

GOView User Manual

December 22, 2015

GOView is a web-based application, which allows users visualize and compare multiple provided GO term lists in a directed acyclic graph (DAG) to reveal relationships among the terms. Through the use of tightly coupled, interactive visualization of clickable venn diagram (or sortable heat map) and GO DAG, GOView allows easy comparison of multiple GO term lists to identify common and specific biological themes. GOView employs highly efficient software library and powerful visualization components to enable fast plotting, navigation and analysis of the GO DAG.

1. Input

To start an analysis, the user should first select an GO ontology (e.g. biological process, cellular component and molecular function) from the dropdown menu (Figure 1A) and then select an ID type from the “Search By” dropdown menu (Figure 1B). The options of the menu include GO ID (e.g. GO:0007050), GO Name (e.g. cell cycle arrest) and GO Name from GSEA result (e.g. CELL_CYCLE_ARREST_GO_0007050). Upon selection of the ontology, an input box will appear on the bottom left side of the webpage (red box in Figure 1C). The user can input a name of the GO term list. The name can only include letters, numbers, and the symbol “-” to dictate conjunctions between words. Spaces and any other symbols are not allowed in the entry of the names. Then, clicking “Add Field” button, a box will be added under the “Search By” dropdown menu for GO term input (blue box in Figure 1C). The user can add up to a max of 10 lists for each analysis. Clicking the title bar of each box, the user can input or modify a line-separated list of GO terms using the selected ID type. To help input related GO terms, a search bar can be found above the input area of the box. The user can input the search keyword of the ID type selected on the “Search By” dropdown menu. This search bar will give suggestions to the user on terms that are related to user input upon entering 5 characters. For example, the user may search “cell ” and see a list of GO terms that are related to “cell” (Figure 1D).

To facilitate the input of multiple GO term lists, GOView supports uploading a GVF file (goviev format file) containing all input information. Each row of a GVF file represents a GO term list and columns are separated by **tab**. The first column is the name of a GO term list and other columns are the GO terms (see an example below). Up to ten rows can be included in a GVF file. Clicking the “Choose File” button (red box in Figure 1C), the user can upload the GVF file to GOView and GOView will automatically generate all input box based on the information in the GVF file.

Example:

List1	GOTerm11	GOTerm12	GOTerm13	GOTerm14	
List2	GOTerm21	GOTerm22	GOTerm23	GOTerm24	GOTerm25
List3	GOTerm31	GOTerm32			

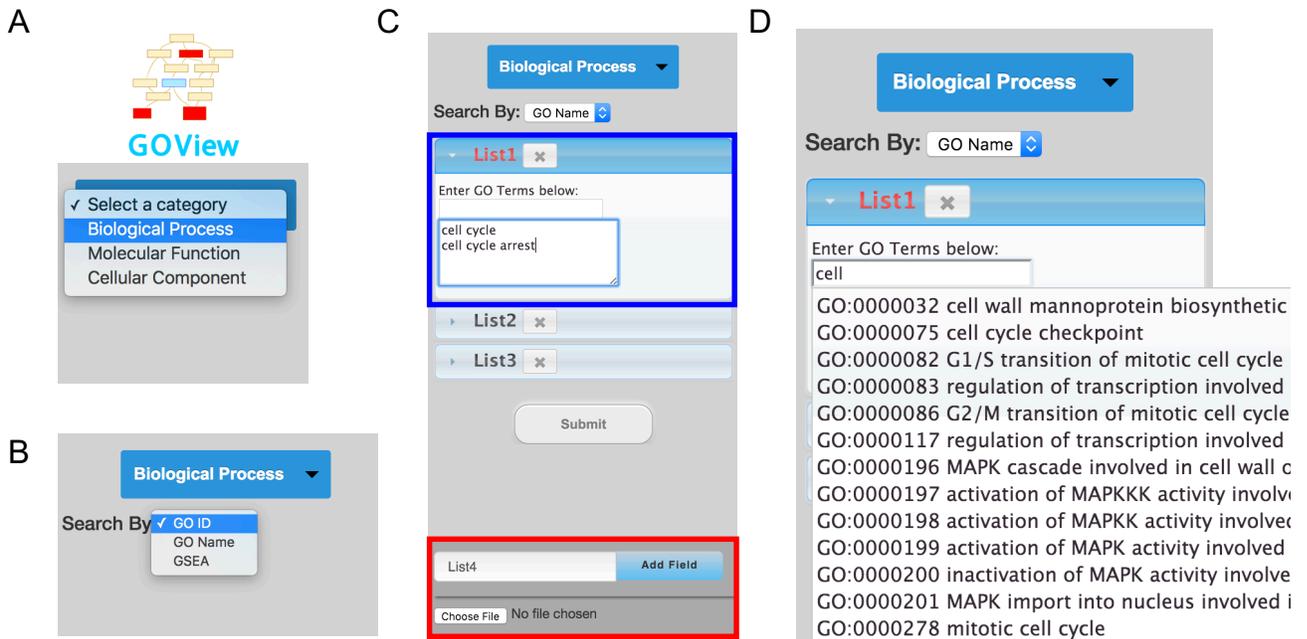


Figure 1. The input of GO term lists in GOView. (A) Ontology selection; (B) ID type selection; (C) Input box generation; (D) Suggestion function for GO term input.

2. Visualization and comparison

After inputting the GO term lists or uploading the GVF file, the user can click the “Submit” button to visualize and compare different lists in the GO DAG structure. GOView can not only plot the GO DAG structure for each list but also compare different lists by using tightly coupled, interactive visualization of clickable venn diagram (or sortable heat map) and GO DAGs.

2.1 GO DAG visualization

Red boxes in the GO DAG structure represent the GO terms in the list while yellow boxes represent the ancestors of these terms (Figure 2A). The user may zoom in and out through using the mouse wheel to zoom to the desired amount. Clicking a term will zoom the DAG into the area around the term and the border color of the selected term will be changed to blue. The user may move the view port on holding the left mouse button on the graph and dragging to the desired location. The current location of the viewport of the graph can be seen in the minimap on the bottom right side of the graph. Similar to the main graph, the minimap can be zoomed and dragged to change the viewport of the graph.

Hovering on a term, the term information will be shown in a pop-up dialog and its ancestors and descendants will be highlighted (Figure 2B). The user may select multiple term through first clicking on a term, then holding the shift button and clicking another term, which selects all of the terms in the path between the two terms, if there is a path, or select both nodes if there is not one. Similarly, the control key can be used in Windows computers to select multiple nodes. The user may also right click on a node and get multiple options, such as looking up the terms’ detailed information on the Gene Ontology website, hiding the currently selected nodes, non-selected nodes, inverting the selection, selecting all, selecting the adjacent neighbors and the path

(Figure 2C). Upon hitting hide nodes, the graph redraws itself without the selected nodes. To return the terms back and to unhide the terms, click on the “User Selection” and the terms will be unhidden.

Underneath the graph, there are three buttons to improve the usability of the graph. The first button allows the user to download the complete GO graph – to do so click the download button and then click the desired extension from the dropdown menu. The second button allows the user to search for a GO term in the graph. On click, the dropdown menu opens and allows the user to type terms. There is an auto-fill function attached with the search box: typing part of either the GO term ID or the GO function name will allow the user to see a list of suggestions on what to search. Once the term is selected, the user can press the search button to the right of the textbox in order to zoom in to the term in the GO graph (Figure 2D). Finally, on click of the final refit button to the right, the GO graph refits to the maximum allotted space given to the graph.

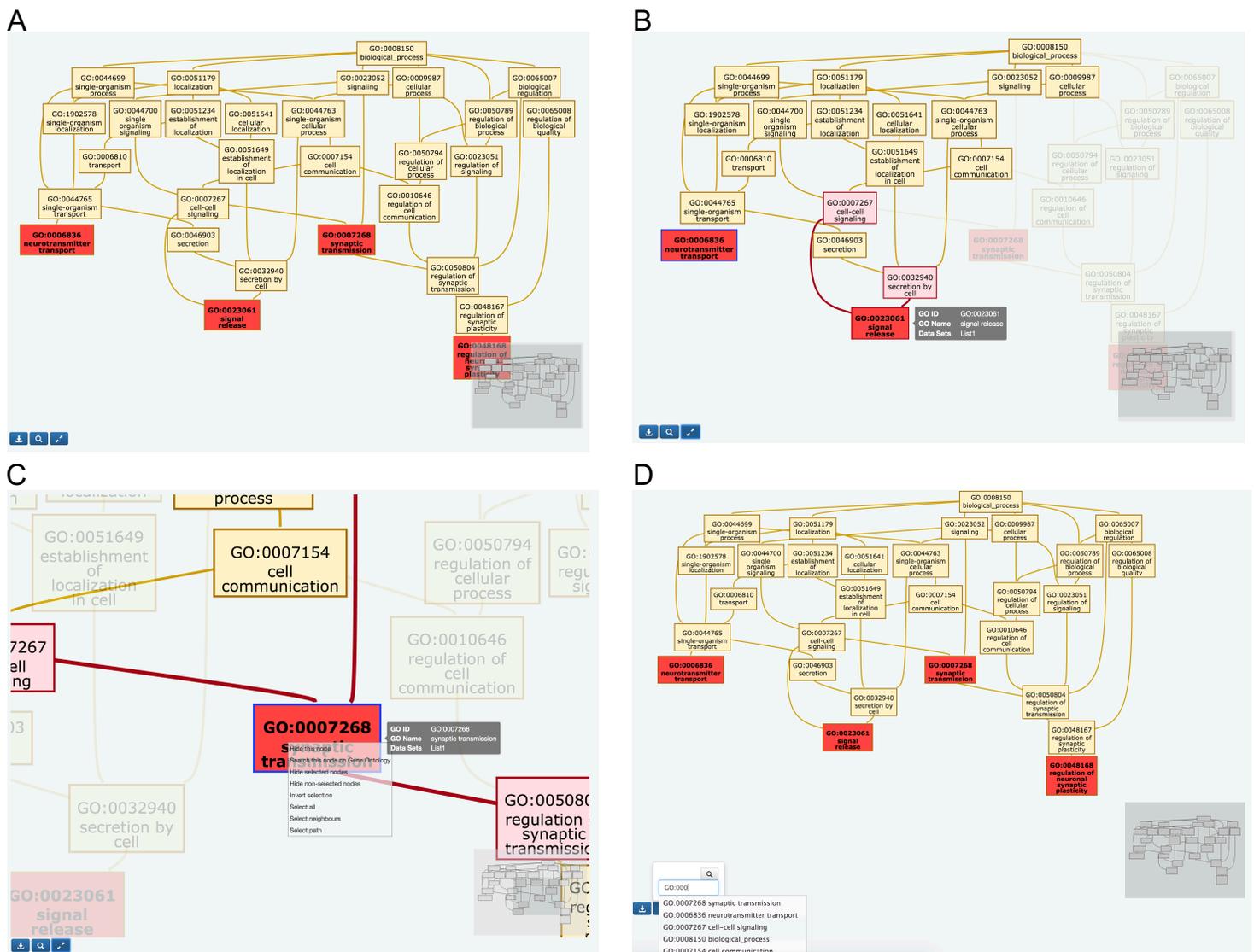


Figure 2. GO DAG visualization. (A) GO DAG for a list of GO terms; (B) Highlight function when hovering on a term; (C) More options when right-clicking the graph; (D) Search function.

2.2 Comparison of GO term lists

When the number of GO term lists is less than 3, GOView will use an interactive visualization of clickable venn diagram and GO DAG to compare GO term list. As shown in Figure 3, the left GO DAG contains the GO terms from all lists (red color) and their ancestor terms (yellow color). A venn diagram illustrates the similarities and differences among two or three lists. Clicking a section on the venn diagram will change the GO terms in this section as a dark blue color in the left GO DAG while all other terms with red color will be desaturated. Clicking on the section of the venn diagram will also show a list of the GO IDs and GO names of the terms in a table.

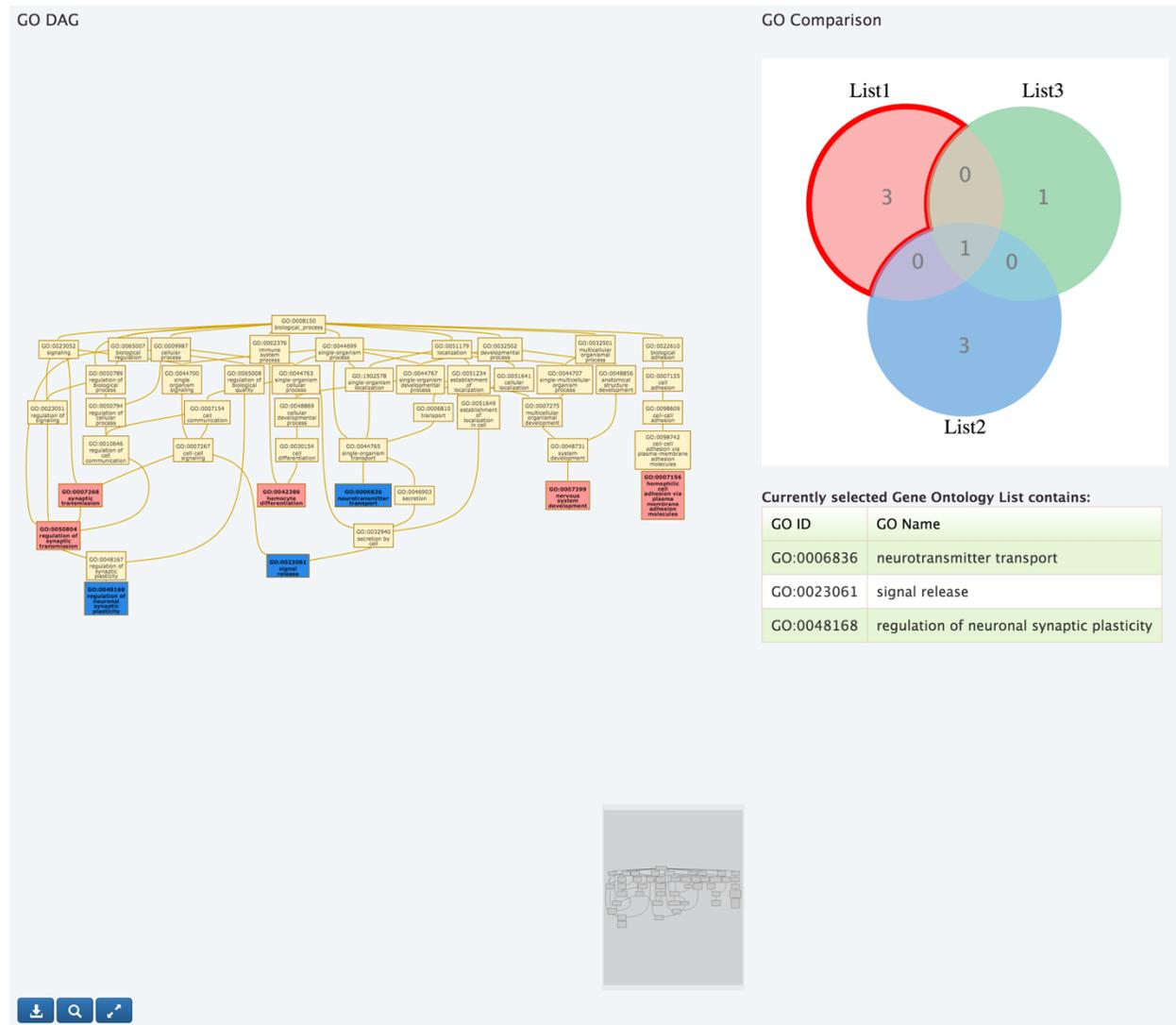


Figure 3. Interactive visualization of clickable venn diagram and GO DAG for the comparison of two or three GO term lists.

When the number of GO term lists is more than 4, GOView will use an interactive visualization of sortable heat map and GO DAG to compare GO term list. As shown in Figure 4, the left GO DAG contains the GO terms from all lists (red color) and their ancestor terms (yellow color).

The rows of the right heat map represent the GO terms from all lists and the columns represent all lists. Clicking the “Include” or “Exclude” checkbox for each list in the heat map will create a selected list that include or exclude GO terms from the list. Some examples about how to select GO terms can be found in Figure 5. The un-selected GO terms will be moved to the bottom of the heat map and desaturated. The selected list will also be shown in a table under the heat map and colored as dark blue in the left GO DAG.

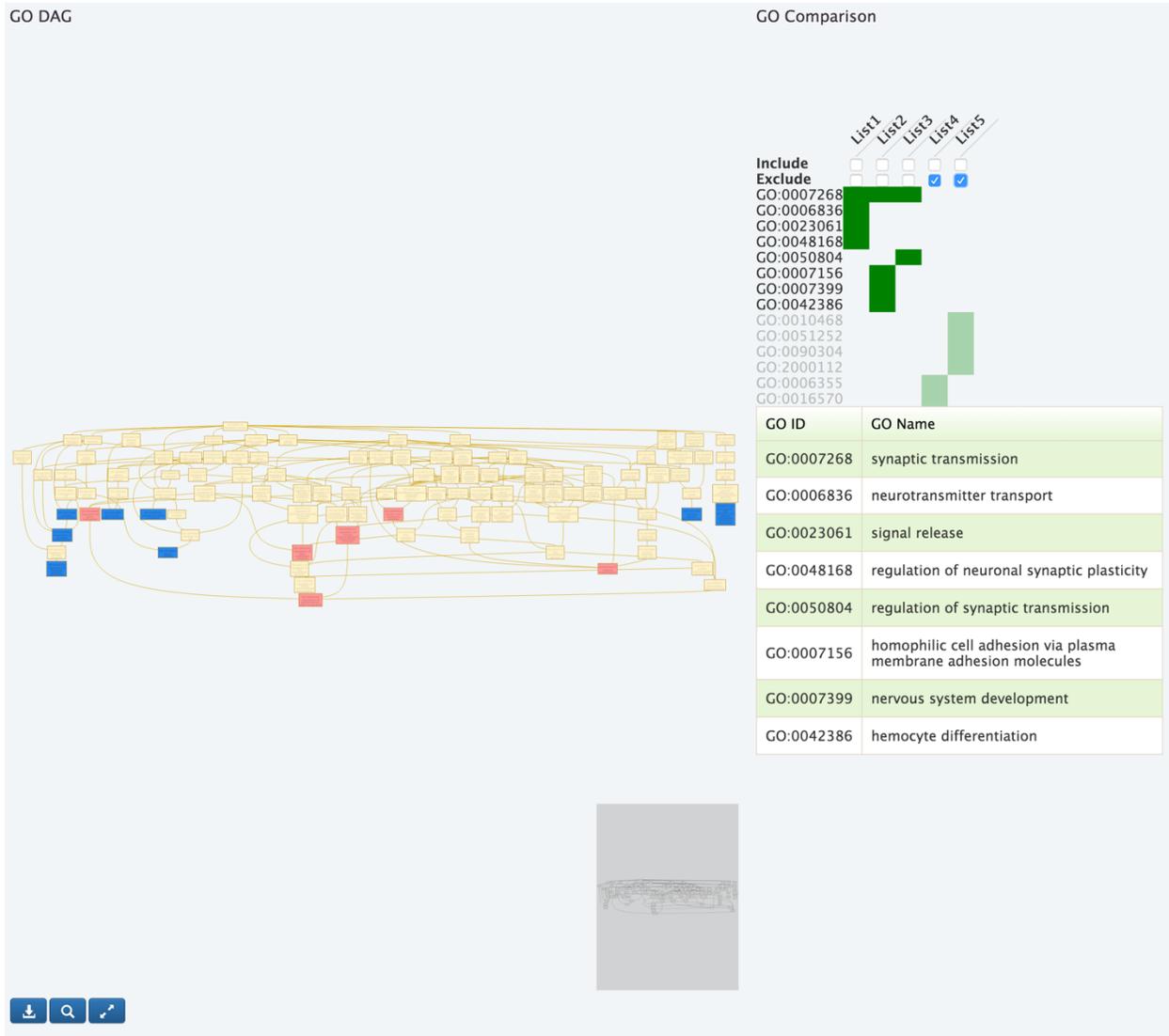
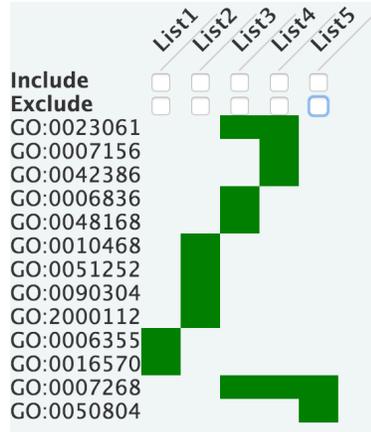


Figure 4. Interactive visualization of sortable heat map and GO DAG for the comparison of four or more GO term lists.

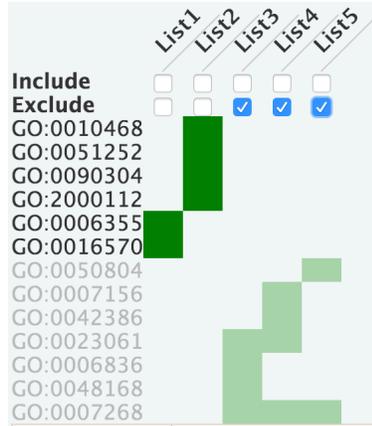
Example1

If users do not check any checkbox, GO terms from all lists will be selected.



Example2

If users want to select GO terms included in List1 **or** List2, "Exclude" checkboxes of List3, List4 and List5 should be checked.



Example3

If users want to select GO terms included in List3 **and** List4 but not in List5, "Include" checkboxes of List3 and List4 and "Exclude" checkbox of List5 should be checked.

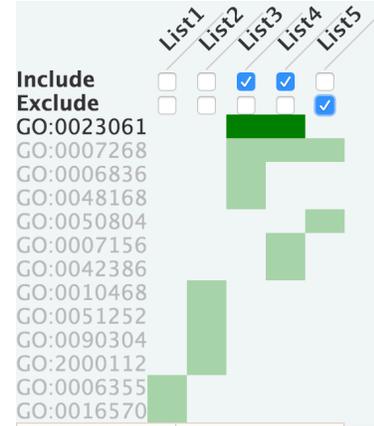


Figure 5. Examples for selecting GO terms in the sortable heat map.