An Xlispstat/R Bridge

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Directions in Statistical Computing 2009

Outline

Integrating R with Other Software Environments

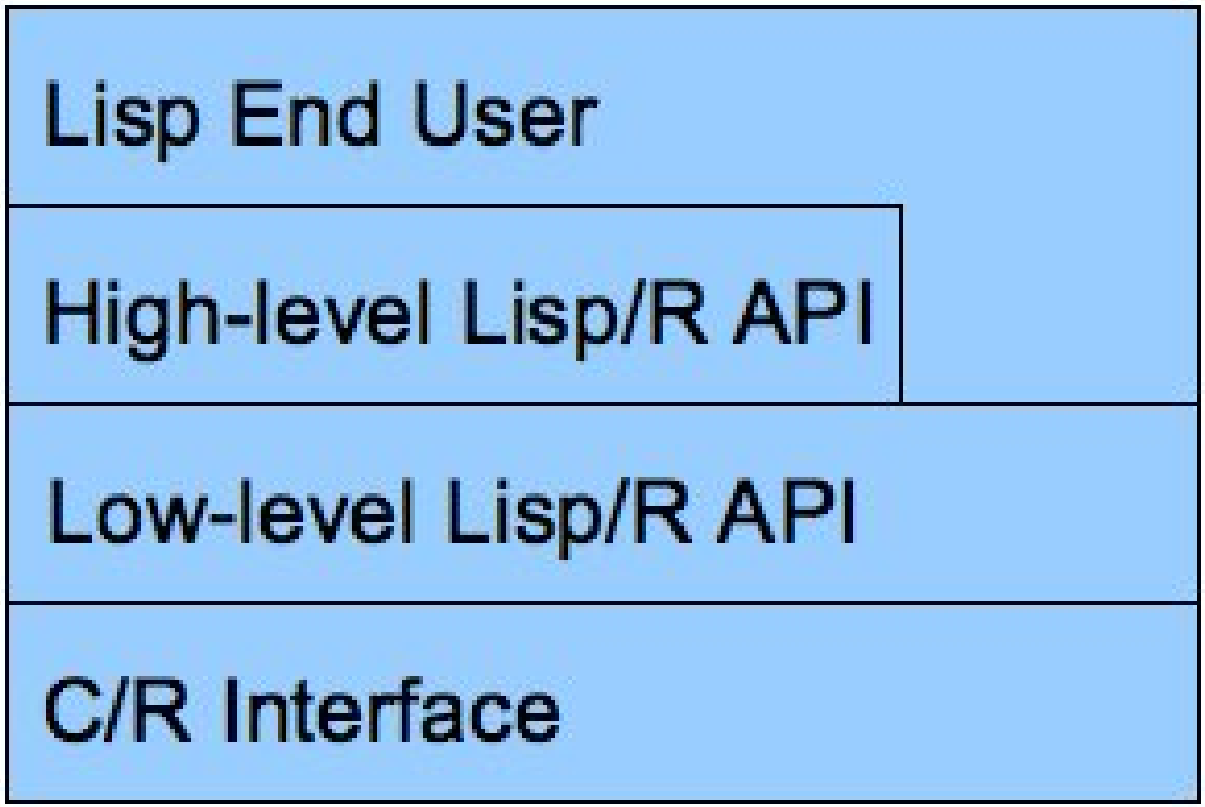
- Link using the R dynamic library
- Use interface packages, e.g., JRI
- Connect to R through a network connection, e.g., Rserve or JavaStat

Linking via the R dynamic library

- Allows for a natural interface for software written in C
- Calls R directly
- Does not depend on other software, except for R
- Needs no setup or configuration
- Compile R with the –enable-R-shlib option
- Recompile xlispstat after upgrading R (if necessary)

A Layered Structure

- C/R Interface
- Low level Lisp/R API
- High level Lisp/R API



C/R Interface

- The C/R interface is a thin wrapper of the embedded R API.
- The C/R interface avoids name conflicts between xlispstat and R
- R functions are mapped to C-based R interface macros/functions in xlispstat
- The C/R layer is invisible to users of xlispstat

Low Level Lisp/R API

- Developed in C for communicating with the external C interface in R
- Provides basic functions for allowing the Lisp user to access R
- Requires the user to take care of details, e.g., data synchronization between Lisp and R
- Designed for developers and advanced users
- Used as a platform for xlispstat packages, e.g., xstatR, that require the flexible use of R

High Level Lisp/R API

- Developed in Lisp
- Communicates with the low-level C macros/functions
- Provides convenient functions based on the embedded R environment
- Hides the embedded R environment from the user
- Is customizable and extendible, e.g., the user can customize the mapping between an R object and a Lisp object

Data type mapping

- Data type mapping needs to be dealt with in bridging/interface software
- One-to-one mapping is the ideal situation
- Due to the rich data structures in Lisp and R and their flexibility, no such mapping exists

A possible solution

- Convert simple data types, e.g., vectors of scalers.
- Returns a reference to R objects rather than converting complex data types
- Depends on the user to retrieve information from the R object references
- Used by R interface packages such as JRI and RServe

Problems of this method

- R objects need to be locked to avoid garbage collection
- User is responsible for releasing R objects
- Proper access methods to the object references are needed

Our strategy

- Use a generic structure to represent R objects
- Copy the data into this structure, ignoring unrecognized components
- Unlock the R object by default after all information is copied
- Assign R objects to variable names to retain them in memory, if persistence is needed

The generic structure representing R objects

- A list of length one or three
- The first element is the data part
- The second and third elements, for R objects with attributes, are the attribute names and the attribute values
- Attribute name list is a list of strings
- Attribute value list provides the corresponding values of the named attributes
- Data part is either an array of scalars/strings, etc., or (recursively) a list of generic structures

Current Implementation

- Many complicated structures are (currently) copied without special handling, e.g., `lm` objects.
- This structure is not convenient for direct use.
- The generic structure is a good foundation for building highly flexible conversions to meet users' needs, e.g., as has been implemented for data frames.

Low Level C Functions

- `(callR "R statement")`
  Parse and evaluate an R statement. The evaluation result will be copied into a generic structure and returned to the user.
- `(saveToR "rName", lispObj)`
  Save the value of `lispObj` into the embedded R environment (the value has to be encoded into the generic structure).

Examples

```
(setf y-list (callR "rnorm(50)"))
(setf y (first y-list))
(histogram y)
(saveToR "y" y-list)
```

High level functions: converting R objects

- A prototype, `Rengine-proto`, was built to ease the process of calling R.
- `Rengine-proto` directly supports the xstatR package, but can be used by any xlispstat package.
- The user can determine how to convert an R object based on its class name, dimension, etc.
- `Rengine-proto` currently includes loading data from R, saving an xstatR dataset to an R data frame, etc.

List of major methods

- `(send R :call "statement" &key asis)`
  Parse and evaluate a R statement.
  asis is a boolean value indicating whether to bypass the conversion process or not
- `(send R :save "rName" lispObj &key attr attrNames)`
  Save a lisp object to R. Attributes and names can be attached
- `(send R :save-dataset "rName" lispObj &key cols rows)`
  Save a dataset or part of a dataset as data frame in R

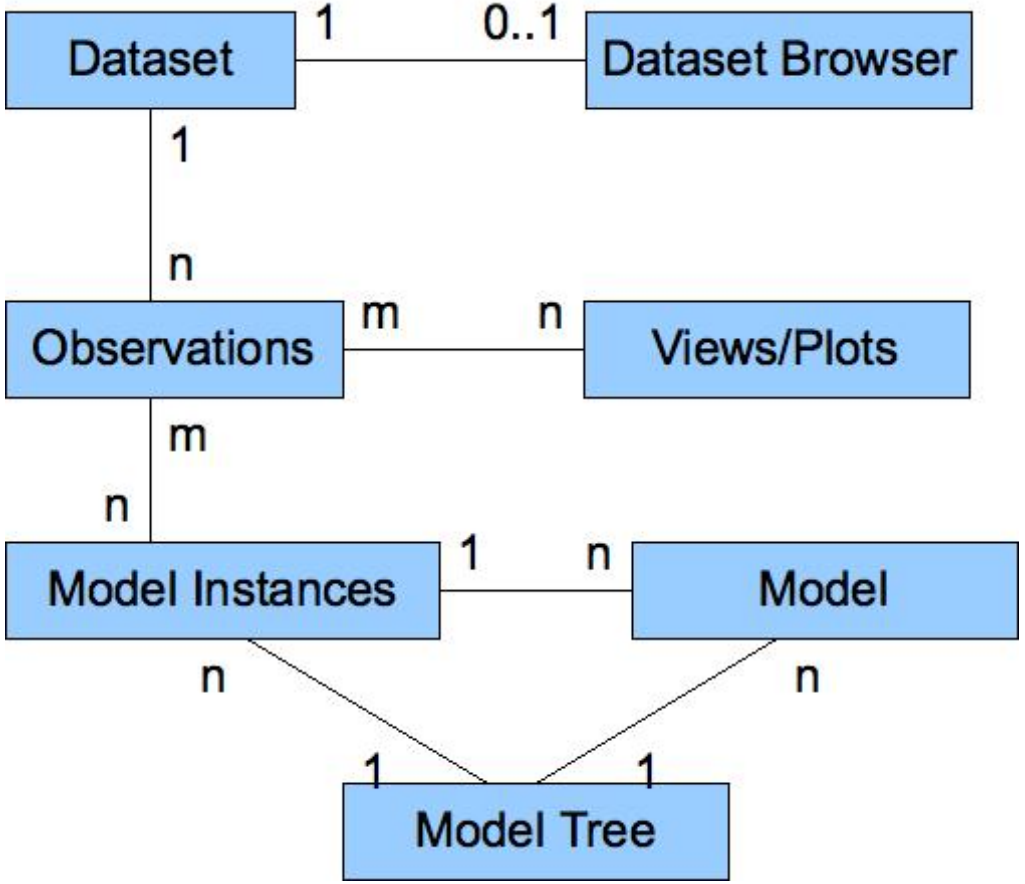
Examples

```
(setf iris (send R :data "iris"))
(send R :save-dataset "iris.data" iris
:cols '(SEPAL.LENGTH SEPAL.WIDTH)
:rows (iseq 1 10))
(send R :call "ls()")
(setf x (send R :call "iris.data"))
```

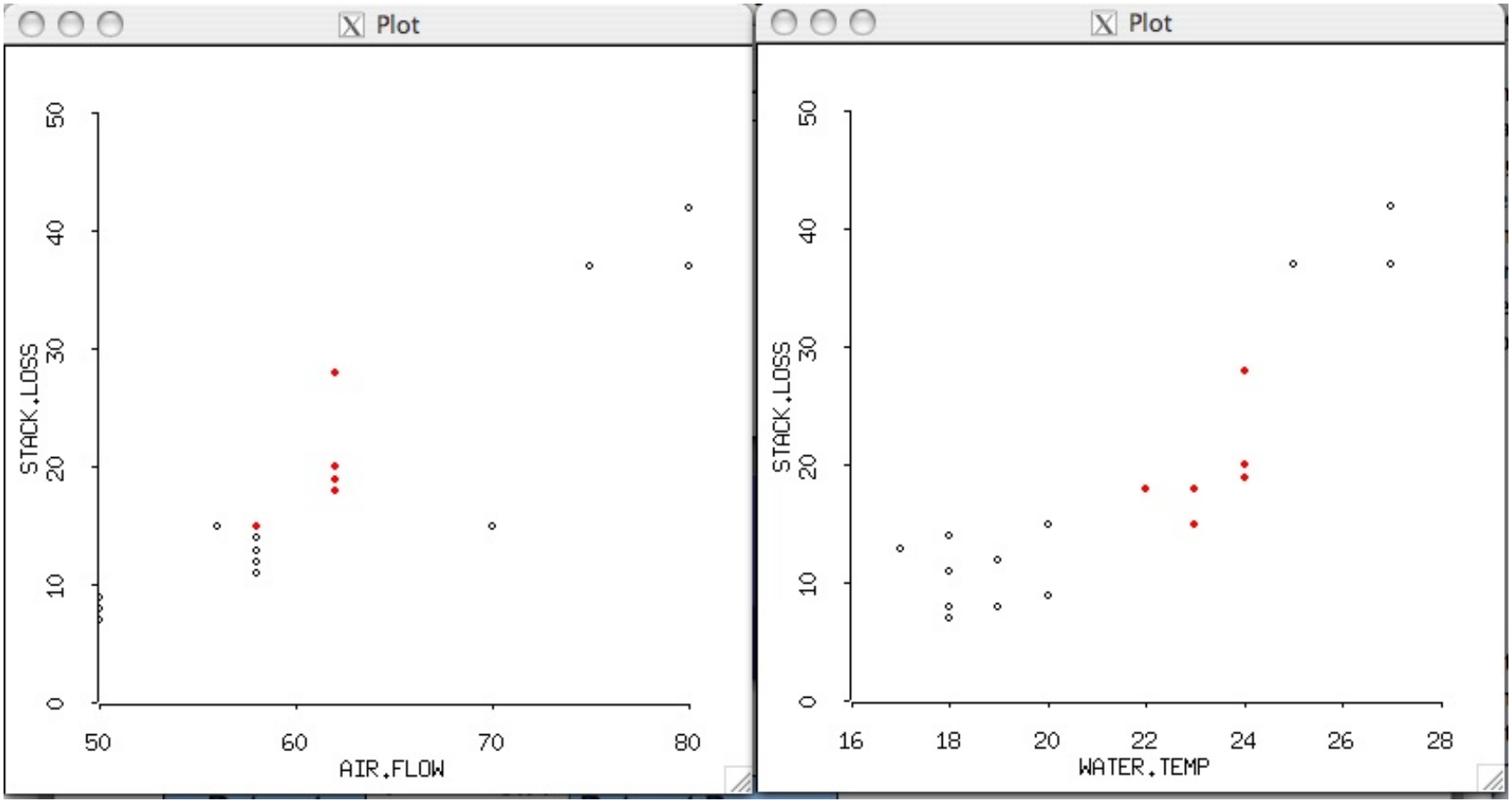
The xstatR package

- A lisp package used for dynamic graphics, data modeling, and multivariate analysis
- Dataset objects are defined in terms of observation objects
- Virtual datasets are constructed to encapsulate derived variables from model or other statistical objects
- Observations are objects viewable in different graphs
- Point state, color, and symbol are properties of the observation
- Changes in an observation value or property is immediately updated in its linked views
- R acts as a computational engine using the Lisp/R bridge

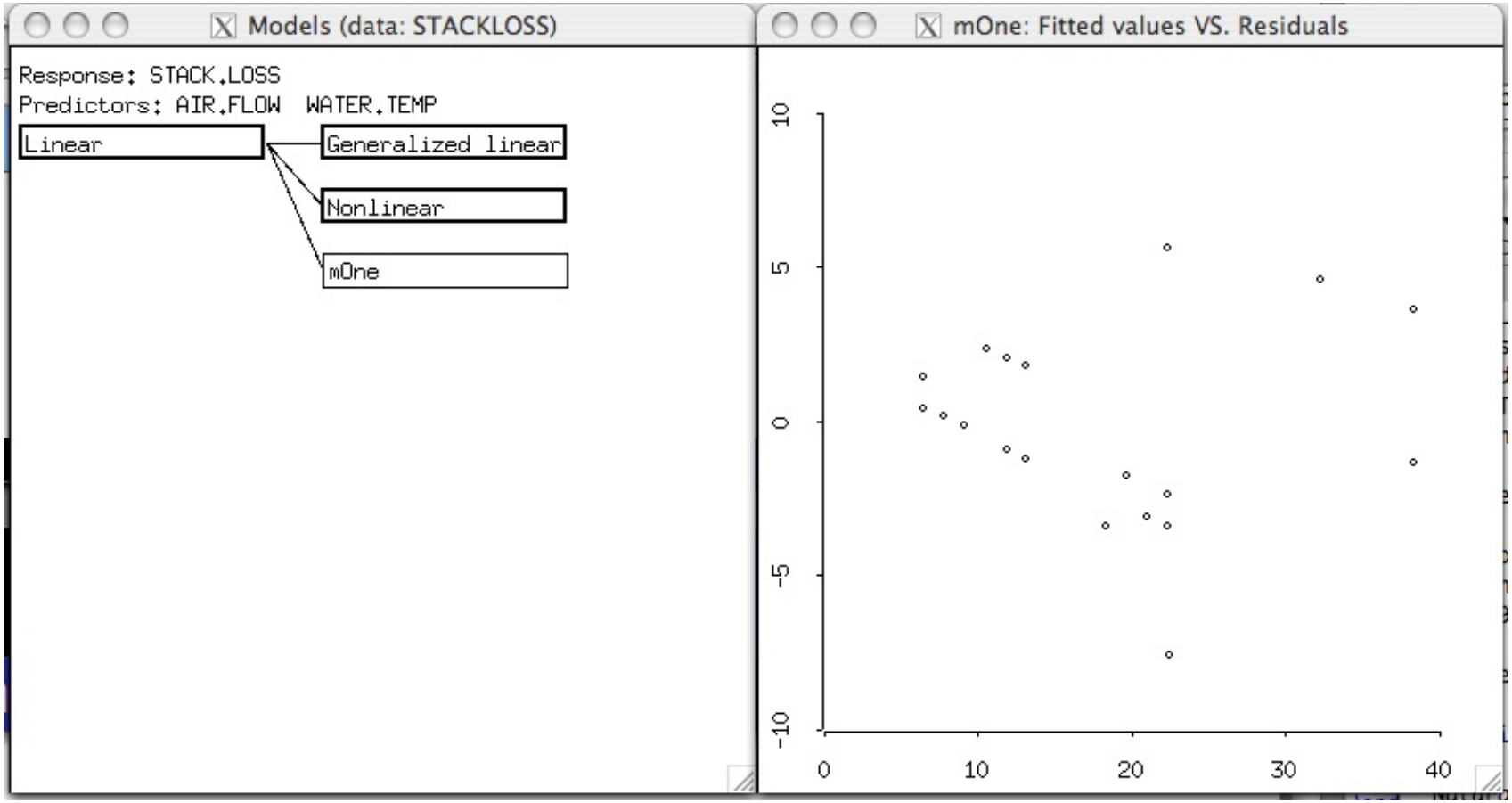
Partial Overview



Linked plots



Modeling Tree



More about virtual datasets for models

- Models generate derived variables from the original model variables.
- The newly generated data often need to be combined with the original dataset, e.g., to plot residuals against a predictor.
- SAS/JMP add (optionally) derived variables from models to the same dataset and the user soon loses track of which derived variables go with which model.
- R generates (optionally) named model and summary objects and the user soon loses track of the underlying models/summaries.
- Virtual datasets combined with tree-based model visualizations provide a solution.

More about virtual datasets for models (cont.)

virtualDataset.jpg

Currently working on...

- Virtual datasets combine the “variables” in a dataset with the “derived variables” from a model object
- The dataset browser shows the virtual dataset by clicking on the statistical object view, e.g., a model view
- Virtual datasets support linking, e.g., for model diagnostic plots
- Virtual model datasets combined with a model tree recursively allow model comparisons