GILDAS
An Introduction to the
Grenoble Image and Line Data Analysis System

a GILDAS working group software

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1 Introduction

GILDAS is one of the numerous image processing systems used in Astronomy. GILDAS was born sometime ago in the Groupe d'Astrophysique de Grenoble (now LAOG, Laboratoire d'Astronomie de l'Observatoire de Grenoble), and has been adopted as the IRAM standard data reduction package. GILDAS is jointly maintained by IRAM & LAOG. GILDAS contains many facilities, most of which are oriented towards spectral line mapping, or in fact all kind of 3-dimensional data.

GILDAS has grown on top of two pre-existing programs, CLASS and GreG, which seemed to please their users. As many other packages, GILDAS had to move out of its original VAX-VMS environment towards the growing Unix area. The original software was modified in order to run on VMS and Unix operating systems, with (near) transparent file sharing even between heterogeneous computers. The current implementation even allows remote task submission on a compute server from a workstation. However, because of lack of manpower, VMS is no longer supported. On the other hand, a complete Windows (95 or 98) version is available and supported.

This guide is a general introduction to the GILDAS package. It does not describe any utility, but gives cross-reference to other documentations and many usefull hints on how to customize your GILDAS environment.

2 Organisation

GILDAS consists of five major parts:

- The documentations, a set of PostScript files. An HTML documentation is also available.
- Dedicated utilities, which are programs using the SIC (Sympathetic Interpreter of Commands) user-friendly interface. Each utility normally has its own manual, accessible through the general documentation system.
  - GreG an all purpose 1-D and 2-D graphic program
  - CLASS (Continuum and Line Analysis Single-dish Software), for single-dish data processing and CFITS, a FITS to CLASS format translator.
  - ASTRO, an astronomical tool, very useful to prepare an observing session, or for amateur astronomy...
  - CLIC (Continuum and Line Interferometric Calibration), to calibrate interferometer data from Plateau de Bure.
- Dedicated small programs to perform non interactive time consuming processing : smoothing, transceitions, fitting, etc... These programs will be called "Tasks". They are not intended for interactive use (although you may do it if you are an expert), but require instead a monitor program to activate them.
- Two monitor programs named respectively VECTOR and GRAPHIC,
  - VECTOR is a SIC based program which can submit or run in parallel any GILDAS task through the use of its RUN and SUBMIT commands. By using SIC vector computing facilities, it also allows direct operations on images.
3 CONCEPTS AND USEFUL HINTS

- GRAPHIC, a superset of GreG and VECTOR, which in addition allows access to some astronomical catalogs.

GRAPHIC includes the VECTOR program, and hence can run or submit any Task.

- GFITS is a FITS translator for exchange of data with the outer world. CLASS and CLIC have a direct interface with the GILDAS Image format.

- Additional applications programs, such as MAPPING (a deconvolution tool), which includes GRAPHIC as a subset.

3 Concepts and Useful Hints

3.1 Images

Images and Tables are the two most useful concepts in GILDAS. Practically all data used by GILDAS are stored as Images (or Tables). An Image is a data file containing an array of up to 4 dimensions, and a small but comprehensive header to store the array dimensions, associated coordinates, etc... Tables are just 2-d Images with only the dimensions indicated in the header.

Images are used everywhere in GILDAS. The SIC command monitor directly manipulates Images through the DEFINE IMAGE command. The GreG program is able to display Images as contour plots with overlaid bitmaps. CLASS and CLIC, after working with their own data files, produce Images for further processing and display. And finally, all Tasks use Images for input and output.

Because of this importance of Images, we recommend the GILDAS users to read carefully the corresponding section in the SIC manual. Very efficient use of Images is possible within SIC, but it is also possible to do things a 1000 times more slowly. The ability of SIC to perform mathematics on Images can solve many problems, and avoid many “on-purpose” programs.

Images can even be initialized easily from external files of many different formats using the ACCEPT command of SIC, which allows the user to read in a totally flexible way data files to set the content of SIC variables.

3.2 Customizing

Although your system manager will provide reasonable defaults, you may wish to customize a few things to your own taste. Customizing the GILDAS environment can be done at two levels: Logical Names, and Initialization files for the SIC based utilities.

3.2.1 Logical Names

All logical names are placed in a file named .gag.dico in your home directory ($HOME). The format of the .gag.dico file is

LOGICAL_NAME1  equivalent_name1
LOGICAL_NAME2: Equivalent_Name2

where the logical names should always be in capital letters, while case matter for equivalent names. The ‘:’ indicates that the logical name is a directory (pathname). Besides logical names which you can use to define special files, or directories, a few peculiar names are used to customize your GILDAS environment:
3 CONCEPTS AND USEFUL HINTS

- **GAG.EDIT**
  the name of your preferred text editor (e.g. vi, emacs, vuepad, ved, ...)

- **GAG.HARDCOPY**
  the default type you wish for graphic hardcopies in **G**reg. Major possibilities are

  \[
  \begin{array}{ll}
  \text{PS FAST} & \text{"Fast" grey-scale postscript} \\
  \text{PS GREY} & \text{"Nice" grey-scale postscript (clipping more accurate)} \\
  \text{PS COLOR} & \text{Color postscript} \\
  \text{HPGL} & \text{HP-GL language}
  \end{array}
  \]

  See **G**reg command **DEVICE** for details.

- **GAG.PLOTTER**
  The (queue) name of the plotter you prefer to use by default. Beware that it should be compatible with the description given in **GAG.HARDCOPY**. Funny results can be obtained sending HPGL commands to a PostScript printer.

- **GILDAS_LOCAL**:  
The path for your own **GILDAS** tasks. For advanced users only.

- **GAG.LOG**:  
The path of a directory where you wish to store the log files for all **GILDAS** applications. The default is **$HOME**.

- **GAG_TMP**:  
A path where you wish to store temporary files which may be created by some applications. For optimum performance, use a local disk of the computer.

### 3.2.2 File Names

Two problems may arise when running **GILDAS** under Unix. The first one is due to the use of the _ as an option separator in **SIC**, and as a tree/subtree separator in pathnames under Unix. The second is that **SIC** is normally case insensitive, while Unix is case sensitive. To alleviate these problems, filenames are treated in the following way under **GILDAS**

- By default, automatic conversion to lower case is done

- Logical names (as defined above) can be used to refer to a file name. For example, **GAG.LOG**: **TOTO.LOG** will be expanded to **/users/me/toto.log** if **/users/me** is the equivalent name of **GAG.LOG**:

- To prevent case translation, the filename should be preceded by an exclamation mark (!). Since the exclamation mark is normally the comment flag in **SIC** commands, the whole filename should be included within double quotes. To illustrate this behaviour, compare these two examples

  \[
  \begin{array}{ll}
  \text{Typed name} & \text{Expanded Filename} \\
  "Toto.Log" & toto.log \\
  "!Toto.Log" & Toto.Log \\
  "gag_log:Toto.Log" & /users/me/toto.log \\
  "!/gag_log:Toto.Log" & /users/me/Toto.Log
  \end{array}
  \]
• As shown above, logical name translation occurs even when an exclamation mark precedes the filename.

• VMS-like names can be typed and will be translated to Unix-like names.

<table>
<thead>
<tr>
<th>Typed named</th>
<th>Expanded Filename</th>
</tr>
</thead>
<tbody>
<tr>
<td>GAG_LOG:[SUB.DIRE]TOTO.LOG</td>
<td>/users/me/sub/dire/toto.log</td>
</tr>
<tr>
<td>&quot;!gag_log:[SUB.dire]Toto.Dat&quot;</td>
<td>/users/me/SUB/dire/Toto.Dat</td>
</tr>
</tbody>
</table>

• DOS-like names can also be typed and will be translated to Unix-like names.

<table>
<thead>
<tr>
<th>Typed named</th>
<th>Expanded Filename</th>
</tr>
</thead>
<tbody>
<tr>
<td>\users\me\toto.log</td>
<td>/users/me/toto.log</td>
</tr>
<tr>
<td>&quot;!sub\DIRE\Toto.Dat&quot;</td>
<td>sub/DIRE/toto.dat</td>
</tr>
</tbody>
</table>

Filename handling is somewhat cumbersome, but becomes very simple when filenames are kept simple and lower case, as often happens.

3.2.3 Initialisation Files

All SIC based interactive programs read a initialisation file before starting. This file is a standard command procedure for the corresponding program. For example, for GreG it could contain:

```
SIC\SYMBOL CL "CLEAR PLOT"   ! Short cut to clear the plot
SIC\DEFINE DOUBLE SEC/GLOBAL !
SIC\LET SEC PI[180]3600      ! Second in Radian
SIC\SIC HELP CONTENT         ! Use PostScript file for HELP
GTKL\DEVICE                  ! Prompt for a graphics device
```

The initialisation file is located in your home directory, and its name is ‘‘init.program’’ where ‘‘program’’ is the default file extension for the application; this is usually just the application name.

4 Getting Started

The normal starting point is then to use the GreG graphic program, which will give you a first experience with the SIC command monitor. It is recommended to read first the SIC and GreG Cookbooks (15 and 5 pages respectively).

To get really started with image processing, read the GILDAS chapters 2 and 3 (Running Tasks, and Displaying Images) trying to run some of the image processing tasks (8 pages). However, since GILDAS is an image processing system, some practice with the GREG2\GreG language will be soon necessary. This practice can be done using the GRAPHIC program, but reading the GreG Manual will help (12 more pages).

Reference to more specific sections of the SIC and GreG documentations become only necessary for advanced users, and obviously for programmers. While the user become more and more familiar with GILDAS he (or she) will find that constant reference to the documentations is hardly ever necessary. The internal HELP is usually sufficient.