

PlasmoID Technical Guide

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INTRODUCTION

PlasmoID is an open access plug-in to cytoscape that allows to query and edit the *P. falciparum* interaction database (DB) which contains interactome data. It allows the user to retrieve the interactions from the database and the view them in a graph representation. The current schema of the interactome database also allows the user to create new interactions and integrate them into the database for retrieval. The basic unit of work can be a pathway or a graph. The entities include gene, protein, chemical entity, pathway, graph, process, phase and location, of which the database contains the data for gene, protein, chemical entity, pathway and graph. The plug-in has been designed to explore the database for interactions between any of these basic entity types; to visualize them and analyze them; and to create new interactions and save them to the database in sync with the existing interactions.

PlasmoID has been developed using JAVA. The salient features of the plug-in include:

- (1) Functionality for querying the underlying interactome database. Allows sub strings and comma-separated multiple input strings for a specific entity type in the *Input Dialog*.
- (2) In addition to the graph view and the tree view of the network, this provides a tabular view of nodes and interactions, where the table view and graph view are synchronized.
- (3) Retrieving and displaying only the relevant data for these entity types. For example, while displaying interactions for pathways, only two interaction types, "Gives Rise to" & "Acts On" applicable to proteins and chemical entities in a pathway are shown in the graph view.
- (4) A controlled display of the graph by setting a predefined layout for queries based on specific entity types
- (5) Different node representation (shape/color) for different entities. A 'Legend' containing the list of available Entity Types and corresponding shape and color of each entity type is also made available
- (6) Saves the graph view into the database as either a Graph or a Pathway. Stored interactions can be retrieved as either Graph or Pathway
- (7) Provides an easy-to-use database configuration UI to set the parameters for database access
- (8) Displaying shortest path on canvas
- (9) Retrieving shortest path in database
- (10) Provides node operations on canvas like, Collapse/Expand a selected node, removing orphan nodes from the canvas
- (11) Provides node operations in database like, expanding a selected node, retrieving direct interactions between two selected nodes, finding common effectors and common regulators between two selected nodes.

PlasmoID is developed by the *Plasmodium falciparum* Genome Annotation team at the Life Sciences R&D Division of Tata Consultancy Services Ltd (<http://pfalciparum.atc.tcs.com/>). It integrates seamlessly with Cytoscape. New functionalities are provided, in addition to the features and functionality that Cytoscape offers.

QUERYING THE DATABASE

PlasmoID plug-in supports functionality for querying the underlying interactome database. PlasmoID allows sub strings and comma-separated multiple input strings for a specific entity type in the *Input Dialog*.

Sub String:

plug-in allows sub strings in can be given as input in Input Dialog while searching the database for a specific entity type.

Ex: If the input is “PF” and entity selected is of type “gene”, then the query is like:

```
select geneId from gene where name like "%PF%"
```

As a next step, it lists all the entries for that entity that contain the sub string entered.

The result will be a widget that displays selection box for the given input string. A list of all genes that have the substring “PF” will be displayed, from which the user can choose the gene of interest.

Multiple Input:

plug-in allows multiple input strings can be given as input in Input Dialog while searching the database for a specific entity type.

Ex: If the input is “Ferrochelatase; Uroporphyrinogen” and entity selected is of type “protein”, then the query for first input is like:

```
select proteinId from protein where name = “Ferrochelatase”
```

and the query for second input is like:

```
select proteinId from protein where name like “Uroporphyrinogen”
```

As a next step, it lists all the entries for that entity that contain the strings entered.

The result will be a widget that displays selection boxes for the two input strings. The first part of the input string “Ferrochelatase” is very specific and will not have multiple options but the second part of it “Uroporphyrinogen” is very general. So a list of all proteins that have the substring “Uroporphyrinogen” will be displayed, from which the user can choose the gene of interest.

TABLE VIEW

For each interaction retrieved, the table provides information regarding the name and entity type of the source and target node and the interaction type between the two. Table view is synchronized with Graph View and vice versa.

SPECIFIC INTERACTIONS

PlasmoID plug-in allows to retrieve and display only the relevant data for entity types. For example, while displaying interactions for pathways, only two interaction types, "Gives Rise to" & "Acts On" applicable to proteins and chemical entities in a pathway.

DEFAULT LAYOUT

PlasmoID plug-in allows to change the visual aspects. While rendering the graph, layout can be controlled by using available algorithms in Cytoscape.

For example to view the UI in “force-directed” layout, by using available algorithms from Cytoscape:

```
CyLayoutAlgorithm cyAlog = CyLayouts.getLayout(“force-directed”)
```

ENTITY TYPE REPRESENTATION

PlasmoID plug-in allows to change visual aspects. While rendering the graph, different entity types can be represented in different Color and Shape.

For example, entity type “gene” is represented in “Round Rectangle”, entity type “protein” is represented in “Ellipse” etc.

SAVE GRAPH

PlasmoID plug-in allows to save the UI into database as either in Graph or in Pathway. Stored interactions can be retrieved as either Graph or Pathway.

Following is the list of steps while saving the UI to the database:

- 1) Get the current UI/Table View
- 2) For each interaction (each row in Table View):
 - a) Get the Source EntityId
 - b) Get the Target EntityId
 - c) Get the linkTypeId from linkTypeTable using the Interaction type of Source , Target
 - d) Search in linkPart for Source EntityId and get all linkId's
 - e) Search in linkPart for Target EntityId for each linkId (of step d)If no record is available , then insert the interaction in the database

3) Check for the Save To DB type: Pathway/Graph

4) If it is Graph:

- a) Insert Into Graph Table -- (graphName)
- b) Insert Into EntityType Table -- (targetNodeName, targetentityType)
- c) Insert Into Entity Table -- (targetentityType)
- d) Insert Into Link table
- e) Insert Into LinkPart table
- f) repeat steps d) and e) for all other interactions with GraphId

If it is Pathway:

- a) Insert Into Pathway Table -- (graphName)
- b) Insert Into EntityType Table -- (targetNodeName, targetentityType)
- c) Insert Into Entity Table -- (targetentityType)
- d) Insert Into Link table
- e) Insert Into LinkPart table
- f) repeat steps d) and e) for all other interactions

LASSO EFFECT

PlasmoID plug-in synchronizes Graph View and Table View. Following is the list of steps to capture the synchronization between Graph view and table view.

- 1) Get Swing event, Swing Property Change Support
- 2) Add Property Change Listener to this Swing event
- 3) Get the Current CyNetwork
- 4) Add Select Event Listener to this CyNetwork
- 5) For each Select/UnSelect event, listener will be fired
- 6) For each select/UnSelect, get the edge list of the current network
- 7) Get the details of source node and target node of each edge in the list

8) Update the Table view, with this source and target node details.

ADD NEW NODE

PlasmoID plug-in allows to add new node to the Graph. After adding a new node, as a next step, it displays a widget with one input box to enter name for the added node and combo box of available entity types.

After entering new node name and entity type, new node's shape and color will be changed according to the specified entity type.

LEGEND

The legend gives a graphical representation of the color and shape of the nodes used for different types of entities shown in the graph.

Copy the “legend.jpeg” to Cytoscape home folder.

NODE LINKOUT

PlasmoID plugin Provides node link out feature, which links out to the appropriate source URL.

Following is the list of steps to add new options for Node Link Out feature:

- 1) Get the cytoscape's properties
- 2) Get all the sources from database.
- 3) Append each source to "Plasmodium falciparum'
- 4) Add each entry to cytoscape properties file in the form of key-value pairs.

Eg:nodelinkouturl.Plasmodium

falciparum.PlasmoDB.gene=[http://www.plasmodb.org/plasmo/showRecord.do?](http://www.plasmodb.org/plasmo/showRecord.do?name=GeneRecordClasses.GeneRecordClass&primary_key=%ID%&project_id=PlasmoDB)

[name=GeneRecordClasses.GeneRecordClass&primary_key=%ID%&project_id=PlasmoDB](http://www.plasmodb.org/plasmo/showRecord.do?name=GeneRecordClasses.GeneRecordClass&primary_key=%ID%&project_id=PlasmoDB)

EDGE LINKOUT

PlasmoID plugin Provides edge link out feature, which links out to the appropriate source URL.

Following is the list of steps to add new options for Edge Link Out feature:

- 1) Get the cytoscape's properties
- 2) Get the link Id of each edge and get the corresponding source of that link Id.
- 3) Append each source to "Plasmodium falciparum'
- 4) Add each entry to cytoscape properties file in the form of key-value pairs.

Eg:edgelinekouturl.Plasmodium

falciparum.PlasmoDB.gene=[http://www.plasmodb.org/plasmo/showRecord.do?
name=GeneRecordClasses.GeneRecordClass&primary_key=PF11_0431&project_id=PlasmoDB](http://www.plasmodb.org/plasmo/showRecord.do?name=GeneRecordClasses.GeneRecordClass&primary_key=PF11_0431&project_id=PlasmoDB)

FIND SHORTEST PATH ON CANVAS

The user can view the shortest path between two selected nodes on the canvas.

For this functionality, we should have PeSca (Path Extraction by Shortest Cost Algorithms) jar under plugins folder. The PeSca jar is available from: <http://profs.sci.univr.it/~scardoni/PescaDownload.php>

FIND SHORTEST PATH IN DATABASE

The user can navigate through the database to see the shortest link(s) between two nodes. This includes direct relations , relations that are one-step removed (having one intermediate node)

NODE OPERATIONS

Plugin provides DB expand features like expand from database, Direct interaction between two selected nodes, common effectors and common regulators between two selected nodes & Canvas features like

Expand/Collapse , removing orphan nodes.