BUILDING DREAM.3D WITH EMSOFT SUPPORT ON MAC OS X

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The EMsoftToolbox contains a number of DREAM.3D filters to create EMsoft input files, or to actually run EMsoft programs, either via system calls or via shared dynamical library calls. To set up the development environment for the EMsoftToolbox requires a number of things to be in place. This document describes which steps to take and in what order. It is assumed that you start from scratch; in all cases you must pay attention to proper upper and lower case! You must have XCode, gcc, and gfortran installed; instructions for other (non-Mac) platforms may follow in later version of this document.

(1) *Download the source codes*:
   (a) Create a folder called Workspace somewhere in your home folder[1]; inside this folder, create a DREAM3D_Plugins folder.
   (b) Pull the latest source codes for EMsoft and DREAM.3D into the Workspace folder; this should create an EMsoft folder and a DREAM3D folder.
   (c) Pull the latest source code for EMsoftToolbox into the DREAM3D_Plugins folder; this should create an EMsoftToolbox folder.

(2) *Build EMsoft*:
   (a) Navigate to the Workspace/EMsoft/Support/SDK_Build_Scripts/OSX_Build_Scripts folder, edit the SDK_Configuration.conf file to define to location of the SDK as well as the location of the fortran compiler, and build the EMsoft Software Developer Kit (SDK) by executing the following command:

```
prompt> sudo ./Build_SDK.sh
```

   Note that you will need to have sudo access. The scripts are currently set up so that the EMsoft_SDK is built in the /opt/EMsoft_SDK folder. This can be changed by editing the SDK_Configuration.conf file in the Workspace/EMsoft/Support/SDK_Build_Scripts /OSX_Build_Scripts folder. Another logical location would be the /Users/Shared folder. The build process will download an archive with several libraries from the BlueQuartz web site and unpack the archive; then each package will be built and installed within the SDK folder. This takes several minutes during which the following packages will be installed:
      - CMake: this is the preferred build environment for this entire package;
      - fftw3: fast Fourier transform package;
      - fortrancl: limited fortran-90 interface to the OpenCL language;

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[1]In this document, pathnames will be relative to this folder, unless stated otherwise.

- json-fortran: fortran-90 implementation of the Java Script Object Notation (json);
- HDF5: Hierarchical Data Format libraries; these will be built with fortran support turned on. Ignore any compilation warnings during the build of this library.

(b) Add the following command to your *.bash_rc* file and restart your shell:

```
export PATH=$PATH:/opt/EMSoft_SDK/cmake-3.4.1-Darwin-x86_64/CMake.app/Contents/bin/
```

Note that the version numbers (3.4.1) may change over time; use the correct numbers and the correct SDK location for your particular installation. If you use a different shell, e.g., *csh*, then use the appropriate command to extend your path. *Make sure that there is no other CMake installation anywhere in your path!* Don't forget to restart your shell.

(c) Navigate to the Workspace folder and create a EMsoftBuild subfolder; cd to the EMsoftBuild folder and execute the following command:

```
cmake -DEMsoft_SDK=/opt/EMsoft_SDK -DCMAKE_BUILD_TYPE=Debug ../EMsoft
```

This step will read the /opt/EMsoft_SDK/EMsoft_SDK.cmake file and initialize the proper variables to enable compilation of the project. Note that this step only needs to be carried out once after each update of the SDK.

(d) In the Build folder, execute the command

```
make -j
```

to carry out a parallel compile of the EMsoft project.

(3) *Build the DREAM.3D SDK:*

(a) Navigate to the /Users/Shared folder and create the DREAM3D_SDK folder.

(b) Go to URL http://download.qt.io/official_releases/qt/5.5/5.5.1/ and download the following file:

```
qt-opensource-mac-x64-clang-5.5.1.dmg
```

Once the download is completed, double click on the .dmg icon and then on the .app file to start the installation process; *make sure you set the installation folder to the following string:* /Users/Shared/DREAM3D_SDK/Qt5.5.1. Click on Continue and wait until the installation process is completed.

(c) Navigate to the Workspace/DREAM3D/Support/Scripts/OSX_Build_Scripts folder and execute the command:

```
prompt> sudo ./Build_SDK.sh
```

This will download and unpack an archive from the BlueQuartz web site; then, the script will build and install several packages:

- CMake
- boost
- Doxygen
- DREAM3D_Data
- Eigen
- HDF5

- InsightToolkit
- ITK
- protobuf
- qwt
- threading building blocks (tbb)

The build process takes a while, and you will likely see many warnings during the compilation of HDF5 which you can safely ignore. Note that the HDF5 library is built twice, once in Debug mode and once in Release mode. In addition, this build does not enable fortran support, so it is different from the HDF5 build in the EMsoft_SDK; both HDF5 builds are needed to enable the integration of EMsoft and DREAM.3D.[2]

(4) *Install EMsoft in the DREAM3D_SDK folder:*

(a) To enable compilation of DREAM.3D with support for EMsoft routines, a release version of the EMsoft libraries needs to be installed inside the DREAM3D_SDK. In a Terminal window, navigate to the Workspace/EMsoftBuild folder and execute the following command (all on one line):

```
prompt> cmake -DCMAKE_BUILD_TYPE=Release
        -DCMAKE_INSTALL_PREFIX=/Users/Shared/DREAM3D_SDK/EMsoft ../EMsoft
```

Then recompile EMsoft with the make -j command, followed by make install. This will install an EMsoft folder inside the DREAM3D_SDK.

(b) To return EMsoft to debug mode for further development, execute

```
prompt> cmake -DCMAKE_BUILD_TYPE=Debug ../
```

followed by make -j to recompile the package.

(5) *Tell DREAM.3D where to look for the EMsoft installation:*

(a) Navigate to the Workspace/DREAM3D_Plugins/EMsoftToolbox/Support/Scripts folder and execute the following command:

```
prompt> ./Create_EMsoftToolbox_SDK.sh  /Users/Shared/DREAM3D_SDK /opt/EMsoft_SDK
```

This will create an extra CMake configuration file inside the DREAM3D_SDK folder which will inform DREAM.3D about the whereabouts of the EMsoft libraries.

(6) *Build DREAM.3D with EMsoft support:*

(a) In a Terminal window, go to the Workspace folder and enter the following commands:

```
prompt> mkdir DREAM3D-Build-Debug
prompt> open /Users/Shared/DREAM3D_SDK/cmake-3.4.1-Darwin-x86_64
```

This will open a Finder window; double click on the *CMake.app* which will pop up an interactive display. Browse to the DREAM.3D source folder and select it (should be /path/Workspace/DREAM3D where path will depend on your home folder setup); then

[2]This is due to an issue with the compilation of HDF5 on Mac OS X when fortran support is enabled; in this case, there is a bug that prevents the creation of dynamical libraries, which is what DREAM.3D needs for its compilation. Hence, EMsoft uses static HDF5 libraries, which are not compatible with DREAM.3D. This issue only occurs on Mac OS X and may be resolved by the HDF-Group in the future.

browse to the binaries folder that you just created and select it (/path/Workspace/DREAM3D-Build-Debug).

(b) Click on the Add Entry button and enter DREAM3D_SDK for the first prompt, Path for the second, and /Users/Shared/DREAM3D_SDK for the third. Accept these entries, which will pop up a line with a red background in the main Name-Value window.

(c) Click once on the Configure button below the main window. Many additional entries will appear with a red background. Next, look for the DREAM3D_EXTRA_PLUGINS entry and enter EMsoftToolbox (note upper and lower case!). Then hit the Configure button again until no more items with a red background appear.

(d) Click on the Generate button; select *Unix Makefiles* from the list of options and *Use default native compilers*. Hit Done to start the generation process. Then quit the CMake app.

(e) In the DREAM3D-Build-Debug folder, execute the command make -j to build DREAM.3D; this will take quite a while, but should result in a DREAM.3D executable in the Bin subfolder that includes the EMsoftToolbox filters.

Further comments: As of February 2016, the source code structure of the DREAM.3D package has been modified substantially. The source code is now split over several code repositories. In principle, only the DREAM.3D code needs to be pulled from the GitHub repository, and the CMake scripts will take care of checking out code from the other repositories, but this is only done for the initial installation. The user needs to make sure that all source code folders are regularly pulled from the respective repositories (DREAM.3D, SIMPL, SIMPLView and CMP). Once DREAM.3D has been installed, all other operations described in this manual are still valid.