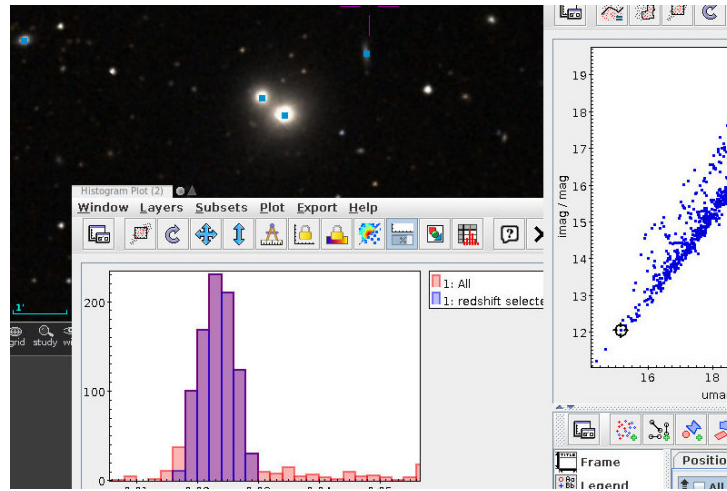


TOPCAT and Aladin Working Together



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Abstract

One of the greatest achievements of the Virtual Observatory (VO) is the development of standards for how data should look like (data formats and models) and how machines are expected to exchange such data (protocols).

Desktop and web applications in the Virtual Observatory can communicate with each other by using the so-called “Simple Application Messaging Protocol”, or short “SAMP”.

This tutorial will show how tabular data can be easily transferred between the table processing application [TOPCAT](#) and the image tool [Aladin](#).

Software: [TOPCAT](#), [Aladin](#)

In this example, we will use Aladin to discover SDSS objects geometrically within the center of the Coma Cluster and use TOPCAT to filter out objects SDSS has actually recognised as galaxies with about the right redshift.

1 Aladin: A1656 and SDSS-DR7

- ▷ **1** *Find the Coma Cluster in Aladin* – Start Aladin and type **A1656**¹ into the text field **Command**. When you press Enter, an image from the DSS of the corresponding area is loaded into Aladin. Zoom out a bit using the zoom slider in the right side panel or a mouse wheel until your image covers about 20' (you will see the approximate size of the part of the sky you're looking at at the bottom of the Aladin image pane).
- ▷ **2** *Add sources from an SDSS photometric catalogue* – We now want to find sources in SDSS' photometric catalogue for this field. To do that, in Aladin's discovery tree (on the left side of the window), type "SDSS photo" into the **select** field and hit enter. In the discovery tree, you will see a lot of resources – the green ones have data for your view. Click on one of the photometric catalogue entries, make sure **in view** is checked and hit **Load**. A new plane will open, and the objects SDSS has identified will be plotted on top of the image. Clearly, not all of these are galaxies, let alone members of the Coma Cluster. Let's filter out everything else.

2 Linking up TOPCAT and Aladin

- ▷ **3** *Launch TOPCAT* – Note that in the following we tell you how to invoke functionalities through TOPCAT menu entries. Most of these have shortcuts in the icon bars – try them (it's just a lot harder to describe them in text).
- ▷ **4** *Transfer the Aladin object catalogue to TOPCAT* – In Aladin's "Stack" (that's the pane on the right) right-click on the label of your new plane and then choose **Broadcast selected tables to...** → **topcat**. Your table will then show up in TOPCAT.
- ▷ **5** *Configure TOPCAT to tell Aladin what you look at* – In TOPCAT's main window, go to **Views**→**Activation Actions**. A new window will open where you can configure what TOPCAT should do when you select a row or plot point. Here, check **Send Sky Coordinates** under **Actions**. Note that by clicking on an action you can further configure it. In this case, TOPCAT has automatically figured out what to use as a position, so there's nothing you need to do; this could be different for other actions.
- ▷ **6** *Inspect objects in a plot* – Plot the table you received (e.g., **Graphics** → **Plane Plot**), perhaps **umag** over **imag**. Zoom in in Aladin to a field of view of perhaps an arcminute (you may also want to reduce the opacity of the objects layer; there's a slider for that when you select the plane in Aladin's plane stack). Now, as you click on points in the TOPCAT plot, you will see images of their counterparts in Aladin.
- ▷ **7** *Try Aladin-to-TOPCAT communication* – Conversely, if you mouse over the dots in Aladin's image, the corresponding points in TOPCAT are highlighted.

¹A1656, also referred to as the "Coma Cluster", is a large cluster of galaxies that contains over 1,000 identified galaxies.

3 Selecting Galaxies in TOPCAT

Let us now create a new sub-table containing only galaxies that SDSS thinks likely belong to the Coma Cluster.

- ▷ **8** *Start defining a named subset* – TOPCAT has a powerful feature called subsets; you can define these graphically or through conditions on columns. To do the latter, select **Views** → **Row Subsets** in the main window, and then in the “Row Subsets” window on **Subsets** → **New subset**. Name your subset, perhaps “redshift-selected”.

We now need to write the constraint. For that, it is usually helpful to consult the column metadata available through **Views** → **Column Info** in the main menu.

- ▷ **9** *Constrain the redshift* – For the redshift, you can filter on SDSS’ estimated redshifts. To find a suitable range, you can do **View** → **Histogram Plot**, use *zsp* in **X** and then zoom in to the area with a pronounced over-abundance (mouse wheel or right drag). We’d choose 0.0175 ··· 0.03 as a conservative range, but do whatever you see fit. Our choice would translate into `zsp>0.0175 && zsp<0.03` in the **Expression** field in the **Define Row Subset** window. Once you fill in the expression, hit **Ok**.

You will find a reference of the functions and operators available for the expressions if you click on the **f(x)** button.

- ▷ **10** *Make your TOPCAT ignore objects filtered out* – In the “Current Table Properties” box of TOPCAT’s main window, select the name of your subset in the “Row Subset” selector. In your Plot, in the **Subsets** tab, uncheck **All**; **Plot** → **Rescale** will zoom the plot to the remaining points. By the way, you may see a few outliers; click on them to see why SDSS might have gotten these wrong.
- ▷ **11** *Does SDSS agree these are Galaxies?* – Open a table view (e.g., by double-clicking on the table in TOPCAT’s table list in the main window). SDSS says what it thinks an object is in the **cl** column. If you sort by it (right click in the column), you can see if there are any non-galaxies (**cl** would be $\neq 3$) left; again, selecting the corresponding row will show you the doubtful object in the plot and in Aladin.
- ▷ **12** *Send the new subset back to Aladin* – Click on **Interop** → **Send table to...** → **Aladin** to bring your filtered catalogue back to Aladin; TOPCAT will transmit what you set as the row subset above.
- ▷ **13** *Tune up Aladin’s display* – You can now delete your original plane (right click on the label in the stack). You can make the galaxies a bit more conspicuous by right-clicking on your new plane and selecting **Properties** from the context menu. If the basic catalogue gave dimensions of the matched sources, you could go much further by using **Catalog** → **Create a filter** in Aladin. But that is for another tutorial.