2.7 — Programs with multiple code files

ALEX AUGUST 27, 2021

Adding files to your project

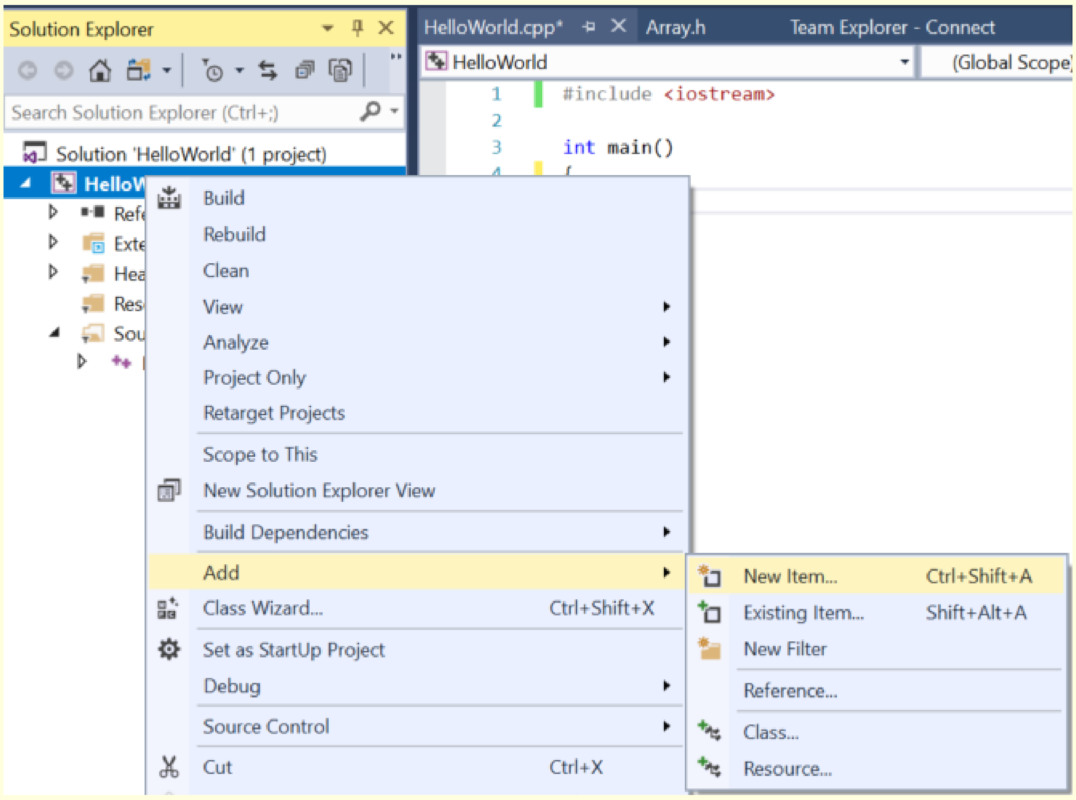
As programs get larger, it is common to split them into multiple files for organizational or reusability purposes. One advantage of working with an IDE is that they make working with multiple files much easier. You already know how to create and compile single-file projects. Adding new files to existing projects is very easy.

Best practice

When you add new code files to your project, give them a .cpp extension.

For Visual Studio users

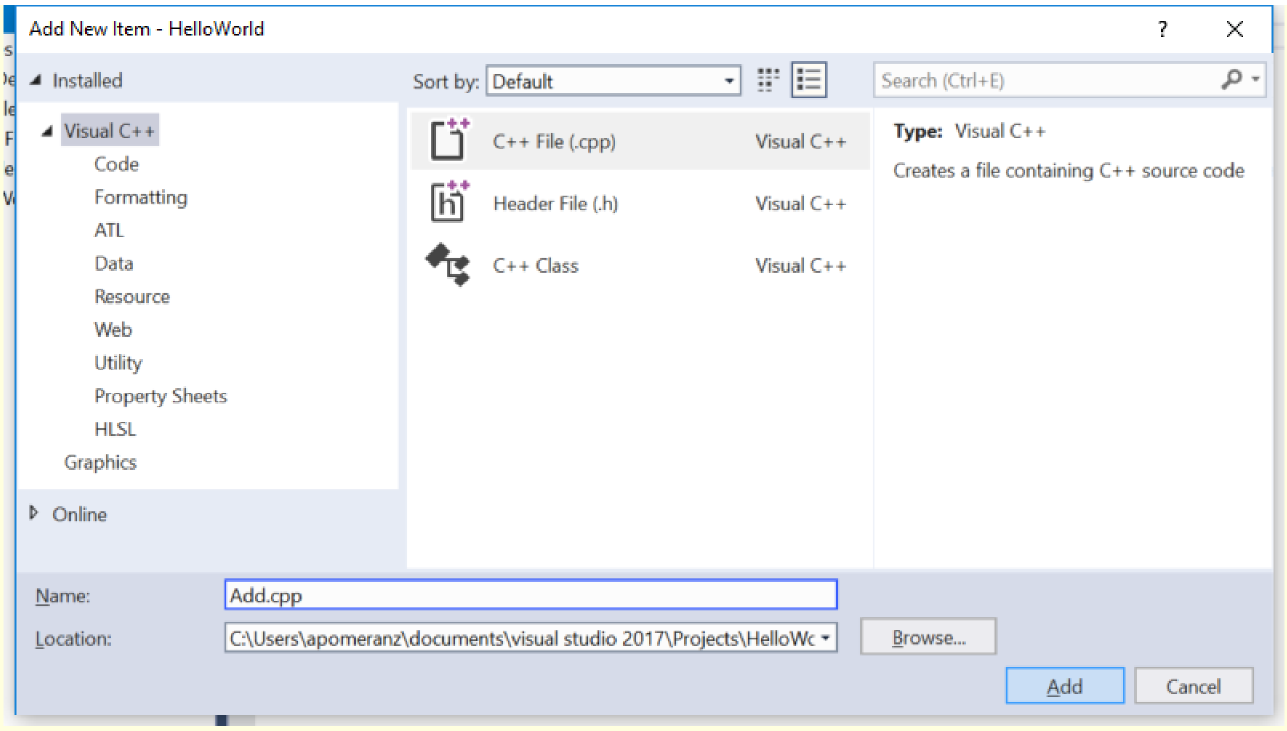
In Visual Studio, right click on the *Source Files* folder in the Solution Explorer window, and choose *Add > New Item...*



```
#include <iostream>

int main()
{
```

Make sure you have *C++ File (.cpp)* selected. Give the new file a name, and it will be added to your project.

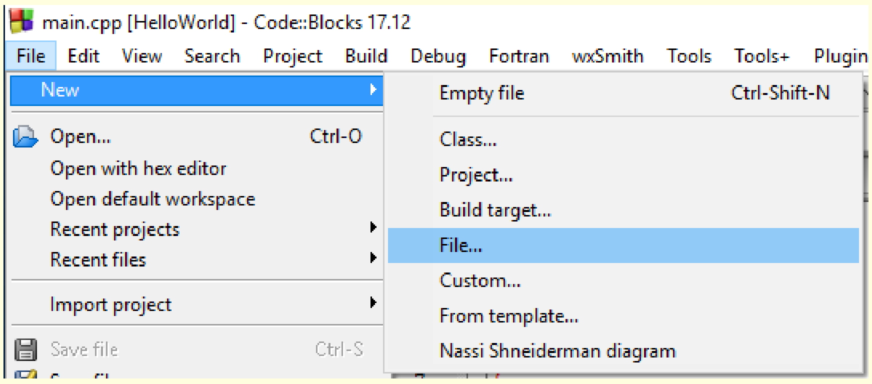

Add New Item - HelloWorld
Installed
Visual C++
Code
Formatting
ATL
Data
Resource
Web
Utility
Property Sheets
HLSL
Graphics
Online
Sort by: Default
Search (Ctrl+E)
C++ File (.cpp) Visual C++
Header File (.h) Visual C++
C++ Class Visual C++
Type: Visual C++
Creates a file containing C++ source code
Name: Add.cpp
Location: C:\Users\apomeranz\documents\visual studio 2017\Projects\HelloWc
Browse...
Add
Cancel

Note: If you create a new file from the *File menu* instead of from your project in the Solution Explorer, the new file won't be added to your project automatically. You'll have to add it to the project manually. To do so, right click on *Source Files* in the *Solution Explorer*, choose *Add > Existing Item*, and then select your file.

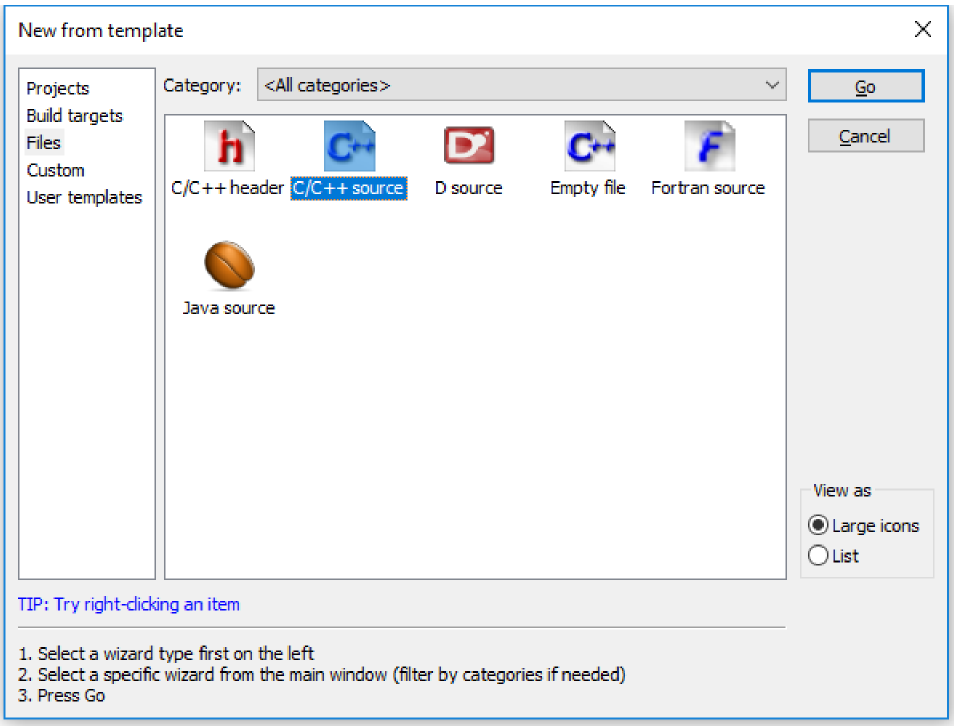
Now when you compile your program, you should see the compiler list the name of your file as it compiles it.

For Code::Blocks users

In Code::Blocks, go to the *File menu* and choose *New > File...*.



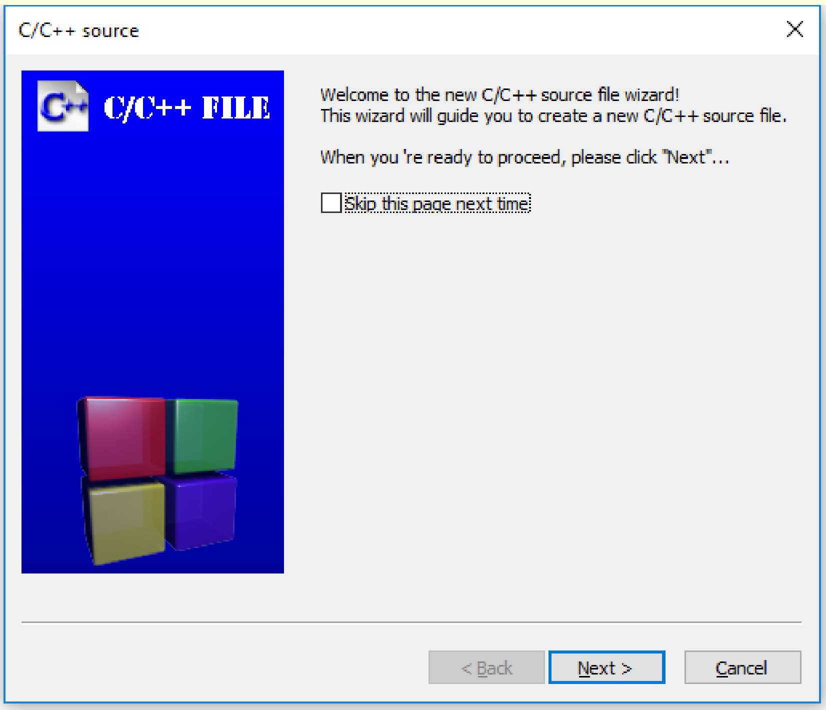
In the *New from template* dialog, select *C/C++ source* and click *Go*.



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

You may or may not see a *welcome to the C/C++ source file wizard* dialog at this point. If you do, click *Next*.

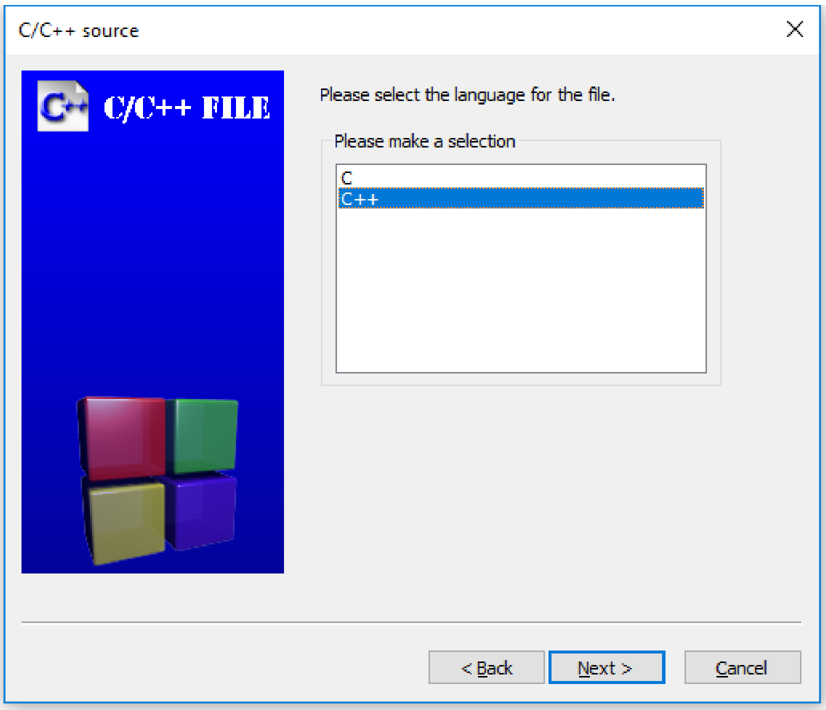


Welcome to the new C/C++ source file wizard!
This wizard will guide you to create a new C/C++ source file.

When you 're ready to proceed, please click "Next"...

☐ Skip this page next time

On the next page of the wizard, select "C++" and click *Next*.

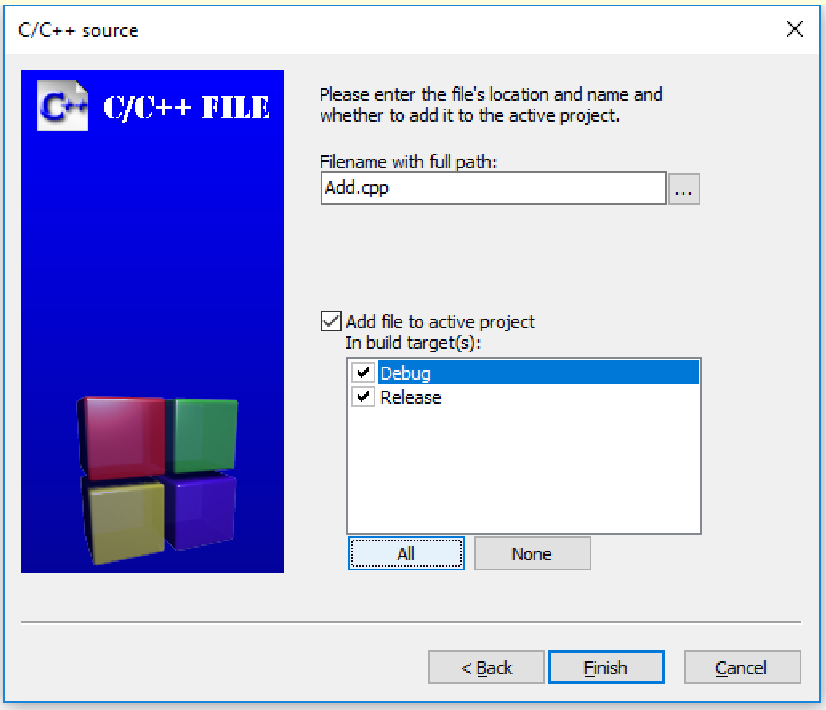

C/C++ source

Please select the language for the file.

Please make a selection

C
C++

Now give the new file a name (don't forget the .cpp extension), and click the*All* button to ensure all build targets are selected. Finally, select *finish*.


C/C++ source

Please enter the file's location and name and whether to add it to the active project.

Filename with full path:
Add.cpp

☑ Add file to active project
In build target(s):
☑ Debug
☑ Release

Now when you compile your program, you should see the compiler list the name of your file as it compiles it.

For GCC/G++ users

From the command line, you can create the additional file yourself, using your favorite editor, and give it a name. When you compile your program, you'll need to include all of the relevant code files on the compile line. For example: *g++ main.cpp add.cpp -o main*, where *main.cpp* and *add.cpp* are the names of your code files, and *main* is the name of the output file.

A multi-file example

In lesson 2.6 -- Forward declarations and definitions, we took a look at a single-file program that wouldn't compile:

```cpp
#include <iostream>

int main()
{
    std::cout << "The sum of 3 and 4 is: " << add(3, 4) << '\n';
    return 0;
}

int add(int x, int y)
{
    return x + y;
}
```

When the compiler reaches the function call to *add* on line 5 of *main*, it doesn't know what *add* is, because we haven't defined *add* until line 9! Our solution to this was to either reorder the functions (placing *add* first) or use a forward declaration for *add*.

Now let's take a look at a similar multi-file program:

add.cpp:

```cpp
int add(int x, int y)
{
    return x + y;
}
```

main.cpp:

```cpp
#include <iostream>

int main()
{
    std::cout << "The sum of 3 and 4 is: " << add(3, 4) << '\n'; // compile error
    return 0;
}
```

Your compiler may decide to compile either *add.cpp* or *main.cpp* first. Either way, *main.cpp* will fail to compile, giving the same compiler error as the previous example:

```
main.cpp(5) : error C3861: &#039;add&#039;: identifier not found
```

The reason is exactly the same as well: when the compiler reaches line 5 of *main.cpp*, it doesn't know what identifier *add* is.

Remember, the compiler compiles each file individually. It does not know about the contents of other code files, or remember anything it has seen from previously compiled code files. So even though the compiler may have seen the definition of function *add* previously (if it compiled *add.cpp* first), it doesn't remember.

This limited visibility and short memory is intentional, so that files may have functions or variables that have the same names without conflicting with each other. We'll explore an example of such a conflict in the next lesson.

Our options for a solution here are the same as before: place the definition of function *add* before function *main*, or satisfy the compiler with a forward declaration. In this case, because function *add* is in another file, the reordering option isn't a good one.

The better solution here is to use a forward declaration:

main.cpp (with forward declaration):

```cpp
#include <iostream>

int add(int x, int y); // needed so main.cpp knows that add() is a function declared
elsewhere

int main()
{
    std::cout << "The sum of 3 and 4 is: " << add(3, 4) << '\n';
    return 0;
}
```

add.cpp (stays the same):

```cpp
int add(int x, int
y)
{
    return x + y;
}
```

Now, when the compiler is compiling *main.cpp*, it will know what identifier *add* is and be satisfied. The linker will connect the function call to *add* in *main.cpp* to the definition of function *add* in *add.cpp*.

Using this method, we can give files access to functions that live in another file.

Try compiling *add.cpp* and the *main.cpp* with the forward declaration for yourself. If you get a linker error, make sure you've added *add.cpp* to your project or compilation line properly.

Something went wrong!

There are plenty of things that can go wrong the first time you try to work with multiple files. If you tried the above example and ran into an error, check the following:

1. If you get a compiler error about *add* not being defined in *main*, you probably forgot the forward declaration for function *add* in *main.cpp*.
2. If you get a linker error about *add* not being defined, e.g.

```
unresolved external symbol "int __cdecl add(int,int)" (?add@@YAHHH@Z) referenced in function _main
```

2a. ...the most likely reason is that *add.cpp* is not added to your project correctly. When you compile, you should see the compiler list both *main.cpp* and *add.cpp*. If you only see *main.cpp*, then *add.cpp* definitely isn't getting compiled. If you're using Visual Studio or Code::Blocks, you should see *add.cpp* listed in the Solution Explorer/project pane on the left or right side of the IDE. If you don't, right click on your project, and add the file, then try compiling again. If you're compiling on the command line, don't forget to include both *main.cpp* and *add.cpp* in your compile command.

2b. ...it's possible that you added *add.cpp* to the wrong project.

2c. ...it's possible that the file is set to not compile or link. Check the file properties and ensure the file is configured to be compiled/linked. In Code::Blocks, compile and link are separate checkboxes that should be checked. In Visual Studio, there's an "exclude from build" option that should be set to "no" or left blank.

3. Do *not #include "add.cpp"* from *main.cpp*. This will cause the compiler to insert the contents of *add.cpp* directly into *main.cpp* instead of treating them as separate files.

Summary

When the compiler compiles a multi-file program, it may compile the files in any order. Additionally, it compiles each file individually, with no knowledge of what is in other files.

We will begin working with multiple files a lot once we get into object-oriented programming, so now’s as good a time as any to make sure you understand how to add and compile multiple file projects.

Reminder: Whenever you create a new code (.cpp) file, you will need to add it to your project so that it gets compiled.

Quiz time

Question #1

Split the following program into two files (main.cpp, and input.cpp). Main.cpp should have the main function, and input.cpp should have the getInteger function.

Show Hint

```
#include <iostream>

int getInteger()
{
 std::cout << "Enter an integer: ";
 int x{};
 std::cin >> x;
 return x;
}

int main()
{
 int x{ getInteger() };
 int y{ getInteger() };

 std::cout << x << " + " << y << " is " << x + y << '\n';
 return 0;
}
```

Show Solution

Next lesson
2.8 Naming collisions and an introduction to namespaces

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