

Image I/O-Ext – Setup Guide

V. 1.0



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1 Introduction

This guide will provide you with the instruction instructions to build and set up all the libraries as well as the various tools needed to use the Image I/O-Ext Project.

The Image I/O-Ext project requires the same tools for both Windows and Linux operating systems. However, the set of operations needed to properly configure each tool may OS-defendant. For this reason, the instructions have been separated in OS specific chapters. You can jump directly to the one that matches your platform of choice and skip the others.



2 Windows instructions

2.1 JAVA

First of all, you need your machine has the last JAVA 1.5.0_XX installed. You may download it from this site: http://java.sun.com/javase/downloads/index_jdk5.jsp.

As an instance, select the JDK 5.0 Update 14 and download the Windows Offline Installation on your hard-disk and run the installer.

Finally, be sure to properly set a `JAVA_HOME` environment variable¹ referring to the location of the JDK (As an instance, `C:\ProgramFiles\Java\jdk.1.5.0_14`)

NOTE: On Windows Vista you will need to choose an install location other than the default (the program files folder has access restrictions on it which will prevent maven from installing additional DLL files as part of our build process). As an example `C:\java\jdk.1.5.0_14` will work just fine.

2.2 ANT

Apache ANT is another needed tool. You can download the last version from:

<http://ant.apache.org/>. When you downloaded it (as an instance, on `C:\ProgramFiles\Apache-ant-1.7.0`), be sure to properly set an `ANT_HOME` environment variable referring to that location. Then, edit the `PATH` environment variable by adding the Ant's bin directory (as an instance, `C:\ProgramFiles\Apache-ant-1.7.0\bin`).

2.3 MAVEN 2

Maven 2 (in the following instructions it will be simply called "Maven") is another important tool needed by the Image I/O-Ext project. You can download the last version from <http://maven.apache.org/download.html>

Download the last `maven-xxx-bin.zip` version and unzip it somewhere on your hard-disk, as an instance on `C:\ProgramFiles\Apache-maven-2.0.9`.

Then, edit the `PATH` environment variable by adding the Maven's bin directory (as an instance, `C:\ProgramFiles\Apache-maven-2.0.9\bin`).

2.4 JAI

Go to <https://jai.dev.java.net/binary-builds.html> and select the daily builds link. Then, download the proper windows version. After you downloaded it, extract the content of the lib folder on your `JAVA_HOME\lib` folder as well as on your `JAVA_HOME\JRE\lib`. (where `JAVA_HOME` defines your JDK, as an instance, `C:\programFiles\java\jdk1.5.0_14`).

¹To set an environment variable on Windows XP, open the Control Panel -> System. Then, in the "Advanced" tab, click "Environment Variables". Lastly, click the "NEW" button from the System variables box to add a new Environment Variable. Define the name of the Environment Variable (as an instance: `JAVA_HOME`) and provide a value for this variable (as an instance, the path of your JDK -> `C:\ProgramFiles\Java\jdk.1.5.0_14`). Note that if you open a windows command line or the Visual Studio Command Prompt prior to change or set new environment variables via the Control Panel, these changes will not be updated on your command line window. Thus you need to close your command line and open a new one.



2.5 JAI-ImageIO Toolkit

Go to <https://jai-imageio.dev.java.net/binary-builds.html> and select the daily builds link. Then, download the proper windows version. After you downloaded it, extract the content of the lib folder on your JAVA_HOME\lib folder and on your JAVA_HOME\JRE\lib. (where JAVA_HOME defines your JDK, as an instance, c:\programFiles\java\jdk1.5.0_14).

2.6 SWIG

Be sure you have properly downloaded SWIG, the Simplified Wrapper and Interface Generator which allows to produce JAVA bindings for C/C++ code. You can obtain it at this site:

<http://www.swig.org/download.html>

You should download the last swigwin version which includes a prebuilt executable. (When this guide has been released, the last available swigwin version was 1.3.31 available at: <http://prdownloads.sourceforge.net/swig/swigwin-1.3.31.zip>)

After you downloaded it, extract the zipped file on your hard-disk (as an instance on C:\ProgramFiles\Swig)

2.7 GDAL

GDAL, which stands for Geospatial Data Abstraction Library, provides data access to several raster data formats. Image I/O-Ext deeply leverages on this complex library which needs to be properly configured.

2.7.1 GDAL requirements

Depending on the format you wish to support, you need to properly download and setup several libraries prior to build GDAL. The following instructions describe how to achieve this for the following formats:

- Kakadu (v. 5.2.6)
- MrSID (v 6.0.7)
- ECW (v 3.3)
- HDF4 (v. 4.2r1)

NOTE: If you have no time to follow all the instructions contained in the following sections or if you encounter problems which you cannot solve, you may leverage on the ready-to-use DLLs available for the Image I/O-EXT project using the deploy module. This module will deploy all the DLLs in the proper location (In such a case, the available GDAL DLL is built to support MrSID, ECW and HDF4). **However** it is worth to point out that this approach is not recommended and it should be used only as last resort. Anyway, the instructions to auto deploy DLL are contained in section 2.9.1

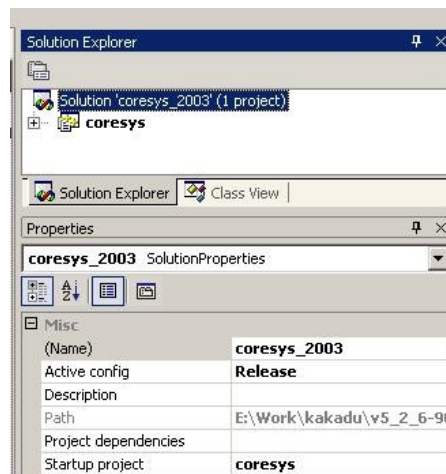
2.7.1.1 Kakadu

Supposing you have your own Kakadu licensed source code, you need to build the Kakadu DLL.

The visual studio solution for kakadu allows to build a shared Debug DLL. We need to change some settings to build a shared Release DLL. Otherwise, sometimes, memory allocations errors could occur especially when you build GDAL with support for several external formats (which need additional DLLs) since some libs may use MSVCRT71D and some others MSVCR71.



First step is opening the proper ready-to-use Visual Studio Solution² of kakadu coresys (located in kakadu\VERSION\coresys) and change the solution properties (right click on the solution -> Properties). Select “*Configuration Properties*” and switch the *Configuration* value from “*Debug*” to “*Release*”.



Then, you are ready to build your solution. After you done this, open the Kakadu apps solution (located in kakadu\VERSION\apps). Change the Configuration properties to Release in the same way you just do it for Coresys solution and build this solution. If some errors occur for a specific project, rebuild that one.

2.7.1.2 MrSID

As a first requirement, you need the LizardTech Decoding Software Development Kit (DSDK). You can download it free of charge from this site: <http://developer.lizardtech.com> (You need to be registered in order to download it). After logged in, select “*Download*” -> “*Software Development Kits*” -> “*Download SDK's*”. Select the proper version of SDK to be downloaded (select the **GeoExpress SDK for Windows - VC7.1**).

When your download is completed, unzip the DSDK somewhere on your hard disk, as an instance, on C:\work\libs\MrSid

2.7.1.3 ECW

Download the Image Compression SDK (source code) from ER Mapper site at this address:

<http://www.ermapper.com> (You need to be registered in order to download it).

From the main site, select the menu “*products & downloads*” -> “*Image Compression SDK*” from the *Desktop* section. Download the *Image Compression SDK Source Code 3.3* file and extract this somewhere on your hard disk, as an instance on C:\work\libs\libecwj2-3.3.

Be sure you have *Microsoft Windows® Server 2003 R2 Platform SDK installed*. If not yet installed, download it from this location: <http://www.microsoft.com/downloads/details.aspx?FamilyID=484269e2-3b89-47e3-8eb7-1f2be6d7123a&DisplayLang=en>

Then, open the ready-to-use Visual Studio Solution available in C:\work\libs\libecwj2-3.3\Source\C\NCSEcw\NCSEcw\NCSEcw.sln.

²As an instance, if you are using Visual Studio .Net 2003, open the coresys_2003.sln solution file.



Edit the properties of the solution (right click on it) and select the *Configuration Manager* button to open the Configuration Manager. Finally, set “Release” as Active Solution Configuration and close the windows.

Then, you are ready to build your solution.

2.7.1.4 HDF4

As a first requirement, you need to download the binary distribution of HDF4 release from this site:

<http://hdf.ncsa.uiuc.edu/release4/obtain.html>

Scroll this page until you find the link to the binary distribution file for Windows and download it. When your download is completed, unzip the binary somewhere on your hard disk, as an instance, on C:\work\libs\HDF4.

Then, enter in the `release` subfolder and create a `libpath` folder where you need to copy 4 *.lib files contained in `release\lib` and `release\dll` subfolders. They are: `hd421.lib`, `hd421m.lib`, `hm421.lib`, `hm421m.lib`

This could seem a strange workaround but it avoids errors when building GDAL against HDF4.

It is finally worth to point out that HDF4 leverages on some external libs: JPEG, ZLIB, SZIP. Be sure you have them. <http://hdf.ncsa.uiuc.edu/release4/obtain.html> also contains 3 links to download the required libraries: From the *External Software* section -> *External Libraries used by HDF*, for each library, you need to select the “Pre-Compiled Binaries” link and select the Windows version.

2.7.2 GDAL Configuration

Firstly, you need to download GDAL 1.4.5 from OSGeo SVN.

You may use Tortoise SVN (available at: <http://tortoisesvn.net/downloads>) to download it.

Create a `GDAL` folder on your Hard-disk and open the contextual menu on it (It's the menu which appears when you click on some element with the right's button of your mouse) and select “SVN Checkout...”. Finally, specify <http://svn.osgeo.org/gdal/tags/1.4.5/gdal> as “URL of repository”.

Although TortoiseSVN is a very helpful/easy-to-use program, it can reduce the performances of your machine. If you need a very light SVN client³ you can download the Collabnet Subversion Command Line client, available at: <http://downloads.open.collab.net/collabnet-subversion.html>

When installed SVN, to checkout GDAL, you simply need to run the following command:

```
svn co http://svn.osgeo.org/gdal/tags/1.4.5/gdal gdal-1.4.5
```

After this, you need to apply the patch available at this location:

<https://imageio-ext.dev.java.net/svn/imageio-ext/trunk/patches/gdal1.4.5.patch>

This patch contains several changes for:

³Alternatively, you could also download SmartSVN at:
<http://www.syntevo.com/smartsvn/download.html>



- Kakadu support: More Kakadu create options and error management supported. Makefile modified
- Java bindings: improved data access (read/write Dataset at once instead of read/write RasterBands at once; BandMap, PixelSpace, LineSpace and BandSpace parameters now are allowed), improved palette management, added setMetadataItem capabilities

To apply the patch, supposing you are using Tortoise SVN, you need to select the GDAL folder on your hard-disk, then, from the contextual menu, select *TortoiseSVN ->Apply patch...* At this point, you need to specify the previously downloaded gdal1.4.5.patch file and apply.

Alternatively, if you don't have TortoiseSVN, you may use the *patch* command distributed with MSYS⁴. In such a case, to apply the patch, enter in the GDAL main folder and run:

```
patch -p0 -f -i PATH_TO_DOWNLOADED_PATCH/gdal1.4.5.patch
```

(where PATH_TO_DOWNLOADED_PATCH represents the location where you have previously downloaded the patch).

Finally, you need to modify your GDAL\NMAKE.opt as explained in the following sections.

2.7.2.1 Preliminar variables settings

As a first step, edit the GDAL_HOME variable by linking it to the folder where you just downloaded GDAL.

For future JAVA bindings creation, be sure the SWIG variable is properly set. Check this by finding the following lines:

```
# Set the location of your SWIG installation
#ifdef SWIG
SWIG = C:\ProgramFiles\swigwin-1.3.31\swig.exe
#endif
```

Be sure SWIG variable refers to the proper swig.exe path.

Finally, depending on the specific format you wish to support, follow the instructions contained in the following sections.

2.7.2.2 Kakadu specific configuration option

Find the KAKADU Setting properties in GDAL\NMAKE.opt by looking for the following line:

```
# Uncomment if you have Kakadu 4.0 or newer
```

Supposing your KAKADU library has been placed in C:\work\libs\kakadu, edit the next line, like this: KAKDIR = C:\work\libs\kakadu\v5_2_6-90032L

Be sure the proper version subfolder is set. (In this case: v5_2_6-90032L).

⁴You can download MSYS from here: http://sourceforge.net/project/showfiles.php?group_id=2435&package_id=24963

After the download, run the MSYS-1.0.10 executable which will install MSYS on your hard disk, as an instance on C:\MSYS\1.0. Finally, edit the PATH environment variable (as explained in note 1) by adding the bin subfolder of your MSYS installation (as an instance, C:\MSYS\1.0\bin)



To enable kakadu support we need to change only another property. Go ahead in the `NMAKE.OPT` and look for the following line:

```
# Any extra libraries needed on this platform?
```

Then, edit the `ADD_LIBS` variable by adding the kakadu lib, like this:

```
ADD_LIBS = C:\work\libs\kakadu\lib\kdu_v52R.lib
```

2.7.2.3 MrSID specific configuration option

Find the MrSID Setting properties in `GDAL\NMAKE.opt` by looking for the following line:

```
#Uncomment the following for MrSID support
```

Supposing your MrSID library has been placed in `C:\work\libs\MrSid`, edit the next lines, like this

```
MRSID_DIR = C:\work\libs\MrSid
```

```
MRSID_INCLUDE = -I$(MRSID_DIR)\include\base -I$(MRSID_DIR)\include\support \
               -I$(MRSID_DIR)\include\metadata \
               -I$(MRSID_DIR)\include\mrsid_readers \
               -I$(MRSID_DIR)\include\j2k_readers
```

```
MRSID_LIB = $(MRSID_DIR)\lib\Release_md\lti_dsdk_dll.lib advapi32.lib user32.lib
```

Lastly, if you also need to enable JPEG2000 support by means of MrSID library, you need to add the following line:

```
MRSID_FLAGS = -DMRSID_J2K
```

2.7.2.4 ECW specific configuration option

Find the ECW Setting properties in `GDAL\NMAKE.opt` by looking for the following line:

```
# Uncomment the following and update to enable ECW support.
```

Supposing your ECW library has been placed in `C:\work\libs\libecwj2-3.3`, edit the next 2 lines, like this:

```
ECWDIR = C:\work\libs\libecwj2-3.3
```

```
ECWLIB = $(ECWDIR)\lib\NCScnet.lib $(ECWDIR)\lib\NCSEcw.lib $(ECWDIR)\lib\NCSUtil.lib
```

2.7.2.5 HDF4 specific configuration option

Find the HDF4 Setting properties in `GDAL\NMAKE.opt` by looking for the following line:

```
# Uncomment the following and update to enable NCSA HDF Release 4 support.
```

Supposing your HDF4 library has been placed in `C:\work\libs\HDF4`, edit the next 2 lines, like this:

```
HDF4_DIR = c:\work\libs\HDF4\release
```

```
HDF4_LIB = /LIBPATH:$(HDF4_DIR)\libpath
```



2.7.3 Building GDAL

Now, you are ready to build GDAL. Open Visual Studio Command Prompt, and enter in your GDAL home folder. At this point, you are ready to start the build process by running the following command:

```
nmake /f makefile.vc
```

When the build is terminated, you need to generate JAVA bindings.

2.7.3.1 Generating JAVA Bindings

Variable settings

Then, check your GDAL\SWIG\JAVA\java.opt is properly configured. (Basically, you need to check the JAVA_HOME and ANT_HOME variables are properly set)

Running SWIG

Now, you are ready to generate java bindings. From the command line, enter in your GDAL\SWIG folder and run `nmake /f makefile.vc java`

This command will automatically generate wrappers and bindings.

2.7.3.2 Final Settings

At this point, you should have:

- some external DLLs (for Kakadu, ECW, MrSID, HDF4)
- a GDAL DLL (gdal14.dll)
- 4 JNI DLL (gdalconstjni.dll, gdaljni.dll, ogrjni.dll, osrjni.dll)
- a jar file (gdal.jar)

You need to place all the DLLs in the folder where your application will look for libraries. Your JAVA_HOME\BIN folder could be a typical location where to place them.

Finally, be sure you properly set the GDAL_DATA environment variable. This needs to be set with your GDAL\DATA location in order to properly evaluate EPSG codes.

2.8 ImageMagick & Jmagick

The Image I/O-Ext project provides an additional plugin to handle JPEG format, leveraging on Jmagick. In order to build and use this plugin, you need to download and build the ImageMagick library from this site:

<ftp://ftp.imagemagick.org/pub/ImageMagick/windows/ImageMagick-windows.zip>

Prior to build ImageMagick you need to configure it:

Run the Visual Studio IDE and from the “Open->Project” menu, select the configure workspace available at the ImageMagick-6.X.X\VisualMagick\configure folder and press Open. Choose “Build->Build Solution” to compile the configuration tool and, when finished, you will find a configure.exe tool on the configure folder. Now, you are ready to configure the build of your ImageMagick libraries:

Run configure.exe and the wizard will be opened. Press Next and click on the multi-threaded DLL. Now press, on Next twice and finally Finish. The configuration utility just created a workspace



required to build ImageMagick from source. Open the `VisualDynamicMT.sln` Visual Studio Solution from the `ImageMagick-6.X.X\VisualMagick` folder. Change the solution properties (right click on the solution -> Properties). Select “*Configuration Properties*” and switch the *Configuration* value from “*Debug*” to “*Release*”.

Finally, choose Build->Build Solution to compile and build the ImageMagick distribution. (Advanced Users may manually disable unrequired modules. Actually, the Image I/O-Ext plugin module leveraging on Jmagick, only provides support for JPEG files.

When finished, you need to place all the DLLs from the `ImageMagick-6.X.X\VisualMagick\bin` folder in the folder where your application will look for libraries. Your `JAVA_HOME\BIN` folder could be a typical location where to place them.

Future versions of this document will provide better instructions about how to customize the ImageMagick build.

2.9 Image I/O-EXT Project

You need to download the **imageio-ext** project from Java.net SVN. To do this, you need to create an `imageio-ext` folder and use Tortoise SVN or another SVN client as explained in section 2.7.2

The URL of repository for the *SVN Checkout* command is:

<https://imageio-ext.dev.java.net/svn/imageio-ext/https://imageio-ext.dev.java.net/svn/imageio-ext/trunk>

2.9.1 DLL deployment instructions (Optional) - [deploylibs] property

In case you have skipped the manual building process introduced in the previous sections, you should leverage on the DLL available via the deploy module although this approach is not recommended. To deploy available DLLs and additional required elements, you need to set the *deploylibs* properties as true with the `-Ddeploylibs` option when building the project (as explained in 2.9.3).

IMPORTANT NOTES:

- you also need to setup a `GDAL_DATA` environment variable with the path of the location where you want the deploy module will store required files for EPSG codes parsing.
- The following error may occur if you are running Windows Vista and your Java installation is in the default program files folder (which has access restrictions): “*Unable to deploy required libs...*”. To solve this issue, simply install JAVA to a different folder as explained in section 2.1

2.9.2 JMagick libraries deployment instructions (Optional)- [jmagick] profile

In case you want to deploy and add Jmagick library support to the Image I/O-Ext project, specify the *jmagick* profile as well as the *deploylibs* property (as explained in 2.9.1) when building the project (as will be explained in 2.9.3). Multiple profiles may be specified; simply use the comma sign to specify more profiles (as an instance, `-Pbase,jmagick`).

2.9.3 Image I/O-Ext Project building

Actually, depending on the set of available DLLs or the formats you need, it is possible to build the project in 2 configuration.

1. **base**: only the plugins which don't depend on external libraries are built



2. **full**: All the available plugins are built (that is: Kakadu, MrSID, ECW, HDF4)

When executing tests, any configuration requires the proper set of DLLs. You could also leverage on the DLLs available via the deploy module, as explained in chapter 2.9.1 using `-Ddeploylibs5`. Anyway, note that the test cases will internally check if the requested libraries are available. When executing tests, you will be notified through WARNING messages in case some driver or library is missing (but tests will not be interrupted).

To build the Image I/O-Ext project, enter in `imageio-ext\` and, select the configuration you need, using the proper configProfile running the command:

```
mvn install -PconfigProfile (where configProfile is one of base, full)
```

(Remind to add the `-Ddeploylibs=true` in case you need the DLLs from the deploy module. In case you also need the jmagick build, add the `jmagick` profile as explained in 2.9.2).

This command will build and test all required modules and plugins and store the produced JARS in the local maven repository.

In case you need to perform a fast build of the Image I/O-Ext project, without tests, just add the `-Dmaven.test.skip` option to the previous `mvn` command.

2.9.3.1 Testing Image I/O-Ext modules with Maven.

In case you simply need testing some Image I/O-Ext modules, as an instance in order to check if everything is working fine, you can enter in the module you are interested in and run the maven test. As an instance:

```
C:\Projects\imageio-ext>cd plugin\gdalarcgrid
C:\Projects\imageio-ext\plugin\gdalarcgrid>mvn test
```

Lastly, if you want to perform interactive tests (which usually display data read on a windows), you should use the `interactive.tests` profile like this:

```
C:\Projects\imageio-ext\plugin\gdalarcgrid>mvn test -Pinteractive.tests
```

Anyway, displaying the image is a not blocking/not waiting operation so you will barely see the image, just for an instant (when displayed, it will be automatically closed. Future versions may include a property to customize “waiting time” before close). Note that tests require you have all the needed DLLs, otherwise they will be skipped.

2.9.3.2 Testing JPEG2000 Kakadu (GDAL) writer capabilities

The JPEG2000 Kakadu (GDAL based) plugin contains a wide suite for testing write operations with different write parameters leveraging on the available create options / Kakadu customizations. As default, the test performs only a simple write operation without testing any supported kakadu create option to reduce build time. In case you need to test all these operations simply use the `extensive.tests` profile like this:

```
C:\Projects\imageio-ext\plugin\gdalkakadujp2>mvn test -Pextensive.tests
```

⁵Depending on the selected configuration, the proper set of DLL will be deployed by the deploy module. Note that, due to licensing issues, no Kakadu DLLs are available by means of this module and you should have built them as explained in the previous chapters.



Moreover, as default, when the test is terminated, all the written files are automatically deleted. In case you would like to maintain the produced files, avoiding delete, you should add the profile `tests.holdwrittenfiles` to the previous one, using the following command:

```
C:\Projects\imageio-ext\plugin\gdalkakadujp2>mvn test  
-Pextensive.tests,tests.holdwrittenfiles
```



3 Linux instructions

The following instructions have been tested on Linux Fedora Core 5 distribution and Ubuntu 8.04.

Note: On some Linux distributions (as an instance, Ubuntu), you can install Java, Swig and Ant using the Package Manager (with the command `sudo apt-get install "package name"`).

3.1 JAVA

First of all, you need your machine has the last JAVA 1.5.0_XX installed. You may download it from this site: http://java.sun.com/javase/downloads/index_jdk5.jsp.

As an instance, select the JDK 5.0 Update 14 and download the Linux Self-extracting file (A `jdk-1_5_0_14-linux-i586.bin` file). After you have downloaded it (as an instance on `/usr/local/java`), be sure that execute permissions are set on the downloaded file, by running this command:

```
chmod +x jdk-1_5_0_14-linux-i586.bin
```

Then, go in `/usr/local/java` and run: `./jdk-1_5_0_14-linux-i586.bin`

Usually, Fedora Core 5 distribution comes with a OLD java version (as an instance, 1.4.2). Now, you could add symbolic links on your `alternatives`.

Just run the following commands:

```
alternatives --install /usr/bin/java java /usr/.../jdk1.5.0_14/bin/java 2
```

next you can configure alternatives for java by using the following command:

```
alternatives --config java
```

```
alternatives --display java
```

Some Linux distributions come with Java 6 version. When building ImageIO-Ext with Java 6, an error related to `customstreams` module appears.

3.2 ANT

Apache ANT is another needed tool. You can download the last version from:

<http://ant.apache.org/>

When you downloaded it (as an instance, on `/usr/local/apache-ant-1.7.0`), you may create a symbolic link as follow: `ln -s /usr/local/apache-ant-1.7.0/bin/ant /usr/bin/ant`

3.3 MAVEN 2

Maven 2 is another important tool needed by the Image I/O-Ext project. You can download the last version from <http://maven.apache.org/download.html>.

When you downloaded it, extract the archive to the directory where you wish to install it, as an instance on `/usr/local/maven-2.0.9`

Create a folder which will contains the installed external libraries as well as the additional files:

```
cd /home/myuser
```




```
mkdir mylibs
cd mylibs
mkdir lib
mkdir include
```

At this point, on your `/etc` folder, edit the "profile" file by adding the following lines:

```
PATH=$PATH:/usr/local/maven-2.0.9/bin
export JAVA_HOME=/usr/local/java/jdk1.5.0_14/
export JRE_HOME=/usr/local/java/jdk1.5.0_14/jre/
export MAVEN_HOME=/usr/local/maven-2.0.9/
export ANT_HOME=/usr/local/apache-ant-1.7.0/
export LD_LIBRARY_PATH=/usr/local/lib:/home/myuser/mylibs/lib
```

3.4 JAI

Go to <https://jai.dev.java.net/binary-builds.html> and select the daily builds link. Then, download the proper Linux version. After you downloaded it, extract the content of the lib folder on your `JAVA_HOME/lib` folder as well as on your `JAVA_HOME/JRE/lib`. (where `JAVA_HOME` defines your JDK, as an instance, `/usr/java/jdk1.5.0_14`).

3.5 JAI-ImageIO Toolkit

Go to <https://jai-imageio.dev.java.net/binary-builds.html> and select the daily builds link. Then, download the proper Linux version. After you downloaded it, extract the content of the lib folder on your `JAVA_HOME/lib` folder and on your `JAVA_HOME/JRE/lib`. (where `JAVA_HOME` defines your JDK, as an instance, `/usr/java/jdk1.5.0_14`).

3.6 SWIG

Be sure you have properly downloaded SWIG, the Simplified Wrapper and Interface Generator which allow to produce JAVA bindings for C/C++ code. You can obtain it by simply running:

```
yum update swig or sudo apt-get install swig
```

3.6.1 Manual SWIG installation

In case `yum` is not supported by your distribution, just download swig from:

<http://mesh.dl.sourceforge.net/sourceforge/swig/swig-1.3.32.tar.gz>. (Or a more recent version). Unzip this somewhere on your hard disk and then run:

```
./configure
```

```
make
```

```
sudo make install (As you may notice, this command requires superuser privileges)
```

3.7 GDAL

GDAL, which stands for Geospatial Data Abstraction Library, provides data access to several raster data formats. Image I/O-Ext deeply leverages on this complex library which needs to be properly configured.



3.7.1 GDAL requirements

Depending on the format you wish to support, you need to properly download and setup several libraries prior to build GDAL. The following instructions describe how to achieve this for these formats:

- Kakadu (v. 5.2.6)
- MrSID (v 6.0.7)
- ECW (v 3.3)

3.7.1.1 Kakadu

Supposing you have your own Kakadu licensed source code, browse to the main kakadu folder (as an, instance on `home/myuser/work/libs/kakadu/v5_2_6`). Enter in `coresys/make` and modify the `Makefile-Linux-x86-gcc` file as follows:

- Enable the static build by setting `KDU_GLIBS = -static -static-libgcc`
- Run `make -f Makefile-Linux-x86-gcc`

This will generate libs in `kakadu/lib/Linux-x86-gcc`.

From the kakadu folder, run: `sudo cp lib/Linux-x86-gcc/* /home/myuser/mylibs/lib`

After this, enter in `apps/make` and modify the `Makefile-Linux-x86-gcc` file as follows:

- Enable the static build by setting `KDU_GLIBS = -static -static-libgcc`
- Set `LIB_SRC` as follow: `LIB_SRC=$(LIB_DIR)/libkdu.a`
- Run make: `make -f Makefile-Linux-x86-gcc`

The following additional steps are not required by GDAL but it is needed by the Image I/O-Ext plugin which directly leverages on the Kakadu Library.

Enter in `managed/make` and modify the `Makefile-Linux-x86-gcc` file. You will notice the presence of a `INCLUDES += -I../all_includes` row. In top of this, add the following additional setting:

```
INCLUDES += -I$(JAVA_HOME)/include -I$(JAVA_HOME)/include/linux
```

Run make: `make -f Makefile-Linux-x86-gcc`

Then, from the kakadu folder, run: `sudo cp /lib/Linux-x86-gcc/libkdu_jni.so /home/myuser/mylibs/lib`

Finally, run `sudo ldconfig`

3.7.1.2 MrSID

As a first requirement, you need the LizardTech Decoding Software Development Kit (DSDK). You can download it free of charge from this site: <http://developer.lizardtech.com> (You need to be registered in order to download it). After logged in, select “Download” -> “Software Development Kits” -> “Download SDK’s”. Select the proper version of SDK to be downloaded (select the **GeoExpress SDK for Linux (x86) - gcc 3.4**)



3.7.1.3 ECW

Download the Image Compression SDK (source code) from ER Mapper site at this address:

<http://www.ermapper.com> (You need to be registered in order to download it).

From the main site, select the menu “*products & downloads*” -> “*Image Compression SDK*” from the *Desktop* section. Download the *Image Compression SDK Source Code 3.3* file and extract this somewhere on your hard disk, as an instance on `/home/myuser/libs/libecwj2`

From the command line, just enter this folder and simply run:

- `./configure --prefix=/home/myuser/mylibs`
- `make`
- `sudo make install`

3.7.2 GDAL Configuration

Firstly, you need to download GDAL 1.4.5 from OSGeo SVN. Enter the folder where you want to download GDAL and run:

```
svn co http://svn.osgeo.org/gdal/tags/1.4.5/gdal gdal1.4.5
```

Then, you need to apply the patch available at this location:

<https://imageio-ext.dev.java.net/svn/imageio-ext/trunk/patches/gdal1.4.5.patch>

This patch contains several changes for:

- Kakadu support: More Kakadu create options and error management supported. Makefile modified
- Java bindings: improved data access (read/write Dataset at once instead of read/write RasterBands at once; BandMap, PixelSpace, LineSpace and BandSpace parameters now are allowed), added setMetadataItem capabilities

To apply the patch, enter in the GDAL main folder and run:

```
patch -p0 -f -i PATH_TO_DOWNLOADED_PATCH/gdal1.4.5.patch
```

(where `PATH_TO_DOWNLOADED_PATCH` represents the location where you downloaded the patch, as an instance, `/home/myuser/Desktop/`)

Be sure you properly set the `GDAL_DATA` environment variable. This need to be set with your `GDAL/DATA` location in order to properly evaluate EPSG codes. As an instance, supposing you installed GDAL on `/home/myuser/gdal1.4.5`, you can use the following command:

```
export GDAL_DATA=/home/myuser/gdal1.4.5/data/
```

Next step is configuring GDAL by means of the `./configure --prefix=/home/myuser/mylibs` command. Such a command allows to specify several options to enable formats, change build properties, customize libraries and much more. Depending on the required formats you wish to enable on GDAL, you need to add some options to this command as explained in the following sections.



3.7.2.1 Kakadu configuration option

Add `--with-kakadu=KAKADU_FOLDER` option to the `./configure` command, where `KAKADU_FOLDER` represents the path where your Kakadu library is located.

3.7.2.2 MrSID configuration option

Add `--with-mrsid=MRSID_FOLDER` option to the `./configure` command, where `MRSID_FOLDER` represents the path where you previously downloaded GeoDSDK.

Note: During the future build process (3.7.3) a similar error could occur:

```
/...../include/base/lti_sceneBuffer.h:356:  
error: extra qualification 'LizardTech::LTISceneBuffer::' on member
```

You need to fix the issue in the header `MRSID_FOLDER/include/base/lti_sceneBuffer.h` by simply removing the class scope declaration from the `inWindow` method declaration. Line 356 should look like this:

```
bool inWindow(lt_uint32 x, lt_uint32 y) const;
```

Then repeat build process as suggested in 3.7.3.

3.7.2.3 ECW configuration option

Add `--with-ecw=/home/myuser/mylibs` option to the `./configure` command, where `/home/myuser/mylibs` represents the path where you previously installed ECW.

3.7.3 GDAL Building

Finally, you are ready to build GDAL. Supposing you properly configured it as explained in section 3.7.2, run the following commands:

- `make clean`
- `make`
- `sudo make install` (As you may notice, this command requires superuser privileges)

When the build is terminated, run `sudo ldconfig`.

Next step is generating JAVA bindings.

3.7.3.1 Generating JAVA Bindings

SWIG will generate java bindings for you.

As a first step, check your `GDAL/SWIG/JAVA/java.opt` is properly configured.

Basically, you need to check the `JAVA_HOME`, `JAVA_INCLUDE` and `ANT_HOME` variables are properly set. Be sure the following line exists: `JAVA_INCLUDE=-I$(JAVA_HOME)/include -I$(JAVA_HOME)/include/linux)`

A second step is required in order to customize the compiler options (This is needed to change default optimizations settings, which may cause JVM crashes). Just redefine the `CXX_OPTFLAGS` and `C_OPTFLAGS` in the `GDALmake.opt` file on your GDAL main folder. You need to set these 2 flags with the `-O1` value (Note that the minus sign ("-") is followed by the "O" letter instead of the



“zero” digit). Search the following line (#Flags to build optimized release version) in GDALmake.opt and change the flags like this:

```
#Flags to build optimized release version
CXX_OPTFLAGS = -O1
C_OPTFLAGS = -O1
```

Then, enter in your main GDAL folder and run:

```
cd swig
cd java
make veryclean
make generate
make build
```

This command will automatically generate wrappers and bindings. Then, copy the generated libs in /home/myuser/mylibs/lib using the command:

```
sudo cp *.so /home/myuser/mylibs/lib
```

Finally, run `sudo ldconfig`.

3.8 Image I/O-EXT Project

You need to download the **imageio-ext** project from Java.net SVN. Enter the folder where you want to download Image I/O-EXT and run:

```
svn co https://imageio-ext.dev.java.net/svn/imageio-ext/trunk imageio-ext --
username MYUSERNAME
```

(Note: MYUSERNAME need to be replaced with your own username)

3.8.1 Libraries deployment instructions (Optional) - [deploylibs] property

In case you have skipped the GDAL manual building process introduced in the previous sections, you should leverage on the libraries contained in the deploy module although this approach is not recommended.

In that case, you need to deploy available libraries before building the Image I/O-Ext project. You also need to setup a GDAL_DATA environment variable with the path of the location where you want the deploy module will store required files for EPSG codes parsing, as explained in 3.7.2.

Moreover, depending on the set of required libraries, you need to specify a configuration profile from the following set:

1. **base**: in case you need the libraries built to support only the plugins which don't depend on external libraries
2. **full**: in case you need the libraries built to support MrSID and ECW plugins (HDF4 and Kakadu are not available as deployed libraries).

Note that, since adding additional libraries to your JRE requires admin privileges, you need to execute this deployment phase as a separated preliminary step. You need to enter in `imageio-ext\` and run the following command:



`sudo mvn generate-resources -PconfigProfile -Ddeploylibs` (where `configProfile` is one of **base** or **full**). You need superuser privileges since this command will deploy all the required libraries (*.so) on the `JRE/lib/i386` folder. This phase simply deploys libraries while the real Image I/O-Ext project building will be performed in the next phase, as explained in

3.8.2 Image I/O-Ext Project building

Actually, it is possible to build the project in 2 configuration.

1. **base**: only the plugins which don't depend on external libraries are built
2. **full**: All the available plugins are built

When executing tests, any configuration requires the proper set of libraries. You could also leverage on the libraries available via the deploy module, as explained in chapter 3.8.1. Anyway, note that the test cases will internally check if the requested libraries are available. When executing tests, you will be notified through WARNING messages in case some driver or library is missing (but tests will not be interrupted).

To build the Image I/O-Ext project, enter in `imageio-ext\` and, select the configuration you need, using the proper `configProfile` running the command: `mvn install -PconfigProfile` (where `configProfile` is one of **base** or **full**)

This command will build and test all required modules and plugins and store the produced JARS in the local maven repository. (Note that actually HDF4 plugin is not tested on Linux).

In case you need to do a fast build of the Image I/O-Ext project, without tests, just add the `-Dmaven.test.skip` option to the previous `mvn` command.

NOTE: Maven should automatically-recognize the running operative system in order to use the proper deploy module. In case some errors occur due to an unrecognized OS name (which should be "Linux") you can explicitly specify it with the additional `linux` profile. As an instance, if you are building the full configuration, you can use the `-Pfull,linux` profiles.

3.8.2.1 Testing Image I/O-Ext modules with Maven

In case you simply need testing some Image I/O-Ext modules, as an instance in order to check if everything is working fine, you can enter in the module you are interested in and run the maven test. As an instance:

```
imageio-ext/plugin>cd plugin/gdalarcgrid
imageio-ext/plugin/gdalarcgrid>mvn test
```

Lastly, if you want to perform interactive tests (which usually display data read on a windows), you should use the `interactive.tests` profile like this:

```
imageio-ext/plugin/gdalarcgrid>mvn test -Pinteractive.tests
```

Anyway, displaying the image is a not blocking/not waiting operation so you will barely see the image, just for an instant (when displayed, it will be automatically closed. Future versions may include a property to customize "waiting time" before close). Note that tests require you have all the needed SO. libraries, otherwise they will be skipped.

3.8.2.2 Testing JPEG2000 Kakadu (GDAL) writer capabilities

The JPEG2000 Kakadu (GDAL based) plugin contains a wide suite for testing write operations with different write parameters leveraging on the available create options / Kakadu customizations. As



default, the test performs only a simple write operation without testing any supported kakadu create option to reduce build time. In case you need to test all these operations simply use the `extensive.tests` profile like this:

```
imageio-ext/plugin/gdalkakadujp2>mvn test -Pextensive.tests
```

Moreover, as default, when the test is terminated, all the written files are automatically deleted. In case you would like to maintain the produced files, avoiding delete, you should add the profile `tests.holdwrittenfiles` to the previous one, using the following command:

```
imageio-ext/plugin/gdalkakadujp2>mvn test  
-Pextensive.tests,tests.holdwrittenfiles
```



4 Mac OS X Instructions

The following instructions have been tested on Mac OSX Leopard distribution.

4.1 JAVA & ANT

Java and ant in the needed versions are shipped in the developer tools shipped in the install cds of leopard.

4.2 MAVEN 2

Maven 2 is another important tool needed by the Image I/O-Ext project. You can download the last version from <http://maven.apache.org/download.html>.

As taken from the apache site, here come the install instructions for:

Unix-based Operating Systems (Linux, Solaris and Mac OS X)

1. Extract the distribution archive to the directory you wish to install Maven 2.0.9. These instructions assume you chose `/usr/local/apache-maven-2.0.9`. The directory `apache-maven-2.0.9` will be created from the archive.
2. Add the bin directory to your path, eg. `export PATH=/usr/local/apache-maven-2.0.9/bin:$PATH`
3. Make sure that `JAVA_HOME` is set to the location of your JDK, as an instance,
`export JAVA_HOME= /System/Library/Frameworks/JavaVM.framework/Versions
/CurrentJDK/ Home/`
4. Run `mvn --version` to verify that it is correctly installed.

4.3 JAI

JAI is already present in the java installation of leopard.

4.4 JAI-ImageIO Toolkit

Jai-imageio has not yet been compiled and inserted into the macosx java installation by Apple. For now it is possible to download the jai-imageio from:

<http://download.java.net/media/jai-imageio/webstart/early-access/1.1/linux-i586/>

and install it to the macosx jvm using the cp command to `/System/Library/Java/Extensions`

This will mean no native acceleration for now. Anyway as soon as Apple builds it for mac, it should work out of the box.

4.5 SWIG

Be sure you have properly downloaded SWIG, the Simplified Wrapper and Interface Generator which allow to produce JAVA bindings for C/C++ code.

Since the macports project supports SWIG, the easiest way to install SWIG is to install macports (www.macports.org) and simply run:

```
port install swig
```



4.5.1 Manual SWIG installation

In case `yum` is not supported by your distribution, just download swig from:

<http://mesh.dl.sourceforge.net/sourceforge/swig/swig-1.3.32.tar.gz>. (Or a more recent version). Unzip this somewhere on your hard disk and then run:

```
./configure
```

```
make
```

```
sudo make install
```

 (As you may notice, this command requires superuser privileges)

4.6 GDAL

GDAL, which stands for Geospatial Data Abstraction Library, provides data access to several raster data formats. Image I/O-Ext deeply leverages on this complex library which needs to be properly configured.

4.6.1 GDAL requirements

Depending on the format you wish to support, you need to properly download and setup several libraries prior to build GDAL. The following instructions describe how to achieve this for these formats:

- Kakadu (v. 5.2.6)
- MrSID (v 6.0.7)
- ECW (v 3.3) Requires some workaround to be found in order to build GDAL against it.

4.6.1.1 Kakadu

Supposing you have your own Kakadu licensed source code, go in the main kakadu folder (as an instance on `usr/local/kakadu`).

Enter in `coresys/make` and run make: `make -f Makefile-Mac-x86-gcc`

Enter in `apps/make` and run make: `make -f Makefile-Mac-x86-gcc`

Finally, enter in `managed/make` and run make: `make -f Makefile-Mac-x86-gcc`

In case you encountered an “archive has no table of contents” error against `libkdu.a` you should run the `ranlib` command against that lib.

Finally, copy all the generated libs in `/usr/local/lib`

If you plan to use the ImageIO-Ext module which leverages directly on the kakadu library without using GDAL you have to rename the `libkdu_jni.so` file to `libdku_jni.dylib`.

4.6.1.2 MrSID

As a first requirement, you need the LizardTech Decoding Software Development Kit (DSDK). You can download it free of charge from this site: <http://developer.lizardtech.com> (You need to be registered in order to download it). After logged in, select “Download” -> “Software Development Kits” -> “Download SDK’s”. Select the proper version of SDK to be downloaded (select the **GeoExpress SDK for Mac OS X (universal) - gcc 4.0**)



4.6.2 GDAL Configuration

Firstly, you need to download GDAL 1.4.5 from OSGeo SVN. Enter the folder where you want to download GDAL and run:

```
svn co http://svn.osgeo.org/gdal/tags/1.4.5/gdal gdal1.4.5
```

Then, you need to apply the patch available at this location:

<https://imageio-ext.dev.java.net/svn/imageio-ext/trunk/patches/gdal1.4.5.patch>

This patch contains several changes for:

- Kakadu support: More Kakadu create options and error management supported. Makefile modified
- Java bindings: improved data access (read/write Dataset at once instead of read/write RasterBands at once; BandMap, PixelSpace, LineSpace and BandSpace parameters now are allowed), added setMetadataItem capabilities

To apply the patch, enter in the GDAL main folder and run:

```
patch -p0 -f -i PATH_TO_DOWNLOADED_PATCH/gdal1.4.5.patch
```

(where `PATH_TO_DOWNLOADED_PATCH` represents the location where you downloaded the patch, as an instance, `/home/youruser/Desktop/`)

Be sure you properly set the `GDAL_DATA` environment variable. This need to be set with your `GDAL/DATA` location in order to properly evaluate EPSG codes. As an instance, supposing you installed GDAL on `/home/youruser/gdal1.4.5`, you can use the following command:

```
export GDAL_DATA=/home/youruser/gdal1.4.5/data/
```

Next step is configuring GDAL by means of the `./configure` command. Such a command allows to specify several options to enable formats, change build properties, customize libraries and much more. Depending on the required formats you wish to enable on GDAL, you need to add some options to this command as explained in the following sections.

4.6.2.1 Kakadu configuration option

Add `--with-kakadu=KAKADU_FOLDER` option to the `./configure` command, where `KAKADU_FOLDER` represents the path where your Kakadu library is located.

4.6.2.2 MrSID configuration option

Add `--with-mrsid=MRSID_FOLDER` option to the `./configure` command, where `MRSID_FOLDER` represents the path where you previously downloaded GeoDSDK.

Note: During the future build process (4.6.3) a similar error could occur:

```
/...../include/base/lti_sceneBuffer.h:356:  
error: extra qualification 'LizardTech::LTISceneBuffer::' on member
```

You need to fix the issue in the header `MRSID_FOLDER/include/base/lti_sceneBuffer.h` by simply removing the extra qualification from the `inWindow` declaration. Line 356 should look like this: `bool inWindow(lt_uint32 x, lt_uint32 y) const;`
Then repeat build process as suggested in 4.6.3.



4.6.3 GDAL Building

Finally, you are ready to build GDAL. Supposing you properly configured it as explained in section 4.6.2, run the following commands:

```
make clean
```

```
make
```

```
sudo make install (As you may notice, this command requires superuser privileges)
```

Next step is generating JAVA bindings.

4.6.3.1 Generating JAVA Bindings

SWIG will generate java bindings for you.

As a first step, check your GDAL/SWIG/JAVA/java.opt is properly configured.

Basically, you need to check the `JAVA_HOME`, `JAVA_INCLUDE` and `ANT_HOME` variables are properly set. Be sure the following line exists: `JAVA_INCLUDE=-I$(JAVA_HOME)/include`

Edit the `GNUMakefile` file and do the following changes:

1. in the `JAVA_MODULES` variable, change any `".so"` extension to `".dylib"`
2. edit the "build:" target:

~~cp ../libs/*.so ./~~ needs to become `cp ../libs/*.dylib ./`

3. edit the `$(JAVA_MODULES)` section:

~~lib%jni.so: %_wrap.o~~ needs to become `lib%jni.dylib: %_wrap.o`

~~\$(LD) -shared \$(LDFLAGS) \$(CONFIG_LIBS) \$< -o \$@~~

needs to become

`$(LD) -dynamiclib $(LDFLAGS) $(CONFIG_LIBS) $< -o $@`

Then, enter in your main GDAL folder and run:

```
cd swig
```

```
cd java
```

```
make veryclean
```

```
make build
```

This command will automatically generate wrappers and bindings. Then, copy the generated libs in `/usr/local/lib` using the command:

```
sudo cp *.so /usr/local/lib (As you may notice, this command requires superuser privileges)
```

4.7 Image I/O-EXT Project

You need to download the **imageio-ext** project from Java.net SVN. Enter the folder where you want to download Image I/O-EXT and run:

```
svn co https://imageio-ext.dev.java.net/svn/imageio-ext/trunk imageio-ext --username MYUSERNAME
```

(Note: MYUSERNAME need to be replaced with your own username)

