Chapel: Hands-On Session

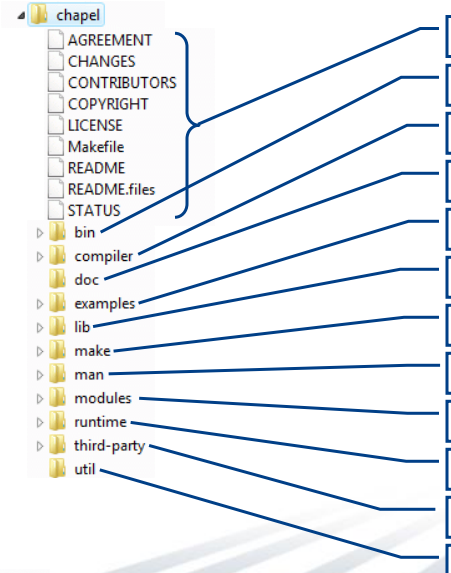
Chapel Team

PRACE Winter School
12 February 2009

Outline

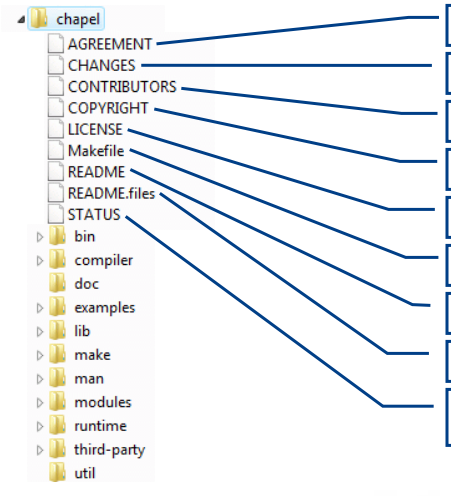
- Overview of the release structure
  - overall structure
  - documentation structure
  - examples structure
- Getting started with the hands-on session
- Chapel environment settings

Release Directory Structure



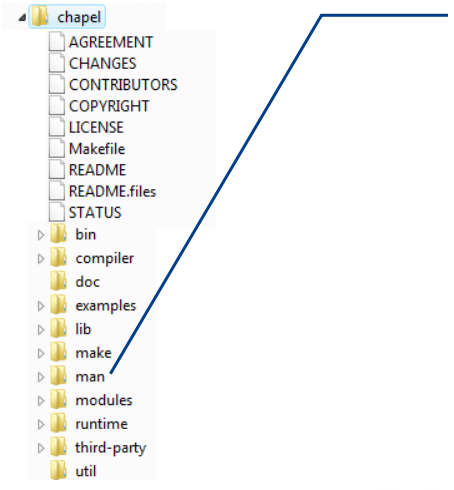
- Top-level README files
- Chapel compiler
- Compiler source code
- Documentation
- Example codes
- Runtime support libraries
- Makefiles
- Man pages
- Standard and Internal Chapel modules
- Runtime support library source code
- Third party software
- Utility scripts

Top-Level Documentation

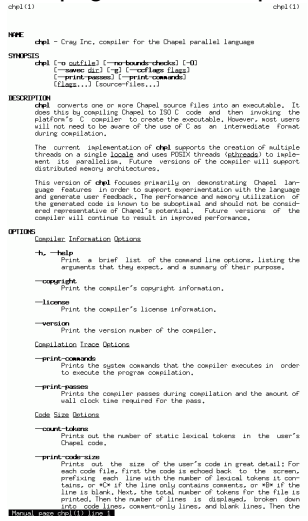


- User agreement
- Changes from previous releases
- Project contributors
- Copyright statement
- License agreement (BSD)
- top-level Makefile
- top-level README (START HERE!)
- a map of the file structure (like this one)
- known bugs and unimplemented features

Man Page



man page for the Chapel compiler



chpl(1) chpl(1)

NAME

chpl - Cray Inc. compiler for the Chapel parallel language

SYNOPSIS

chpl [-o outfile] [--no-bounds-checks] [-O]
[--savec dir] [-g] [--ccflags flags]
[--print-passes] [--print-commands]
{flags...} {source-files...}

DESCRIPTION

chpl converts one or more Chapel source files into an executable. It does this by compiling Chapel to ISO C code and then invoking the platform's C compiler to create the executable. However, most users will not need to be aware of the use of C as an intermediate format during compilation.

The current implementation of chpl supports the creation of multiple threads on a single locale and uses POSIX threads (pthreads) to implement its parallelism. Future versions of the compiler will support distributed memory architectures.

This version of chpl focuses primarily on demonstrating Chapel language features in order to support experimentation with the language and generate user feedback. The performance and memory utilization of the generated code is known to be suboptimal and should not be considered representative of Chapel's potential. Future versions of the compiler will continue to result in improved performance.

OPTIONS

Compiler Information Options

-h, --help
Print a brief list of the command line options, listing the arguments that they expect, and a summary of their purpose.

--copyright
Print the compiler's copyright information.

--license
Print the compiler's license information.

--version
Print the version number of the compiler.

Compilation Trace Options

--print-commands
Prints the system commands that the compiler executes in order to execute the program compilation.

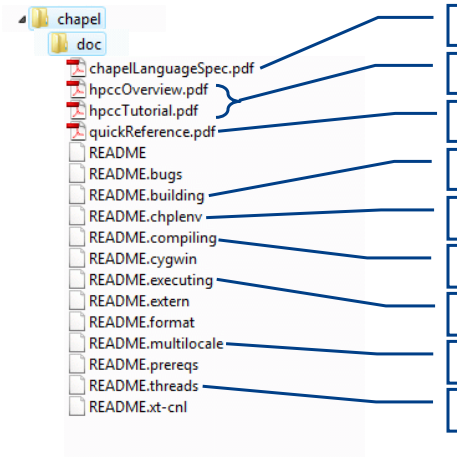
--print-passes
Prints the compiler passes during compilation and the amount of wall clock time required for the pass.

Code Size Options

--count-tokens
Prints out the number of static lexical tokens in the user's Chapel code.

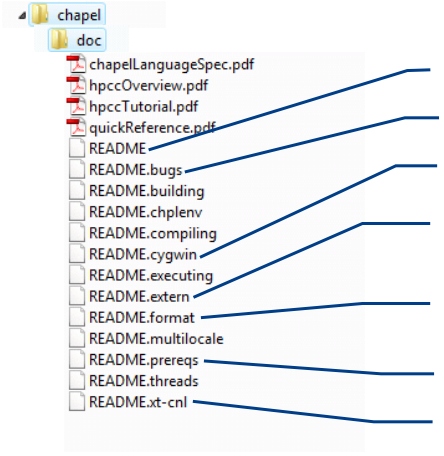
--print-code-size
Prints out the size of the user's code in great detail: For each code file, first the code is echoed back to the screen, prefixing each line with the number of lexical tokens it contains, or *C* if the line only contains comments, or *B* if the line is blank. Next, the total number of tokens for the file is printed. Then the number of lines is displayed, broken down into: code lines, comment-only lines, and blank lines. Then the

Doc Directory: Main files



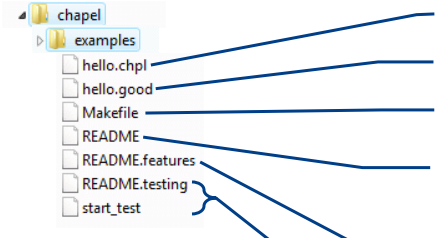
- Chapel Language Specification
- HPC Challenge Documentation
- Quick Reference Sheet
- details on how to build the compiler
- Chapel environment variables
- details on using the Chapel compiler
- executing Chapel programs
- executing using multiple locales
- executing using multiple threads

Doc Directory: Other files



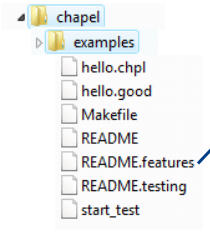
- map of this directory (like these slides)
- how to report bugs
- notes for Cygwin users
- technical note on stopgap measure for calling external C routines
- technical note on stopgap measure for formatting string conversions
- prerequisites for using Chapel
- technical notes for Cray XT users

Examples Directory: Notable files



- example Chapel source code
- expected output for test system
- Makefile to build all examples
- directory structure and overview of example codes
- feature grid mapping examples to language features
- information about the Chapel testing system

Examples Directory: Feature Grid



test	Data Parallel Features: frall	prmte	slice	reind	reduc	scan	xxxxx	xxxxx
hello								
hello-module								
beer	x							
blockLU	x		x	*	x			
fileIO					x			
genericStack								
iterators								
jacobi	*		*		*			
linkedList								
norm	x	x						
prodCons								
quicksort			x					
reductions		*	*		x			
slices	*	*	x	x				
sparse	x				x			
tree								
hpcc/stream	x	*			x			
hpcc/ra	x				x			
hpcc/fft	x	x	x		x			

key:
  frall = uses forall loops
  prmte = uses promotion and/or whole-array operators/assignment
  slice = uses array slices
  reind = uses array reindexing/array views
  reduc = uses reductions
  scan = uses scans

Outline

- Overview of the release structure
- Getting started with the hands-on session
  - platform notes
  - getting started
  - then what?
- Chapel environment settings

Supported Platforms for hands-on session

- **Option 1:** Use the provided installation

- **Option 2:** Use your own machine
  - **Linux, Mac, UNIX users:** should have no problems
  - **Windows users:** have three options:
    - use Cygwin (UNIX emulation environment)
      - works fairly well in practice, particularly for experienced users
      - can be a bit sluggish, particularly on Vista
      - read README.cygwin on the web before getting started
      - we can help you install Cygwin if you're not familiar with it
    - ssh/telnet into a UNIX platform and work there
    - find someone to partner with

- **No computer?** find someone to partner with

Steps to getting started (from the README)

1. Make sure you're in the `chapel/` directory
2. Build the compiler and runtime libraries using `gmake`
   - or `make` if your copy is GNU-make-compatible (as on Cygwin)
3. Set up your shell's environment to use Chapel
   - if you use… then type…

     …csh, tcsh `source util/setchplenv.csh`

     …bash `source util/setchplenv.bash`

     …sh `. util/setchplenv.sh`

     …something else? Come talk to us
4. Compile an example program using:

   ```
   chpl -o hello examples/hello.chpl
   ```
5. Execute the resulting program:

   ```
   ./hello
   ```

Then what?

- Whatever you want to do:
  - Look at, compile, execute our example programs
  - Explore the release -- see the bottom of the README for pointers
  - Try executing Chapel on multiple locales -- see README.multilocale
  - Try coding up an algorithm of interest to you
  - Work through some of the exercises we've prepared
- Please ask us questions if you have any difficulties
  - (or simply questions)
- Reminders:
  - break at 17:00
  - please fill out and return a survey form before you leave today

Outline

- Overview of the release structure
- Getting started with the hands-on session
- Chapel environment settings
  - main settings
  - cross-compilation settings
  - other settings

Main Chapel Environment Settings

CHPL_HOME: points to location of `chapel/` directory
- **default:** none
- **typical values:** `~/chapel`, `/cygdrive/c/chapel`, or any path

CHPL_HOST_PLATFORM: architecture on which compiler is built, run
- **default:** a best guess is made using uname -a
- **typical values:** cygwin, darwin, linux, linux64, sunos, xt-cle

PATH: the Chapel compiler's path should be added to yours
- **default:** none
- **typical value**: `$CHPL_HOME/bin/$CHPL_HOST_PLATFORM`

MANPATH: Chapel's man page path should be added to yours
- **default:** none
- **typical value**: `$CHPL_HOME/man`

(See `$CHPL_HOME/doc/README.chplenv` for more detail)

Cross-Compilation Environment Variables

CHPL_TARGET_PLATFORM: architecture for which Chapel is compiled
- **default:** $CHPL_HOST_PLATFORM
- **typical values:** mta, x1, x2, xmt, xt-cle

CHPL_HOST_COMPILER: compiler to use for the host platform

CHPL_TARGET_COMPILER: compiler to use for the target platform
- **default:** a best guess is made using the corresponding PLATFORM variable
- **typical values:** gnu, intel, pathscale, pgi, cray-mta, cray-vec, cray-xt-gnu, cray-xt-pathscale, cray-xt-pgi, ibm

CHPL_MAKE: the GNU-compatible make utility to use for the target
- **default:** a best guess is made using the PLATFORM variables
- **typical values**: gmake, make

(See `$CHPL_HOME/doc/README.chplenv` for more detail)

Other Environment Variables

CHPL_THREADS: threading layer to use for the generated code
- **default:** a best guess is made using $CHPL_TARGET_PLATFORM
- **typical values:** none, pthreads, mta

CHPL_COMM: communication layer to use for the generated code
- **default:** none
- **typical values:** none, gasnet, armci

CHPL_*: most compiler options can be set using an environment variable
- see `chpl --help-env` and `--help` for details

(See `$CHPL_HOME/doc/README.chplenv` for more detail)

To Download:

http://chapel.cs.washington.edu

Example starting points (and sample solutions):

http://chapel.cs.washington.edu/PRACE/exercises

Emacs and vim modes:

http://chapel.cs.washington.edu/publicRelease/editors.html

Questions?