



mpideXcode

Embedded Computing Template on Xcode 4.3

Installation Guide



© Rei VILO, 2010—2012

Documentation <http://embedXcode.weebly.com/>

GitHub repository <http://github.com/rei-vilo/embedXcode>

Contact <http://embedxcode.weebly.com/contact.html>

How to Help



Contribute to the project on [GitHub](http://github.com/rei-vilo/embedXcode).



Help me buy books on Xcode through my [Amazon Wish List](#).

Summary

1. Install the Template	3
2. Create a New Project	7
3. Configure the Project.....	8
3.1. Declare Sketch .pde File as C++ File	8
3.2. Declare User's Sketchbook.....	10
3.3. Add User's Libraries	11
3.4. Declare Sources for Code-Sense	14
3.5. Define the Directories for the Target.....	16
4. Use the Project.....	18
4.1. Change the Board	18
4.2. Add a File	20
4.3. Insert #include Statements From Code Snippet.....	22
4.4. Manage Code for Multiple Platforms	25
4.5. Re-Index the Keywords for Code-Sense	27
5. Appendixes.....	32
5.1. What Has Been Tested	32
5.2. Known Issues	32
5.3. Contributions and References	32
5.4. Version History	33
5.5. Referenced Boards.....	34
6. Copyright and Licence	36
6.1. Summary	36
6.2. Legal Code	37

1. Install the Template

Before installing the template, you need to install at least one IDE.



If you plan to use Arduino boards:

- Download and install Arduino 0023 or Arduino 1.0.
- Launch it.
- Define the path of the sketchbook in the menu `Aduino > Preferences > Sketchbook location`.

embedXcode identifies the version of Arduino automatically.

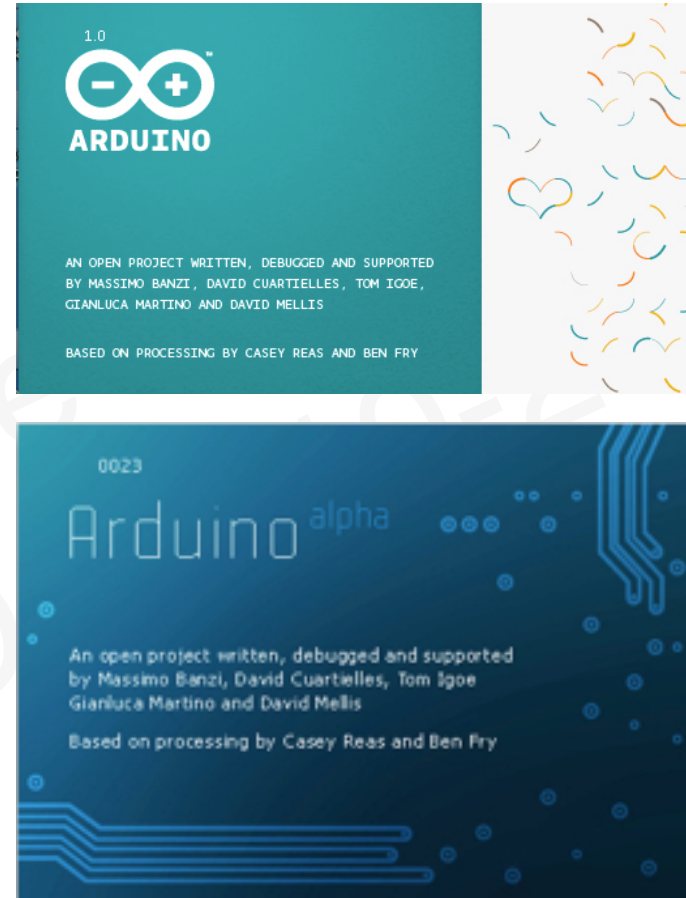
As a matter of fact, Wiring is considered as the framework of reference for embedded computing.

Arduino 0023 should be preferred over Arduino 1.0 because Arduino 0023 is Wiring compliant. So is chipKIT MPIDE 0023.

Arduino 1.0 has introduced many small changes in the syntax which are not compatible with previous release. Energia 1.0 is derived from Arduino 1.0.

So I strongly recommend to pick the release of Arduino which is compatible with the other platforms you plan to use:

- either Arduino 0023 with chipKIT MPIDE, Wiring and Maple IDEs,
- or Arduino 1.0 with LaunchPad Energia IDE.





If you plan to use chipKIT boards:

- Download and install Mpipe 0023.
- Launch it.
- Define the path of the sketchbook in the menu Mpipe > Preferences > Sketchbook location.



If you plan to use Wiring boards:

- Download and install Wiring 1.0.
- Launch it.
- Define the path of the sketchbook in the menu Wiring > Preferences > Sketchbook location.

The two following files require to be deleted.



Multiplatform Arduino compatible IDE
Arduino 0023 Compatibility

Modified version of the Arduino IDE created by
Rick Anderson and Mark Sproul of Fair Use Building
and Research on May 21, 2011.
This software is not supported by the Arduino LLC

Version 1.0 Build 100



An open project initiated by Hernando Barragán

The Wiring team is composed of Hernando Barragán, Brett Hagman and Alexander Brevig

Special thanks to contributors: Paul Stoffregen, Michael Margolis, Hans-Christoph Steiner, Annelie Franke, Maarten Lamers, Christoph Waltmann, Etienne Ribeiro, Nicholas Zambetti, Thomas Ouellet Fredericks, Mikal Hart, Pascal Stang, Brian Dean, Carlos Mario Rodriguez, James Partaik, Sawad Brooks, Yaniv Steiner, Tom Igoe, David Cuartielles, David Mellis, Massimo Banzi, Bill Verplank, Gillian Crampton-Smith and many others listed at wiring.org.co/about.html

© 2004-2010 Hernando Barragán, © 2011 Hernando Barragán, Brett Hagman and Alexander Brevig

Processing is © 2004-2011 Ben Fry and Casey Reas
© 2001-2004 Massachusetts Institute of Technology

/Applications/Wiring.app/Contents/Resources/
Java/cores/AVR8Bit/program.cpp

/Applications/Wiring.app/Contents/Resources/
Java/cores/AVR8Bit/makefile



If you plan to use LaunchPad boards:

- Download and install Energia 1.0.
- Launch it.
- Define the path of the sketchbook in the menu Energia > Preferences > Sketchbook location.



If you plan to use Maple boards:

- Download and install MapleIDE.
- Launch it.
- Define the path of the sketchbook in the menu MapleIDE > Preferences > Sketchbook location.

The Maple reset script — which sends control signals over the USB-serial connection to restart and enter the bootloader — is written in Python and requires the PySerial library:

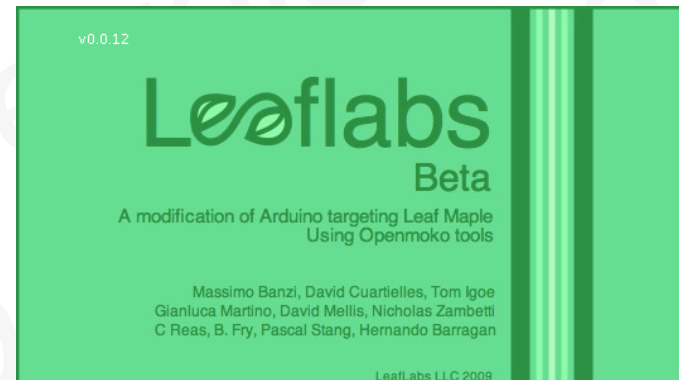
- Read the instructions at <http://leafflabs.com/docs/unix-toolchain.html#os-x> and
- Download PySerial library from <http://pypi.python.org/pyserial/>.



Energia 1.0

Modified version of the Arduino IDE for the Texas Instrument LaunchPad MSP430 created by Robert Wessels on January 2012.

This software is not supported by the Arduino LLC.



For other boards with a Processing-based IDE, same procedure:

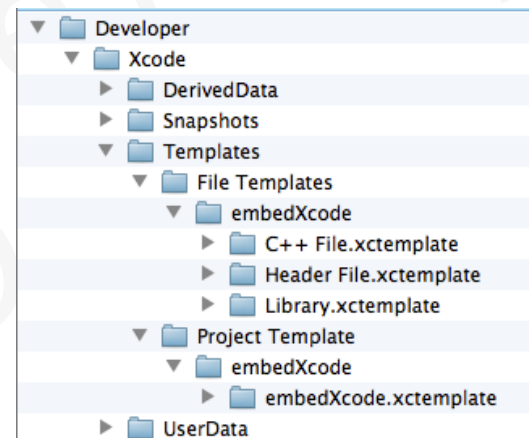
- Download and install the corresponding Processing-based IDE.
- Launch it.
- Define the path of the sketchbook.
- Additionally, develop a specific makefile and adapt the Step1 makefile.



Now, the template can be installed:

Check and create `~ /Library/Developer/Xcode`.

Copy the folder Templates into `~/Library/Developer/Xcode`

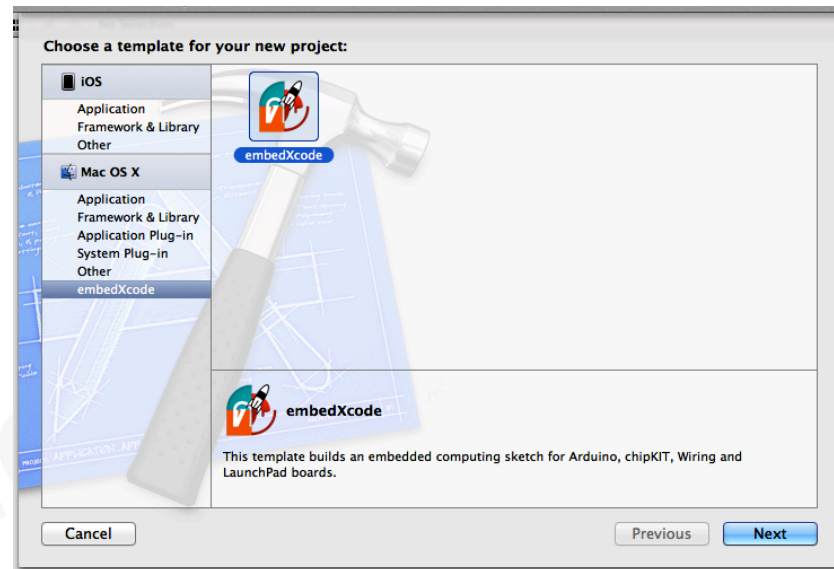


2. Create a New Project

Call the menu File > New > New Project... or press
⇧⌘N.

Select embedXcode > embedXcode.

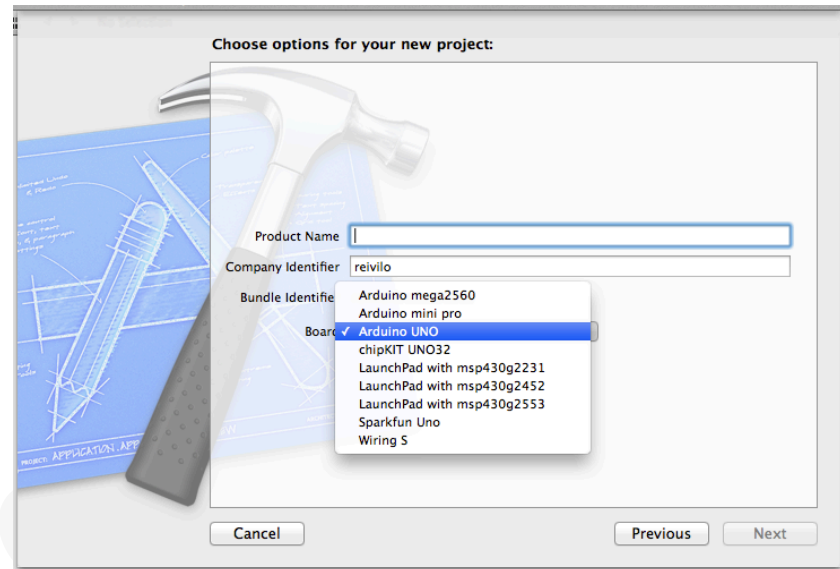
Click on Next to proceed to the next step.



Type in the name of the project.

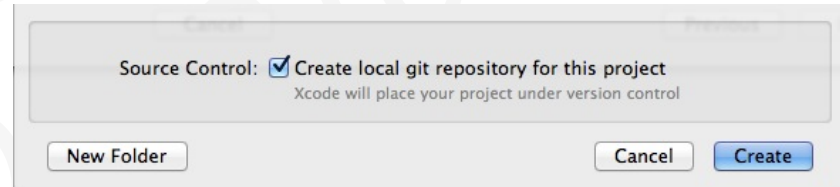
Select the board on the drop-down list.

Click on Next to proceed to the last step.



Select the folder where the project is going to be saved and check **Create local git repository for this project** if you want so.

Then click **Create** to confirm and create the project.



3. Configure the Project

The template doesn't define all the parameters, so some of them need to be set manually.

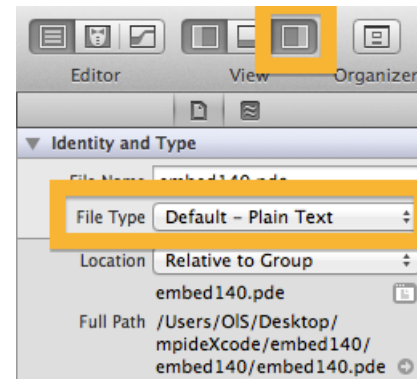
The goal is to have the following work done by the template, provided the right keywords are known.

3.1. *Declare Sketch .pde File as C++ File*

The sketch .pde file is considered as plain text. For code-sense, it should be declared as C++ file.

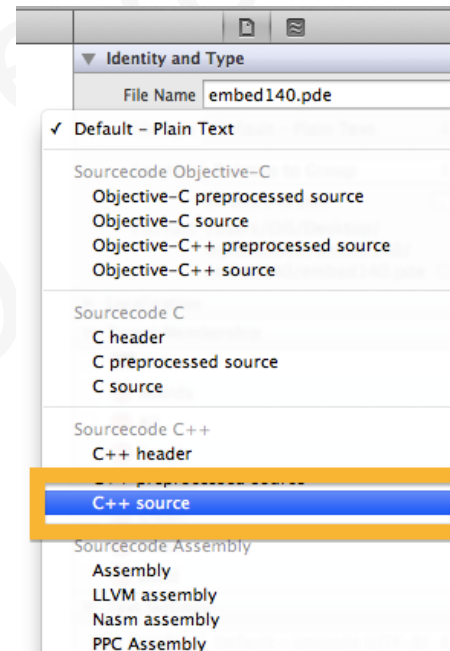
Select the sketch .pde file.

In the right-most column,

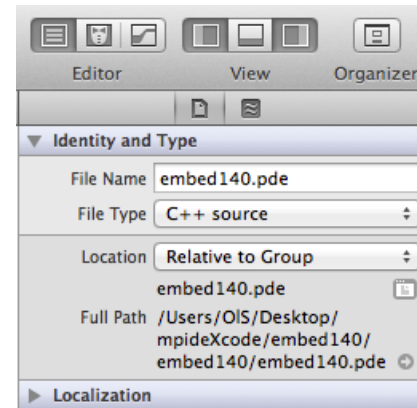


Click on the drop-down list of File Type.

Select C++ source.



Now, the sketch is considered as C++ code for code-sense.

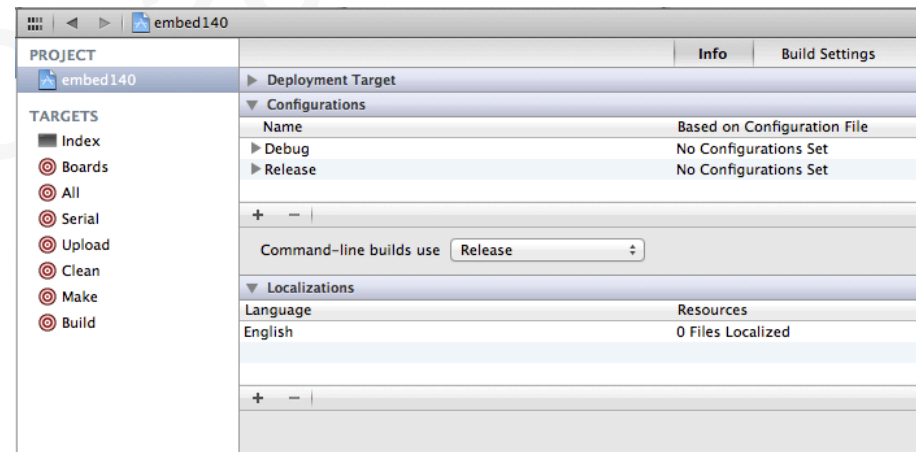


This manual procedure is considered as an issue and reported under [#3 Declare PDE File as C++ Source](#).

3.2. Declare User's Sketchbook

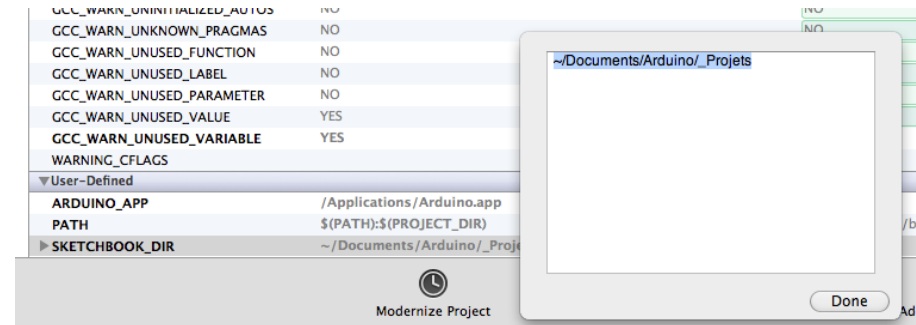
The user's sketchbook is a folder where the user's sketches are saved, among them the libraries in a dedicated sub-folder Libraries.

Select the project and the Build Settings pane.



At the very bottom, double-click on SKETCHBOOK_DIR and either type in the name of the folder or drag-and-drop it from a Finder window.

The ~ character is accepted.



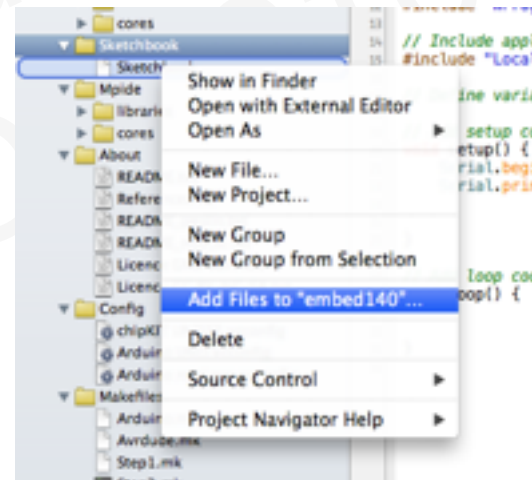
If no sketchbook is defined, SKETCHBOOK_DIR takes the value defined for Arduino or chipKIT during the installation process.

3.3. Add User's Libraries

Open the Sketchbook group on the project hierarchy.

Right-click to obtain the contextual menu.

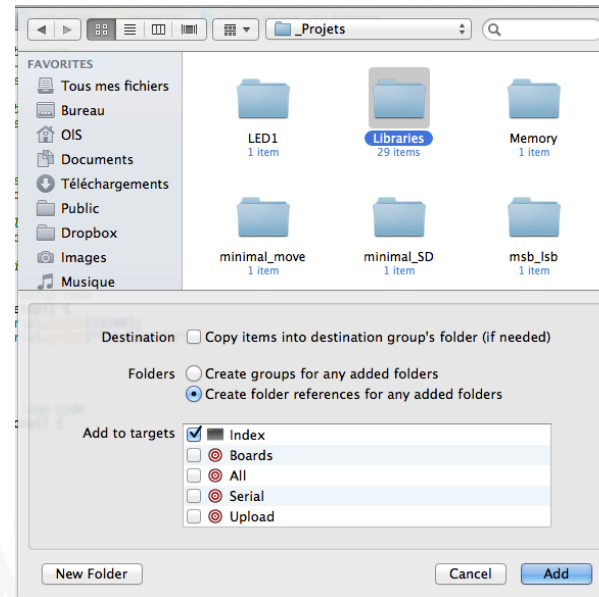
Choose Add file to...



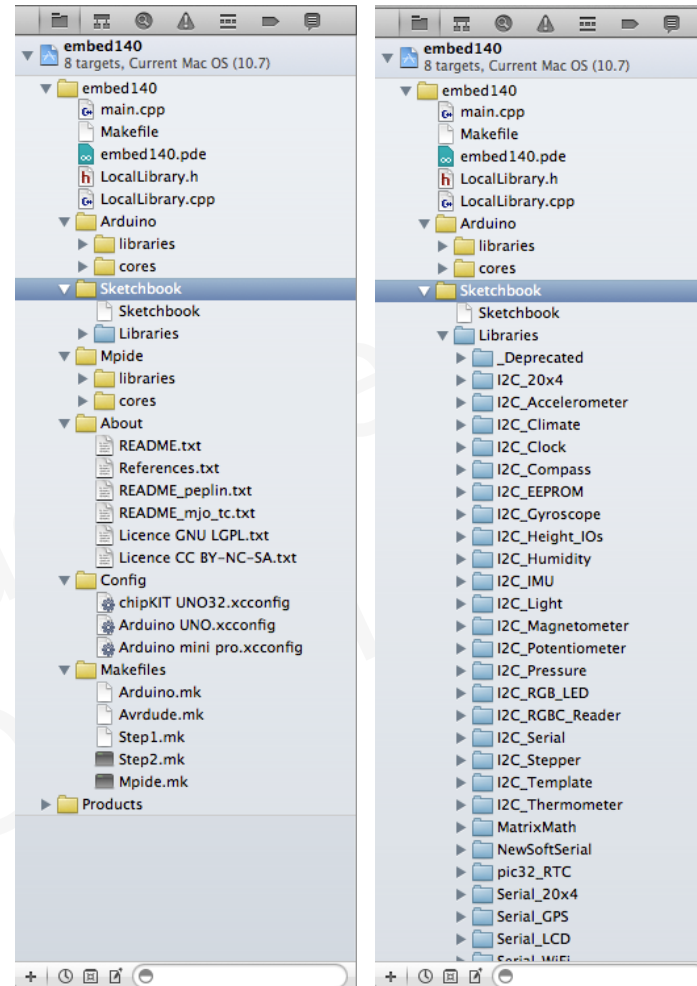
Select the Library sub-folder on the sketchbook folder, tick Add to target > Index and validate with Add.

Both Create group for any added folders and Create folder references for any added folders are relevant.

Don't tick Copy items into destination group's folder (if needed) folder (in needed) to avoid duplicating files.



The project hierarchy shows all your libraries.



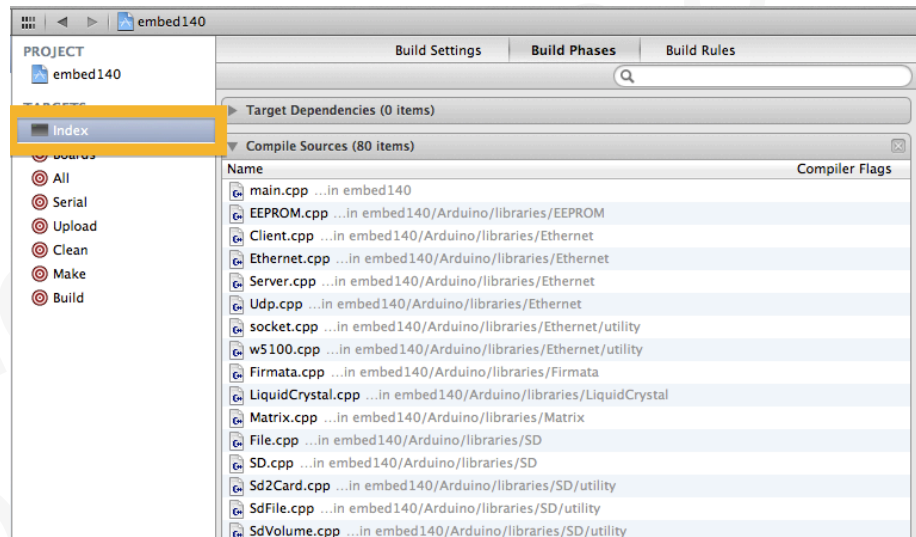
3.4. Declare Sources for Code-Sense

Standard C++ keywords are already known, but not some Arduino and user's library keywords.

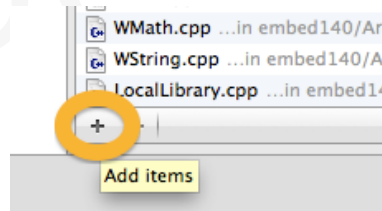
The selection of a board defines the headers for code-sense.

So Xcode needs to be taught where to find them.

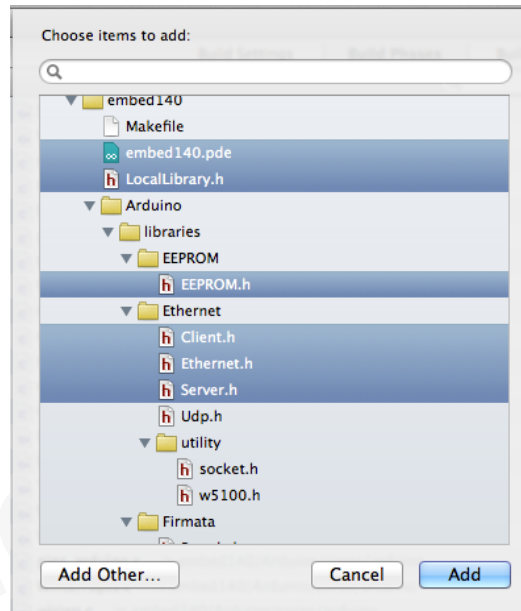
Select the target Index and the Build Phases pane.



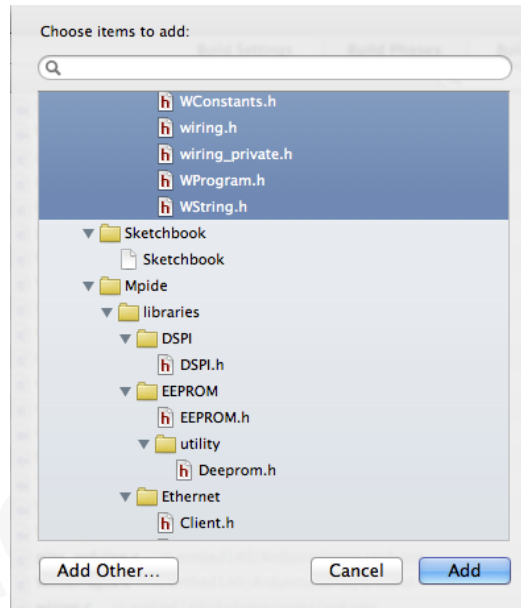
Go to the bottom of the list and click on the + button.



A list shows up.



Select all the .h and .cpp files and click on Add.



This manual procedure is considered as an issue and reported under [#2 Populated Sources List for Code-Sense](#).

3.5. Define the Directories for the Target

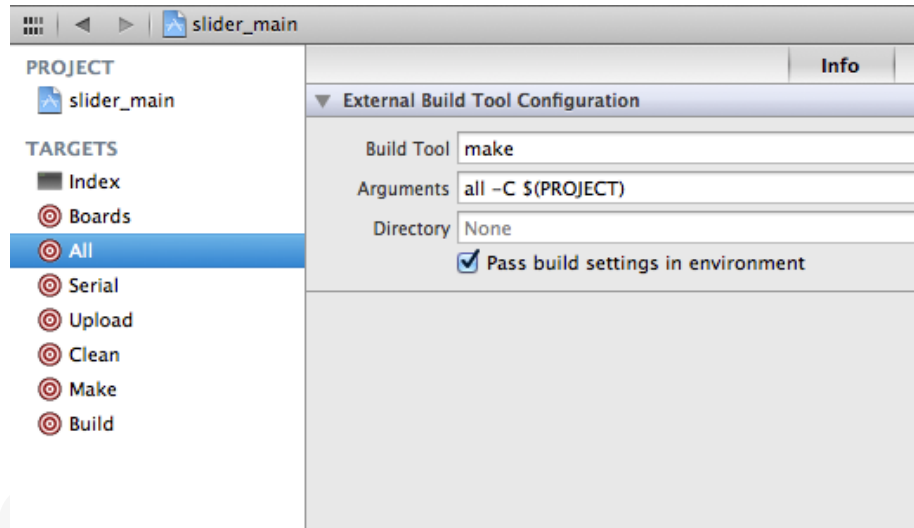
The template doesn't allow to specify the exact directory for the target. In case of an building error, the click-to-error feature may not work properly for the main sketch and the local libraries.

So Xcode needs to be taught where to find them.

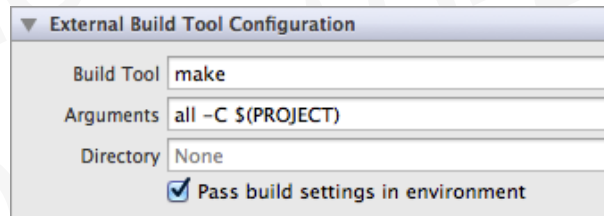
This is an optional procedure.

Select the target All.

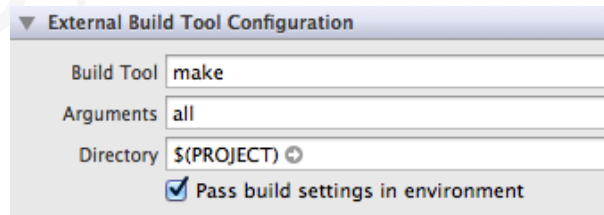
Feel free to update other targets you use often, as Build and Make.



By default, the template mentions `all -C $(PROJECT)` as arguments.



Remove `-C $(PROJECT)` from the arguments and add `$(PROJECT)` into directory.



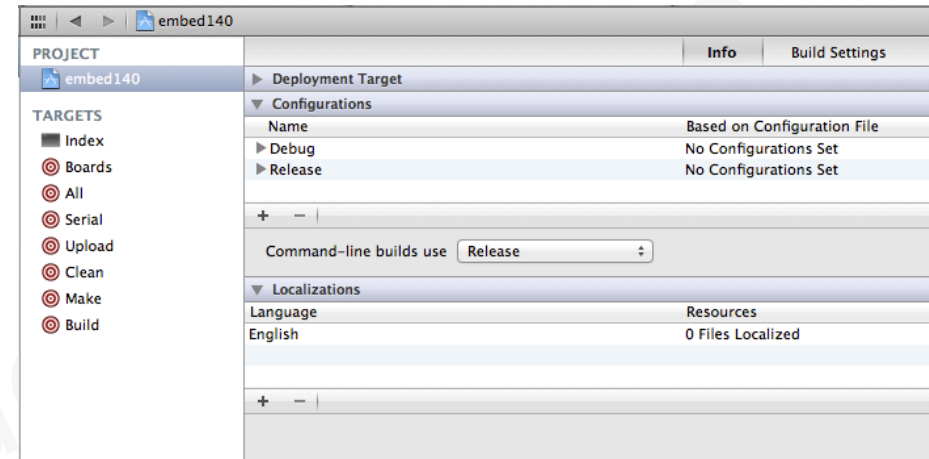
This manual procedure is considered as an issue and reported under [#12 Define Directory for a Target](#).

You're ready now!

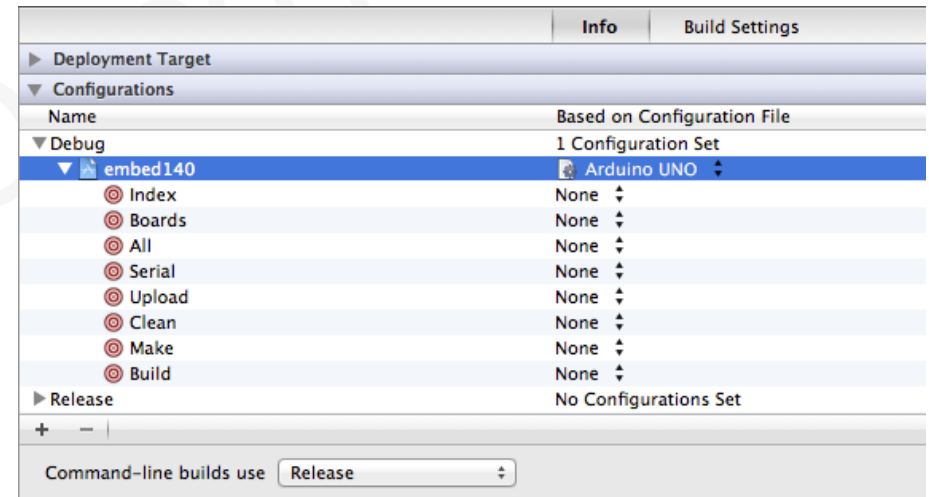
4. Use the Project

4.1. Change the Board

To change the board, select the project and the Info pane.

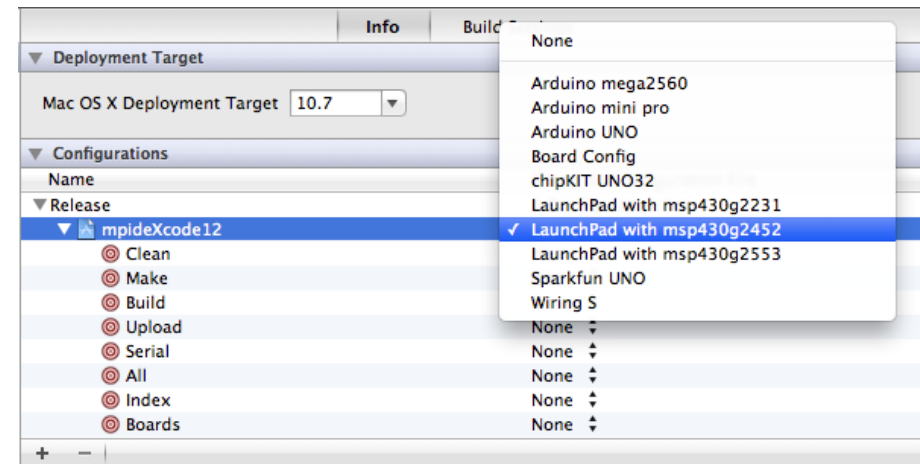


A drop-down list shows the boards available.



Just select one.

If your board isn't listed, you can create a configuration file.
Please refer to [§6 Add a file](#).



The sketch contains conditional `#include` for the supported IDEs.

They are based on the micro-controller reference or on the IDE version. For more information, please refer to [Manage Code for Multiple Platforms](#).

The version of Arduino, either 0023 or 1.0, is detected automatically and the corresponding library `Arduino.h` or `WProgram.h` selected accordingly.

Those `#include` statements are included on a code snippet for easy use.

Please refer to [Insert Code Snippet with #include Statements](#).

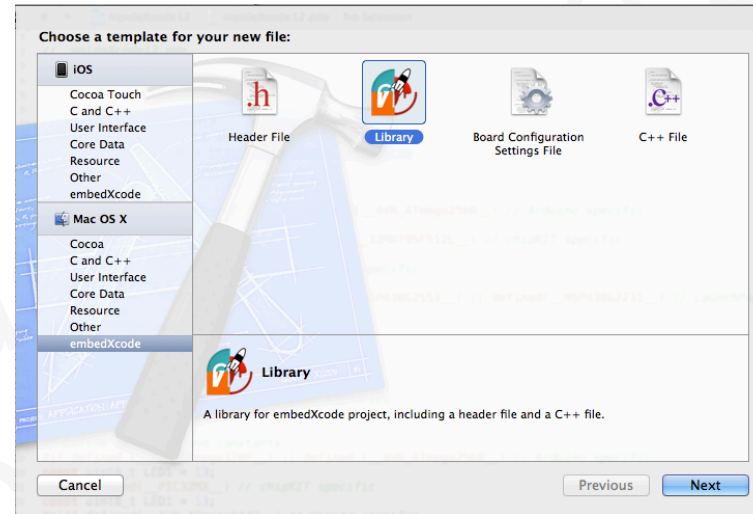
```
// Core library – MCU-based
#if defined(__AVR_ATmega328P__) || defined(
  __AVR_ATmega2560__) // Arduino specific
  #if defined(ARDUINO) && (ARDUINO >= 100)
    #include "arduino.h" // – for Arduino 1.0
  #else
    #include "WProgram.h" // – for Arduino 23
  #endif
#elif defined(__32MX320F128H__) ||
  defined(__32MX795F512L__) // chipKIT specific
  #include "WProgram.h"
#elif defined(__AVR_ATmega644P__) // Wiring specific
  #include "Wiring.h"
#elif defined(__MSP430G2452__) ||
  defined(__MSP430G2553__) || defined(__MSP430G2231__) //
  LaunchPad specific
  #include "Energia.h"
#elif defined(MCU_STM32F103RB) ||
  defined(MCU_STM32F103ZE) || defined(MCU_STM32F103CB) ||
  defined(MCU_STM32F103RE) // Maple specific
  #include "WProgram.h"
#endif
```

When a board is selected, the configuration file defines parameters for code-sense.

4.2. Add a File

Call the menu File > New > New File... or press ⌘N

Select embedXcode and then Header File, C++ file, Library or Board Configuration Settings File.



Library creates a header file and a C++ code file with the `#include "LocalLibrary.h"` statement ready!

Board Configuration Settings File allows to define the settings for a new board.

Specify:

- BOARD_TAG is the unique identifier of the board, found in the Boards.txt file.
- BOARD_PORT defines the USB port to be used. This parameter is optional.
- GCC_PREPROCESSOR_DEFINITIONS is the name of the micro-controller of the board, found in the Boards.txt file.
- HEADER_SEARCH_PATHS needs to be updated with the reference of the IDE, ARDUINO_APP for Arduino, MPIDE_APP for Mpide, WIRING_APP for Wiring, or ENERGIA_APP for Energia.

The last two parameters improves the selection of the headers for code-sense.



```
1 //
2 // Board Config.xcconfig
3 // Board config file
4 //
5 // Developed with embedXcode
6 //
7 // Project mpideXcode12
8 // Created by Rei VILO on 17/04/12
9 // Copyright (c) 2012 http://sites.google.com/site/vilorei
10 //
11
12 // Board identifier
13 // see Boards.txt for <tag>.name=Arduino Uno (16 MHz)
14 //
15 BOARD_TAG = uno
16
17 // Port (optional)
18 // most common are /dev/tty.usbserial* and /dev/tty.usbmodem*
19 BOARD_PORT = /dev/tty.usbserial*
20
21 // References for Xcode code-sense
22 // see Boards.txt for <tag>.build.mcu=<GCC_PREPROCESSOR_DEFINITIONS>
23 // specify ARDUINO_APP for Arduino, MPIDE_APP for Mpide, WIRING_APP for Wiring, ENERGIA_APP for Energia
24 //
25 GCC_PREPROCESSOR_DEFINITIONS = __AVR_ATmega328P__
26 HEADER_SEARCH_PATHS = $(ARDUINO_APP)/** $(SKETCHBOOK_DIR)/Libraries/**
27
```

4.3. Insert #include Statements From Code Snippet

A code snippet includes all the #include statements for selecting the core libraries.

There are two versions: one MCU-based and another IDE-based.

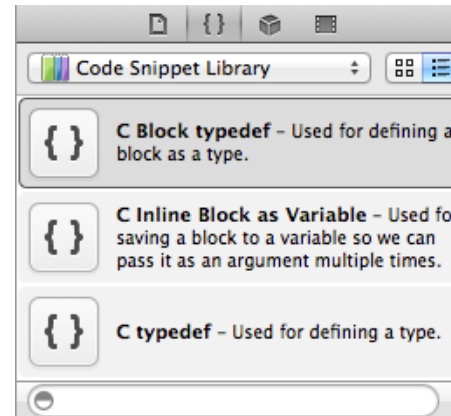
For more information, please refer to [Manage Code for Multiple Platforms](#).

```
// Core library – MCU-based
#if defined (__AVR_ATmega328P__) || defined
(__AVR_ATmega2560__) // Arduino specific
  #if defined(ARDUINO) && (ARDUINO >= 100)
    #include "arduino.h" // – for Arduino 1.0
  #else
    #include "WProgram.h" // – for Arduino 23
  #endif
#elif defined(__32MX320F128H__) ||
defined(__32MX795F512L__) // chipKIT specific
#include "WProgram.h"
#elif defined(__AVR_ATmega644P__) // Wiring specific
#include "Wiring.h"
#elif defined(__MSP430G2452__) || defined(__MSP430G2553__)
|| defined(__MSP430G2231__) // LaunchPad specific
#include "Energia.h"
#elif defined(MCU_STM32F103RB) || defined(MCU_STM32F103ZE)
|| defined(MCU_STM32F103CB) || defined(MCU_STM32F103RE) //
Maple specific
#include "WProgram.h"
#endif
```

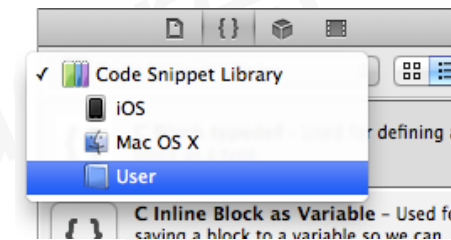
To display the code snippets, click on the right button of the View selector.



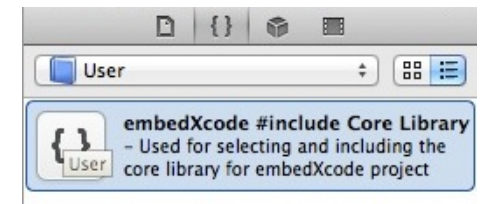
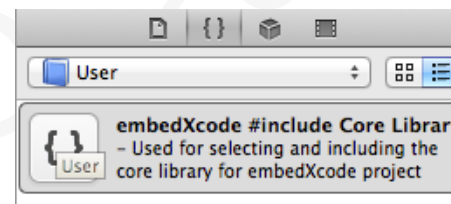
The library of code snippets is at the bottom of the right-most pane.



Select User on the drop-down list.



Select the embedXcode #include Core Library snippet.




Click and drop to the destination.



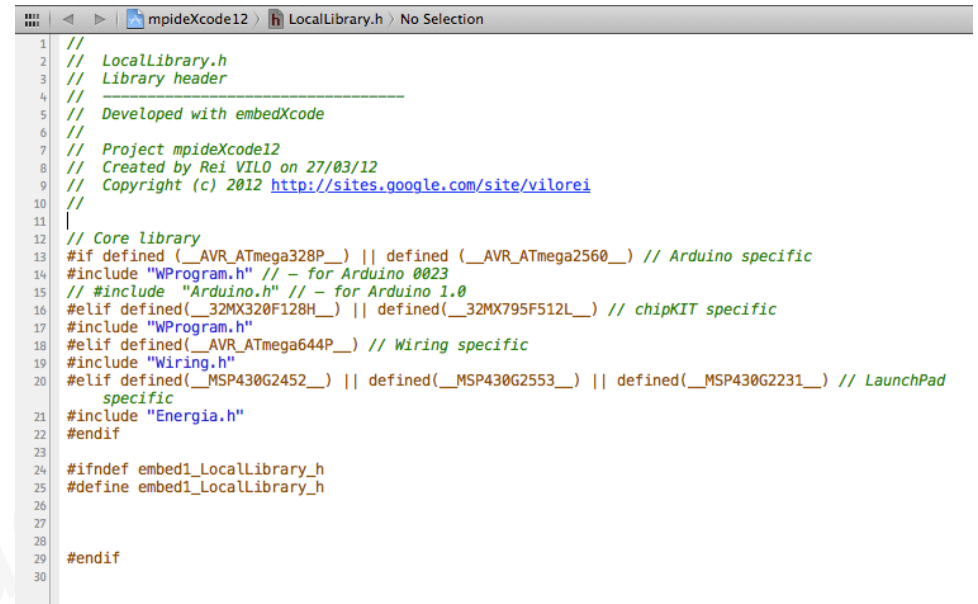
The pointer changes for

The cursor appears on the code.



```
1 //  
2 // LocalLibrary.h  
3 // Library header  
4 //  
5 // -----  
6 // Developed with embedXcode  
7 //  
8 // Project mpideXcode12  
9 // Created by Rei VILO on 27/03/12  
10 // Copyright (c) 2012 http://sites.google.com/site/vilorei  
11 //  
12 |  
13  
14 #ifndef embed1_LocalLibrary_h  
15 #define embed1_LocalLibrary_h  
16  
17  
18  
19 #endif  
20
```


The code is inserted.

A screenshot of an IDE window titled 'mpideXcode12' showing the file 'LocalLibrary.h'. The code is a C header file for a library. It starts with a comment 'LocalLibrary.h' and 'Library header'. It then has a section for 'Core library' with conditional includes for different microcontroller architectures: AVR_ATmega328P, AVR_ATmega2560 (Arduino specific), 32MX320F128H, 32MX795F512L (chipKIT specific), AVR_ATmega644P (Wiring specific), and MSP430G2452, MSP430G2553, MSP430G2231 (LaunchPad specific). It also includes 'Energia.h'. The file ends with a guard to prevent multiple inclusion using 'embed1_LocalLibrary.h'.

```
1 //
2 // LocalLibrary.h
3 // Library header
4 //
5 // -----
6 // Developed with embedXcode
7 //
8 // Project mpideXcode12
9 // Created by Rei VILO on 27/03/12
10 // Copyright (c) 2012 http://sites.google.com/site/vilorei
11 //
12 // Core library
13 #if defined (__AVR_ATmega328P__) || defined (__AVR_ATmega2560__) // Arduino specific
14 #include "WProgram.h" // - for Arduino 0023
15 // #include "Arduino.h" // - for Arduino 1.0
16 #elif defined (__32MX320F128H__) || defined (__32MX795F512L__) // chipKIT specific
17 #include "WProgram.h"
18 #elif defined (__AVR_ATmega644P__) // Wiring specific
19 #include "Wiring.h"
20 #elif defined (__MSP430G2452__) || defined (__MSP430G2553__) || defined (__MSP430G2231__) // LaunchPad
    specific
21 #include "Energia.h"
22 #endif
23
24 #ifndef embed1_LocalLibrary_h
25 #define embed1_LocalLibrary_h
26
27
28
29 #endif
30
```

4.4. Manage Code for Multiple Platforms

Managing code for multiples platforms is a real issue, and needs to take into account two dimensions:

- the boards, as Arduino Uno or Wiring S,
- and the frameworks, some of them with incompatible releases, as Arduino 0023, Arduino 1.0 or Wiring.

This can be done in two ways, MCU-based or IDE-based. Both are valid from an embedXcode point of view.

The first approach is **MCU-based** and relies on the micro-controller type.

This approach is compatible with the respective IDEs, as no new environment variable is created or required.

In the Arduino case, two frameworks exist so the IDE variable is required for disambiguation.

```
// Core library – MCU-based
#if defined (__AVR_ATmega328P__) || defined
(__AVR_ATmega2560__) // Arduino specific
    #if defined(ARDUINO) && (ARDUINO >= 100)
        #include "arduino.h" // – for Arduino 1.0
    #else
        #include "WProgram.h" // – for Arduino 23
    #endif
#elif defined(__32MX320F128H__) ||
defined(__32MX795F512L__) // chipKIT specific
    #include "WProgram.h"
#elif defined(__AVR_ATmega644P__) // Wiring specific
    #include "Wiring.h"
#elif defined(__MSP430G2452__) || defined(__MSP430G2553__)
|| defined(__MSP430G2231__) // LaunchPad specific
    #include "Energia.h"
#else // error
    #error Platform not defined
#endif
```

The second approach is **IDE-based**. Most of the IDEs defines a specific environment variable combine boards type and framework version.

For example, the Arduino IDE defines ARDUINO=101 and passes it on to the tool-chain with -D, as -DARDUINO=101.

As at today, this approach is compatible with Arduino, Wiring and Maple IDEs, which have the environment variables already defined: ARDUINO=23, ARDUINO=101, WIRING=100 and MAPLE_IDE.

The remaining two IDEs, MPIDE and Energia doesn't know the environment variables used by embedXcode: MPIDE=23 and ENERGIA=6. embedXcode creates them.

```
// Core library – IDE-based
#if defined(WIRING) // Wiring specific – official
    #include "Wiring.h"
#elif defined(MAPLE_IDE) // Maple specific – official
    #include "WProgram.h"
#elif defined(MPIDE) // chipKIT specific – embedXcode only
    #include "WProgram.h"
#elif defined(ENERGIA) // LaunchPad specific – embedXcode
only
    #include "Energia.h"
#elif defined(ARDUINO) && (ARDUINO >= 100) // Arduino 1.0
specific – official
    #include "Arduino.h"
#elif defined(ARDUINO) && (ARDUINO < 100) // Arduino 23
specific – official
    #include "WProgram.h"
#else // error
    #error Platform not defined
#endif
```

The second approach allows more compact and easier to read code, and doesn't require maintenance at code level when a new MCU appears.

```
#if defined(WIRING) // Wiring specific
    text = in.trim();
#elif defined(ARDUINO) && (ARDUINO>=100) // for Arduino 1.0
    text.trim();
#else
    text = text.trim();
#endif
```

Both approaches are valid from an embedXcode point of view.

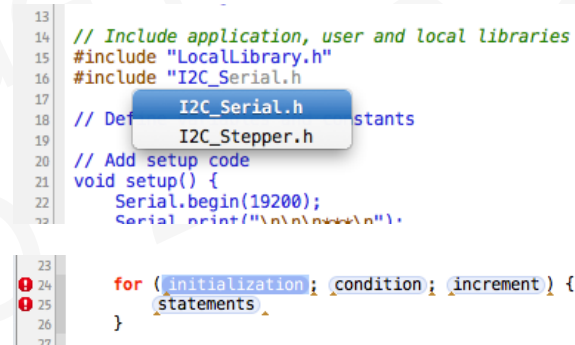
The first is not compatible with chipKIT MPIDE and Energia for LaunchPad IDEs.

4.5. *Re-Index the Keywords for Code-Sense*

Code-sense is a major feature of Xcode.

Apart from pretty colours on the code and enhanced visibility, code-sense brings:

- auto-completion,
- code-snippets and check-as-you-type code monitoring,



The screenshot shows two snippets of code in Xcode. The top snippet is a C++-style preprocessor block with conditional compilation for WIRING and ARDUINO. The bottom snippet shows a C++-style code block with a for loop. A tooltip is visible over the code, showing a list of suggestions: I2C_Serial.h, I2C_Stepper.h, and I2C_Stepper.h. The code is color-coded, and the for loop has a tooltip showing the structure: for (initialization; condition; increment) { statements }.

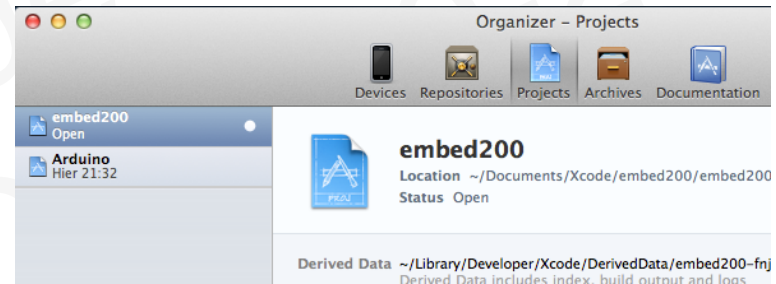
- click-to-definition



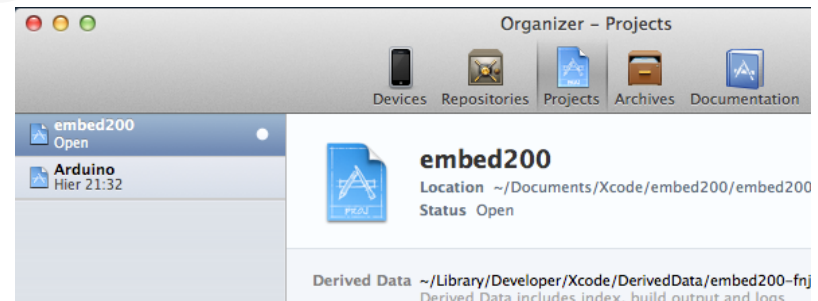
If code-sense doesn't work, we need to force a re-indexing of the key words.

To do so, first close the project.

Call the menu Window > Organiser and select the Projects pane.



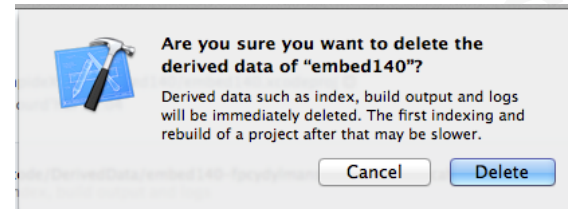
Select then the project.



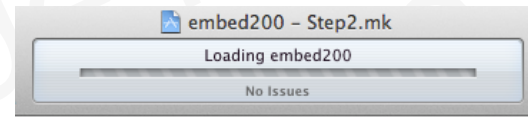
The index is saved within the Derived Data folder.
Click on the Delete button to delete them.



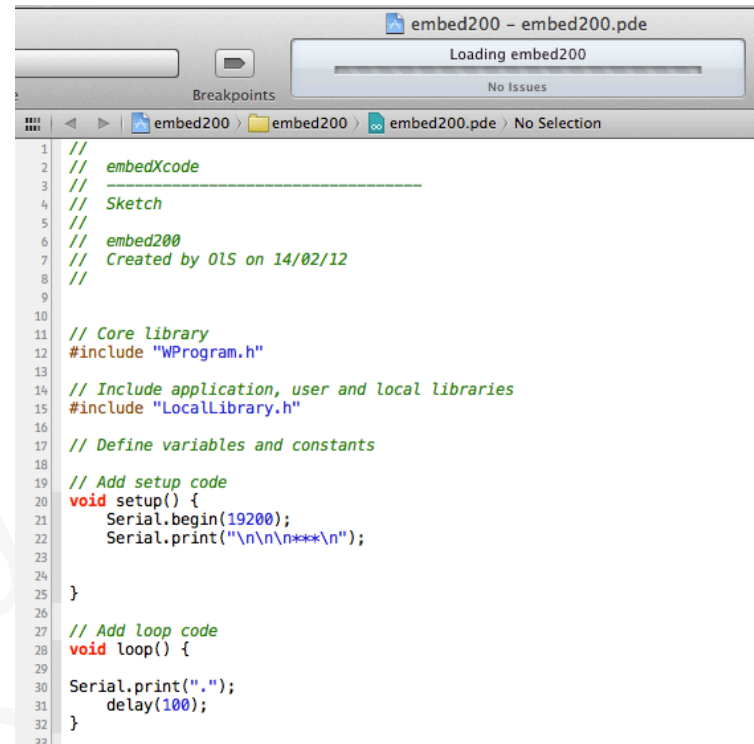
Confirm the deletion.



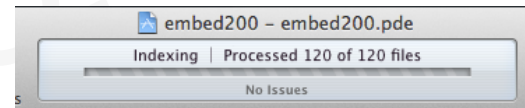
Load the project.



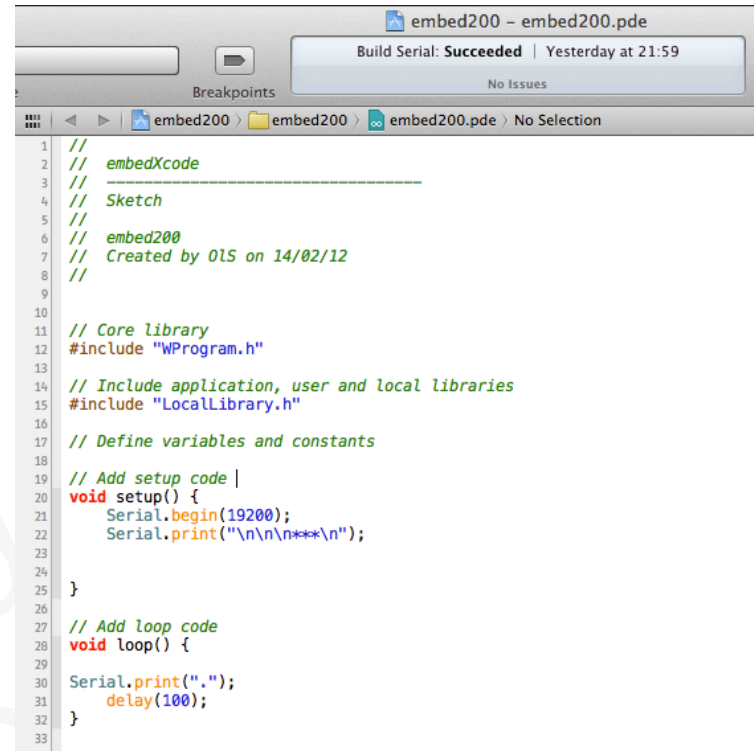
There's no code-sense yet: everything is in black-and-white, except standard C++ keywords.



The index is being built.



When the index is built, code-sense shows pretty colours.



The screenshot shows the Arduino IDE interface. At the top, a status bar indicates 'Build Serial: Succeeded' and 'Yesterday at 21:59'. Below this, a breadcrumb trail shows the file path: 'embed200 > embed200 > embed200.pde'. The main editor area displays a sketch with syntax highlighting. The code includes comments, preprocessor directives, and function definitions. The text 'embedXcode' and '© Rei VILO' are visible as a large, light gray watermark across the editor area.

```
1 //  
2 // embedXcode  
3 // -----  
4 // Sketch  
5 //  
6 // embed200  
7 // Created by OLS on 14/02/12  
8 //  
9  
10  
11 // Core library  
12 #include "WProgram.h"  
13  
14 // Include application, user and local libraries  
15 #include "LocalLibrary.h"  
16  
17 // Define variables and constants  
18  
19 // Add setup code |  
20 void setup() {  
21   Serial.begin(19200);  
22   Serial.print("\n\n\n***\n");  
23  
24 }  
25  
26 // Add loop code  
27 void loop() {  
28   Serial.print(".");  
29   delay(100);  
30 }  
31  
32  
33
```

5. Appendixes

5.1. What Has Been Tested

Platform	What Has Been Tested	What Has Not Been Tested	Reference Boards
Arduino	Sketch compilation and upload		Arduino Uno, Arduino mega2560 and Arduino mini pro
chipKIT	Sketch compilation and upload		chipKIT UNO32
Wiring	Sketch compilation and upload		Wiring S
LaunchPad	Sketch compilation and upload		LaunchPad with MSP430G2542, MSP430G2331 and MSP430G2553
Maple	Sketch compilation and upload		Maple revision 5

5.2. Known Issues

Most of the issues are related to unknown keywords for the Xcode 4.3 template.

Most critical issues are:

[#2 Populated Sources List for Code-Sense](#)

[#3 Declare PDE File as C++ Source](#)

[#12 Define Directory for a Target](#)

5.3. Contributions and References

See documents on the About folder for additional contributions and detailed references.

5.4. Version History

Date	mpideXcode	embedXcode	Installation Guide	Comment
Jan 22, 2012	a			Initial release
Feb 02, 2012	b			chipKIT operational
Feb 04, 2012	c			Code-sense operational
Feb 06, 2012	d			User libraries
Feb 06, 2012	e			Code checking while typing with Index as target
Feb 08, 2012	f			Code-sense, click-to-error with standard targets
Feb 14, 2012	g	1	1	Multi-application, check-as-you-type, template
Feb 18, 2012	6	2	2	Improvements
Feb 26, 2012		3		Modular makefiles
Mar 06, 2012	7	4	3	Arduino 1.0 implementation
Mar 12, 2012	8	5		Bugs fixed
Mar 15, 2012	9	6	4	All Arduino/chipKIT/Wiring/Energia and user libraries included by default
Apr 05, 2012	10	7	5	Wiring 1.0 and Energia 1.0 implementations
Apr 08, 2012	11	8	5	Bugs fixed
Apr 16, 2012	12	9	6	Code-sense reference defined by selected board
May 23, 2012	13	10	7	LeafLabs Maple implementation
Jun 03, 2012	14	11	8	MCU- or IDE-based platform identification for #include library

5.5. Referenced Boards

Not all boards have been tested. Please refer to [What Has Been Tested](#) for more details.

According to the Boards.txt files:

Arduino	chipKIT	Wiring	LaunchPad	Maple
Arduino Uno	chipKIT UNO32	Wiring S @ 16 MHz	LaunchPad with mps430g2452	LeafLabs Maple Rev 3+ to Flash
Arduino Duemilanove or Nano w/ ATmega328	chipKIT MAX32	Wiring S with Play Shield @ 16 MHz	LaunchPad with mps430g2231	LeafLabs Maple Rev 3+ to RAM
Arduino Diecimila, Duemilanove, or Nano w/ ATmega168	chipKIT MAX32-USB for Serial	Wiring V1.0/Wiring Mini V1.0 @ 16 MHz	LaunchPad with mps430g2553	LeafLabs Maple Mini Rev 2 to Flash
Arduino Mega 2560	Cerebot MX3cK	Wiring V1.1 ATmega1281 @ 16 MHz		LeafLabs Maple Mini Rev 2 to RAM
Arduino Mega (ATmega1280)	Cerebot MX4cK	Wiring V1.1 ATmega2561 @ 16 MHz		LeafLabs Maple RET6 Edition to Flash
Arduino Mini	Cerebot MX7cK			LeafLabs Maple RET6 Edition to RAM
Arduino Fio	Cerebot 32MX4			LeafLabs Maple Native (Beta) to Flash
Arduino BT w/ ATmega328	Cerebot 32MX7			LeafLabs Maple Native (Beta) to RAM
Arduino BT w/ ATmega168	Microchip PIC32 Starter kit			
LilyPad Arduino w/ ATmega328	Microchip PIC32 Ethernet Starter kit			
LilyPad Arduino w/ ATmega168	Microchip PIC32 USB Starter kit II			

Arduino	chipKIT	Wiring	LaunchPad	Maple
Arduino Pro or Pro Mini (5V, 16 MHz) w/ ATmega328	Microchip PIC32 Explorer 16			
Arduino Pro or Pro Mini (5V, 16 MHz) w/ ATmega168	MirkoElektronika PIC32 Multimedia Board			
Arduino Pro or Pro Mini (3.3V, 8 MHz) w/ ATmega328	MirkoElektronika PIC32 mikroMedia Board			
Arduino Pro or Pro Mini (3.3V, 8 MHz) w/ ATmega168	Pic32 UBW32-MX460			
Arduino NG or older w/ ATmega168	Pic32 UBW32-MX795			
Arduino NG or older w/ ATmega8	Pic32 CUI32-Development Stick			

6. Copyright and Licence

Attribution-NonCommercial-ShareAlike 3.0 Unported (CC BY-NC-SA 3.0)

This is a [human-readable summary](#) of the [Legal Code](#).

6.1. Summary

You are free:

- **to Share** — to copy, distribute and transmit the work
- **to Remix** — to adapt the work

Under the following conditions:

- **Attribution** — You must attribute the work in the manner specified by the author or licensor (but not in any way that suggests that they endorse you or your use of the work).
- **Noncommercial** — You may not use this work for commercial purposes.
- **Share Alike** — If you alter, transform, or build upon this work, you may distribute the resulting work only under the same or similar license to this one.

With the understanding that:

- **Waiver** — Any of the above conditions can be **waived** if you get permission from the copyright holder.
- **Public Domain** — Where the work or any of its elements is in the **public domain** under applicable law, that status is in no way affected by the license.
- **Other Rights** — In no way are any of the following rights affected by the license:
 - Your fair dealing or **fair use** rights, or other applicable copyright exceptions and limitations;
 - The author's **moral** rights;
 - Rights other persons may have either in the work itself or in how the work is used, such as **publicity** or privacy rights.

Notice — For any reuse or distribution, you must make clear to others the license terms of this work. The best way to do this is with a link to this web page.

Disclaimer — The Commons Deed is not a license. It is simply a handy reference for understanding the Legal Code (the full license) — it is a human-readable expression of some of its key terms. Think of it as the user-friendly interface to the Legal Code beneath. This Deed itself has no legal value, and its contents do not appear in the actual license.

Creative Commons is not a law firm and does not provide legal services. Distributing of, displaying of, or linking to this Commons Deed does not create an attorney-client relationship.

6.2. Legal Code

CREATIVE COMMONS CORPORATION IS NOT A LAW FIRM AND DOES NOT PROVIDE LEGAL SERVICES. DISTRIBUTION OF THIS LICENSE DOES NOT CREATE AN ATTORNEY-CLIENT RELATIONSHIP. CREATIVE COMMONS PROVIDES THIS INFORMATION ON AN "AS-IS" BASIS. CREATIVE COMMONS MAKES NO WARRANTIES REGARDING THE INFORMATION PROVIDED, AND DISCLAIMS LIABILITY FOR DAMAGES RESULTING FROM ITS USE.

License

THE WORK (AS DEFINED BELOW) IS PROVIDED UNDER THE TERMS OF THIS CREATIVE COMMONS PUBLIC LICENSE ("CCPL" OR "LICENSE"). THE WORK IS PROTECTED BY COPYRIGHT AND/OR OTHER APPLICABLE LAW. ANY USE OF THE WORK OTHER THAN AS AUTHORIZED UNDER THIS LICENSE OR COPYRIGHT LAW IS PROHIBITED.

BY EXERCISING ANY RIGHTS TO THE WORK PROVIDED HERE, YOU ACCEPT AND AGREE TO BE BOUND BY THE TERMS OF THIS LICENSE. TO THE EXTENT THIS LICENSE MAY BE CONSIDERED TO BE A CONTRACT, THE LICENSOR GRANTS YOU THE RIGHTS CONTAINED HERE IN CONSIDERATION OF YOUR ACCEPTANCE OF SUCH TERMS AND CONDITIONS.

1. Definitions

- a. **"Adaptation"** means a work based upon the Work, or upon the Work and other pre-existing works, such as a translation, adaptation, derivative work, arrangement of music or other alterations of a literary or artistic work, or phonogram or performance and includes cinematographic adaptations or any other form in which the Work may be recast, transformed, or adapted including in any form recognizably derived from the original, except that a work that constitutes a Collection will not be considered an Adaptation for the purpose of this License. For the avoidance of doubt, where the Work is a musical work, performance or phonogram, the synchronization of the Work in timed-relation with a moving image ("synching") will be considered an Adaptation for the purpose of this License.
- b. **"Collection"** means a collection of literary or artistic works, such as encyclopedias and anthologies, or performances, phonograms or broadcasts, or other works or subject matter other than works listed in Section 1(g) below, which, by reason of the selection and arrangement of their contents, constitute intellectual creations, in which the Work is included in its entirety in unmodified form along with one or more other contributions, each constituting separate and independent works in themselves, which together are assembled into a collective whole. A work that constitutes a Collection will not be considered an Adaptation (as defined above) for the purposes of this License.
- c. **"Distribute"** means to make available to the public the original and copies of the Work or Adaptation, as appropriate, through sale or other transfer of ownership.
- d. **"License Elements"** means the following high-level license attributes as selected by Licensor and indicated in the title of this License: Attribution, Noncommercial, ShareAlike.
- e. **"Licensor"** means the individual, individuals, entity or entities that offer(s) the Work under the terms of this License.
- f. **"Original Author"** means, in the case of a literary or artistic work, the individual, individuals, entity or entities who created the Work or if no individual or entity can be identified, the publisher; and in addition (i) in the case of a performance the actors, singers, musicians, dancers, and other persons who act, sing, deliver, declaim, play in, interpret or otherwise perform literary or artistic works or expressions of folklore; (ii) in the case of a phonogram the producer being the person or legal entity who first fixes the sounds of a performance or other sounds; and, (iii) in the case of broadcasts, the organization that transmits the broadcast.
- g. **"Work"** means the literary and/or artistic work offered under the terms of this License including without limitation any production in the literary, scientific and artistic domain, whatever may be the mode or form of its expression including digital form, such as a book, pamphlet and other writing; a lecture, address, sermon or other work of the same nature; a dramatic or dramatico-musical work; a choreographic work or entertainment in dumb show; a musical composition with or without words; a cinematographic work to which are assimilated works

expressed by a process analogous to cinematography; a work of drawing, painting, architecture, sculpture, engraving or lithography; a photographic work to which are assimilated works expressed by a process analogous to photography; a work of applied art; an illustration, map, plan, sketch or three-dimensional work relative to geography, topography, architecture or science; a performance; a broadcast; a phonogram; a compilation of data to the extent it is protected as a copyrightable work; or a work performed by a variety or circus performer to the extent it is not otherwise considered a literary or artistic work.

- h. **"You"** means an individual or entity exercising rights under this License who has not previously violated the terms of this License with respect to the Work, or who has received express permission from the Licensor to exercise rights under this License despite a previous violation.
- i. **"Publicly Perform"** means to perform public recitations of the Work and to communicate to the public those public recitations, by any means or process, including by wire or wireless means or public digital performances; to make available to the public Works in such a way that members of the public may access these Works from a place and at a place individually chosen by them; to perform the Work to the public by any means or process and the communication to the public of the performances of the Work, including by public digital performance; to broadcast and rebroadcast the Work by any means including signs, sounds or images.
- j. **"Reproduce"** means to make copies of the Work by any means including without limitation by sound or visual recordings and the right of fixation and reproducing fixations of the Work, including storage of a protected performance or phonogram in digital form or other electronic medium.

2. Fair Dealing Rights. Nothing in this License is intended to reduce, limit, or restrict any uses free from copyright or rights arising from limitations or exceptions that are provided for in connection with the copyright protection under copyright law or other applicable laws.

3. License Grant. Subject to the terms and conditions of this License, Licensor hereby grants You a worldwide, royalty-free, non-exclusive,

perpetual (for the duration of the applicable copyright) license to exercise the rights in the Work as stated below:

- a. to Reproduce the Work, to incorporate the Work into one or more Collections, and to Reproduce the Work as incorporated in the Collections;
- b. to create and Reproduce Adaptations provided that any such Adaptation, including any translation in any medium, takes reasonable steps to clearly label, demarcate or otherwise identify that changes were made to the original Work. For example, a translation could be marked "The original work was translated from English to Spanish," or a modification could indicate "The original work has been modified.";
- c. to Distribute and Publicly Perform the Work including as incorporated in Collections; and,
- d. to Distribute and Publicly Perform Adaptations.

The above rights may be exercised in all media and formats whether now known or hereafter devised. The above rights include the right to make such modifications as are technically necessary to exercise the rights in other media and formats. Subject to Section 8(f), all rights not expressly granted by Licensor are hereby reserved, including but not limited to the rights described in Section 4(e).

4. Restrictions. The license granted in Section 3 above is expressly made subject to and limited by the following restrictions:

- a. You may Distribute or Publicly Perform the Work only under the terms of this License. You must include a copy of, or the Uniform Resource Identifier (URI) for, this License with every copy of the Work You Distribute or Publicly Perform. You may not offer or impose any terms on the Work that restrict the terms of this License or the ability of the recipient of the Work to exercise the rights granted to that recipient under the terms of the License. You may not sublicense the Work. You must keep intact all notices that refer to this License and to the disclaimer of warranties with every copy of the Work You Distribute or Publicly Perform. When You Distribute or Publicly Perform the Work, You may not impose any effective technological measures on the Work that restrict the ability of a recipient of the Work from You to exercise the rights granted to that recipient under the terms of the License. This

Section 4(a) applies to the Work as incorporated in a Collection, but this does not require the Collection apart from the Work itself to be made subject to the terms of this License. If You create a Collection, upon notice from any Licensor You must, to the extent practicable, remove from the Collection any credit as required by Section 4(d), as requested. If You create an Adaptation, upon notice from any Licensor You must, to the extent practicable, remove from the Adaptation any credit as required by Section 4(d), as requested.

- b. You may Distribute or Publicly Perform an Adaptation only under: (i) the terms of this License; (ii) a later version of this License with the same License Elements as this License; (iii) a Creative Commons jurisdiction license (either this or a later license version) that contains the same License Elements as this License (e.g., Attribution-NonCommercial-ShareAlike 3.0 US) ("Applicable License"). You must include a copy of, or the URI, for Applicable License with every copy of each Adaptation You Distribute or Publicly Perform. You may not offer or impose any terms on the Adaptation that restrict the terms of the Applicable License or the ability of the recipient of the Adaptation to exercise the rights granted to that recipient under the terms of the Applicable License. You must keep intact all notices that refer to the Applicable License and to the disclaimer of warranties with every copy of the Work as included in the Adaptation You Distribute or Publicly Perform. When You Distribute or Publicly Perform the Adaptation, You may not impose any effective technological measures on the Adaptation that restrict the ability of a recipient of the Adaptation from You to exercise the rights granted to that recipient under the terms of the Applicable License. This Section 4(b) applies to the Adaptation as incorporated in a Collection, but this does not require the Collection apart from the Adaptation itself to be made subject to the terms of the Applicable License.
- c. You may not exercise any of the rights granted to You in Section 3 above in any manner that is primarily intended for or directed toward commercial advantage or private monetary compensation. The exchange of the Work for other copyrighted works by means of digital file-sharing or otherwise shall not be considered to be intended for or directed toward commercial advantage or private monetary compensation, provided there is no payment of any monetary compensation in connection with the exchange of copyrighted works.
- d. If You Distribute, or Publicly Perform the Work or any Adaptations or Collections, You must, unless a request has been made pursuant to Section 4(a), keep intact all copyright notices for the Work and provide, reasonable to the medium or means You are utilizing: (i) the name of the Original Author (or pseudonym, if applicable) if supplied, and/or if the Original Author and/or Licensor designate another party or parties (e.g., a sponsor institute, publishing entity, journal) for attribution ("Attribution Parties") in Licensor's copyright notice, terms of service or by other reasonable means, the name of such party or parties; (ii) the title of the Work if supplied; (iii) to the extent reasonably practicable, the URI, if any, that Licensor specifies to be associated with the Work, unless such URI does not refer to the copyright notice or licensing information for the Work; and, (iv) consistent with Section 3(b), in the case of an Adaptation, a credit identifying the use of the Work in the Adaptation (e.g., "French translation of the Work by Original Author," or "Screenplay based on original Work by Original Author"). The credit required by this Section 4(d) may be implemented in any reasonable manner; provided, however, that in the case of a Adaptation or Collection, at a minimum such credit will appear, if a credit for all contributing authors of the Adaptation or Collection appears, then as part of these credits and in a manner at least as prominent as the credits for the other contributing authors. For the avoidance of doubt, You may only use the credit required by this Section for the purpose of attribution in the manner set out above and, by exercising Your rights under this License, You may not implicitly or explicitly assert or imply any connection with, sponsorship or endorsement by the Original Author, Licensor and/or Attribution Parties, as appropriate, of You or Your use of the Work, without the separate, express prior written permission of the Original Author, Licensor and/or Attribution Parties.
- e. For the avoidance of doubt:
 - i. **Non-waivable Compulsory License Schemes.** In those jurisdictions in which the right to collect royalties through any statutory or compulsory licensing scheme cannot be waived, the Licensor reserves the exclusive right to collect such royalties for any exercise by You of the rights granted under this License;
 - ii. **Waivable Compulsory License Schemes.** In those jurisdictions in which the right to collect royalties through any statutory or

compulsory licensing scheme can be waived, the Licensor reserves the exclusive right to collect such royalties for any exercise by You of the rights granted under this License if Your exercise of such rights is for a purpose or use which is otherwise than noncommercial as permitted under Section 4(c) and otherwise waives the right to collect royalties through any statutory or compulsory licensing scheme; and,

iii. **Voluntary License Schemes.** The Licensor reserves the right to collect royalties, whether individually or, in the event that the Licensor is a member of a collecting society that administers voluntary licensing schemes, via that society, from any exercise by You of the rights granted under this License that is for a purpose or use which is otherwise than noncommercial as permitted under Section 4(c).

f. Except as otherwise agreed in writing by the Licensor or as may be otherwise permitted by applicable law, if You Reproduce, Distribute or Publicly Perform the Work either by itself or as part of any Adaptations or Collections, You must not distort, mutilate, modify or take other derogatory action in relation to the Work which would be prejudicial to the Original Author's honor or reputation. Licensor agrees that in those jurisdictions (e.g. Japan), in which any exercise of the right granted in Section 3(b) of this License (the right to make Adaptations) would be deemed to be a distortion, mutilation, modification or other derogatory action prejudicial to the Original Author's honor and reputation, the Licensor will waive or not assert, as appropriate, this Section, to the fullest extent permitted by the applicable national law, to enable You to reasonably exercise Your right under Section 3(b) of this License (right to make Adaptations) but not otherwise.

5. Representations, Warranties and Disclaimer

UNLESS OTHERWISE MUTUALLY AGREED TO BY THE PARTIES IN WRITING AND TO THE FULLEST EXTENT PERMITTED BY APPLICABLE LAW, LICENSOR OFFERS THE WORK AS-IS AND MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND CONCERNING THE WORK, EXPRESS, IMPLIED, STATUTORY OR OTHERWISE, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF TITLE, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, NONINFRINGEMENT, OR THE

ABSENCE OF LATENT OR OTHER DEFECTS, ACCURACY, OR THE PRESENCE OF ABSENCE OF ERRORS, WHETHER OR NOT DISCOVERABLE. SOME JURISDICTIONS DO NOT ALLOW THE EXCLUSION OF IMPLIED WARRANTIES, SO THIS EXCLUSION MAY NOT APPLY TO YOU.

6. Limitation on Liability.

EXCEPT TO THE EXTENT REQUIRED BY APPLICABLE LAW, IN NO EVENT WILL LICENSOR BE LIABLE TO YOU ON ANY LEGAL THEORY FOR ANY SPECIAL, INCIDENTAL, CONSEQUENTIAL, PUNITIVE OR EXEMPLARY DAMAGES ARISING OUT OF THIS LICENSE OR THE USE OF THE WORK, EVEN IF LICENSOR HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

7. Termination

- a. This License and the rights granted hereunder will terminate automatically upon any breach by You of the terms of this License. Individuals or entities who have received Adaptations or Collections from You under this License, however, will not have their licenses terminated provided such individuals or entities remain in full compliance with those licenses. Sections 1, 2, 5, 6, 7, and 8 will survive any termination of this License.
- b. Subject to the above terms and conditions, the license granted here is perpetual (for the duration of the applicable copyright in the Work). Notwithstanding the above, Licensor reserves the right to release the Work under different license terms or to stop distributing the Work at any time; provided, however that any such election will not serve to withdraw this License (or any other license that has been, or is required to be, granted under the terms of this License), and this License will continue in full force and effect unless terminated as stated above.

8. Miscellaneous

- a. Each time You Distribute or Publicly Perform the Work or a Collection, the Licensor offers to the recipient a license to the Work on the same terms and conditions as the license granted to You under this License.

- b. Each time You Distribute or Publicly Perform an Adaptation, Licensor offers to the recipient a license to the original Work on the same terms and conditions as the license granted to You under this License.
- c. If any provision of this License is invalid or unenforceable under applicable law, it shall not affect the validity or enforceability of the remainder of the terms of this License, and without further action by the parties to this agreement, such provision shall be reformed to the minimum extent necessary to make such provision valid and enforceable.
- d. No term or provision of this License shall be deemed waived and no breach consented to unless such waiver or consent shall be in writing and signed by the party to be charged with such waiver or consent.
- e. This License constitutes the entire agreement between the parties with respect to the Work licensed here. There are no understandings, agreements or representations with respect to the Work not specified here. Licensor shall not be bound by any additional provisions that may appear in any communication from You. This License may not be modified without the mutual written agreement of the Licensor and You.
- f. The rights granted under, and the subject matter referenced, in this License were drafted utilizing the terminology of the Berne Convention for the Protection of Literary and Artistic Works (as amended on September 28, 1979), the Rome Convention of 1961, the WIPO Copyright Treaty of 1996, the WIPO Performances and Phonograms Treaty of 1996 and the Universal Copyright Convention (as revised on July 24, 1971). These rights and subject matter take effect in the relevant jurisdiction in which the License terms are sought to be enforced according to the corresponding provisions of the implementation of those treaty provisions in the applicable national law. If the standard suite of rights granted under applicable copyright law includes additional rights not granted under this License, such additional rights are deemed to be included in the License; this License is not intended to restrict the license of any rights under applicable law.

Creative Commons Notice

Creative Commons is not a party to this License, and makes no warranty whatsoever in connection with the Work. Creative Commons will not be liable to You or any party on any legal theory for any damages whatsoever, including without limitation any general, special, incidental or consequential damages arising in connection to this license. Notwithstanding the foregoing two (2) sentences, if Creative Commons has expressly identified itself as the Licensor hereunder, it shall have all rights and obligations of Licensor.

Except for the limited purpose of indicating to the public that the Work is licensed under the CCPL, Creative Commons does not authorize the use by either party of the trademark "Creative Commons" or any related trademark or logo of Creative Commons without the prior written consent of Creative Commons. Any permitted use will be in compliance with Creative Commons' then-current trademark usage guidelines, as may be published on its website or otherwise made available upon request from time to time. For the avoidance of doubt, this trademark restriction does not form part of this License.

Creative Commons may be contacted at <http://creativecommons.org/>.