Installation and Running ASPECT on Mac OS X Mavericks and Yosemite

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This document is installation procedure of ASPECT on Mac OS X using a binary package for deal.II, which is the easiest way to run ASPECT on Mac as of May, 2015. I test on mac OS X Mavericks (10.9) and Yosemite (10.10). If you have trouble with any part of this, don't hesitate to contact Hiro (MSB 1227) or by email (hrmatsui@ucdavis.edu.edu).

1 Preparation

1.1 Working directory

You need to decide where you save the source codes on your mac. I always use directory `$HOME/src` as a directory for packages.

```
% mkdir $HOME/src
```

1.2 "open" command

I use `open` command sometimes in this installation. The `open` command is implemented the all version of Mac OS X, and opens a file (or a directory or URL), just as if you had double-clicked the file's icon in Finder.

1.3 Cmake

CMake is a cross-platform, open-source build system. CMake can be downloaded from `http://www.cmake.org`. The following procedure is required to install. There are various way to install CMake "(e.g. Download installer from http://www.cmake.org/download/, install by MacPorts). If you install CMake.app, the cmake command in the terminal will be

```
% /Applications/CMake.app/Contents/bin/cmake
```

2 Download

Next you will download the deal.II package and ASPECT source. Current latest deal.ii version is 8.2.1. Be sure to get the parallel version of deal.ii.

To obtain deal.ll package, simply type on terminal:

```
% open \
https://github.com/dealii/dealii/releases/download/v8.2.1/dealii-8.2.1-parallel-bundle.dmg
```

Safari starts to download the binary package. You can start this command in any directory, and Safari downloads the file into `$HOME/Download` directory. Alternatively, you can down load the package from Safari at "https://www.dealii.org/download.html" (See Figure ??).
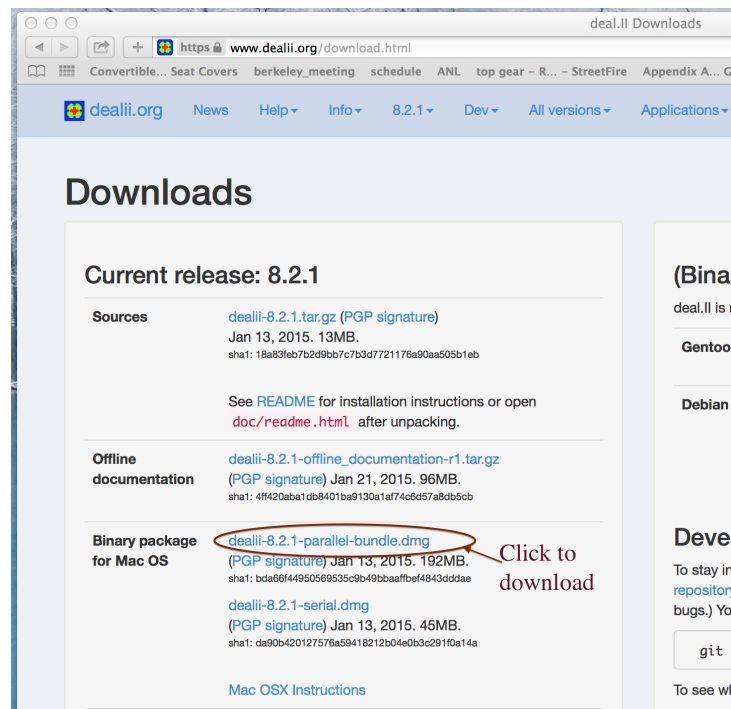

Figure 1: Download page for deal.II

Second, Get the latest ASPECT source code using git commands as:

```
% cd $HOME/src
% git clone https://github.com/geodynamics/aspect.git
```

If you download ASPECT successfully, you can find these files and directories in `$HOME/src/aspect`:

```
% ls aspect/
. CMakeLists.txt doc
.. CTestConfig.cmake include
.DS_Store README.md readme.html
.git VERSION source
.gitattributes benchmark tests
.gitignore cookbooks write_config.cmake
AspectConfig.cmake.in data
```

To update your source codes from git repository, type the following command in `$HOME/src/aspect`:

```
% cd $HOME/src/aspect
% git pull
```

so, you can update your ASPECT to the latest version.

3   Install deal.ii

This deai.ii package install all required libraries for ASPECT (p4est, parMeTiS, and Trilinos). To open the downloaded disk image, double click the downloaded image (See Figure **??**), or type the following command on Termanal:

```
%   open ~/Downloads/dealii-8.2.1-parallel-bundle.dmg
```

This command processes to open the deal.ii disk image, you can find a window for deal.ii.app (See Figure **??**). By dragging deal.II.app icon and dropping into `Applications`, deai.ii is installed into `/Applications/` folder.

This deal.II.app opens a Terminal window including environment valuables to use required libraries. To start deal.II.app, double click the icon in "Applications" folder, or type the following command in Termainal:

```
%   open /Applications/deal.II.app
```

New terminal window will start with this message as in Figure **??**. You **MUST** <u>build</u> and <u>run</u> ASPECT in the terminal window started by deal.ii.app.

Figure 2: Open image file for deal.II package on Finder

4 Build ASPECT

Now you can compile ASPECT. We need the location of deal.ii library to build ASPECT. Deal.ii library is under /Applications/deal.II.app/Contents/Resources/ directory as

```
bash-3.2$ ls /Applications/deal.II.app/Contents/Resources/
LICENSE bin common examples lib
README.md cmake deal.II.icns include opt
bash-3.2$ ls /Applications/deal.II.app/Contents/Resources/lib
cmake libdeal_II.g.8.2.1.dylib
libdeal_II.8.2.1.dylib libdeal_II.g.dylib
libdeal_II.dylib
```

Configuration is set to build ASPECT by CMake. Now, make a empty directory to configure and build ASPECT. Go to the ASPECT directory and run the following commands:

```
bash-3.2$ cd $HOME/src/aspect
bash-3.2$ mkdir build_deal.ii.app
bash-3.2$ cd build_deal.ii.app
bash-3.2$ /Applications/CMake.app/Contents/bin/cmake \
-D DEAL_II_DIR=/Applications/deal.II.app/Contents/Resources \
-D CMAKE_C_COMPILER="mpicc" \
-D CMAKE_CXX_COMPILER="mpicxx" \
-D CMAKE_CXX_FLAGS="-g -O3 -std=c++11" \
-D CMAKE_C_FLAGS="-g -O3" \
../
==================================================
```
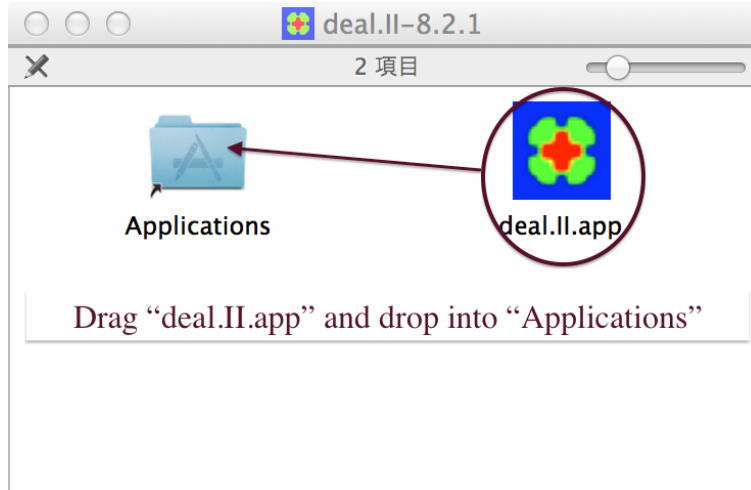
Figure 3: Drag and Drop Deal.II.app into Applications

```
============ Configuring ASPECT ===================
===================================================
...
-- Configuring done
...
-- Generating done
-- Build files have been written to: /Users/matsui/src/aspect/build_deal.ii.app
```

It is noted that `-std=c++11` option is required in compile option for c++ sources. And run make:

```
bash-3.2$ make
Scanning dependencies of target aspect
[  0%] Building CXX object CMakeFiles/aspect.dir/source/adiabatic_conditions/initial_profile.cc.o
[  0%] Building CXX object CMakeFiles/aspect.dir/source/adiabatic_conditions/interface.cc.o
...
Linking CXX executable aspect
[100%] Built target aspect
bash-3.2$ ls -l aspect
-rwxr-xr-x  1 matsui  staff  19131292 May  7 15:02 aspect
```

There may be many warnings from the compiler, but if the aspect target is created then it was successful. By default, ASPECT compiles the debug version of the code. You should use this version when changing the ASPECT code.

The compilation often take long minutes. make command supports parallel build by using `-j #process` option. To build using 4 processors, for example, run make command as;

```
bash-3.2$ make -j 4
```

Figure 4: Terminal window for Deal.II

This parallel build sometimes fails due to making a wrong order. In that case, please run make again with fewer processes.

For scientific work, you should change to the optimized version. To compile the optimized version use the -DCMAKE_BUILD_TYPE=Release flag in CMake:

```
bash-3.2$ /Applications/CMake.app/Contents/bin/cmake \
-D DEAL_II_DIR=/Applications/deal.II.app/Contents/Resources \
-D CMAKE_C_COMPILER="mpicc" \
-D CMAKE_CXX_COMPILER="mpicxx" \
-D CMAKE_CXX_FLAGS="-g -O3 -std=c++11" \
-D CMAKE_C_FLAGS="-g -O3" \
-D CMAKE_BUILD_TYPE=Release \
../
====================================================
============ Configuring ASPECT ===================
====================================================
...
```

and run make again.

5   Running

Again, we **must** run ASPECT on the terminal window which is opened by "deal.II.app". If you have already closed the terminal window to build ASPECT, double click "deal.II.app" icon in Applications folder, or type in the terminal again as;

```
%   open /Applications/deal.II.app
```

ASPECT uses MPI for parallelization, so we recommend to start ASPECT by using `mpirun` command to invoke MPI. The command to invoke ASPECT is the following:

```
mpirun -np <# of processes> $HOME/src/aspect/build_deal.ii.app/aspect <parameter file>
```

To check quickly if you are running ASPECT on the terminal by deal.II, check the location of `mpirun` command as;

```
bash-3.2$ which mpirun
/Applications/deal.II.app/Contents/Resources/opt/openmpi-1.6.5/bin/mpirun
```

There are parameter files for various examples in `$HOME/src/aspect/cookbooks/` directory. To invoke the simulation by using file `shell_simple_2d.prm`, for example,

```
bash-3.2$ mpirun -np 4 $HOME/src/aspect/build_deal.ii.app/aspect \
$HOME/src/aspect/cookbooks/shell_simple_2d.prm
-----------------------------------------------------------------------------
-- This is ASPECT, the Advanced Solver for Problems in Earth's ConvecTion.
--     . version 1.3.pre
--     . running in DEBUG mode
--     . running with 4 MPI processes
--     . using Trilinos
-----------------------------------------------------------------------------

Number of active cells: 3072 (on 6 levels)
Number of degrees of freedom: 40836 (25090+3201+12545)

*** Timestep 0:  t=0 years
   Solving temperature system... 0 iterations.
   Rebuilding Stokes preconditioner...
   Solving Stokes system... 30+7 iterations.

Number of active cells: 5256 (on 7 levels)
Number of degrees of freedom: 70420 (43286+5491+21643)
...
```