The **Black Box Toolkit**

User's Guide

`bbtk` version 0.9.0 (15/10/2008)

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Eduardo Dávila, Laurent Guigues, Jean-Pierre Roux

CREATIS-LRMN, Centre de Recherche en Imagerie Médicale
CNRS UMR 5220, INSERM U620, INSA Lyon, Université Claude-Bernard Lyon 1
http://www.creatis.insa-lyon.fr/creatools/bbtk

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1 Introduction

1.1 What is bbtk ?

The **Black Box Toolkit** (`bbtk`) is a set of tools (`C++` libraries and executables) providing a `C++` framework for the definition of elementary processing *units*, called **black boxes**, and the definition and execution of processing *chains* made up of these black boxes.

1.1.1 The black box philosophy

The Answers Dictionary defines a **black box** as *"A device or theoretical construct with known or specified performance characteristics but unknown or unspecified constituents and means of operation"*
Wikipedia defines a **black box** as *"any component in a system in which only the input and output characteristics are of interest, without regard to its internal mechanism or structure"*.
We should merge these definitions. : not only the inputs and outputs are of interest but also *what the box does* ! Hence, we would say that a black box is any **documented** component of a system, letting the user know **what** the box is supposed to do and **how to use it** but not **how it does it**.

The **Black Box Toolkit** provides a systematic framework to encapsulate (or "wrap") any existing `C` or `C++` processing code into an object (a black box) having a **generic symbolic interface**, where

- **generic** means that the interface is *the same* for all boxes. Hence one does not need to know which particular method allows, say, to set a particular input or get a particular output of the box. One can use a black box in a purely abstract way.
- **symbolic** means that a particular input or output is referenced by a 'name', that is by a symbol which identifies the input or output. It also means that symbolic information (text) is attached to a box: description of the box, author, description of its inputs and outputs, etc.

(Actually, genericity is achieved because the interface is symbolic. We let you think about this...)

Of course, symbolic data attached to a box may be **queried** : what are the inputs/outputs of the box ? what are their type ? their description ? etc. This allows **automatic documentation** of boxes.

The abstract definition of black boxes is the most basic aspect of The **Black Box Toolkit** architecture. Another key aspect is the groupement of black boxes into so called **packages**, which are *dynamic libraries* which can also be queried, in particular about the boxes they provide. The package structure then offers a mechanism which is like a *'plug-in'* mechanism. The **Black Box Toolkit** provides the methods to load a package at run-time, and create instances of the boxes it contains.

These two mechanisms (black boxes and packages) then gives the way to:

- The definition of an **interpreted script language**, which allows to manipulate packages and boxes very easily in symbolic way. The **Black Box Toolkit** provides one : `bbs` (the Black Box Script language) and its interpreter `bbi` (the Black Box Interpreter).
- **Automatic documentation** of existing packages. `html` documentation of packages is proposed by `bbStudio`.

Finally, these different components allow **efficient** :

- **capitalization and reuse** of existing processing units, including **documentation**
- **testing, prototyping** in a very simple script language
- **inter-operability** between atomic processings which have been written by different persons, using different libraries, etc.

1.1.2 `bbtk` components

The **Black Box Toolkit** includes :

- A `C++` ***library*** - called `bbtk` - which defines a framework (abstract classes) to develop black boxes and store them into dynamic libraries, called black box *packages*.
- Different ***"core" black box packages*** :
  - ***std*** : the 'standard' package including basic useful boxes.
  - ***wx*** : basic graphical interface elements (widgets : sliders, buttons, etc. based on the `wxWidgets` library).
  - ***itk*** : the basic image processing package, based on the `itk` library.
  - ***vtk*** : the basic images and surfaces processing and visualization package, based on the `vtk` library.
  - ***wxvtk*** : widget boxes based on the `vtk` library (2D and 3D vizualization and interaction).

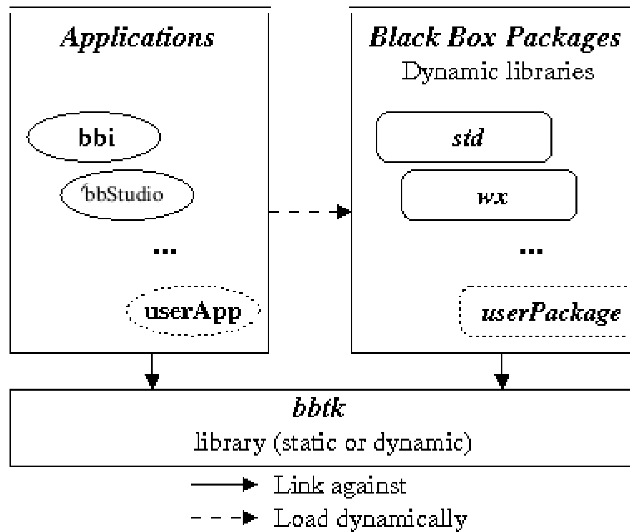
  - ***toolsbbtk*** : Tools for bbtk administration and package development.

- A ***Developement environment***, called `bbStudio` , which provides
  - An online ***script editor and interpretor***
  - A powerful html ***Help environment***, integrating :
    * Online documentation scaning
    * Retreiving boxes on various criterions
    * Checking Demo and examples
- An standalone ***interpreter***, called `bbi`, which allows to execute `bbs` scripts or commands.
- ***Various Development Utilities*** :
  - `bbfy` generates the `C++` code of a black box from a description file written in `xml`.
  - `bbCreatePackage` allows to create the basic file architecture. to start the development of a new black box package.
  - `bbCreateBlackBox` allows to create the basic file architecture. to start the development of a new black box, that will be included in an already existing package.
  - `bbs` 2cpp translates a `.bbs` script into a `C++` file.
  - `bbc` (sorry : Linux Only, for the moment) that compiles `.bbs` scripts into executables.
  - `bbRegeneratePackageDoc` which creates the html documentation of the Package.
  - `bbRegenerateBoxesLists` which creates the html pages of the various lists of all the currenly installed boxes.
  - `bbPlugPackage` which automatically incorporates a new package.
- A full ***documentation*** printable (pdf), browsable (html), queryable throught keywords.

The general architecture of The **Black Box Toolkit** is shown in figure 1.

1.2 Content of this guide

Figure 1: The **Black Box Toolkit** architecture



2 Getting started with bbStudio

2.1 The interface

Just run it, typing in a console `bbStudio` or clicking on its icon or its menu entry. You'll get something like in figure 2 (the exact appearance of `bbStudio` is Operating System and `bbtk` version dependent).

At start, `bbStudio` opens with a very minimal 'How to use' in the middle. Don't forget to read it : it will vanish at the first mouse click.

The interface is divided into four parts : `Files`, `Messages`, `Command`, `Help`. It is written using the Advanced User Interface library of wxWidgets (a.k.a. AUI), whose 'docking manager' allows windows and toolbars to be floated/docked onto a frame. Feel free to resize/reposition any part you want. Your preferences will be kept next time you run again `bbStudio`.

2.1.1 'Files' part

It's the `bbs` script editor.

If you load a file holding a script, it will be displayed here, and you'll be able to modify it, to save it, to save-as it, to run it, using the lower toolbar (see figure 3)

Figure 2: The bbStudio Development environment interface at start time

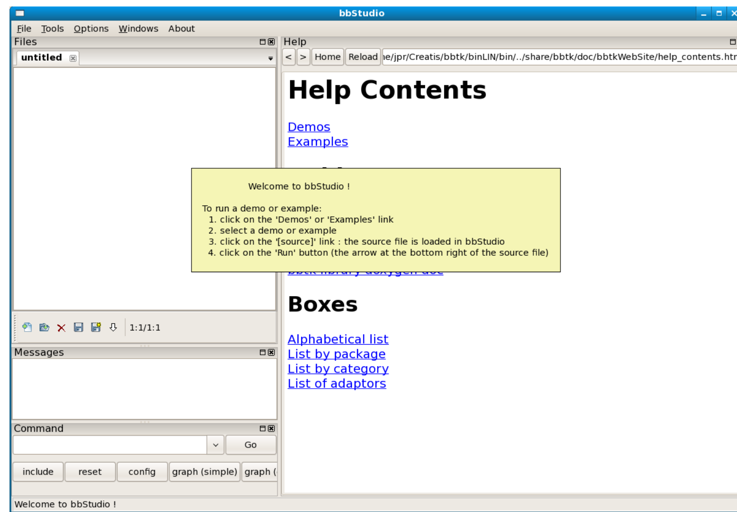
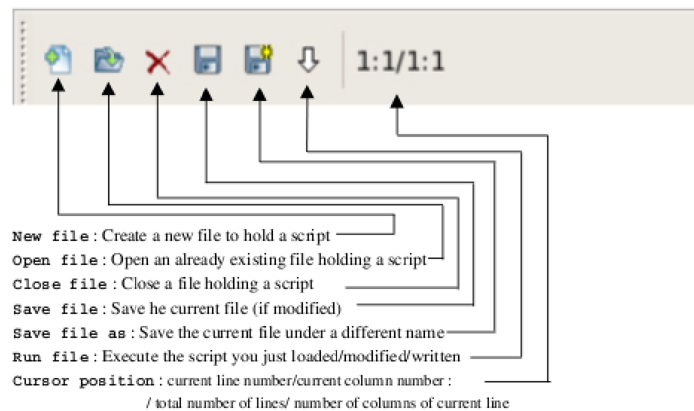


Figure 3: The 'Files' lower tool bar



2.1.2 'Messages' part

Two kinds of messages will be output here:
System messages : produced by the kernel, in case of a user mistyping, or an execution error
Script messages : produced by the `bbtk` equivalent of `printf` or `std::cout` in user programs.

2.1.3 'Command' part

You can type here `bbs` commands which are executed on the fly. The buttons are shortcuts to usual commands.

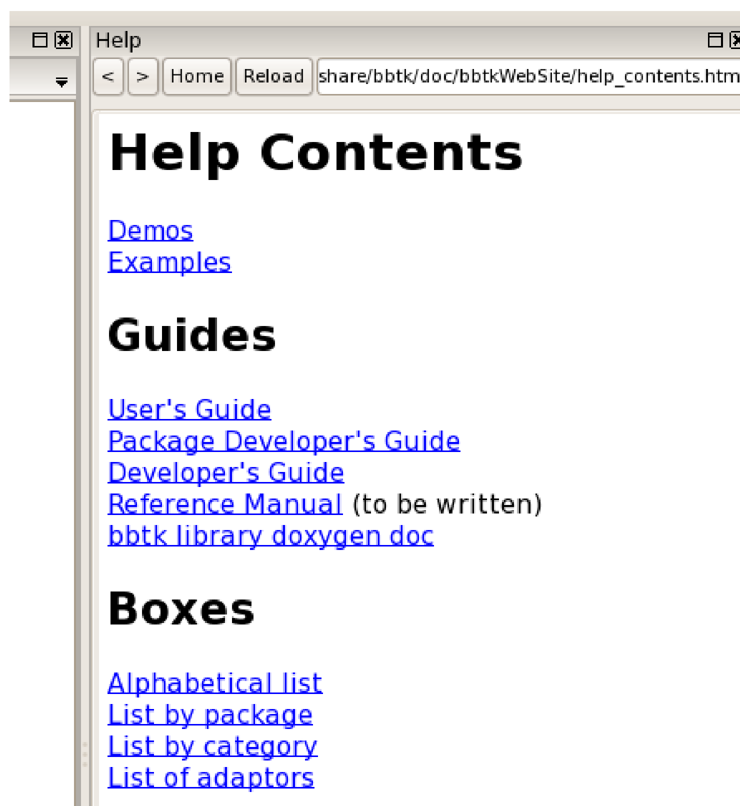
2.1.4 'Help' part

The 'Help' part of `bbStudio` is used to browse the html help of The **Black Box Toolkit**.

2.2 Running Demos and Examples

In the 'Help' part (See figure 4), select `Examples` link.

Figure 4: `bbStudio` 'Help' panel



You will get a list of examples (See figure 5).
Note : due to an unfixed bug in Linux, you have to click on 'reload' to get it.

Select `wx::exampleSlider`.

Figure 5: Examples list

You can see information on the example and the graphical representation of the workflow defined by the script (the elementary boxes that compose it, and their connections, see figure 6).

Click on `[source]`, it will be loaded in the 'Files' part, within the script editor (See figure 7);

Run it, using the 'Files' toolbar (see figure 3)

You'll get something like in figure 8.

Feel free to move the slider, to check it actually works...

Just a few words on what you saw :

- In the source code of the script :

```
load std
load wx
```

These `bbs` commands load the packages std and wx

Figure 6: Html documentation of example 'exampleSlider'

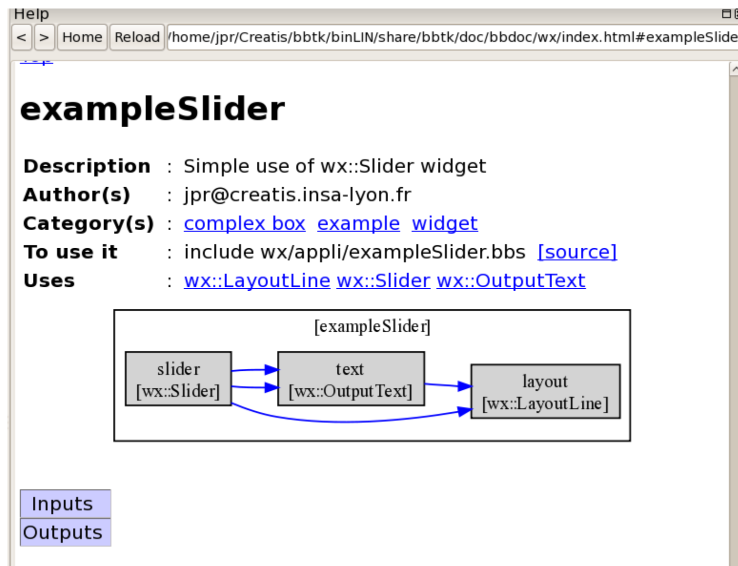
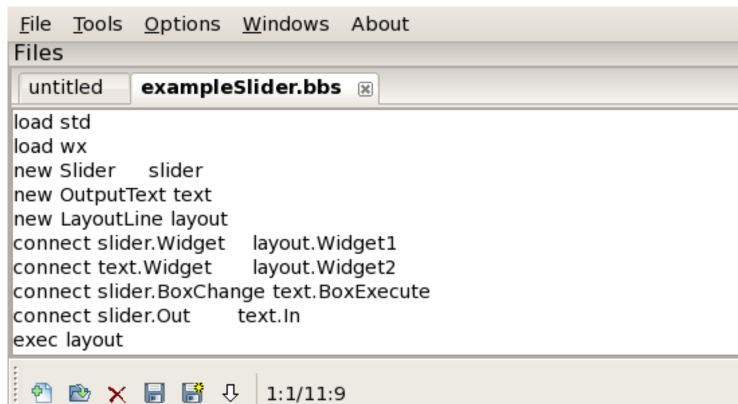


Figure 7: Source code of 'exampleSlider'



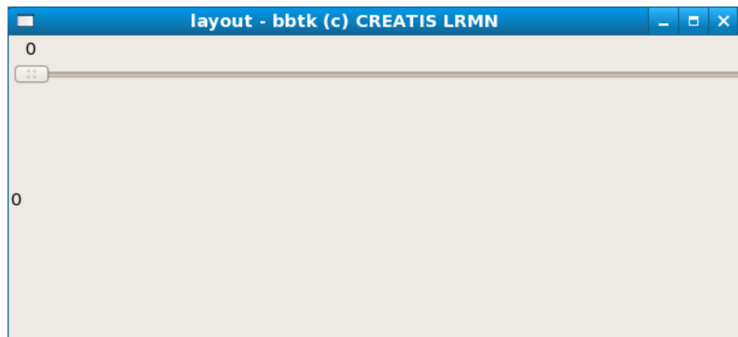

```
new Slider      slider
set slider.ReactiveOnTrack 1
```

We create a `Slider` box called *slider*.

We tell it to inform anybody that's interested in, that the cursor moved, each time it moved. The default behaviour is to inform only when cursor is released.

```
new OutputText text
```

Figure 8: Execution of 'exampleSlider'



We create an `OutputText` box called *text* (in which slider value will be displayed)

```
new LayoutLine layout
```

We create a `LayoutLine` box called *layout*, a widget box designed to embed other widgets (say, a main window)

```
connect slider.Widget    layout.Widget1
connect text.Widget      layout.Widget2
```

We embed *slider* and *text* into *layout*.

```
connect slider.BoxChange text.BoxExecute
connect slider.Out       text.In
```

We tell *slider* to inform *text* every time it's modified.

We tell *slider* to pass its output value (`Out`) to *text* input value (`In`)

```
exec layout
```

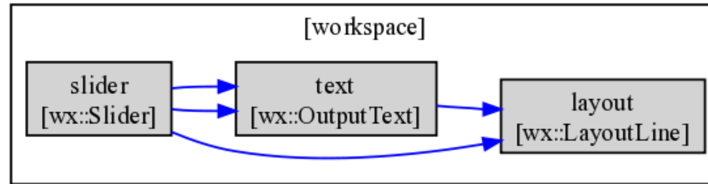
We tell *layout* to process itself. This also produces the execution of the boxes connected to it (the slider, the text).

- In the Help part

  You can see the graphical representation of the workflow (pipeline) created by the script, as in figure 9.

  The representation includes both the graphical interface-related pipeline (*slider* and *text* are embedded into *layout*) and the data processing-related pipeline

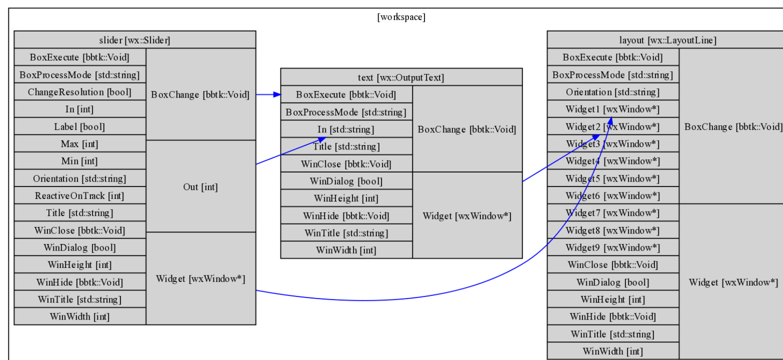
Figure 9: Graphical representation of a pipeline



(*slider* warns *text* immediately when it's modified, *slider* passes *text* its output value)[1].

You can get a much more detailled graph, like in figure 10, just clicking on the button '`graph (detailled)`' in the toolbar of the `Command` part.

Figure 10: Detailled graphical representation of a pipeline



2.3 Online Help

Various levels or help are suplied by `bbStudio`.

2.3.1 Command line help

The 'working' area (the left one, as opposed to the 'help' area, on the right side) is composed of : one single line area (`Command`), at the bottom, in which you can enter your commands and a multiple line zone in which the Command interpreter prints out the result of your commands. Command line help for the black box scripting language (`bbs`) can be obtained in this zone (see 3).

[1]Yes, we know : all the arrows (graphical interface pipeline arrows and data processing arrows) are blue; using different colors is planned for next release...

2.3.2 Guides

An html version of all the guides is browsable in the `Help` part of `bbStudio`.

- ***User's Guide*** : This guide !
- ***Package Developper's Guide*** : Step to step How-to for programmer who wants to create his own black boxes/packages.
- ***Doxygen Documentation*** : Doxygen source browser.
  Automatically generated from source files. Should only concern the kernel developpers.

2.3.3 Boxes Help

Lists of currently available boxes from installed packages

- ***Alphabetical list*** :
- ***List by package*** Boxes indexed by package
- ***List by category*** : Each box is indexed by a list of keywords, called 'categories', such as '`read/write`', '`filter`' '`viewer`', ... A given box may belong to more than one `category`, however some categories are mutually exclusive. Standard categories are :
  - `atomic box/complex box`
    Whether it's a 'atomic' unit written is C++ and available in binary form in a package or it's an assembly of several black boxes (atomic or complex) which is described in `bbs` script language.
    Any box is either atomic ou complex.
    Any pipeline described in a `bbs` script is itself viewed as a complex black box hence is tagged as belonging to this category.
  - `example` / `demo` / `application`
    These ones are scripts which produce a result when executed (i.e. they execute a pipeline like `exampleSlider` above), contrarily to the scripts which only define complex boxes but do not instanciate and execute boxes.
    - `example` : It's just a (simple) example, for programmers, on how to use a given feature. The `Examples` link on the starting page links to the list of the boxes of this category.
    - `demo` : It can be a 'good looking' (a.k.a 'sexy') example on some sophisticated work, done only by using `bbtk`. The `Demos` link on the starting page links to the list of the boxes of this category.
    - `application` : It's a final application, end user intended (e.g. Subscale a huge volume witout loading it in memory, Crop a DICOM image, etc.)

- `widget` : A piece of graphical interface (based on `wxWidgets`)
- `dicom` : Dicom medical image-related box.
- `viewer` : A box allowing to view something (e.g. an image).
- `read/write` : An I/O-related box
- `mesh` : A mesh-related box
- `filter` : A filter, mainly image filters.
- `image` : An image-related box
- `3D object creator` : A box which creates a 3D object to be injected into a 3D view (e.g. a plane, a surface).
- `math` : Math
- `misc` : Miscellaneous...

Remark that the list of categories is 'auto-extensible' : each time a new box is created which belongs to a new category and the boxes list is regenerated, then the new category appears in the list, holding the new box. The above list only contains the categories used in the packages provided with current `bbtk` release.

- ***List of adaptors*** : The adaptors are a special type of black box which are used internaly to perform type conversions. Thought there are not end user intended, you may see their list. Adaptors belong to the `adaptor` category.

2.3.4 The Package Browser

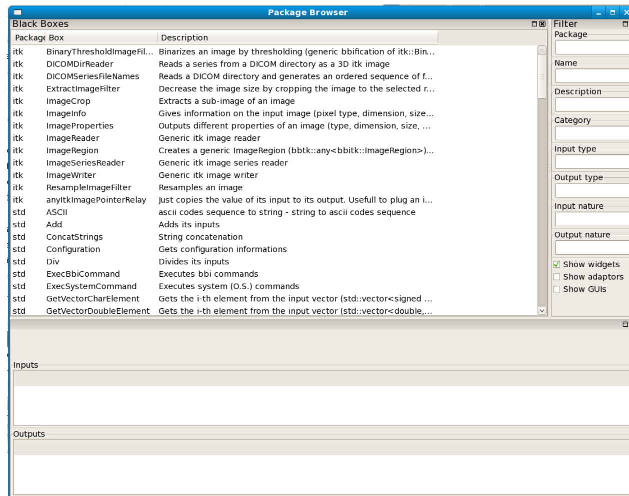
The package browser is a standalone application which dynamically loads and queries the available packages. It is thus a smarter tool than the static html documentation. You can run it with the command `bbPackageBrowser` or in `bbStudio` using either the button of the 'Command' part or the menu entry 'Windows>Start Package Browser'. Remark that it may take some time to start because it loads all available packages at start. Its appearance is reproduced in figure 11.

It allows you to find boxes using a multi-criteria filtering principle : The boxes listed are the one whose attributes match *all* the words entered in the 'Filter' part. You can get the whole description of a given box clicking on its name.

Warnings :

- It's case sensitive, i.e '`Button`' will give different results than '`button`'
- You have to press enter in the filter zone to update the boxes list
- A filtering string only has to match a subpart of the related attribute of a box. For example, entering 'utt' in the 'Name' attribute will match a box called 'Button'.

Figure 11: The Package Browser



Attributes :

- Package : The name of the package to which the box belongs (e.g. `wxvtk`, `std`)
- Name : The name of a box or an application (e.g. `Reader`, `example`)
- Description : A part of the description of a box (e.g. `3D`, `image`)
- Category : The categories of the box (e.g. `demo`)
- Input/Output Type : The `C++` type of an input or output (e.g. `int`, `vtkImageData*`, `std::string`)
- Input/Output Nature : The `nature` of an input or output (e.g. `file name`, `signal`)

2.4 The Menu

At last, let's have a look at `bbStudio` menu.(See figure 12)

Figure 12: The bbStudio menu

- `File`
  - `Open the bbtk configuration file`
  - `Quit`
- `Tools`
  - `Create package` : Provides a graphical interface to help package developpers to create a new empty package.
  - `Create black box` Provides a graphical interface to help package developpers to create a new empty black box, and add it to an already existing package.
  - `Plug Package` Incorporates a package into the list of known packages. Updates the html documentation.
  - `Regenerate package doc` : If a package has changed (e.g. new boxes) this updates the package html documentation.
  - `Regenerate boxes list` : Updates the boxes lists (alphabetical, by package, ...)
  - `Regenerate all` Regenerates all the packages documentations and the boxes lists (may be long...).
  - `Show last graph` Shows the last pipeline graph that was generated
- `Options`
  - `Reset before running` Before running a script, all the already created boxes are destroyed, all the already loaded packages are unloaded (this is the recomended option).
- `Windows` User may decide, for any reason of his own, to hide one or more panels:
  - `Show 'Files' panel`
  - `Show 'Help' panel`
  - `Show 'Command' panel`
  - `Show 'Messages' panel`
  - `Start Package browser` : starts the package browser (see 2.3.4).
- `About`
  - `About` : Info about `bbStudio`.

3 Writing black box scripts (bbs)

This section introduces how to write down black box scripts (bbs) to create and execute pipelines.

3.1 The commands

In bbStudio , try typing in the Command area (in what follows, the commands entered by the user will be preceded by a prompt >) :

```
> help
```

you get the list of the commands of the interpreter :

```
Available commands :
 author
 category
 config
 connect
 debug
 define
 delete
 description
 endefine
 endpackage
 exec
 graph
 help
 include
 index
 input
 kind
 load
 message
 new
 newgui
 output
 package
 print
 quit
 reset
 set
 unload
```

To get help on a particular command type `help <command-name>`, for example:

```
> help author
```

gives :

```
 usage : author <string>
  Adds the string <string> to the author information of the black box being defined
```

The `help` command has multiple usages. It is used to get help about almost anything in the interpreter! Type `'help help'` to get help on the `help` command itself :

```
> help help
 usage :
         (1) help
         (2) help <command name>
         (3) help packages [all]
         (4) help <package name> [all]
         (5) help <black box type>
         (6) help <black box name>
  Effect :
         (1) Lists all available commands;
         (2) Prints help on a particular command;
         (3) Lists the packages loaded and their black boxes.
             Add 'all' to list adaptors;
         (4) Prints short help on the black boxes of a package.
             Add 'all' to include adaptors;
         (5) Prints full help on a black box type;
         (6) Prints information on the inputs, outputs and connectionns
     of a black box instance.
```

3.2 Creating and executing black boxes

At start the interpreter does not know any black box. If you type `'help packages'`, which is the third form of the `help` command, you get :

```
> help packages
user
  workspace
```

which means that the interpretor only knows one package (library of black boxes) called `user` and which contains a black box called `workspace`. The `user` package is an internal package of the interpreter, which stores user-defined black box types. At start, it already contains one box, called `workspace`. `workspace` is a special type of black box, called complex black box, whose purpose is to store other black boxes.

Any black box you create in bbStudio is stored in workspace (this will be explained in details in sections 3.5 and ??).

If you type 'help workspace', you get :

```
> help workspace
 Complex Black Box <user::workspace>
  User's workspace
  By : bbtk
  Category(s) : complex box;
  * No inputs
  * No outputs
  * No boxes
```

In the text displayed, the user:: prepended to the name workspace means that the box workspace belongs to the user package. Then comes a description and three lines which tell that workspace does not have any input nor output nor boxes yet.

In order to let the interpreter know of some black boxes, you must load another package. The std package is the "standard" package, which contains basic useful black boxes.

To load it, type :

```
> include std
```

Then if you type :

```
> help packages
```

you get something like :

```
 std
   ASCII                    : ascii codes sequence to string - string to ascii...
   Add                      : Adds its inputs
   ConcatStrings            : String concatenation
   Configuration            : Gets configuration informations
   Div                      : Divides its inputs
   ExecBbiCommand           : Executes bbi commands
   ExecSystemCommand        : Executes system (O.S.) commands
   GetVectorCharElement     : Gets the i-th element from the input vector (std...
     ...
   MagicBox                 : Takes *any kind* of data and copies it to its ou...
   MakeFileName             : Makes a kosher file name
   Mul                      : Multiplies its inputs
   MultipleInputs           : This box has multiple Void inputs and one Void o...
   StringRelay              : Just copies the value of its input to its output...
```

```
  StringSelect            : Outputs the string set to the ith input Ini (In0...
 user
  workspace
```

Now the interpreter knows the package `std` and the black boxes it provides, such as the `Add` box, the `ConcatStrings` box, and so on. Remark that the content of `std` may vary from one version to another as new black boxes might be added to it. If you type :

```
> help Add
```

You'll get a text help, in the 'Message' part :

```
Black Box <std::Add>
  Adds its inputs
  By : laurent.guigues@creatis.insa-lyon.fr
  Categories : atomic box;math;
  * Inputs :
     'BoxExecute'     <bbtk::Void> [signal] : Any signal received by this input
                                               executes the box
     'BoxProcessMode' <String>     []       : Sets the processing mode of the box
                                               (Pipeline | Always | Reactive)
     'In1'            <Double>     []       : First number to add
     'In2'            <Double>     []       : Second number to add
  * Outputs :
     'BoxChange'      <bbtk::VoidS> [signal] : Signals modifications of the box
     'Out'            <Double>     []       : Result
```

After loading the package it belongs to, you can create an *instance* of an `Add` box by the command `new` :

```
> new Add a
```

The `'a'` at the end is the *name* of the instance, which will be used to reference it later. It is important to distinguish a box *type* and an *instance* of a box type. The `Add` box of the package `std` is actually a *box type* , like `int` is a data type in `C` langage. The `new` command allows to create an instance of a box type, exactly like `int i;` in a `C` code declares a variable of type `int` whose name is `i`. Of course, like in `C` Language, you can declare multiple boxes of the same type in `bbi` .

After the creation of the box `a`, type :

```
> help workspace
```

you get :

```
Complex Black Box <user::workspace>
 User's workspace
 By : bbtk
 Category(s) : complex box;
 * No inputs
 * No outputs
 * Boxes :
    'a' <std::Add>
```

which means that `bbi` workspace now contains a black box named `a`, of type `std::Add`.

Type

```
Help Add
```

and have a look to the 'Help' Part (see figure : 13)

Figure 13: The html Help

Add

Description : Adds its inputs
Author(s) : laurent.guigues@creatis.insa-lyon.fr
Category(s) : atomic box math
To use it : include std

Inputs		
In1	<double>	First number to add
In2	<double>	Second number to add
BoxExecute	<bbtk::Void>	Any signal received by this input executes the box
BoxProcessMode	<std::string>	Sets the processing mode of the box (Pipeline | Always | Reactive)
Outputs		
Out	<double>	Result
BoxChange	<bbtk::Void>	Signals modifications of the box

You can see a description (the one which was provided by the author of the box), the author(s) of the box (usually e-mail adress(es)) and the categories to which the box belongs. Finally comes the lists of inputs and outputs of the box. For each input or output, `bbi` provides its *name* , its *type* (between `<` and `>`, e.g. `<Int>`) and a description. Remark that the box `Add` is not a 'complex' black box but an 'atomic' box, hence its help does not include a pipeline graph.

You can see that `Add` boxes have two inputs, with name `In1` and `In2`, and an output, with name `Out`.

You can set the input `In1` of the `Add` box `a` to the value 1 by the command :

```
> set a.In1 1
```

Similarly, setting the input `In2` of `a` to the value 2 is done with :

```
> set a.In2 2
```

And you print the output `Out` of the box `a` with :

```
> print "result=$a.Out$"
result=3
```

In the string passed to the `print` command, each substring enclosed between a couple of $ is considered as the name of an output of a box. To process this special substrings, the interpretor :

1. Processes the box if needed (see below)

2. Converts the output of the box to a string if possible (see below)

3. Substitutes the result in the string to print

4. Postpones an implicit 'new line' character to the string

Box processing is needed if :

- either at least input has changed since last processing

- or the input `'BoxProcessMode'` of the box is set to `'Always'`, which forces box reprocessing.

Note that all boxes have an input named `'BoxProcessMode'`.
Another way to process the box `a` is to issue the command :

```
> exec a
```

however this command does not display anything (except if the box itself displays something in its processing). It just processes the box if needed. This command is used to execute boxes that do not have any output, such as boxes that write something to a file or, display a graphical interface, and so on.

Summary

- The include command allows to load a package, and the complex black boxes that come with it..
- help gives help on :
  - Available commands if you just type help.
  - A particular command if you type help <command-name>.
  - All available packages and their boxes (without description) if you type help packages.
  - A particular package and its boxes (with brief description) if you type help <package-name>.
  - A particular black box type (with full description) if you type help <box-type-name>. In particular, help workspace displays information on the content of the 'workspace' black box, which stores the boxes created by the user (by new).
- new : creates an instance of a black box.
- set : sets the value of an input of a black box.
- Under any component of bbStudio, to reference the input called i of a black box called b you must type 'b.i'. The same syntax holds for outputs.
- print : prints a string, substituting each substring of the form $b.o$ by the value of the output o of the black box b. Note that an implicit trailing 'new line character' is added at the final string.
- exec : runs, if needed, the process of a box.

3.3 Connecting black boxes

The **Black Box Toolkit** allows to create and execute processing chains, also called *pipelines*, by connecting black boxes. This section explains how to do it with examples. Read section **??** to get more information on pipeline processing.

First start bbStudio and load the package std, typing :

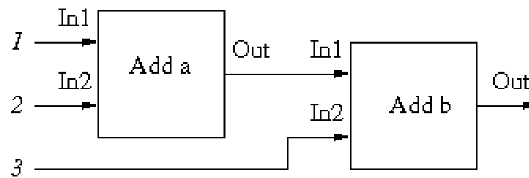
```
> include std
```

in the 'Command' part.

Assume you want to compute 1+2+3. You can do it by chaining two Add boxes, as shown in figure 14.

The bbi instructions to create and execute this pipeline are :

Figure 14: A simple pipeline which adds 3 numbers




```
> new Add a
> new Add b
> connect a.Out b.In1
> set a.In1 1
> set a.In2 2
> set b.In2 3
> print $b.Out$
```

You will see the (very expected) result :

```
6
```

The first three commands build the pipeline, the next three set `a` and `b` black boxes inputs and the last one prints `b` black box output (the pipeline is executed before printing, because the interpretor 'knows' the box `b`, whose output is requested, is not up to date).

The command `'connect a.Out b.In1'` "plugs" the output `Out` of the box `a` into the input `In1` of the box `b`. Once the boxes are connected, the processing of the two boxes are chained : getting the output of `b` requires getting its inputs, hence getting the output of `a` which is connected to it. This pipeline mechanism can recurse into arbitrary long chains of boxes (see **??** for details).

Lets' consider an other, more image oriented, example :

```
> include vtk
> include wx
> include itk
> include wxvtk

> new FileSelector fileDialog
> new ImageReader  reader
> new Slider       slider
> new Viewer2D     viewer

> connect fileDialog.Out   reader.In
> connect reader.Out       viewer.In
```

```
> connect slider.Out       viewer.Slice
> connect slider.BoxChange viewer.BoxExecute

> exec viewer
```

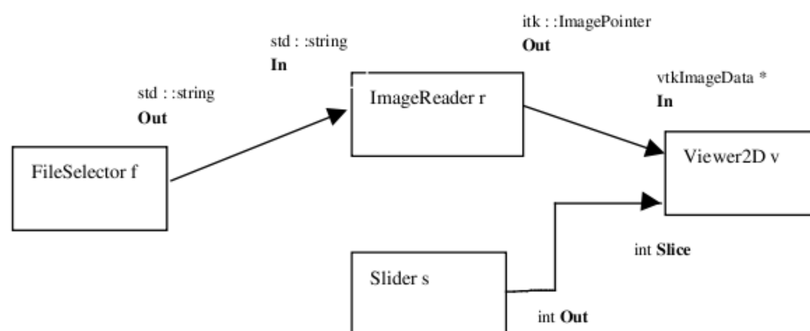
Some explainations : the `include` instructions load the necessary packages.

`FileSelector` will pop a File Selector, at run time, that will out the user chosen file name.
`Slider` will pop a Slider, at run time, that will out an integer, used later as a slice number.
`ImageReader` will read any itk readable file, whose name is passed as a std::string, and return a pointer on an itk image.
`Viewer2D` displays a plane, whose number is specified by an integer.

`connect fileDialog.Out reader.In` plugs the output of the File Selector (a std::string) to the input of the reader (a std::string, too).
`connect reader.Out viewer.In` plugs the output of the reader (an bbtk::any¡bbitk::ImagePointer¿ which is a type defined by the itk package which can hold any itk image pointer) to the input of the Viewer (a vtkImageData *)
`connect slider.Out viewer.Slice` plugs the output of the slider (an int) to an other output (named Slide) of the viewer.
`connect slider.BoxChange viewer.BoxExecute` says the viewer that it must re process itself any time the slider is modified.

`exec viewer` processes the viewer.
This would correspond to the graph in figure 15

Figure 15: (Very) simple Graph of a (very) simple pipeline



Of course, to be able to connect two boxes, the output and the input must be compatibles. You can always connect an output to an input of the *same* type, but

you can do more, thanks to particular (hidden) black boxes called **adaptors**.

An adaptor is a black box which has at least one input, called `In`, and at least one ouput called `Out` and whose role is to convert a data of the type of `In` into a data of the type of `Out` (other inputs or outputs may serve to parameter the adaptor or retreive other useful information).

Under `bbStudio`, if you type :

```
> load std
> help std all
```

you get :

```
 Package std v1.0.0 - laurent.guigues@creatis.insa-lyon.fr
 Basic useful black boxes
 Black boxes :
      ...
   BoolToString        [DA]  : Converts a Bool (bool) into a string
   CastBoolToChar      [DA]  : Static cast from Bool (bool) to Char (signed c...
   CastBoolToDouble    [DA]  : Static cast from Bool (bool) to Double (double...
      ...
   CastBoolToUChar     [DA]  : Static cast from Bool (bool) to UChar (unsigne...
   CastBoolToUInt      [DA]  : Static cast from Bool (bool) to UInt (unsigned...
      ...
   CastUIntToBool      [DA]  : Static cast from UInt (unsigned int) to Bool (...
   CastUIntToChar      [DA]  : Static cast from UInt (unsigned int) to Char (...
   CastUIntToDouble    [DA]  : Static cast from UInt (unsigned int) to Double...
      ...
```

`[DA]` stands for *default adaptor*.

Once you have loaded the package `std`, you can plug an output of type `char` into an input of type `double`. When the interpreter encounters the `connect` command, it looks for an adequate *adaptor* in the loaded packages. In our case, as the package `std` provides the `CastUCharToDouble` adaptor, the interpreter automatically creates an instance of this adaptor and place it *between* the output and the input you want to connect (however this adaptor is hidden to you, it is embedded into the created connection and does not appear as an existing black box). When the pipeline is processed the adaptor converts the output data into the required input type, in a totally transparent way. In our example, the `CastUCharToDouble` adaptor would simply cast the value of the `char` into a `double`, however arbitrarily complex type conversion may be done.

`WARNING` : these adaptors are `C++ static cast`, i.e., there is, right now, no 'intelligent' conversion (only truncation) e.g. think to `CastDoubleToUChar`!

Note that the `set` and `print` commands of interpreter work with adaptors from `string` to the type of the input to set or from the type of the output to print to

string. Hence in order to set or print values the adequate adaptors must be available in the packages currently loaded.

Summary

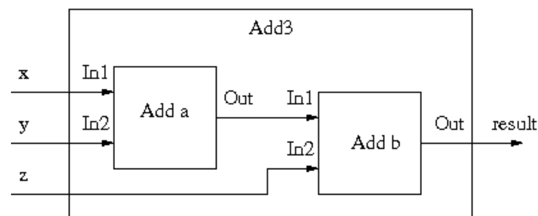
- The connect command allows to connect two black boxes
- You can connect two black boxes if (and only if) :
  - The output and the input are of the same type, or
  - There is an adaptor black box in the packages loaded which converts data of the output type into data of the input type
- help <package name> does not display the adaptors of the package. To see them use : help <package name> all. including adaptors

---

3.4 Creating complex black boxes

Remember the pipeline of figure 14, which computed the sum of three doubles. You can consider it as a whole and define a new black box type, which will be a *complex black box*, having three inputs and one output, as shown in figure 16.

Figure 16: Creating the complex black box Add3



The bbi commands to define this complex black box are the following :

```
> load std
>
> define Add3
>
> new Add a
> new Add b
> connect a.Out b.In1
>
> author "myself"
> description "adds 3 doubles"
```

```
> input x a.In1 "first double to add"
> input y a.In2 "second double to add"
> input z b.In2 "third double to add"
> output result b.Out "output"
>
> endefine
```

Explainations :

As we will use `Add` boxes, we need to load the package `std`, which is done in first line.

The command `define` then starts the definition of the complex box type, which will be called `Add3`.

The next three lines define the pipeline, exactly in the same way than outside a complex box definition.

The commands `author`, `description`, `input` and `output` are commands specific to complex boxes definition :

`author` and `description` are used for the documentation of the new box. You can provide multiple `author` or `description` commands, the arguments of the commands will be concatenated to produce the final author and description strings.

`input` and `output` are used to define the inputs and outputs of the new complex box. Their syntax is the same : for each new input/output you need to say to which internal input/output it corresponds and to provide a help string documenting the input/output. In our example, we define that the box `Add3` has three inputs : `x`, `y` and `z`. The input `x` corresponds to the input `In1` of the internal box `a`. In the same way, the external input `y` corresponds to the internal input `a.In2`, and the external input `In3` to `b.In2`. The only output of the new box is called `result` and corresponds to `b.Out`. The figure 16 illustrates the external to internal input/output correspondence.

Finally, the `endefine` command ends the definition of the new box type.

After this definition, if you ask for help on packages, you get :

```
> help packages
std
  Add
  ...
user
  Add3
  workspace
```

The `user` package now contains a new black box type, called `Add3`. If you ask for help on this type of box, you get :

```
> help Add3
Complex Black Box <user::Add3>
 adds 3 doubles
```

```
By : myself
* Inputs :
   'x'      <double> : first double to add
   'y'      <double> : second double to add
   'z'      <double> : third double to add
* Outputs :
   'result' <double> : output
* Boxes :
   'a' <std::Add>
   'b' <std::Add>
```

and you can use it like any other box, for example type :

```
> new Add3 a
> set a.x 1
> set a.y 2
> set a.z 3
> print $a.result$
6
```

As a side note, we can say that, for consistency reasons, it would have been better to name `In1`, `In2` and `In3` the inputs of the black box `Add3`, since all the 'natural entry' of a box is named `In`, or `In`x if there are more than one 'natural entry' .

Summary

- The `define/endefine` commands allows to define complex black box types, i.e. types of black boxes made up of other black boxes. Inside a `define/endefine` block :
  - The `author` and `description` commands allow to document the new type of box
  - The `input` and `output` commands allow to define the inputs and outputs of the new type of box, that is to which inputs and outputs of internal boxes they correspond.

3.5 Writing scripts files

Once you have defined a new type of complex box, you may like to reuse it. To do this, you can simply write the `bbs` commands defining the new box into a text file and afterwards include that file in `bbi`. Doing this, you start writing `bbs` scripts. The conventional (and mandatory) extension for such scripts is `bbs` (black box script). For consistency reasons, you are requested to prepend `bb` to the name.

For example, the `Add3` complex box we previously worked on can be defined in the `bbAdd3.bbs` file :

File bbAdd3.bbs

```
# Defines the Add3 black box which adds 3 doubles
load std

define Add3
  # I am the author
  author "myself"
  description "adds 3 doubles"
  # Pipeline creation
  new Add a
  new Add b
  connect a.Out b.In1
  # Inputs definition
  input x a.In1 "first double to add
  input y a.In2 "second double to add
  input z b.In2 "third double to add"
  # Output definition
  output result b.Out "output"
endefine
```

End of file

Lines starting with a `#` character or a `//` character are ignored, they are considered as comments by the interpreter. To use this file in `bbStudio`, click on the `include` button, and browse your filestore to find the file.

```
> include bbAdd3.bbs
> help Add3
Complex Black Box <user::Add3>
 adds 3 doubles
 By : myself
 * Inputs :
    'x'      <double> : first double to add
    'y'      <double> : second double to add
    'z'      <double> : third double to add
 * Outputs :
    'result' <double> : output
 * Boxes :
    'a' <std::Add>
    'b' <std::Add>
>
and so on ...
```

If the file has the `bbs` extension, you can ommit it and just type :

```
> include Add3
```

3.6 Creating complex black boxes that use complex black boxes

Of course, you can include script files in other script files, like in the following example :

File bbAdd4.bbs

```
# Defines the Add4 black box which adds 4 doubles
include Add3

define Add4
  author "myself"
  description "adds 4 doubles"
  new Add3 a
  new Add b
  connect a.Out b.In1
  input In1 a.In1 "first double to add
  input In2 a.In2 "second double to add
  input In3 a.In3 "third double to add"
  input In4 b.In2 "fourth double to add"
  output Out b.Out "output"
endefine
```

End of file

The inner boxes have they own entries (In1, In2, In3 for box a, In1, In2 for box b)
Only the inputs In1, In2, In3 of box a and the input In2 of box b is of interest for the end user, but he dosn't want to have to care neither about the inner boxes name, nor about the names of their Inputs.
The writer of the complex box has the ability to give these inputs a meaningfull name !

```
  input In3 a.In3 "third double to add"
  input In4 b.In2 "fourth double to add"
```

3.7 Naming Conventions

- File names : For consistency reasons, you are requested to prepend `bb`, and postpone an extention `.bbs`, to the names of the files that hold a `complex black box` definition.

  For example, the `Add3` complex box we previously worked on can be defined in the `bbAdd3.bbs` file.

- Search Paths : For consistency reasons, the names of dynamic libraries holding the packages start by `bb`. For instance, the package `wx` will be in the library `bbwx.dll` (Windows) or `libbbwx.so` (Linux).

Summary

- The `include` command tells the interpreter to include a script file.
- Lines starting with a `#` or with a `//` are considered as comments by the interpreter.
- Lines between a line starting with a `/*` an a line ending with a `*/` are considered as comments by the interpreter.

3.8 Creating command line applications

Now that you know how to create complex black boxes (with `define/endefine`), think back to the `workspace` object. Remember that it is also a `complex black box`. Actually, when you type interpreter commands outside a `define/endefine` block, you progressively define the `workspace` complex black box. You can think of it like if at start the interpreter was issuing a command `'define workspace'` and then letting you define the interior of the box `workspace`.

Remember that the command `inputs` allows to define an input of a complex box. Now, if you use the command `input` outside a `define/endefine` block then it defines an input of the `workspace` box, that is an input of the *main program*. This input will then be connected to the parameters that the user passes to the command line.

For example, consider the script :

File add.bbs

```
load std
new Add a
input x a.In1 "first number to add"
input y a.In2 "second number to add"
print "x+y=$a.Out$"
```

End of file

The third and fourth lines define two inputs `x` and `y`. When you execute this script, you can pass these two arguments on the command line, like this :

```
> bbi add x=1 y=1
x+y=2
```

You can also invoke `bbi` the option `-h`, which gives help on the `workspace` box :

```
> bbi add -h
 User's workspace
 By : bbi (internal)
 * Inputs :
    'x' <double> : first number to add
    'y' <double> : second number to add
```

To get a better help, use the `description` and `author` commands :

File add.bbs

```
description "Adds two numbers"
author "foo@bar.com"
load std
new Add a
input x a.In1 "first number to add"
input y a.In2 "second number to add"
print "x+y=$a.Out$"
```

End of file

Now if you ask for help on the `add` script, you get :

```
> bbi add -h
 Adds two numbers
 By : foo@bar.com
 * Inputs :
    'x' <double> : first number to add
    'y' <double> : second number to add
```

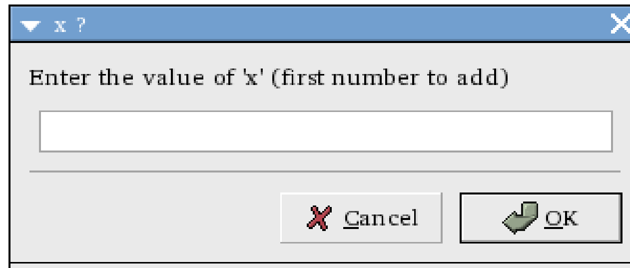
Rather than getting the inputs of a script from the command line, you can ask `bbi` to prompt the user for the values, using the `-t` commutator :

```
> bbi add -t
x=[the program waits for user answer]2
y=[the program waits for user answer]5
x+y=7
```

You can also use the `-g` commutator. `bbi` then prompts the user in graphical mode, displaying a dialog box for each input, like in fig. 17.

Note that for both `-t` and `-g` options, the input from the user is a `string` and `bbi` converts it to the right input type using an `adaptor`, hence the right adaptors must be loaded.

Figure 17: Input dialog box



Summary

- The input, description and author commands, when they are used outside a define/endefine block allow to define the inputs, description and author of the main program.
- Inputs of the main program can be passed on the command line using the syntax <input-name>=<value>. No white space is allowed, if the value or the input name contains white spaces, enclose them between double quotes, e.g. "parameter with white spaces = gnu's not unix".
- The -h option of bbi prints help on the main program.
- The -t option of bbi orders the program to prompt for its inputs in text mode.
- The -g option of bbi orders the program to prompt for its inputs in graphical mode.

3.9 Using graphical interface boxes (widget boxes)

Basic graphical interface components are provided in the package wx, such as buttons, sliders, file open/save dialogs, etc.

As first example, type the following commands in bbi :

```
> load wx
> new InputText t
> print $t.Out$\n
```

When you type enter after the last line, a window pops up in which you can entrer a text. When you close the window, the text you entered is printed by the print command.

Type help wx, you get something like :

```
Package wx v1.0.0- info-dev@creatis.insa-lyon.fr
Basic graphical interface elements (sliders, buttons ...) based on wxWidgets
Black boxes :
  ColourSelector         : Colour Selector dialog (bbfication of wxColourSele...
  ColourSelectorButton   : A button which displays a colour picker dialog whe...
  CommandButton          : Button which executes bbi commands
  DirectorySelector      : Pops up a directory selection dialog (wxDirDialog)
  FileSelector           : Pops up a file selection dialog for reading or sav...
  InputText              : A zone in which the user can enter a text (wxTextC...
  LayoutLine             : LayoutLine widget (wxBoxSizer)
  LayoutSplit            : Widget which splits a window in two fixed size par...
  LayoutTab              : LayoutTab widget (wxNotebook)
  OutputText             : Text zone to be inserted into a window (wxStaticTe...
  RadioButton            : RadioButton group widget 0-9 entries
  Slider                 : Slider widget (wxSlider)
```

You can reproduce the same experiment as above using a `Slider` or a `FileDialog` rather than a `InputText`..

There is a special kind of widget, called 'Layout', designed to contain other widgets in order to build larger dialog boxes.

For example, the `LayoutSplit` widget is a container which "splits" a window into two parts, either horizontally or vertically, each part including another widget. The initial size of the two parts can be fixed by the input 'Proportion' and be adjusted by the user thanks to a "handle".

The example `exampleLayoutSplit` demonstrates its use. Run it : it displays a window with two sliders. Move the sliders and close the window. Now look at the source file to see how this is done :

File scripts/test/testSplit.bbs

```
load wx

new Slider s1
new Slider s2

new LayoutSplit s
connect  s1.Widget s.Widget1
connect  s2.Widget s.Widget2

exec s
```

End of file

First, the two sliders `s1` and `s2` are created. A `LayoutSplit` box `s` is also created. The `connect` commands then "includes" the sliders in the split widget. The input

`Widget` is common to all widget boxes : every widget can be inserted into another widget. The outputs `Widget1`,`Widget2` are specific of *layout* widgets (in `bbi` type `help Slider` : you will see the output `Widget`; type `help LayoutSplit` : you will see the inputs `Widget1` and `Widget2` and the output `Widget`). When you connect the `Widget` output of a box to the `Widgeti` input of a layout widget, you order to include the widget in the layout. Of course, the order of connection is important. In our case, the slider `s1` is included first, then the slider `s2` : `s1` will be placed on top of `s2` (the `LayoutSplit` box is implemented that way, but this is arbitrary choice).

Right now, there are only *three* layout widgets in the `wx` package :

- the `LayoutSplit` widget we just described
- the `LayoutLine` widget can have multiple children (`Widget1`, `Widget2`,... `Widget9` inputs) and divides its window into as much parts as children, each part of equal size. The orientation of the `LayoutSplit` or of the `LayoutLine` can be changed by the input `Orientation`. With only those two layout widgets you can already create complex dialog boxes (of course layouts can be nested, which leads to tree-like structures of widgets).
  See the script `exampleComplexLayoutSplit_In_LayoutSplit` for an example.
- The `LayoutTab` widget arranges its children in different pages or 'tabs' (`wxNotebook`-based). The label of each page is the name of the widget it contains.

3.10 Deeper in the boxes

3.10.1 Default and mandatory inputs and outputs

- Any `atomic` black box has two default Inputs, which are created by the system :
  - ***BoxExecute*** : Any signal received by this input executes the box
  - ***BoxProcessMode*** : Sets the processing mode of the box :
    * ***Pipeline*** :The box executes itself only when an input was changed (normal pipeline processing).
    * ***Reactive*** : Re-processes immediately when *any input* changes.
      To be more selective, better use '`connect A.BoxChange B.BoxExecute`'.
    * ***Always*** :Usefull for 'sources', that must be processed, even when no input changed (e.g. : FileSelector, ColorSelector)
      This one is not end user intended (for Package developer only)
- And one default output :
  - ***BoxChange*** : Signals any modification of the box. This output may be connected if necessary to the *BoxExecute* input of an other box : each time the boxes changes (e.g. a Slider is moved) the box it is connected to will be forced to update.

If you create complex boxes, it is a good idea to define those inputs and outputs to be able to force the execution of your complex box or be aware of its changes...

- Any **widget** box has five Inputs, that will be dealt with only if the box is not connected to the *Widget*i of any *Layout* box :
  - ***WinHeight*** : Height of the window
  - ***WinWidth*** : Width of the window
  - ***WinTitle*** : Title of the window
  - ***WinClose*** : Any received signal closes the window
  - ***WinHide*** : Any received signal hides the window
  - ***WinDialog*** : When set to 'true', creates a *dialog window*, that blocks the pipeline until it is closed (*modal*)

  If you define a complex widget box, it is a good idea to define these inputs to be able to customize your window settings.

- Any **widget** box has one mandatory Output :
  - ***Widget*** : that is the `wxWindow` itself. If it's not connected to the `Widget`*i* of any *Layout box*, then the box will create its own window (frame or dialog) on execution. If it's connected to the `Widget`*i* of a `Layout box`, it will be embedded in its parent window.

  If you define a complex widget box, it is a good idea to use this standard name for your window output

- Any **Layout** box (i.e. *LayoutLine*, *LayoutSplit* or *LayoutTab*) has one or more mandatory Inputs :
  - ***Widget*i** : e.g. a *LayoutSplit* box (Widget which splits a window in two resizeable parts) has two Input parameters *Widget1* and *Widget2*, used to embed the child windows.
    e.g. a *LayoutLine* divides the window in up to 9 (depending on the number of inputs *Widget*i) fixed size parts.

  If you define a complex layout box, it is a good idea to use these standard names for your sub-windows inputs.

---

4 Using third party Package

4.1 Plugging in a Package

bbStudio makes it easy for you : in the menu Tools just click on the option Plug Package. You will be asked to 'Select package directory'. Browse untill you find the install or the build directory, depending whether you installed the package or not.

bbStudio will update the configuration file, generate the 'Package documentation', and update the 'Boxes Lists'.

You will be able to use the new package just as you did for any other bbtk canonical Package.

4.2 Hard incorporating of a Package

If the Package you want to use is supplied in a non standard way (e.g. : you where given one ore more dynamic libraries (.dll or .so), and/or one or more directories containing bbtk scripts (.bbs) you can edit your bbtk configuration and add the appropriate paths, see 7.1.

4.3 Updating the documentation

You may add your own boxes (simple boxes, if you are aware enough in C++ language, or complex boxes if you are aware enough in bbtk scripting).

To update the html help of this package, use the option Regenerate package doc in the menu Tools of bbStudio. You'll be prompted for the Package name. Avoid using the -a option (Regenerate all), since it's time consumming.

To update html boxes lists with the new boxes, use the option Regenerate Boxes Lists in the menu Tools of bbStudio.

4.4 Using the package

The only thing you have to do is to include or load the package, within a script, or from the Command part, and enjoy the black boxes it contains.

5 Using black boxes in C++ programs

A very useful feature is that you may use any widget black box within a C++ program without worrying about writing a wxWidgets main application.

Let's look a the following bbs script :

```
# Load the packages
load std
load wx

# Create the Objects
new Slider     slider
new OutputText text
new LayoutLine layout

# Graphical pipeline
connect slider.Widget    layout.Widget1
connect text.Widget      layout.Widget2

# Execution pipeline
connect slider.BoxChange text.BoxExecute
connect slider.Out       text.In

# Go!
exec layout
```

User wants to create a slider and an output text, within a LayoutLine, and display the slider value in the output text. Think about the (little!) nightmare to code the same, in 'raw C++', using wxWidgets.

The following C++ code does the same :

```
#include <bbtkFactory.h>
#include <bbwxSlider.h>
#include <bbwxOutputText.h>
#include <bbwxLayoutLine.h>

int main(int argv, char* argc[])
{
  try
    {
      // we need to intanciate a bbtk::Factory to be aware of the adaptors
      bbtk::Factory::Pointer factory = bbtk::Factory::New();
```

```
      // Load the packages
      // -----------------
      factory->LoadPackage("std");
      factory->LoadPackage("wx");

      // Create the Objects
      // ------------------
      bbwx::Slider::Pointer     slider   = bbwx::Slider::New("slider");
      bbwx::OutputText::Pointer text     = bbwx::OutputText::New("text");
      bbwx::LayoutLine::Pointer layout   = bbwx::LayoutLine::New("layout");

      // Graphical pipeline
      bbtk::Connection::Pointer c1       = bbtk::Connection::New(slider,"Widget",
         layout,"Widget1");

      bbtk::Connection::Pointer c2       = bbtk::Connection::New(text,"Widget",
         layout,"Widget2");

      // Execution pipeline
      // ------------------

      // We have to pass the 'factory', in order to call automatically an adaptor,
      // if necessary.
      bbtk::Connection::Pointer s2t      = bbtk::Connection::New(slider,"Out",
         text,"In",
         factory);
      bbtk::Connection::Pointer c3       = bbtk::Connection::New(slider,"BoxChange",
                                                             text,"BoxExecute");
      layout->bbSetInputWinDialog(true);

      // Go!
      // ---
      layout->bbExecute();

    }
  catch (bbtk::Exception e)
    {
      bbtk::MessageManager::SetMessageLevel("Error",1);
      e.Print();
    }
}

In this code, we use the headers of the \texttt{bbwx} \CPP library,
```

```
which define the black boxes of the \texttt{wx} package.

to be continued ...
```

---

6 bbs language reference

6.1 Pipeline creation and execution related commands

Table 1: bbs pipeline creation and execution related commands.

Command	Parameters	Effect
new	<box-type> <box-name>	Creates a box of type box-type and name box-name.
newgui	<box-name> <gui-box-name>	Automatically creates a graphical user interface with name gui-box-name for the black box box-name and connects it to the box inputs
delete	<box-name>	Destroys the box named box-name
connect	<box1.output> <box2.input>	Connects the output output of the box named box1 to the input input of the box named box2
set	<box.input> <value>	Sets the input input of the box named box to the value value. An adaptor must exist in the packages loaded which converts a std::string to the type of the input input.
exec	<box-name>	Executes the box named box-name. If needed the boxes connected to its inputs are also processed recursively (pipeline processing).
	freeze	Allows to block execution commands while keeping definition commands active (this one is not for end user)
	unfreeze	Turns back to 'normal' mode (this one is not for end user).

6.2 Package related commands

Table 2: `bbs` package related commands.

Command	Parameters	Effect
`include`	`<package-name>`	Loads the package `package-name` and includes all its complex box definition scripts.
`load`	`<package-name>`	Loads the atomic black boxes of package `package-name`. Loads the dynamic library but not the complex boxes defined in the scripts shipped with the package. Use it only if you know that you won't work with its complex black boxes
`unload`	`<package-name>`	Unloads the package `package-name`. The package must have been previously loaded. No box of a type defined in this package must still exist.
`reset`	-	Deletes all boxes and unloads all packages so that the interpreter gets back to its initial state
`package`	`<package-name>`	All complex black boxes definitions until the next `endpackage` will be stored into the package `package-name`
`endpackage`	-	Closes a `package` command

6.3 Interpreter related commands

Table 3: bbs intepreter related commands.

Command	Parameters	Effect
help	-	Prints help on available commands
	<command-name>	Prints help on the command command-name
	packages	Prints help on available packages and their box types (without description)
	<package-name>	Prints help on the package package-name and its boxes (with brief description). The package must have been previously loaded
	<box-type>	Prints help (with full description) on the type of box box-type. The box type must belong to a package which has been previously loaded
message	-	Prints information on available kinds of messages and their current level
	<kind> <level>	Sets the level of verbosity of the interpreter for the kind of messages kind to level.
include	<file-name>	Includes and executes the content of the file named file-name exactly like if you were typing its content at the place were the include command is.
print	<string>	Prints the string after substituting each token of the form $box.output$ by the adaptation to string of the value of the output output of the box named box. An adaptor must exist in the packages loaded which converts the type of the output output to a std::string.
graph	...	Generates the html doc including the pipeline graph for a given complex box
index	...	Generates the html index of currently loaded boxes types
config	-	Displays the configuration parameters
debug	<debug-directive>	[expr—-C—-D] Prints debug info on living bbtk objects containing the string expr (default expr=”). -C checks the factory integrity. -D turns on objects debug info after main ends
quit	-	Exits the interpreter

6.4 Complex black box definition related commands

Table 4: bbs complex black box definition related commands.

Command	Parameters	Effect
define	<box-type> [<package-name>]	Starts the definition of a complex black box of type box-type. If <package-name> is provided then includes the box in the given package (otherwise it is defined in the current package, i.e. user if outside a package/endpackage block).
endefine	-	Ends the definition of a complex black box type
author	<string>	Concatenate the string to the author string of the current complex black box.
description	<string>	Concatenate the string to the description of the current complex black box.
category	<string>	Specifies the categories of the current complex black box. The categories must be separated by semicolons, e.g. "widget;image"
kind	<box kind>	Specifies the kind of the current complex black box (ADAPTOR, DEFAULT_ADAPTOR, WIDGET_ADAPTOR, DEFAULT_WIDGET_ADAPTOR)
input	<name> <box.input> <help>	Defines a new input for the current complex black box, named name. It is defined as corresponding to the input input of the box box. <help> is the help string for the new input. The box box must already have been created in the complex box and of course have an input named input.
output	<name> <box.output> <help>	Defines a new output for the current complex black box, named name. It is defined as corresponding to the output output of the box box. <help> is the help string for the new output. The box box must already have been created in the complex box and of course have an output named output.

Note : if outside a define/endefine block then the current complex black box is 'user::workspace', that is the main program equivalent (this is how applications are documented). This remark holds for all complex black box related commands.

7 Install and run time issues

7.1 bbtk configuration file

At start, bbtk applications (bbStudio , bbi) try to open an xml configuration file named bbtk_config.xml. The search order is

1. The current directory
2. The subdir .bbtk of the user's home directory.
   - On Unix, the home directory is the one stored by the environnement variable HOME, typically /home/username.
   - On Windows, the home directory is the user's profile directory stored by the environnement variable USERPROFILE, typically C:\ Documents and Settings\ username.
3. If none of these two paths contains the file then it creates a new one in the .bbtk directory.

Information on bbtk configuration is obtained in bbStudio by clicking on the Config button of the Command part toolbar.

If you did not installed other packages than the ones provided by bbtk , you get something like :

```
=============
Configuration
=============
bbtk_config.xml    : [/home/guigues/.bbtk/bbtk_config.xml]
Documentation Path : [/usr/local/bin/../share/bbtk/doc]
Data Path          : [/usr/local/bin/../share/bbtk/data]
Temp Directory     : []
File Separator     : [/]
BBS Paths
--- [.]
--- [/usr/local/bin/../share/bbtk/bbs]
PACKAGE Paths :
--- [.]
--- [/usr/local/bin/../lib]
```

The first line let you know which configuration file is currently used.

You can open this file using bbStudio menu Files>Open bbtk Config file.

You will get something like :

```
<?xml version=\"1.0\" encoding=\"iso-8859-1\"?>
<config>
```

```
  <bbs_path>     </bbs_path>
  <package_path> </package_path>
</config>
```

The xml tags bbs_path and package_path allow to set additionnal directories in which to search for bbs files and packages dynamic libraries.

For example, if you add the line :

```
  <bbs_path> /home/guigues/bbs </bbs_path>
```

Then the interpreter will search for bbs in the folder /home/guigues/bbs, which allows a command like 'include bbMyBox.bbs' to work if the folder /home/guigues/bbs contains the file bbMyBox.bbs.

The same, the xml tag <package_path> let you set additional path in which to find a package dynamic library, hence allowing to load additionnal packages with the 'load' command.

All bbs and package paths are summmarized in the information output when pressing 'Config' in bbStudio . You can see that two bbs paths are always set :

- The current directory (.)
- The bbs folder of bbtk

Also, two package paths are always set :

- The current directory (.)
- The libraries folder of bbtk

Additional paths set in your bbtk_config.xml are added after those standard paths. Note that the order displayed is the one in which the folders are searched when include or load commands are issued.

7.2 Misc

- bbStudio is written using the Advanced User Interface library of wxWidgets. If, after some hazardous floating/docking operations onto the frame, you feel very unhappy with the result, just remove from the hidden directory .bbtk the file named bbStudio.aui.