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# The LAL Development Environment

Installing and running LAL and LALWrapper;  
adding a new search code to LALWrapper



# Overview

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- *Today*
  - » *The LAL and LALWrapper development environment*
  - » *Goal: set-up your own personal copy of the LAL/LALWrapper development environment; run a simple search code in LALWrapper; add a simple(r) search to LALWrapper*
- *Thursday*
  - » *Programming in LAL; adding new components to the LAL package*
  - » *Goal: Create, install in (your own copy of) LAL and test a new analysis component*
- *Friday*
  - » *Parallel programming data analysis in LDAS; interfacing a parallel programmed analysis to LDAS*
  - » *Goal: Create, install in (your own copy of) LALWrapper and test a parallel programmed data analysis.*

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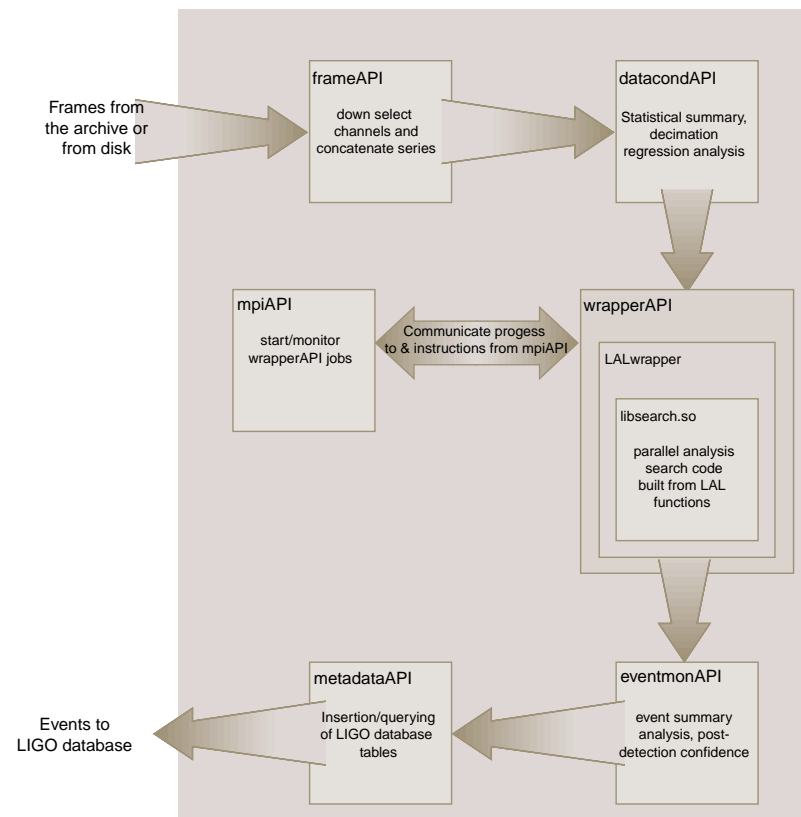
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# LDAS and LAL

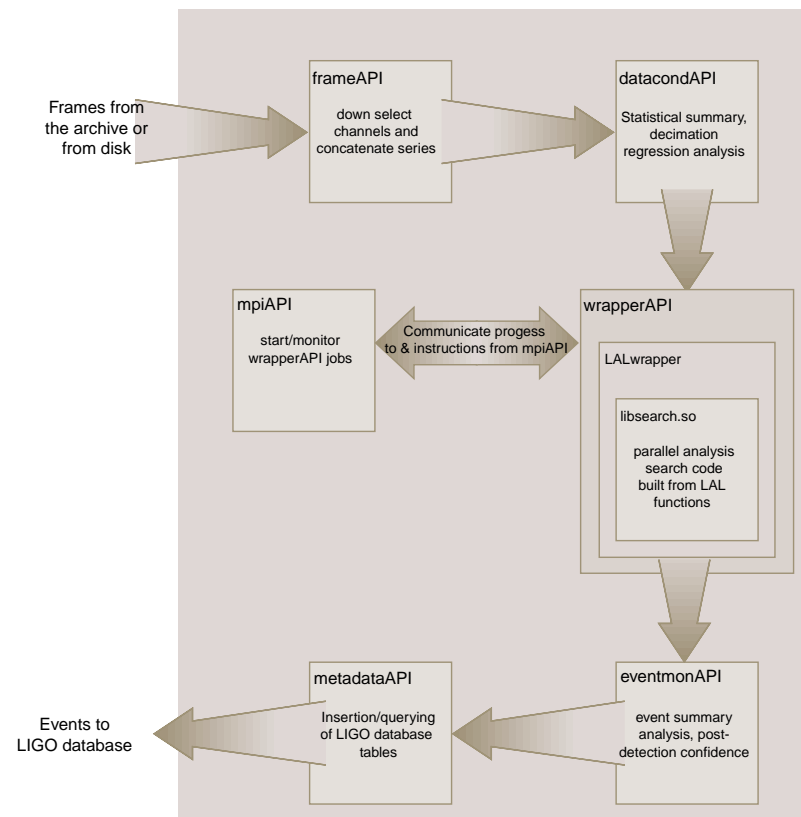
- LDAS is infrastructure
  - » Moves data from place to place
  - » Provides basic functionality for gathering, manipulating and storing data
  - » Provides production-level control and monitoring of analysis resources
- LAL is analysis software
  - » Collection of software subroutines that perform *search-specific* analyses





# wrapperAPI and LALwrapper

- wrapperAPI
  - » The LDAS component responsible for running analyses
- LALwrapper
  - » The LAL component responsible for connecting analysis code to LDAS
- LDAS talks to wrapperAPI
- wrapperAPI talks to LALwrapper
- LALwrapper talks to LAL code
- Insulation
  - » *LAL Developers don't have to worry about LDAS*
  - » LDAS Developers don't have to worry about LAL



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# The LAL/LALwrapper Development Environment

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- The `/ldcg` software tools
- The LAL CVS Repository
- Building and Installing LAL
- The LALwrapper CVS Repository
- Building and Installing LALwrapper
- The LDAS Subset for LALwrapper development
- Building and Installing the LDAS Subset



# The /lscg Software Tools

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- Development of LAL, LALWrapper, LDAS code requires a standard set of software tools
  - » Compilers, libraries, configuration and build utilities, etc.
  - » Interoperability of LAL, LDAS components requires consistency among the tools used
  - » Some build and development operations presume functionality available (or working!) in certain versions of software, or in software compiled in certain ways
- /lscg is the designated home for this software
  - » LAL, LDAS *require* the software be accessible through here
- LDAS, LAL only supported on intel and solaris, with appropriate /lscg and system software versions
- /lscg requires approximately 200MB space installed

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# Some of the software packages in /ldcg

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- Compiler and development tools

- » C Compiler: gcc v2.95.2
  - Soon to be 2.95.3
- » Macro processor m4
- » Configuration software automake, autoconf
- » Make
- » General utilities

- Libraries and other software packages

- » Stow
- » Tcl & tk
- » LAM MPI
- » Perceps (documentation)
- » FFTW
- » Zlib (compression library)
- » Database libraries



# Installing /ldcg

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- “How to Build LDAS” link on the LDAS Home Page
  - » Detailed software installation instructions
  - » LDAS Home Page: <http://ldas-sw.ligo.caltech.edu/>
  - » Follow “How to Build LDAS” link
  - » Follow “LDAS” link
    - wrapper link not yet validated
- Installing /ldcg takes about one full day
  - » Good instructions make installation straightforward, if tedious. We won’t do it here, but you’ll need to do it at home
- Make /ldcg software available
  - » Add executables to path, libraries to loader path
- *Recommended practice:*
  - » Do this in your your shell profile (i.e., .cshrc or .profile or .bashrc or ...)
  - » Sample scripts to make these and other changes at login are available on the [Camp web page](#)
- Coming soon: /ldcg on CD for intel and solaris
  - » Plug and play!





# Preparing to retrieve, build and install LAL and LALwrapper

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- Choose a local home for your copy of the sources and compiled code
  - » You will need a directory hierarchy that should contain only the LAL-related software
  - » The directory hierarchy will need to hold on order 300MB of compiled code
  - » For camp, use `/home/wrkshp/$USER/LAL`
  - » Sources will live in `src` sub-directory
- *Best Practice:*
  - » Define environment variable `LALHOME` in your shell profile (i.e., `.cshrc` or `.profile` or `.bashrc` or ...) and always refer to `$LALHOME` when building, compiling, etc.



# Retrieving LAL

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- LAL lives in a network-accessible *CVS repository*
- CVS? Concurrent Version System
  - » A *version control system*. Files maintained by CVS are marked with version numbers and previous versions of files may be retrieved at any time.
  - » Copies of files maintained by CVS are “checked-out” of the repository. If changed, the modified files can be checked-in, in which case the revisions are automatically marked with a new version number and made available to other users.
  - » CVS is especially suited for projects where multiple people may be working simultaneously on the same set of files. If different users modify a file version simultaneously, CVS will attempt to intelligently merge the changes automatically upon check-in.
- CVS has extensive on-line documentation
  - » Long summary in \*nix man page; full documentation in emacs “info” system



# Using CVS to retrieve LAL

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- To use cvs to retrieve the LAL source
  - » Specify the repository (a.k.a. CVSROOT)
  - » Log-in as an authorized cvs user
  - » (optionally) Specify the release
  - » Specify the directory hierarchy in the repository
- cvs will retrieve the files into the current directory



# Using CVS to retrieve LAL

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- Specifying the repository
  - » `:pserver:anonymous@gravity.phys.uwm.edu:/usr/local/cvs/lal`
- `:pserver`
  - » This repository resides on the internet behind a password-protected cvs server
- `:anonymous@gravity.phys.uwm.edu`
  - » The system (`gravity.phys.uwm.edu`) and user name (`anonymous`) to use to access the repository
- `:/usr/local/cvs/lal`
  - » The location on the server of the repository you want to reference
- *Recommended Practice*
  - » Define the `LALCVS` environment variable in your shell environment



# Log-in as authorized user

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- Log-in to the repository:
  - » `% cvs -d $LALCVS login`
- *Caveat:* The anonymous user can only read from the repository
  - » Code you develop here, today, cannot be put back in the repository
  - » To add code to the repository, you will need a different user id, with write privileges.
  - » To get a user id that allows you to add your own code to the repository you will need to make a request to the software coordinator, Alan Wiseman, directly
- *Caveat:* CVS is not a substitute for developer communication!
  - » As a general rule, you should never do any significant work on a program module you are not responsible for, without first communicating with the responsible developer/author



# Retrieve the source

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- Change to the source directory and issue the cvs “checkout” command:
  - » % `cd $LALHOME/src`
  - » % `cvs -d $LALCVS checkout -rldas_camp lal`
    - The `-rldas_camp` flag specifies that you want, not the latest version of the repository, but the version tagged `ldas_camp`
- You now have a copy of the full lal repository, version `ldas_camp`, in `$LALHOME/src/lal`



# Examining the repository

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- At the top-level
  - » Informational files: AUTHORS, COPYING, ChangeLog, INSTALL, NEWS, README, README.bugs, README.contrib
  - » Configuration files: ./00boot, Makefile.am, config.sub, CVS, missing, aconfig.h, acinclude.m4, ltconfig, config.guess
  - » Helper utilities: mkinstalldirs, install-sh, testscript.sh, ltmain.sh
  - » LAL documentation source files: doc/, misc/
  - » LAL software “packages”: packages/
  - » Headers: include/
- Many of these directories are depopulated: configuration and the build will populate them



# Other ways to access the repository

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- The LAL Repository (and also the LDAS and LALwrapper repositories) have a web-based interface
- The web interface is useful for browsing the repository, both by file and version
- <http://www.lsc-group.phys.uwm.edu/lal> points to the lal home page. Follow the link under CVS Tree to the web interface to the lal repository





# Building LAL

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- Go to `$LALHOME/src/lal`
- Initialize configuration files

- » `% ./00boot`

- Configure

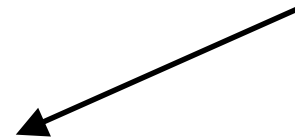
- » `% ./configure --prefix=$LALHOME --enable-shared --enable-mpi --with-cflags=-fexceptions`

- The `-fexceptions` compiler flag is necessary since, ultimately, the `lal` c-code is being run by a c++ process

- » You can get a full list of configuration options by just asking:

- `% ./configure --help`

Note: one line!





# Building LAL, cont'd

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- Make LAL, check build, make documentation
  - » `% make`
  - » `% make check`
    - Builds and executes programs that check each LAL package
  - » `% make dvi`
    - Building LAL also builds LSD: LAL Software Documentation
    - Really makes pdf files!
- Install LAL
  - » `% make install prefix=$LALHOME/stow_pkgs/lal-ldas_camp`
  - » `% cd $LALHOME/stow_pkgs`
  - » `% stow lal-ldas_camp`



# Where has everything gone?

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- The build step produces libraries and documentation
  - » Documentation in doc/ directory, headers in include/lal
- The install step copies libraries, header files and some (not all!) documentation out of lal/ and into \$LALHOME/stow\_pkgs/lal-ldas\_camp
- The stow step creates in \$LALHOME bin, doc, include and lib directories, which are linked (or have files in them linked) to \$LALHOME/stow\_pkgs/lal-ldas\_camp
  - » Stow manages different versions of compiled packages
  - » Allows you to have different versions of lal, etc., compiled and available, and quickly change between them.



# Documentation

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- LAL Software Documentation (LSD)
  - » Extensive documentation of existing LAL Packages
  - » Made as part of LAL Build
  - » Installed in `$LALHOME/doc/lal *`
  - » Not yet available in DCC
  - » Available now at <http://gravity.phys.psu.edu/LDASCamp/lsd.pdf>
- LAL Software Specification and Style Guide
  - » Describes rules for writing LAL C-code
    - Subject of tomorrow's workshop!
  - » Made as part of LAL Build
  - » Installed in `$LALHOME/doc/lal */lalspec .pdf`
  - » T990030-00 not yet available in DCC (soon?)
  - » Available now at <http://gravity.phys.psu.edu/T990030.pdf>



# Reporting Problems

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- What is a “problem”?
  - » *Anything* that doesn’t work as advertised
  - » Also enhancement requests, suggestions
  - » Problems can be in software, or documentation, web sites, etc.
- How do I report problems?
  - » LAL, LALwrapper:  
<http://www.lsc-group.phys.uwm.edu/lal/bugs.html>
  - » LDAS: <http://ldas-sw.ligo.caltech.edu/doc/ProblemTracking.html>
- What goes in a report?
  - » Who am I?
  - » Synopsis
  - » Criticality & seriousness
  - » Longer description and how-to-reproduce
  - » See also [How to Report Bugs Effectively](#)
- What if I’m not sure?
  - » When in doubt, **report!**



# LALwrapper

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- Retrieve from cvs repository

- » CVS Root:

- » `:pserver :anonymous@gravity.phys.uwm.edu:/usr/local/cvs/lalwrapper`

- » Recommended practice: set environment variable (WRAPPERCVS) to cvs root

- » `% cd $LALHOME/src; cvs -d $WRAPPERCVS checkout -rldas_camp lalwrapper`

- *Caveat!*

- » Always retrieve the same version of lalwrapper as you retrieve of lal

- » Lalwrapper code depends sensitively on lal code. Though in separate repositories, lalwrapper of one version will almost certainly not compile against lalwrapper of a different version!

- LALwrapper repository browser:

- » <http://www.lsc-group.phys.uwm.edu/cgi-bin/cvs/lalwrapper.cgi/>



# Building LALwrapper

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- Initialize configuration files
  - » % ./00boot
- Configure
  - » % ./configure --prefix=\$LALHOME --with-extra-cppflags="-I\$LALHOME/include -I/ldcg/include"
- Build
  - » % make
  - » % make check
  - » % make dvi
- Stow and install
  - » % make install prefix=\$LALHOME/stow\_pkgs/lalwrapper-ldas\_camp
  - » % cd \$LALHOME/stow\_pkgs
  - » % stow lalwrapper-ldas\_camp

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# LALwrapper Documentation

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- Caveat!

- » LALwrapper and its documentation is a work in progress: much of install documentation is wrong, other documentation out-of-date

- Three documents

- » search-code-howto.pdf: Betty Crocker lal. *Beware:* much information wrong or out-of-date. No dcc number yet.
- » Idas-lal.pdf: the specification for the interface between lal and Idas. Has invalid dcc number; out-of-date.
- » lalwrapper.pdf: combination of previous two, plus rudimentary documentation on lalwrapper package





# Documentation and Useful Web Wites

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- The LAL Home Page
  - » <http://www.lsc-group.uwm.edu/lal>
  - » Not complete; some documents out-of-date
- The LALwrapper Home Page
  - » <http://www.lsc-group.uwm.edu/lalwrapper>
  - » Not complete; some documents out-of-date
- The LDAS Home Page
  - » <http://ldas-sw.ligo.caltech.edu>
- PDF Presentations and Documentation for Camp
  - » <http://gravity.phys.psu.edu/LDA/SCamp>
- Corrected “How to develop search codes ...”
  - » <http://gravity.phys.psu.edu/LDA/SCamp/T01XXXXX.pdf>
- Today’s Lecture
  - » <http://gravity.phys.psu.edu/LDA/SCamp/G010227-00.pdf>



# Lab Activities

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- Install LAL, LALwrapper, LDAS subset in /home/wrkshp/\$USER/LAL
- Run the example wrapper programs
- Add HelloWorld to lalwrapper, following the directions in the amended [How to develop search codes ...](#) document
- Use the web-based interface to the archive to browse one or more of the lal, lalwrapper, or lidas repositories.