Grid Architecture Evaluation Tool Users Guide

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1.0 Getting Started

1.1 Introduction

The grid architecture evaluation tool is a web-based application that allows users to create, modify, compare, organize and inspect properties of grid architecture representations. This document describes the operation of the grid architecture evaluation tool. A general visual overview of the tool is provided first, followed by detailed instructions on how to create grid architecture representations and a discussion of the primary and ancillary features of the tool. More information on grid architecture is available at the PNNL grid architecture web site [1]. A whitepaper detailing information on grid architectures and their representations is also available [2].

1.2 Accessing the Tool

The tool can be accessed at the Methods page of the grid architecture website [1]. The following browsers and versions have been tested with the tool:

- Chrome 78.0.3904.108
- Safari 13.0.3 (14608.3.10.10.1)
- Firefox 70.0.1

1.3 Tool Working Area and Functions

Figure 1 shows an annotated view of the grid architecture evaluation tool working area. The toolbar contains several buttons that activate features that apply to the current architecture representation. Hovering the mouse cursor over a button will display a tooltip that briefly describes the function of the button. Figure 2 enumerates each of the toolbar button functions. The specific function of each button will be described in later sections. Tips for specific mouse and keyboard actions can be found by hovering over the mouse and keyboard help button in the bottom-left corner of the tool.

Primary working area is divided into three columns where qualities, properties, architectural elements can be created and linked together. Calculated attributes of the current architecture representation are directly above the working area. The working area and its contents will scale with the size of the browser window upon resize. The next section describes the typical workflow for creating architecture representations

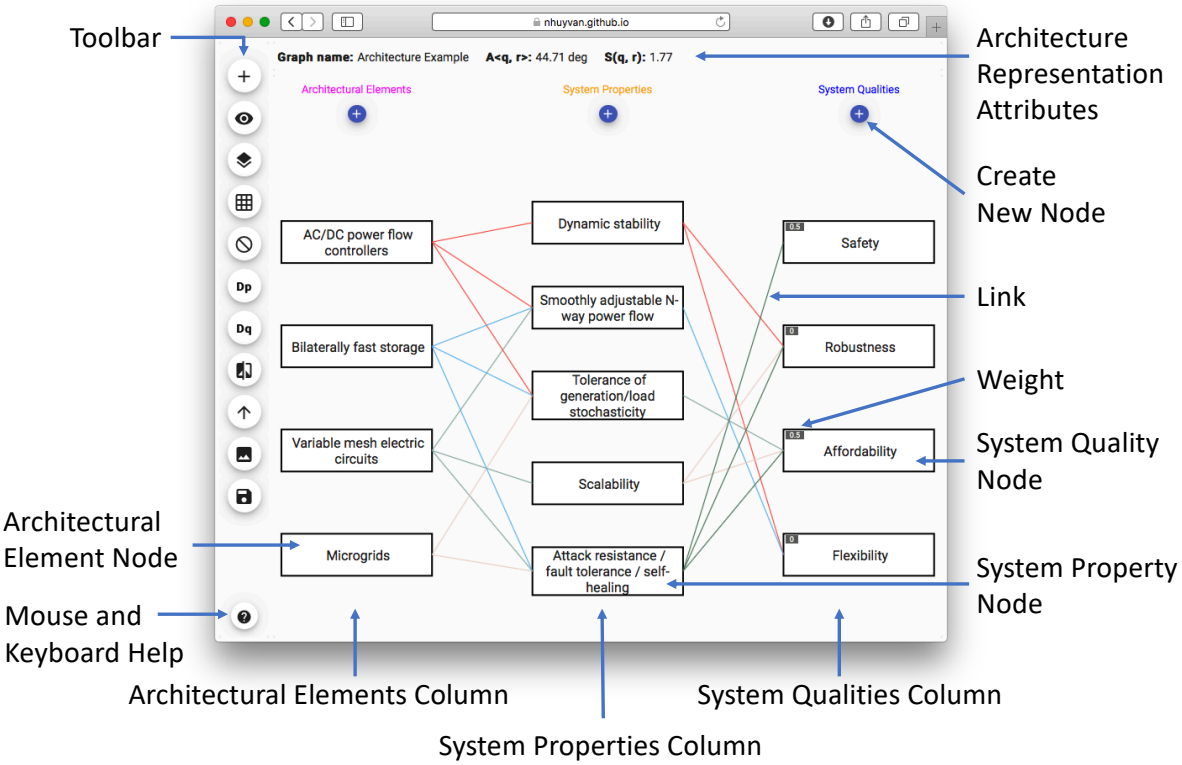

Figure 1. Annotated view of the grid architecture evaluation tool. The toolbar, mouse and keyboard help, architectural elements, system properties and qualities columns, and attributes of the architecture representation are shown.

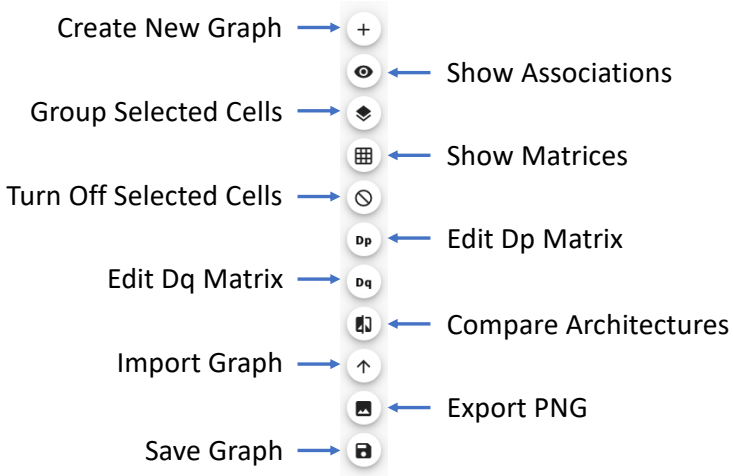

Figure 2. Toolbar button functions. Hovering the mouse cursor over a button will display a tooltip that briefly describes the function of the button.

2.0 Creating Architecture Representations

2.1 Typical Workflow

At any time, a new, empty architecture representation may be created by clicking on the *Create New Graph* button. New architecture representations are typically created in a specific sequence, starting with the creation of system qualities and assigning weights, creation of system properties, linking properties to qualities and assigning weight to these links, and ending with the creation of architectural elements, linking to system properties and assigning weights to these links.

The weights of system qualities correspond to an assignment of importance to the qualities. The weights of links correspond to how much an architectural element contributes to a linked system property, or how much a system property contributes to a linked system quality; by default, all links are assigned a weight of 1, which indicates that an element or property contributes fully to the linked property or quality, respectively.

Section 4 of [2] describes the rationale behind this process. Details of the specific creation and linking operations are described below.

2.2 Adding Qualities, Properties and Architectural Elements

To add a new system quality, system property or architectural element node, click on the *Create New Node* button in any of the three columns; a new node will appear. When a node is created, the text of the node may be immediately changed. Click anywhere outside of the node or press escape to finish editing the node's text. To change the text of a node any time after it has been created, double-click the node and type the new text.

The weight of a system quality may be changed by pressing control-left-click (Windows) or command-left-click (Mac) and typing the new weight. The weights of all system qualities must sum to 1.

2.3 Selecting Nodes and Links

Several functions of the tool only work when one or more nodes are selected. To select a node, left-click on the node; the border of the selected node will change from solid to dashed. To select multiple nodes, shift-left-click the nodes. To deselect all selected nodes, left-click on any empty space in the work area. To delete a node, select the node and press the delete key.

Links can also be selected. To select a link, left-click on the link; the selected link will be highlighted.

2.4 Linking Qualities, Properties and Architectural Elements

Architectural element nodes may be linked to system property nodes, and system property nodes may be linked to system quality nodes. To link nodes, first select a node, then select the node to link to. A new link will appear connecting the two nodes.

The weight of a link between two nodes may be changed by double-clicking on the link. The weight can be viewed by hovering the mouse cursor over the link. To delete a link, select the link and press the delete key.

3.0 Calculating and Viewing Architecture Characteristics

The tool automatically calculates two characteristics of the current architecture representation. These characteristics appear above the primary working area and are populated once a path from at least one architectural element to at least one system quality is present; the characteristics update in real-time as the architecture representation is changed. More information on the calculation of these features can be found in section 6.4 of [2].

4.0 Comparing Architectures

The representations of related architectures can be compared with each other. The comparison function shows how two architecture representations differ in terms of alignment and strength. The angle between two architecture representations is also computed.

To compare two architecture representations, load the first one by clicking the *Import Graph* button, and then click the *Compare Architectures* button. A file selection dialog will appear. Select the second architecture representation to compare with, and a window will appear that shows the alignment and strength of the two architectures side-by-side. The angle between the two architectures is also shown. Figure 3 shows the comparison of two architectures. More information on the computation of angle between architectures can be found in section 6.4 of [2].

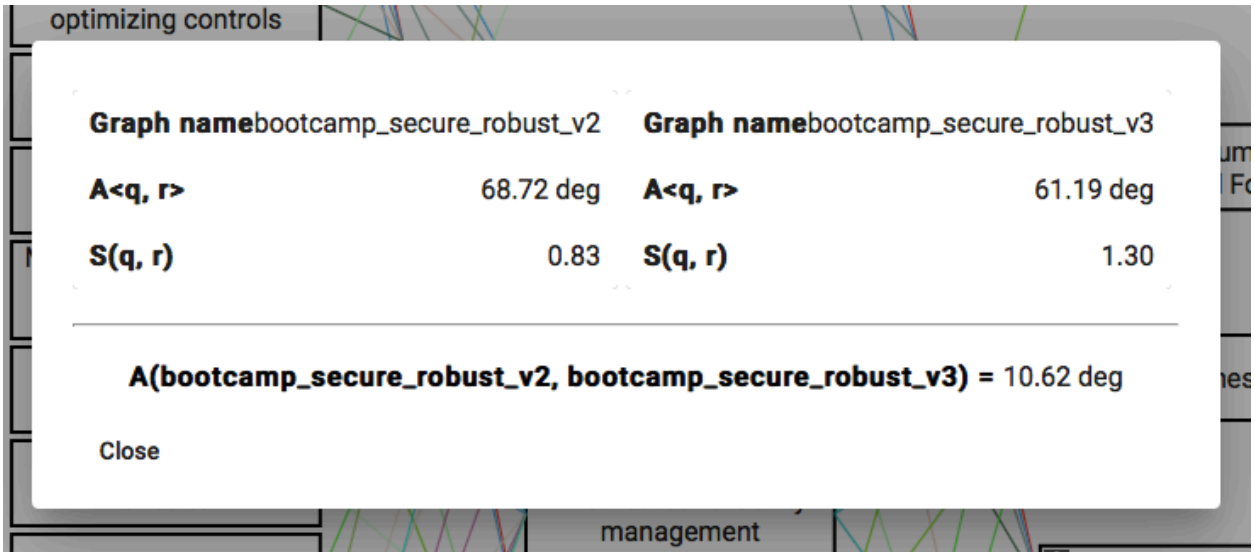

Figure 3. Comparison of two architectures. Architectural alignment and strength are shown side-by-side and the angle between the two architectures is shown at the bottom.

5.0 Viewing and Manipulating Representations

The tool provides three features that display architecture representations in forms that are more organized and easier to read: *Show Associations*, *Group Cells* and *Turn Off Selected Cells*. These features are helpful for examining large or complex representations.

The *Show Associations* feature hides all nodes but those that are connected to the currently selected nodes. This allows dependencies between properties, qualities and elements to be seen more clearly for densely connected architecture representations. To use this feature, first select one or more nodes. Next, click the *Show Associations* button. The tool then hides all nodes but the selected nodes and those connected to the selected nodes. To revert to normal viewing, click the *Show Associations* button again.

The *Group Cells* feature organizes one or more selected architectural element nodes into a group; only architectural elements can be grouped. This spatial aggregation can improve understanding of a representation with a large number of architectural elements. More than one group can be created. To create a group, select one or more nodes and click the *Group Cells* button. To remove a node from a group, select the node and click the *Group Cells* button. To remove all nodes from a group, select all of the nodes in a group and click the *Group Cells* button.

The *Turn Off Selected Cells* feature hides selected nodes, which may make viewing of dense architectures easier. To hide nodes, first select one or more nodes to be hidden, and then click the *Turn Off Selected Cells* button. To unhide hidden nodes, select the nodes and click the *Turn Off Selected Cells* button again.

6.0 Viewing and Editing the Matrices

As described in [2], the underlying mathematical representation of an architecture representation is a set of vectors and matrices. These elements can be viewed by clicking on the *Show Matrices* button. Figure 4 shows the display of matrices for an architecture representation. These matrices are computed from the architecture representation graph in the work area and cannot be edited directly.

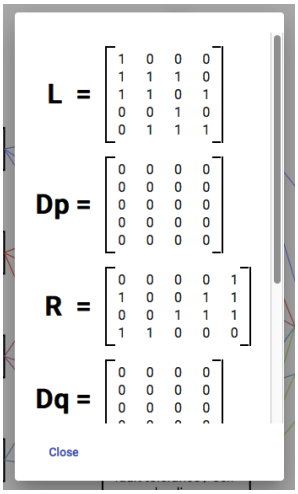

Figure 4. The Show Matrices feature displays the underlying matrices used to calculate architecture characteristics.

Quality and property detractor matrices can be viewed and edited directly since they are not modeled as part of the architecture representation graph. To view and edit the detractor matrices, click on the *Edit Dp Matrix* or *Edit Dq Matrix* buttons. Figure 5 shows the display of the D_p and D_q detractor matrices. Section 6.3 of [1] describes detractor matrices in more detail.

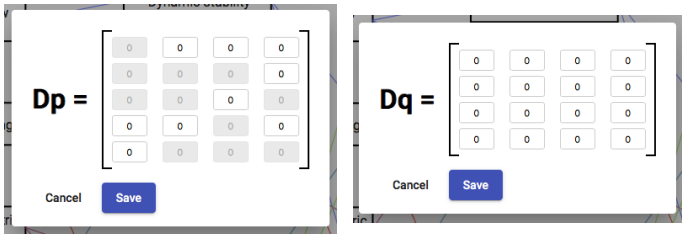

Figure 5. The property and quality detractor matrices. The cells of these matrices can be edited directly.

7.0 Importing and Exporting Representations

Architecture representations can be imported into and exported from the tool as JSON files. To import an architecture representation, click the *Import Graph* button. A file selection dialog will appear; select a JSON file to import. If the imported file is correctly formatted, the architecture representation will appear in the tool.

To export an architecture representation, click the *Save Graph* button. A dialog box will appear that allows the name and date to be modified. The exported file will be saved in the local filesystem using the value specified for the *Graph name* attribute with a ".json" extension. Additional metadata may also be added to the exported file by clicking on the *Add Attribute* button and specifying attribute names and values; this is useful for describing information about the architecture representation, such as an informational description or a version number, for example.

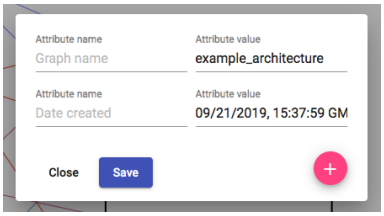

Figure 6. The Save Graph dialog. By default, the name and data can be specified. New metadata can also be added to the exported file by clicking the Add Attribute (pink) button and specifying attribute names and values.

Architecture representations can also be exported as Portable Network Graphics (PNG) file. To export a PNG of the architecture representation, click the *Export PNG* button. A file dialog window will appear where the name of the exported PNG file can be specified. The exported PNG file will be saved to the local filesystem.

8.0 Reporting Bugs and Issues

Please report all bugs and issues to Jeffrey.Taft@pnnl.gov.

9.0 References

[1] Grid Architecture Home page. Accessed from https://gridarchitecture.pnnl.gov on November 20, 2019

[2] J. D. Taft. A Mathematical Representation of System Architectures. PNNL-27387. March 2018. Accessed from https://gridarchitecture.pnnl.gov/media/advanced/Math_Representation_of_Sys_Arch_v0_3_GMLC.pdf on November 20, 2019

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