



embedXcode

Embedded Computing on Xcode

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



Improve the template on [GitHub](#).

After having played with [embedded computing](#) platforms for a while, I was looking for one single IDE and a better one.

Code-sense, colour syntaxing, check-as-you-type, click-to-error, self-documentation and tool-tip texts are some niceties **Xcode** brings.

The **embedXcode** project allows to use [Xcode](#) to develop for [Arduino](#), [chipKIT](#), [LaunchPad MSP430](#), [Wiring](#) and [LeafLabs Maple](#) platforms.

Because **embedXcode** relies on a modular design and on the boards IDEs for easier installation, virtually any board with a [Processing](#)-based [Wiring](#)-derived IDE can be implemented.

As I'm not a professional developer, please contribute and help me buy books, and feel free to improve the template. Thanks!

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1. Install the Template

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

1.1. Install Xcode



Install Xcode from the DVD or download it from the Mac App Store.



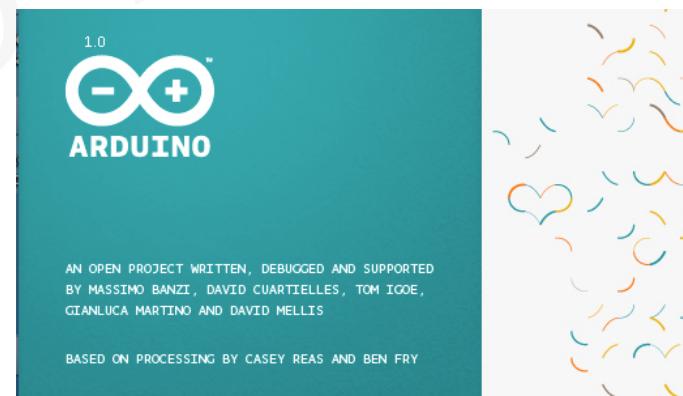
1.2. Install the IDEs for the Boards



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 Mpide 0023.
- Launch it.
- Define the path of the sketchbook in the menu Mpide > Preferences > Sketchbook location.



0023-macosx-20111222
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



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**.

Version 1.0 Build 100

Wiring

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 Lammers, Christoph Wartmann, Etienne Ribeiro, Nicholas Zambetti, Thomas Ouellet Fredericks, Mikal Hart, Pascal Stang, Brian Dean, Carlos Mario Rodríguez, James Partailk, 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

The two following files require to be deleted.



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**.

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

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



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.



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

For other boards with a Processing-based Wiring-derived IDE, the procedure is the same:

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



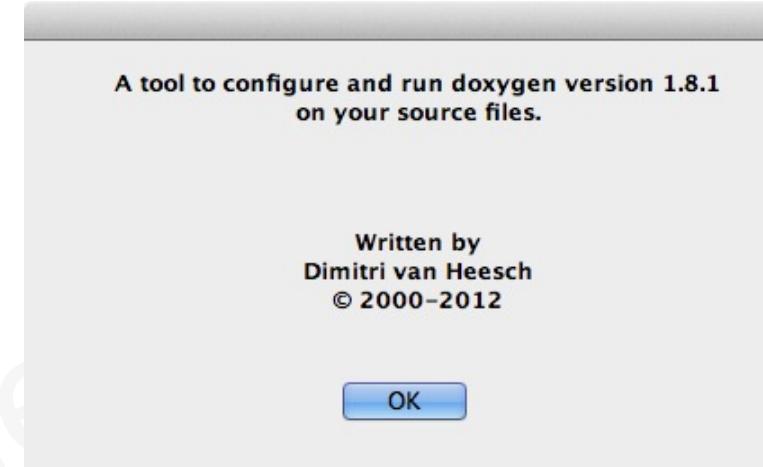
1.3. Install Optional Tools

If you want to use the self-documentation, please install also:



Install [Doxygen](#) to parse the code, looks for comments and generate the HTML pages

I strongly recommend to install DoxyWizard included in the package for an easy tweaking of the parameters.



To ease and speed up the writing of the comments, I use the Automator Service [Doxygen Helper](#) developed by Fred McCann / Duck Rowing.

By just selecting a function and pressing $\text{⌘} \text{D}$ cmd-shift-D, the helper generates a template for the comment lines.

Download and install it following the instructions provided on the [Doxygen helper page](#).

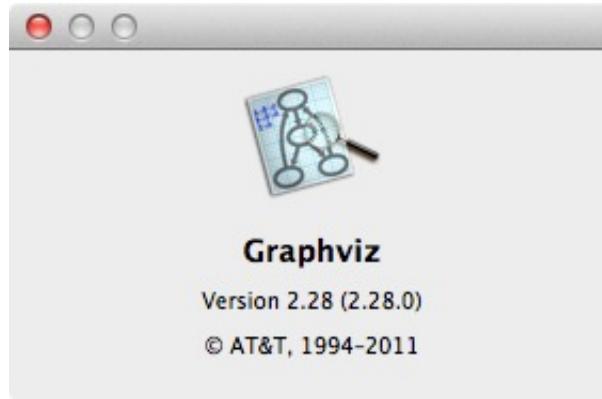
A screenshot of a text editor showing a code snippet with Doxygen comments. The code is as follows:

```
80
81 /**
82  * @brief Description
83  * @param a a description
84  * @param b b description
85  * @return return value description
86 /**
87 uint16_t function(uint16_t a, uint16_t b) {
88     return a + b;
89 }
```

The word 'Description' is highlighted in blue, along with 'a', 'b', and 'return value description'. The line numbers 80 through 89 are visible on the left.



Install [DataWiz](#) to add dependency trees



And optionally install [TeXShop](#) to build a PDF document from the files Doxygen has generated.

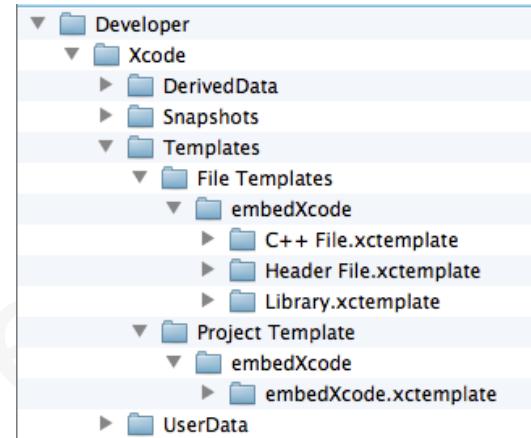


1.4. Install the Template

Now, the template can be installed:

Check and create ~ /Library/Developer/Xcode.

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

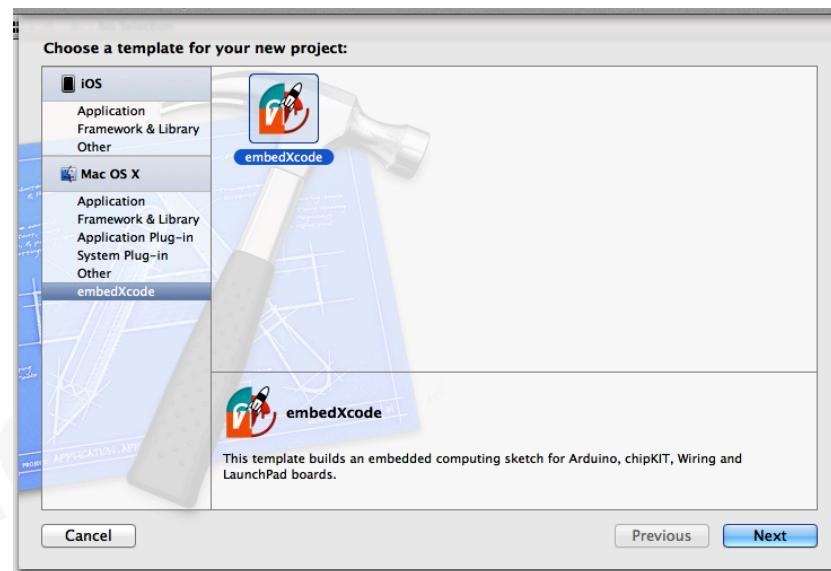


2. Create a New Project

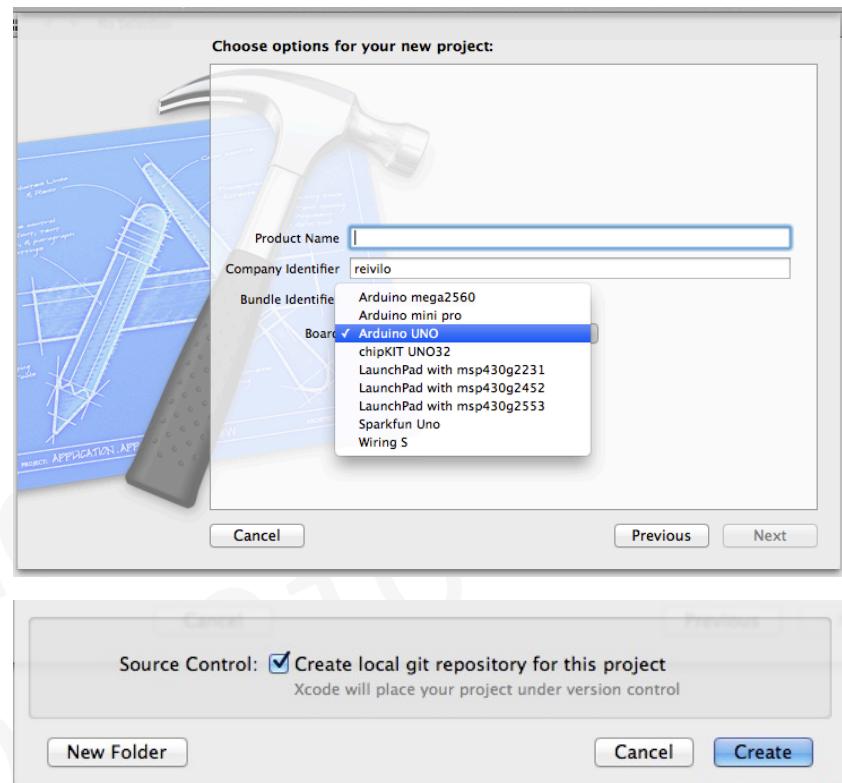
Call the menu File > New > New Project... or press ⌘N.

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.

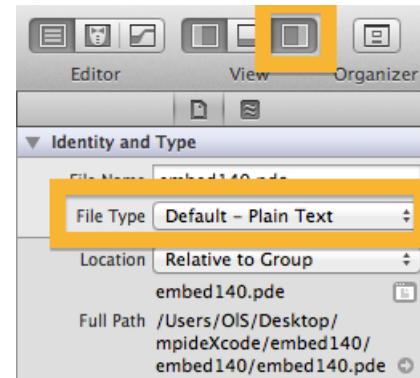
The goal is to have the following work done by the template, provided the right keywords are known.

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.

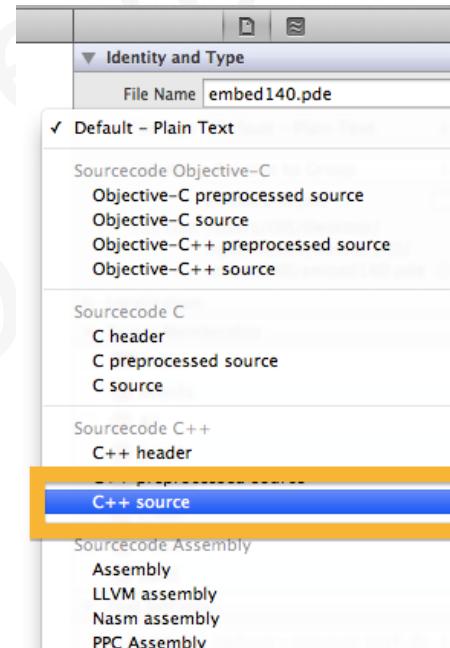
Select the sketch .pde file.

In the right-most column,

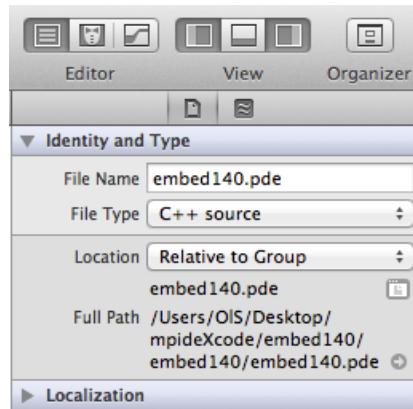


Click on the drop-down list of File Type.

Select C++ source.



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

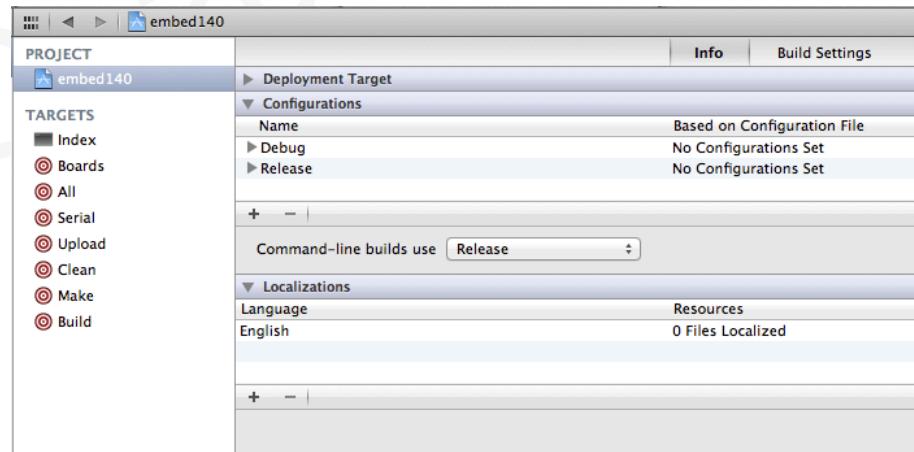


This manual procedure is considered as an issue and reported under [#3 Declare PDE File as C++ Source](#).

3.2. Declare User's Sketchbook

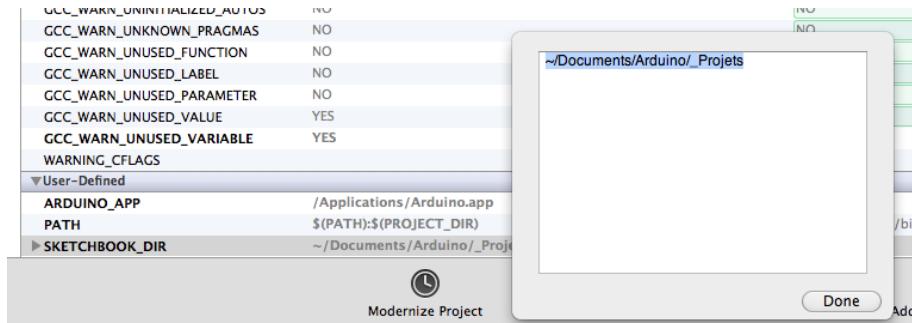
The user's sketchbook is a folder where the user's sketches are saved, among them the libraries in a dedicated sub-folder Libraries.

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.



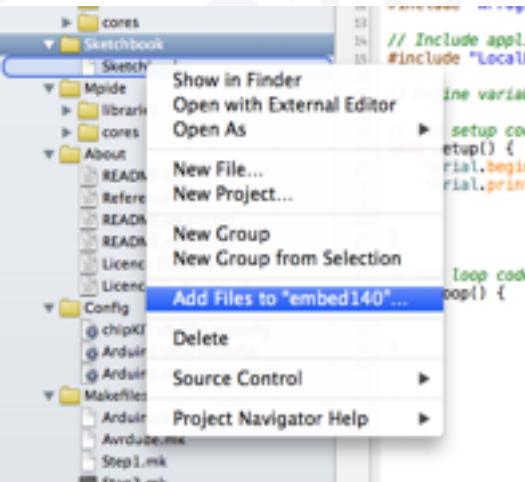
If no sketchbook is defined, SKETCHBOOK_DIR takes the value defined for Arduino or chipKIT during the installation process.

3.3. Add User's Libraries

Open the Sketchbook group on the project hierarchy.

Right-click to obtain the contextual menu.

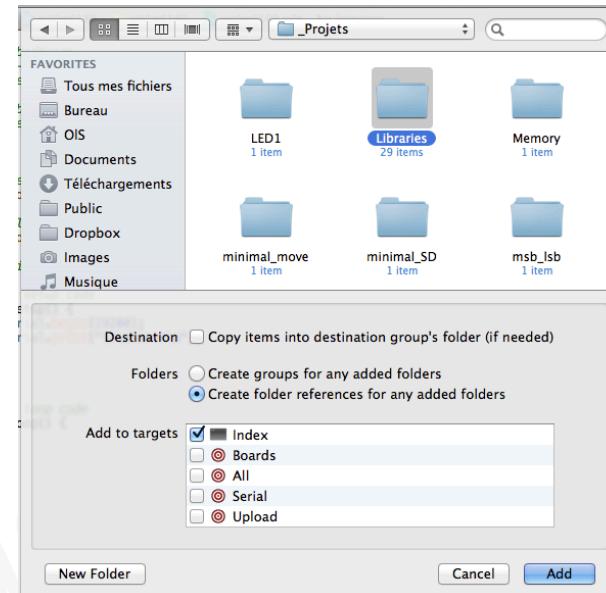
Choose Add file to...



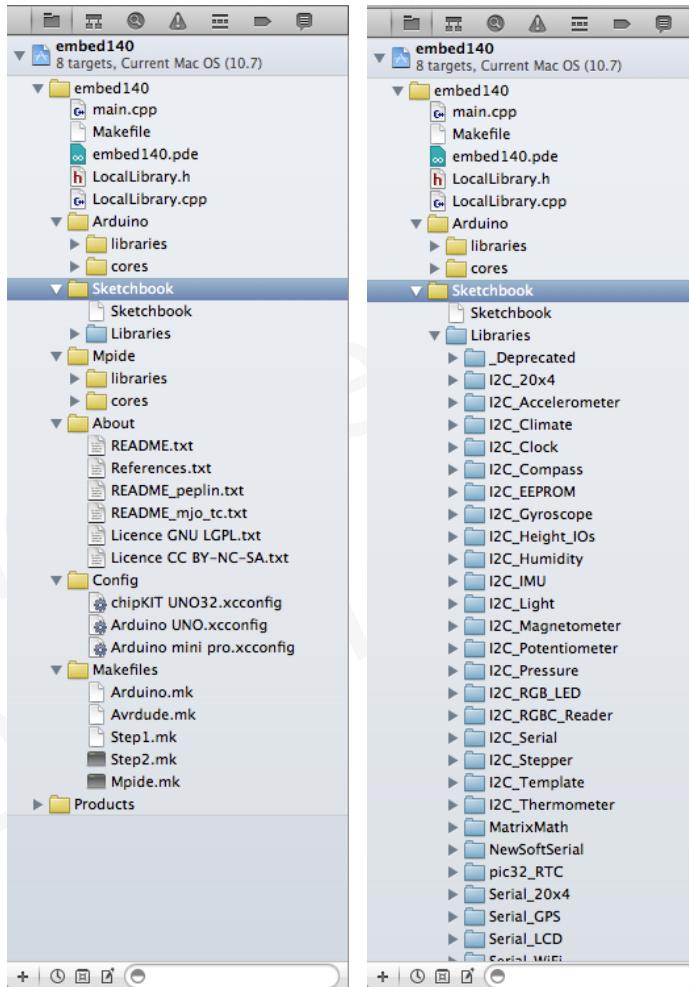
Select the Library sub-folder on the sketchbook folder, tick Add to target > Index and validate with Add.

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 (in needed) to avoid duplicating files.



The project hierarchy shows all your libraries.



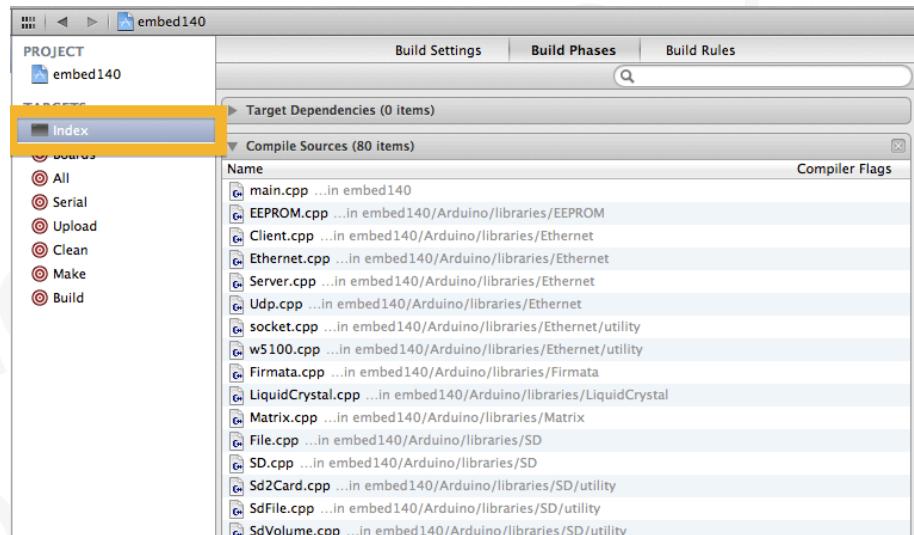
3.4. Declare Sources for Code-Sense

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

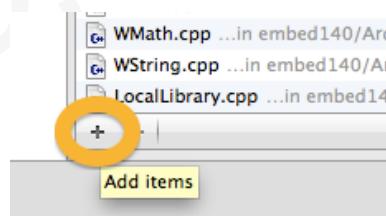
The selection of a board defines the headers for code-sense.

So Xcode needs to be taught where to find them.

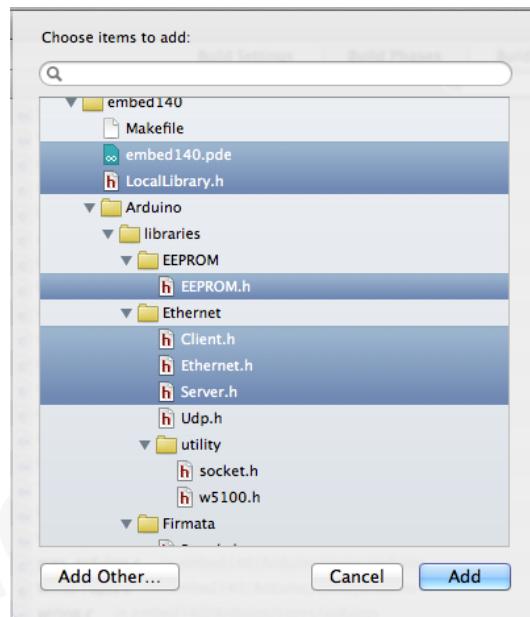
Select the target Index and the Build Phases pane.



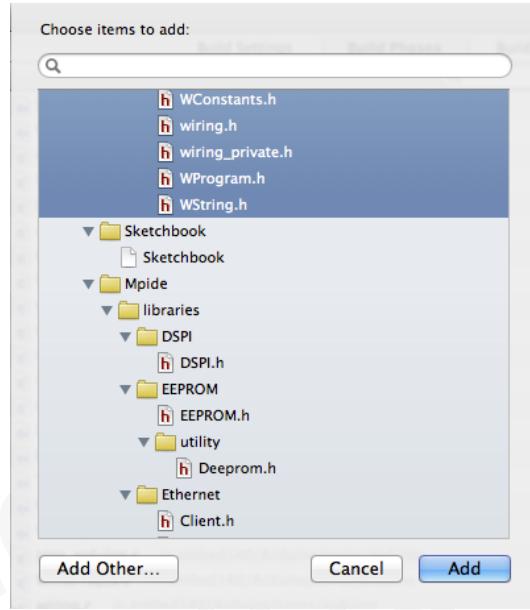
Go to the bottom of the list and click on the + button.



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

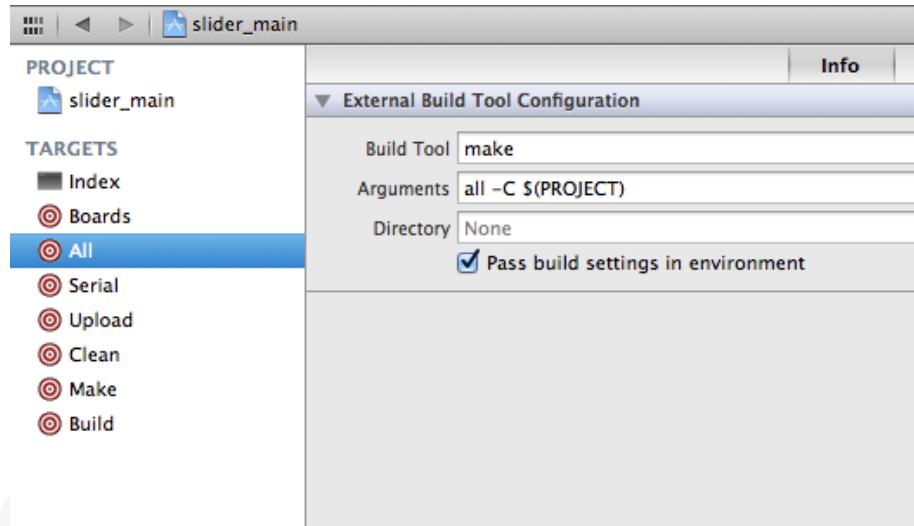
The template doesn't allow to specify the exact directory for the target. In case of an building error, the click-to-error feature may not work properly for the main sketch and the local libraries.

So Xcode needs to be taught where to find them.

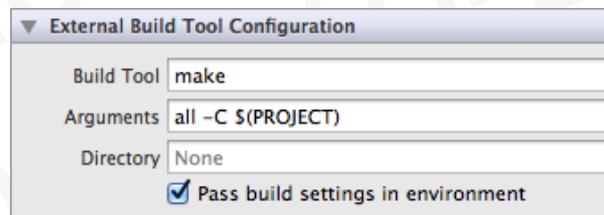
This is an optional procedure.

Select the target All.

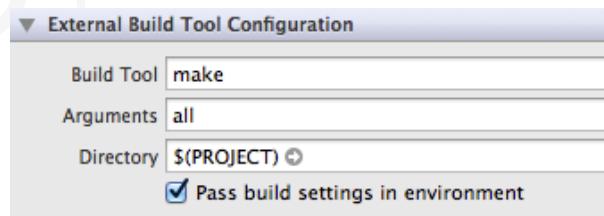
Feel free to update other targets you use often, as Build and Make.



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



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



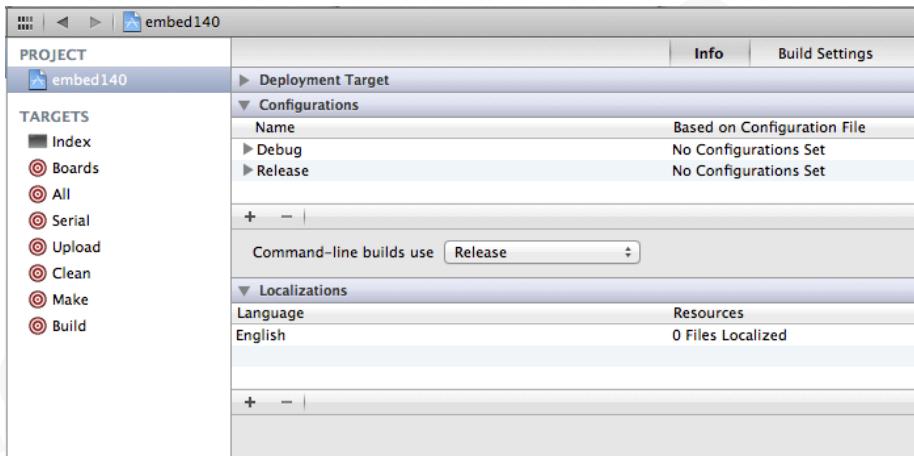
This manual procedure is considered as an issue and reported under [#12 Define Directory for a Target](#).

You're ready now!

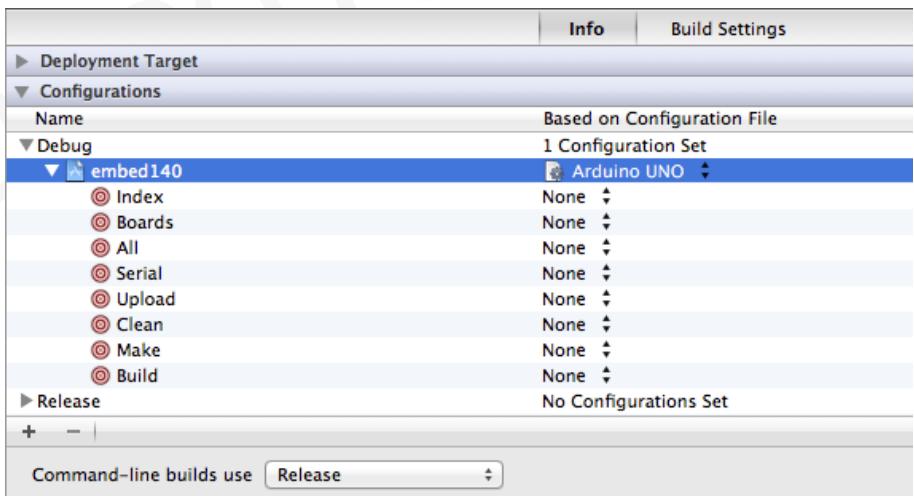
4. Use the Project

4.1. Change the Board

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

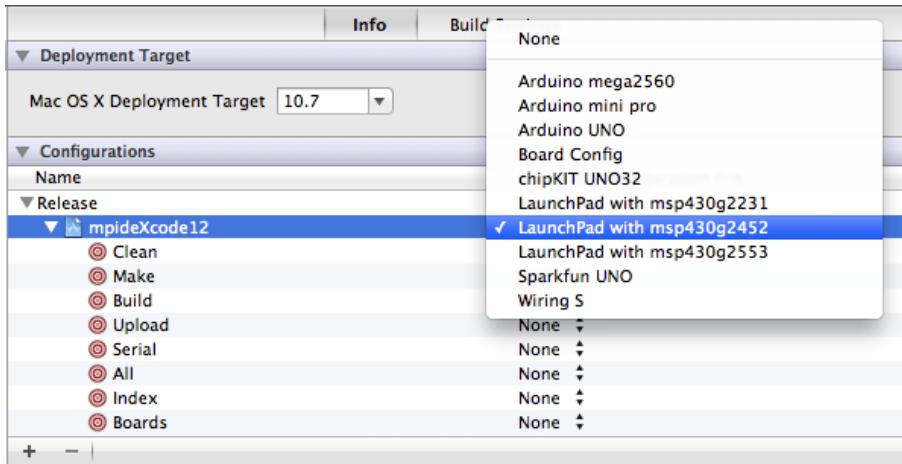


A drop-down list shows the boards available.



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](#).

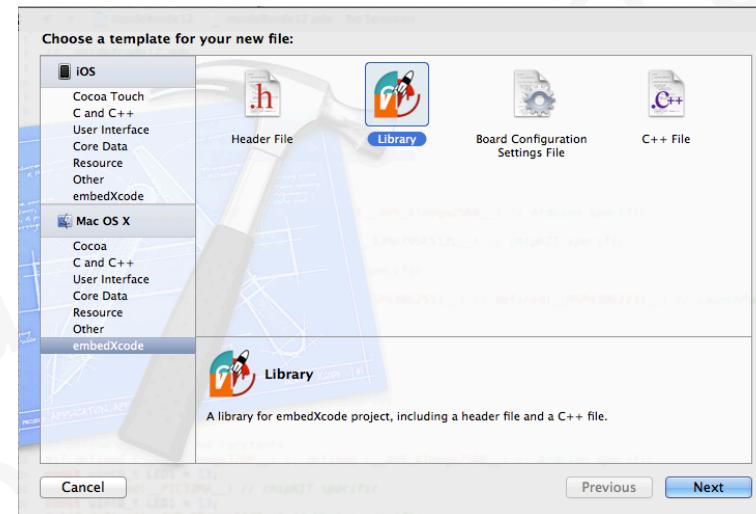
```
// Core library - MCU-based
#if defined(__AVR_ATmega32P__) || defined(__AVR_ATmega2560__) // Arduino specific
  #if defined(ARDUINO) && (ARDUINO >= 100)
    #include "arduino.h" // - for Arduino 1.0
  #else
    #include "WProgram.h" // - for Arduino 23
  #endif
#elif defined(__32MX320F128H__) ||
      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"` `#include` 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.



The screenshot shows the Xcode interface with the file 'Board Config.xcconfig' selected in the sidebar. The main pane displays the following configuration code:

```
1 // Board Config.xcconfig
2 // Board config file
3 //
4 // Developed with embedXcode
5 //
6 // Project mpideXcode12
7 // Created by Rei VILO on 17/04/12
8 // Copyright (c) 2012 http://sites.google.com/site/vilorei
9 //
10 //
11 // Board identifier
12 // see Boards.txt for <tag>.name=Arduino Uno (16 MHz)
13 //
14 BOARD_TAG = uno
15
16 // Port (optional)
17 // most common are /dev/tty.usbserial* and /dev/tty.usbmodem*
18 BOARD_PORT = /dev/tty.usbserial*
19
20 // References for Xcode code-sense
21 // see Boards.txt for <tag>.build.mcu=<GCC_PREPROCESSOR_DEFINITIONS>
22 // specify ARDUINO_APP for Arduino, MPIDE_APP for Mpide, WIRING_APP for Wiring, ENERGIA_APP for Energia
23 //
24 GCC_PREPROCESSOR_DEFINITIONS = _AVR_ATmega328P_
25 HEADER_SEARCH_PATHS = $(ARDUINO_APP)/** $(SKETCHBOOK_DIR)/Libraries/**
```

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.

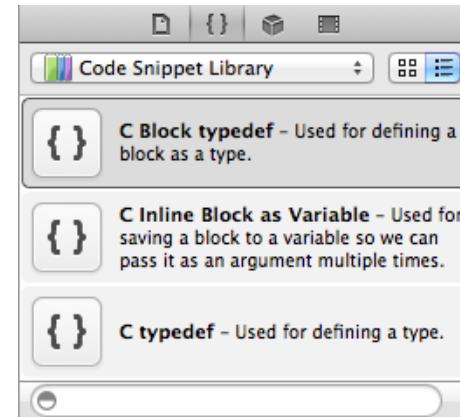
For more information, please refer to [Manage Code for Multiple Platforms](#).

```
// 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
```

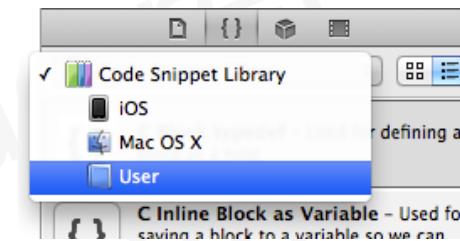
To display the code snippets, click on the right button of the View selector.



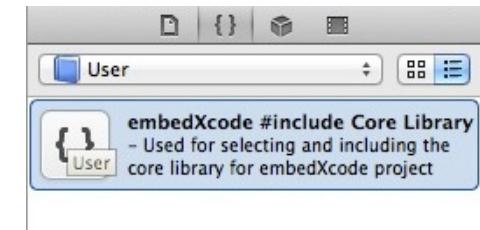
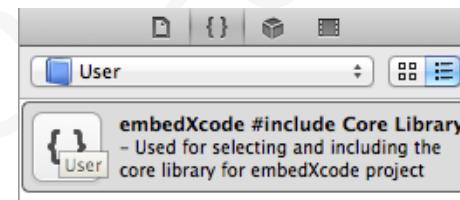
The library of code snippets is at the bottom of the right-most pane.



Select User on the drop-down list.



Select the embedXcode #include Core Library snippet.



Click and drop to the destination.

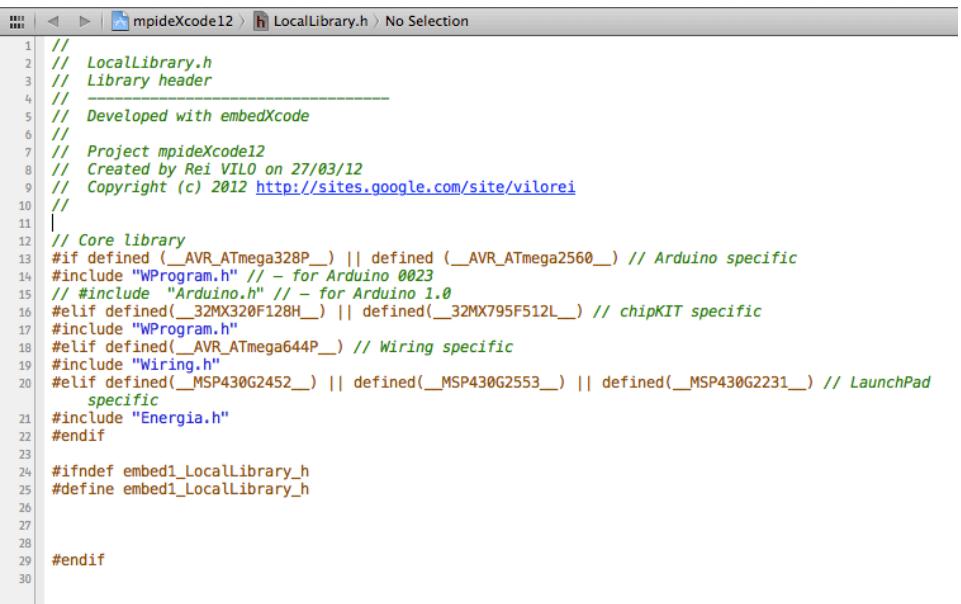


The pointer changes for

The cursor appears on the code.

```
1 // LocalLibrary.h
2 // Library header
3 //
4 // -----
5 // Developed with embedXcode
6 //
7 // Project mpideXcode12
8 // Created by Rei VILO on 27/03/12
9 // Copyright (c) 2012 http://sites.google.com/site/vilorei
10 //
11 |
12
13 #ifndef embed1_LocallLibrary_h
14 #define embed1_LocallLibrary_h
15
16
17
18
19
20 #endif
```

The code is inserted.



A screenshot of an Xcode editor window titled "LocalLibrary.h". The code is a header file for a local library, containing comments and #include directives for various microcontroller families. The code is color-coded for syntax highlighting.

```
1 // LocalLibrary.h
2 // Library header
3 //
4 // -----
5 // Developed with embedXcode
6 //
7 // Project mpideXcode12
8 // Created by Rei VILO on 27/03/12
9 // Copyright (c) 2012 http://sites.google.com/site/vilorei
10 //
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
21     specific
22     #include "Energia.h"
23 #endif
24
25 #ifndef embed1_LocalLibrary_h
26 #define embed1_LocalLibrary_h
27
28
29#endif
```

4.4. Select a target

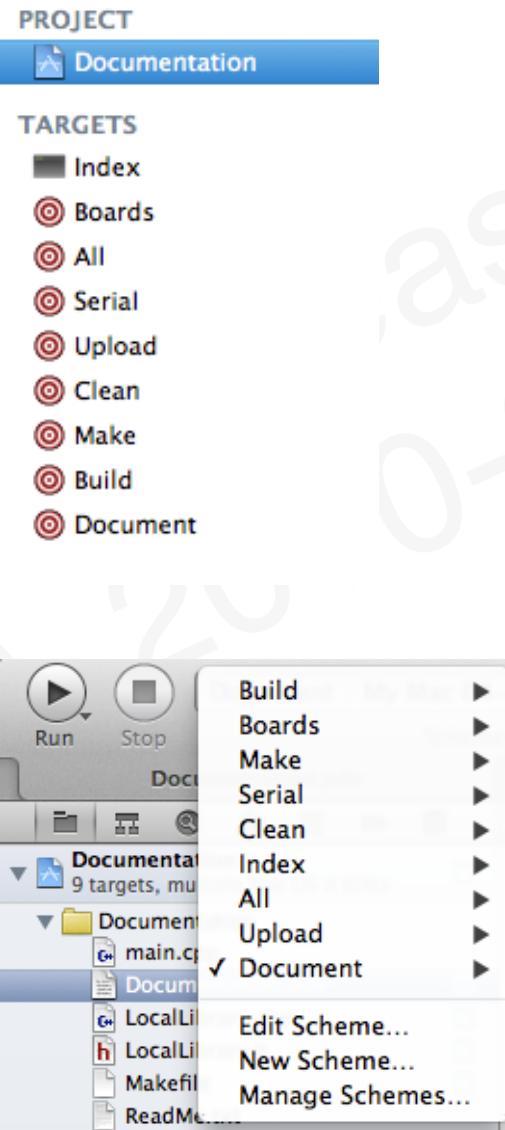
Nine targets are offered:

- Clean cleans the files from a previous compilation.
- Make compiles only the files changed since last compilation and links them.
- Build compiles all the files, changed and unchanged, and links them.
- Upload uploads the resulting HEX or BIN executable file to the board.
- Serial open the serial console in a Terminal window.
- All cleans the files from a previous compilation, compiles and links, uploads and open a serial window in Terminal.
- Boards lists all the boards with their tags and their names.
- Document builds the documentation.
- Index is a proxy target solely used for code-sense.

Just select the target you want from the drop-down list.

As a matter of fact, I mainly use Build and All for developing the code, and Document to write the documentation.

Other targets may be useful for specific needs.



4.5. 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__)
    #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__)
    #include "WProgram.h"
#elif defined(__AVR_ATmega644P__)
    #include "Wiring.h"
#elif defined(__MSP430G2452__) || defined(__MSP430G2553__)
    || defined(__MSP430G2231__)
    #include "Energia.h"
#else // error
    #error Platform not defined
#endif
```

The second approach is **IDE-based**. 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 all IDEs.

The Arduino, Wiring and Maple IDEs set one single environment variables: ARDUINO=23, ARDUINO=101, WIRING=100 and MAPLE_IDE.

The remaining two IDEs, MPIDE and Energia defines two environment variables, their own on top of the default one: MPIDE=23 and ARDUINO=23, ENERGIA=6 and ARDUINO=101.

So embedXcode tests ARDUINO after the specific variables.

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

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

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

4.6. 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,
- click-to-definition

The screenshot shows a portion of an Arduino sketch in Xcode. At the top, there's a code completion dropdown for the 'I2C_Serial.h' header file. Below it, a 'for' loop template is shown. Further down, another code completion dropdown appears for the 'WhoAmI()' method. A tooltip window is open over the 'WhoAmI()' call, displaying its name and declaration location: 'Name: WhoAmI' and 'Declared In: I2C_Serial.h'. The code itself includes standard setup and loop sections with serial communication and I2C initialization.

```
// Include application, user and local libraries
#include "LocalLibrary.h"
#include "I2C_Serial.h"

// Define variables and constants
I2C_Serial mySerial;

// Add setup code
void setup() {
    Serial.begin(19200);
    Serial.print("\n\n***\n");

    for (initialization; condition; increment) {
        statements
    }
}

// Define variables and constants
I2C_Serial mySerial;

// Add setup code
void setup() {
    Serial.begin(19200);
    Serial.print("\n\n***\n");

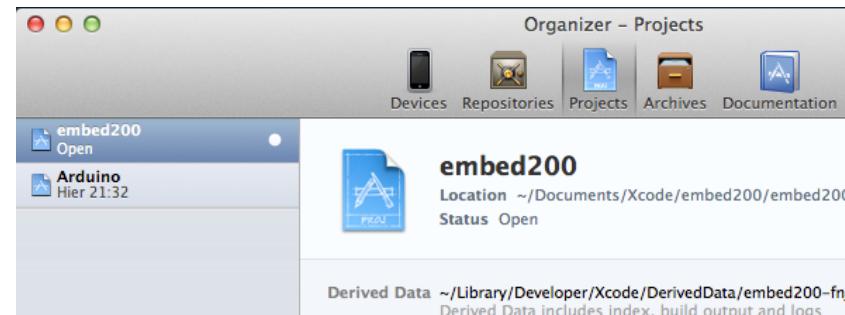
    mySerial.begin(9600);
    mySerial.print("\n\n***\n");
    mySerial.print(mySerial.WhoAmI());
}

// A void
void WhoAmI()
{
    Name: WhoAmI
    Declared In: I2C_Serial.h
}
```

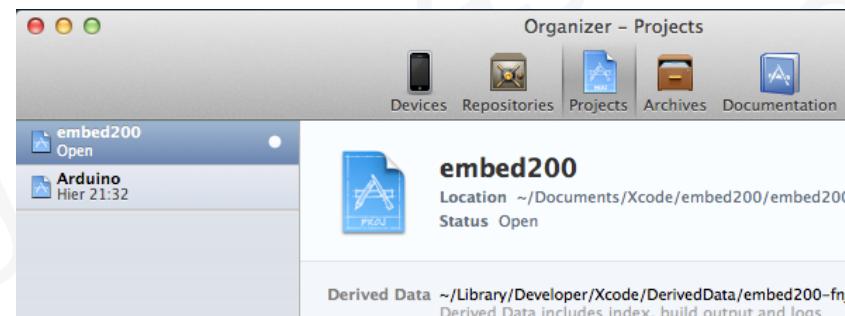
If code-sense doesn't work, we need to force a re-indexing of the key words.

To do so, first close the project.

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

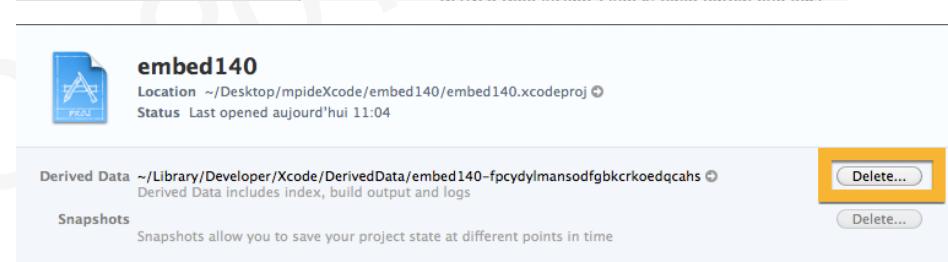


Select then the project.

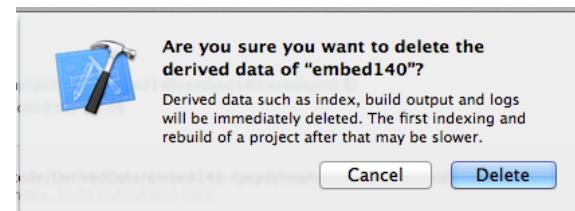


The index is saved within the Derived Data folder.

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 screenshot shows the embedXcode IDE interface. At the top, there are two progress bars: one for 'Loading embed200' and another for 'embed200 - embed200.pde'. Both show 'No Issues'. Below the progress bars is a toolbar with icons for file operations, a search bar, and a 'Breakpoints' button. The main area is a code editor titled 'embed200 - embed200.pde'. It displays a simple sketch with comments and standard C++ keywords like `#include`, `void`, and `Serial`. The code is as follows:

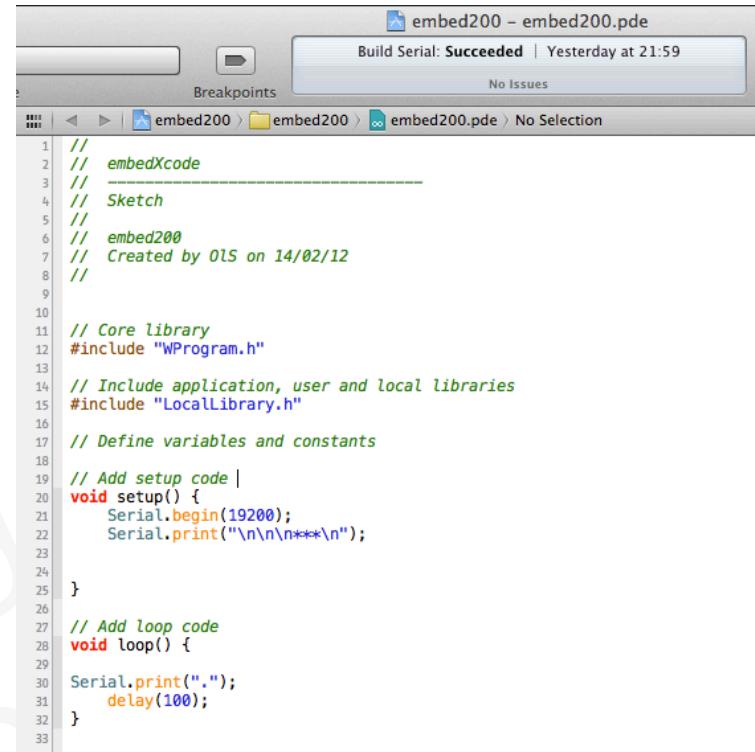
```
// embedXcode
// -----
// Sketch
// -----
// embed200
// Created by OLS on 14/02/12
//
// Core library
#include "WProgram.h"
// Include application, user and local libraries
#include "Locallibrary.h"
// Define variables and constants
// Add setup code
void setup() {
    Serial.begin(19200);
    Serial.print("\n\n\n***\n");
}

// Add loop code
void loop() {
    Serial.print(".");
    delay(100);
}
```

At the bottom of the interface, there is another progress bar for 'Indexing | Processed 120 of 120 files' with the message 'No Issues'.

The index is being built.

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



The screenshot shows the embedXcode IDE interface. At the top, there's a toolbar with icons for file operations like New, Open, Save, and Build. To the right of the toolbar, the status bar displays "embed200 - embed200.pde", "Build Serial: Succeeded | Yesterday at 21:59", and "No Issues". Below the toolbar is a navigation bar with icons for Breakpoints, Sketch, Local Library, and No Selection. The main area is a code editor with syntax highlighting. The code itself is a simple sketch:

```
// embedXcode
// -----
// Sketch
// embed200
// Created by OLS on 14/02/12
//
// Core library
#include "WProgram.h"
//
// Include application, user and local libraries
#include "LocalLibrary.h"
//
// Define variables and constants
//
// Add setup code |
void setup() {
    Serial.begin(19200);
    Serial.print("\n\n***\n");
}
//
// Add loop code
void loop() {
    Serial.print(".");
    delay(100);
}
```

5. Self-Document the Project

In order to obtain documentation,

- Add specific comments with defined keywords to the code,
- Build the documentation with the target **Document**,
- Use Quick Help to access the documentation.

5.1. Comment the Code

In order to obtain automatic documentation, just add specific comments and use defined keywords.

Comments for self-documentation start with `///` instead of the standard `//` and include keywords with a `@` prefix.

This means that standard comments starting with the standard `//` aren't included in the documentation.

Use the Doxygen Helper to speed up and ease the writing of comments for the functions.

Just select a function and press `⌘⇧D` cmd-shift-D, the helper generates a template for the comment lines.

Use the tab key to replace the light-blue fields with the comments.

In this example, the comment includes the `@brief` description of the function, list all the `@parameters` as well as the `@returned value`.

```
/// @file Documentation.pde
/// @brief Main sketch
80 uint16_t function(uint16_t a, uint16_t b) {
81     return a + b;
82 }
83
84
85
86
87
88
89
nn
```

/// @brief Description
/// @param a a description
/// @param b b description
/// @return return value description

```
/// @file Documentation.pde
/// @brief Main sketch
80 uint16_t function(uint16_t a, uint16_t b) {
81     return a + b;
82 }
83
84
85
86
87
88
89
nn
```

Here's the sub-lists of the keywords I use:

- For the main page with details about the author, copyright, references, ...

Note the @mainpage keyword.

- For a file with details about the author, copyright, references, ...

The templates include self-documenting headers.

- For a function with details for parameters.

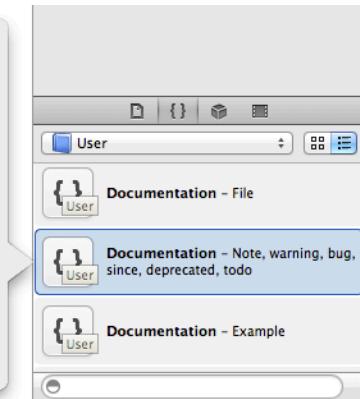
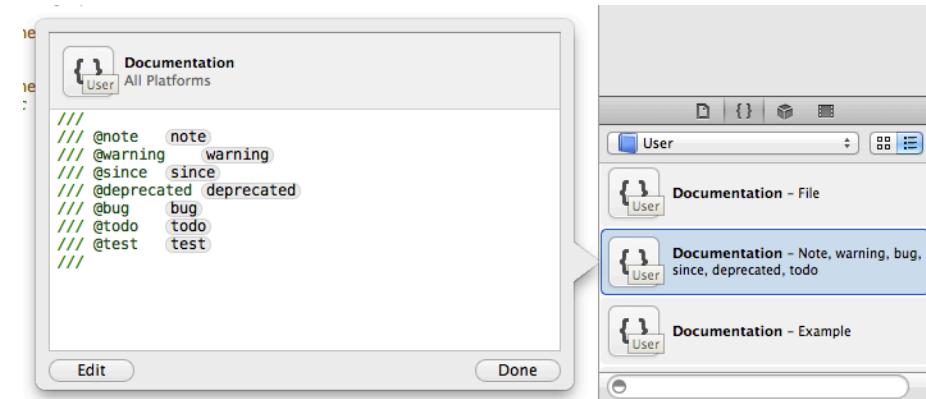
A result is documented with the keyword @result.

```
/// @mainpage Documentation
/// @details Test for doxygen integration
/// @n
/// @n
/// @n @a Developed with [embedXcode](http://embedXcode.weebly.com)
/// @author Rei VILO
/// @author http://embeddedcomputing.weebly.com
/// @date 09/06/12 14:02
/// @version 1
///
/// @copyright © Rei VILO, 2012
/// @copyright CC = BY NC SA
/// @n
/// @see ReadMe.txt for references
/// @n
/// @n

/// @file filename
/// @brief brief
/// @details details
/// @n
/// @n
/// @n @a Developed with [embedXcode](http://embedXcode.weebly.com)
/// @n
/// @author author
/// @author website
/// @date date time
/// @version version
/// @n
/// @copyright © author, year
/// @copyright CC = BY NC SA
/// @see ReadMe.txt for references
/// @n
/// @n

/// @brief Blink a LED
/// LED attached to pin is light on for ms and then light off for ms
/// @param pin pin to which the LED is attached
/// @param times number of times
/// @param ms duration in ms
/// void blink(uint8_t pin, uint8_t times, uint16_t ms);
```

The snippets for the documentation are under the User list.



- In the snippet for different details as note, warning, bug, to-do, test, ...

```
///  
/// @note      note  
/// @warning   warning  
/// @since    since  
/// @deprecated deprecated  
/// @bug       bug  
/// @todo     todo  
/// @test     test  
///
```

- In the snippet for code

```
///  
/// @code (.cpp) code  
/// @endcode  
///
```

Doxygen includes many more options.

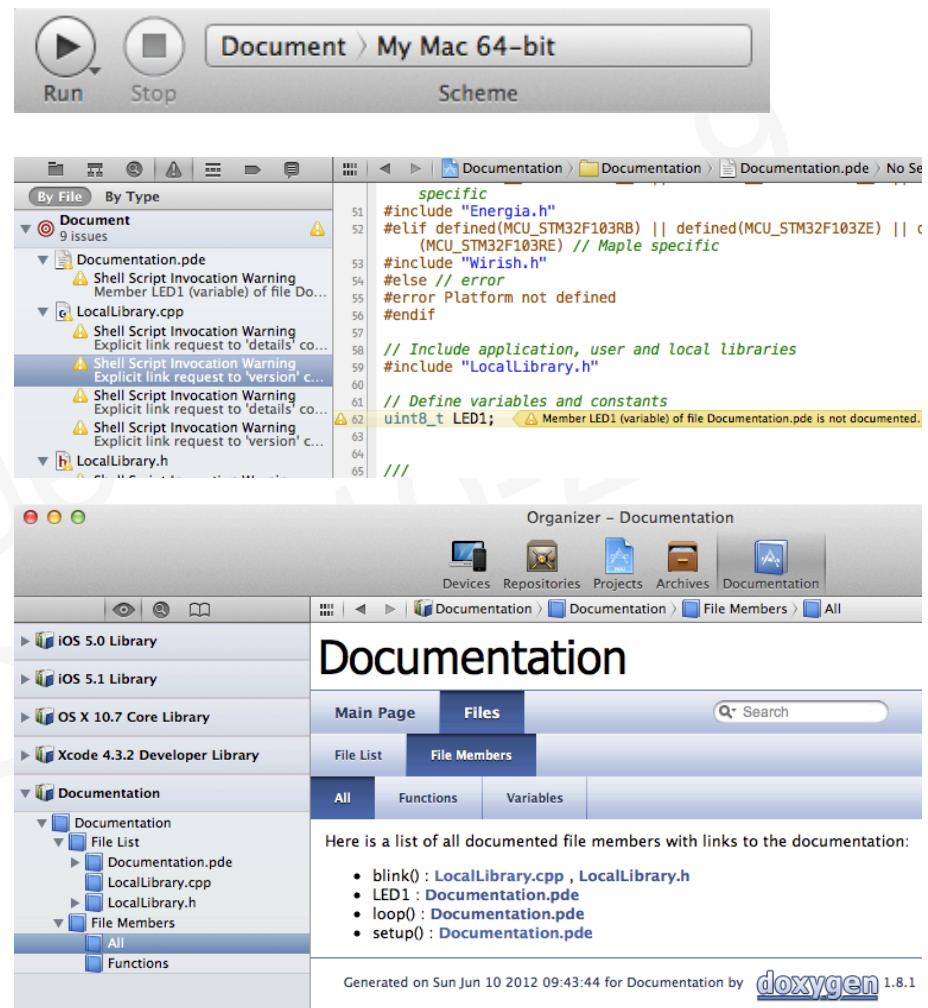
Please refer to its [documentation](#).

5.2. Build the Documentation

To build the documentation, just select the **Document** target and press **Run**.

Doxygen builds the documentation and issues warnings for undocumented portion of your code.

The documentation is packed in a specific file called docset and added to Xcode documentation.

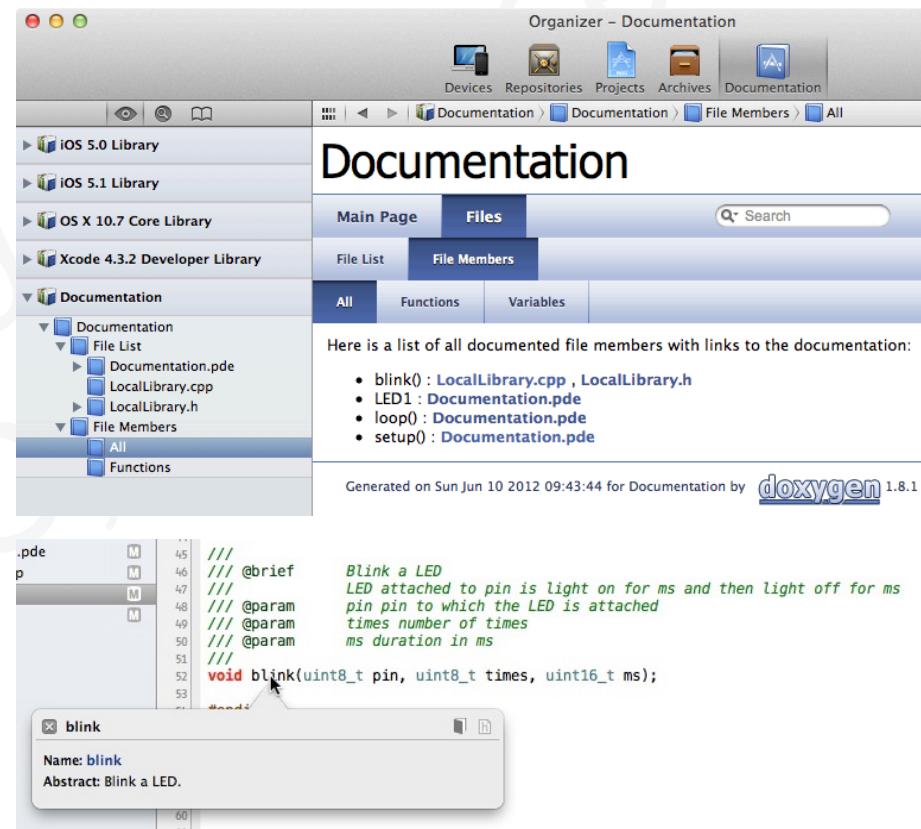


To prepare a PDF file, you need a Latex to PDF converter.
I've chosen [TeXShop](#) because it's easy to use.

Double-clicking on a .tex file launches TexShop and prepares the .pdf file.

5.3. Use the Documentation

The documentation is available on the Organiser.



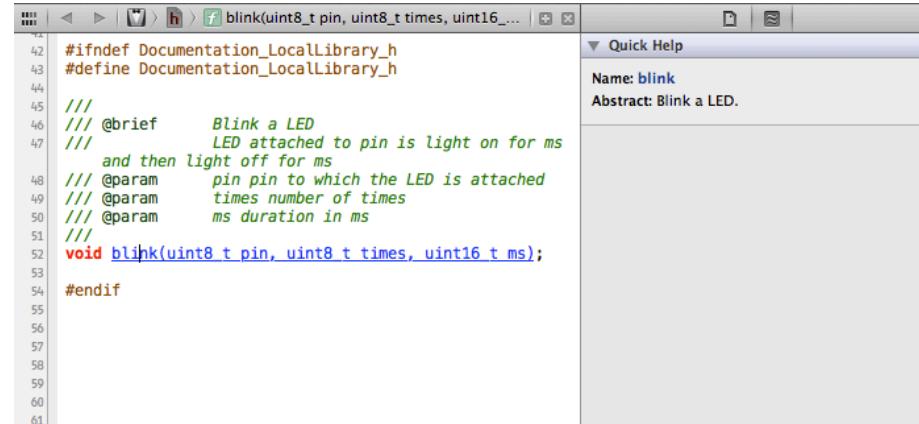
Quick help is also available.

Here, I press ⌘ alt while clicking on the name of the function **blink**: a contextual help pops-up.

Clicking on the name shown in blue **blink** in the help balloon launches the organiser and open the documentation to page related to that function!

When the cursor select a function, the Quick Help pane provides the brief description.

Clicking on the name shown in blue **blink** in the Quick Help pane launches the organiser and open the documentation to page related to that function!



The screenshot shows the Xcode interface with the Quick Help pane open. The code editor on the left contains a snippet of C code with a cursor over the word 'blink'. The Quick Help pane on the right displays the following information:

```
#ifndef Documentation_LocalLibrary_h
#define Documentation_LocalLibrary_h

///
/// @brief      Blink a LED
///             LED attached to pin is light on for ms
///             and then light off for ms
/// @param      pin pin to which the LED is attached
/// @param      times number of times
/// @param      ms duration in ms
///
void blink(uint8_t pin, uint8_t times, uint16_t ms);

#endif
```

Name: **blink**
Abstract: Blink a LED.

The page contains all the information about the function.



6. Appendixes

6.1. 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

6.2. 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](#)

6.3. Version History

Date	mpideXcode	embedXcode	Installation Guide	Comment
Jan 22, 2012	a			Initial release
Feb 02, 2012	b			chipKIT operational

Date	mpideXcode	embedXcode	Installation Guide	Comment
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
Jun 05, 2012	15	12	8	IDE-based identification for all platforms
Jun 14, 2012		13	9	Built-in self-documentation

6.4. Contributions and References

I've compiled a list of additional contributions and detailed references I've consulted to develop the emvedXcode template.

In case of a missing contribution or reference, please let me know so I could update the list.

Date	Title	Author	Links
Feb 07 2009	Bien documenter son code avec Doxygen et Xcode	mouviciel	http://mouviciel.free.fr/blog/index.php?2009/02/07/46-bien-documenter-son-code-avec-doxyg...
Feb 28, 2009	Using Arduino in Xcode	Robert Atkins	http://robertcarlsen.net/2009/02/28/using-arduino-in-xcode-532
Mar 18, 2010	Documenting Objective-C with Doxygen Part I	Fred McCann	http://www.duckrowing.com/2010/03/18/documenting-objective-c-with-doxyg...
Mar 18, 2010	Documenting Objective-C with Doxygen Part II	Fred McCann	http://www.duckrowing.com/2010/03/18/documenting-objective-c-with-doxyg...
Jun 04, 2010	A Makefile for Arduino Sketches	Martin Oldfield	http://bleaklow.com/2010/06/04/a_makefile_for_arduino_sketches.html
Sep 01, 2010	Using Doxygen to Create Xcode Documentation Sets	Apple	http://developer.apple.com/library/mac/#featuredarticles/DoxygenXcode/index.html
Oct 18, 2010	How to compile AVR-Code with Mac OSX	Administrator	http://www.definefalsetrue.com/index.php/en/AVR/how-to-compile-avr-code-with-mac-osx.html
Jan 06, 2011	Thread Update: Linker Problem, Arduino Uno and Xcode	Rei Vilo	http://arduino.cc/forum/index.php/topic,49956.0.html
Mar 11, 2011	A minimal project template for Xcode 4	borealkiss	http://blog.boreal-kiss.net/2011/03/11/a-minimal-project-template-for-xcode-4/ https://github.com/borealkiss/Minimal-Template
May 14, 2011	Using the Doxygen Helper in Xcode 4	Fred McCann	http://www.duckrowing.com/2011/05/14/using-the-doxygen-helper-in-xcode-4/ http://www.duckrowing.com/wp-content/uploads/2011/05/xcode_dox...

Date	Title	Author	Links
Mar 21, 2011	Making custom templates for Xcode 4 – March 2011	Adam (red-glasses)	http://blog.red-glasses.com/index.php/tutorials/making-custom-templates-for-xcode-4-march-2011/
Apr 01, 2011	Advanced Arduino Hacking	Maik Schmidt	http://pragprog.com/magazines/2011-04/advanced-arduino-hacking https://github.com/maik/pragpub
May 30, 2011	Command-line Arduino development	Akkana Peck	http://shallowsky.com/software/arduino/arduino-cmdline.html
Jun 08, 2011	Fixing Xcode 4's Broken Code Completion	Ben Scheirman	http://benscheirman.com/2011/06/fixing-xcode-4s-broken-code-completion
Jun 23, 2011	Arduino from the command line	Martin Oldfield	http://mjo.tc/atelier/2009/02/arduino-cli.html http://mjo.tc/atelier/2009/02/acli/arduino-mk_0.6.tar.gz
Feb 11, 2011	pyserial 2.6, Python Serial Port Extension	Chris Liechti	http://pypi.python.org/pypi/pyserial
Jul 01, 2011	Arduino makefile for Xcode	Rei Vilo	http://embedXcode.weebly.com/arduino/20--arduino-makefile-for-xcode
Jul 21, 2011	MPLAB X project configurations for stk500v2 bootloader	svofski	http://www.chipkit.cc/forum/viewtopic.php?p=1285#p1285 http://pastebin.com/31XXwmUV
Jul 30, 2011	Programming Arduino with Xcode	Nick	http://makesomecode.com/2010/07/30/programming-arduino-with-xcode/
Aug 25, 2011	Minimal AVR project template for Xcode	Jens Willy Johannsen	http://stackoverflow.com/questions/6976500/avr-for-xcode-4
Oct 04, 2011	Visual Micro, Free Arduino Programming IDE for Microsoft Visual Studio	Visual Micro	http://www.visualmicro.com/
Oct 11, 2011	Arduino makefile	Álvaro Justen (Turicas)	https://github.com/turicas/arduinoMakefile/blob/master/resources.markdown
Nov 01, 2011	A command line toolkit for working with Arduino hardware	Амперка (amperka)	http://arduino.cc/forum/index.php/topic,77458.0.html https://github.com/amperka/ino
Nov 02, 2011	pyserial 2.6: Python Serial Port Extension	Chris Liechti	http://pypi.python.org/pypi/pyserial

Date	Title	Author	Links
Nov 06, 2011	Arduino Eclipse Plug-In	Jantje	http://www.baeyens.it/eclipse/ https://github.com/jantje/arduino-eclipse-plugin
Nov 12, 2011	Arduino with Xcode	Tim Knapen	https://github.com/timknapen/Arduino-With-XCode
Nov 15, 2011	Make documentation	gnu.org, collective	http://www.gnu.org/software/make/manual/html_node/index.html
Nov 15, 2011	Using the GNU Compiler Collection	gnu.org, collective	http://gcc.gnu.org/onlinedocs/gcc-4.6.2/gcc/
Dec 04, 2011	Initial repository closed	Rei Vilo	http://github.com/rei-vilo/Xcode-for-MPIDE-Arduino
Dec 04, 2011	Trunk continued by Tim Knapen	Tim Knapen	https://github.com/timknapen/Arduino-With-XCode
Dec 04, 2011	Master cloned by gnimmel	Gnimmel	https://github.com/gnimmel/Xcode-for-MPIDE-Arduino
Dec 09, 2011	chipKIT Compatible Arduino-based Makefile	Christopher Peplin	http://christopherpeplin.com/2011/12/chipkit-arduino-makefile https://github.com/peplin/arduino.mk
Dec 21, 2011	MPIDE 0023 mpide-0023-macosx-20111221	Ricklon	https://github.com/chipKIT32/chipKIT32-MAX/downloads
Jan 11, 2012	Xcode 4 external build system code completion	Mattias Wadman	http://stackoverflow.com/questions/8726869/xcode-4-external-build-system-code-completion
Jan 12, 2012	New IDE for Mac OS X written in Cocoa	fabiankr	http://arduino.cc/forum/index.php/topic,86028.0.html https://github.com/fabiankr/Cocoduino
Jan 16, 2012	Arduino with Xcode	Rei Vilo	https://github.com/rei-vilo/Arduino-With-XCode
Jan 22, 2012	mpideXcode — release a : initial release	Rei Vilo	https://github.com/rei-vilo/mpideXcode
Mar 18, 2012	Energia = Arduino IDE ported to LaunchPad MSP430	Robert Wessel	https://github.com/energia/Energia
Apr 25, 2012	Graphviz 2.28, Graph Visualization Software	ATT	http://www.graphviz.org/

Date	Title	Author	Links
May 19, 2012	Doxxygen 1.8.1	Dimitri van Heesch	http://doxygen.org/
Jun 06, 2012	TeXShop 3.11	Richard Koch	http://www.texshop.org

6.5. 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	chipKIT	Wiring	LaunchPad	Maple
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 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			

7. 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](#).

7.1. Summary

You are free:

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- **to Remix** — to adapt the work

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