

Development for scientific analysis and visualization with the object-oriented language Ruby

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1 Purpose

The purpose of this project is to develop libraries for flexible data analysis, visualization and numerical simulation for use in the object-oriented language Ruby. Ruby is an interpreted scripting language. Though it is a language for programming, it can be used interactively. For overall introduction, refer to the paper (J9.18) "Object-oriented handling of numerical data for scientific analysis and visualization – basic idea and implementation for Ruby" by Horinouchi and Kawanabe.

In this presentation, a multi-dimensional numeric array class for Ruby, development of graphic libraries and an IO library, on which higher-level object-oriented libraries are built, are described. Multidimensional array is "NArray". The graphic libraries are "rbdcl" and "AdvancedDCL". Rbdcl is a one-to-one interface to the DCL (Dennou Club Library) graphic library. AdvancedDCL is a wrapper of rbdcl and a more user-friendly library than rbdcl. The IO library is a Ruby-interface to the NetCDF library.

2 NArray

NArray is a multi-dimensional numeric array class for Ruby by Masahiro Tanaka and covers various functions about multi-dimensional arrays. In earth and planetary science, data is probably a form of multi-dimensional numeric arrays and the arrays are used for analysis and visualization. But an original array for Ruby is not multi-dimensional array, so NArray is necessary. It is used in "rbdcl", "AdvancedDCL" and the interface to NetCDF.

3 Development of graphic libraries

3.1 rbdcl

Ruby does not have a standard library for scientific visualization. Therefore, we developed graphic libraries based on DCL. DCL covers 1D, 2D and limited 3D graphics. It has many functions of customizing for layout, such as coordinate transformation including map projection and handling missing value, so it can meet various need of researchers. It is written in FORTRAN77 and is translated into C. First, we made a wrapping interface, rbdcl for Ruby to the C version. The interface consists of functions that correspond one by one to all the functions in DCL.

3.2 AdvancedDCL

AdvancedDCL was developed to provide a more user-friendly graphic interface than rbdcl, whose calling sequence is the same as that of the Fortran-based DCL. Characteristics of AdvancedDCL is described below.

AdvancedDCL consists of about 15 modules according to types of graphics, such as line plotting, axis drawing, contour plotting. Methods ("methods" correspond to functions in conventional languages) in AdvancedDCL have simpler names than those in rbdcl. A method in AdvancedDCL is called in combination of the module name and the method name, such as *Axis.draw*.

Each module has a number of parameters. Those parameters that have a common function across multiple modules have unified names and their default values can be set by the "Common" module.

AdvancedDCL has two ways to set parameters. One is persistent and the other is temporary. If a parameter is set explicitly (for example `Contour.set("lineindex", 3)`), it is set persistently and is effective until next setting. To set the parameter temporarily, it is specified optionally when a drawing operation is executed, such as `Contour.draw(u, x, y, "lineindex" => 3)`. The temporary setting is effective only during the operation.

4 Development of a NetDCF interface

As the first step to support IO of various file formats, we developed a Ruby interface to the NetCDF library in C. NetCDF is one of the standard file formats used in earth and planetary sciences. It is a file format stored in a self-descriptive way and by which dataset can tell everything needed to handle it. NetDCF is one of the standard file formats used in earth and planetary sciences. We developed a Ruby interface to the NetCDF library in C.

Fig.1 is a sample figure by AdvancedDCL and NetDCF interface

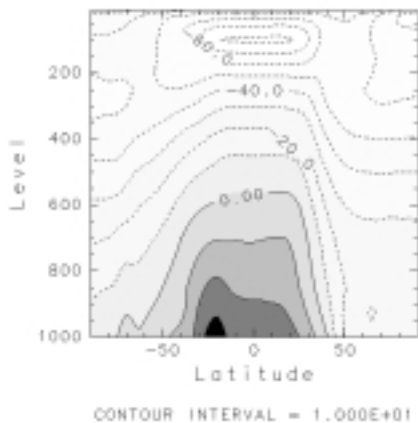


Figure 1: A sample figure by AdvancedDCL and NetDCF interface

5 Our future plan

We are planning to develop Ruby interfaces of the following libraries, as the basic libraiaes to build higher-level applications.

- mathematical and scientific libraries, such as GNU scientific library
- file IO (HDF and other file formats)

And about NArray, we are planning to implement some advanced functions which implemented in Yorick.

6 References

- Dennou-Ruby homepage
<http://www.gfd-dennou.org/arch/ruby/>
- Ruby homepage
<http://www.ruby-lang.org>