openFrameworks

Beginning to use C++

Download **OF** **http://www.openframeworks.cc/**
Download **Code::Blocks** (an IDE) http://www.openframeworks.cc/setup/codeblocks
Or **Visual Studio**
Or **Xcode** for Mac users

openFrameworks (oF) comes into its own
if you want to use 3D, sound or video.

It is apparently much faster than Java and Processing.
Why?

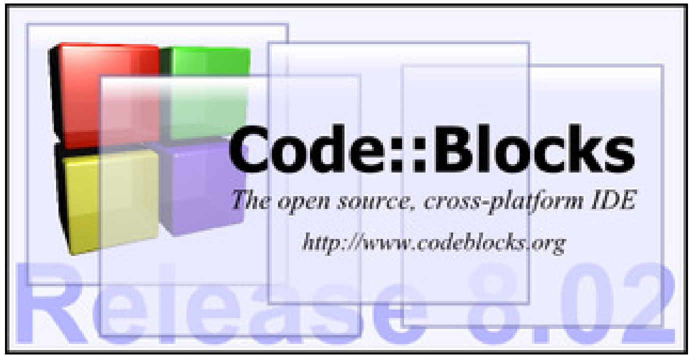
C++ Allows direct calls to native system libraries.

And explicit memory management,
C++ Supports destructors.
C++ is normally compiled directly to machine code which is then executed directly by the operating system.
Java/Processing is normally compiled to byte-code which the Java virtual machine (JVM) then either interprets or JIT compiles to machine code and then executes.

But you cant embed it in an Applet like Java and Processing…

what has been made with openframeworks?
Here's an *incomplete* list of projects, that have been made using openFrameworks code:
re-gaze – chris surgue
graffiti analysis project – evan roth
audio space – theodore watson
drawn – zach lieberman
colors – cory archangel
Magic Torch – Alberto García, Julio Obellerio, Martín Nadal y Alberto Cortés
Memento – Jeldrik Schmuch and Ulrike Gollner
Laser Tag – Graffiti Research Lab
Le Sacre du Printemps - Ars Electronica Futurelab, Chris Surgue, Matthias Bauer
D3SOMBRA- Emanuele Mazza
Predator? – Henrik Wrangel, Carl-Johan Rosén
There have also been openFrameworks workshops at Eyebeam, MedialabMadrid and Ars Electronica.

Open **Code::Blocks**
(or your C++ IDE of choice)


Code::Blocks
The open source, cross-platform IDE
http://www.codeblocks.org
Release 8.02

A first program

We'll use OF's handy project templates

Look in the OF apps >>examples folder,

on my laptop its:

C:\Documents and Settings\student\My Documents\myOF\\of_preRelease_v0061_win_cb_FAT\of_preRelease_v0061_win_cb_FAT\apps\examples\ emptyExample

Copy the **emptyExample** folder and rename the folder

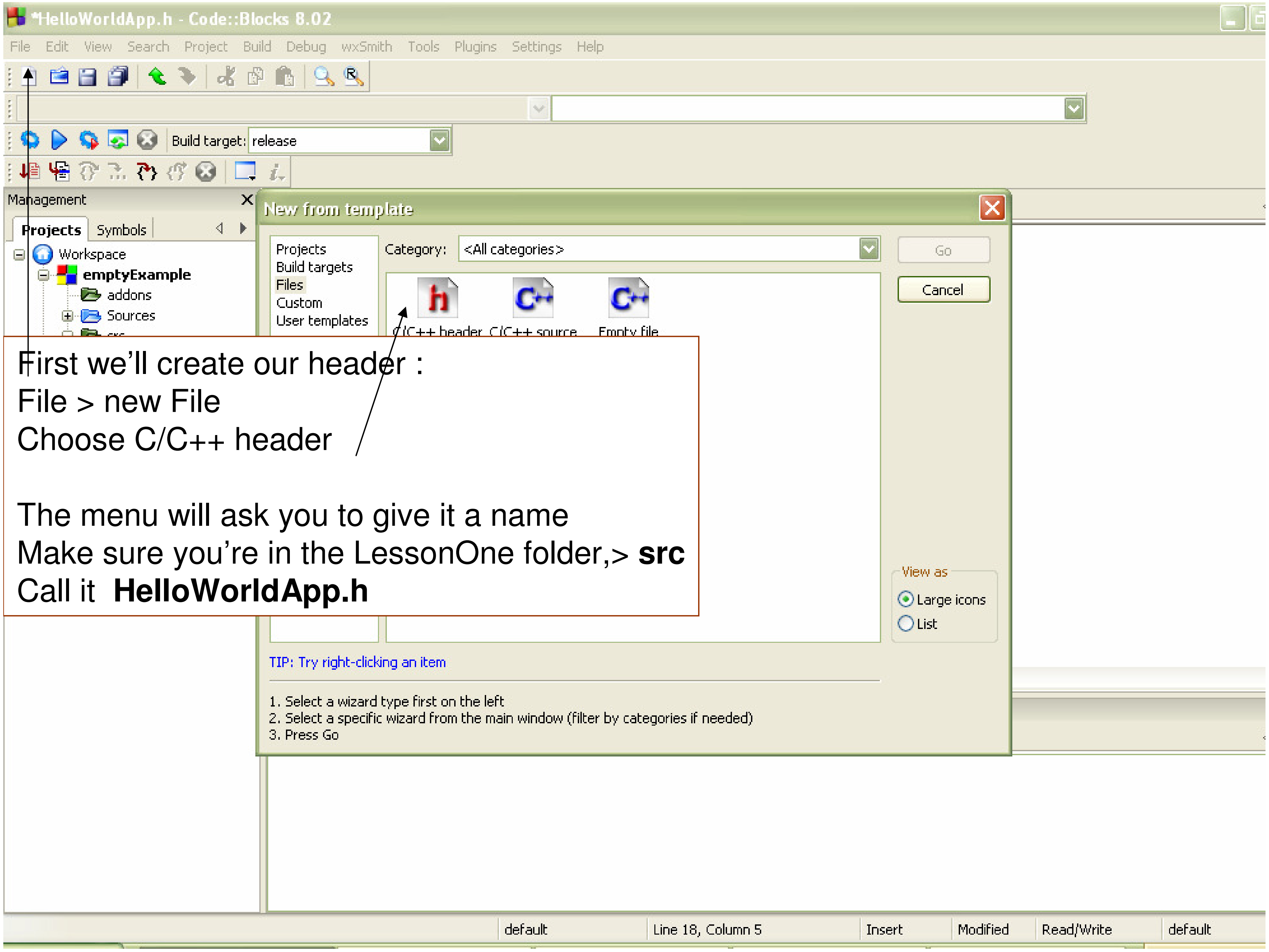
LessonOne

Our first program will be spread over three files:

HelloWorldApp.h (h = header file, a bit like a blue-print or empty structure with no implementation detail)

HelloWorldApp.cpp (a C++ file, here we'll do new stuff and define our functions etc)

main.cpp (another C++ file, like a Java application every oF C++ program needs a **main** method (or function) to get it going). We'll use the one we're taking from the template but make a few changes to it.



TIP: Try right-clicking an item

1. Select a wizard type first on the left
2. Select a specific wizard from the main window (filter by categories if needed)
3. Press Go

First we'll create our header :
File > new File
Choose C/C++ header

The menu will ask you to give it a name
Make sure you're in the LessonOne folder,> **src**
Call it **HelloWorldApp.h**

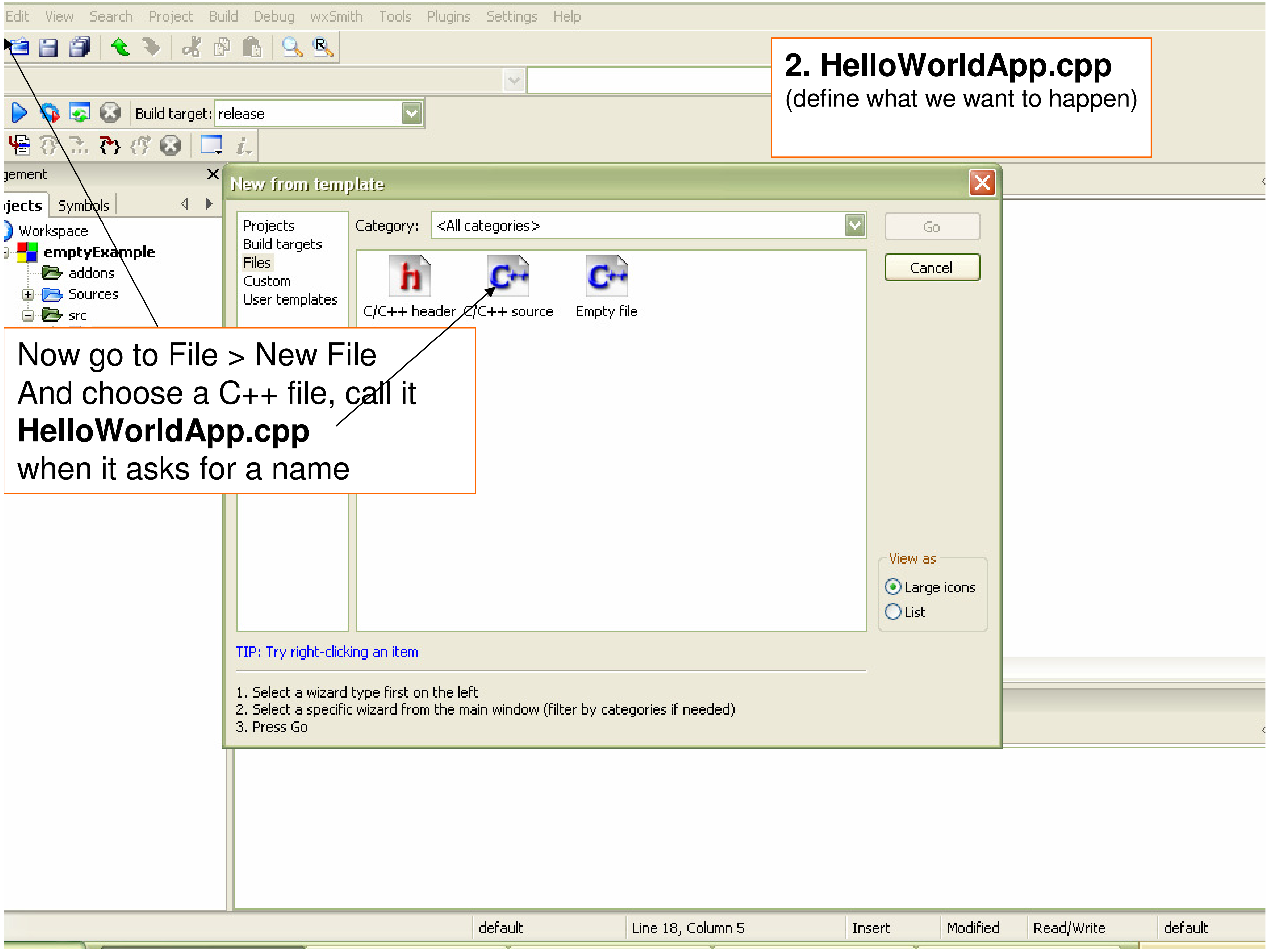
1. HelloWorldApp.h (h = header file)

```
#ifndef _HELLO_WORLD
#define _HELLO_WORLD

#include "ofMain.h"//include oF's ofMain class, linked here


class HelloWorldApp : public ofBaseApp
{



public:
    void setup(); //we need this to load the font
    void draw();//we need this to draw the font to the screen


    ofTrueTypeFont franklin;//the font we will load


};

#endif
```

Extend oF's ofBaseApp

!

Proper format for header files



TIP: Try right-clicking an item

1. Select a wizard type first on the left
2. Select a specific wizard from the main window (filter by categories if needed)
3. Press Go

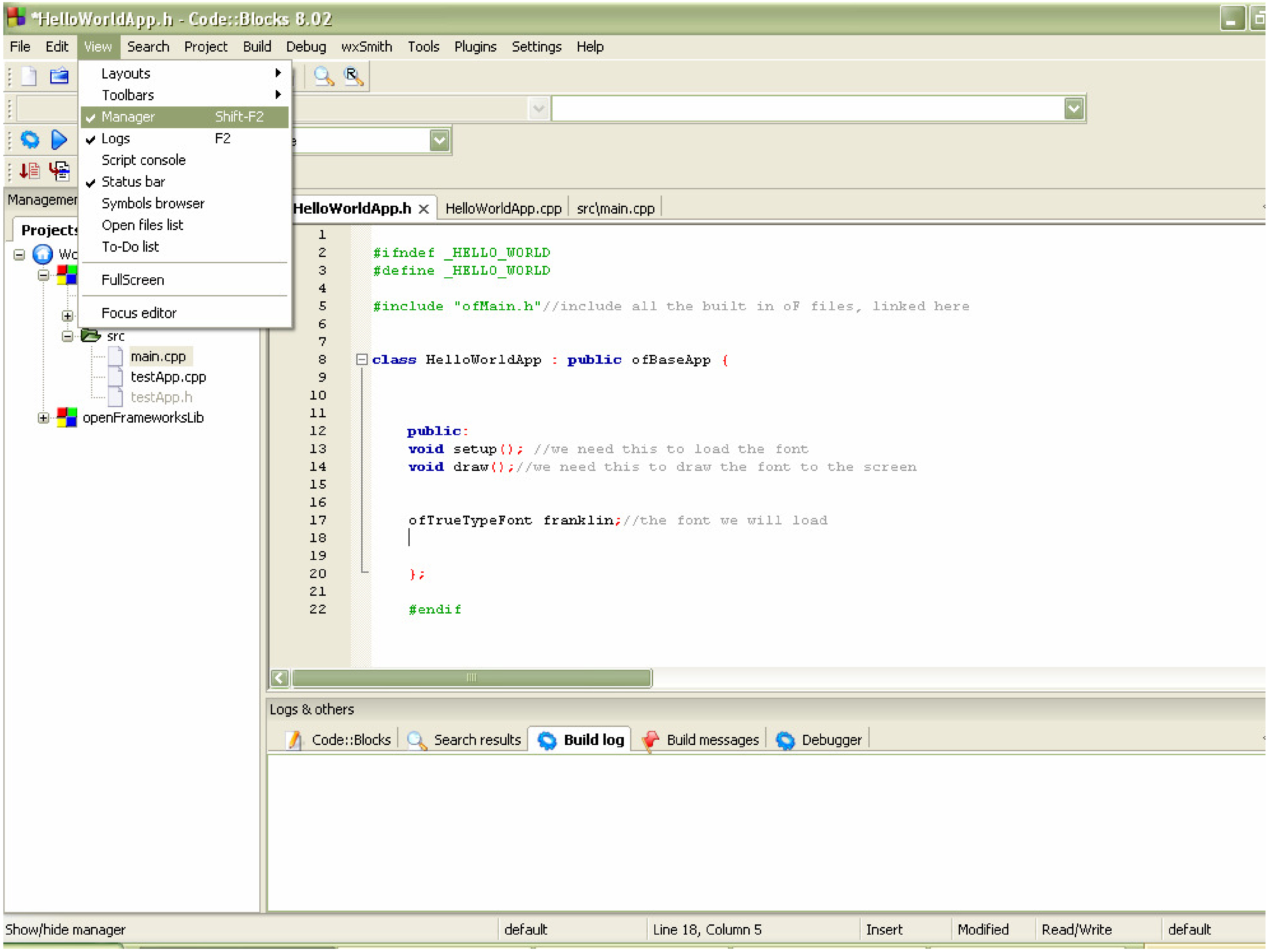
2. HelloWorldApp.cpp
(define what we want to happen)

Now go to File > New File
And choose a C++ file, call it
HelloWorldApp.cpp
when it asks for a name

2. HelloWorldApp.cpp

(define what we want to happen)

```
#include "HelloWorldApp.h"

void HelloWorldApp::setup()
{

    //load our font and give it a name
    franklin.loadFont("frabk.ttf", 32);
    ofBackground(255, 255, 255);

}



void HelloWorldApp::draw()
{

    ofSetColor(0, 0, 0);
    franklin.drawString("Hello World!", 100, 380); //experiment


}
```



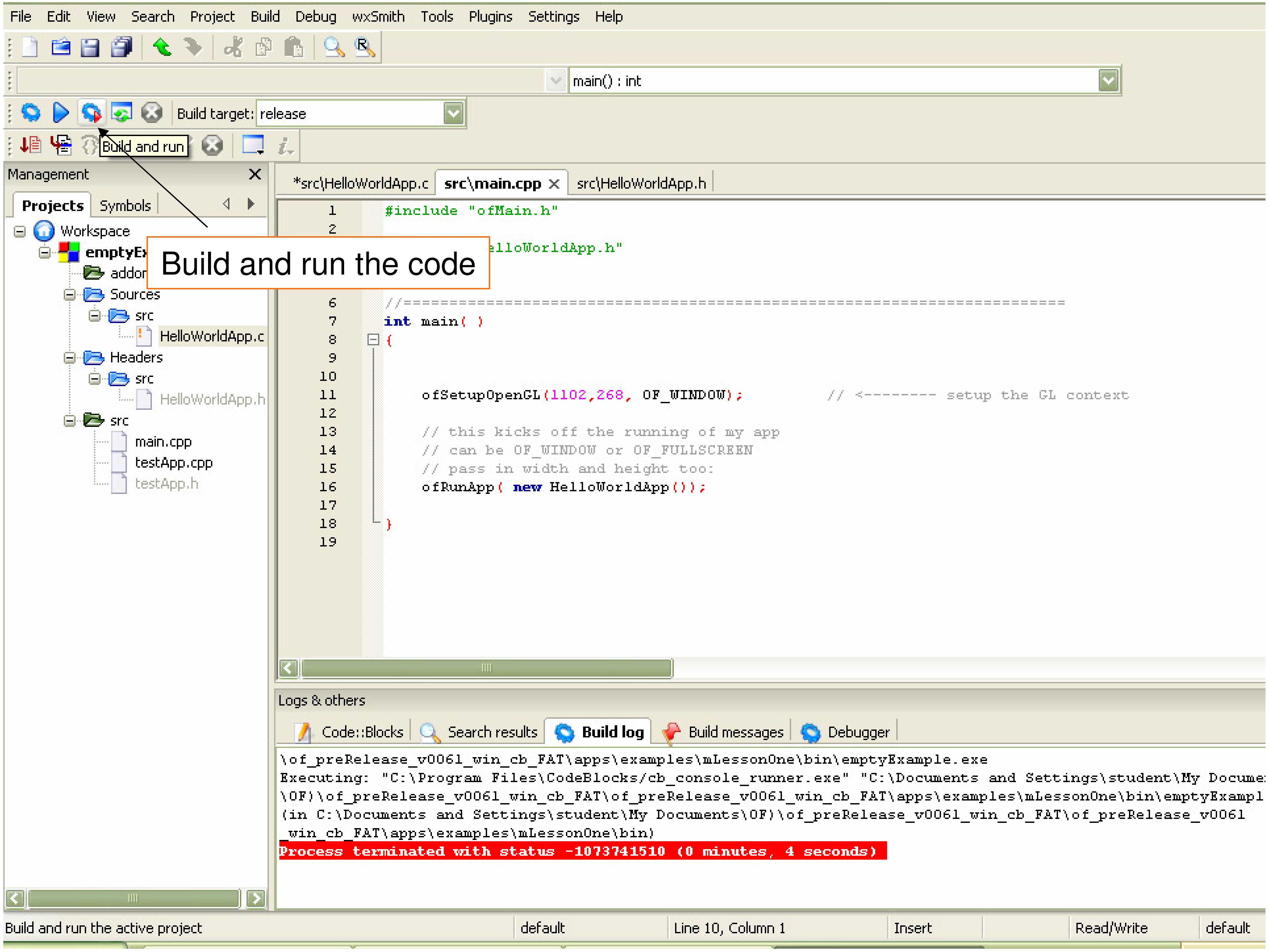
```
#ifndef _HELLO_WORLD
#define _HELLO_WORLD

#include "ofMain.h"//include all the built in oF files, linked here


class HelloWorldApp : public ofBaseApp {



    public:
    void setup(); //we need this to load the font
    void draw();//we need this to draw the font to the screen


    ofTrueTypeFont franklin;//the font we will load
    


    };

    #endif
```

Finally we already have main.cpp
3. main.cpp (gets it all going)

But we need to change it a little

```
#include "ofMain.h"
#include "HelloWorldApp.h"


int main( )
{

  // ofAppGlutWindow window;
   ofSetupOpenGL(300,368, OF_WINDOW); //experiment with sizes
                                          // <-------- setup the GL context

   // this kicks off the running of my app
   // can be OF_WINDOW or OF_FULLSCREEN
   // pass in width and height too:
   ofRunApp( new HelloWorldApp());

}
```

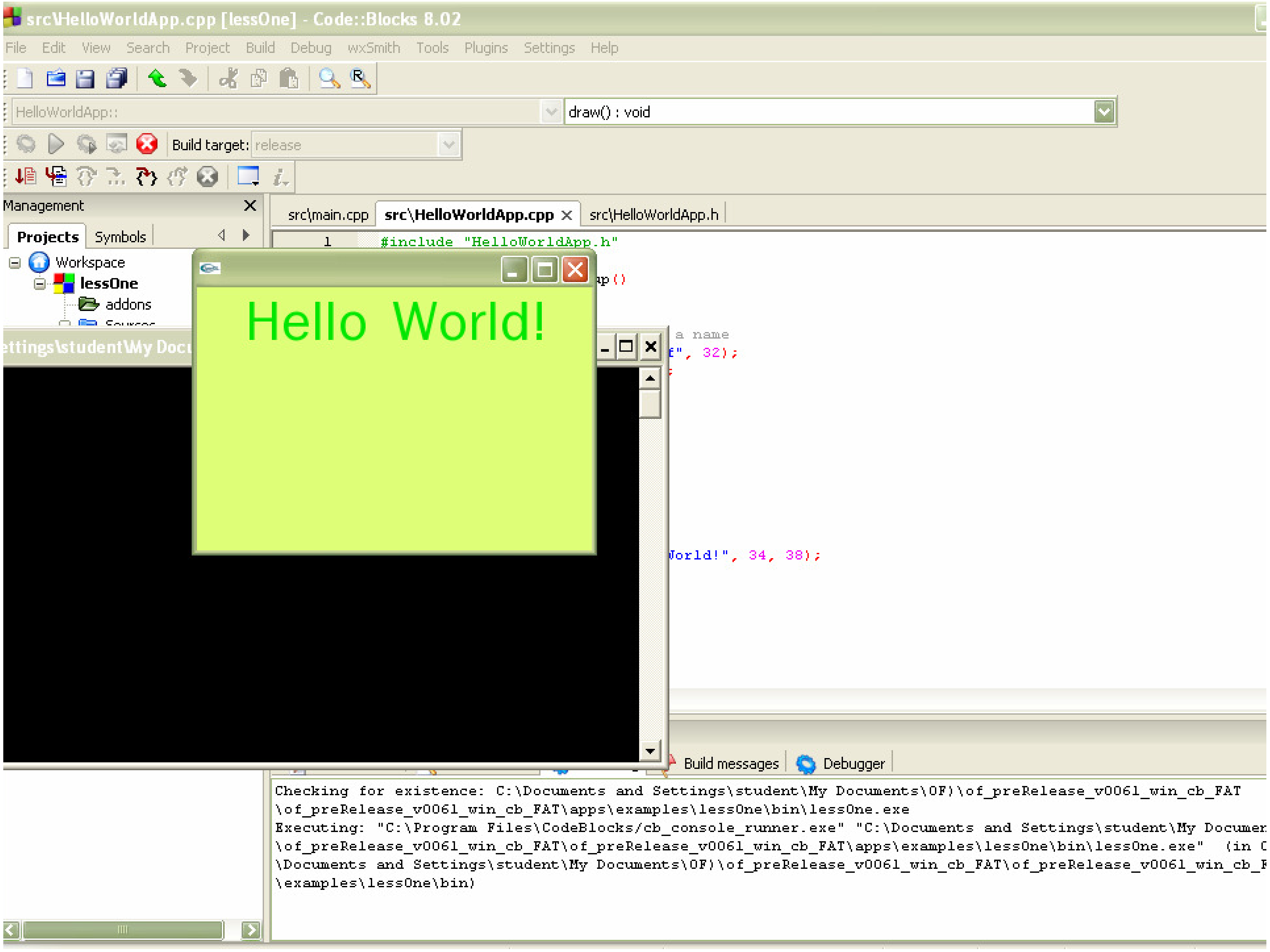
But just like in Processing we also need a data folder with the font in it
Put the font (frabk**.ttf**) file in the data folder in the **bin** folder of this program



Build and run the code

```
#include "ofMain.h"

        elloWorldApp.h"


//========================================================================
int main( )
{


    ofSetupOpenGL(1102,268, OF_WINDOW);          // <-------- setup the GL context

    // this kicks off the running of my app
    // can be OF_WINDOW or OF_FULLSCREEN
    // pass in width and height too:
    ofRunApp( new HelloWorldApp());

}

```

```
\of_preRelease_v0061_win_cb_FAT\apps\examples\mLessonOne\bin\emptyExample.exe
Executing: "C:\Program Files\CodeBlocks/cb_console_runner.exe" "C:\Documents and Settings\student\My Docume
\OF)\of_preRelease_v0061_win_cb_FAT\of_preRelease_v0061_win_cb_FAT\apps\examples\mLessonOne\bin\emptyExampl
(in C:\Documents and Settings\student\My Documents\OF)\of_preRelease_v0061_win_cb_FAT\of_preRelease_v0061
_win_cb_FAT\apps\examples\mLessonOne\bin)
Process terminated with status -1073741510 (0 minutes, 4 seconds)
```



```
#include "HelloWorldApp.h"
```

```
Checking for existence: C:\Documents and Settings\student\My Documents\OF)\of_preRelease_v0061_win_cb_FAT
\of_preRelease_v0061_win_cb_FAT\apps\examples\lessOne\bin\lessOne.exe
Executing: "C:\Program Files\CodeBlocks/cb_console_runner.exe" "C:\Documents and Settings\student\My Documen
\of_preRelease_v0061_win_cb_FAT\of_preRelease_v0061_win_cb_FAT\apps\examples\lessOne\bin\lessOne.exe"  (in C
\Documents and Settings\student\My Documents\OF)\of_preRelease_v0061_win_cb_FAT\of_preRelease_v0061_win_cb_F
\examples\lessOne\bin)
```

In c++ you must define your classes in your header before you use them. This is called prototyping.

How Classes Work in C++ (Two Files!?)

C++ classes comprise of two files. It helps to think of these two classes as a recipe.
The header file (.h) is like the list of ingredients, and contains:
Any preprocessor statements there to prevent multiple header definitions
Any include statements to other classes
Any class extension statements
Any variables local to the class
Prototypes of any functions to be contained in the class
And the security settings of these functions and variables (e.g. public, private, protected, etc).
and a body file (.cpp) which is like the instructions on what to do with the ingredients and contains:
An include statement that references the .h file
All of the code to fill in the function prototypes.
To explore this more, open up the testApp.cpp and testApp.h files.

Inside the Open Frameworks apps folder you will find examples of how to use various parts of openFrameworks. Inside the folder for each example is a project file that can be opened from your IDE. In code::blocks this is the *.cbp* file. In xcode it is the *.xcodeproj* file.

oF provides this information, but our previous way of making a project will also work. If you change the Name of the project files (.cbp etc) you'll need to follow these instructions

2) if you want to make a new project:
----

a) copy the folder inside of apps and paste in the same directory

ie (copy "emptyExample" and paste "copy of emptyExample")

b) rename the folder, and inside the folder, rename the .cbp and .workspace

c) open the .cbp file with a text editor. change the occurances of the old name to the new name:

```
line 5: <Option title="emptyExample" />
line 11: <Option output="bin\emptyExample" prefix_auto="1" extension_auto="1" />
line 18: <Option output="bin\emptyExample_DEBUG" prefix_auto="1" extension_auto="1" />
```

for example, if I copied emptyexample and wanted to call it "coolExample" would look like:

```
line 5: <Option title="coolExample" />
line 11: <Option output="bin\coolExample" prefix_auto="1" extension_auto="1" />
line 18: <Option output="bin\coolExample_DEBUG" prefix_auto="1" extension_auto="1" />
```

in the solution file, change the name of .cbp file:

```
line 4: <Project filename="emptyExample.cbp" active="1" />
```

to whatever you've renamed the cbp to.

as always if you have issues, check or post on the forum: openframeworks.cc/forum

have fun!

Doing more interesting stuff, like drawing shapes

Initially drawing with oF will seem very similar to Processing…

copy the example called graphicsExample call it myDraw
Click on the graphicsExample.cbp
or graphicsExample.*xcodeproj* file
In your IDE open all three files, here we are looking at testApp.h

```
#ifndef _TEST_APP
#define _TEST_APP


#include "ofMain.h"

class testApp : public ofBaseApp{

public:

 void setup();

 void draw();


};

#endif
```

Simplify the code so it looks like this

Include oF's ofMain header file

extend oF's ofBaseApp class

What does this mean?
We'll find out later in this lesson..

Now for the **testApp.cpp**, we already have that in the *src* folder, in the IDE make the necessary changes to simplify it:

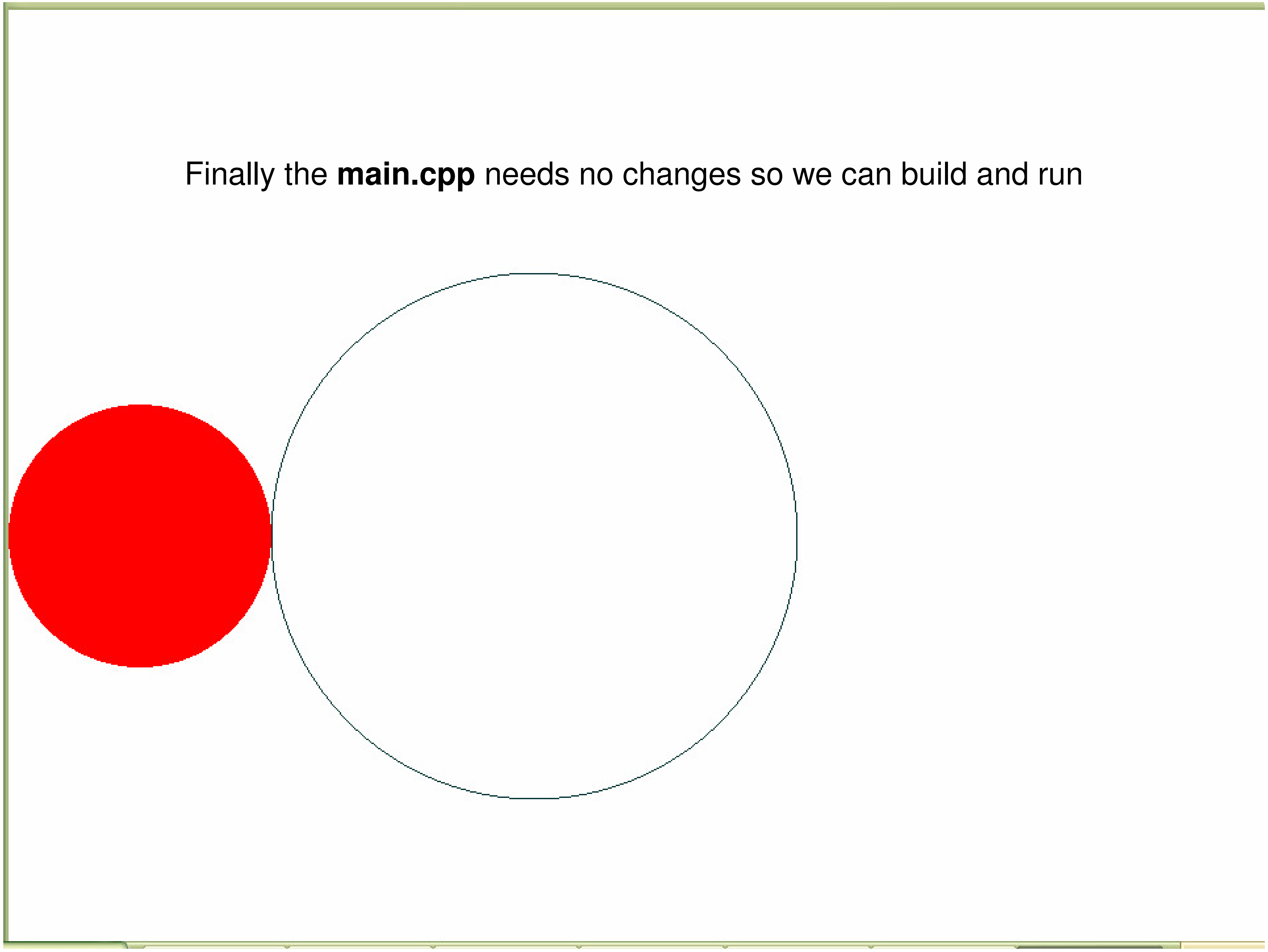
```
#include "testApp.h"


//--------------------------------------------------------------
void testApp::setup()
{

   ofEnableSmoothing();
    ofSetCircleResolution(100);
//  ofSetCircleResolution(int(ofRandom(1, 100)));
    ofBackground(255, 255, 255);

}


//--------------------------------------------------------------
void testApp::draw()
{

    ofSetColor(0xFF0000);
    ofFill();//fill the shapes
    ofCircle(100, 400, 100);
    ofNoFill();//make just an outline
    ofSetColor(0x33333);
    ofCircle(400, 400, 200);


}
```

syntax
ofSetCircleResolution(int res)

description
Sets the resolution for the ofCircle command. By default, the circle is 22 points, but if you need to draw larger circles, you can adjust the resolution using this command.

http://www.openframeworks.cc/documentation?adv=yes

Finally the **main.cpp** needs no changes so we can build and run



Play with your code, add more shapes, colours sizes and placings

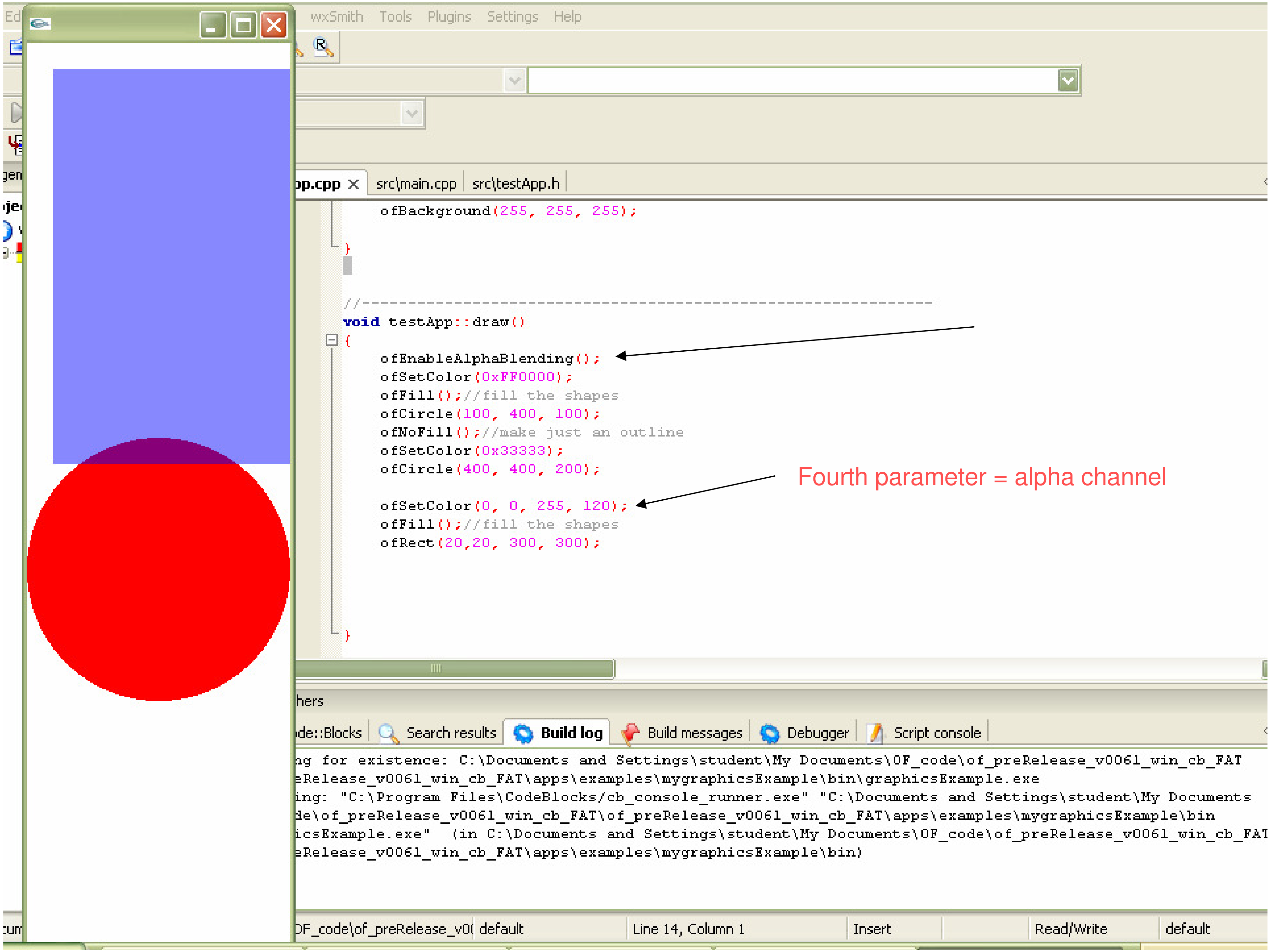
Try all of these together:

ofRect(float x1, float y1, float width, float height);
ofCircle(float x, float y, float radius);
ofEllipse(float x, float y, float width, float height);
ofLine(float x1, float y1, float x2, float y2);
ofTriangle(float x1, float y1, float x2, float y2, float x3, float y3);

Use your own colours and sizes, use fills and no fills with
ofFills();
And
ofNoFill();

You can use RGB colours or hex colour values, you can also use an alpha channel as in Processing but you have to declare this in the draw() method of your **testApp,cpp** code:

ofEnableAlphaBlending();



```
    ofBackground(255, 255, 255);

}

//--------------------------------------------------------------
void testApp::draw()
{
    ofEnableAlphaBlending();
    ofSetColor(0xFF0000);
    ofFill();//fill the shapes
    ofCircle(100, 400, 100);
    ofNoFill();//make just an outline
    ofSetColor(0x33333);
    ofCircle(400, 400, 200);

    ofSetColor(0, 0, 255, 120);
    ofFill();//fill the shapes
    ofRect(20,20, 300, 300);


}
```

Fourth parameter = alpha channel

```
ng for existence: C:\Documents and Settings\student\My Documents\OF_code\of_preRelease_v0061_win_cb_FAT
eRelease_v0061_win_cb_FAT\apps\examples\mygraphicsExample\bin\graphicsExample.exe
ing: "C:\Program Files\CodeBlocks/cb_console_runner.exe" "C:\Documents and Settings\student\My Documents
de\of_preRelease_v0061_win_cb_FAT\of_preRelease_v0061_win_cb_FAT\apps\examples\mygraphicsExample\bin
icsExample.exe"  (in C:\Documents and Settings\student\My Documents\OF_code\of_preRelease_v0061_win_cb_FAT
eRelease_v0061_win_cb_FAT\apps\examples\mygraphicsExample\bin)
```

OF_code\of_preRelease_v0(default | Line 14, Column 1 | Insert | Read/Write | default

Now just to show we can do it, we will add a new
File to the project, go to *file*, *new file,* choose a Header file
call it hello.h and browse to the *src* folder for the program

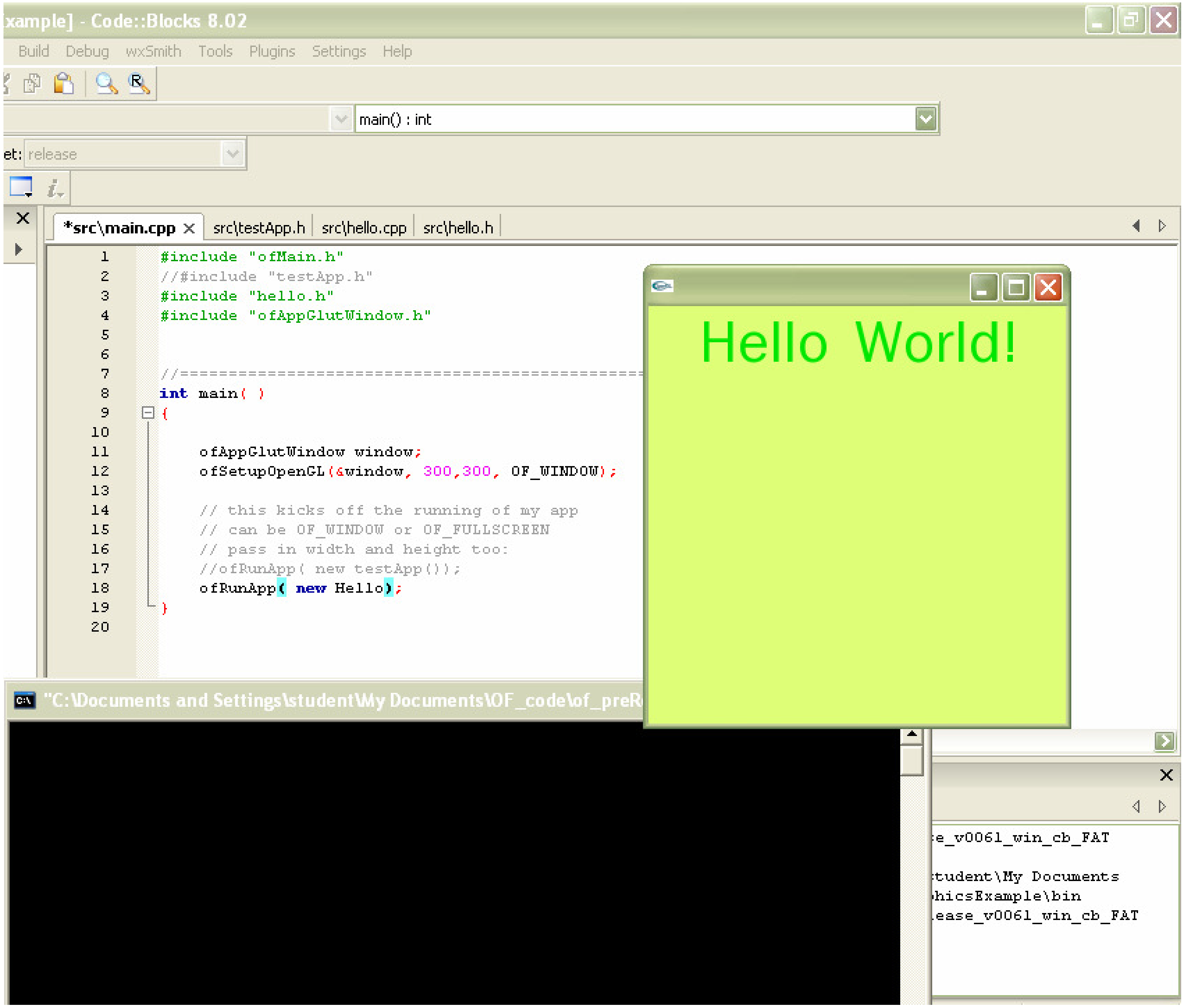
```
#ifndef _HELLO
#define _HELLO


#include "ofMain.h"//include all the built in oF files, linked here


class Hello : public ofBaseApp
{



public:
    void setup(); //we need this to load the font
    void draw();//we need this to draw the font to the screen


    ofTrueTypeFont franklin;//the font we will load


};



#endif
```

Then create another file called **hello.cpp**, make sure the font is In a **data** folder in the **bin** folder of this program

```
#include “hello.h"

void Hello::setup()
{

    //load our font and give it a name
    franklin.loadFont("frabk.ttf", 32);
    ofBackground(222, 255, 120);

}



void Hello::draw()
{

    ofSetColor(0, 230, 0);
    franklin.drawString("Hello World!", 34, 38);


}
```

Now access the main.cpp file again and make
The small changes we need to run hello.cpp
Instead of testApp.cpp:

```
#include "ofMain.h"
//#include "testApp.h"
#include "hello.h"
#include "ofAppGlutWindow.h"


int main( )
{

    ofAppGlutWindow window;
    ofSetupOpenGL(&window, 300,300, OF_WINDOW);
   //ofRunApp( new testApp());
    ofRunApp( new Hello());
}
```



```
#include "ofMain.h"
//#include "testApp.h"
#include "hello.h"
#include "ofAppGlutWindow.h"


//============================================
int main( )
{

    ofAppGlutWindow window;
    ofSetupOpenGL(&window, 300,300, OF_WINDOW);

    // this kicks off the running of my app
    // can be OF_WINDOW or OF_FULLSCREEN
    // pass in width and height too:
    //ofRunApp( new testApp());
    ofRunApp( new Hello);
}
```

```
"C:\Documents and Settings\student\My Documents\OF_code\of_preR
```

```
e_v0061_win_cb_FAT

tudent\My Documents
hicsExample\bin
ease_v0061_win_cb_FAT
```

What do you need to do to make the hello code draw shapes to the screen instead of the testApp?
What would you need to add to the hello.cpp code?

We’ll do that in a moment.

But first, what does
#endif
mean?
And what does this mean:
#ifndef _HELLO
#define _HELLO
?

At the top of our header file we have these lines**:**

#ifndef _HELLO

and

#define _HELLO

At the end we have

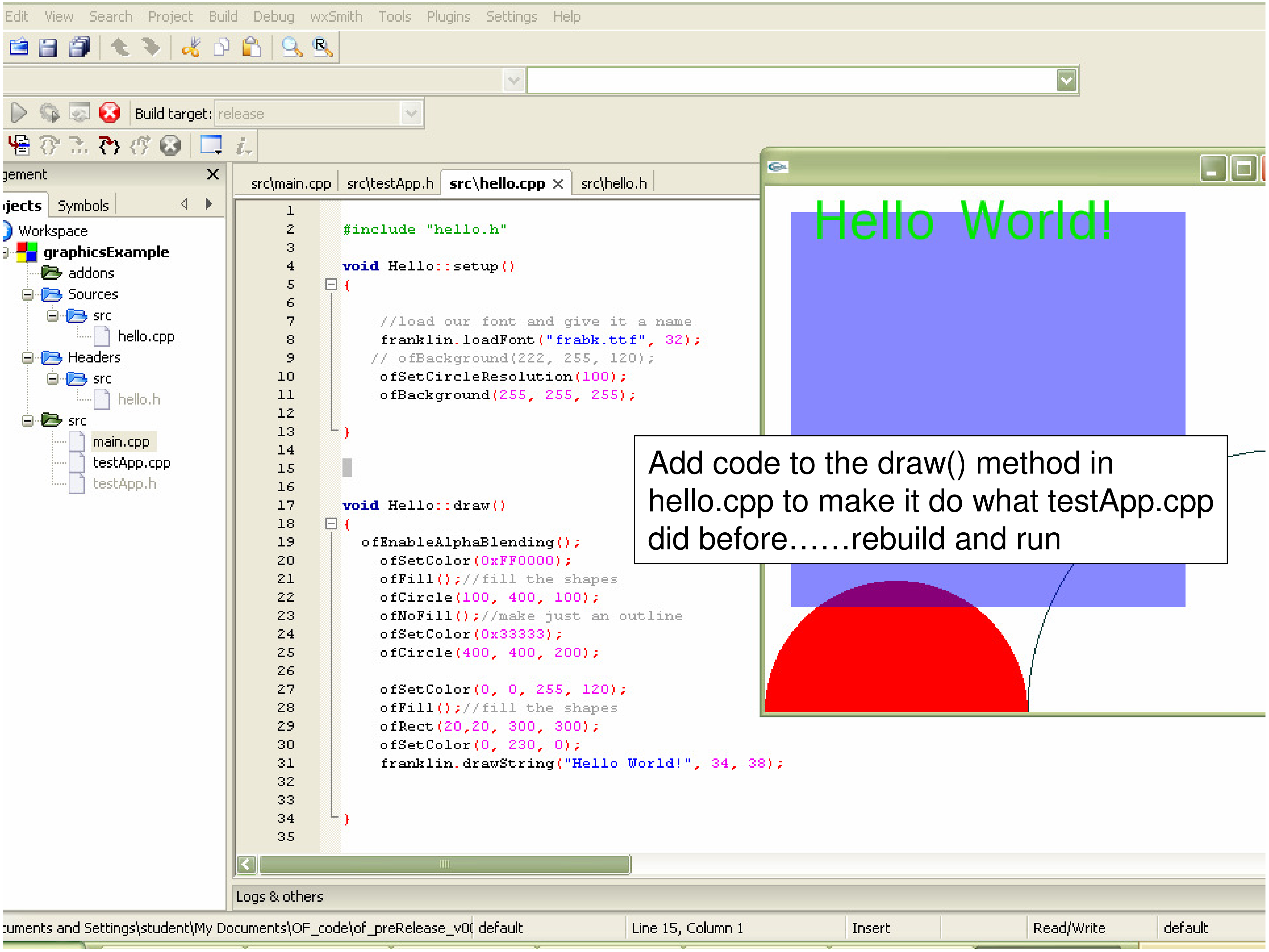
#endif

These are **directives** that effectively **bracket** the header file

These directives make sure that we don't define the same class twice, once it has followed its instructions to define a class called _HELLO
It wont do it again,
how efficient !

```
#ifndef _HELLO
#define _HELLO


#include "ofMain.h"//include all the built in oF files, linked here


class Hello : public ofBaseApp
{



public:
   void setup(); //we need this to load the font
   void draw();//we need this to draw the font to the screen


   ofTrueTypeFont franklin;//the font we will load


};



#endif
```

Next time you open the code you may
Have to go to project>>>add files in the IDE
And add the hello.cpp and hello.h files
select **all** for the files to be ‘debug’ and ‘release’
In the menu that appears when you add files to your
Project. If you saved everything carefully the files should all be there



```
#include "hello.h"

void Hello::setup()
{

    //load our font and give it a name
    franklin.loadFont("frabk.ttf", 32);
   // ofBackground(222, 255, 120);
    ofSetCircleResolution(100);
    ofBackground(255, 255, 255);

}



void Hello::draw()
{
  ofEnableAlphaBlending();
    ofSetColor(0xFF0000);
    ofFill();//fill the shapes
    ofCircle(100, 400, 100);
    ofNoFill();//make just an outline
    ofSetColor(0x33333);
    ofCircle(400, 400, 200);

    ofSetColor(0, 0, 255, 120);
    ofFill();//fill the shapes
    ofRect(20,20, 300, 300);
    ofSetColor(0, 230, 0);
    franklin.drawString("Hello World!", 34, 38);


}
```

Add code to the draw() method in hello.cpp to make it do what testApp.cpp did before……rebuild and run

```
cuments and Settings\student\My Documents\OF_code\of_preRelease_v0( default    Line 15, Column 1    Insert    Read/Write    default
```

Loops and conditions in C++

Easy!!

Loops in C++ are mainly of three types :-

1. 'while' loop
2. 'do while' loop
3. 'for' loop

For those who have studied C or JAVA, this isn't very new, as the syntax for the loops are exactly same. So if you know the above languages, don't waste your time understanding loop syntax in C++.

The 'while' loop :-

A small example of a program which writes **hi** three 3 times.

```
#include <iostream> //lets us use cout
int main()
{

    int i = 0;
    while (i<3)
    {
        i++;
        cout<<"Hi" <<endl;
    }
    return 0;
}
```

C++ basics

Pointers and references
& dereferences

Efficient programming by managing memory

- **&** = a *reference* operator

- It refers to the **address** of a variable

- Using * infront of a variable means it will be a pointer: i.e **int* pVariable;**
- This * has **2** uses**,** it is also a *dereference* operator. Confusingly 2 different things are represented by the same sign…(of course we also know it as the multiplication sign, the clever compiler understands all these meanings by context).

- As a dereference operator you use * to point to the **value** of the variable you want to access (not the **address**).

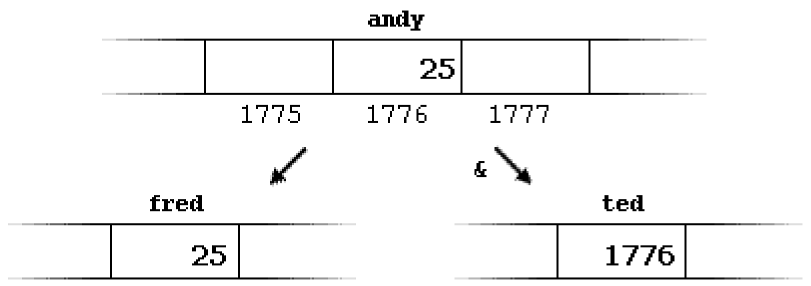
THIS WILL BECOME CLEAR IN THE FOLLOWING SLIDES

First we need to understand a little about computer memory

…variables are seen as memory cells that can be accessed using their identifiers. This way we do not have to care about the physical location of our data within memory, we simply used its identifier whenever we wanted to refer to our variable.

The memory of your computer can be imagined as a succession of memory cells, each one of the minimal size that computers manage (one byte). These single-byte memory cells are numbered in a consecutive way, so as, within any block of memory, every cell has the same number as the previous one plus one.

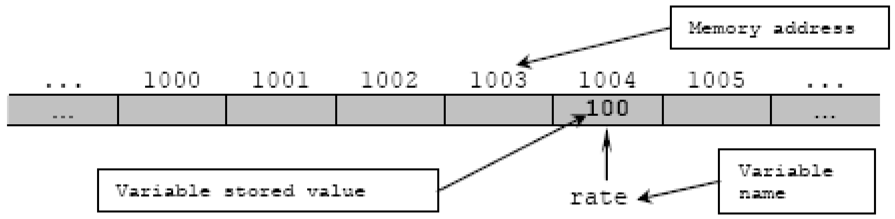
This way, each cell can be easily located in the memory because it has a unique address and all the memory cells follow a successive pattern. For example, if we are looking for cell 1776 we know that it is going to be right between cells 1775 and 1777, exactly one thousand cells after 776 and exactly one thousand cells before cell 2776.

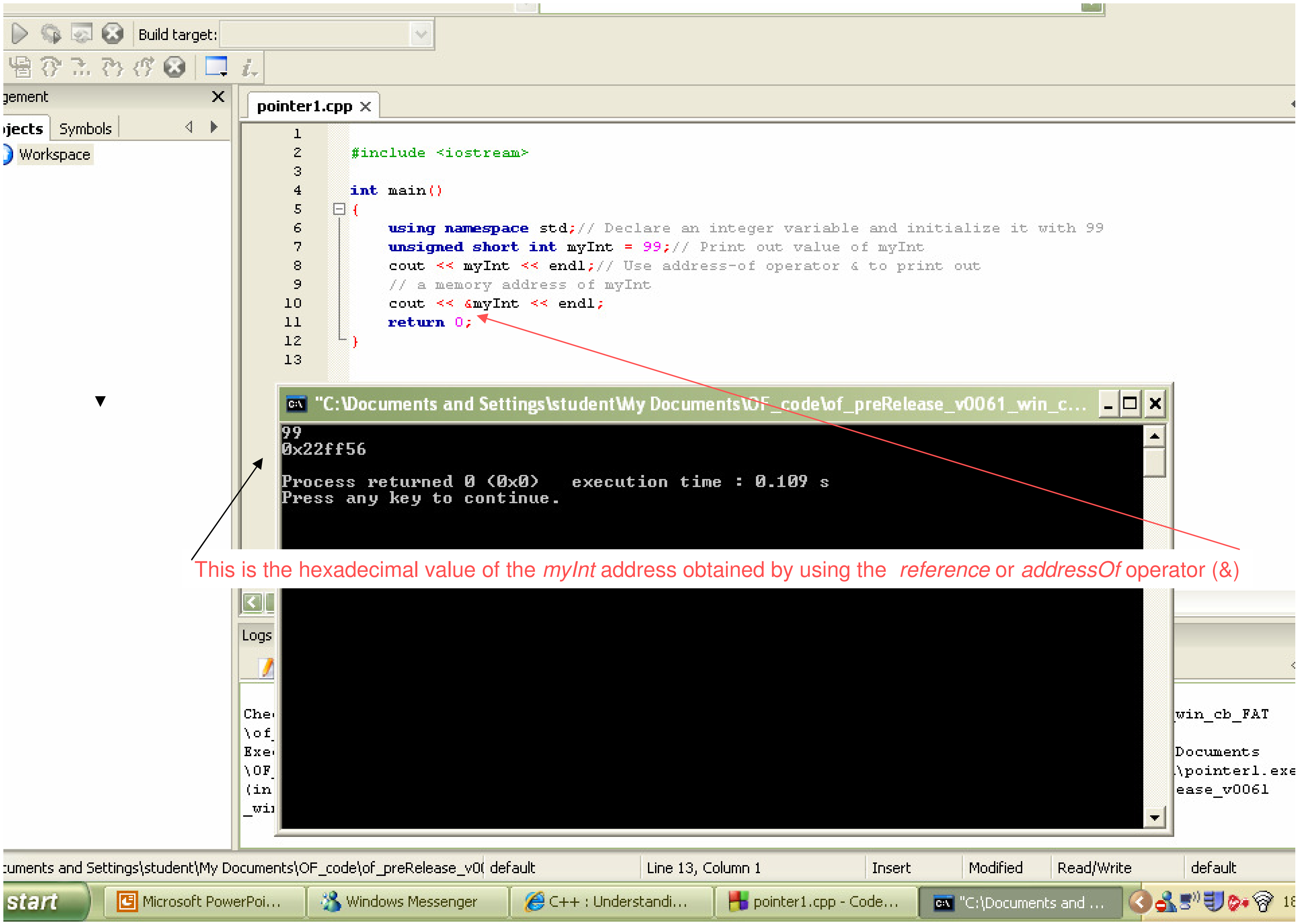


http://www.cplusplus.com/doc/tutorial/pointers/

Open your C++ IDE and run this

```
#include <iostream>
int main()
{
using namespace std;
// Declare an integer variable and initialize it with 99
unsigned short int myInt = 99;
// Print out value of myInt
cout << myInt << endl;
// Use address-of operator or reference operator & to print out
// a memory address of myInt
cout << &myInt << endl;
//& is used to access the reference (memory address) of a variable
return 0;
}
```





```
#include <iostream>

int main()
{
    using namespace std;// Declare an integer variable and initialize it with 99
    unsigned short int myInt = 99;// Print out value of myInt
    cout << myInt << endl;// Use address-of operator & to print out
    // a memory address of myInt
    cout << &myInt << endl;
    return 0;
}
```

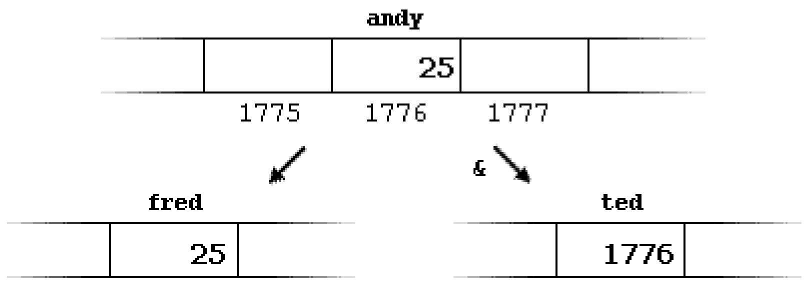
```
"C:\Documents and Settings\student\My Documents\OF_code\of_preRelease_v0061_win_c...
99
0x22ff56

Process returned 0 (0x0)   execution time : 0.109 s
Press any key to continue.
```

This is the hexadecimal value of the *myInt* address obtained by using the *reference* or *addressOf* operator (&)

```
Che                                    win_cb_FAT
\of_
Exe                                    Documents
\OF_                                   \pointer1.exe
(in                                    ease_v0061
_wi
```

```
cuments and Settings\student\My Documents\OF_code\of_preRelease_v0( default    Line 13, Column 1    Insert    Modified    Read/Write    default
```

- The hexadecimal number **ox22ff56** (which is dynamically allocated at runtime) refers to the beginning of the address in the computer’s memory, a bit like an address in a row of houses.



Reference operator (&)
As soon as we declare a variable, the amount of memory needed is assigned for it at a specific location in memory (its memory address). We generally do not actively decide the exact location of the variable within the panel of cells that we have imagined the memory to be - Fortunately, that is a task automatically performed by the operating system during runtime. However, in some cases we may be interested in knowing the address where our variable is being stored during runtime in order to operate with relative positions to it.

The address that locates a variable within memory is what we call a *reference* to that variable. This reference to a variable can be obtained by preceding the identifier of a variable with an ampersand sign (&), known as reference operator, and which can be literally translated as "address of". For example:

```
ted = &andy;
```

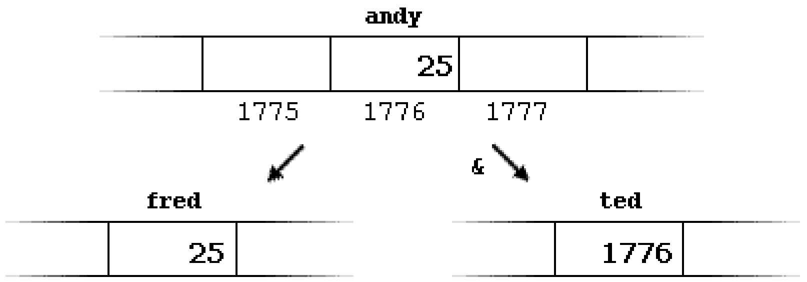
This would assign to ted the address of variable andy, since when preceding the name of the variable andy with the reference operator (&) we are no longer talking about the content of the variable itself, but about its reference (i.e., its address in memory).

From now on we are going to assume that andy is placed during runtime in the memory address 1776. This number (1776) is just an arbitrary assumption we are inventing right now in order to help clarify some concepts in this tutorial, but in reality, we cannot know before runtime the real value the address of a variable will have in memory.

Consider the following code fragment:

```
andy = 25;
fred = andy;
ted = &andy;
```

The values contained in each variable after the execution of this, are shown in the following diagram:



First, we have assigned the value 25 to andy (a variable whose address in memory we have assumed to be 1776).

The second statement copied to fred the content of variable andy (which is 25). This is a standard assignment operation, as we have done so many times before.

Finally, the third statement copies to ted not the value contained in andy but a reference to it (i.e., its address, which we have assumed to be 1776). The reason is that in this third assignment operation we have preceded the identifier andy with the reference operator (&), so we were no longer referring to the value of andy but to its reference (its address in memory).

The variable that stores the reference to another variable (like ted in the previous example) is what we call a *pointer*. Pointers are a very powerful feature of the C++ language that has many uses in advanced programming. Farther ahead, we will see how this type of variable is used and declared.

Dereference operator (*)

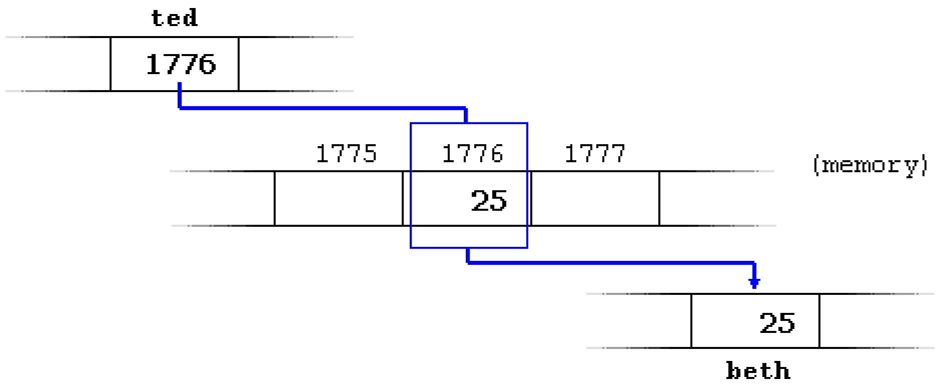
A variable which stores a reference to another variable is called a pointer. Pointers are said to "point to" the variable whose reference they store.

Using a pointer we can directly access the value stored in the variable which it points to. To do this, we simply have to precede the pointer's identifier with an asterisk (*), which acts as dereference operator and that can be literally translated to "value pointed by".

Therefore, following with the values of the previous example, if we write:

```
beth = *ted;
```

(that we could read as: "beth equal to value pointed by ted") beth would take the value 25, since ted is 1776, and the value pointed by 1776 is 25.



You must clearly differentiate that the expression ted refers to the value 1776, while *ted (with an asterisk * preceding the identifier) refers to the value stored at address 1776, which in this case is 25. Notice the difference of including or not including the dereference operator (I have included an explanatory commentary of how each of these two expressions could be read):

```
beth = ted; // beth equal to ted ( 1776 )
 beth = *ted; // beth equal to value pointed by ted ( 25 )
```

Notice the difference between the reference and dereference operators:

& is the reference operator and can be read as "address of"
* is the dereference operator and can be read as "value pointed by"

Thus, they have complementary (or opposite) meanings. A variable referenced with & can be dereferenced with *.

Earlier we performed the following two assignment operations:

```
 andy = 25;
 ted = &andy;
```

Right after these two statements, all of the following expressions would give true as result:

```
andy == 25
&andy == 1776
 ted == 1776
*ted == 25
```

The first expression is quite clear considering that the assignment operation performed on andy was andy=25. The second one uses the reference operator (&), which returns the address of variable andy, which we assumed it to have a value of 1776. The third one is somewhat obvious since the second expression was true and the assignment operation performed on ted was ted=&andy. The fourth expression uses the dereference operator (*) that, as we have just seen, can be read as "value pointed by", and the value pointed by ted is indeed 25.

So, after all that, you may also infer that for as long as the address pointed by ted remains unchanged the following expression will also be true:

***ted == andy**

Declaring variables of pointer types

Due to the ability of a pointer to directly refer to the value that it points to, it becomes necessary to specify in its declaration which data type a pointer is going to point to. It is not the same thing to point to a char as to point to an int or a float.

The declaration of pointers follows this format:

type * name;

```
// declare a pointer variable, m of type int
int *  m;
// assign the address of variable location
// to variable m, so pointer m is pointing to variable location
m = &location;
// the actual data assigned to variable location
location = 200;
```

where type is the data type of the value that the pointer is intended to point to. This type is not the type of the pointer itself! but the type of the data the pointer points to. For example:

***int* * number;**
***char* * character;**
***float* * greatnumber;**

These are three declarations of pointers. Each one is intended to point to a different data type, but in fact all of them are pointers and all of them will occupy the same amount of space in memory (the size in memory of a pointer depends on the platform where the code is going to run). Nevertheless, the data to which they point to do not occupy the same amount of space nor are of the same type: the first one points to an int, the second one to a char and the last one to a float. Therefore, although these three example variables are all of them pointers which occupy the same size in memory, they are said to have different types: int*, char* and float* respectively, depending on the type they point to.

I want to emphasize that the asterisk sign (*) that we use when declaring a pointer only means that it is a pointer (it is part of its type compound specifier), and should not be confused with the dereference operator that we have seen a bit earlier, but which is also written with an asterisk (*). They are simply two different things represented with the same sign.

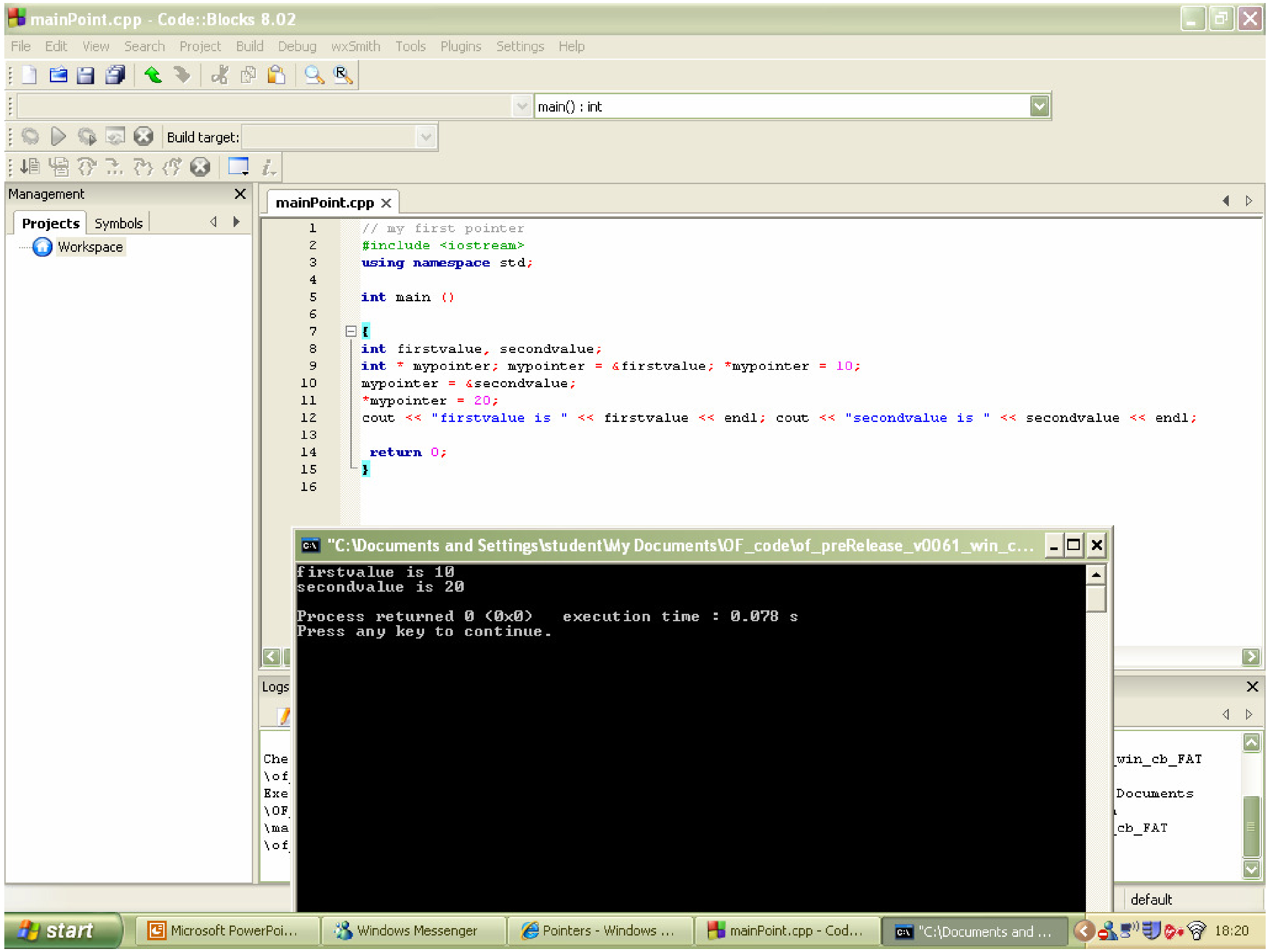
NB Pointers should always be assigned a value by reference (&) to a variable that has a value, pointers without values are called WILD POINTERS and are considered to be DANGEROUS, at least assign it a value of Null or 0;

Pointers also generate many bugs in programs if used improperly or maliciously

Now have a look at this code:

```
// my first pointer
#include <iostream>
using namespace std;

int main ()

{
int firstvalue, secondvalue;
int * mypointer;
mypointer = &firstvalue;
*mypointer = 10;
mypointer = &secondvalue;
*mypointer = 20;
cout << "firstvalue is " << firstvalue << endl;
cout << "secondvalue is " << secondvalue << endl;

 return 0;
}
```

Run the code in Code:Blocks (or your IDE of choose)



```cpp
// my first pointer
#include <iostream>
using namespace std;

int main ()

{
int firstvalue, secondvalue;
int * mypointer; mypointer = &firstvalue; *mypointer = 10;
mypointer = &secondvalue;
*mypointer = 20;
cout << "firstvalue is " << firstvalue << endl; cout << "secondvalue is " << secondvalue << endl;

 return 0;
}
```

"C:\Documents and Settings\student\My Documents\OF_code\of_preRelease_v0061_win_c...

```
firstvalue is 10
secondvalue is 20

Process returned 0 (0x0)   execution time : 0.078 s
Press any key to continue.
```

Notice that even though we have never directly set a value to either firstvalue or secondvalue, both end up with a value set indirectly through the use of mypointer. This is the procedure:

First, we have assigned as value of mypointer a reference to firstvalue using the reference operator (&). And then we have assigned the value 10 to the memory location pointed by mypointer, that because at this moment is pointing to the memory location of firstvalue, this in fact modifies the value of firstvalue.

In order to demonstrate that a pointer may take several different values during the same program I have repeated the process with secondvalue and that same pointer, mypointer.

Why is this useful?

The ability of C++ to access memory directly by pointers makes C++ favorable over some other languages such as Visual Basic, C# or Java. Accessing variables directly by pointers rather than through their memory location results in increased efficiency and flexibility of written code. However, as it can be expected, increased efficiency takes its cost, because using any low-level tool such as a pointer means intensified difficulty in their implementation. The most common use of pointers includes:
Data management on the **free store***
Accessing class member data and functions
Passing variables by reference to functions

***The *free store* is a pool of memory available for you to allocate (and deallocate) storage for objects during the execution of your program. The new and delete operators are used to allocate and deallocate free store, respectively.**

from
http://www.linuxconfig.org/c-understanding-pointers

When to use pointers

- See *Programming Interactivity p147*
- Note that by using pointers you can change the value of variables passed to a method

Print to .txt files in C++

```
#include <iostream>
#include <fstream>

using namespace std;
int main () {

  ofstream myfile;
  myfile.open ("test.txt");
  myfile <<  "Hey this is my first written text file.\n";
  myfile.close();
  return 0;
}
```

Formatting C++ to print ints and floats etc

The C function **printf** was able to format output using Format Specifiers such as %d. Joshua Noble uses these in his examples

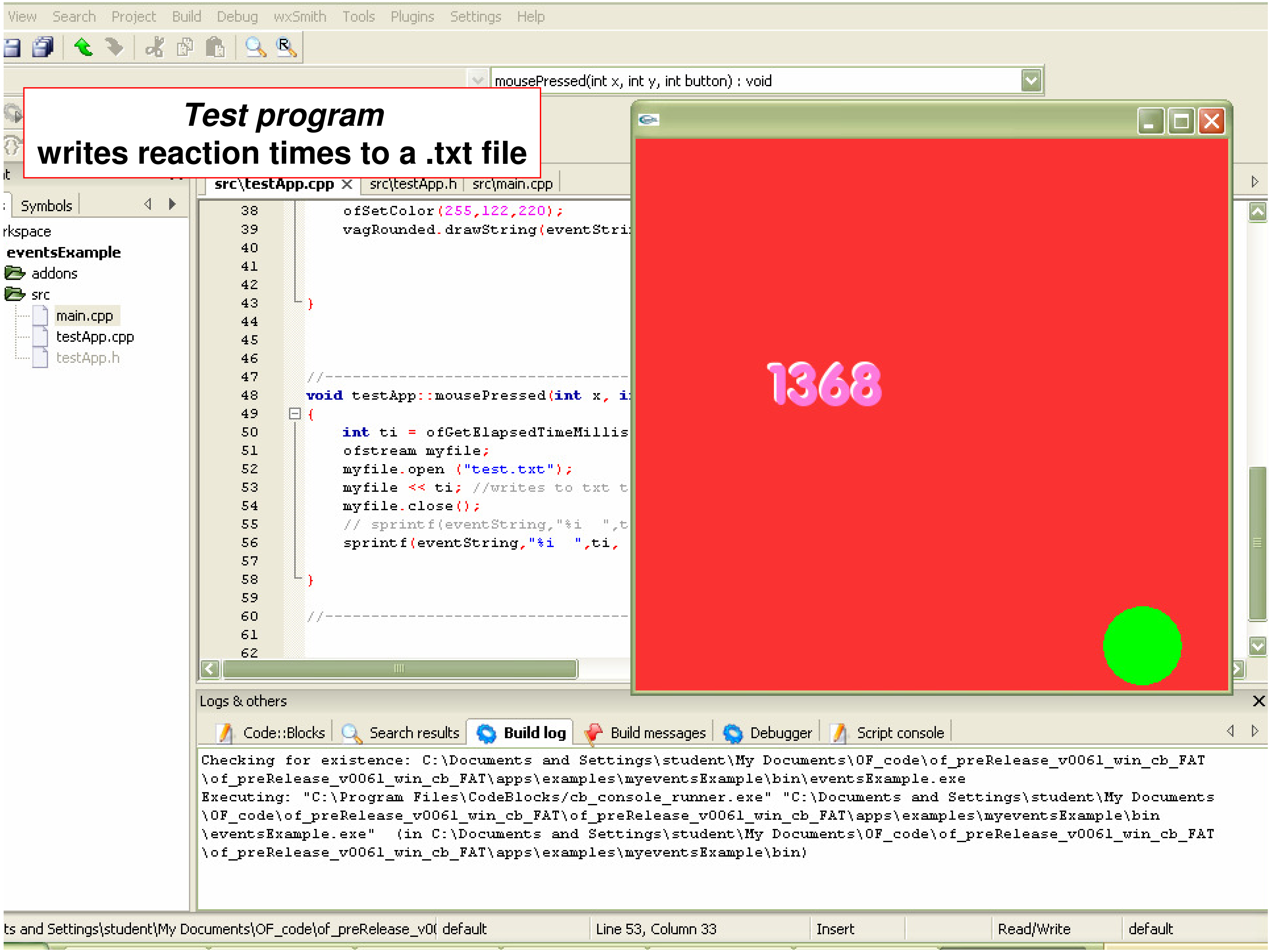
In C++ cout can also format output but uses a different way of doing it.
Using manipulators such as cout<< **fixed** << **setprecision(2);**
The manipulators *fixed* and *setprecision* will change the output format of all floating point numbers

There are quite a number of C format specifiers for printf. Here are the basic ones :

%d print an int argument in decimal
%ld print a long int argument in decimal
%c print a character %s print a string
%f print a float or double argument
%e same as %f, but use exponential notation
%g use %e or %f, whichever is better
%o print an int argument in octal (base 8)
%x print an int argument in hexadecimal (base 16)
%% print a single %

```
printf("%c %d %f %e %s %d%%\n", '1', 2, 3.14, 56000000., "eight", 9);
```
Prints:
```
1 2 3.140000 5.600000e+07 eight 9%
```

Test program
writes reaction times to a .txt file



```
    ofSetColor(255,122,220);
    vagRounded.drawString(eventStri



}



//-----------------------------------
void testApp::mousePressed(int x, i
{
    int ti = ofGetElapsedTimeMillis
    ofstream myfile;
    myfile.open ("test.txt");
    myfile << ti; //writes to txt t
    myfile.close();
    // sprintf(eventString,"%i  ",t
    sprintf(eventString,"%i  ",ti,

}

//-----------------------------------
```

```
Checking for existence: C:\Documents and Settings\student\My Documents\OF_code\of_preRelease_v0061_win_cb_FAT
\of_preRelease_v0061_win_cb_FAT\apps\examples\myeventsExample\bin\eventsExample.exe
Executing: "C:\Program Files\CodeBlocks/cb_console_runner.exe" "C:\Documents and Settings\student\My Documents
\OF_code\of_preRelease_v0061_win_cb_FAT\of_preRelease_v0061_win_cb_FAT\apps\examples\myeventsExample\bin
\eventsExample.exe"  (in C:\Documents and Settings\student\My Documents\OF_code\of_preRelease_v0061_win_cb_FAT
\of_preRelease_v0061_win_cb_FAT\apps\examples\myeventsExample\bin)
```

ts and Settings\student\My Documents\OF_code\of_preRelease_v0(default | Line 53, Column 33 | Insert | Read/Write | default

Reaction time program
tsetApp.h

```
#ifndef _TEST_APP
#define _TEST_APP
#include <fstream> //for printing text file
#include "ofMain.h"

class testApp : public ofBaseApp
{

public:

    void setup();
    void update();
    void draw();



    void mousePressed(int x, int y, int button);

    int ran2;
    float                   ran;
    float                   counter;
    ofTrueTypeFont    vagRounded;
    char eventString[255];
    char timeString[255];
};

#endif
```

Reaction time program **testApp.cpp**

```
#include "testApp.h"

void testApp::setup()
{
    counter = 0;
    vagRounded.loadFont("vag.ttf", 32);
    ofBackground(250,50,50);
    ran = ofRandom(55, 123);
    ran2 = (int)ofRandom(10, ofGetWidth()-20);
}


void testApp::update()
{
    counter = counter + 0.033f;
}

void testApp::draw()
{



    if (counter> ran)
    {
        ofSetColor(0,255,0);
        //randomise position within frame?
        ofCircle(ran2, ran2, 30);
    }

    //makes a two tone effect:
    ofSetColor(0xffffff);
    vagRounded.drawString(eventString, 98,198);

    ofSetColor(255,122,220);
    vagRounded.drawString(eventString, 100,200);


}


void testApp::mousePressed(int x, int y, int button)
{
    int ti = ofGetElapsedTimeMillis();
    ofstream myfile;
    myfile.open ("test.txt");
    myfile << ti; //writes to txt time user pressed - i.e response time
    myfile.close();
   sprintf(eventString,"%i  ",ti, 20, 20, 320);
}
```

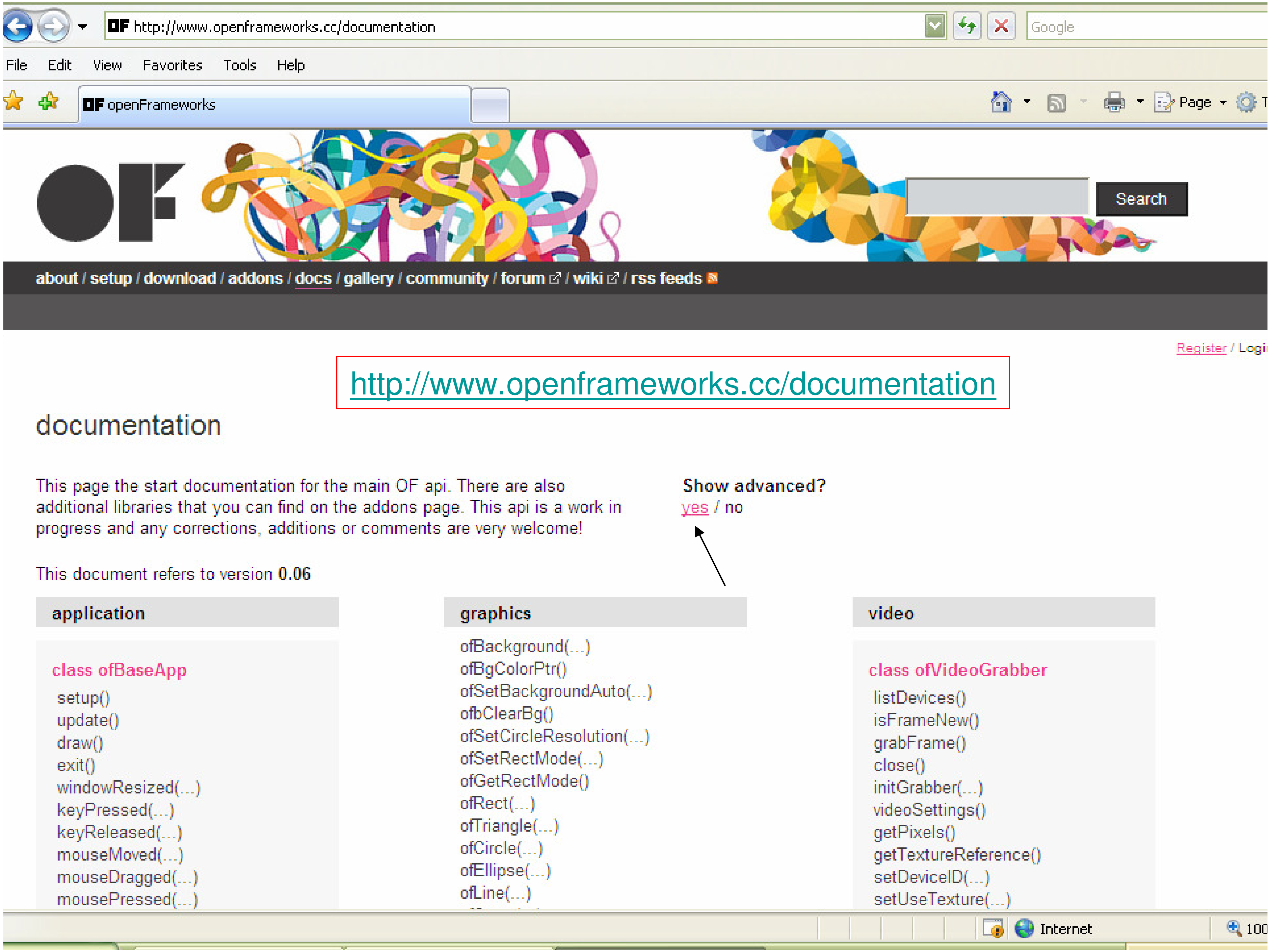
```
#include "ofMain.h"
#include <iostream>
#include "testApp.h"

#include "ofAppGlutWindow.h"



int main( )
{

    ofAppGlutWindow window;
    ofSetupOpenGL(&window, 450,400, OF_WINDOW);

    // this kicks off the running of my app
    // can be OF_WINDOW or OF_FULLSCREEN
    // pass in width and height too:



    ofRunApp( new testApp());

}
```

Reaction time program

Main.cpp

The .txt file is printed in
The *bin* folder

Importing libraries



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documentation

This page the start documentation for the main OF api. There are also additional libraries that you can find on the addons page. This api is a work in progress and any corrections, additions or comments are very welcome!

Show advanced?
yes / no

This document refers to version **0.06**

application

class ofBaseApp
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draw()
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ofSetBackgroundAuto(...)
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getPixels()
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setUseTexture(...)

Internet

OF wiki:
http://wiki.openframeworks.cc/index.php?title=Main_Page

http://www.berio.alg-a.org/Setting-up-Openframeworks
Xcode how to rename a project
http://www.greenghostphotos.com/xcoderename.pdf

http://www.wordpress.openframeworks.cc/faq

Videos about OF
http://vimeo.com/8672780