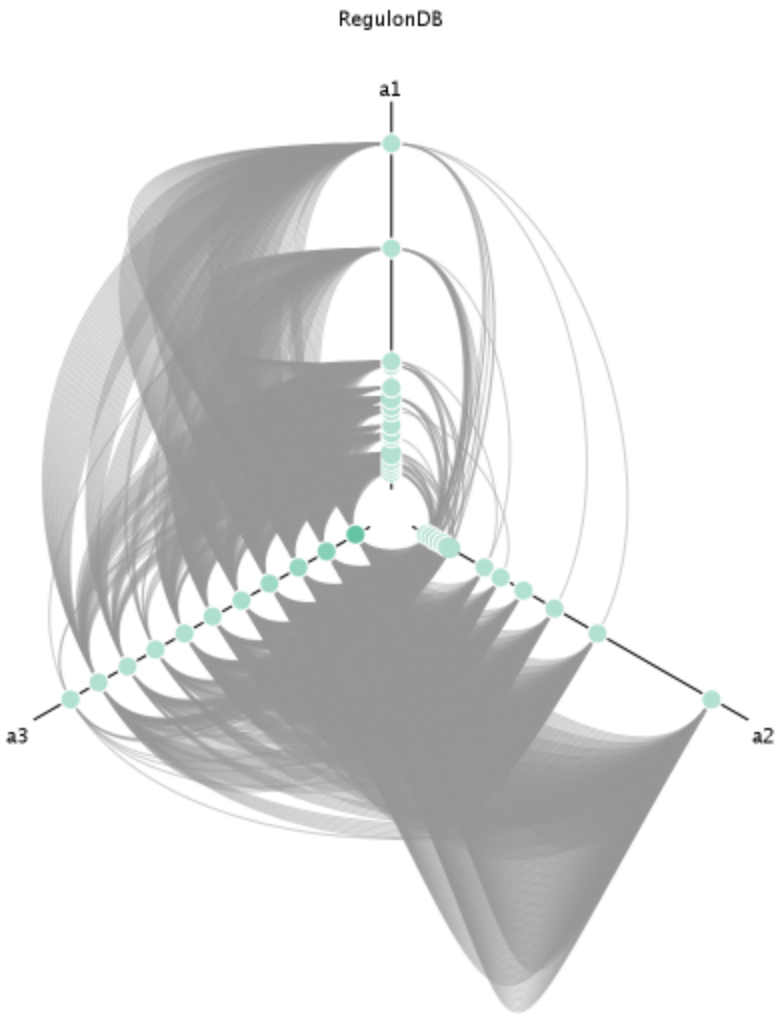
> When each node is given a unique position in a hive plot (ie. when positions are rank ordered or when node name is used for position assignment), there are no stacking nodes and thus normalizing node size and/or opacity would have absolutely no effect.

Fan out edges

Instead of stacking edges at the same position, edges can be fanned out.

By default, stacking edges are *not* fanned out.

Let's fan out the stacking edges:



Normalize edge opacity would have no effect when stacking edges are fanned out.

Support

Please report bugs to Ka Ming Nip.

For more information on hive plots, please visit http://www.hiveplot.net/.