University of Nottingham
UK | CHINA | MALAYSIA

EEEE1042 - Lecture 1
Introduction to Software Engineering and Programming
Autumn Semester 2021.

Dr. Chan, Kheong Sann

kheongsann.chan@nottingham.edu.my

University of Nottingham Malaysia

Department of Electrical and Electronic Engineering

EEEE1042/1032 C Programming: Scheduled classes

EEEE1042: for EE students, EEEE1032: for Mecha students.

Week	Dates	Lecture	EEEE1042 Practical	EEEE1032 Practical	Assessment
4	Sep 26 – 30	Thu2-4pm			
5	Oct 3 – 09	Thu2-4pm	Mon3-6pm	Wed3-6pm	
6	Oct 10 – 14	Thu2-4pm	P.H.	Wed3-6pm	
7	Oct 17 – 21	Thu2-4pm	Mon3-6pm	Wed3-6pm	PT1 5%
8	Oct 24 – 28	Thu2-4pm	P.H.	Wed3-6pm	
9	Oct 31 – Nov 04	Project Week 1			
10	Nov 07 – 11	Thu2-4pm	Mon3-6pm	Wed3-6pm	PT2 5%
11	Nov 14 – 18	Thu2-4pm	Mon3-6pm	Wed3-6pm	CW1 10%
12	Nov 21 – 25	Project Week 2			
13	Nov 28 – Dec 04	Thu2-4pm	Mon3-6pm	Wed3-6pm	PT3 5%
14	Dec 05 – 09	Project Week 3			
15	Dec 12 – 16	Thu2-4pm	P.H.	Wed3-6pm	PT4 5%
16	Dec 19 – 23	Study Week			CW2 30%
17-18	Dec 26 – Jan 06	Study Weeks			
19-20	Jan 09 – 21	Final Exam (40%)			

EEEE1042/1032 Course Information

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Targeted students

This course is targeted at first year electrical (EEEE1042) and mechatronics (EEEE1032) students.

Assessment

- Coursework 1: 10%
- Coursework 2: 30%
- Final Exam : 40%
- Progress Tests: 20%

Submission through upload to Moodle.
Note: coursework or final exams that are substantially similar will be penalized as evidence of plagiarism.

Learning Outcome

- Develop the ability to analyse engineering problems by selecting appropriate software and/or techniques to enable the designing, planning, developing and implementation of practical solutions.

EEEE1042 C Programming: Class Outline

1. Installation of IDE environment, test gcc on HelloWorld.c program
2. Tokens: keywords, identifiers, data type
3. Casting, number systems, variables, scope, functions, libraries
4. Flow of control: for, if while do-while
5. Pointers, references, strings, string functions
6. File handling getchar putchar, fread fwrite, fscanf
7. Pointers, arrays, multidim arrays, pointer&functions
8. Dynamic memory allocation: malloc, calloc, realloc
9. Advanced Data structures, typedef struct, linked list, trees.

Assessment method

Assessment

- 2 Courseworks totaling: 40%
- 4 Progress Tests: 5% each, 1 hour in duration, closed book multiple choice test occurs on Friday afternoon of weeks 7, 10, 13 and 15
- 1 Final exam worth 40%

Coursework Marking Rubric

0-25%	Codes undeveloped or did not compile properly.
26-50%	Codes developed and compiled, but result is incorrect.
51-75%	Codes developed and compiled, result correct, but not well commented/modular, or good programming techniques.
76-100%	Codes developed, compiled with correct results using taught best practice standards, and modularity/good-coding rules are demonstrated/followed.

Significantly similar code as evidence of plagiarism will be penalized.

Outline EEEE1042 C Lecture 1:

Introduction to C

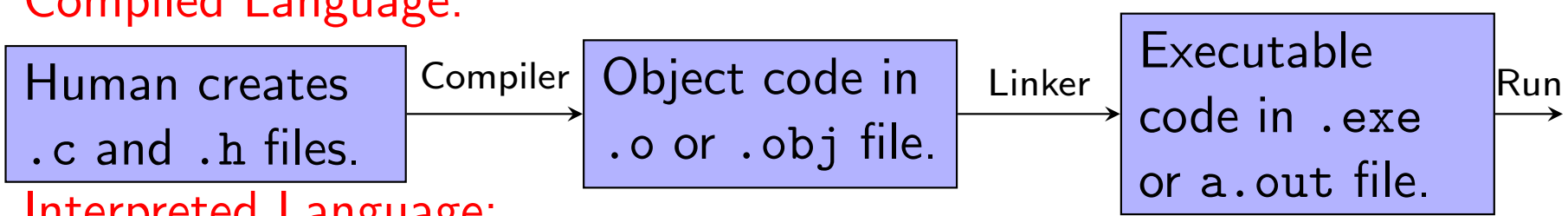
- C is a **compiled**, **low-level**, **procedural** computer programming language developed in 1972 by Dennis Ritchie at Bell Labs and it was used to write the UNIX operating system.

Compiled language takes human-readable code like `printf("hello")` and **compiles** it into **object** code that a CPU can execute.

Low-level language means that its instructions match closely the capabilities of the hardware like the **CPU** and **memory**.

Procedural language makes use of procedures, subroutines or subfunctions. It is one of the tools to help enable **modularity** and **code-reusability**.

Compiled Language:



Interpreted Language:

For interpreted Languages the interpreter (eg: Matlab) reads the commands line by line and executes them at **run-time**.

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Low-level/Mid-level (C)

`z=x+y;` `x`, `y` and `z` must be declared and typed before use.

- Memory allocated by user
- Closer to the hardware
- Runs faster/Slower to program

High-level (Matlab)

`z=x+y;` `x`, `y` and `z` do not need to be pre-declared nor typed

- Memory allocated by interpreter
- Closer to the programmer
- Runs slower/Easier to program

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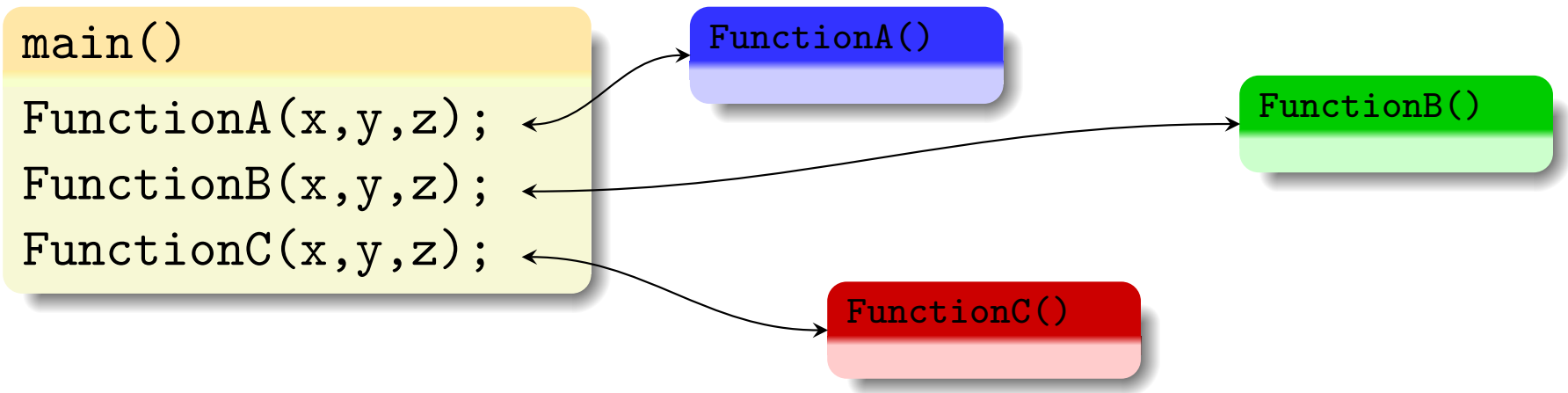


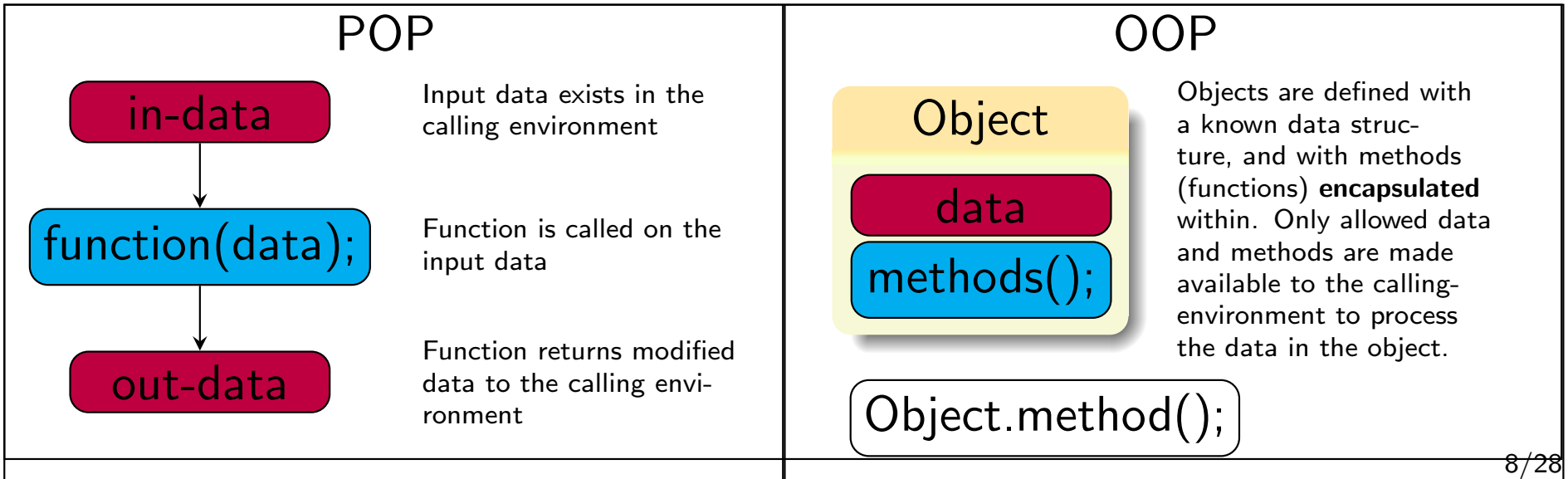
Introduction to C++

- C++ is an **object-oriented** version of C, or C with **classes**, developed by Bjarne Stroustrup from 1979-1985

Object Oriented instead of focusing on data and procedures as in C, C++ focuses on **objects**.

Classes are user defined types that **encapsulate** the data and functions (now called methods) together.

OOP **Object Oriented Programing**, a programming paradigm that defines/uses the object as opposed to **procedural oriented programming** (POP) that defines/uses functions

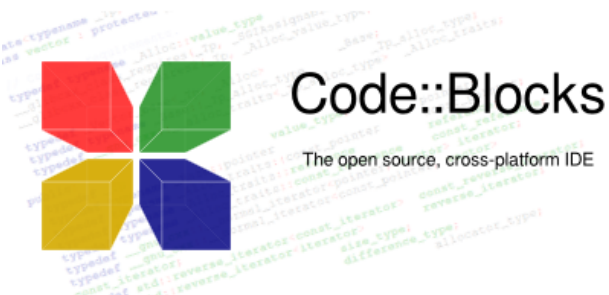


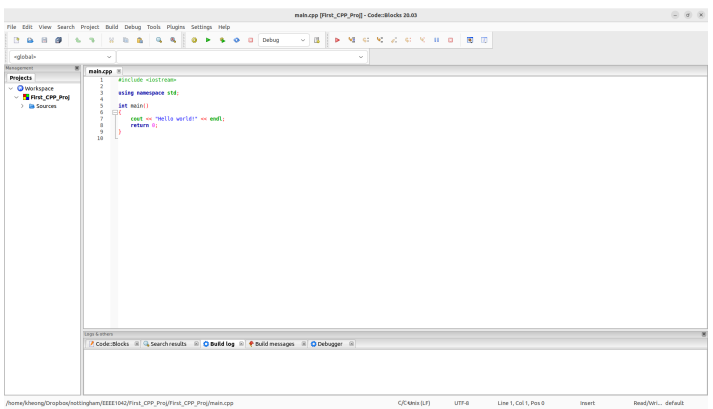
OS, IDE and compiler

- In order to write a C/C++ program, the programmer must select an **OS** (operating system), **IDE** (Integrated Development Environment) and a **C-compiler**.
- In this course the **OS** is: Windows/Mac/Linux
  IDE: CodeBlocks, **Compiler**: `gcc/g++/MinGW`

Code::Blocks is a free, open-source cross-platform integrated development environment (IDE) that ties in to a variety of C compiler back-ends including gcc, MinGW, MS Visual C++, amongst others.

Code::Blocks has binaries for Windows, Mac and Linux platforms.





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Compiler: gcc/g++/MinGW

gcc is the standard GNU C Compiler that comes with the standard Linux OS first released in 1987 by Richard Stallman. **g++** is the front-end for the GNU C++ Compiler.

MinGW is **Minimalist GNU for Windows** that provides GNU utilities including gcc/g++/gnu debugger for the Windows platform. You should choose to install Code::Blocks with MinGW in Windows.

Downloading and Installing Code::Blocks.

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Microsoft Windows

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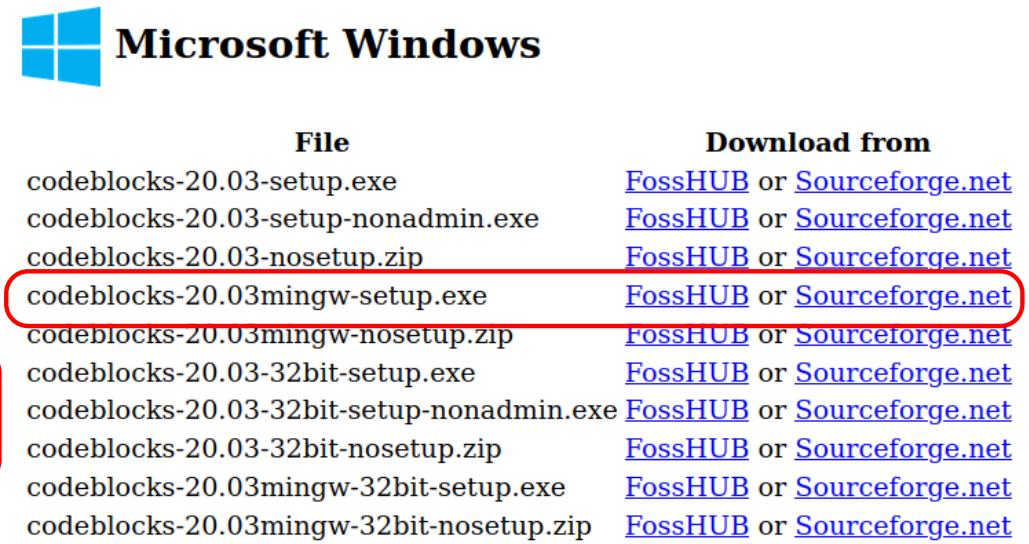

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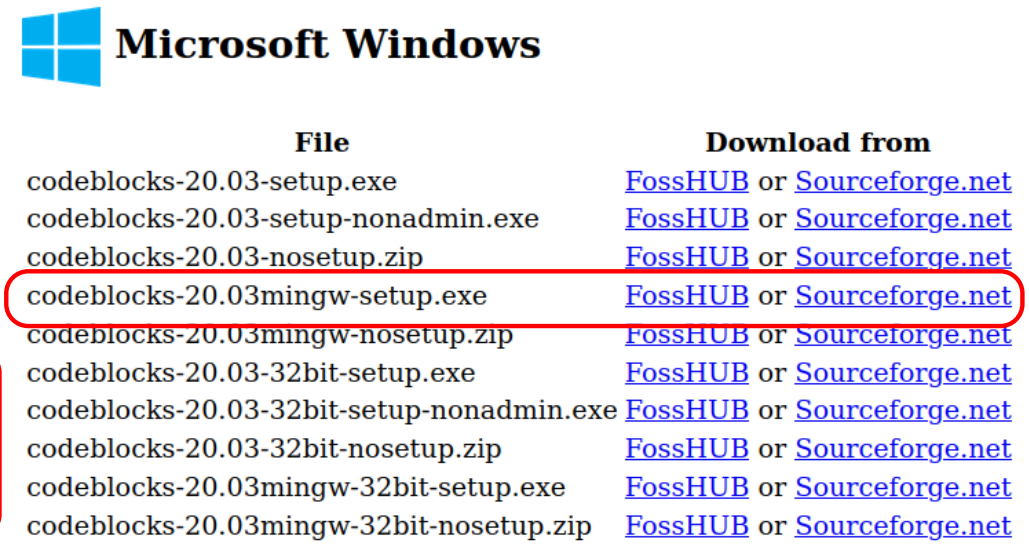
Choose with MinGW to install the files that include the Windows version of the GNU C compiler (gcc)



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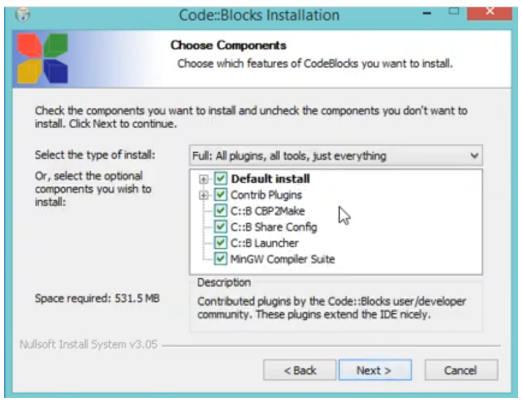
4. You can choose which components to include in the install. Be sure you include MinGW to have the compiler



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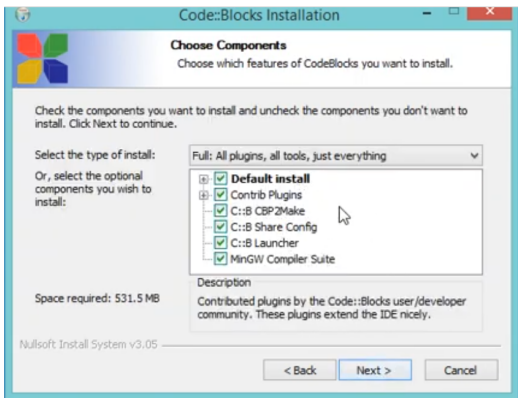
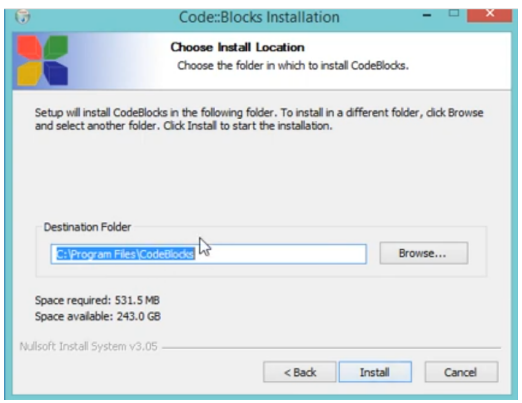


5. This screen allows you to choose where you want to install Code::Blocks, you can just leave it at the default.



Set MinGW to the system path.

6. After installation complete, add MinGW to the system path. This enables Code::Blocks to find and use it. If you used the default install location, this will be at `C:\Program Files\CodeBlocks\MinGW\bin`

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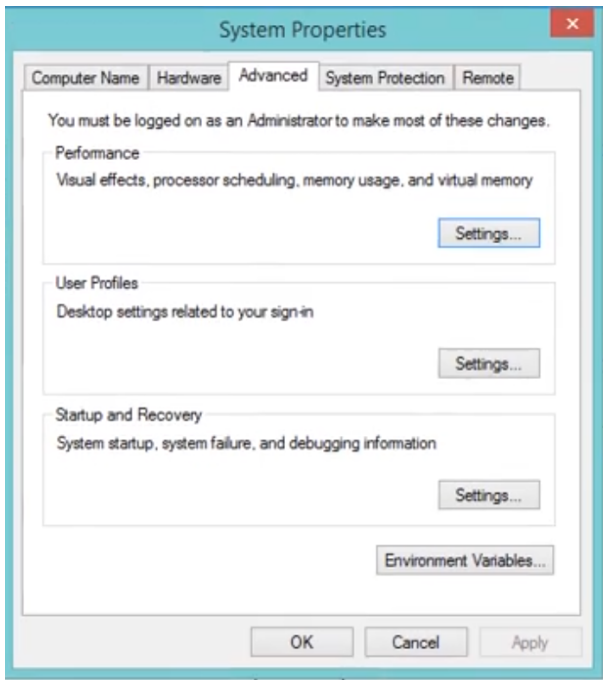

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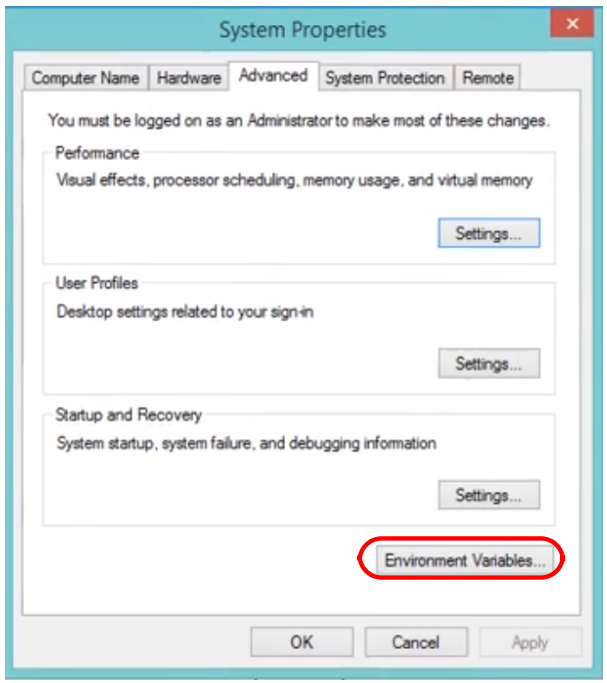

Click Environment variables.

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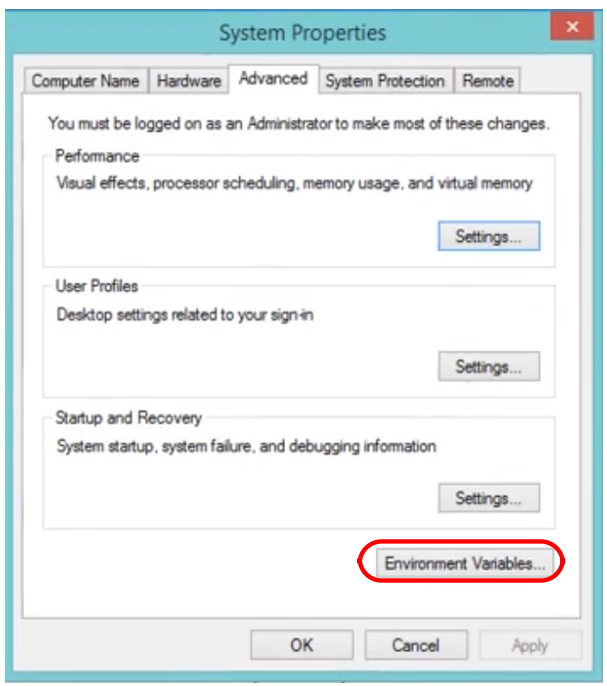

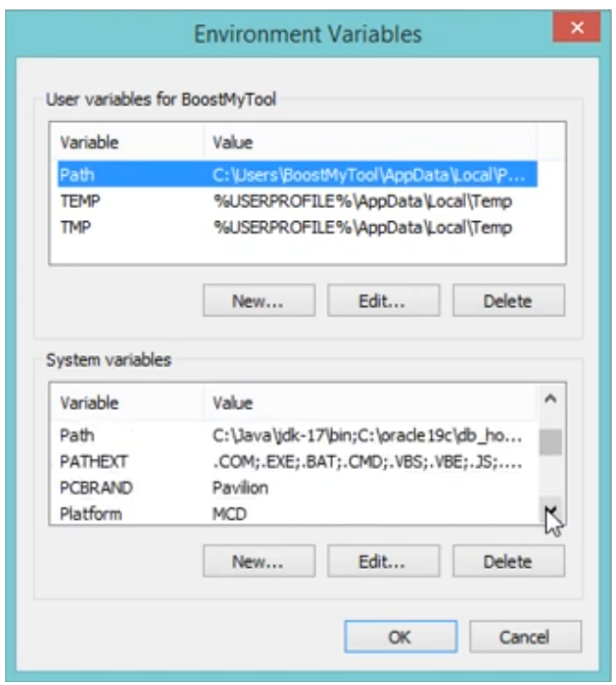

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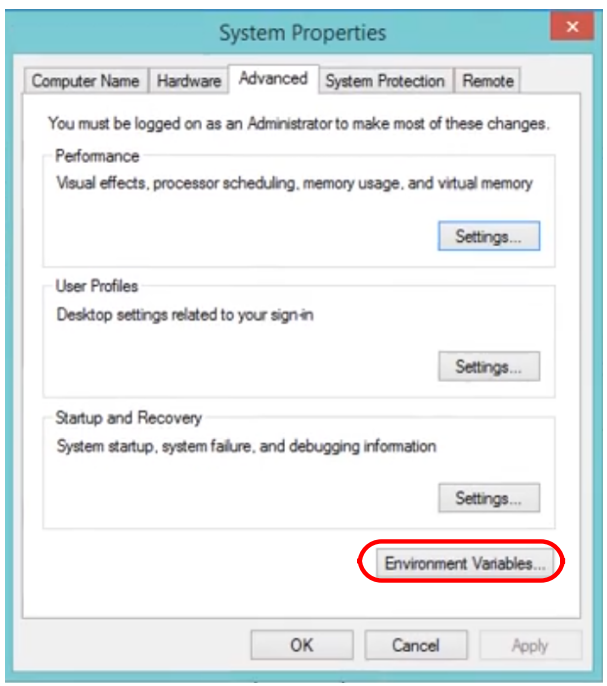

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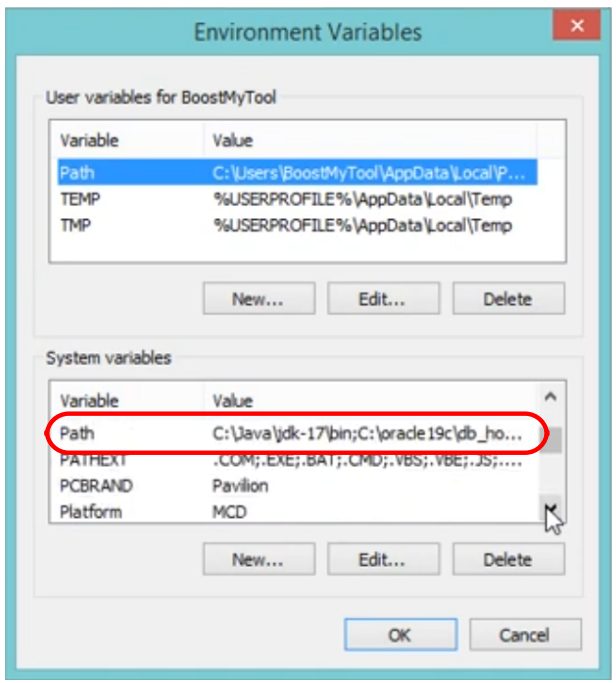
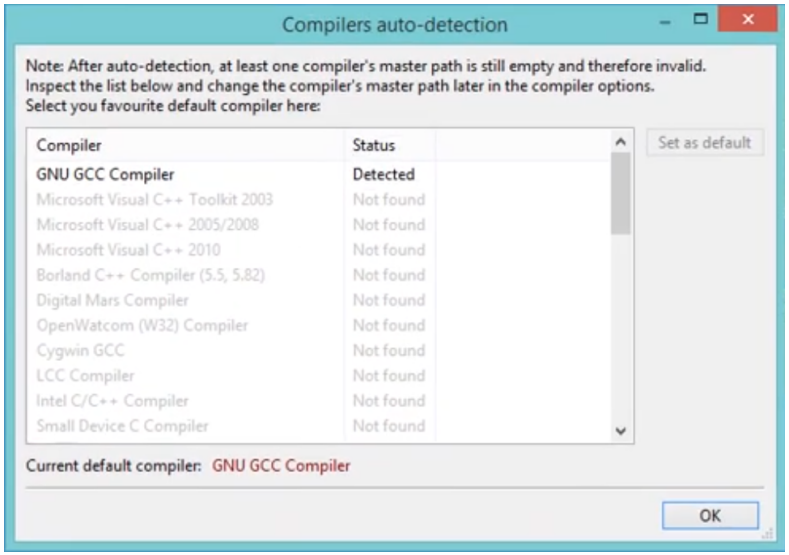


Add MinGW to the system path here.

Run Code::Blocks for the first time.

1. Executing Code::Blocks for the first time, it auto-detects the MinGW GCC compiler. You can set it as the default.



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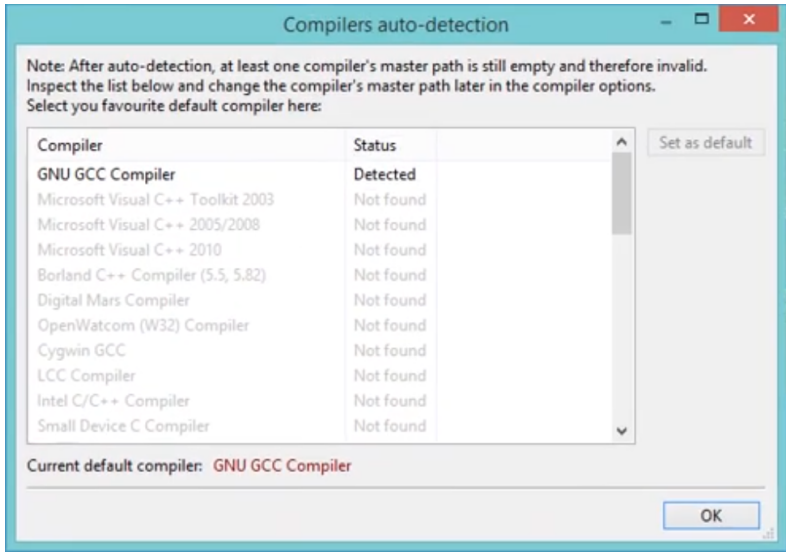
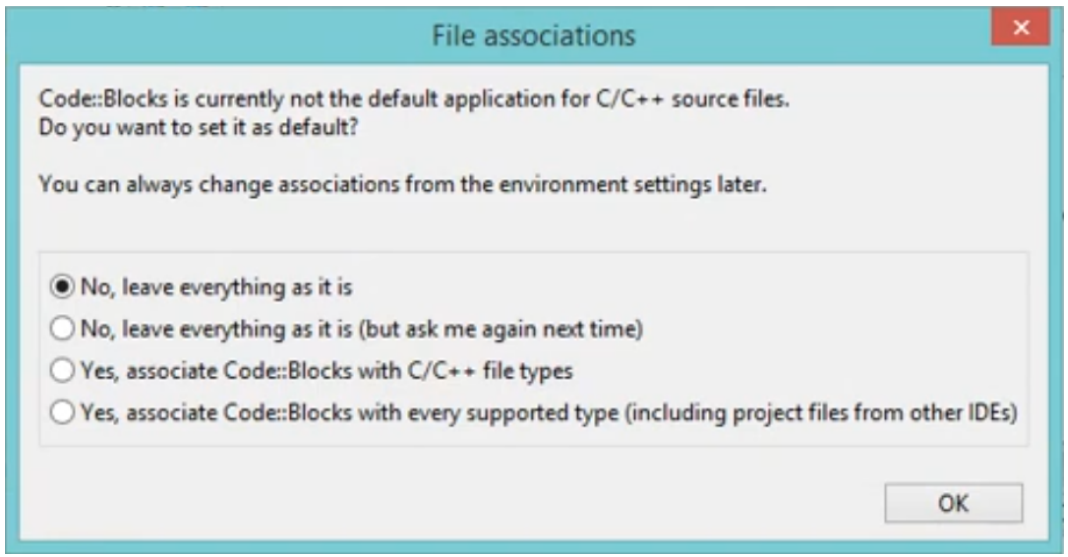


2. You can choose to associate Code::Blocks with .c and .cpp files so that it is the chosen application to run whenever you click them.



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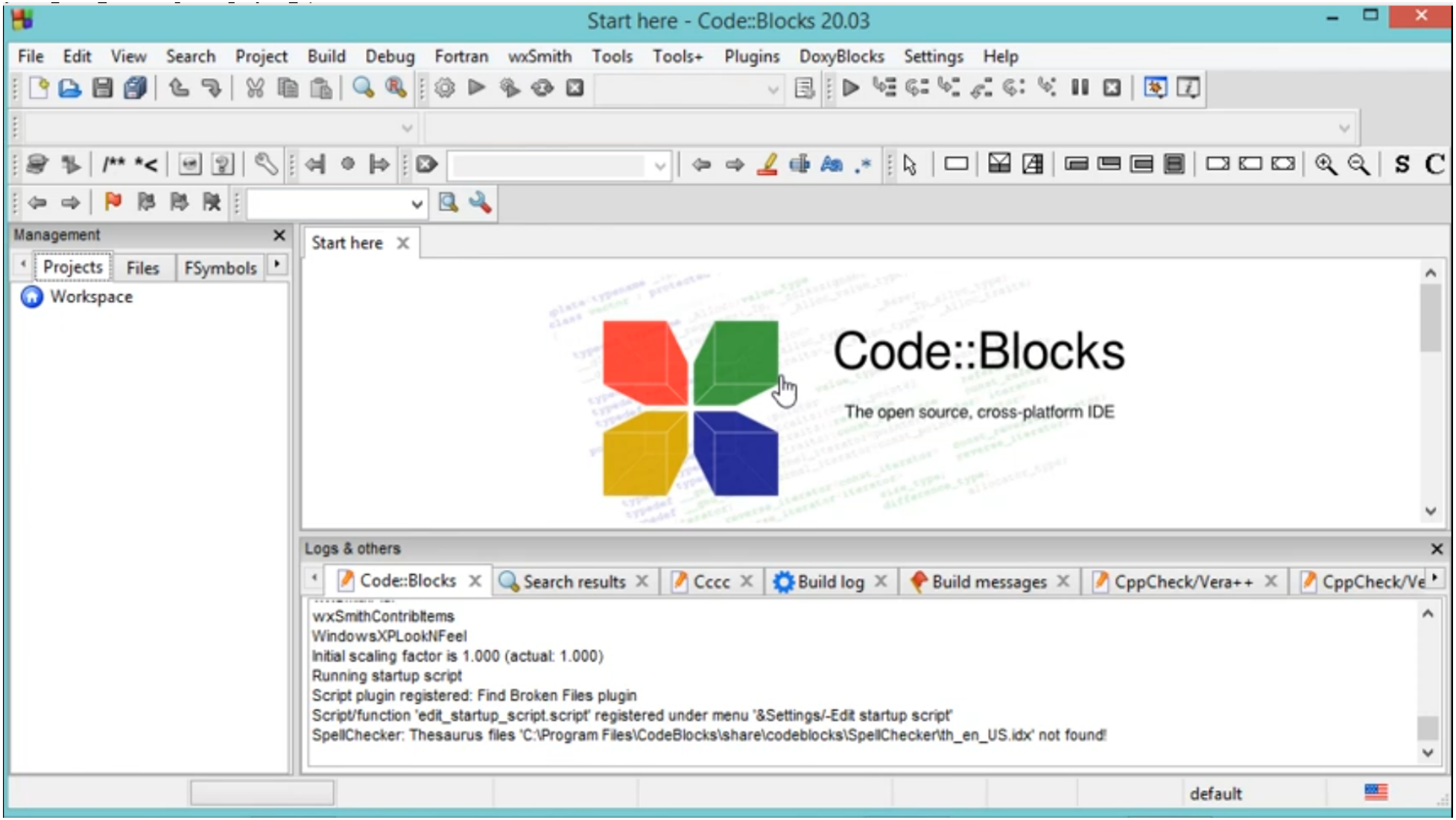

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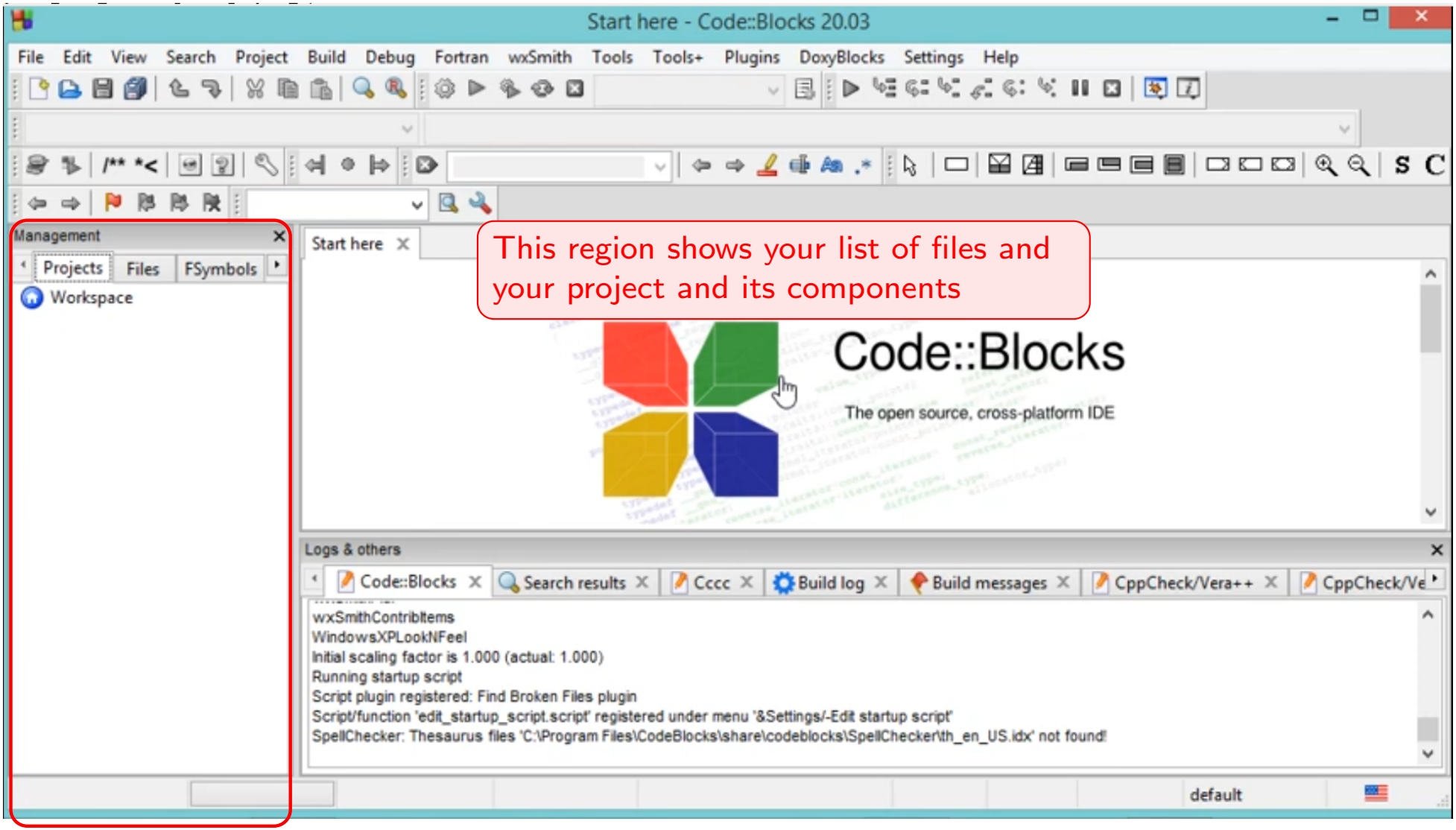

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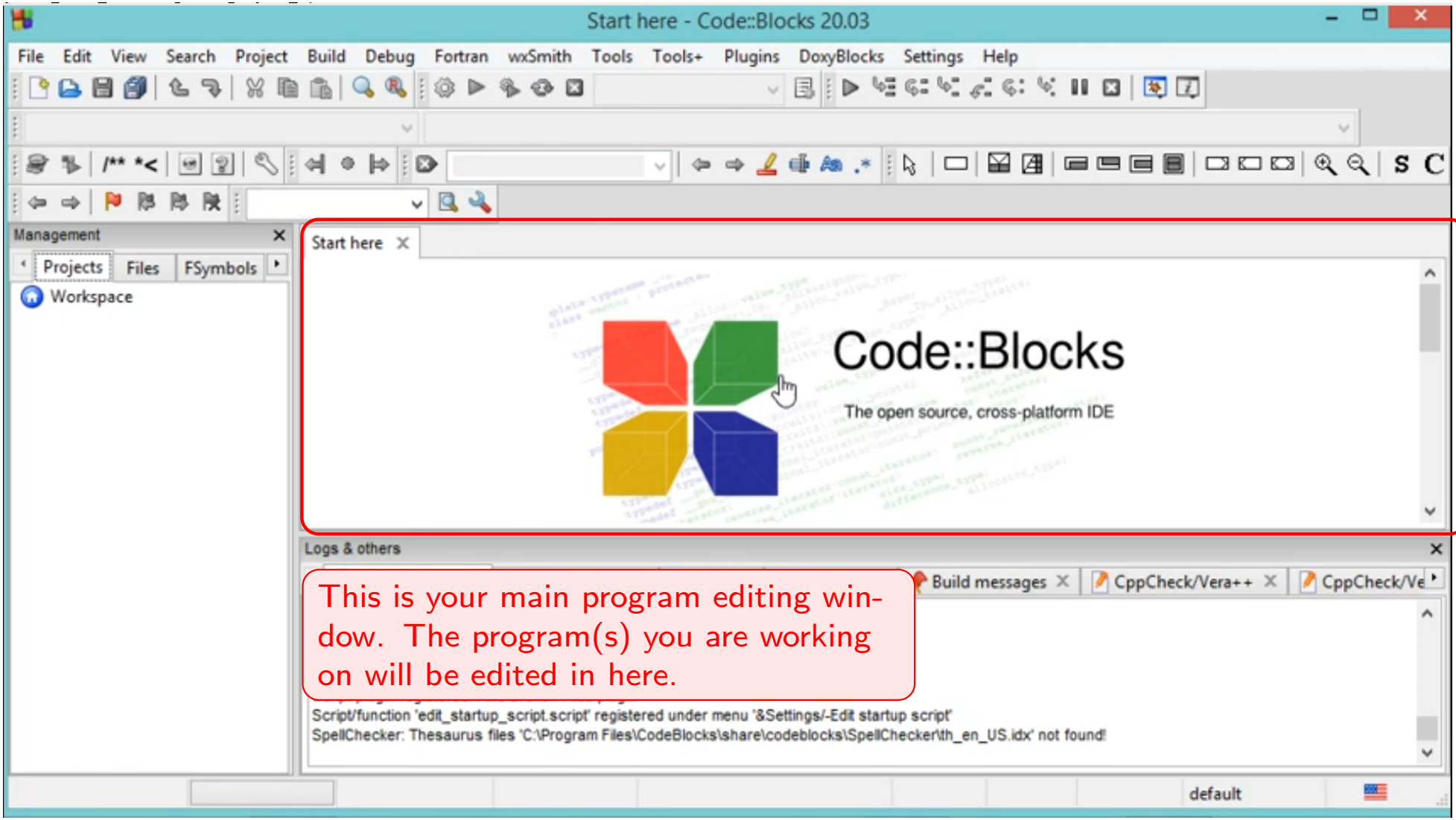

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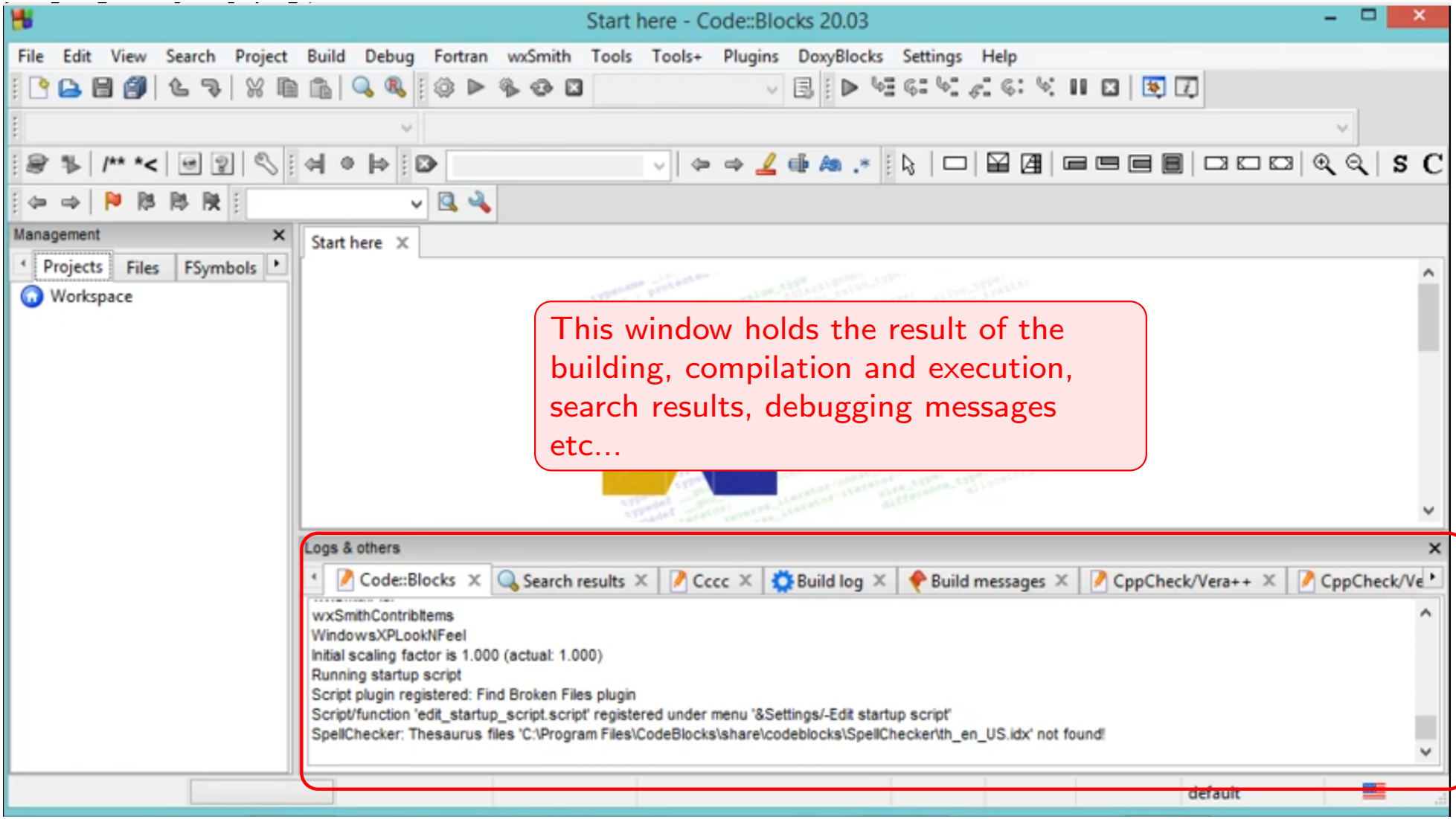

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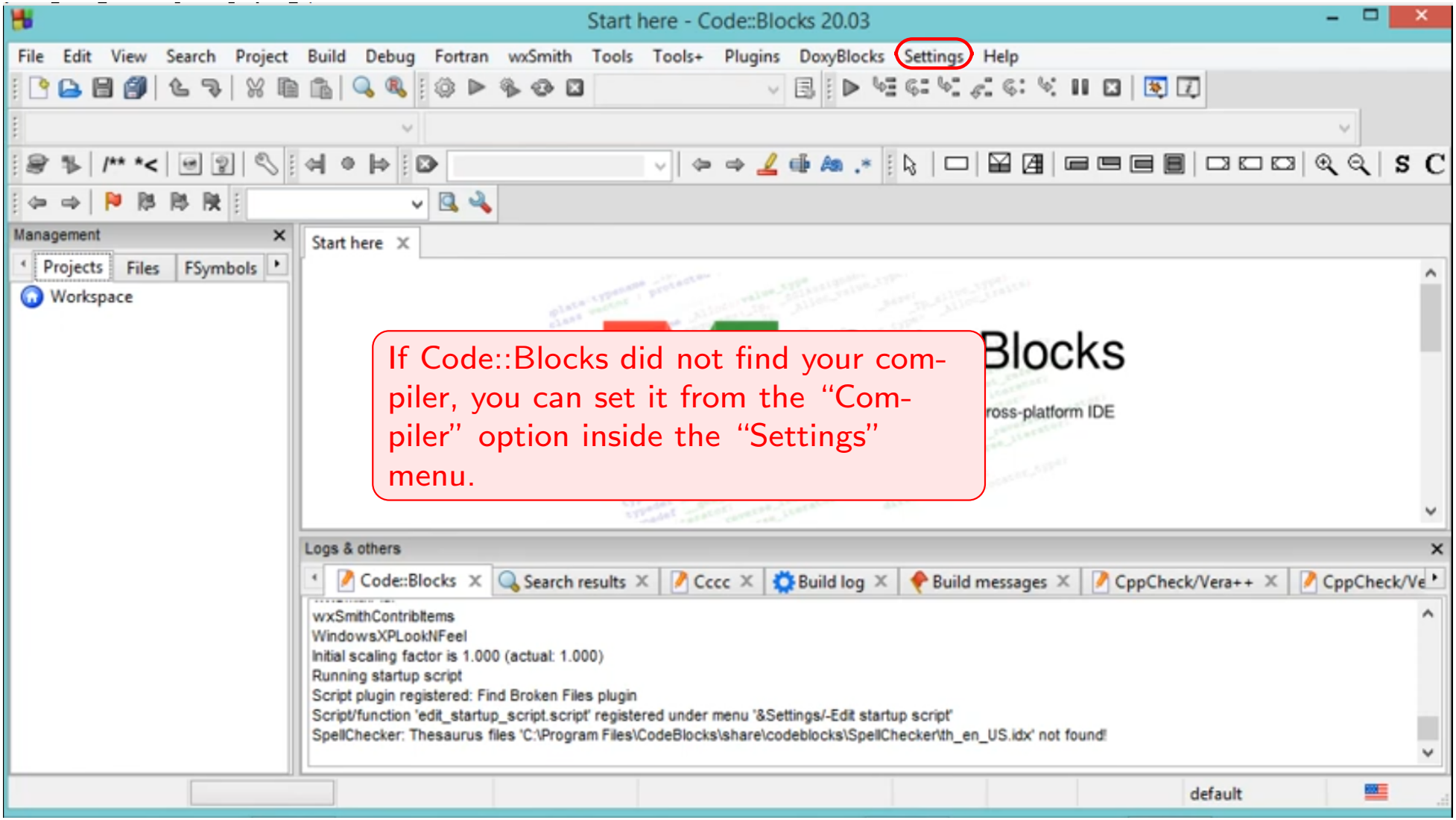

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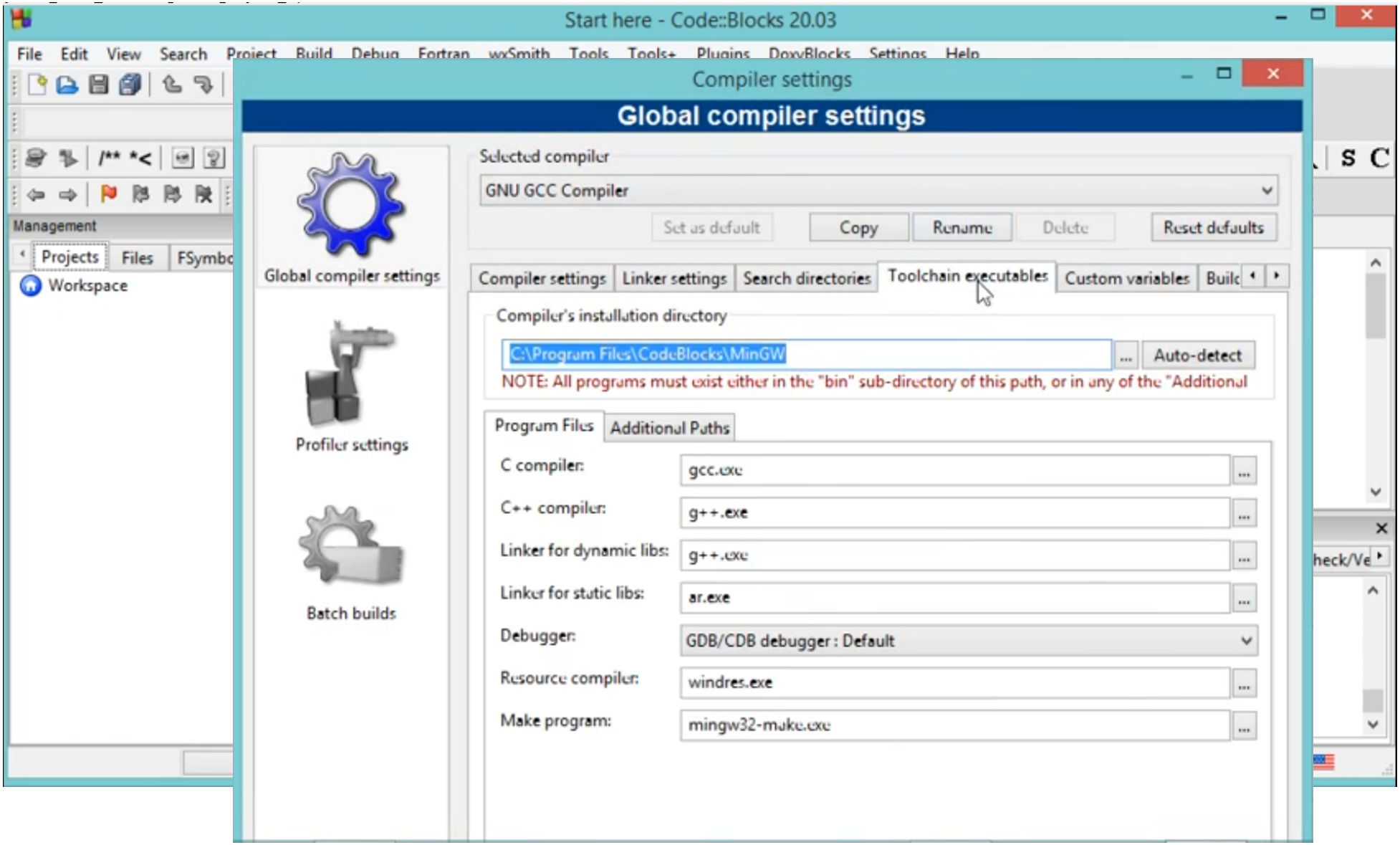

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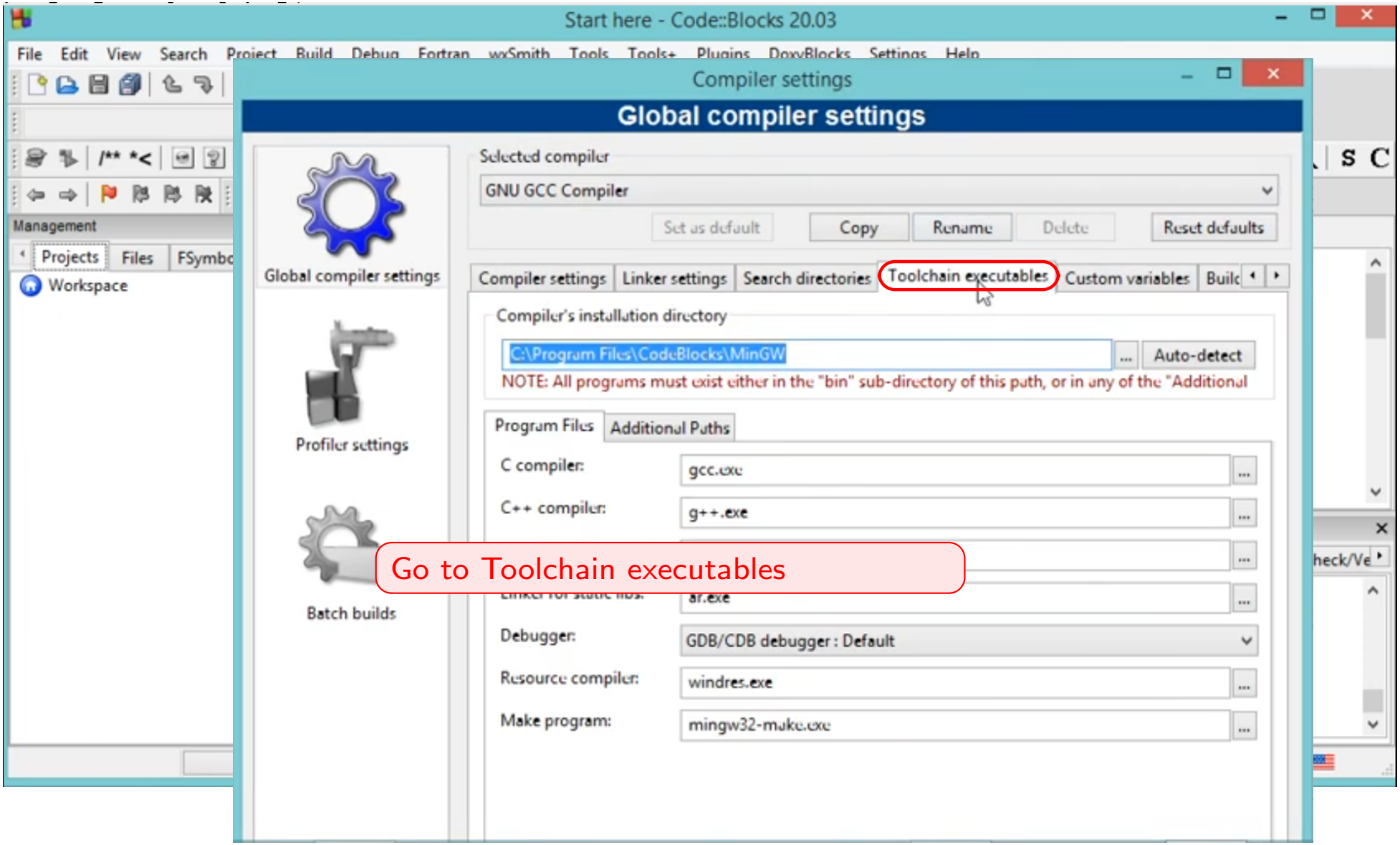
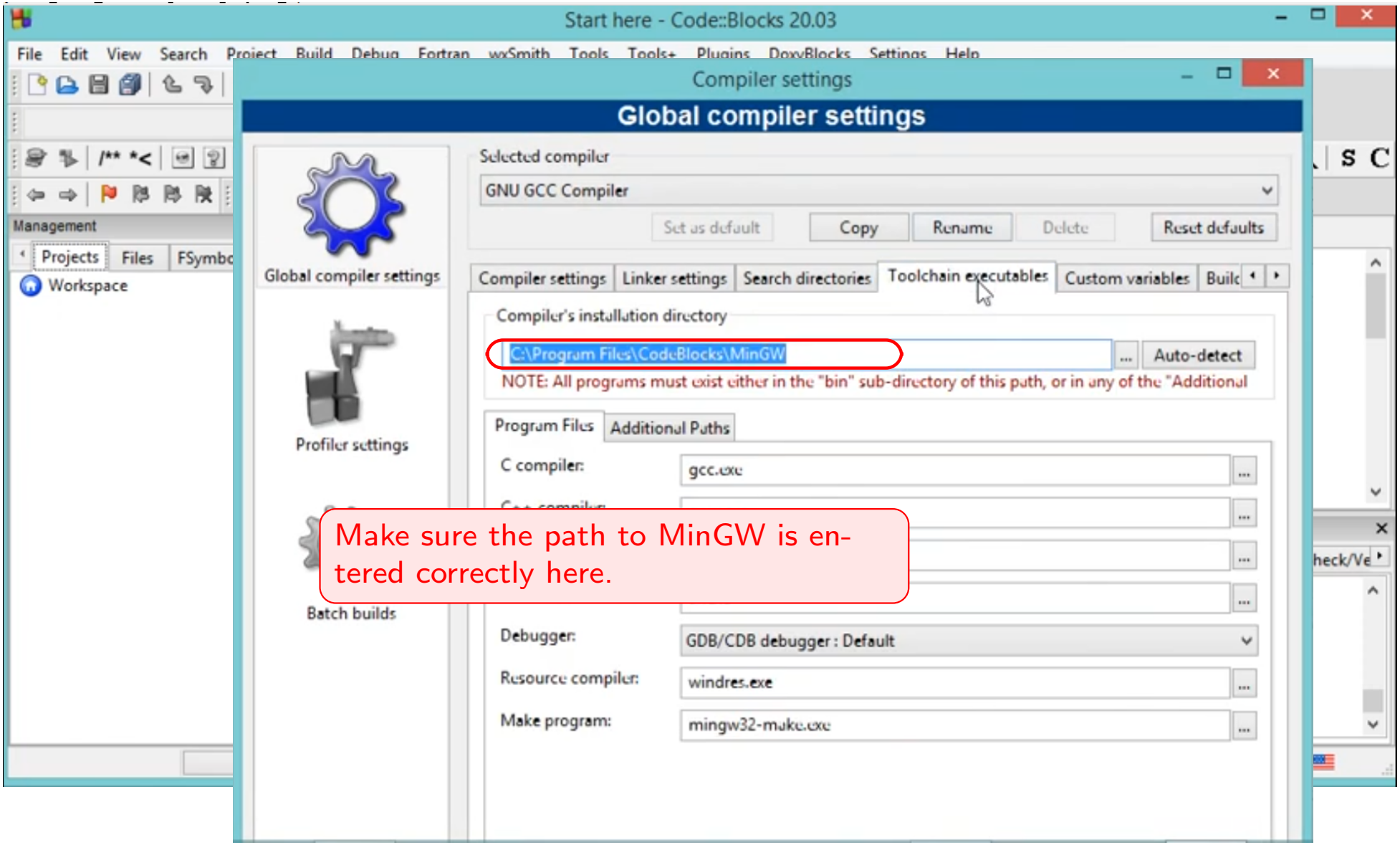
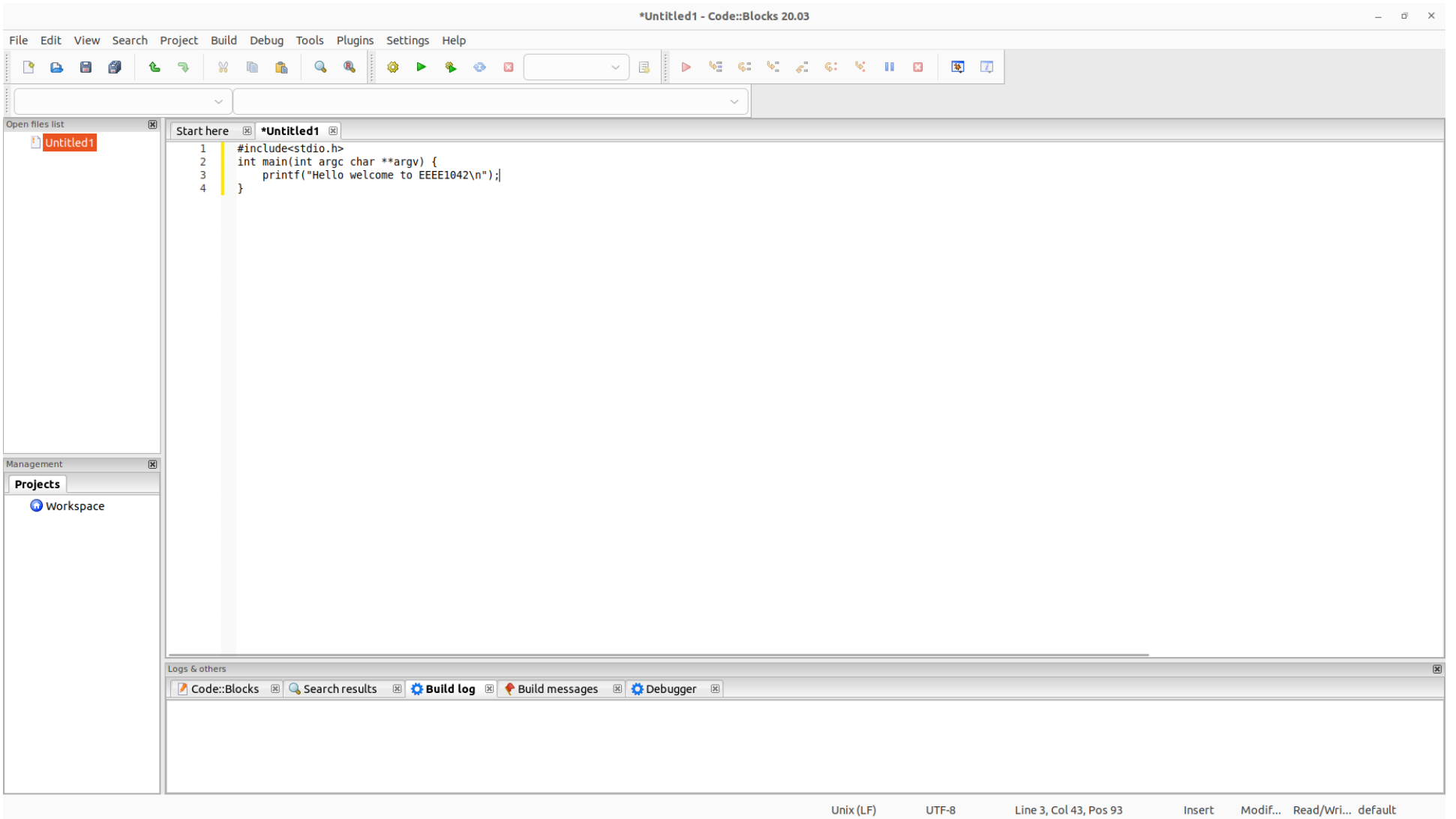


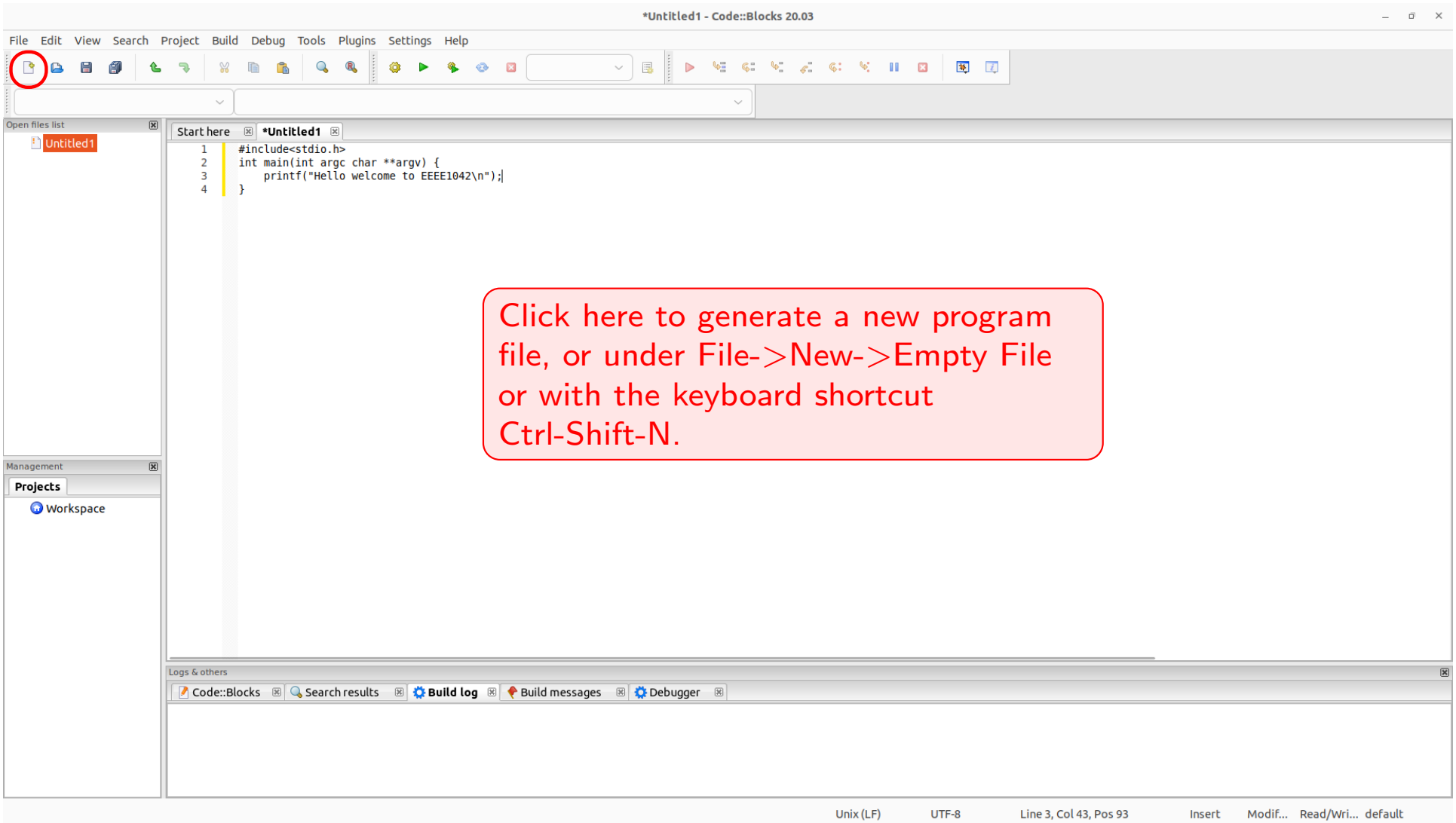
Run Code::Blocks for the first time.



Run Code::Blocks for the first time: generate C-program **without** project.

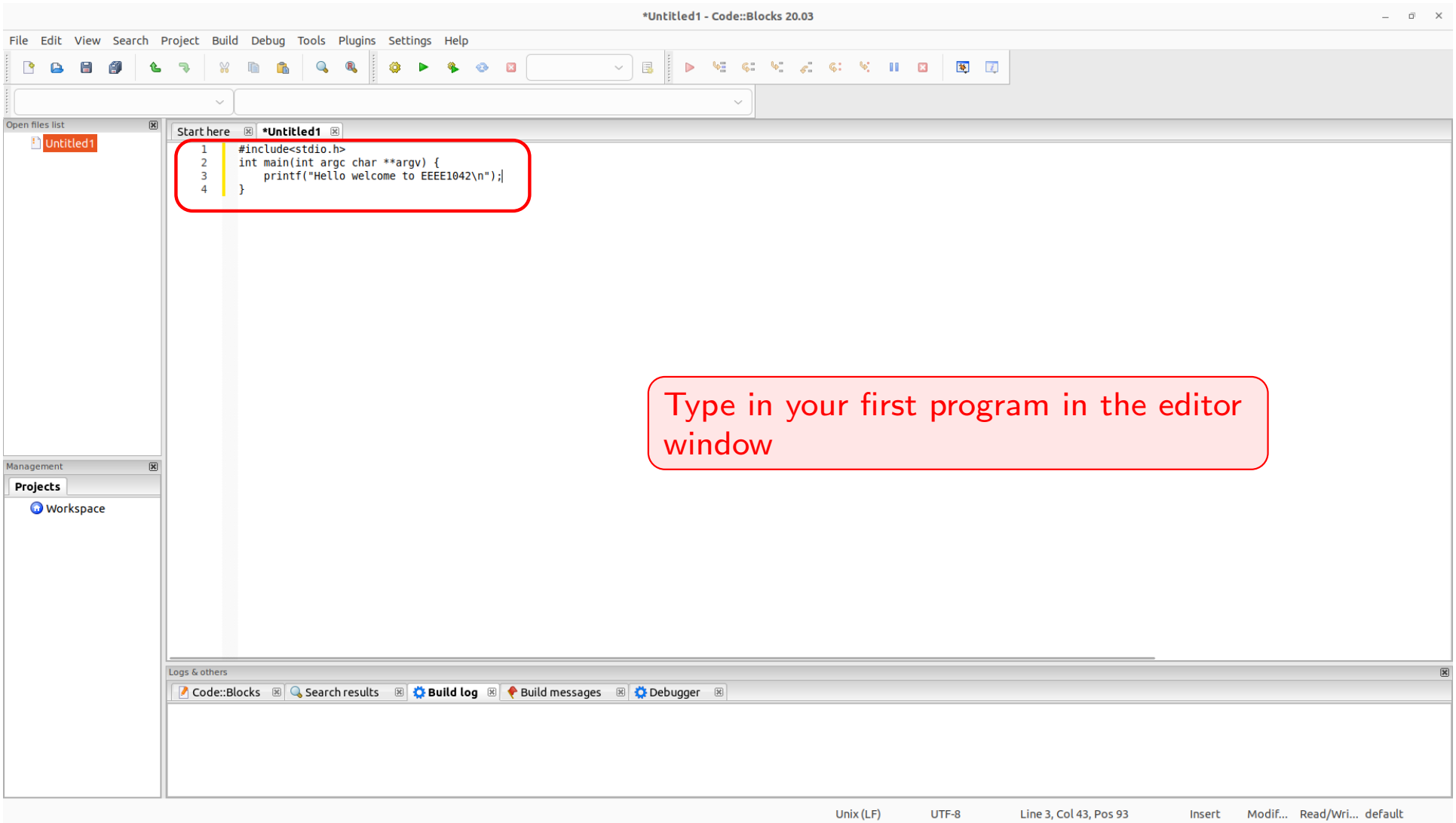


Run Code::Blocks for the first time: generate C-program **without** project.



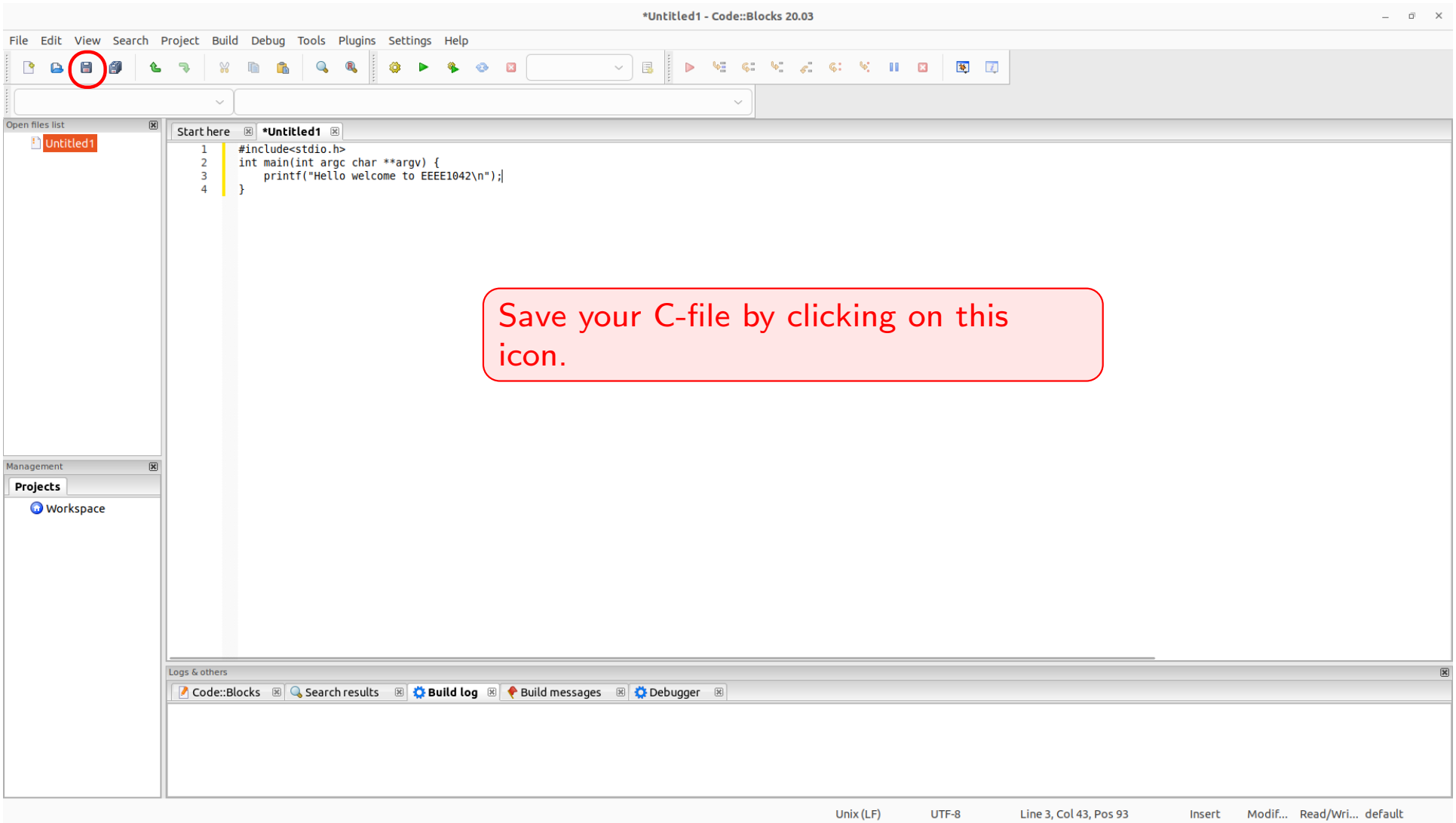
Click here to generate a new program file, or under File->New->Empty File or with the keyboard shortcut Ctrl-Shift-N.

Run Code::Blocks for the first time: generate C-program **without** project.



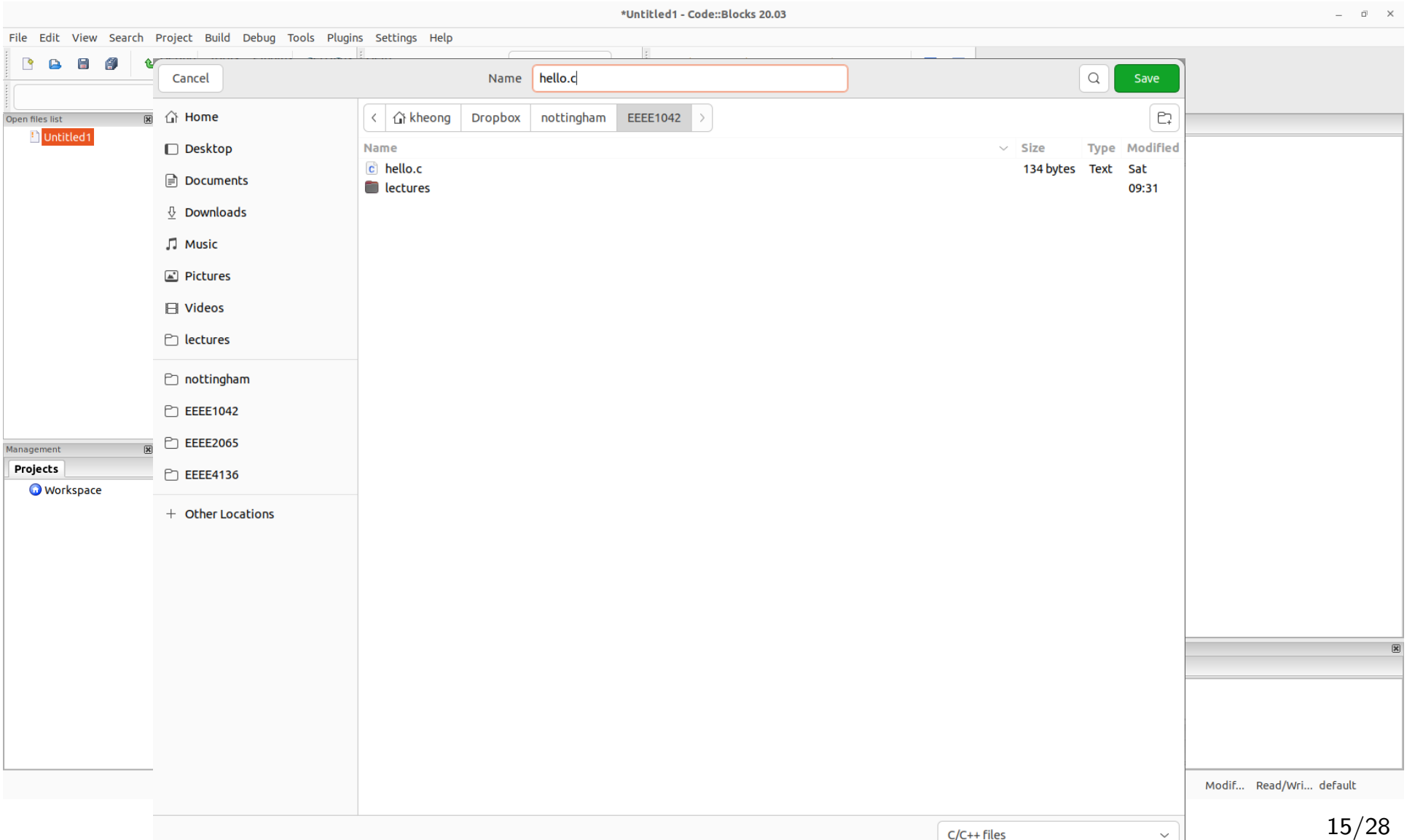
Type in your first program in the editor window

Run Code::Blocks for the first time: generate C-program **without** project.

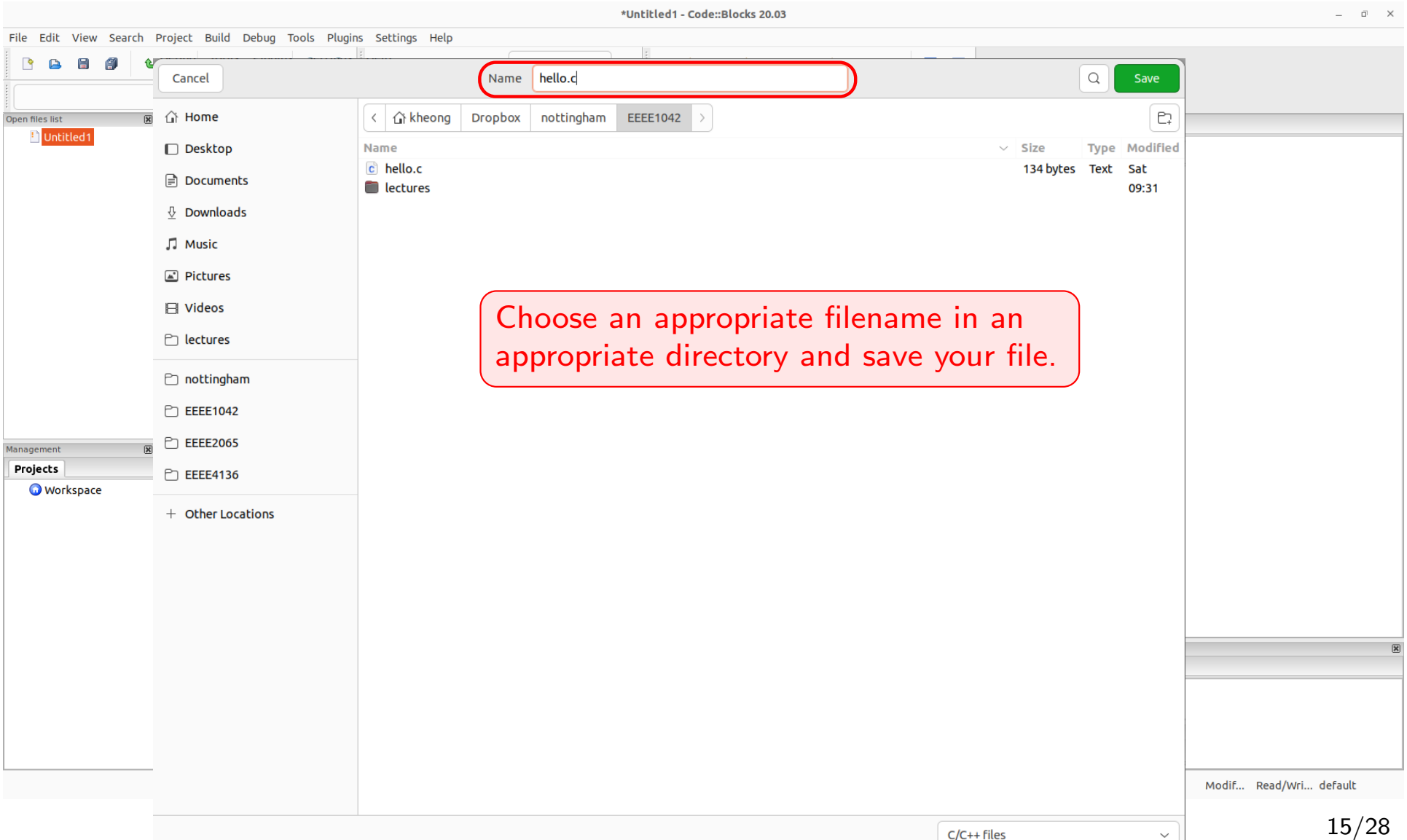


Save your C-file by clicking on this icon.

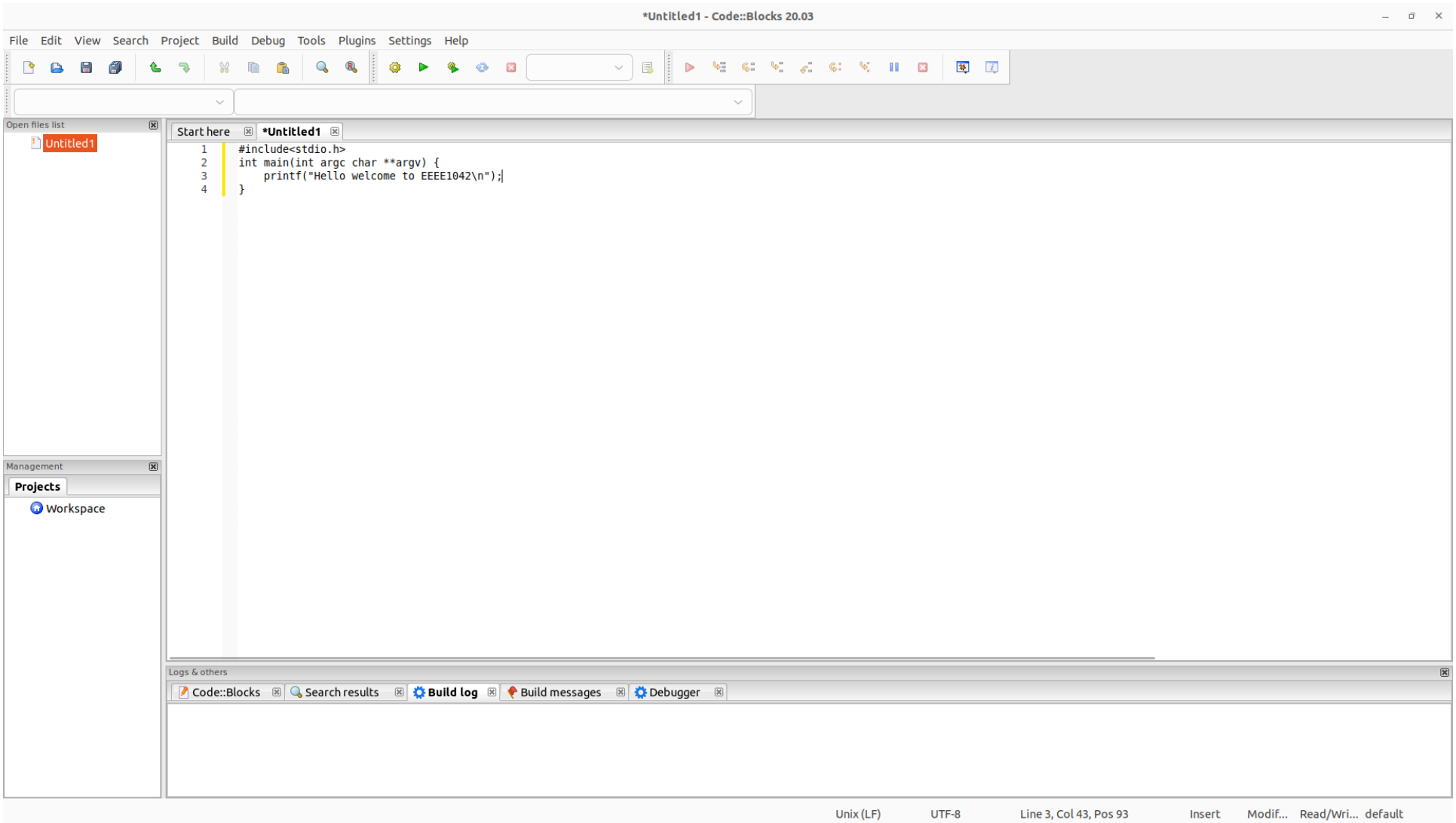
Run Code::Blocks for the first time: generate C-program **without** project.



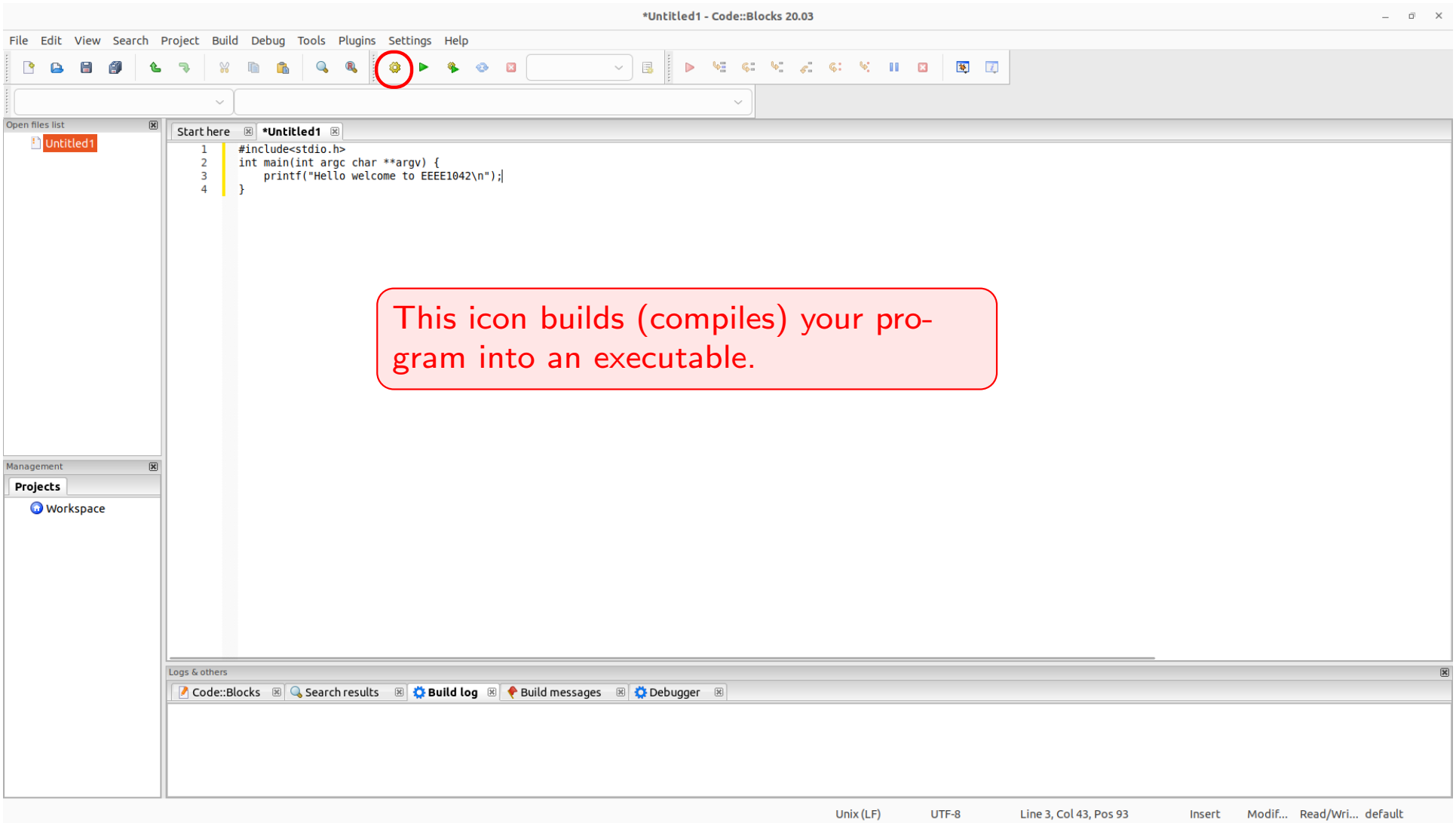
Run Code::Blocks for the first time: generate C-program **without** project.



Run Code::Blocks for the first time: compile and execute your program without project.

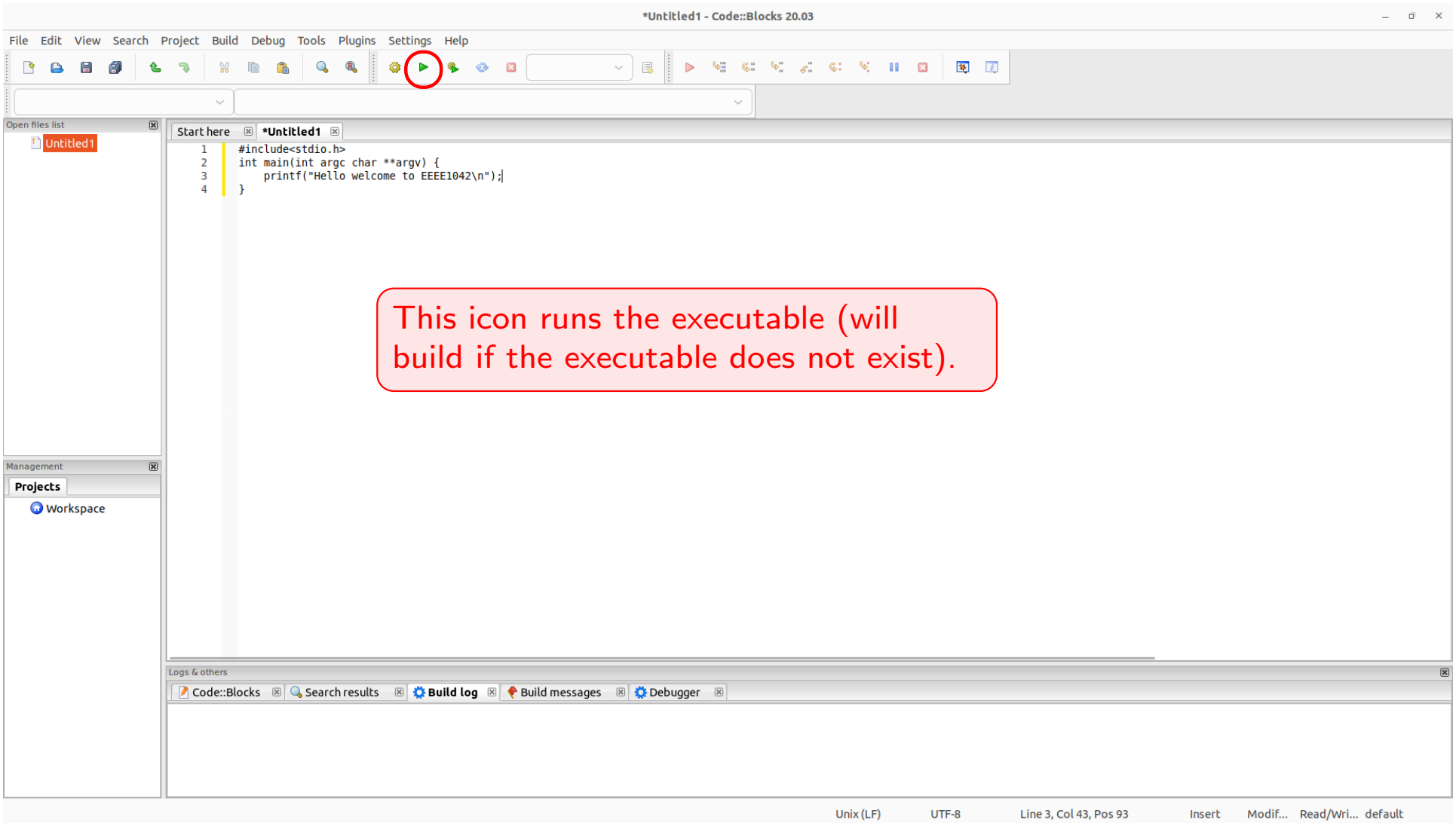


Run Code::Blocks for the first time: compile and execute your program without project.



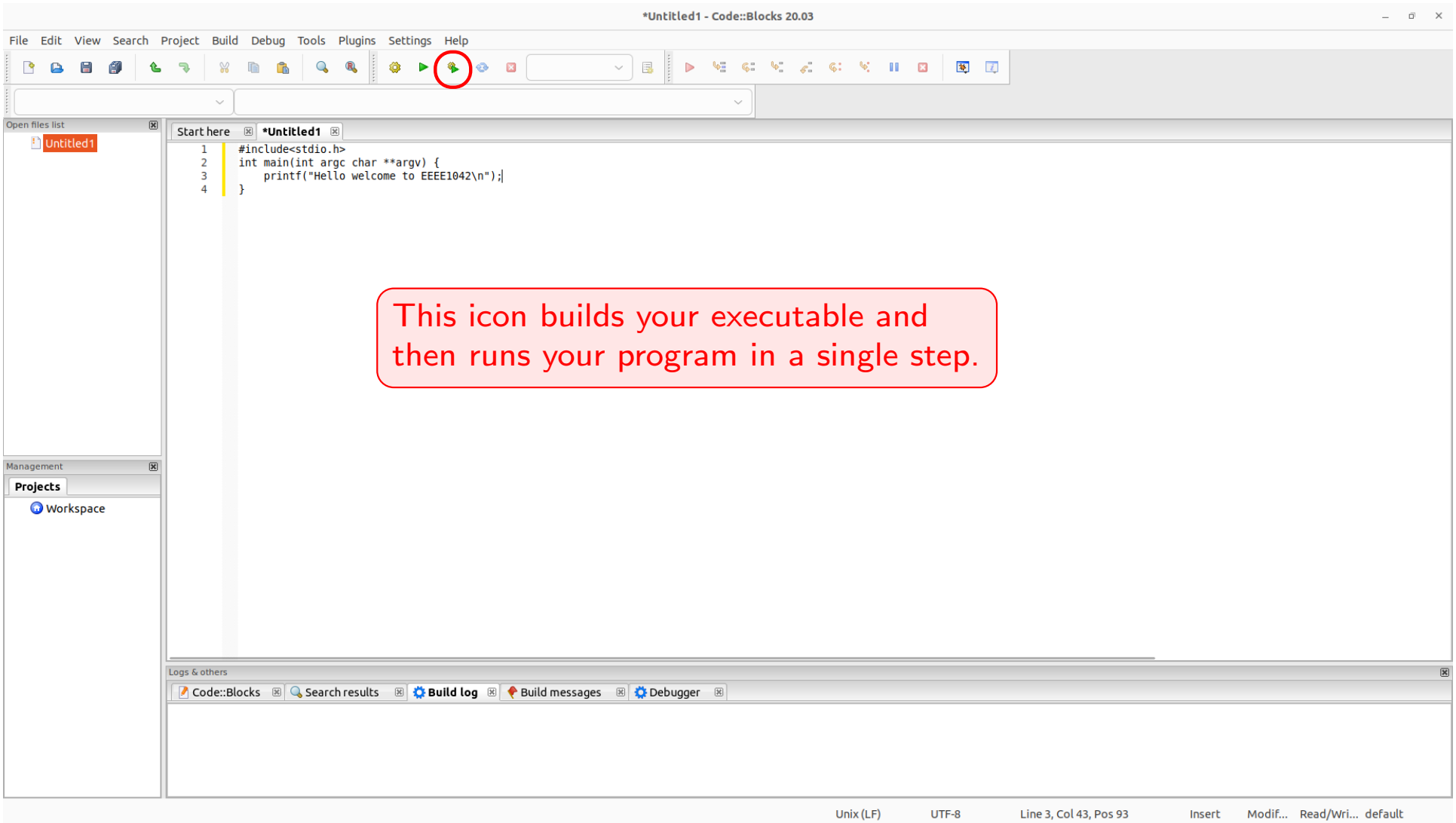
This icon builds (compiles) your program into an executable.

Run Code::Blocks for the first time: compile and execute your program without project.



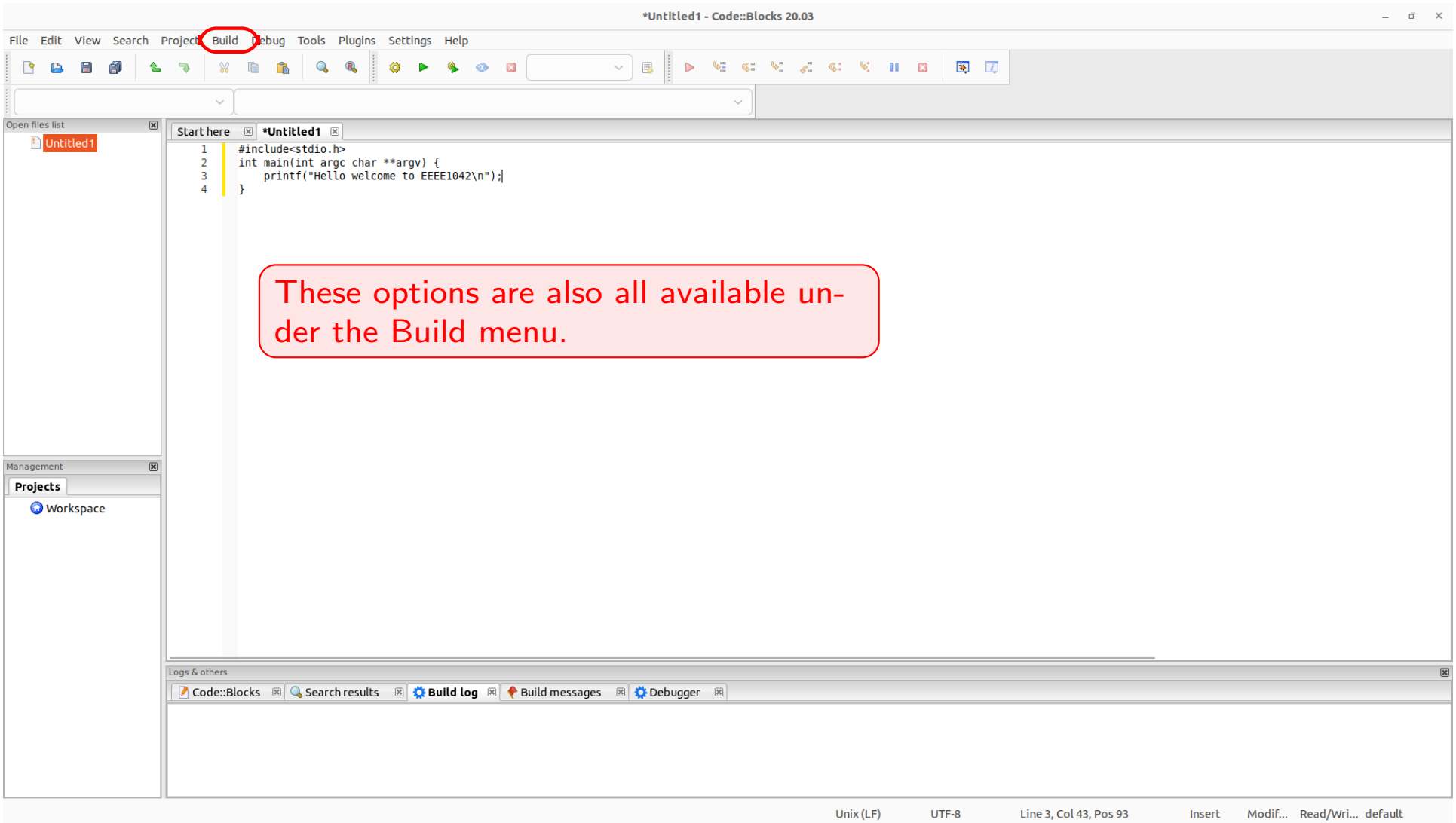
This icon runs the executable (will build if the executable does not exist).

Run Code::Blocks for the first time: compile and execute your program without project.

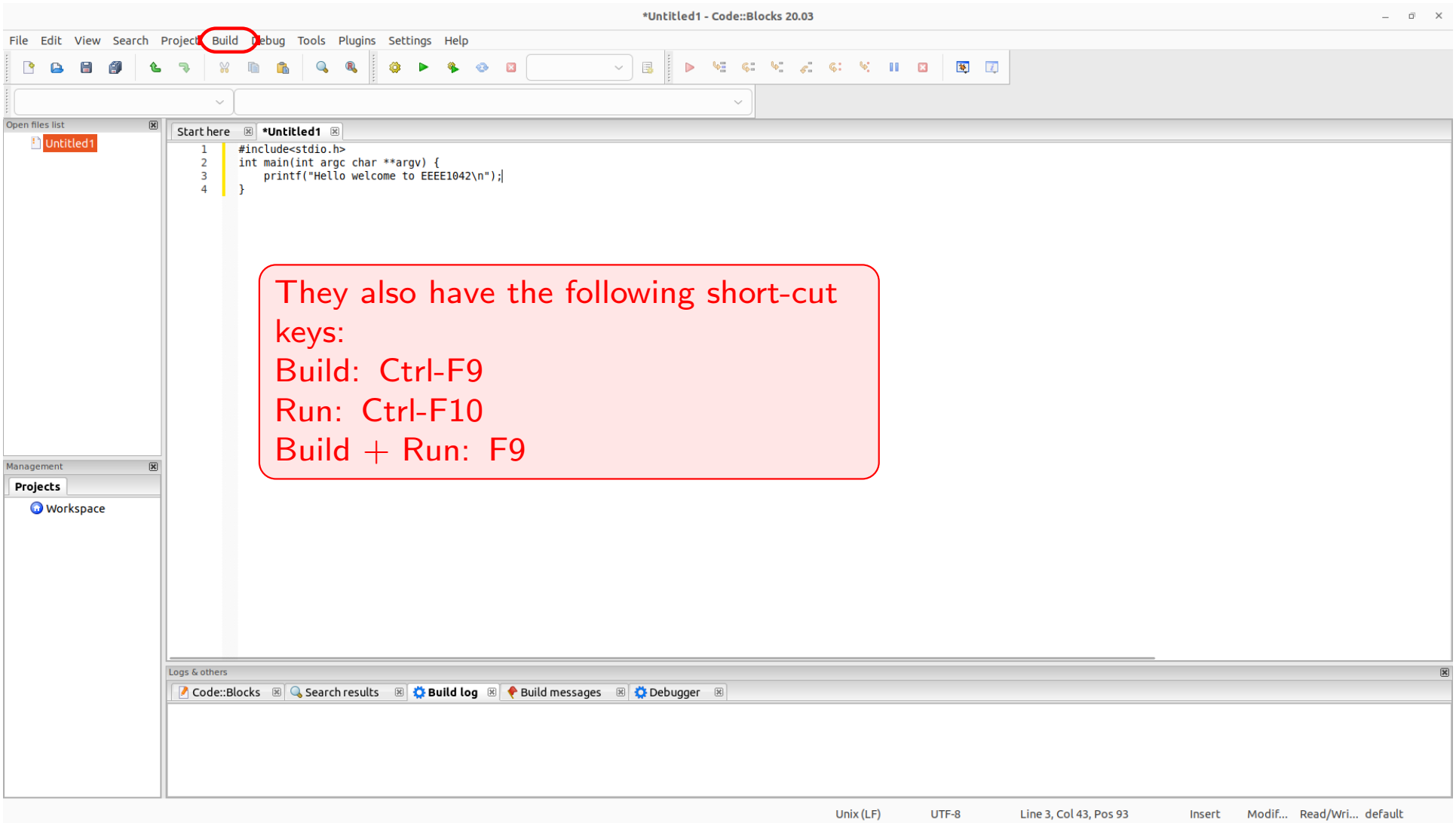


This icon builds your executable and then runs your program in a single step.

Run Code::Blocks for the first time: compile and execute your program without project.

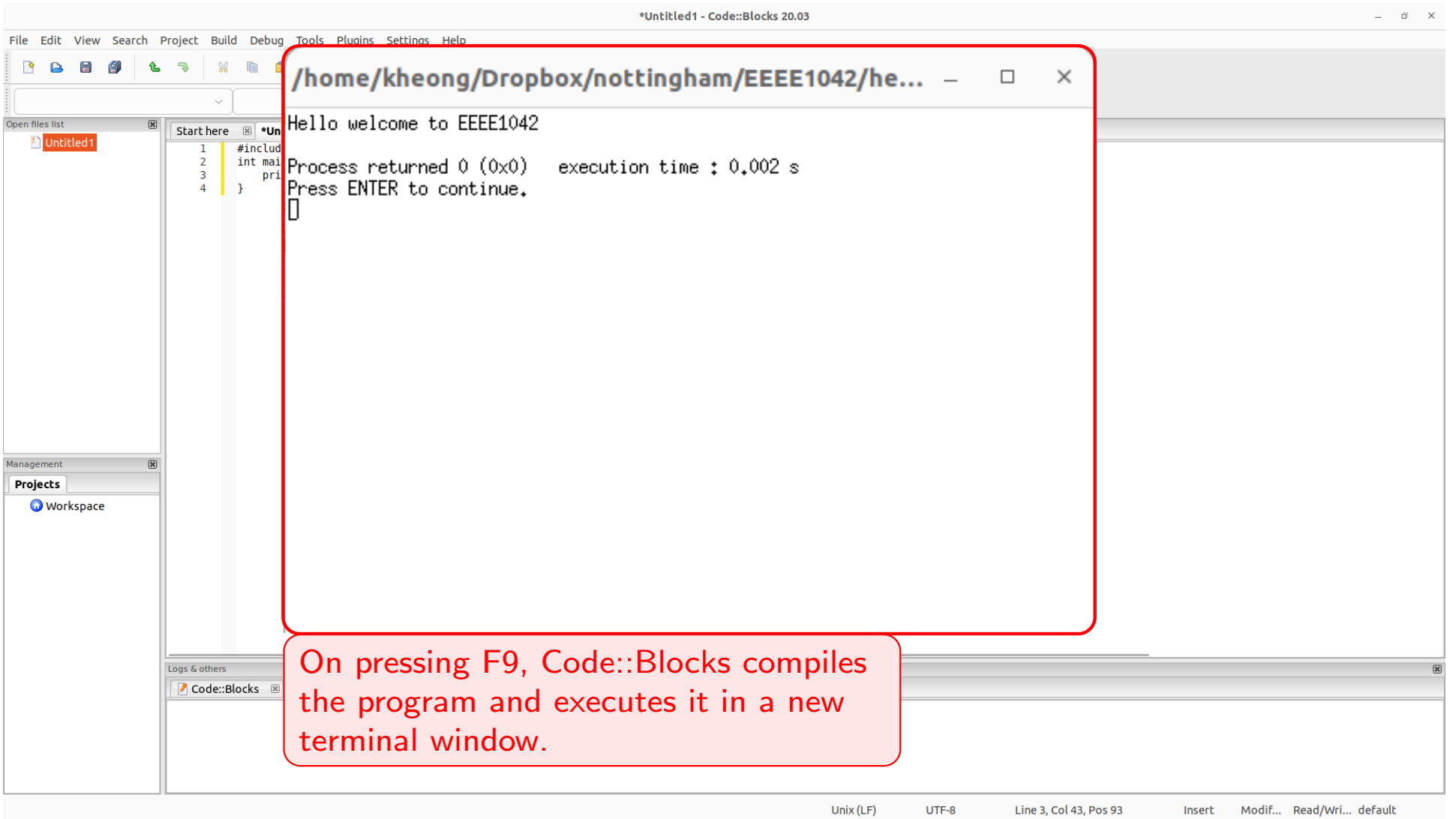


Run Code::Blocks for the first time: compile and execute your program without project.



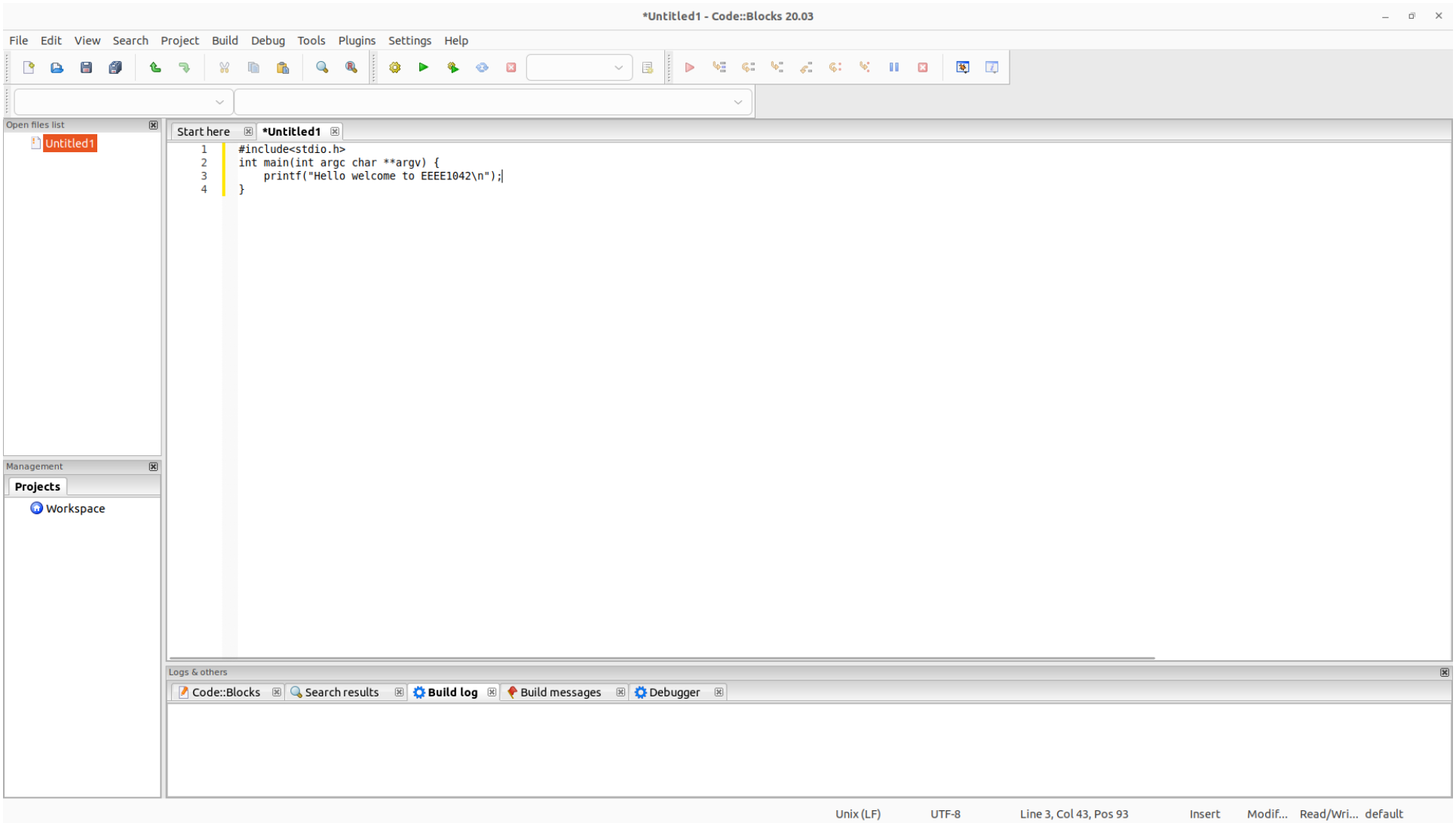
They also have the following short-cut keys:
Build: Ctrl-F9
Run: Ctrl-F10
Build + Run: F9

Run Code::Blocks for the first time: compile and execute your program without project.

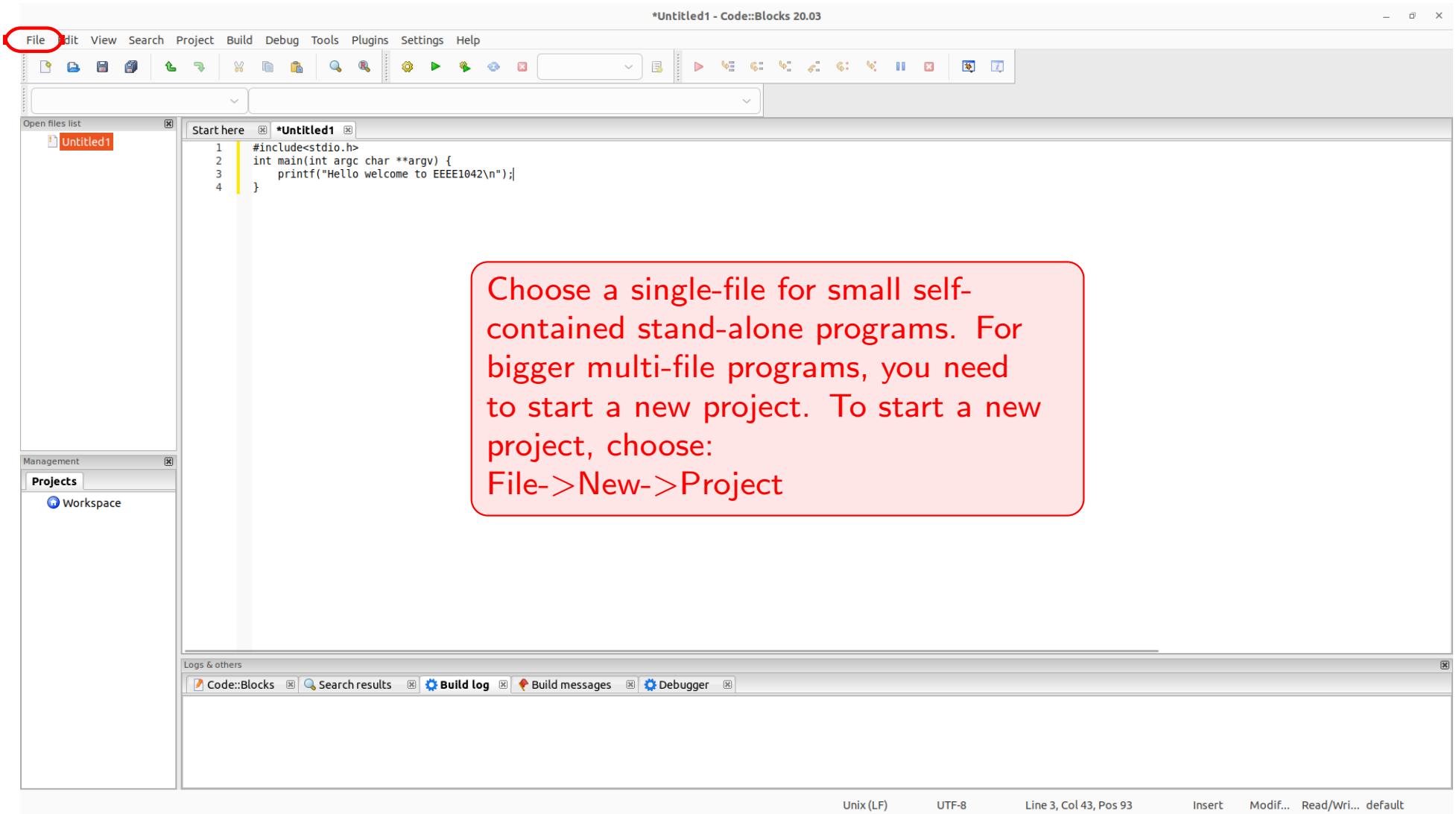


On pressing F9, Code::Blocks compiles the program and executes it in a new terminal window.

Run Code::Blocks for the first time: generate C-program **with** project.

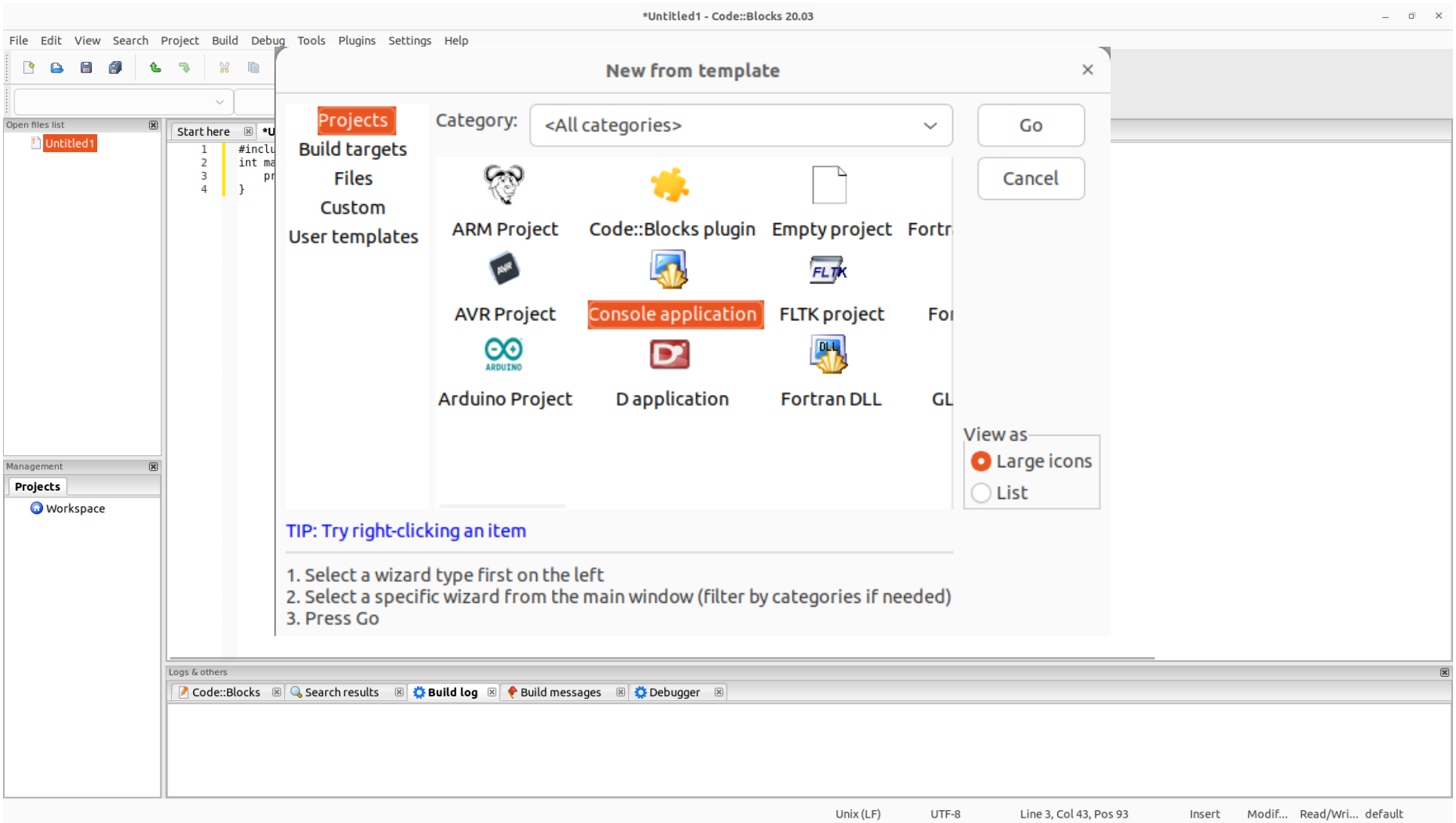


Run Code::Blocks for the first time: generate C-program **with** project.

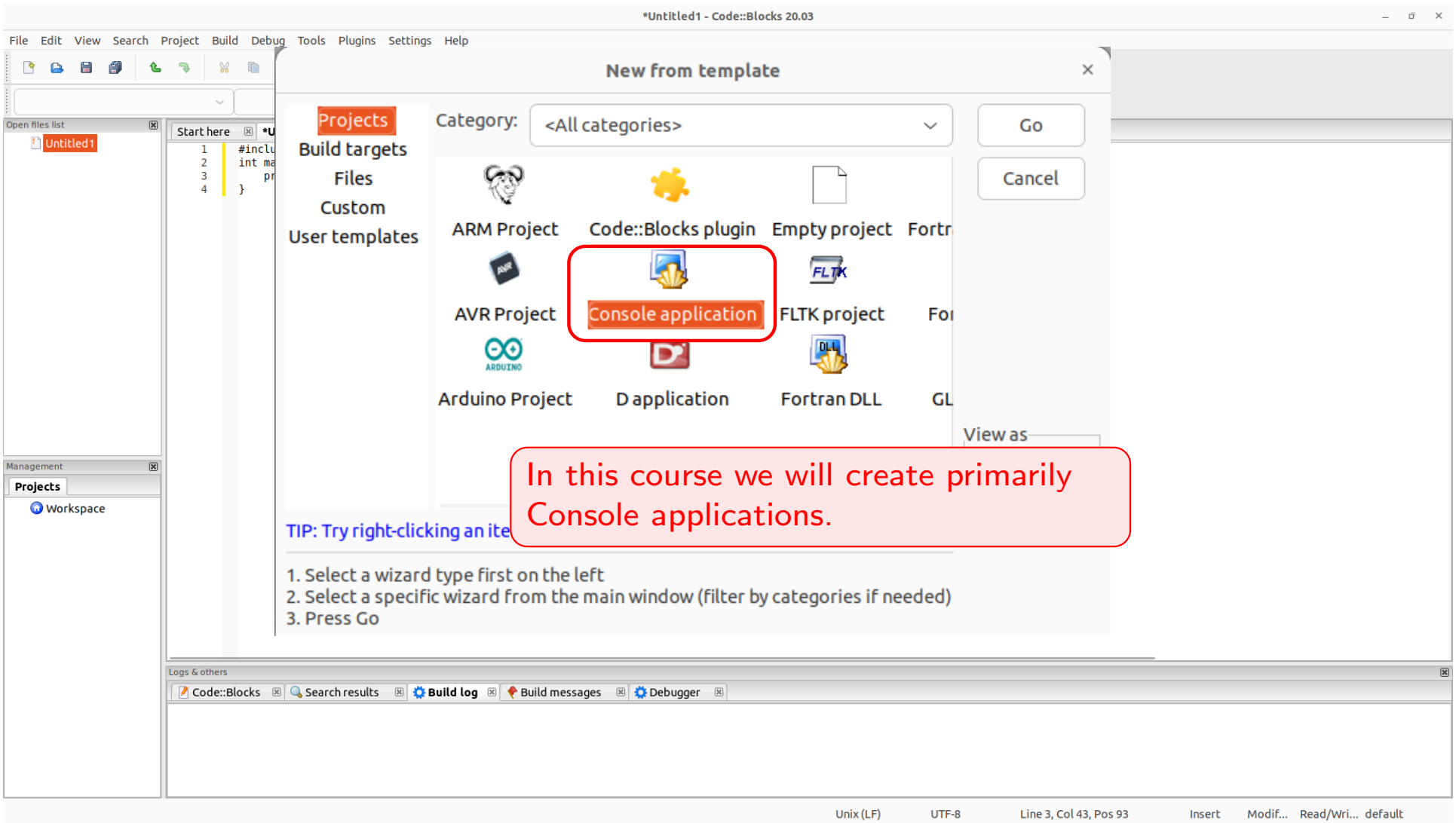


Choose a single-file for small self-contained stand-alone programs. For bigger multi-file programs, you need to start a new project. To start a new project, choose:
File->New->Project

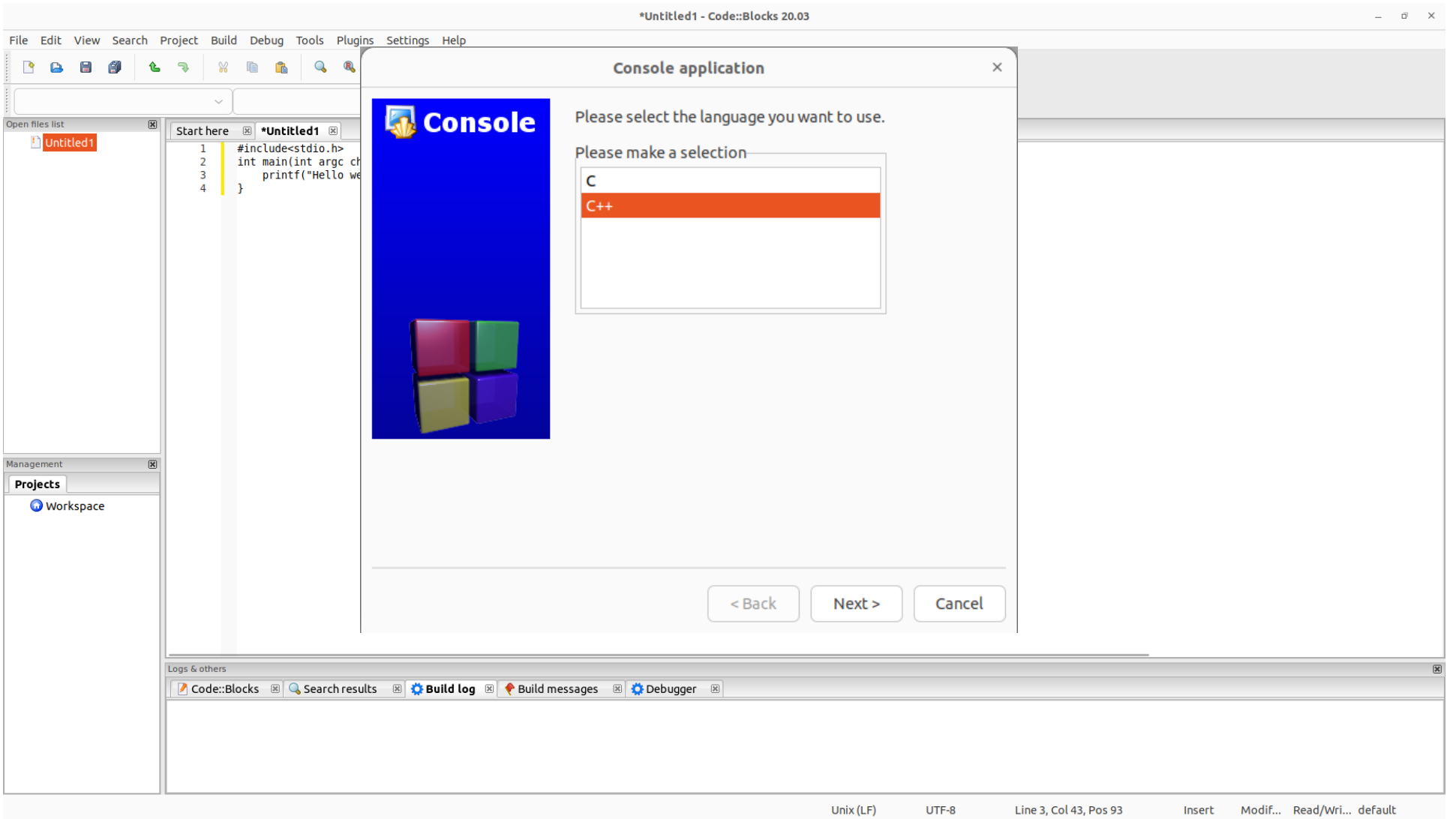
Run Code::Blocks for the first time: generate C-program **with** project.



Run Code::Blocks for the first time: generate C-program **with** project.



Run Code::Blocks for the first time: generate C-program **with** project.



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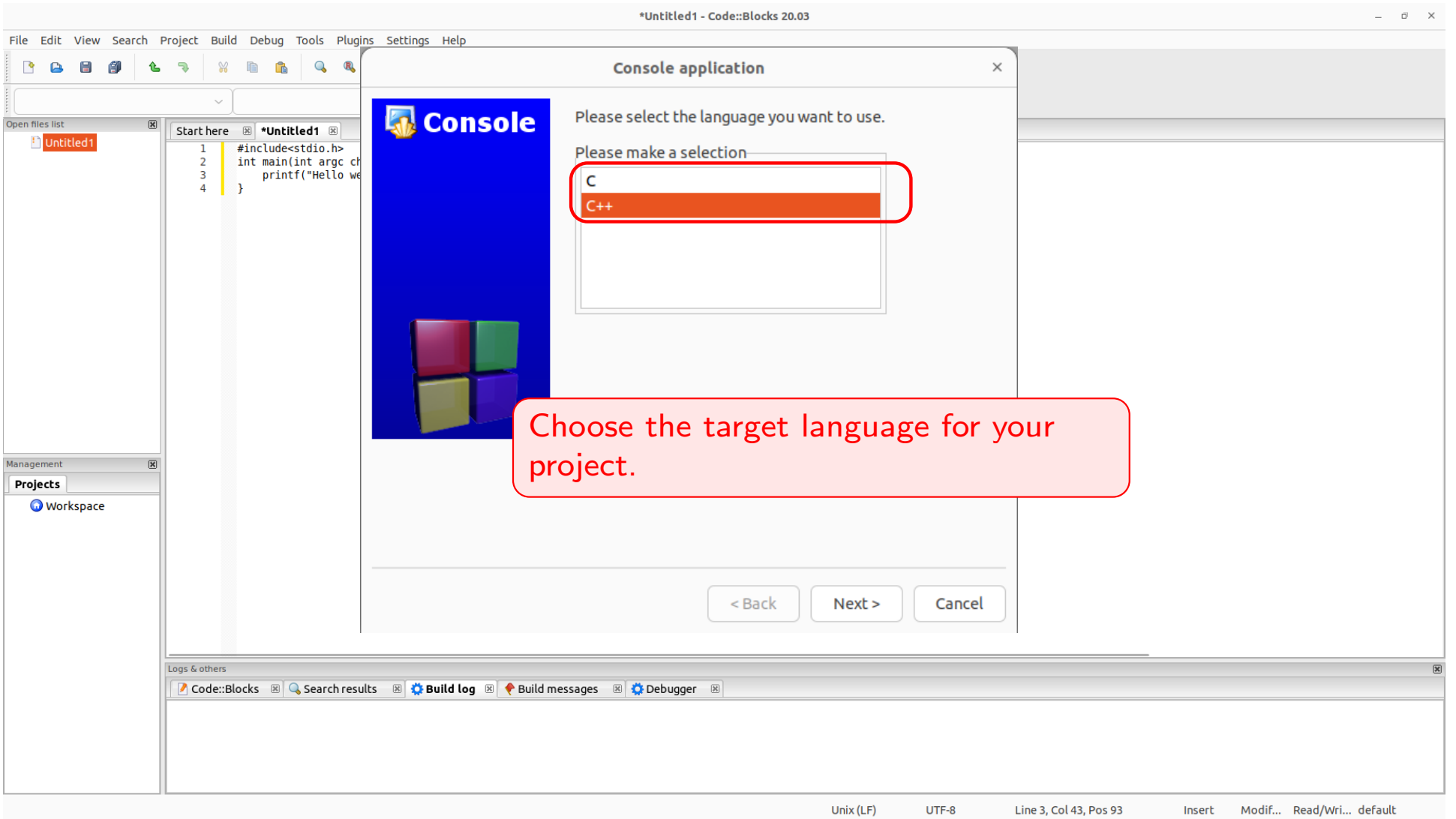
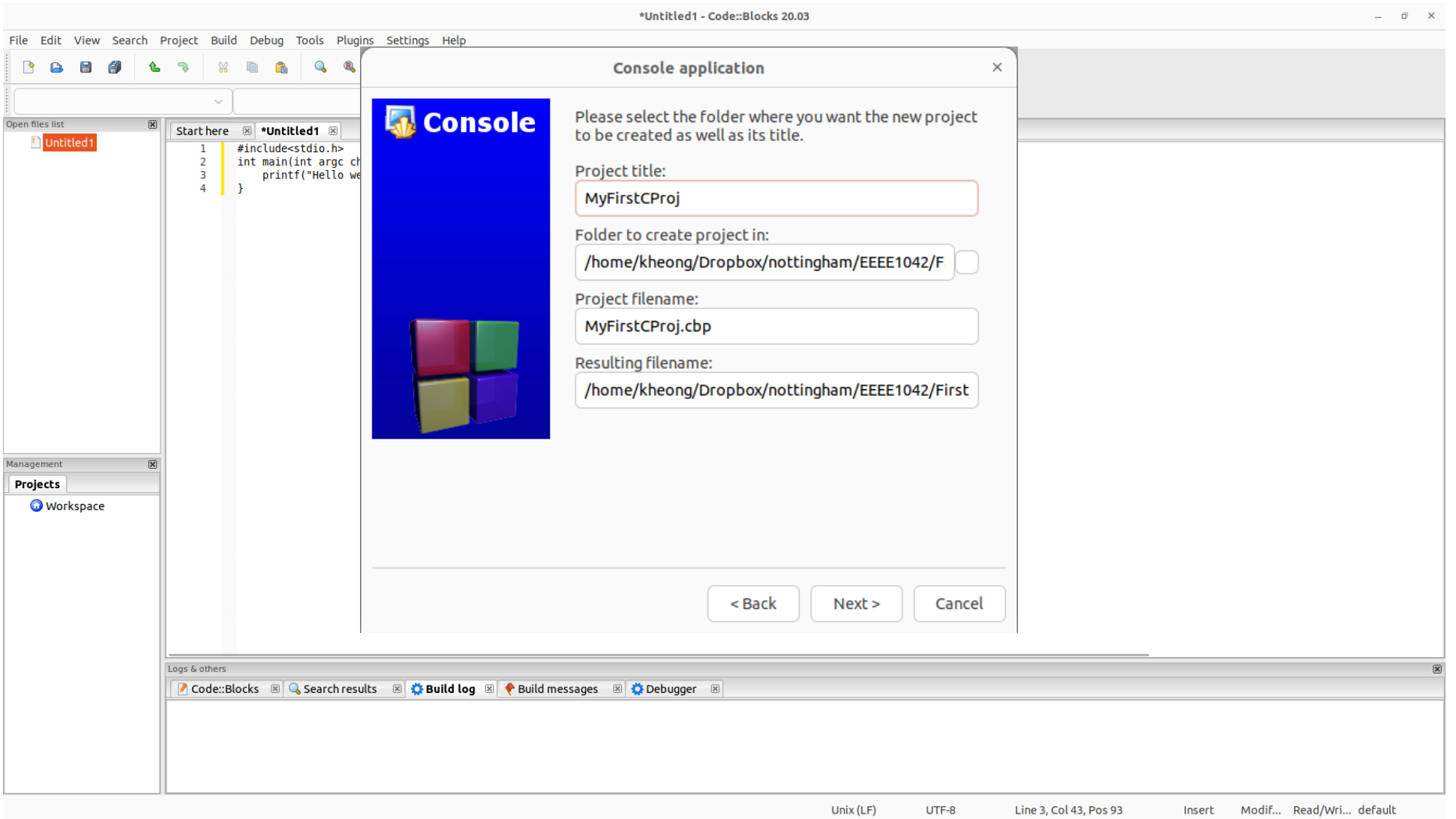
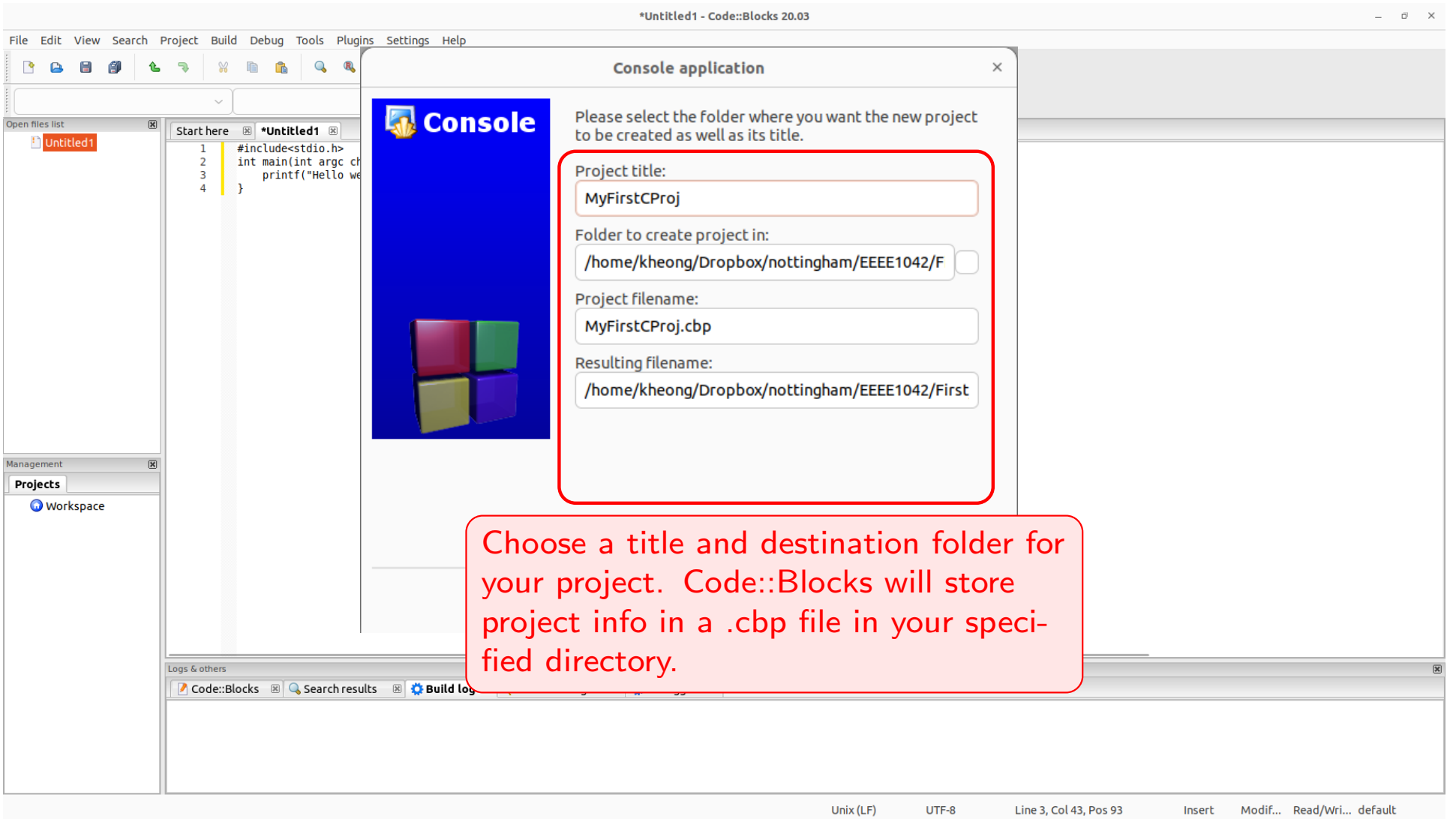


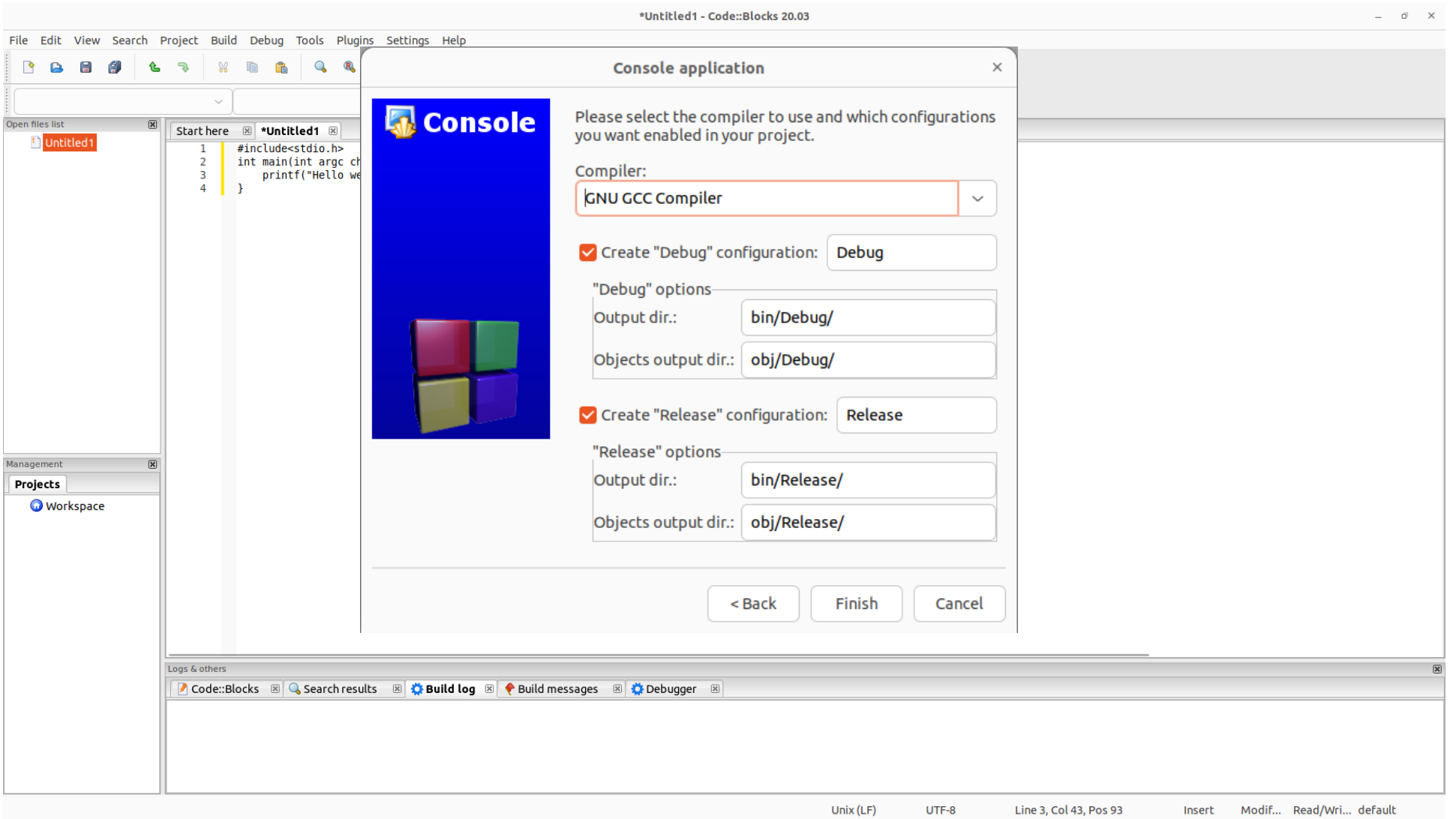
Run Code::Blocks for the first time: generate C-program **with** project.



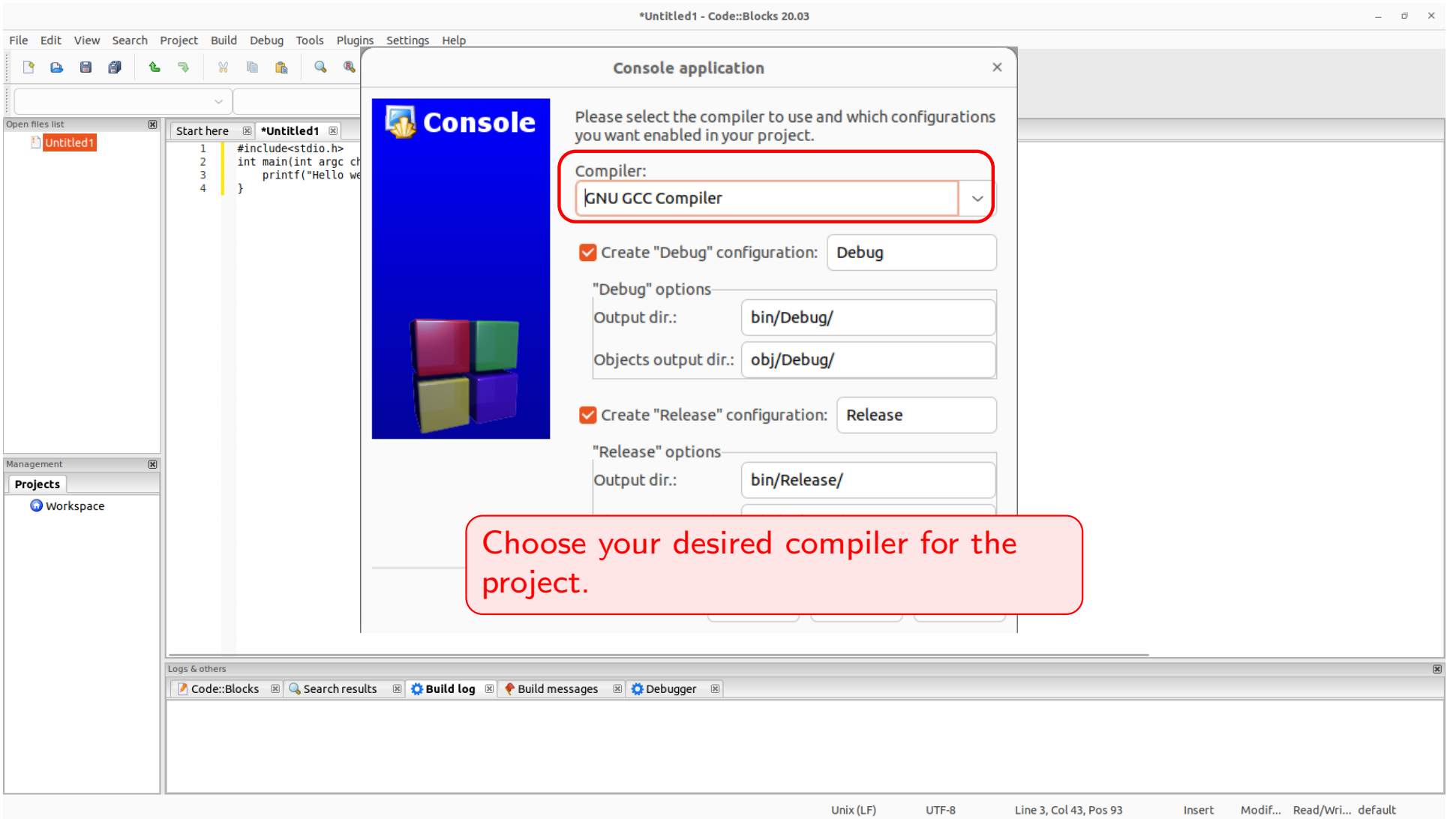
Run Code::Blocks for the first time: generate C-program **with** project.



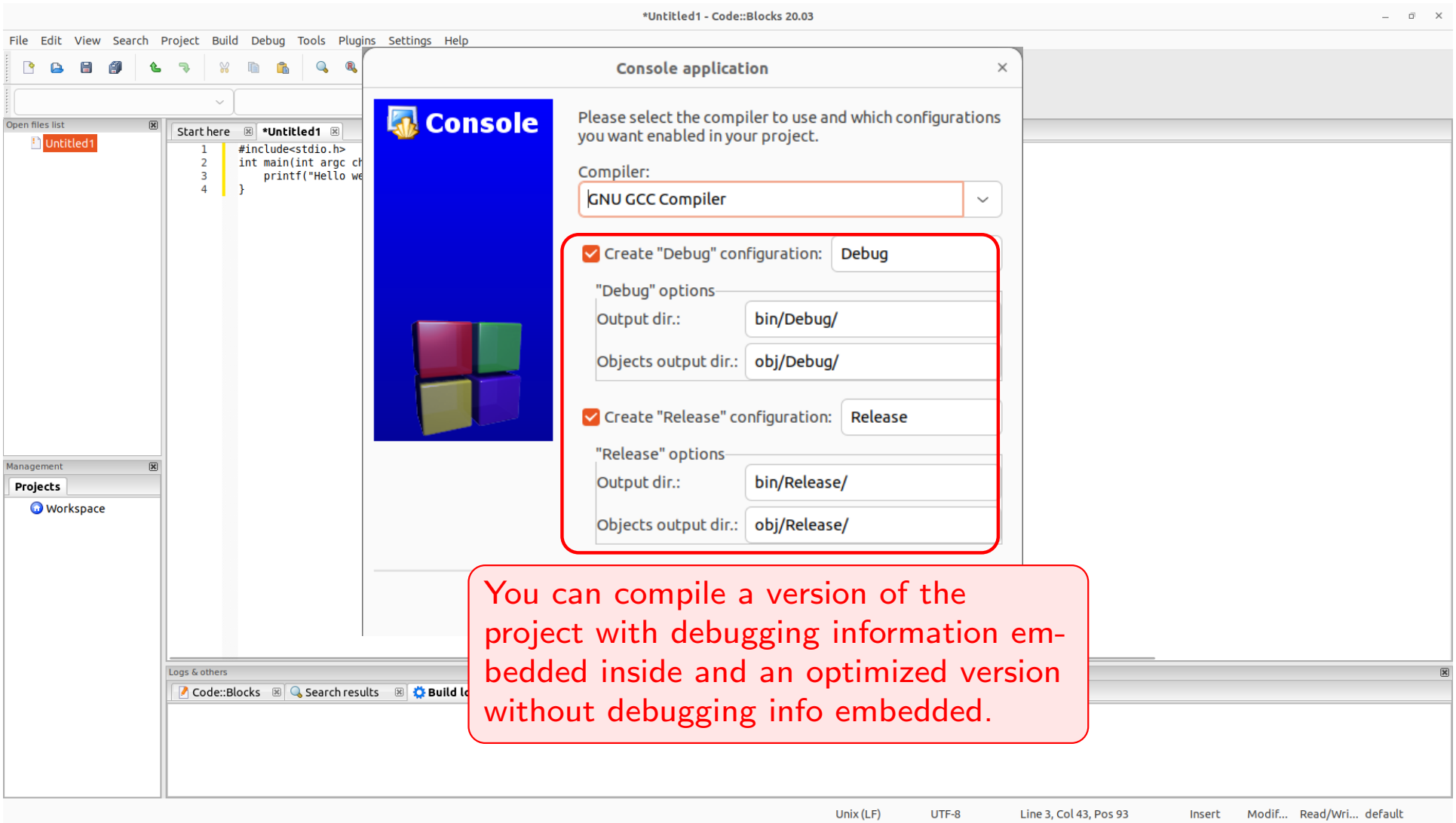
Run Code::Blocks for the first time: generate C-program **with** project.



Run Code::Blocks for the first time: generate C-program **with** project.

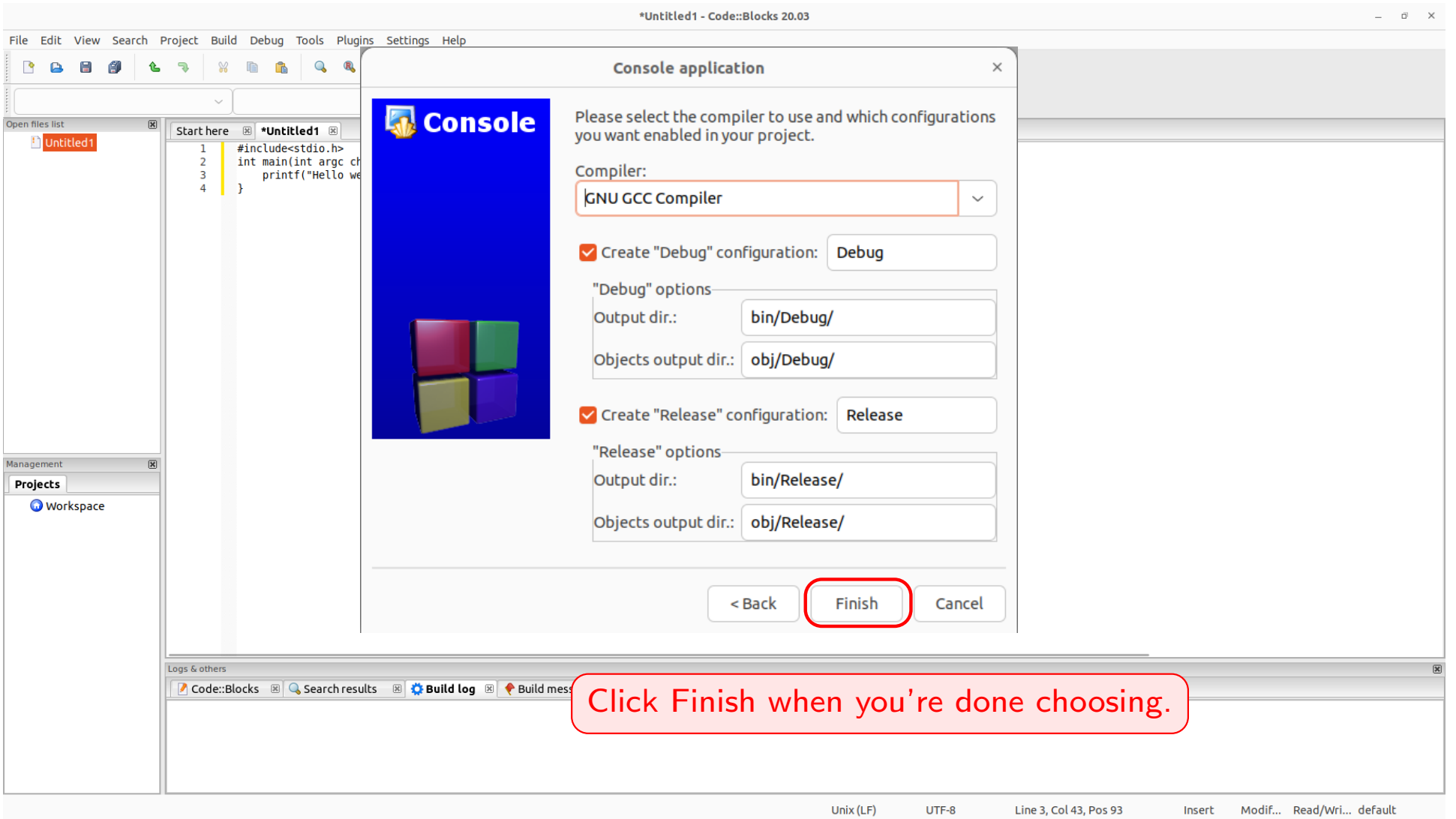


Run Code::Blocks for the first time: generate C-program **with** project.



You can compile a version of the project with debugging information embedded inside and an optimized version without debugging info embedded.

Run Code::Blocks for the first time: generate C-program **with** project.



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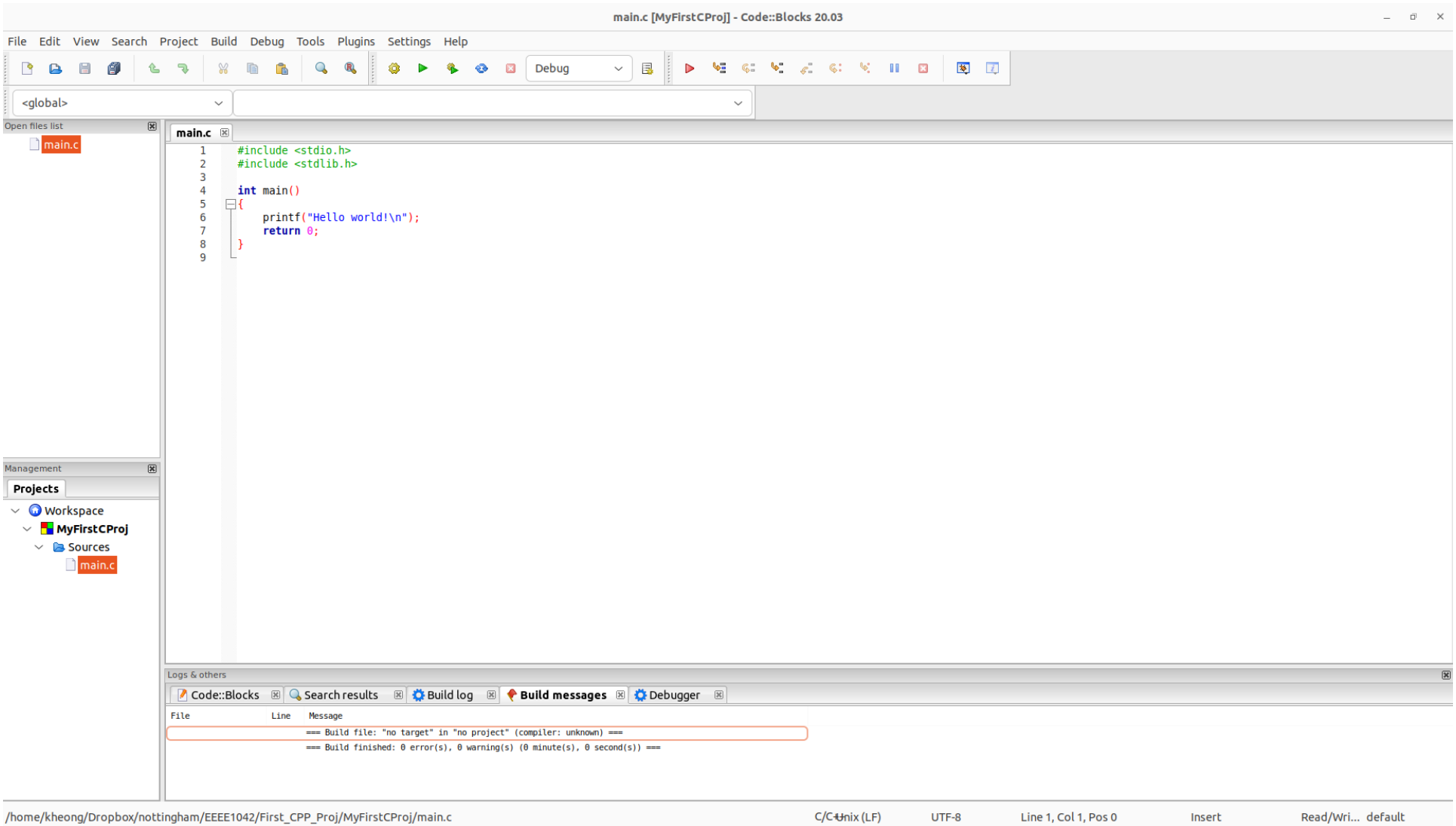

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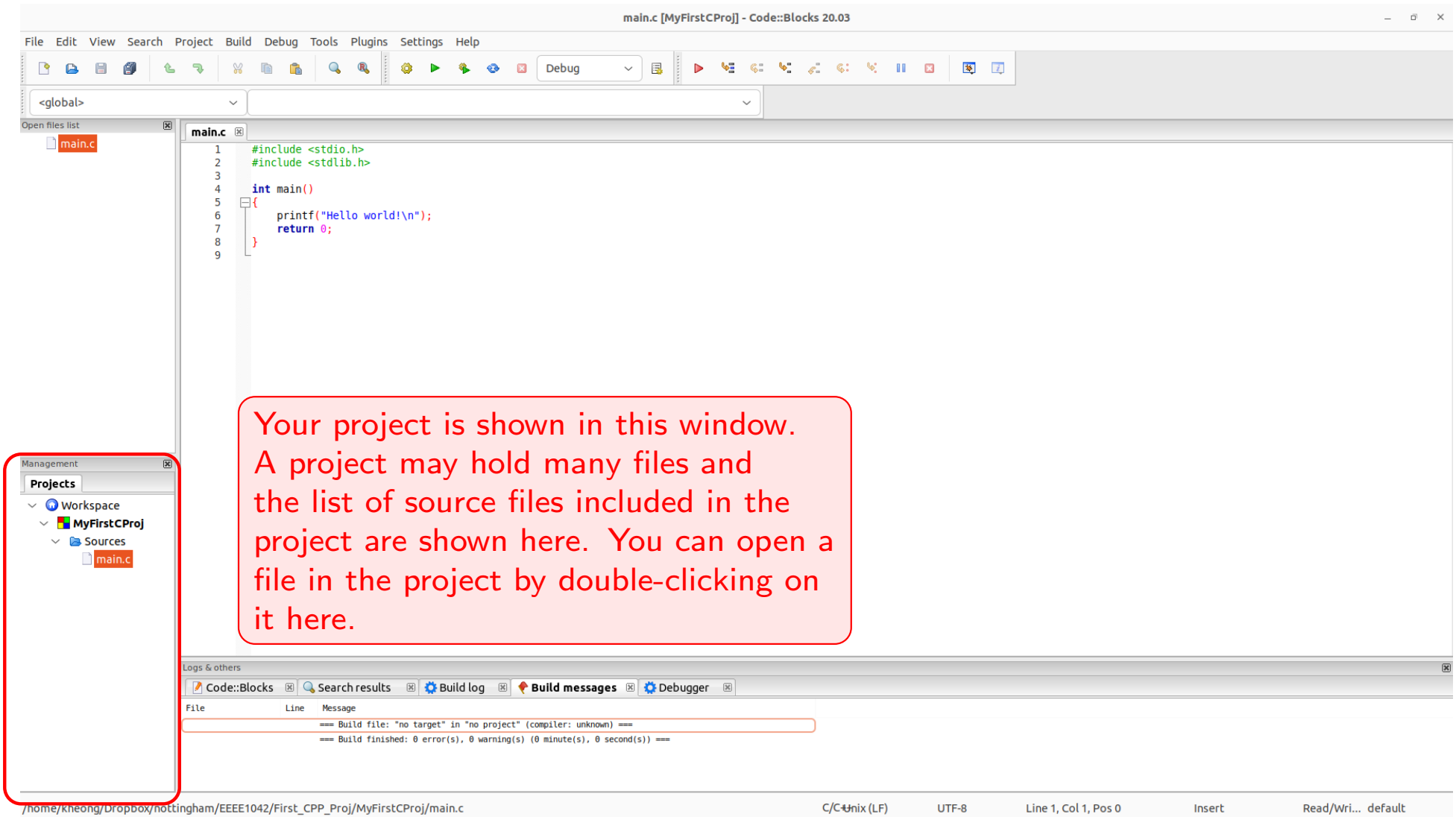

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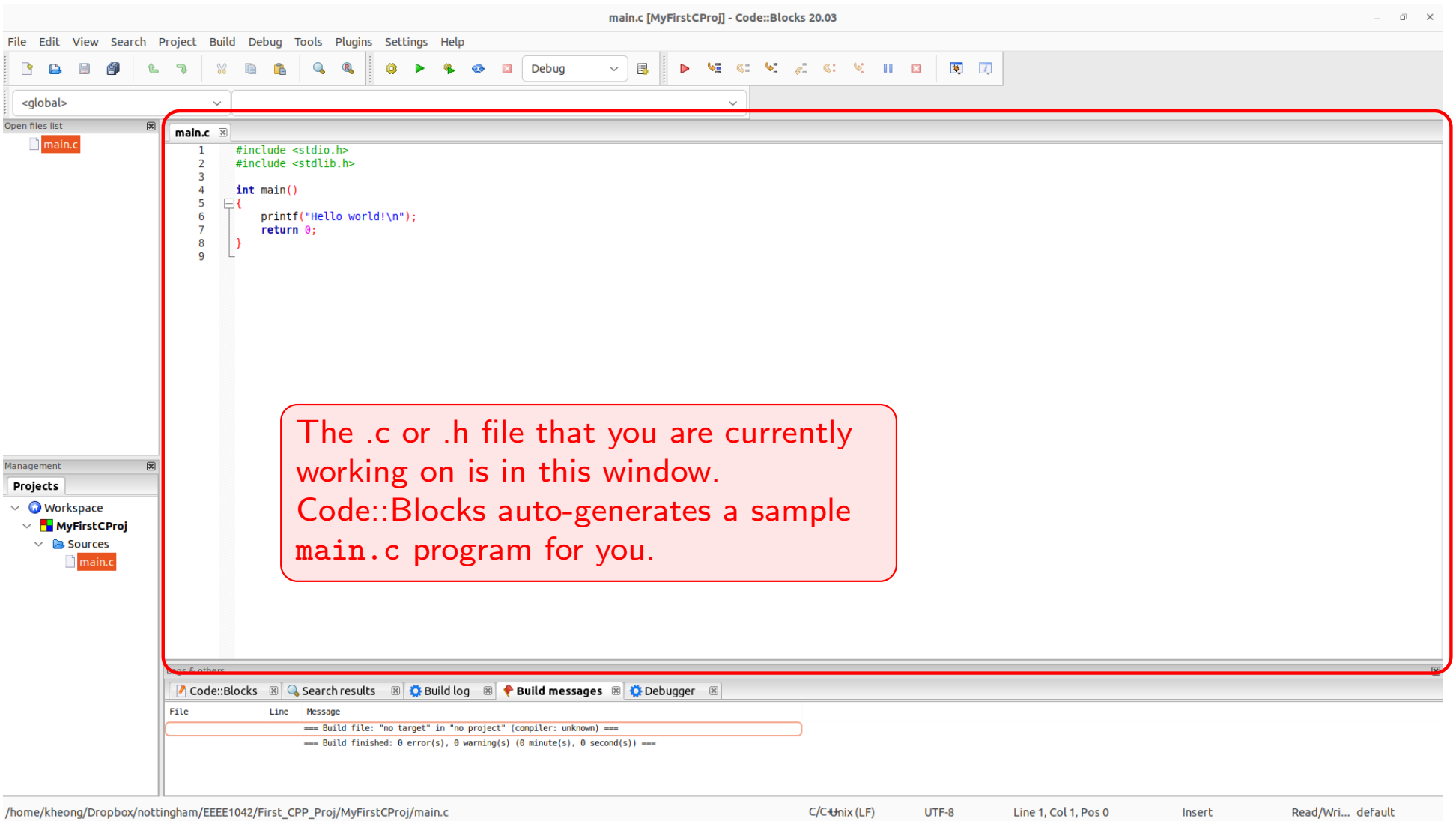

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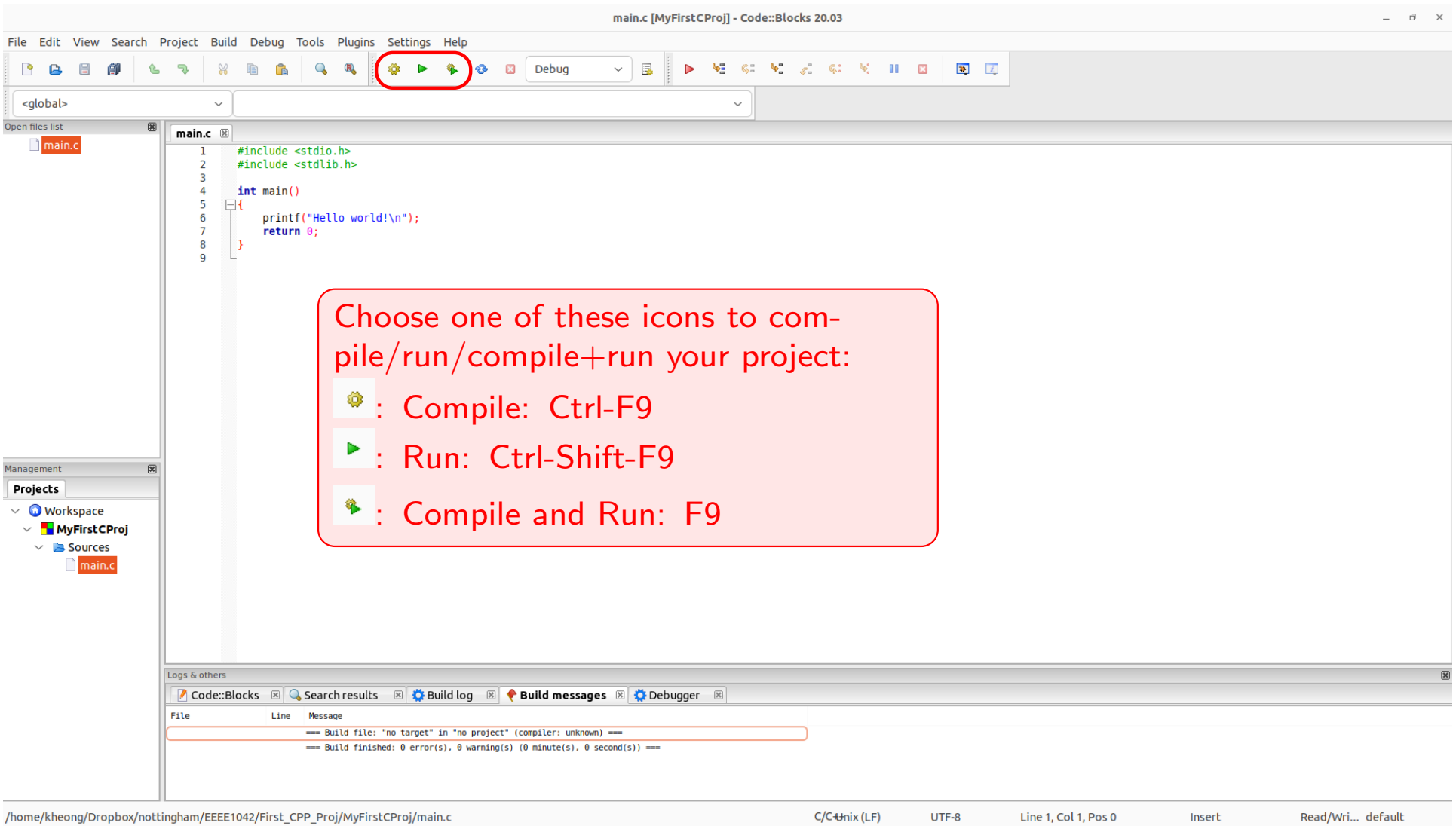

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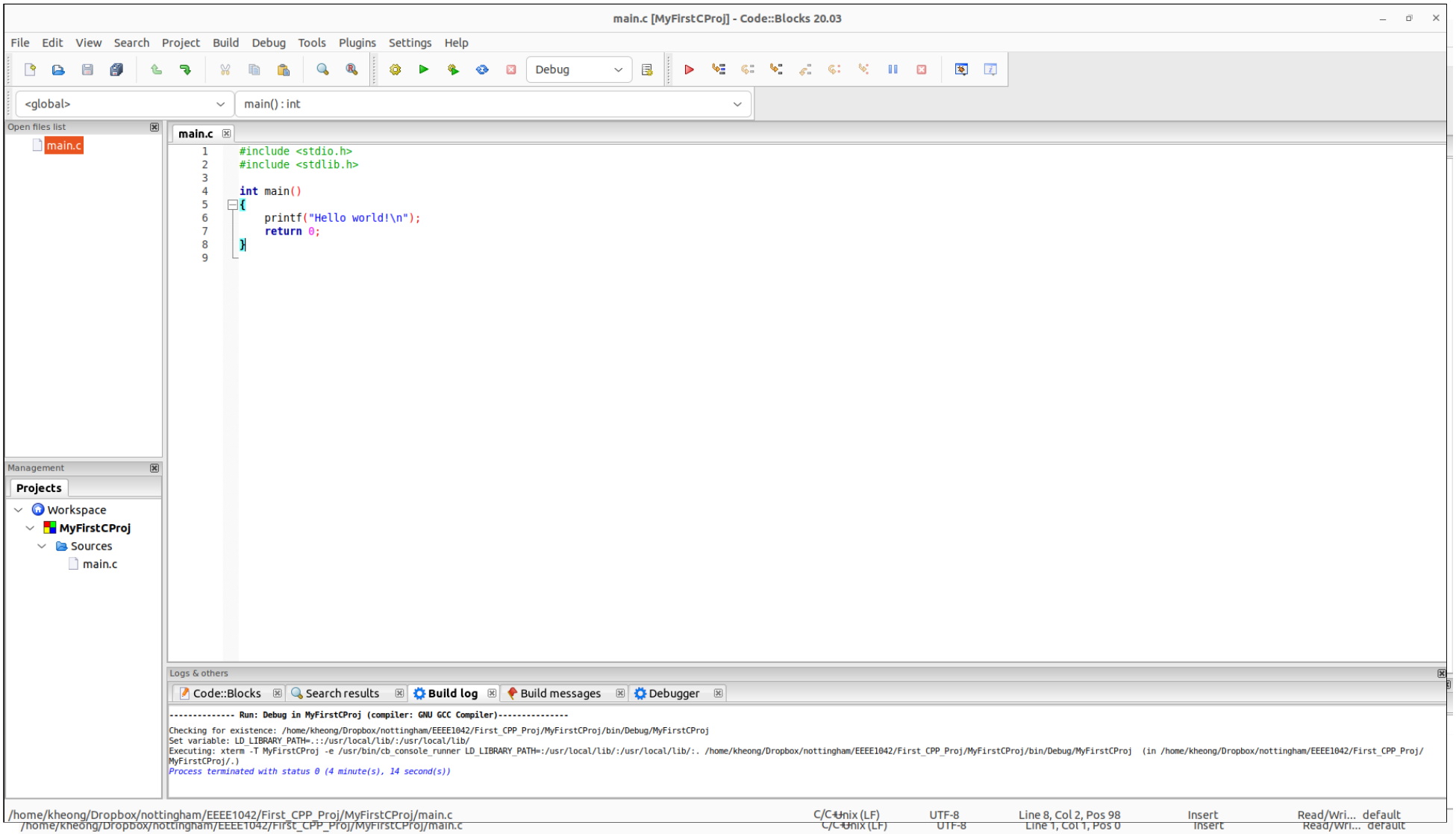
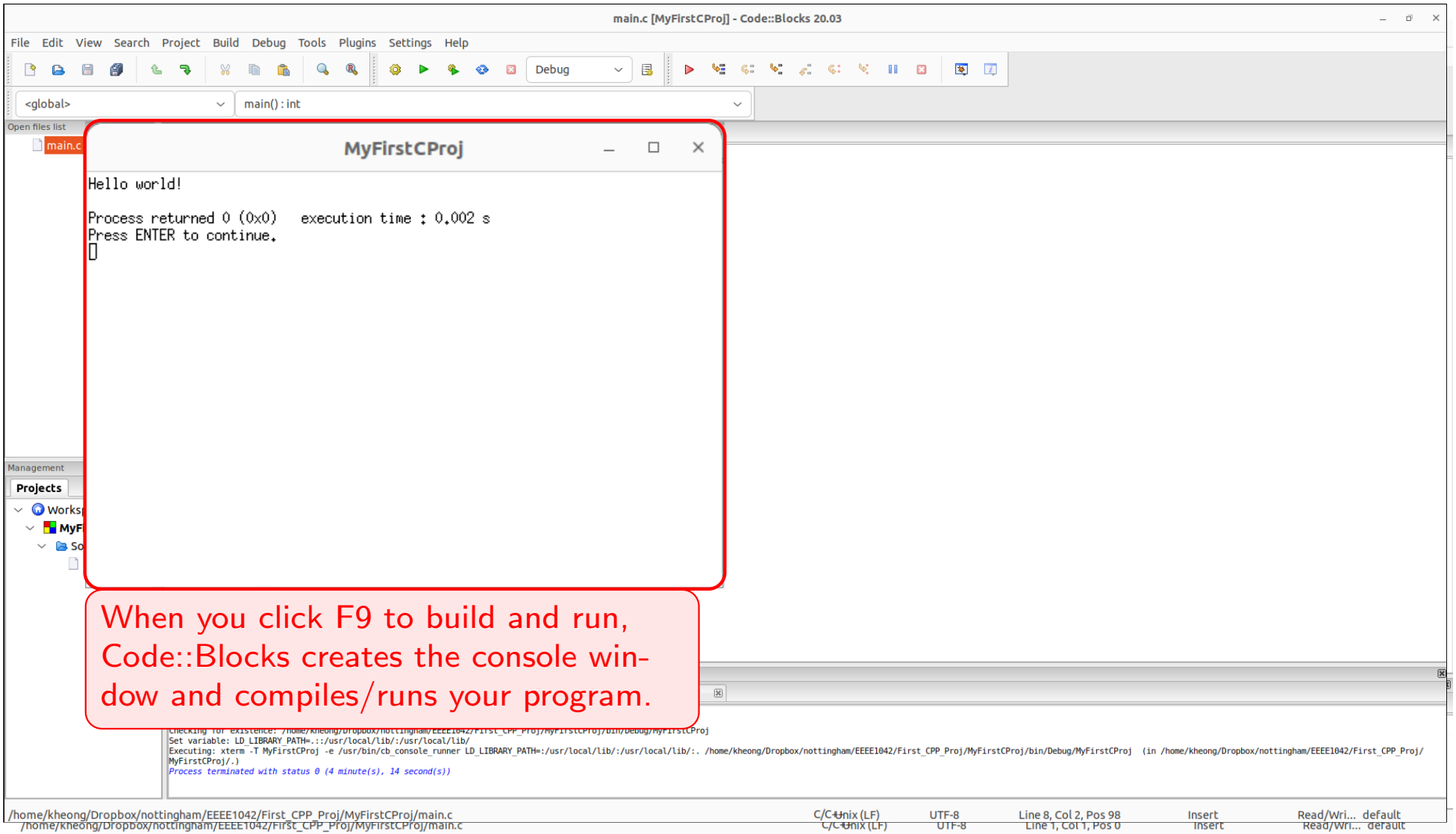


Run Code::Blocks for the first time: generate C-program **with** project.



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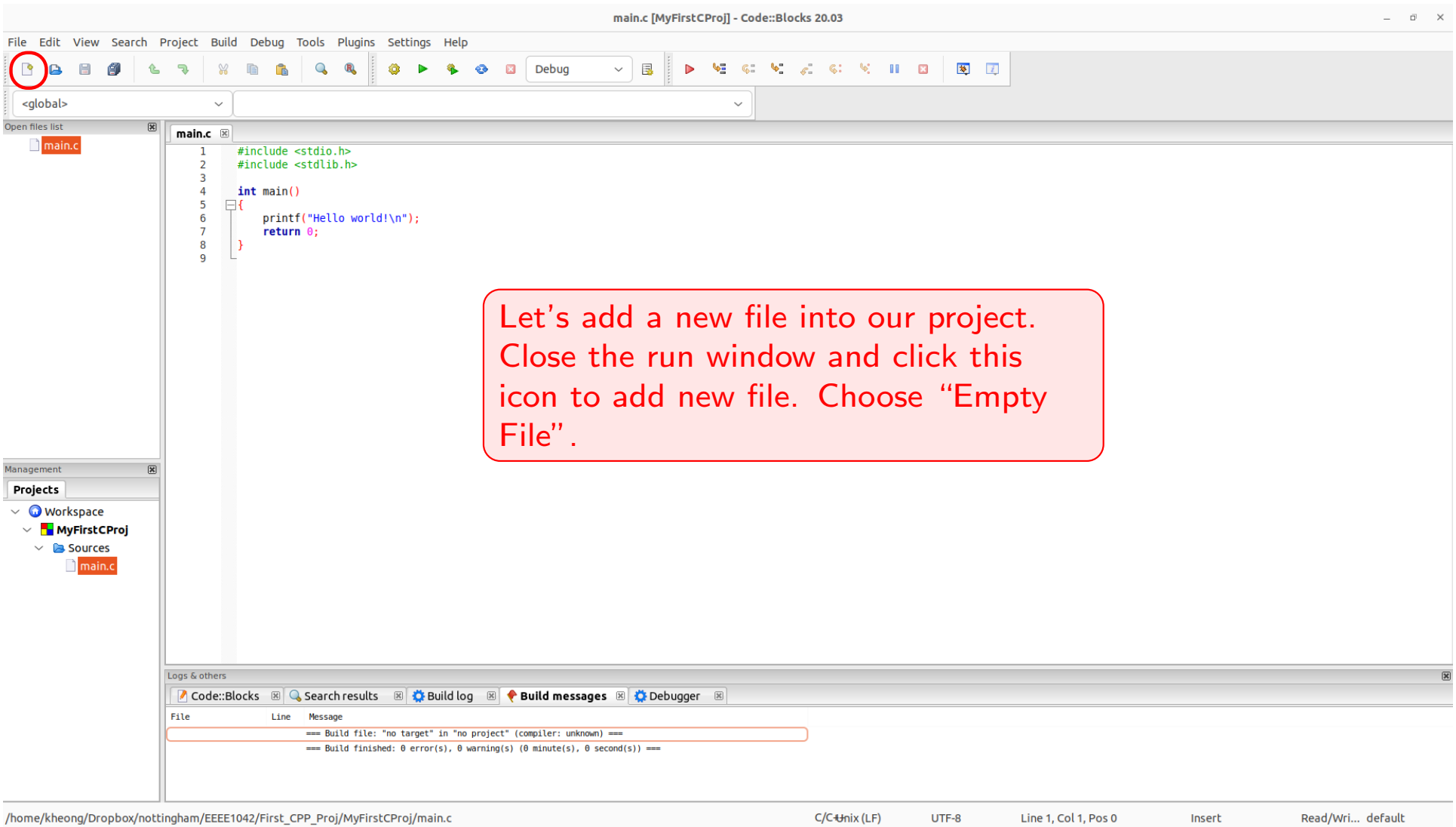

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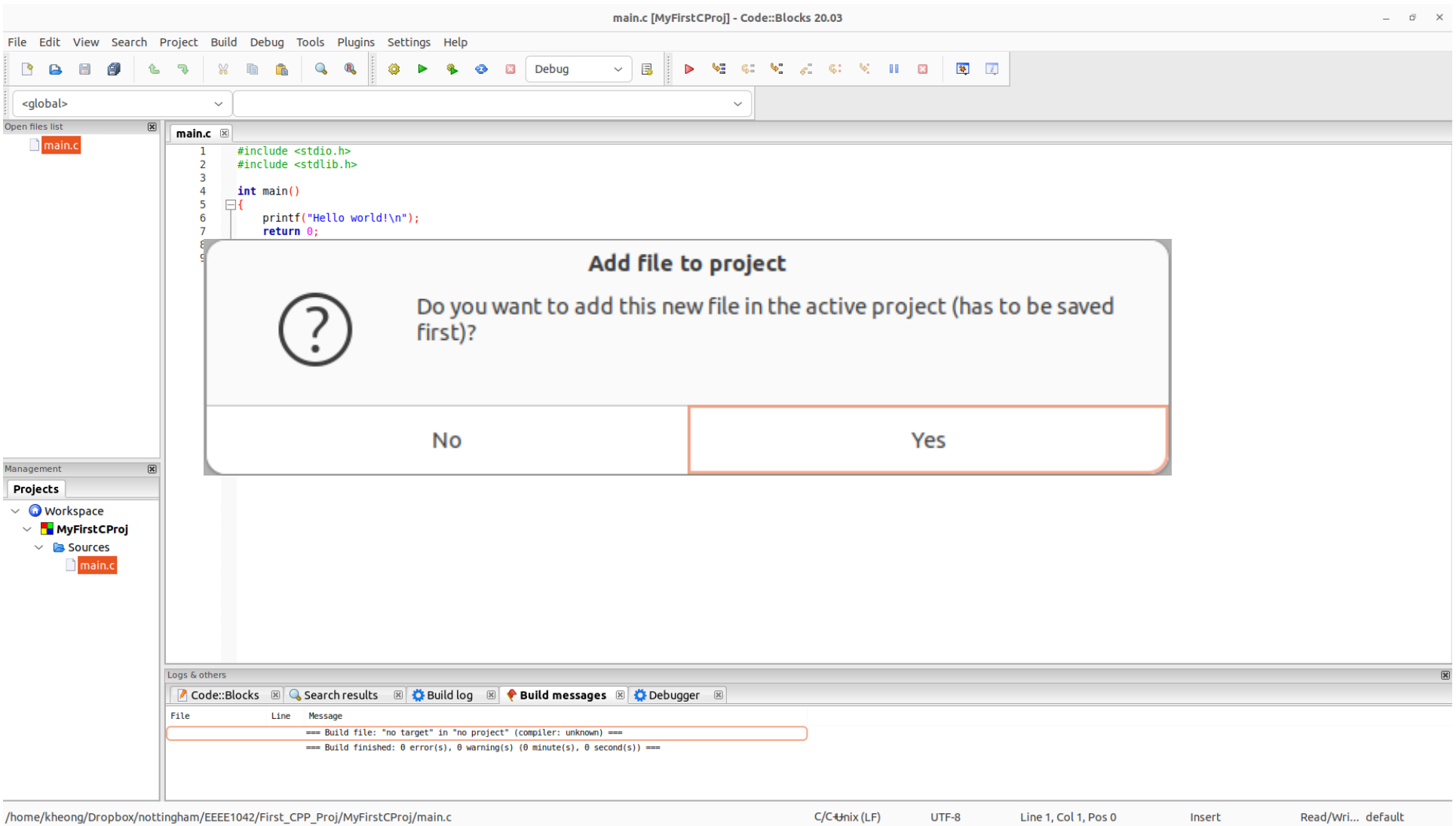

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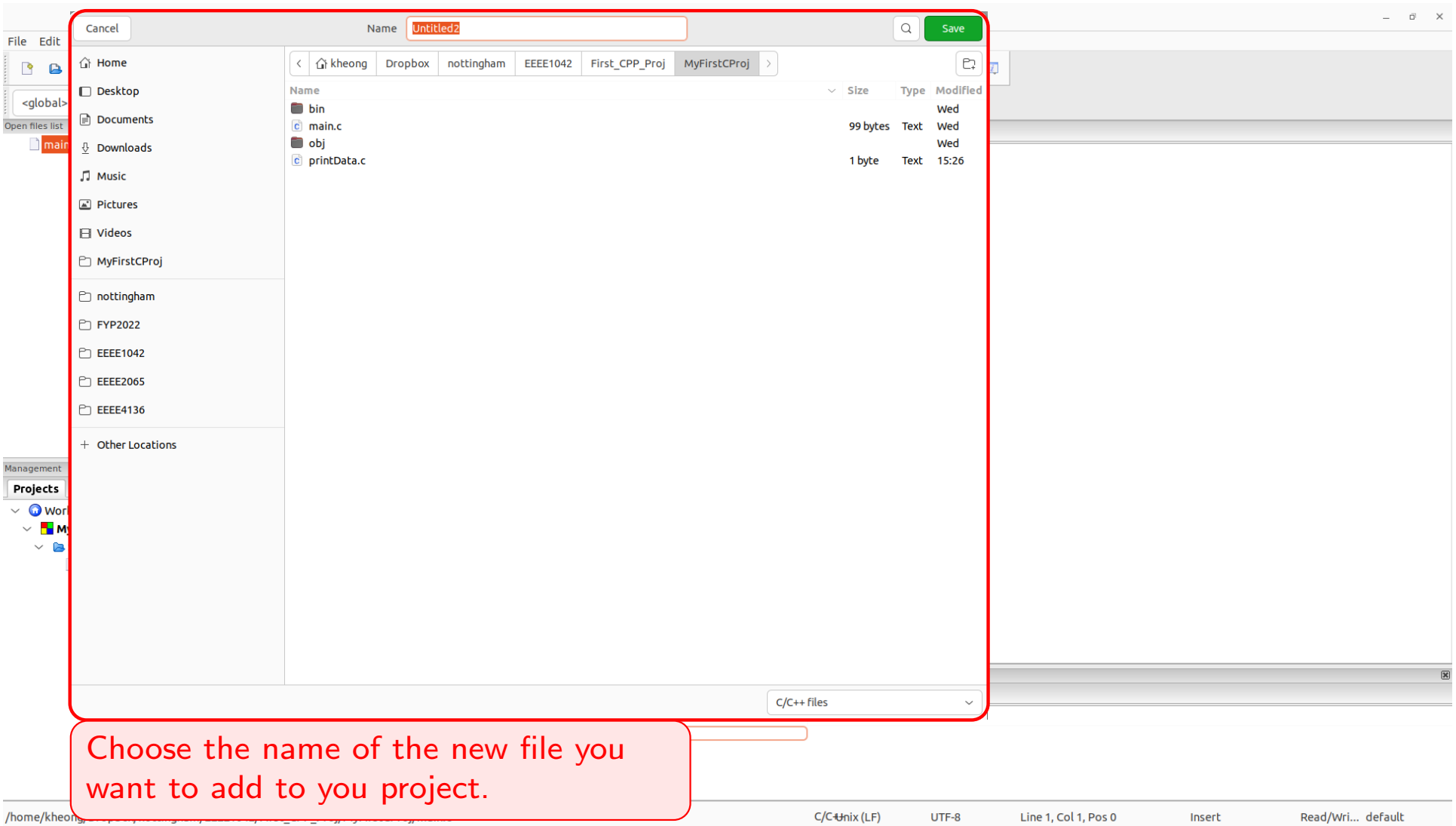

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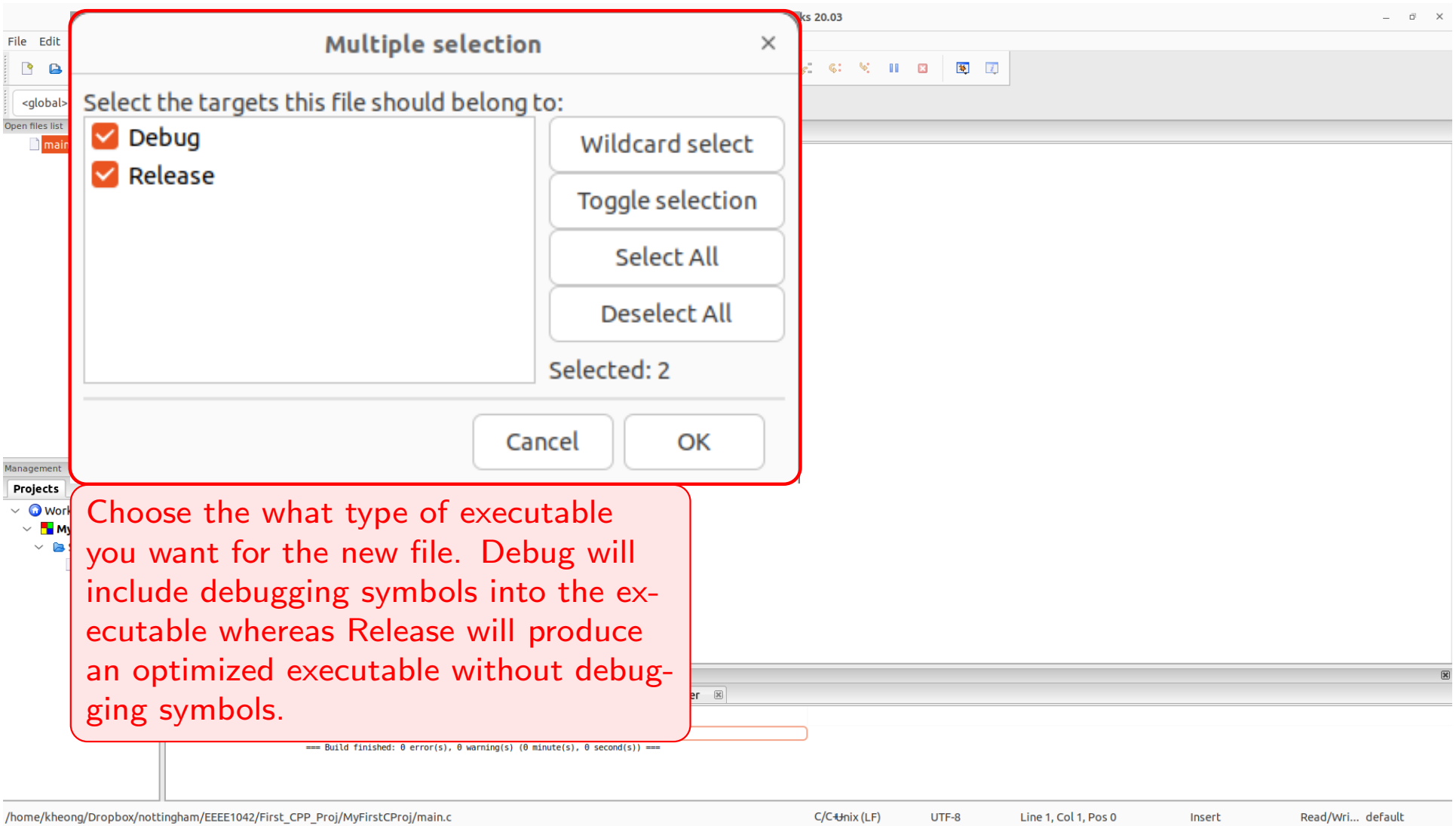
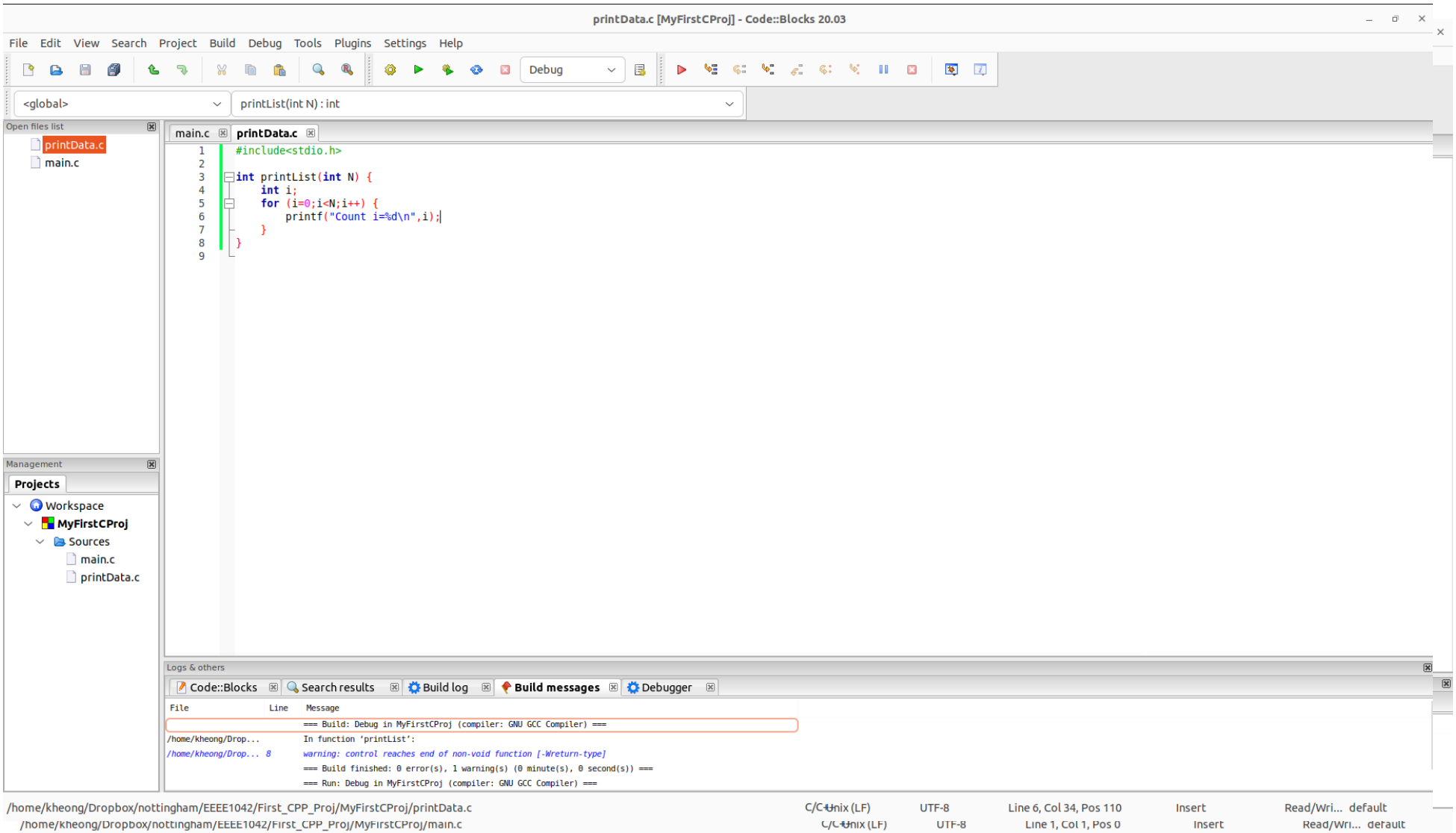


Run Code::Blocks for the first time: generate C-program **with** project.



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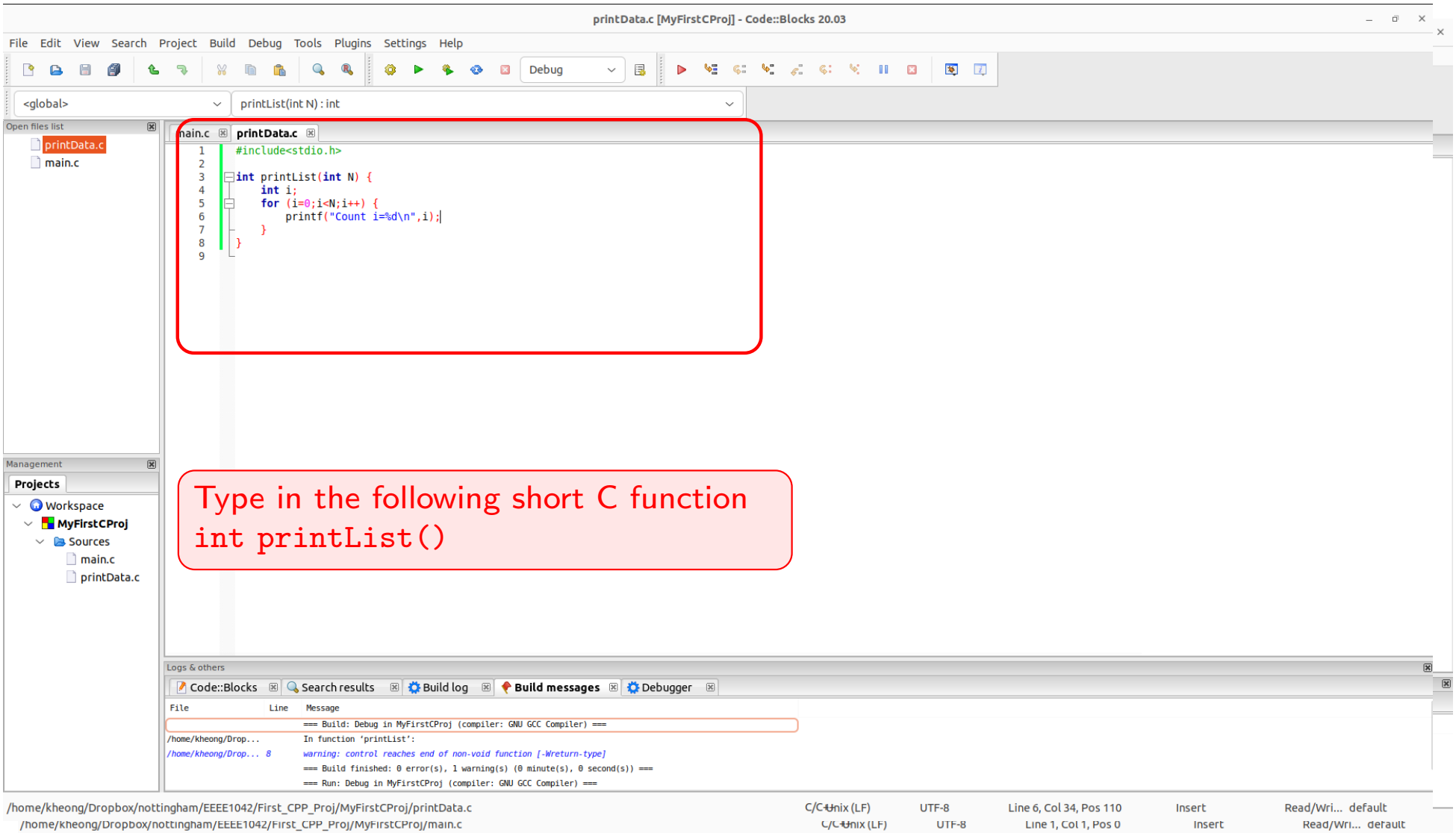

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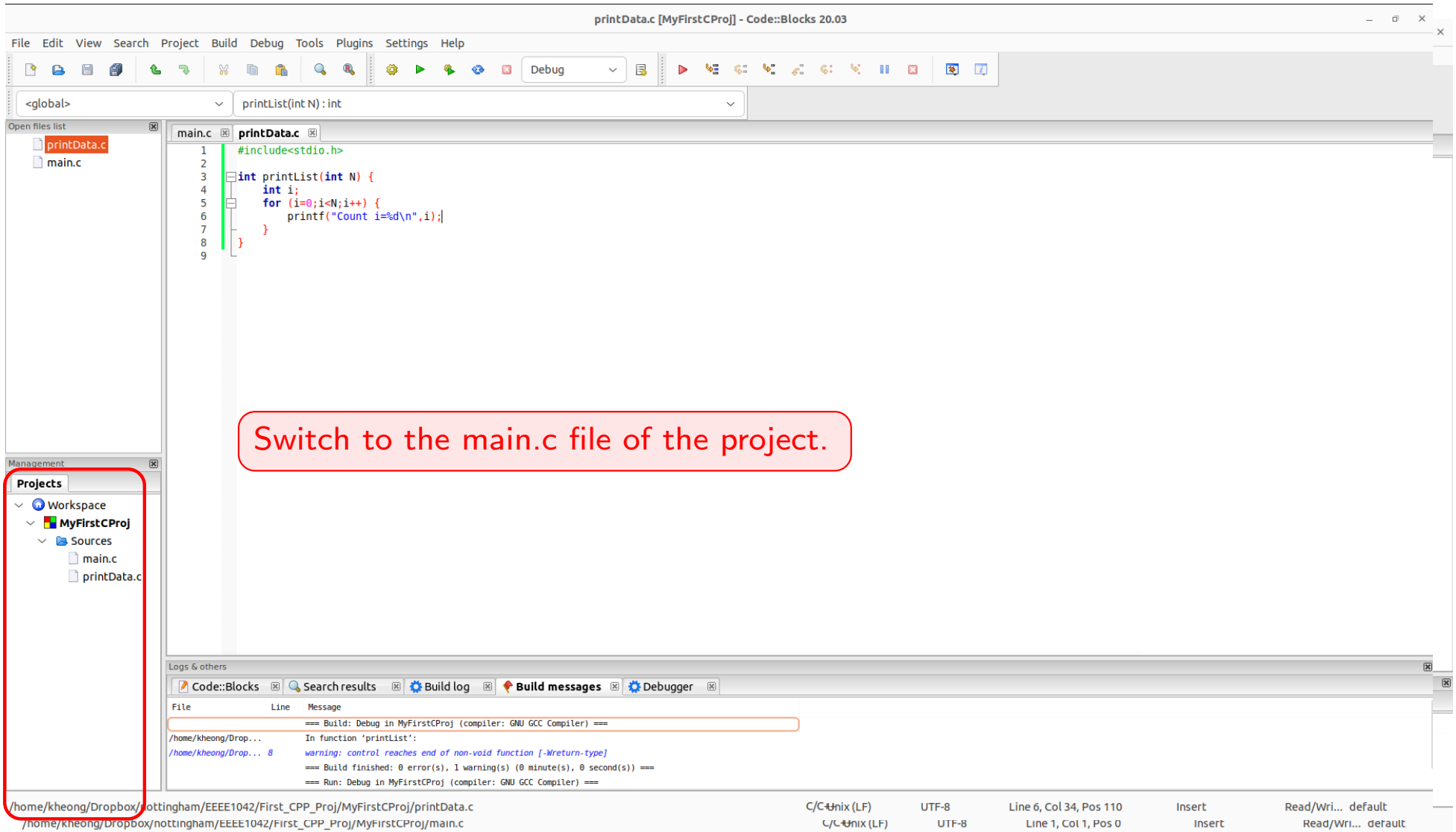

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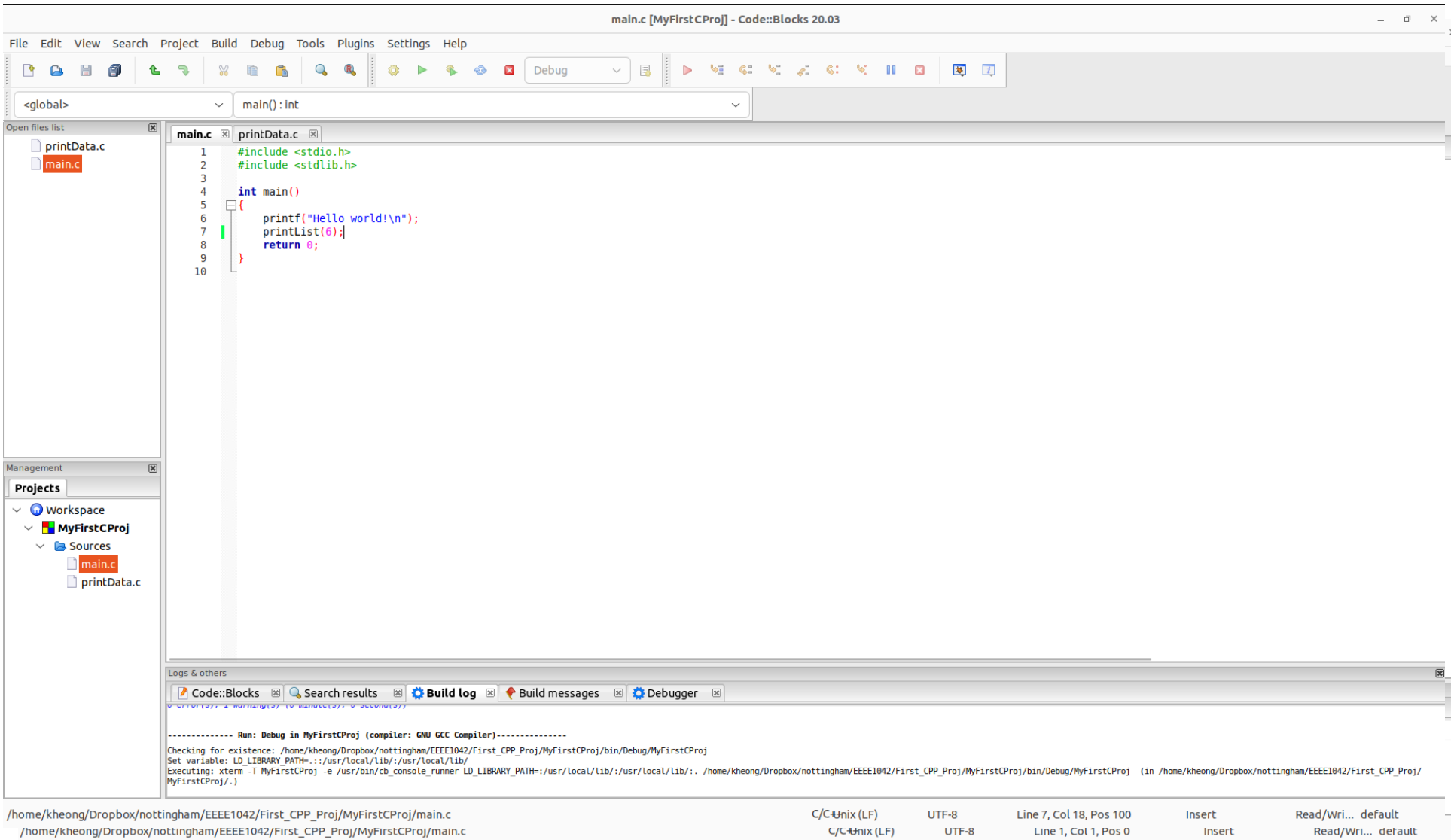
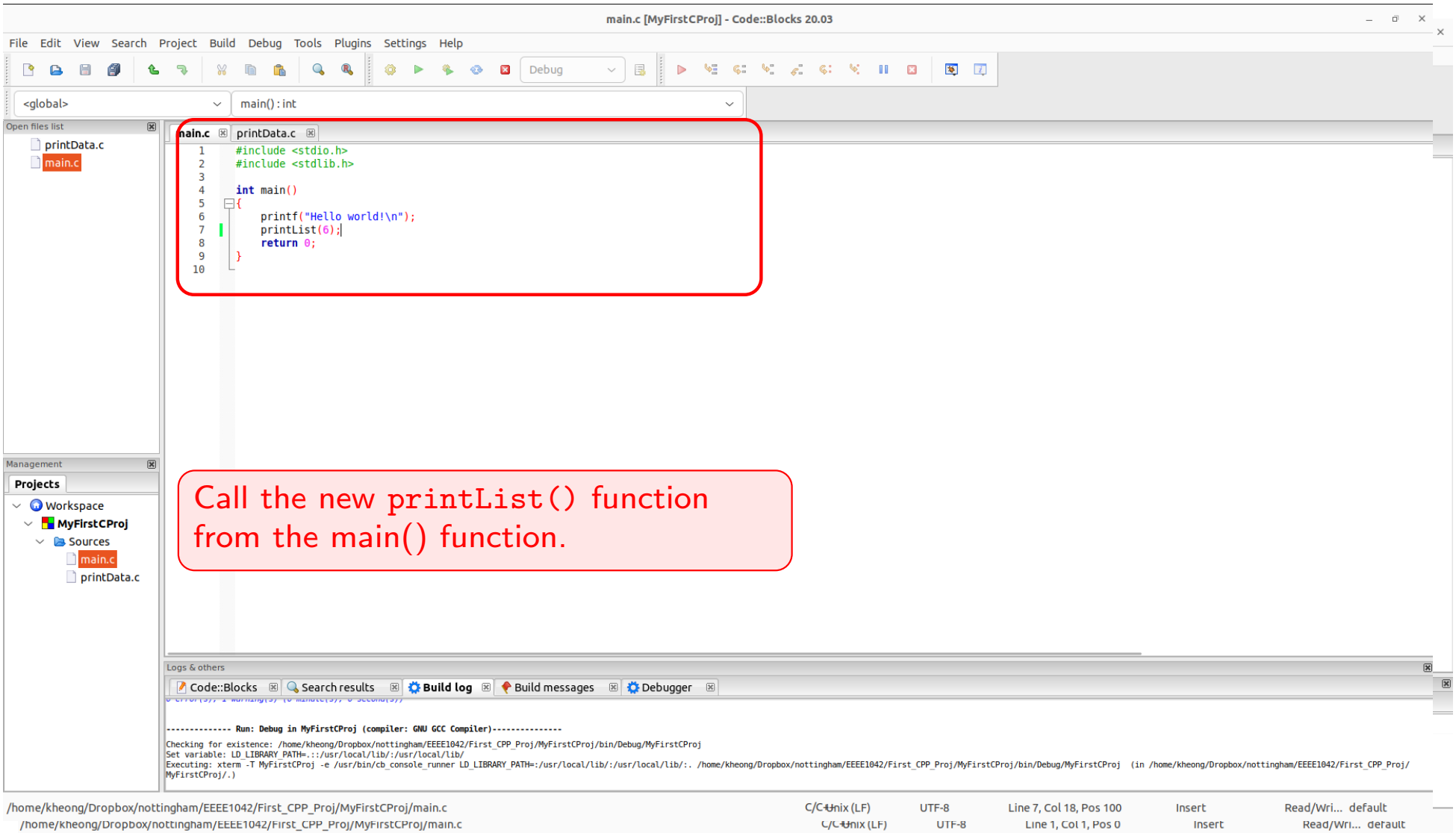
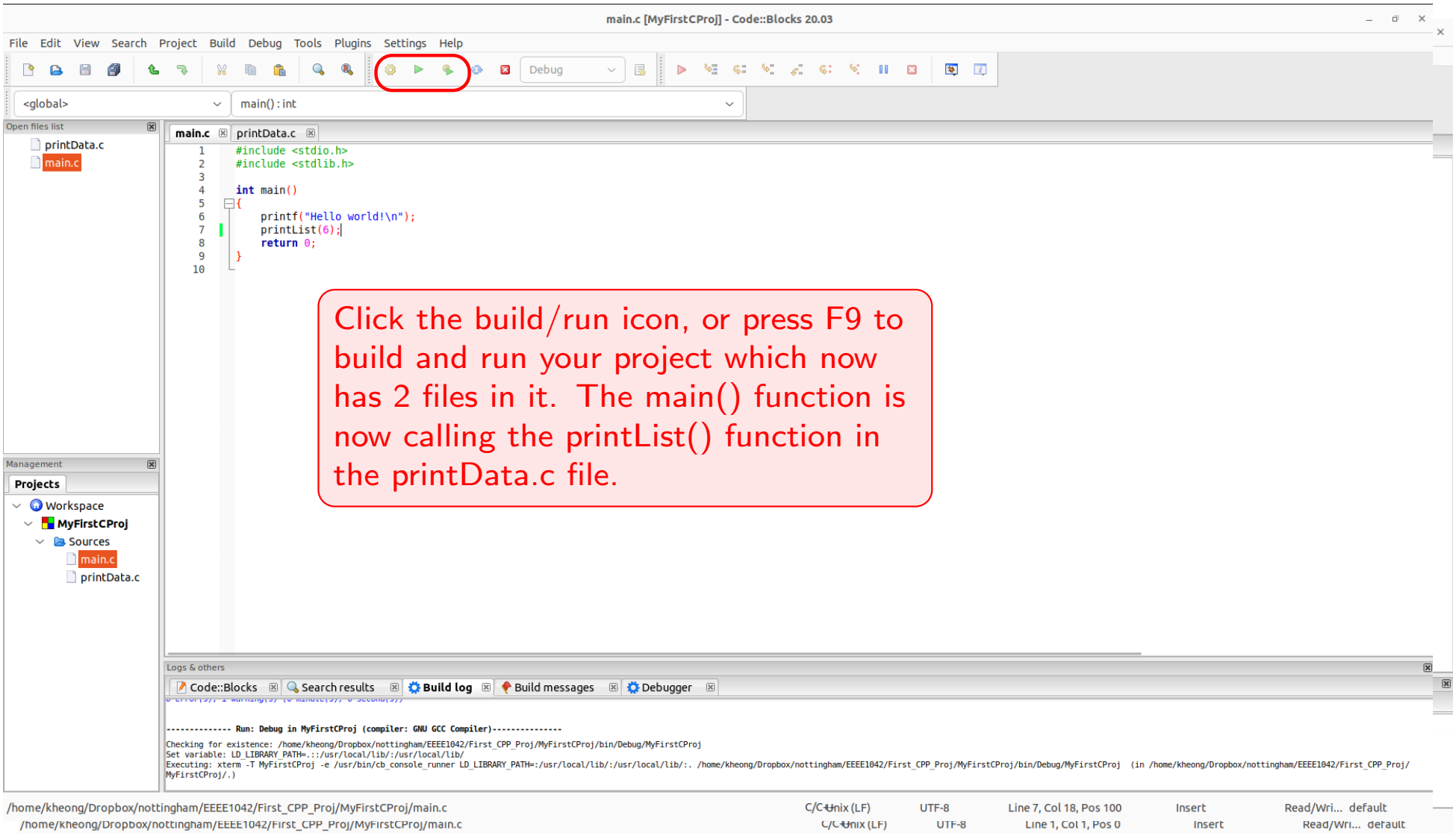


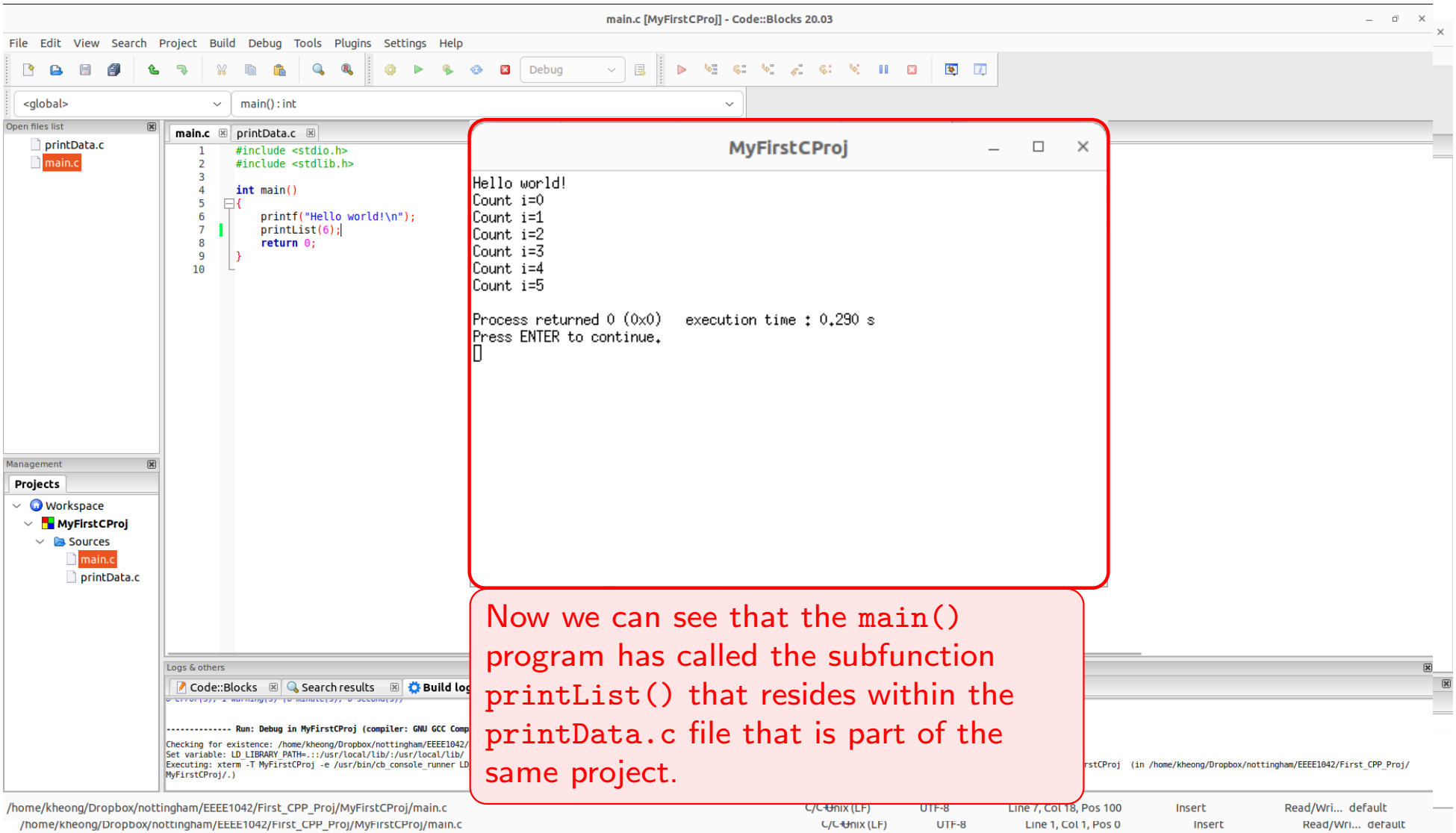
Run Code::Blocks for the first time: generate C-program **with** project.



Run Code::Blocks for the first time: generate C-program **with** project.



Run Code::Blocks for the first time: generate C-program **with** project.



Maintainable, Modular, Re-useable Code

- The **New Project** enables greater **modularity** compared to the **New File** option in Code::Blocks.

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- Here we stress the **Importance of modular programming** especially for bigger projects.

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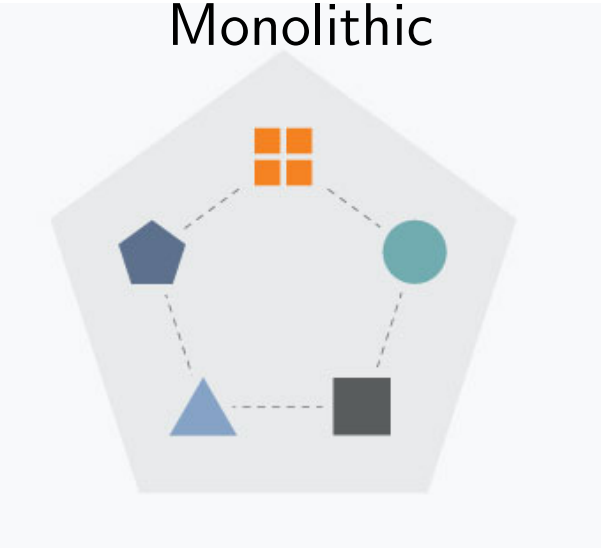
- The **New Project** enables greater **modularity** compared to the **New File** option in Code::Blocks.
- Here we stress the **Importance of modular programming** especially for bigger projects.
- Monolithic: One single big monolithic chunk of code $\rightarrow$ **unmaintainable, not reuseable**.



Maintainable, Modular, Re-useable Code

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- Here we stress the **Importance of modular programming** especially for bigger projects.
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- Modular: Break monolithic code up into subparts→ functions → **maintainable and reuseable**.

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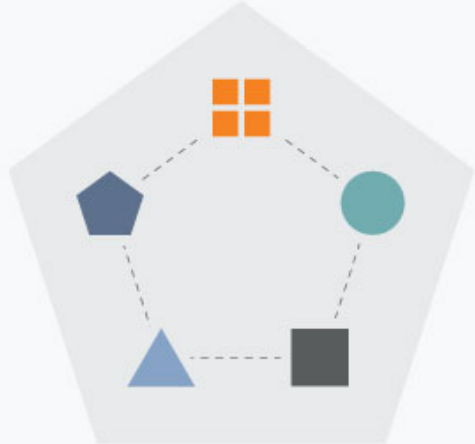
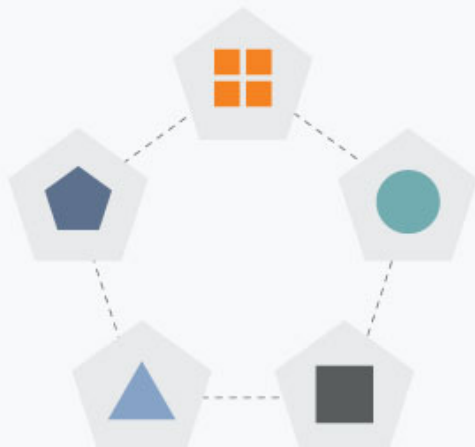


Modular



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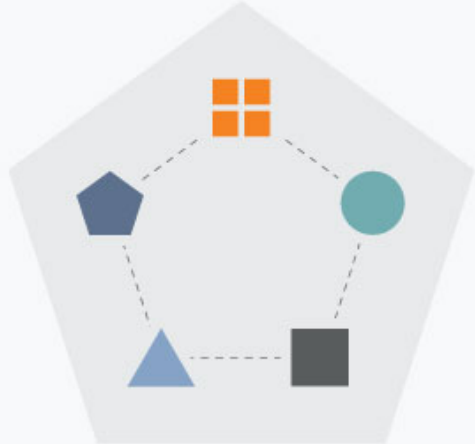

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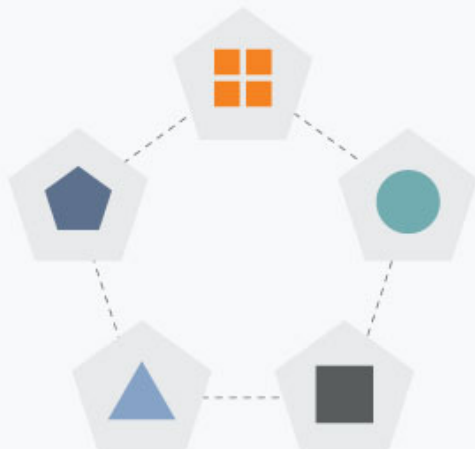

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- Each function can be re-used over and again, when handled/documented properly.

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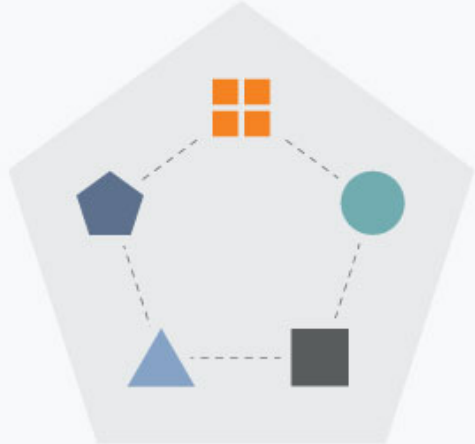

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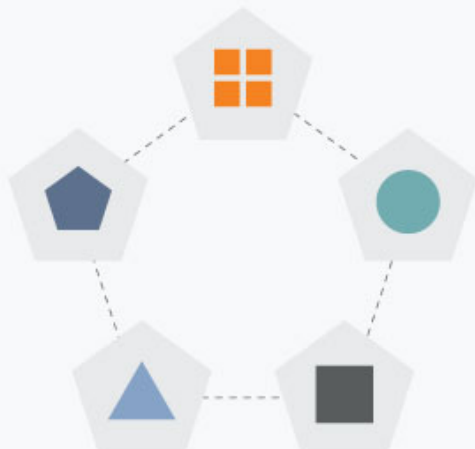

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Try not leave your final program with chunks of code commented out $\rightarrow$ sloppy programming.

Use-case examples in C++.

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// This is the main program where C/C++ will begin its execution
// The main program has an output that returns an int
// The main function takes two inputs: argc (an integer) and argv (an
array of strings)
// argc is the number of inputs
// argv is a list of each input as a string
// The return value is a code indicating the success or failure of the
C/C++ program.
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Always document: the purpose, the inputs and the outputs of every function you write.

Best C++ commenting practices.

1. Use comments to indicate what a chunk of code is supposed to do
2. Use comments to document purpose, inputs and outputs of all functions
3. Use comments to temporarily remove a chunk of code
4. Use comments to delimit sections of your program (the quintessential section of your program being a function)

Outline EEEE1042 C Lecture 1:

Key takeaways

1. Overview of how compilers work
2. Introduced and installed the main coding environment we will be using in this course:
   Code::Blocks
3. Differences between program files and projects
4. Importance of Modular programming
5. Importance of commenting your code