Introduction to Clawpack and GeoClaw

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Overview and goals

1. brief introduction to Clawpack and GeoClaw
2. install virtual machine VMBox
3. load Clawpack virtual machine
4. familiarization with important application files
5. run simple test cases

some additional documentation and exercises:
`https://piazza.com/bu/spring2013/pasi2013/resources`
`http://math.boisestate.edu/ calhoun/teaching/PASI_Chile_2013`
`http://www.clawpack.org`

Clawpack and GeoClaw

- Clawpack is an open source software package
  - routines for solving general hyperbolic problems (1D and 2D)
  - numerical libraries (Fortran)
  - problem set-up scripts (Python)
  - user tools for plotting and manipulating data (Python)
  - website: `www.clawpack.org`
  - docs: `http://depts.washington.edu/clawpack/users/`
- GeoClaw is a subset of Clawpack
  - included with Clawpack
  - solves shallow water problems in 2D (tsunamis etc.)
  - contains tools (python) for setting up tsunami simulations
- Clawpack is intended for UNIX systems (linux, MAC, cygwin)
- Clawpack virtual machine (linux) should run on any system with VirtualBox installed

Installing VirtualBox and Clawpack

Virtual Box is virtualization software: `www.virtualbox.org`

1. download and install VirtualBox binaries for your host OS done
2. run VM VirtualBox. *e.g.*, :
   - linux: applications → system tools
   - MAC: applications
   - Windows: start menu → programs
3. install Clawpack virtual machine (VirtualClaw-4.6.2):
   - this is a small Ubuntu operating system
   - includes Clawpack and sets environment variables

1. have access to file VirtualClaw-4.6.2.vdi
2. it is now at `/opt/`
3. in VirtualBox click "New"
4. choose name *e.g.*, "VirtualClaw".
5. Type: Linux. Version: Ubuntu. "Next"
6. select memory (recommended setting should be fine). "Next"
7. select "Use an existing virtual hard drive file"
8. use folder icon to browse and select VirtualClaw-4.6.2.vdi
9. click "Create"
10. click "Start"

Installing VirtualBox and Clawpack

update the virtual machine:
`http://depts.washington.edu/clawpack/pasi2013/`

Running Clawpack

1. after VirtualClaw starts, login.
2. you now have a customized linux virtual desktop
3. open a terminal window (icon at bottom)
4. `$ pwd`
   `/home/clawuser/`
5. `$ cd claw/`
   (moves you into the top Clawpack directory)
6. `$ ls`
   (lists the directories in Clawpack)

Running Clawpack

Clawpack directory structure: `$CLAW = /home/clawuser/claw`

- `$CLAW/clawpack/` `$CLAW/geoclaw/` `$CLAW/amrclaw/`

  Fortran source libraries
  ordinarily you will not need to interact with Fortran

- `$CLAW/apps`

  contains example "applications"
  "applications" are directories where you run clawpack
  problem specific parameters are set in an application folder
  the make program will build and run executable

Running Clawpack

1. `$ cd apps/advection/1d/example1`
   this is an example application folder
2. `$ ls`
   (displays files present)

requisite files:

- `Makefile`
  contains all the information necessary to create and run executable
- `setrun.py`
  python script contains runtime parameters for given problem

  a GeoClaw simulation only requires modifying `setrun.py` (and providing bathymetry and fault source files)

Running Clawpack

`Makefile`: run with the program "make"

- `$ make help` for a list of options
- `$ make .data` uses `setrun.py` to make Fortran input
- `$ make .exe` compiles Fortran codes
- `$ make .output` runs code, produces `_output/`
- `$ make .plots` plots results in `_plots/`
- `$ make .htmls` produces html versions of files and `README.txt`

Running Clawpack

`Makefile:` run with the program "make"

Documentation: www.clawpack.org/users/makefiles.html

several variables can be adjusted (rarely needed)

- where to find the setrun function and where to put output:
  `CLAW_setrun_file = setrun.py`
  `CLAW_OUTDIR = _output`

- where to find setplot function and where to put plots:
  `CLAW_setplot_file = setplot.py`
  `CLAW_PLOTDIR = _plots`

- lists of source library locations:
  `# Clawpack library to be used: CLAW_LIB =`
  `$(CLAW)/clawpack/1d/lib`
  etc.

Running Clawpack

Setting runtime parameters:

`setrun.py`:

- python script contains a function setrun
- Never need to write from scratch: modify and existing example in `$CLAW/apps`
- Don't need to know much if anything about Python!
- Documentation: www.clawpack.org/doc/setrun.html

Setting plotting parameters:

`setplot.py`:

- python script contains a function setplot
- it plots the output data in `_output`
- Documentation: www.clawpack.org/users/setplot.html

Running a Clawpack application

- from `$CLAW/apps/advection/1d/example1`
  `$ make .htmls`
  `$ firefox README.html`
- you may find it useful to read links in browser
- to simply run the example: `$ make .output`
  Directory `_output` contains many files `fort.t000N`, `fort.q000N` (the data of frame N – the N'th output time).
- to run and plot: `$ make .plots`
- to view plots: `$ firefox _plots/_PlotIndex.html`

Running a Clawpack application

Suggested exercises:

1. explore some 2d applications in `$CLAW/apps/advection/2d/`
2. create your own applications directory: *e.g.*,
   `$MYAPPS = /path/to/my/applications/`
   (you don't need to create an environment variable MYAPPS):
3. copy an application folder of your choice to `$MYAPPS`
   e.g., `$ cp -r advection/2d/swirl $MYAPPS/myswirl`
4. modify some parameters in your `setrun.py` to gain familiarity
5. explore results
6. explore `setplot.py` for plotting parameters
7. optional: if you have a MAC/Linux/Cygwin laptop, you may wish to install Clawpack directly
   www.clawpack.org

Plotting examples and documentation

General plotting information
www.clawpack.org/users/plotting.html

Use of setplot, possible attributes:
www.clawpack.org/users/setplot.

Examples:

1d: www.clawpack.org/users/plotexamples.html
2d: www.clawpack.org/users/plotexamples2d.html
FAQ: www.clawpack.org/users/plotting_faq.html
Gallery of applications: www.clawpack.org/users/apps.html