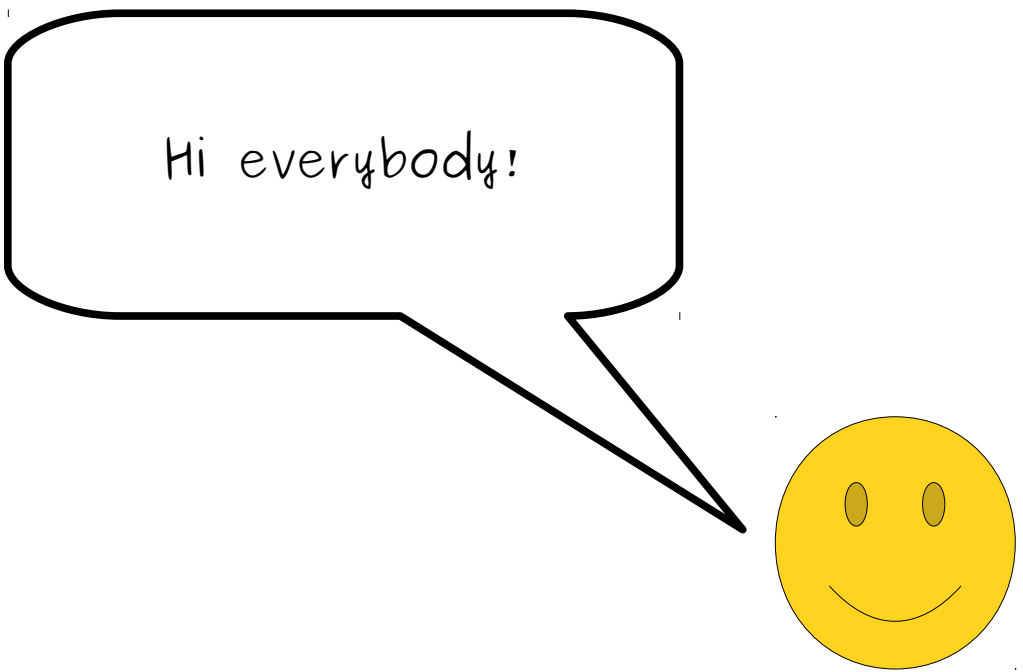
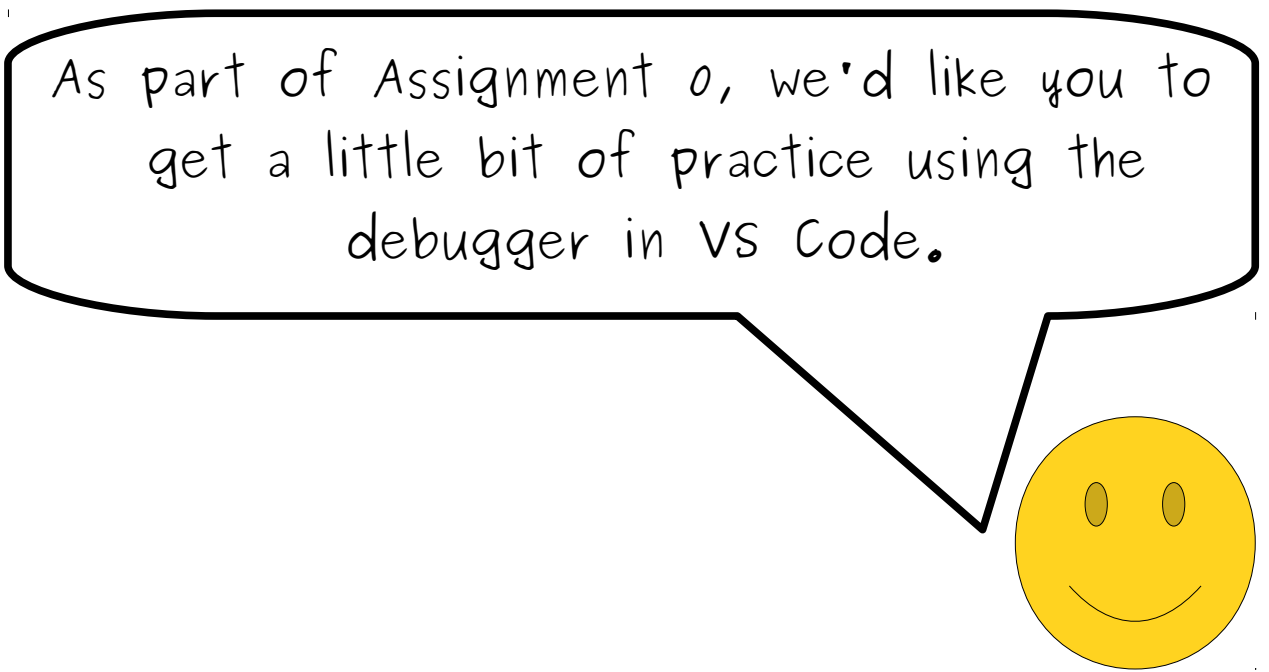
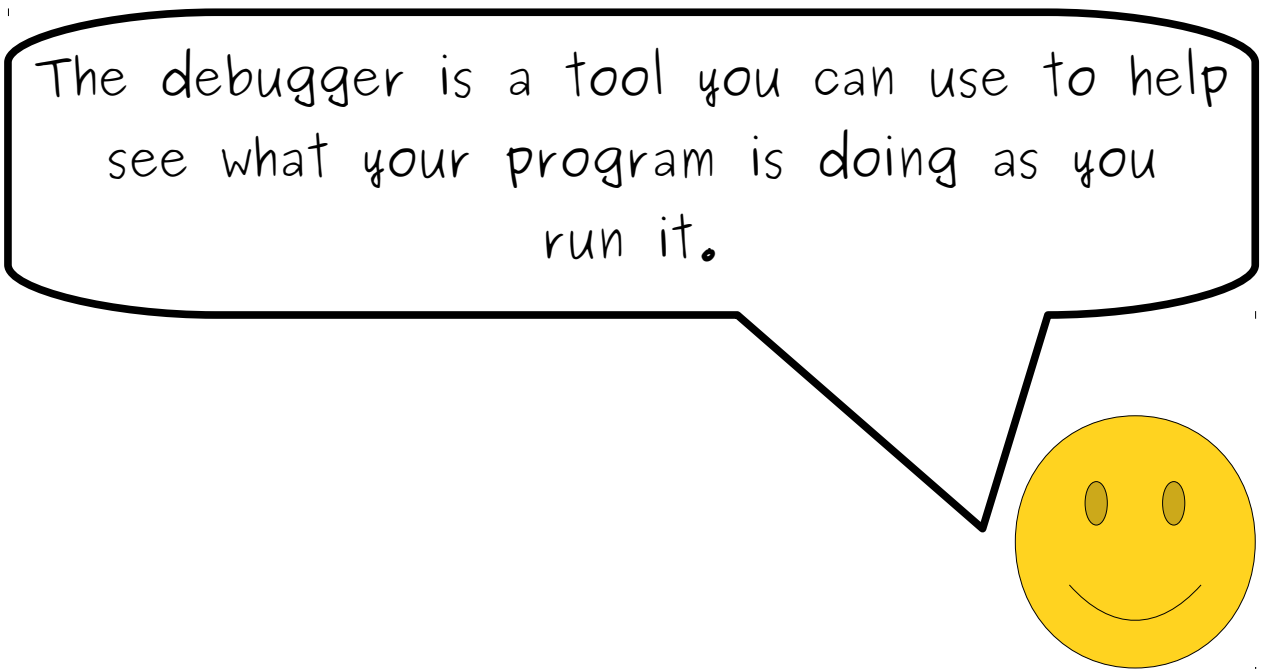
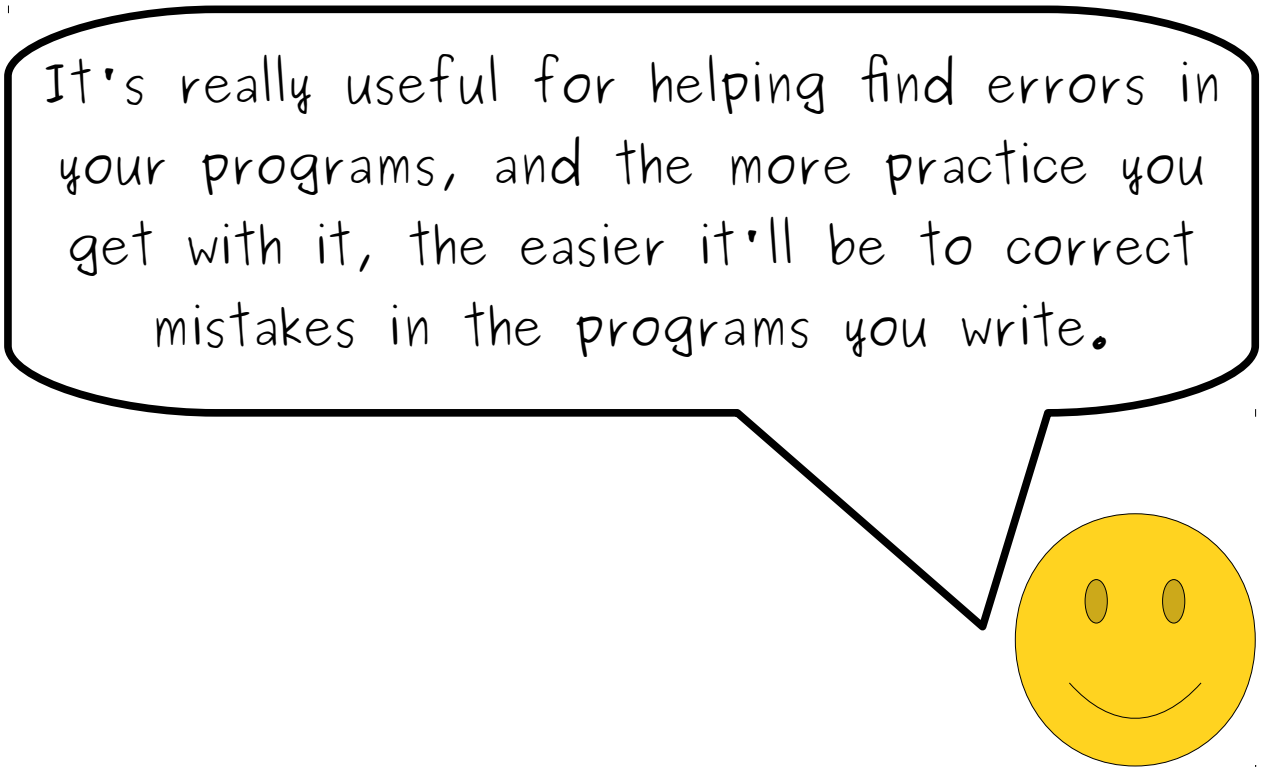
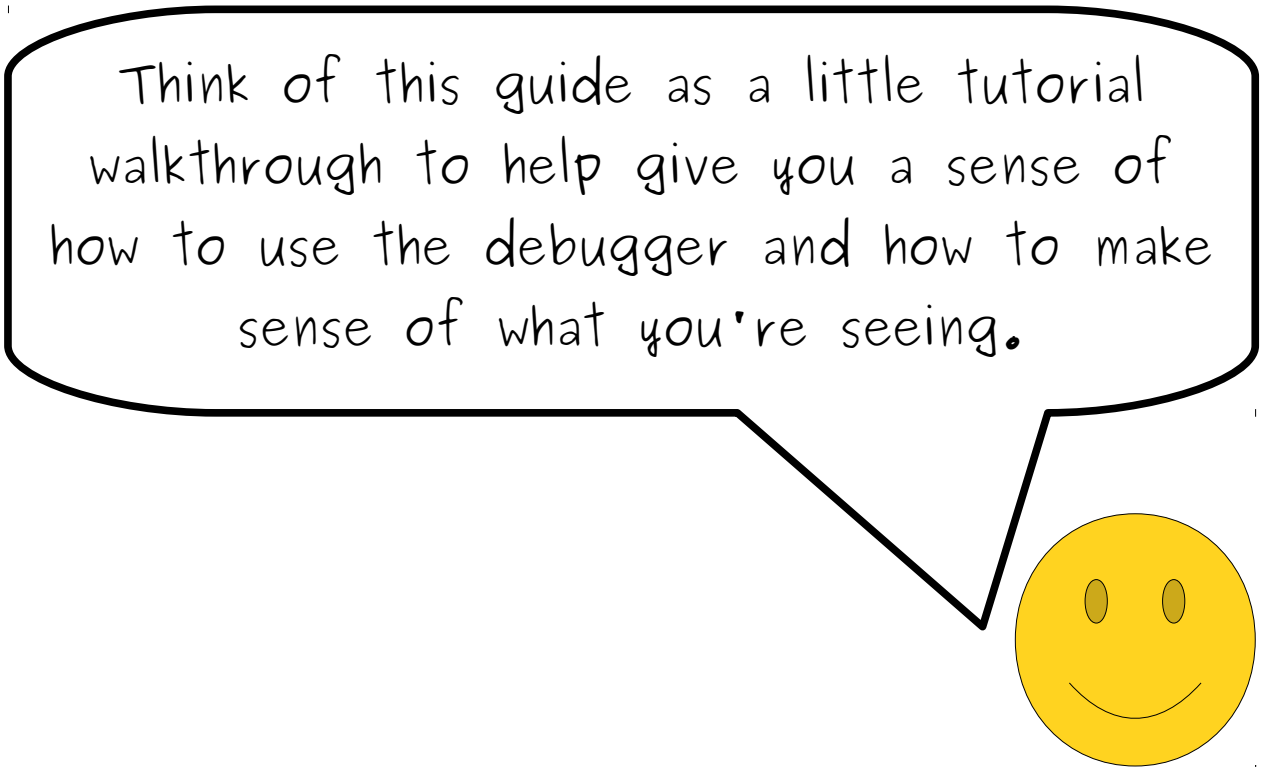
CS101B Debugger Tutorial


Hi everybody!


As part of Assignment 0, we'd like you to get a little bit of practice using the debugger in VS Code.


The debugger is a tool you can use to help see what your program is doing as you run it.


It's really useful for helping find errors in your programs, and the more practice you get with it, the easier it'll be to correct mistakes in the programs you write.


Think of this guide as a little tutorial walkthrough to help give you a sense of how to use the debugger and how to make sense of what you're seeing.

File Edit Selection View Go Run Terminal Help Assignment 0 Debugger Tutorial - Visual Studio Code

EXPLORER

ASSIGNMENT 0 DEBUGGER TUTORIAL

CMakeLists.txt

NameHash.cpp

To start things off, open the Name Hash project you ran in VS Code.

Show All Commands Ctrl + Shift + P

Go to File Ctrl + P

Open Settings Ctrl + ,

Find in Files Ctrl + Shift + F

Start Debugging F5

OUTLINE

TIMELINE

0 0 CMake: [Debug]: Ready No Kit Selected Build [all] Run CTest Run CPack Run Workflow

File Edit Selection View Go Run Terminal Help Assignment 0 Debugger Tutorial - Visual Studio Code

CMAKE

PROJECT STATUS

- Folder
  - Assignment 0 Debugger Tut...
- Configure
  - GCC 14.2.0 x86_64-w64-min...
  - Debug
- Build
  - all
- Test

PROJECT OUTLINE

- Assignment-0
  - Assignment-0 (Executab...
  - CMakeLists.txt

PINNED COMMANDS

- Configure Task
- Run Task

Configure the project in the CMake panel. Check VS Code Workflow if you don't know how to do it.

Show All Commands Ctrl + Shift + P

Go to File Ctrl + P

Open Settings Ctrl + ,

Find in Files Ctrl + Shift + F

Start Debugging F5

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS Filter CMake/Build

```
[cmake] Not searching for unused variables given on the command line.
[cmake] -- Configuring done (0.4s)
[cmake] -- Generating done (0.1s)
[cmake] -- Build files have been written to: C:/Users/xuehao/Desktop/build-cache/Assignment 0 Debugger Tutorial
```

0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow

File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code

CMAKE

PROJECT STATUS

PROJECT OUTLINE

Assignment-0

Assignment-0 (Executab...

References

CMakeLists.txt

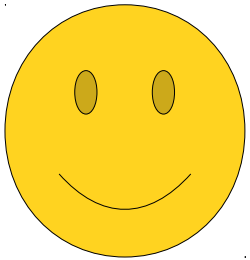
NameHash.cpp

CMakeLists.txt

PINNED COMMANDS

NameHash.cpp

Open up the Name Hash program. Scroll down to the **nameHash** function so that you can see the entire function in your window.



```
/**
 * Thi
 * a p
 * mat
 * In
 * is
 * is
 * While t
 * unique hashes (different names can hash to the
 * same value), there is a relatively low possibility
 * of a "collision" with a class of roughly 325 students.
 *
 * We will learn more about hashing later this quarter!
 */

#include <iostream>
#include <string>
#include "console.h"
#include "simpio.h"  // for getLine
using namespace std;

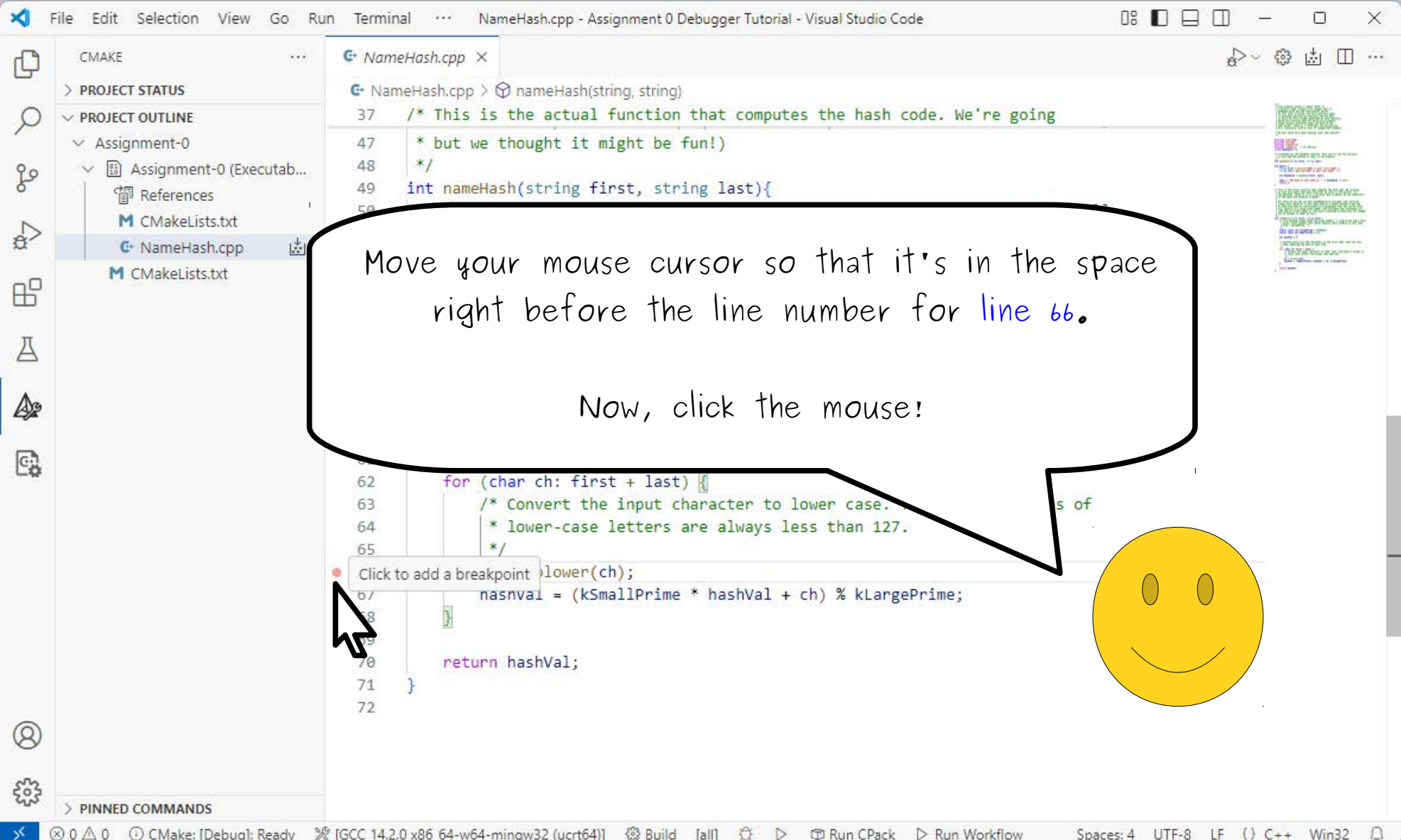
/* Prototype for the nameHash function. This lets us use the function
 * in main and then define it later in the program.
 */
int nameHash(string first, string last);

int main() {
    string first = getLine("What is your first name? ");
    string last = getLine("What is your last name?  ");

    int hashValue = nameHash(first, last);

```

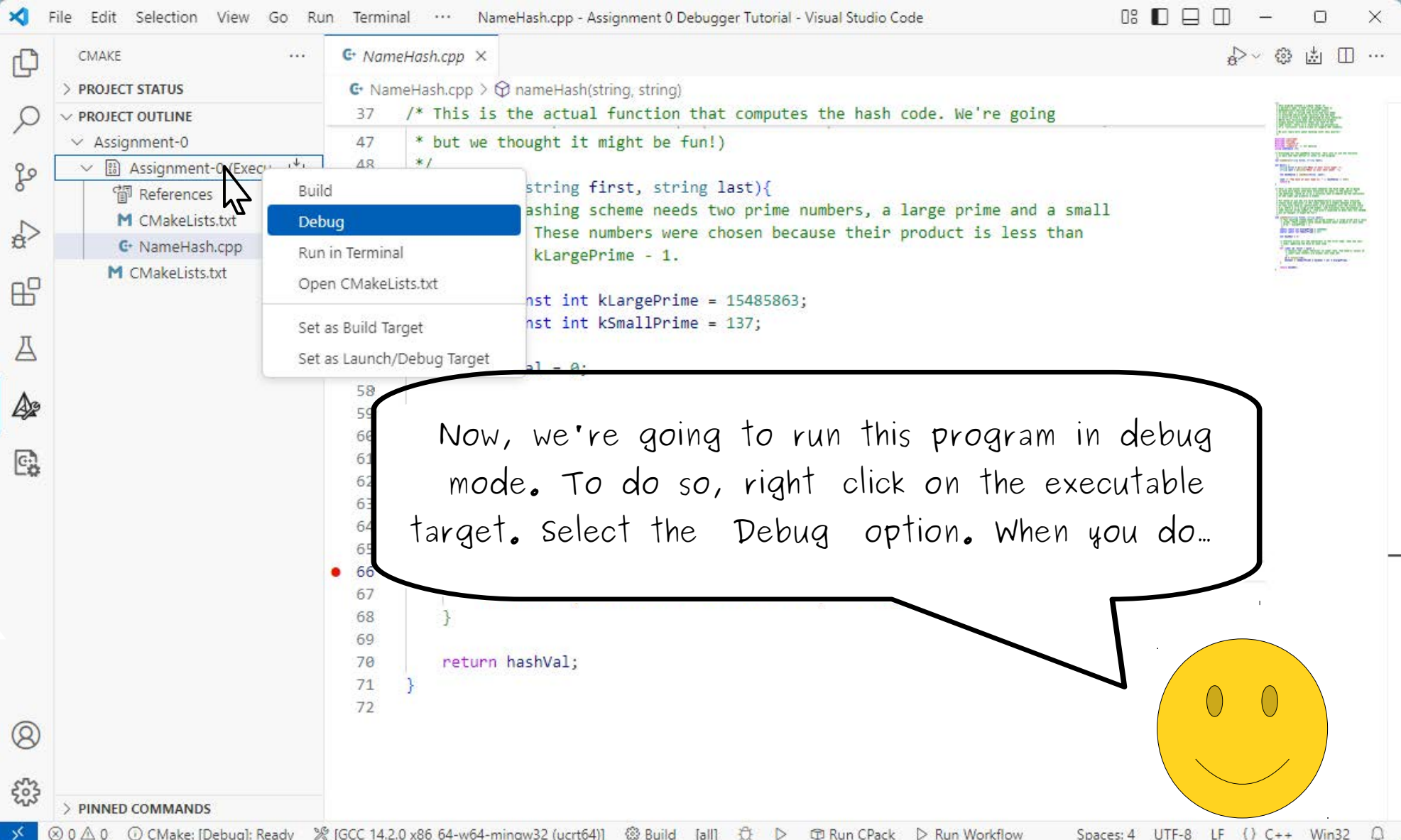
0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow Spaces: 4 UTF-8 LF C++ Win32

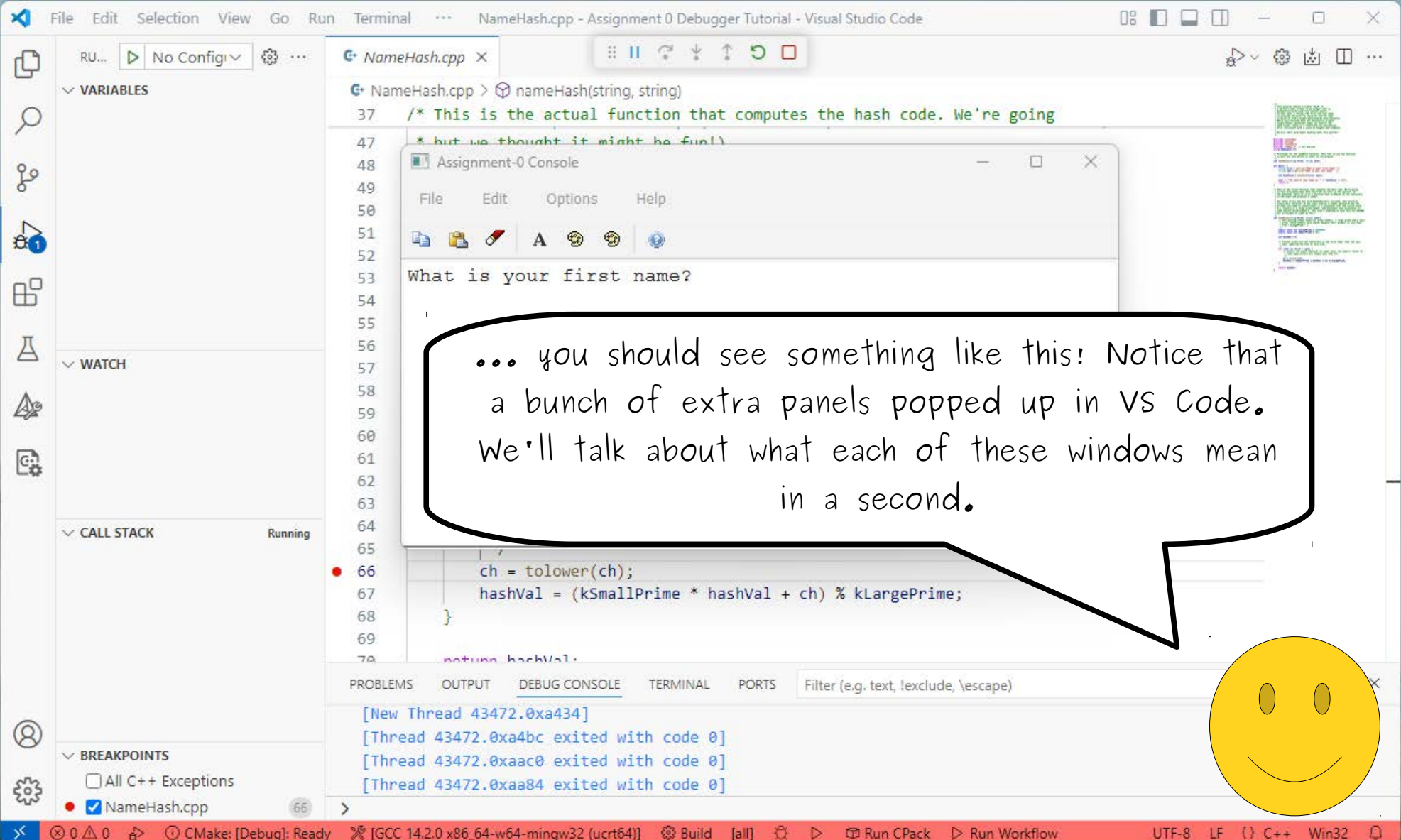

File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
CMAKE
PROJECT STATUS
PROJECT OUTLINE
Assignment-0
Assignment-0 (Executab...
References
CMakeLists.txt
NameHash.cpp
CMakeLists.txt
PINNED COMMANDS
NameHash.cpp
NameHash.cpp > nameHash(string, string)
/* This is the actual function that computes the hash code. We're going
* but we thought it might be fun!)
*/
int nameHash(string first, string last){
for (char ch: first + last) {
/* Convert the input character to lower case.
* lower-case letters are always less than 127.
*/
Click to add a breakpoint
lower(ch);
hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
return hashVal;
}
Move your mouse cursor so that it's in the space right before the line number for line 66.
Now, click the mouse!
0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow Spaces: 4 UTF-8 LF C++ Win32

When you do, you should see a red circle.

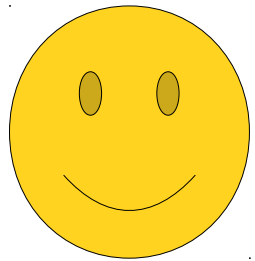
This is called a **breakpoint**. If we run the program in debug mode, whenever the program gets to this line, it will pause and open up the debugger so we can see what's going on.

```
37  /* This is the actual function that computes the hash code. We're going
64          * lower-case letters are always
65          */
66         ch = tolower(ch);
67         hashVal = (kSmallPrime * hashVal + ch) % kLargePrim
68     }
69
70     return hashVal;
71 }
72
```


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
CMAKE
PROJECT STATUS
PROJECT OUTLINE
Assignment-0
References
CMakeLists.txt
NameHash.cpp
CMakeLists.txt
Build
Debug
Run in Terminal
Open CMakeLists.txt
Set as Build Target
Set as Launch/Debug Target
NameHash.cpp
NameHash.cpp > nameHash(string, string)
/* This is the actual function that computes the hash code. We're going
* but we thought it might be fun!)
*/
string first, string last){
ashing scheme needs two prime numbers, a large prime and a small
These numbers were chosen because their product is less than
kLargePrime - 1.
nst int kLargePrime = 15485863;
nst int kSmallPrime = 137;
}
return hashVal;
}
Now, we're going to run this program in debug mode. To do so, right click on the executable target. Select the Debug option. When you do…
PINNED COMMANDS
CMake: [Debug]: Ready
[GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)]
Build
[all]
Run CPack
Run Workflow
Spaces: 4
UTF-8
LF
C++
Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
No Config
NameHash.cpp
NameHash.cpp > nameHash(string, string)
VARIABLES
WATCH
CALL STACK
Running
BREAKPOINTS
All C++ Exceptions
NameHash.cpp
66
/* This is the actual function that computes the hash code. We're going
* but we thought it might be fun!)
Assignment-0 Console
File Edit Options Help
What is your first name?
ch = tolower(ch);
hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
}
return hashVal;
... you should see something like this! Notice that a bunch of extra panels popped up in VS Code. We'll talk about what each of these windows mean in a second.
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
[New Thread 43472.0xa434]
[Thread 43472.0xa4bc exited with code 0]
[Thread 43472.0xaac0 exited with code 0]
[Thread 43472.0xaa84 exited with code 0]
CMake: [Debug]: Ready
[GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)]
Build [all]
Run CPack
Run Workflow
UTF-8 LF C++ Win32

In the meantime, type in the first name **Ada** and hit enter, as shown here. We specifically want you to enter **Ada** here, *not your actual first name*. (Unless your first name is Ada.)



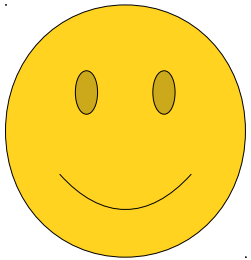
```
What is your first name? Ada
```

```
        ch = tolower(ch);
        hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
    }

    return hashVal;
```

```
[New Thread 43472.0xa63c]
[New Thread 43472.0xa074]
[New Thread 43472.0x3910]
[New Thread 43472.0xa784]
```

Now, type in **Lovelace** as a last name, but don't hit enter yet!



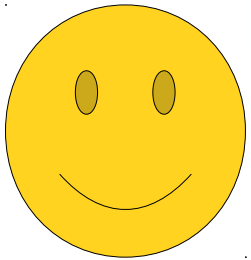
```
What is your first name? Ada
What is your last name?  Lovelace
```

```
        ch = tolower(ch);
        hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
    }

    return hashVal;
```

```
[New Thread 43472.0xa63c]
[New Thread 43472.0xa074]
[New Thread 43472.0x3910]
[New Thread 43472.0xa784]
```

As soon as you hit enter, a bunch of things are going to pop up in VS Code. Don't panic! It's normal.

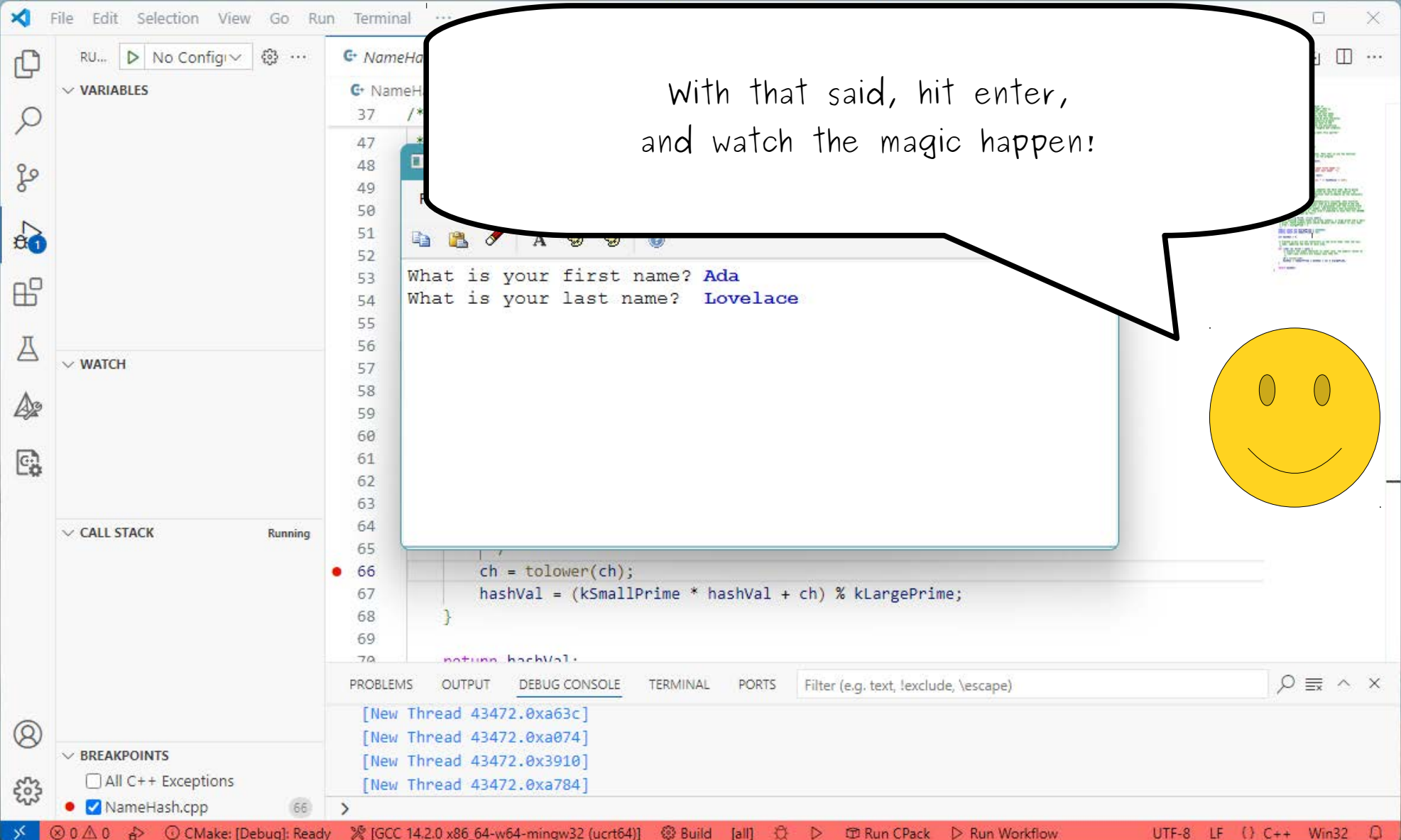


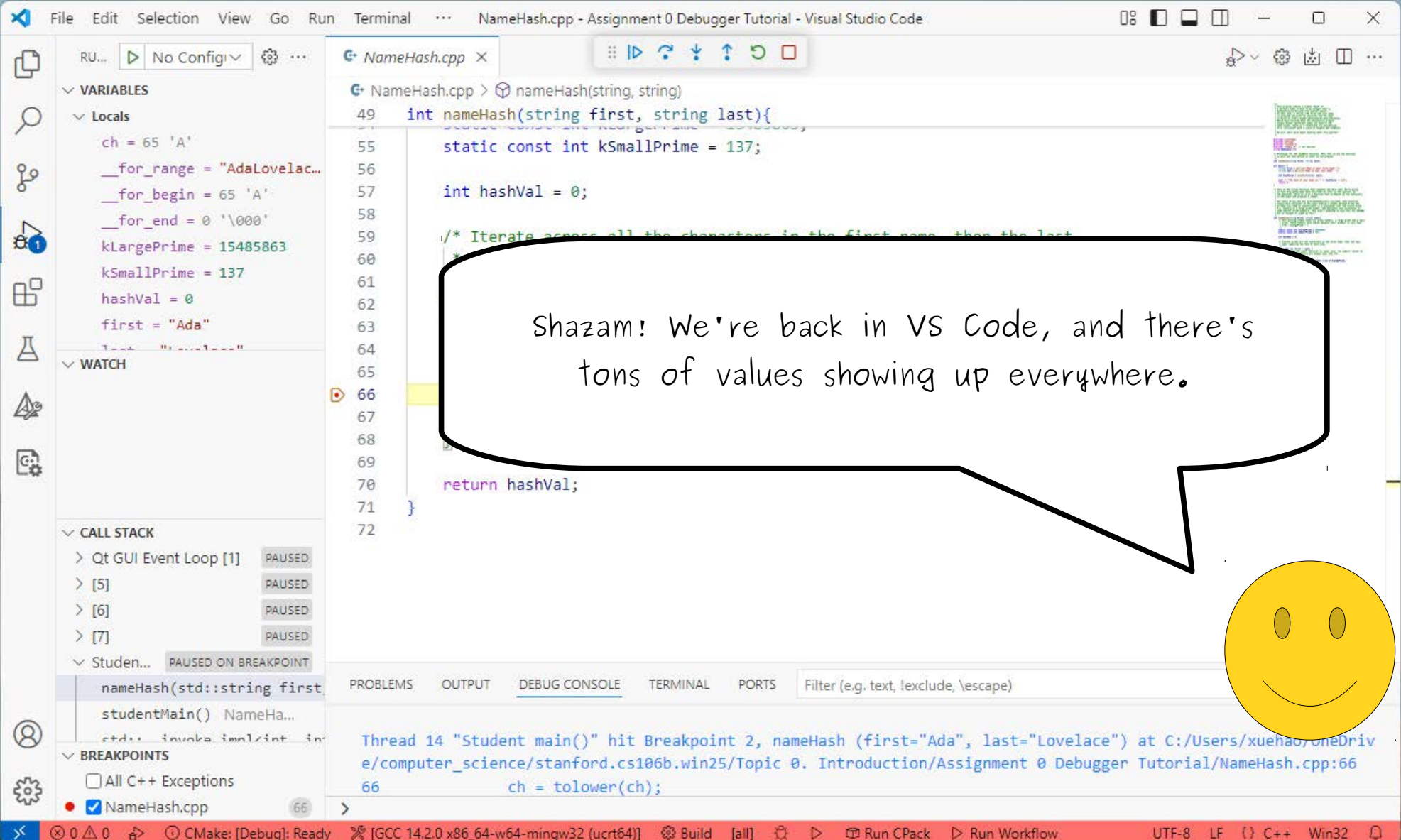
```
What is your first name? Ada
What is your last name?  Lovelace
```

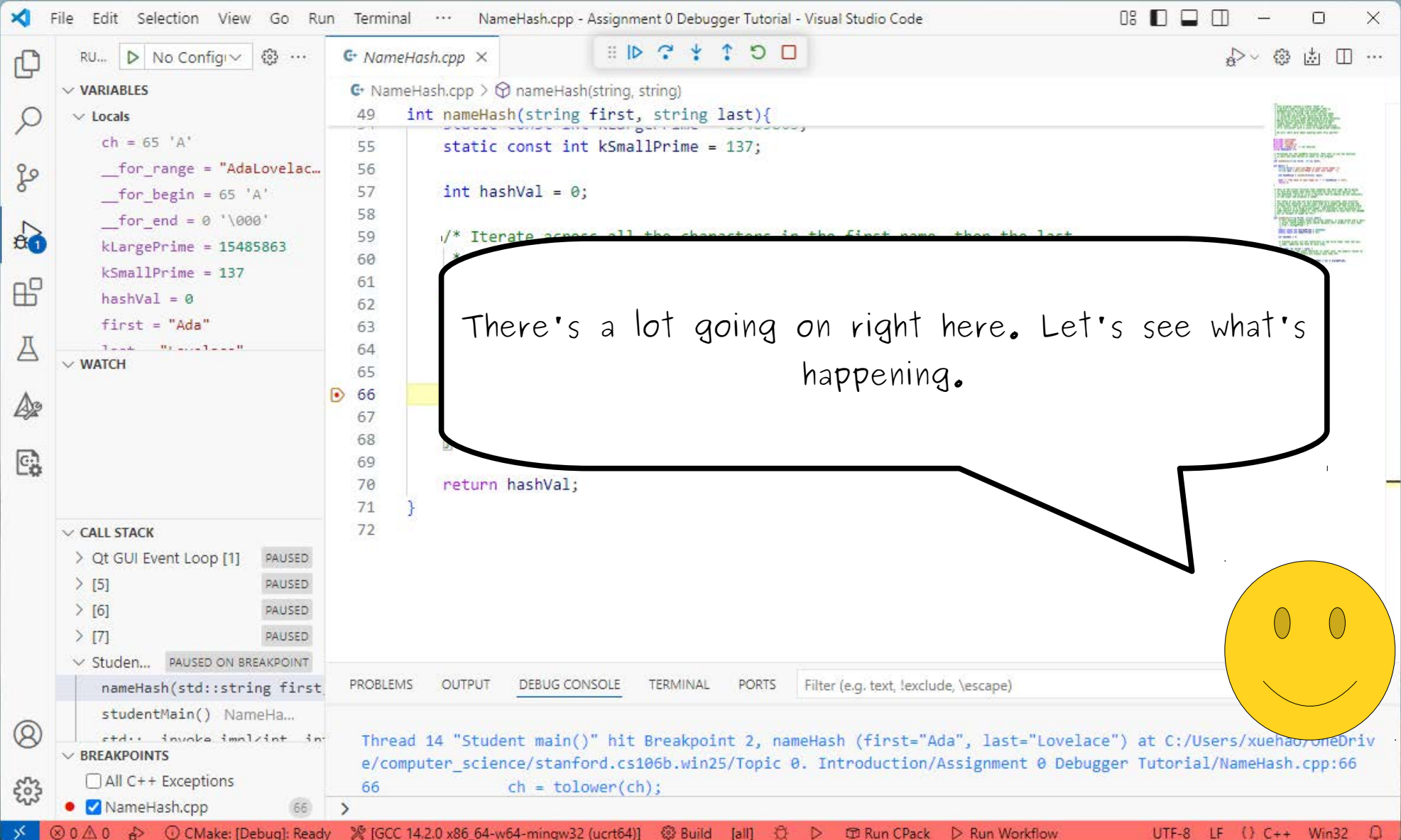
```
        ch = tolower(ch);
        hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
    }

    return hashVal;
```

```
[New Thread 43472.0xa63c]
[New Thread 43472.0xa074]
[New Thread 43472.0x3910]
[New Thread 43472.0xa784]
```


With that said, hit enter,
and watch the magic happen!
What is your first name? Ada
What is your last name? Lovelace
ch = tolower(ch);
hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
}
[New Thread 43472.0xa63c]
[New Thread 43472.0xa074]
[New Thread 43472.0x3910]
[New Thread 43472.0xa784]


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
No Config
VARIABLES
Locals
ch = 65 'A'
__for_range = "AdaLovelac…
__for_begin = 65 'A'
__for_end = 0 '\000'
kLargePrime = 15485863
kSmallPrime = 137
hashVal = 0
first = "Ada"
WATCH
CALL STACK
Qt GUI Event Loop [1] PAUSED
[5] PAUSED
[6] PAUSED
[7] PAUSED
Studen... PAUSED ON BREAKPOINT
nameHash(std::string first
studentMain() NameHa...
BREAKPOINTS
All C++ Exceptions
NameHash.cpp 66
NameHash.cpp
NameHash.cpp > nameHash(string, string)
49 int nameHash(string first, string last){
55 static const int kSmallPrime = 137;
57 int hashVal = 0;
59 /* Iterate across all the characters in the first name, then the last
70 return hashVal;
71 }
Shazam! We're back in VS Code, and there's tons of values showing up everywhere.
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
CMake: [Debug]: Ready
[GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)]
Build [all]
Run CPack
Run Workflow
UTF-8 LF C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
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kLargePrime = 15485863
kSmallPrime = 137
hashVal = 0
first = "Ada"
WATCH
CALL STACK
Qt GUI Event Loop [1] PAUSED
[5] PAUSED
[6] PAUSED
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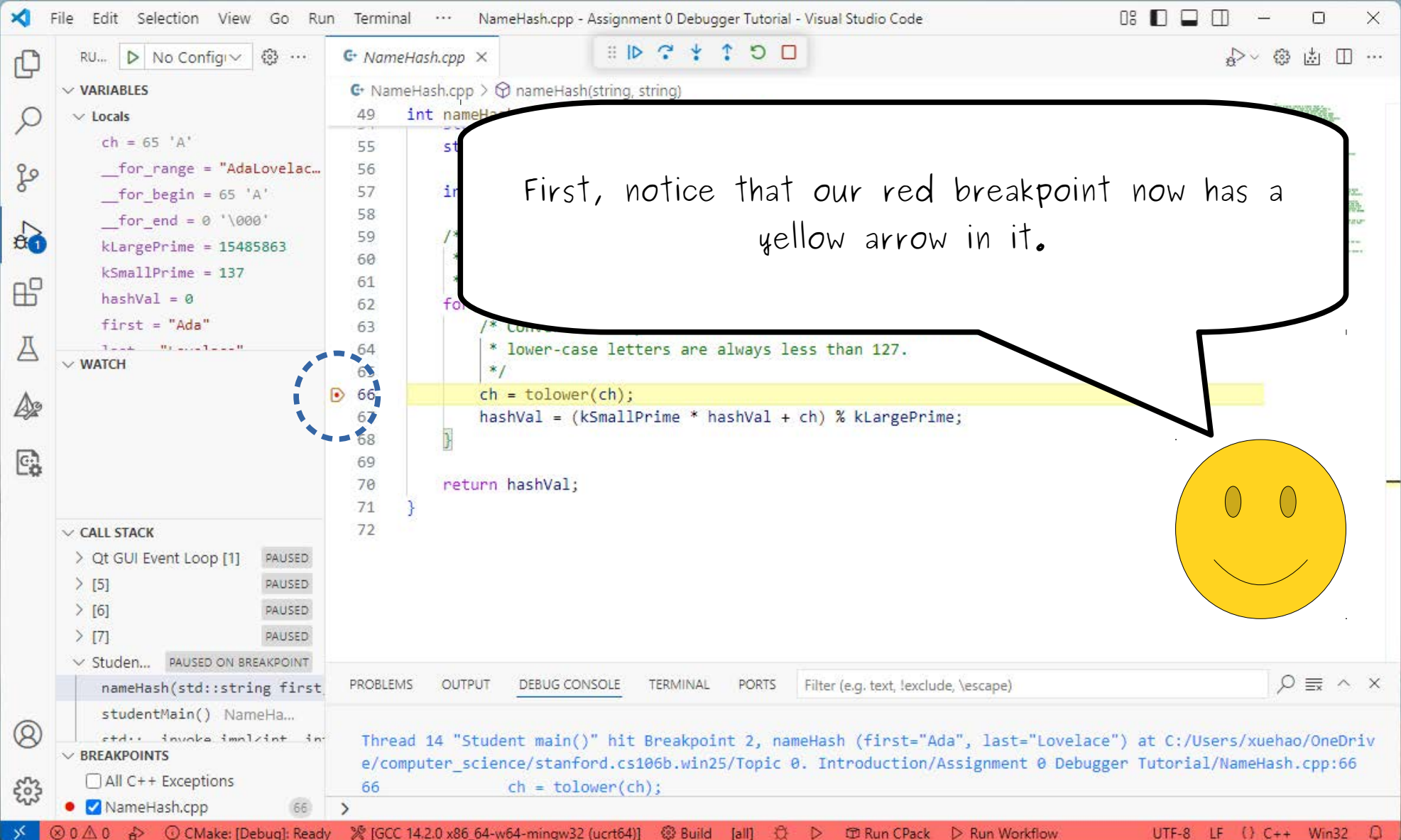
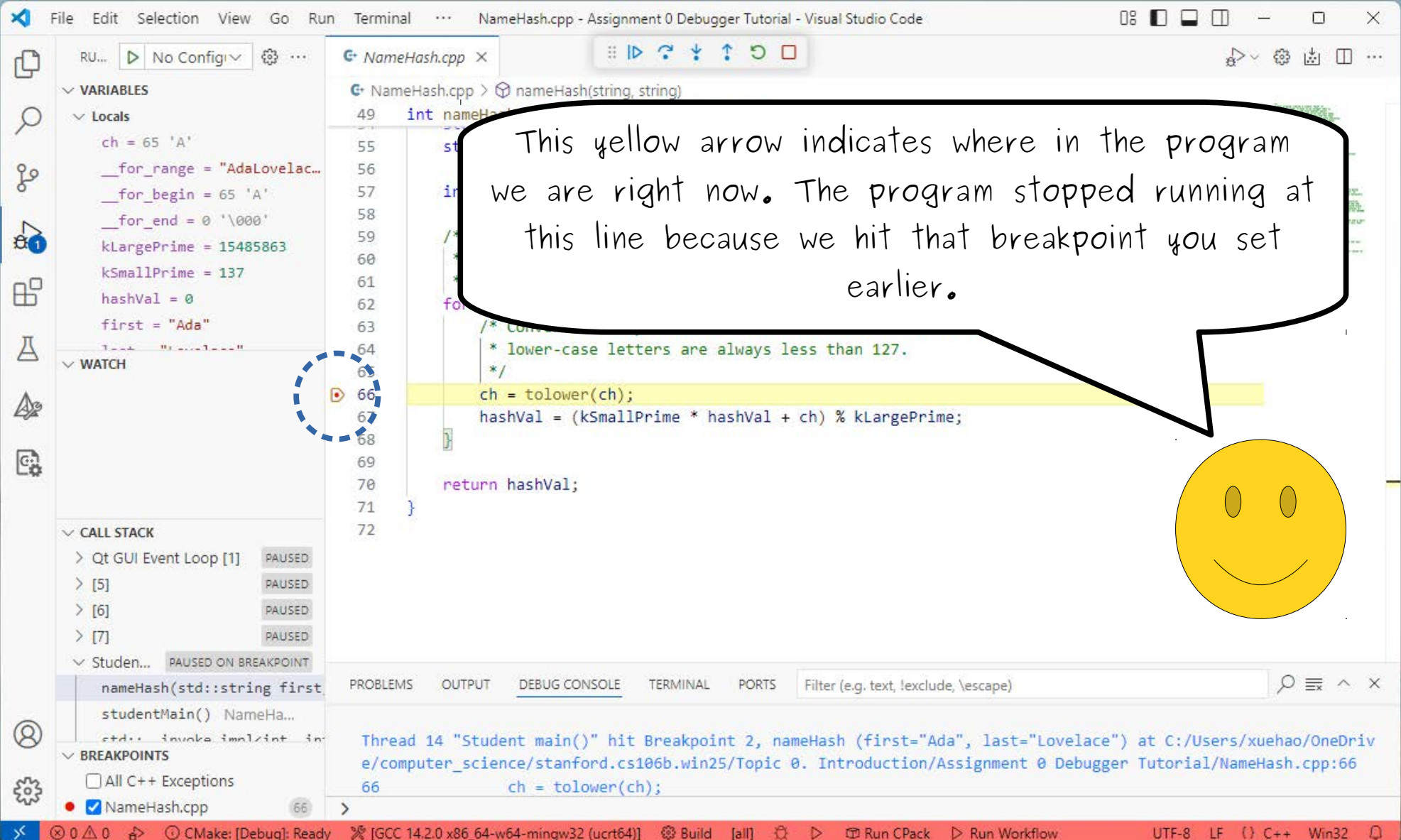
NameHash.cpp
NameHash.cpp > nameHash(string, string)
49 int nameHash(string first, string last){
55 static const int kSmallPrime = 137;
57 int hashVal = 0;
59 /* Iterate across all the characters in the first name, then the last
66
70 return hashVal;
71 }
There's a lot going on right here. Let's see what's happening.
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
CMake: [Debug]: Ready
[GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)]
Build [all]
Run CPack
Run Workflow
UTF-8 LF C++ Win32


First, notice that our red breakpoint now has a yellow arrow in it.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No Config
VARIABLES
Locals
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kLargePrime = 15485863
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hashVal = 0
first = "Ada"
WATCH
CALL STACK
Qt GUI Event Loop [1] PAUSED
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Studen… PAUSED ON BREAKPOINT
nameHash(std::string first
studentMain() NameHa…
BREAKPOINTS
All C++ Exceptions
NameHash.cpp 66
NameHash.cpp
NameHash.cpp > nameHash(string, string)
49 int nameHash(string first, string last) {
55 st
56
57 in
58
59 /*
60 *
61 *
62 fo
63 /* Con
64 * lower-case letters are always less than 127.
65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
69
70 return hashVal;
71 }
72
This yellow arrow indicates where in the program we are right now. The program stopped running at this line because we hit that breakpoint you set earlier.
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
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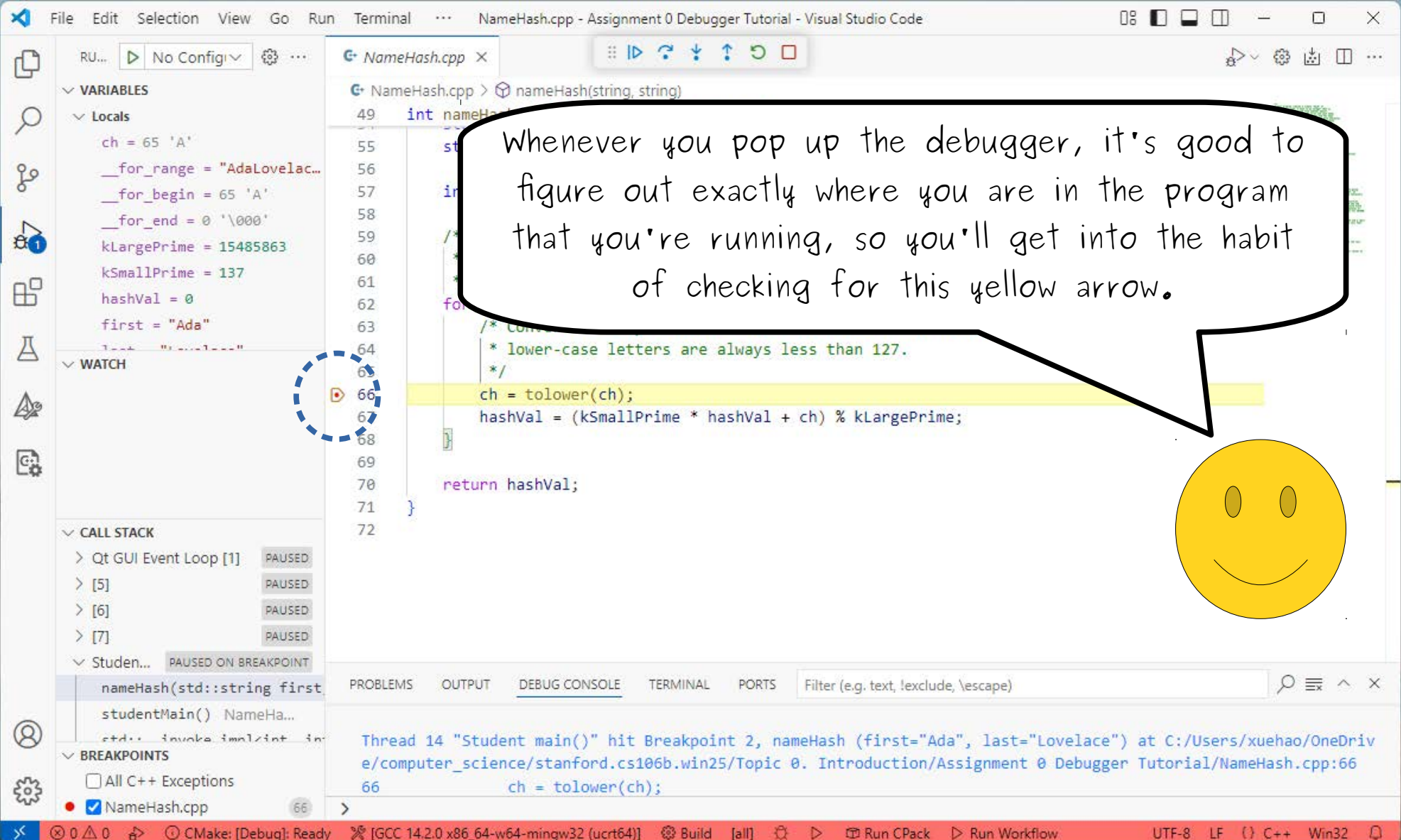
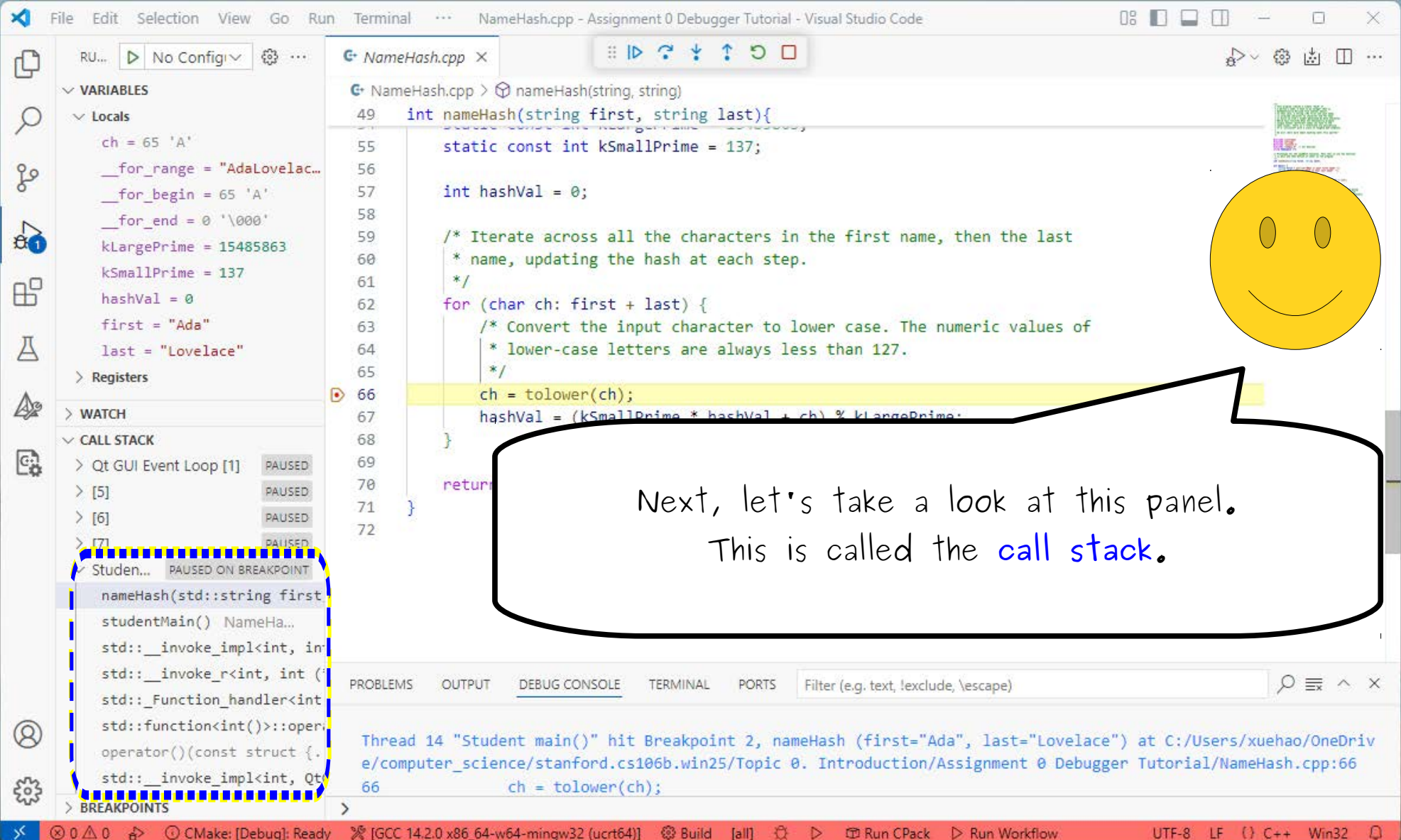

Whenever you pop up the debugger, it's good to figure out exactly where you are in the program that you're running, so you'll get into the habit of checking for this yellow arrow.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first = "Ada"
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Registers
WATCH
CALL STACK
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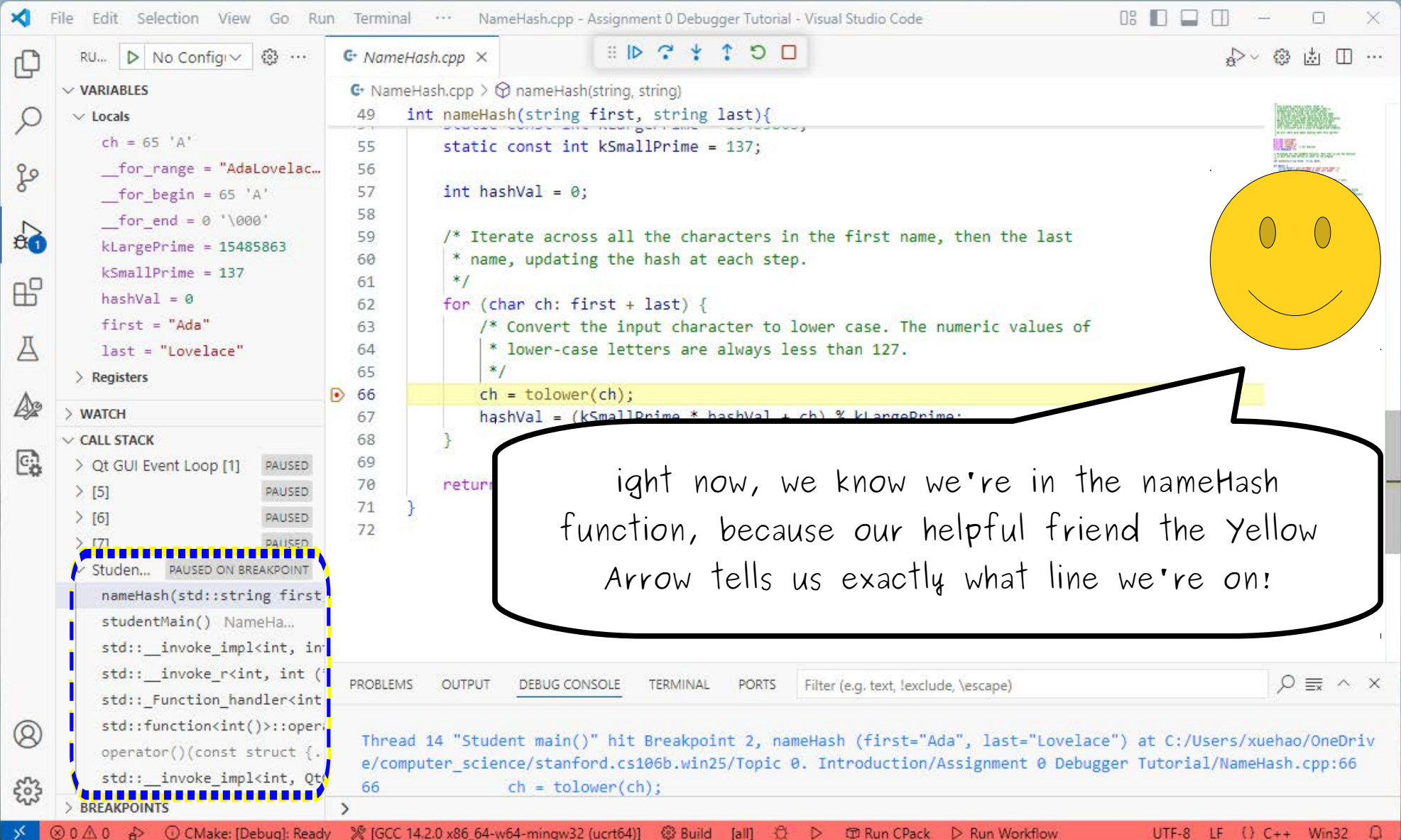
[6] PAUSED
[7] PAUSED
Studen... PAUSED ON BREAKPOINT
nameHash(std::string first
studentMain() NameHa...
std::__invoke_impl<int, in
std::__invoke_r<int, int (
std::_Function_handler<int
std::function<int()>::oper
operator()(const struct {.
std::__invoke_impl<int, Qt
BREAKPOINTS
NameHash.cpp
NameHash.cpp > nameHash(string, string)
49 int nameHash(string first, string last){
55 static const int kSmallPrime = 137;
56
57 int hashVal = 0;
58
59 /* Iterate across all the characters in the first name, then the last
60 * name, updating the hash at each step.
61 */
62 for (char ch: first + last) {
63 /* Convert the input character to lower case. The numeric values of
64 * lower-case letters are always less than 127.
65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
69
70 retur
71 }
72
Next, let's take a look at this panel.
This is called the call stack.
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
CMake: [Debug]: Ready
[GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)]
Build [all]
Run CPack
Run Workflow
UTF-8 LF C++ Win32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Studen... PAUSED ON BREAKPOINT
nameHash(std::string first
studentMain() NameHa...
std::__invoke_impl<int, in
std::__invoke_r<int, int (
std::_Function_handler<int
std::function<int()>::oper
operator()(const struct {.
std::__invoke_impl<int, Qt
BREAKPOINTS
NameHash.cpp
NameHash.cpp > nameHash(string, string)
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65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
69
70 retur
71 }
72
ight now, we know we're in the nameHash function, because our helpful friend the Yellow Arrow tells us exactly what line we're on!
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
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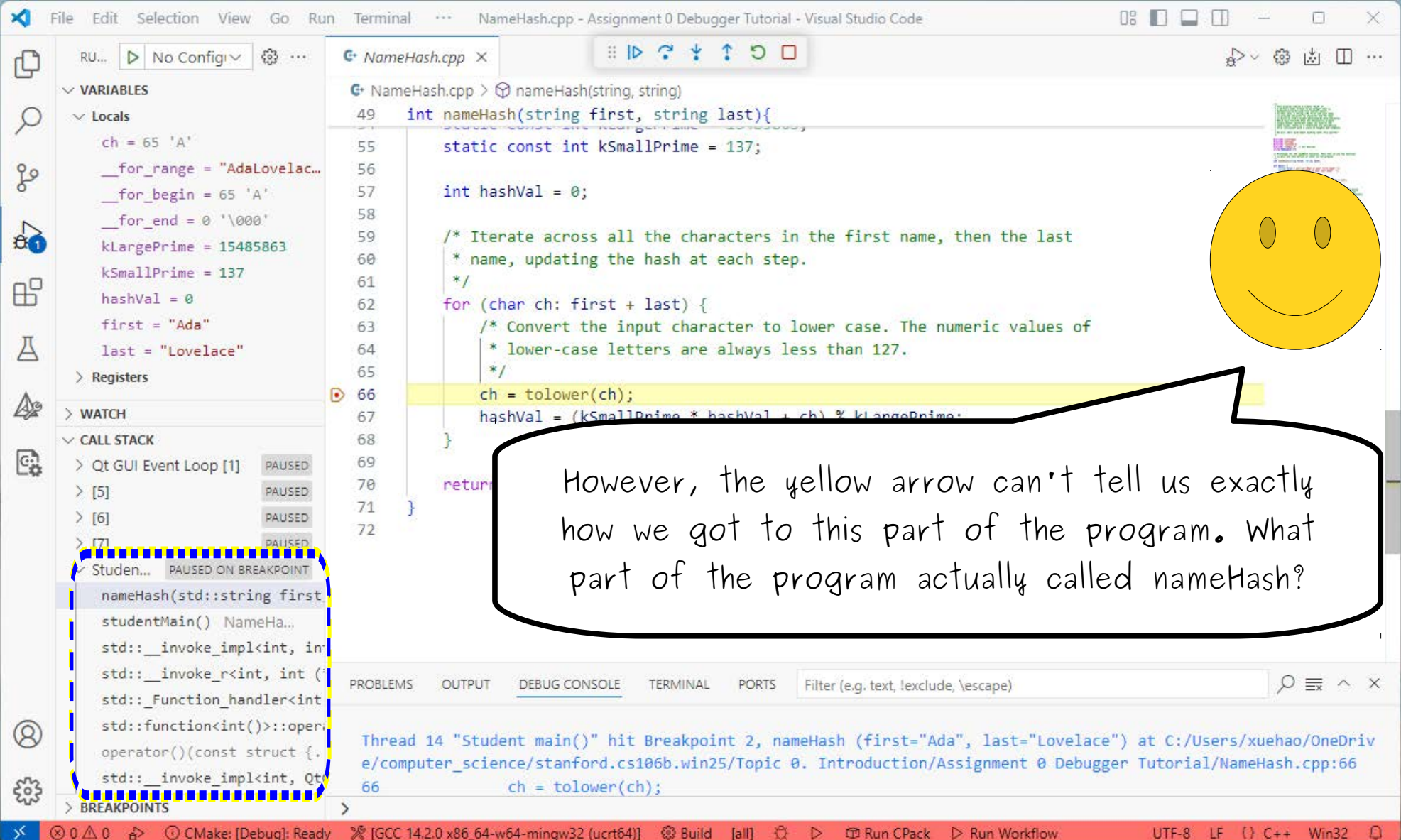
File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
VARIABLES
Locals
ch = 65 'A'
__for_range = "AdaLovelac...
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kSmallPrime = 137
hashVal = 0
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Registers
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CALL STACK
Qt GUI Event Loop [1] PAUSED
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BREAKPOINTS
NameHash.cpp
NameHash.cpp > nameHash(string, string)
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69
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However, the yellow arrow can't tell us exactly how we got to this part of the program. What part of the program actually called nameHash?
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
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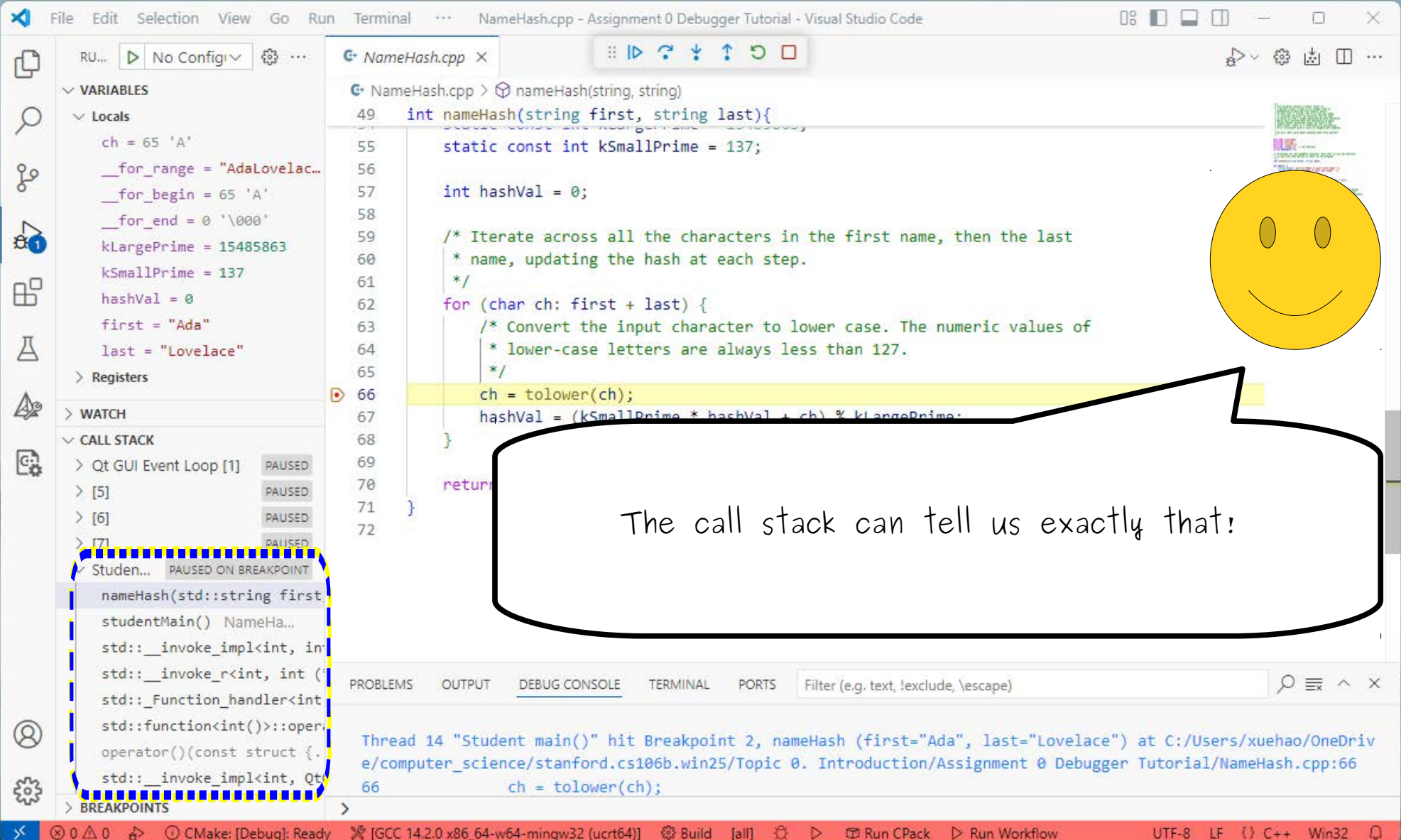
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The call stack can tell us exactly that!
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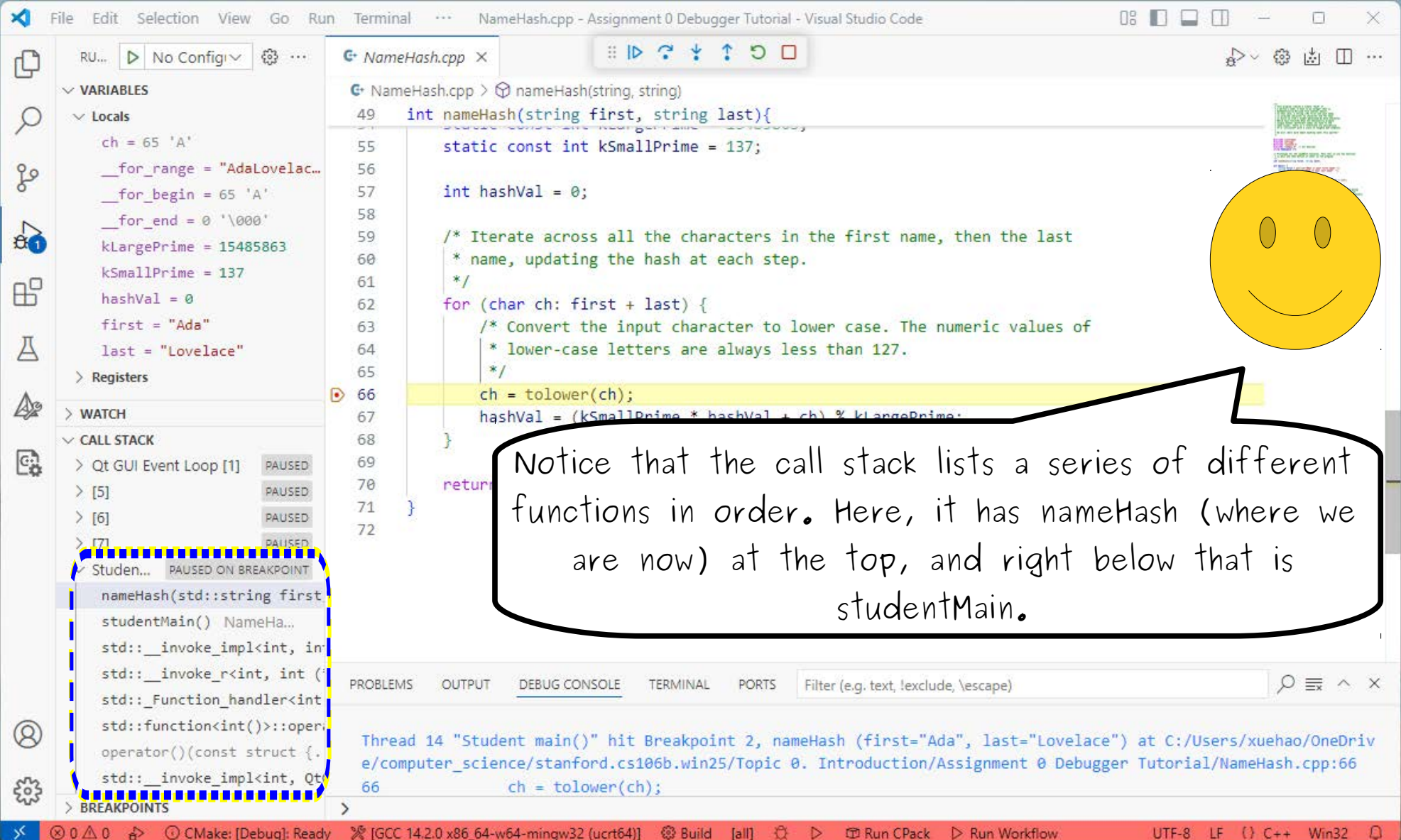
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Notice that the call stack lists a series of different functions in order. Here, it has nameHash (where we are now) at the top, and right below that is studentMain.
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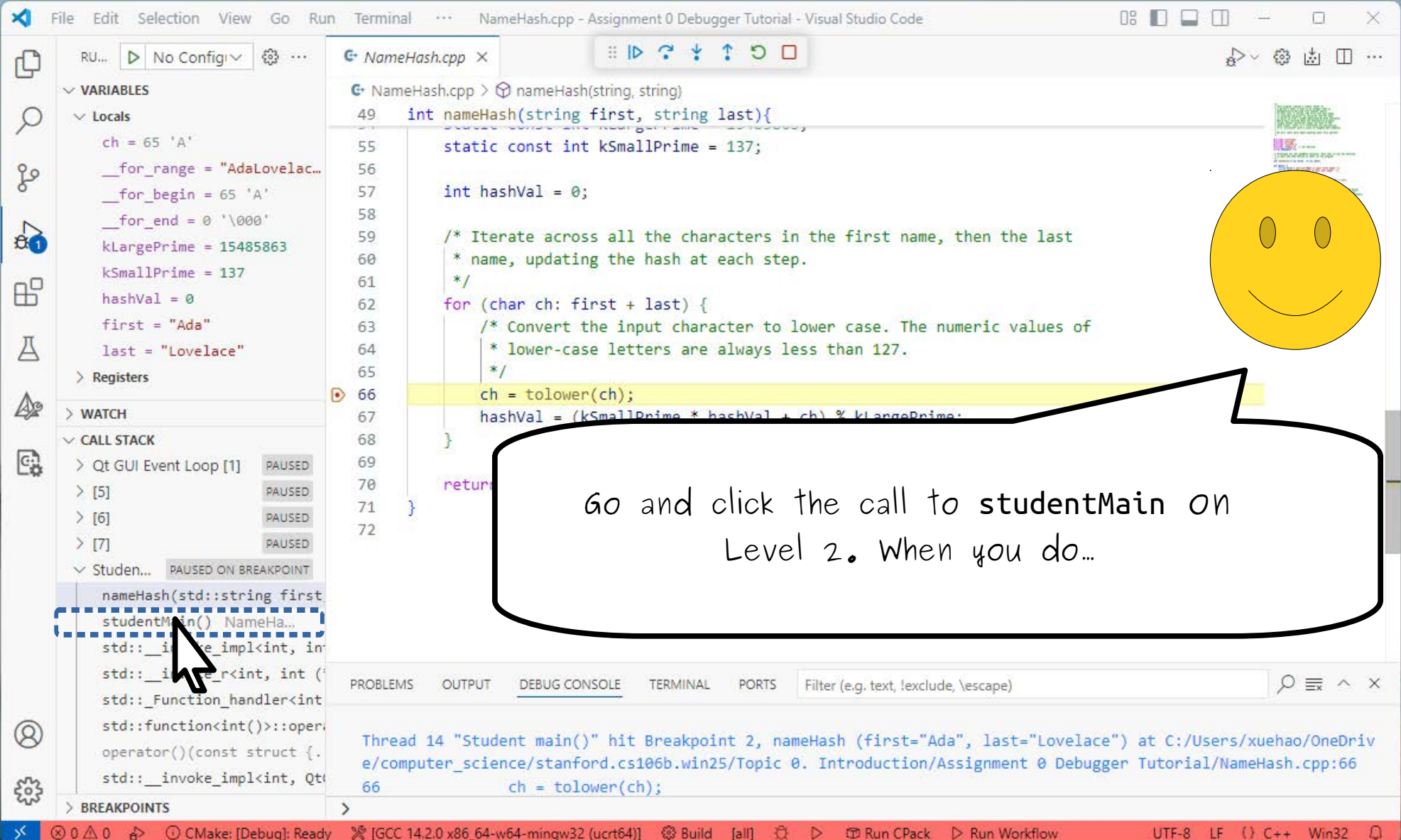
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65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
69
70 retur
71 }
72
Go and click the call to studentMain on Level 2. When you do...
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
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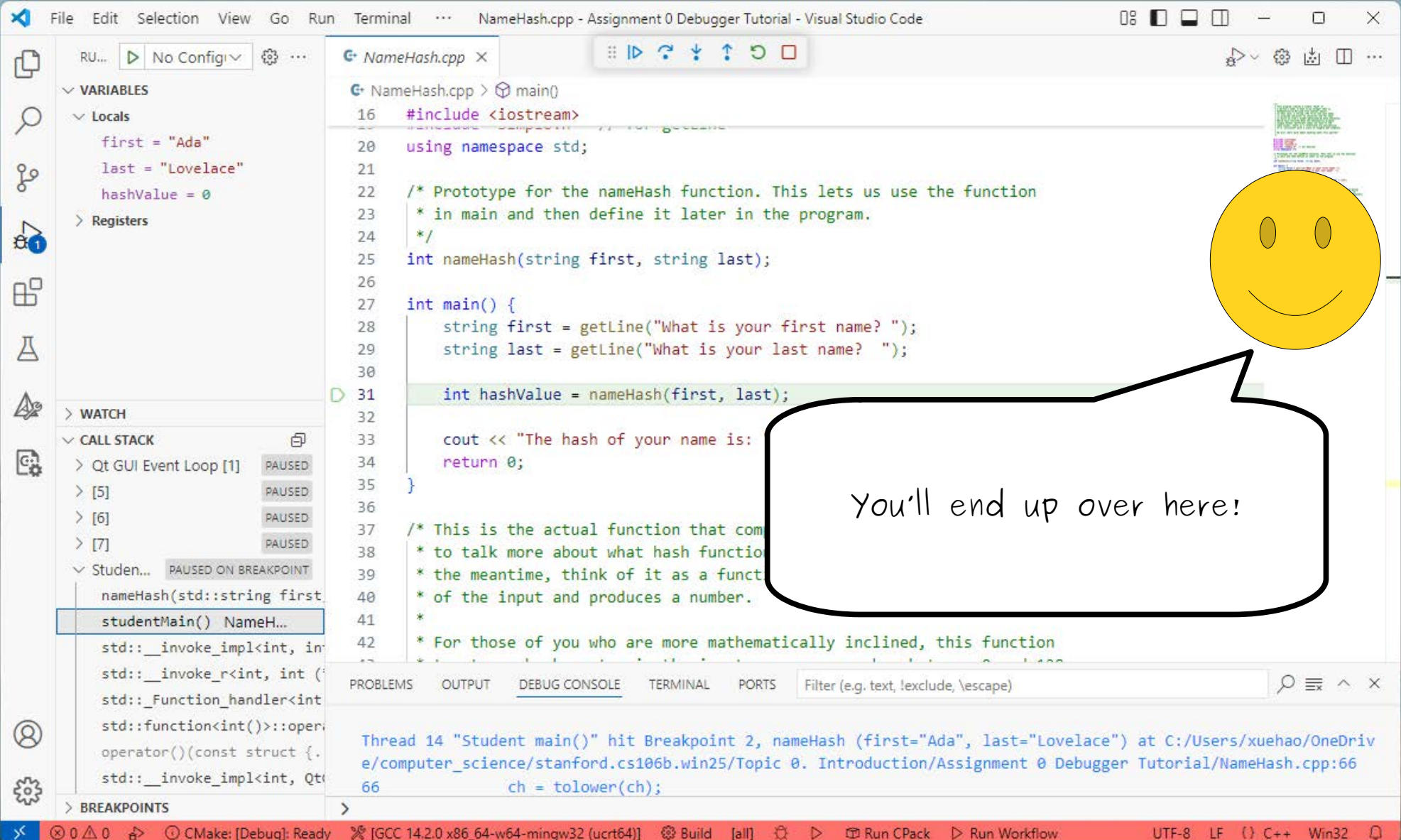
Run Workflow
UTF-8 LF C++ Win32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NameHash.cpp
NameHash.cpp > main()
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22 /* Prototype for the nameHash function. This lets us use the function
23 * in main and then define it later in the program.
24 */
25 int nameHash(string first, string last);
27 int main() {
28 string first = getLine("What is your first name? ");
29 string last = getLine("What is your last name? ");
31 int hashValue = nameHash(first, last);
33 cout << "The hash of your name is:
34 return 0;
35 }
37 /* This is the actual function that com
38 * to talk more about what hash functio
39 * the meantime, think of it as a funct
40 * of the input and produces a number.
41 *
42 * For those of you who are more mathematically inclined, this function
You'll end up over here!
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
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File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code

RU... No Config

VARIABLES

Locals

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Registers

WATCH

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PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL POR

Thread 14 "Student main()" hit Breakpoint 2,

e/computer_science/stanford.cs106b.win25/Topi

66 ch = tolower(ch);

eDriv

p:66

Notice that the green arrow points to Line 31. That line includes a call to the **nameHash** function. This is the part of the code that actually called **nameHash**, which is how we got to the line with the breakpoint!

0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF {} C++ Win32

File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code

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BREAKPOINTS

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33      cout <<
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35  }
36
37  /* This is
38   * to talk
39   * the mea
40   * of the
41   *
42   * For those of you who are more mathematically inclined, this function
```

Generally speaking, you can use the call stack as a way to see which function calls got us to the point where the program paused at the breakpoint!

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS Filter (e.g. text, !exclude, \escape)

Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66

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File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code

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Depending on your OS, you might see some additional functions beneath **studentMain**. What are those?

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS Filter (e.g. text, !exclude, \escape)

```
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⊗ 0 ⚠ 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF {} C++ Win32

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These following functions represent helper functions our libraries automatically call to help get your program set up.

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

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You don't need to worry about these. They'll show up in all the programs you run and you can safely ignore them.

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38   * to tal
39   * the mea
40   * of the
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In the meantime, let's get back to our **nameHash** function. To do that, click on the **nameHash** entry at the top of the call stack. When you do...

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS Filter (e.g. text, !exclude, \escape)

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kSmallPrime = 137
hashVal = 0
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```

Registers

WATCH

CALL STACK

Qt GUI Event Loop [1] PAUSED
[5] PAUSED
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[7] PAUSED
Studen... PAUSED ON BREAKPOINT

nameHash(std::string first
studentMain() NameHa...
std::__invoke_impl<int, in
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BREAKPOINTS

NameHash.cpp

NameHash.cpp > nameHash(string, string)

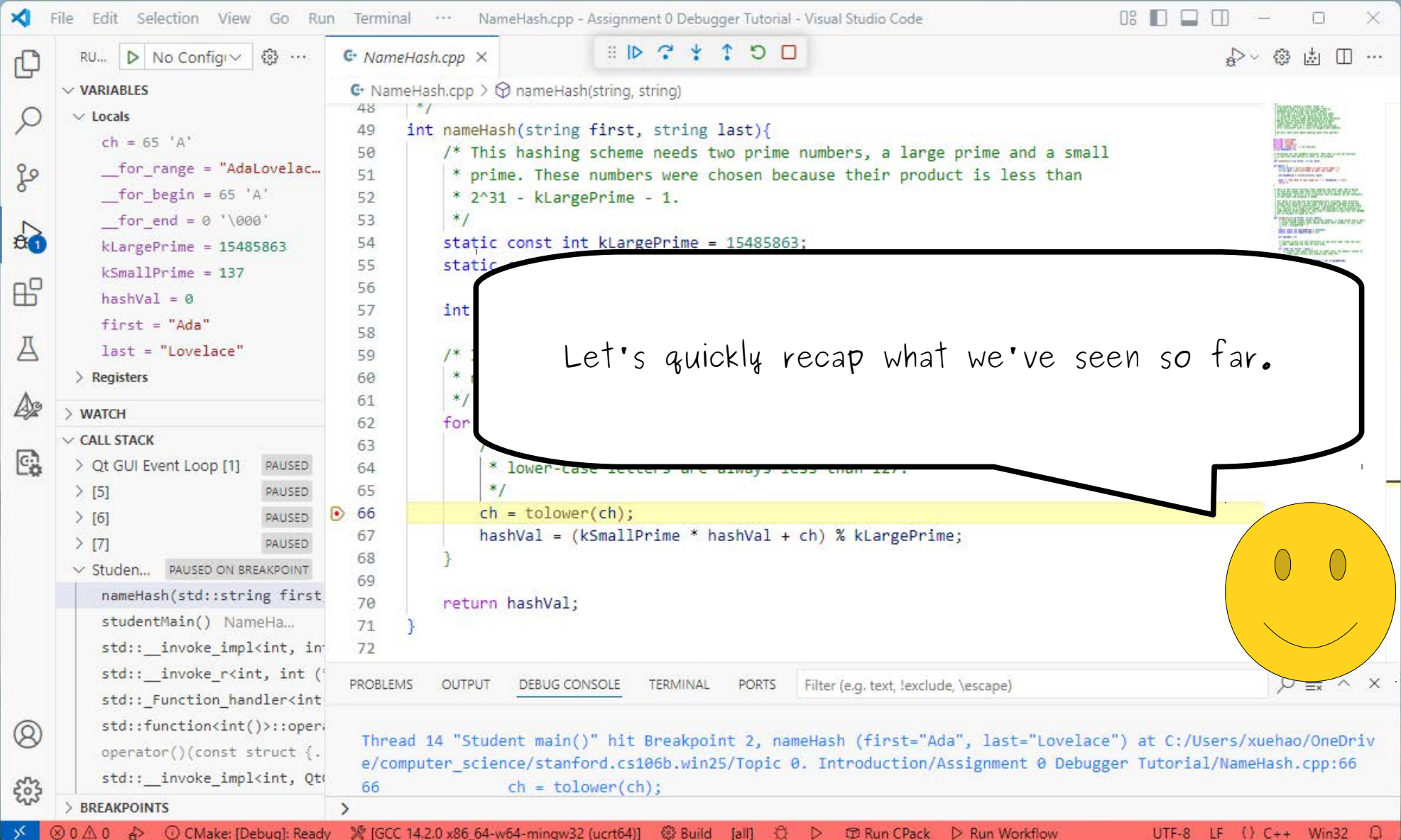
```
48  */
49  int nameHash(string first, string last){
50      /* This hashing scheme needs two prime numbers, a large prime and a small
51       * prime. These numbers were chosen because their product is less than
52       * 2^31 - kLargePrime - 1.
53       */
54      static const int kLargePrime = 15485863;
55      static const int kSmallPrime = 137;
56
57      int hashVal
58
59      /* It
60       * na
61       */
62      for (char ch:
63          /* Convert the input character to lower case. The numeric values of
64           * lower-case letters are always less than 127.
65           */
66          ch = tolower(ch);
67          hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68      }
69
70      return hashVal;
71  }
72
```

You'll be teleported back here!

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS Filter (e.g. text, !exclude, \escape)

```
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66              ch = tolower(ch);
```

⊗ 0 ⚠ 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF {} C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
VARIABLES
Locals
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*/
static const int kLargePrime = 15485863;
static
int
/*
*
*/
for
* lower-case letters are always less than 127.
*/
ch = tolower(ch);
hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
}
return hashVal;
}
Let's quickly recap what we've seen so far.
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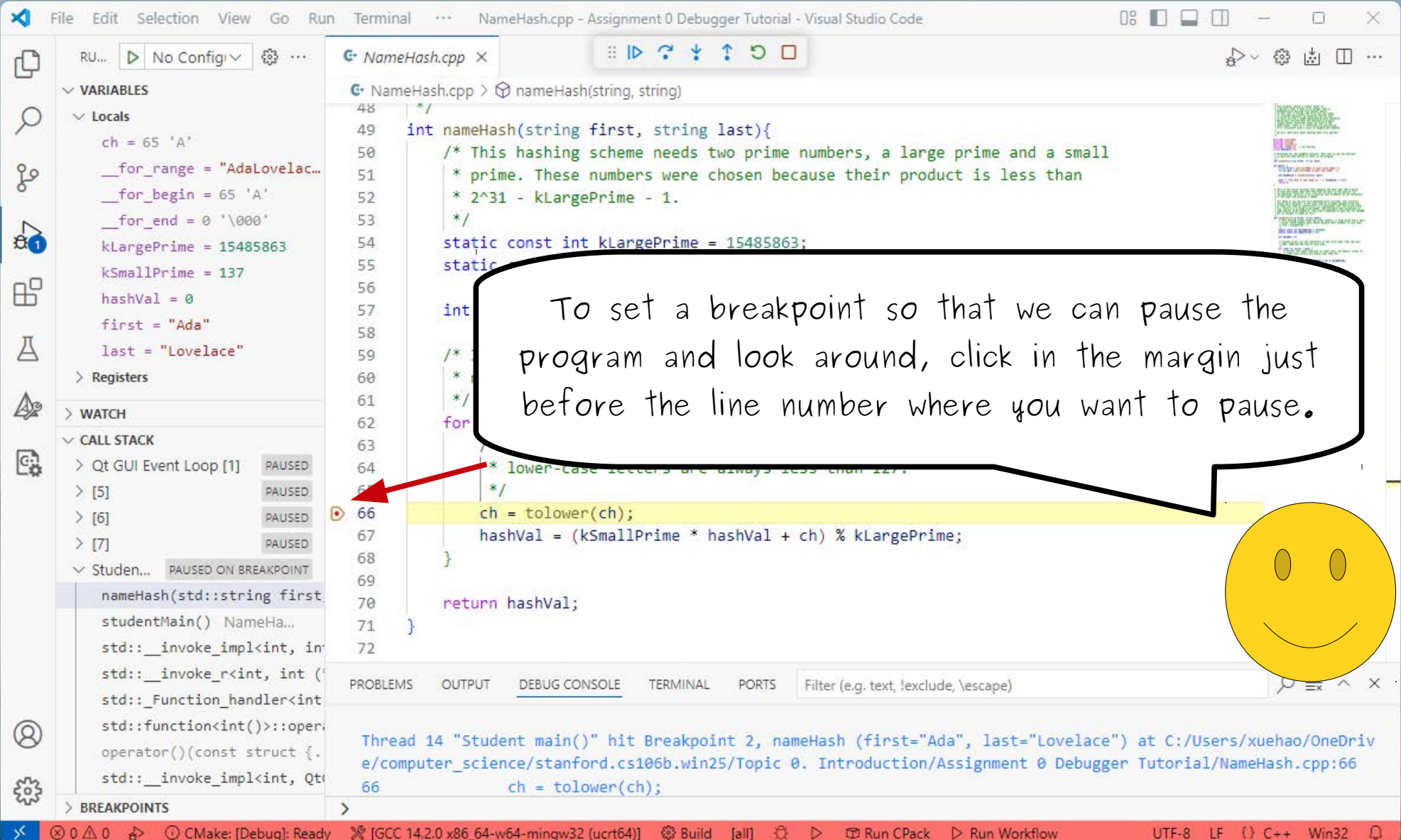
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55 static
56
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60 *
61 */
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66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
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To set a breakpoint so that we can pause the program and look around, click in the margin just before the line number where you want to pause.
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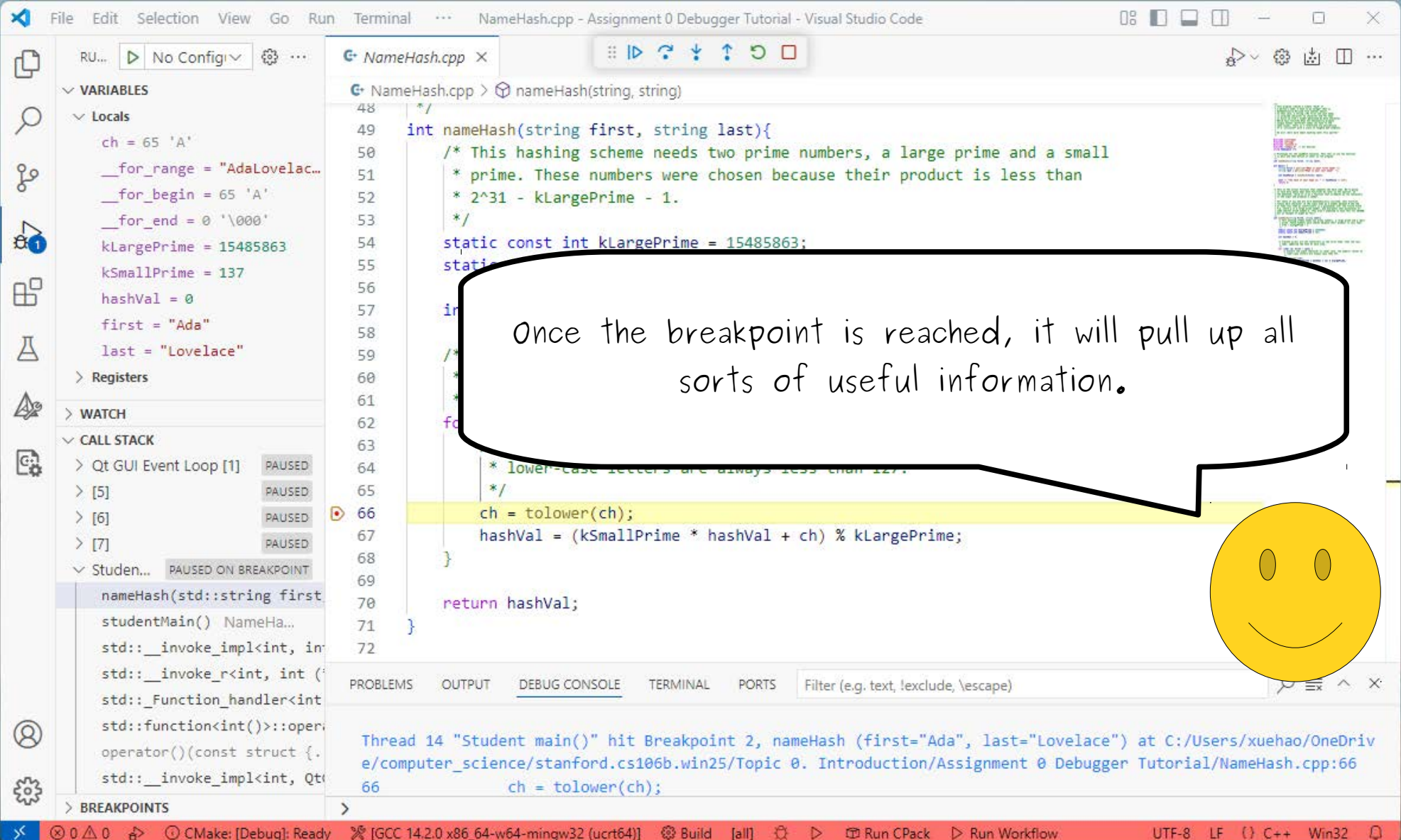
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*/
static const int kLargePrime = 15485863;
ch = tolower(ch);
hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
return hashVal;
}
Once the breakpoint is reached, it will pull up all sorts of useful information.
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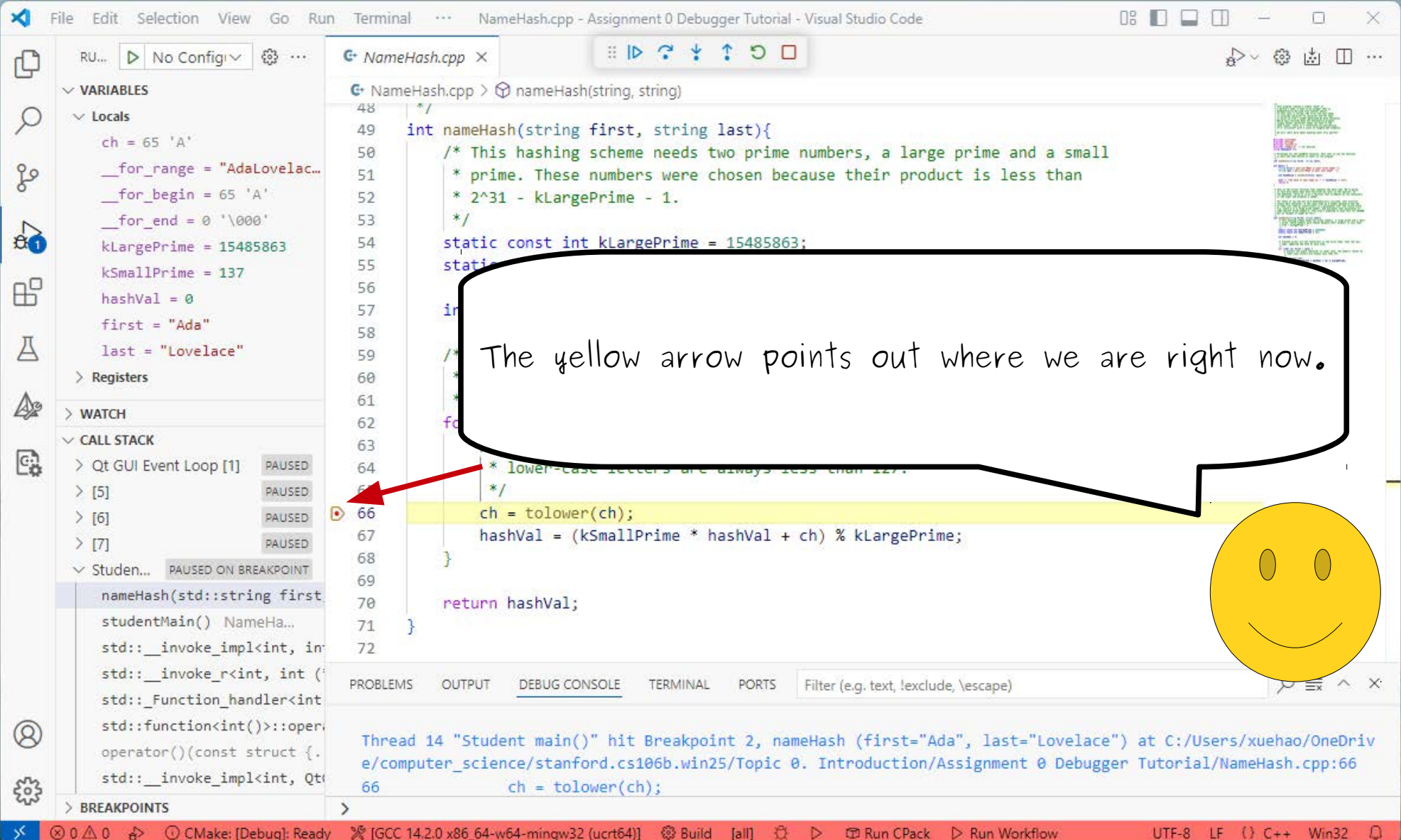
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*/
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67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
69
70 return hashVal;
71 }
72
The yellow arrow points out where we are right now.
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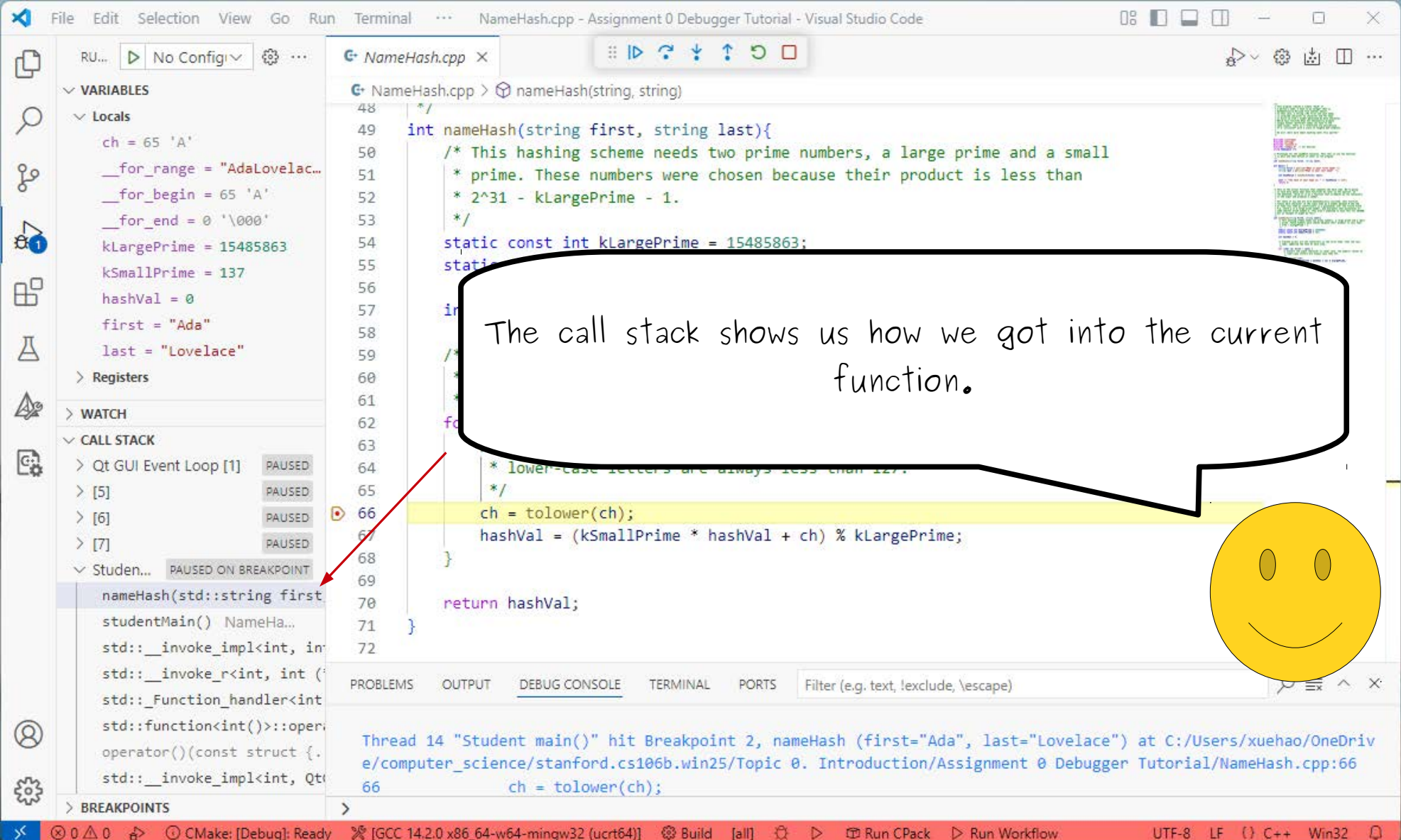
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65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
69
70 return hashVal;
71 }
72
The call stack shows us how we got into the current function.
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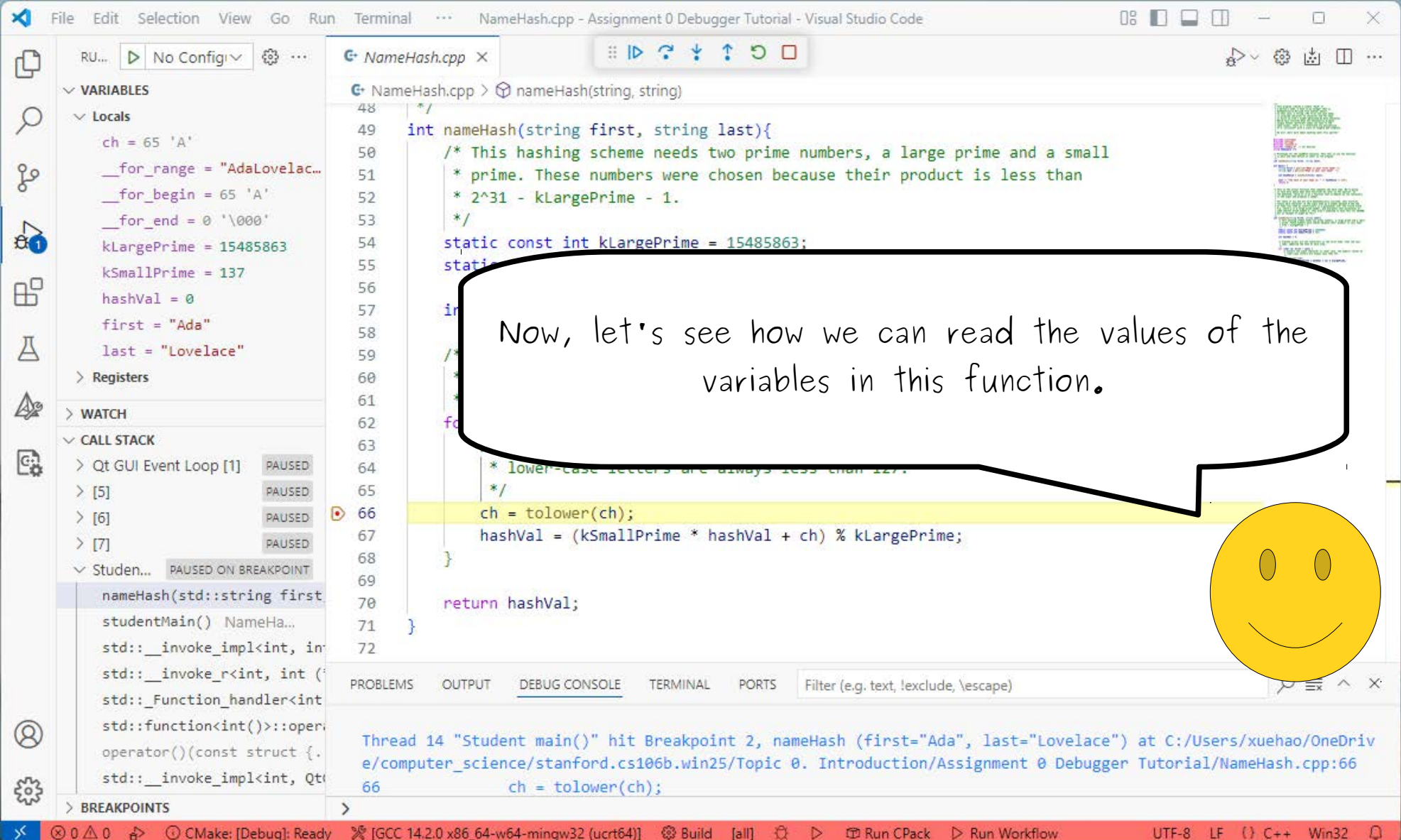
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*/
static const int kLargePrime = 15485863;
ch = tolower(ch);
hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
return hashVal;
}
Now, let's see how we can read the values of the variables in this function.
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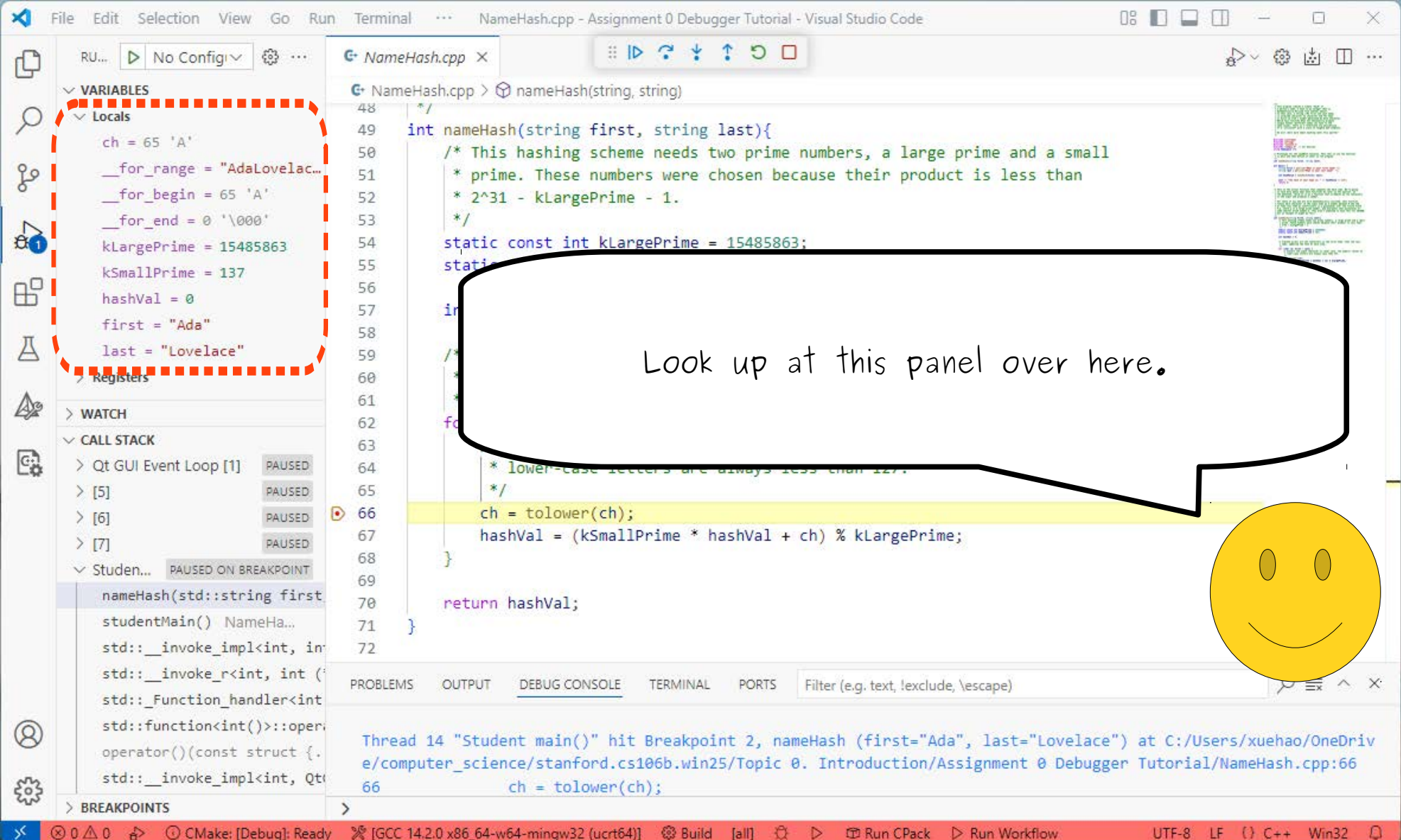
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67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
70 return hashVal;
71 }
Look up at this panel over here.
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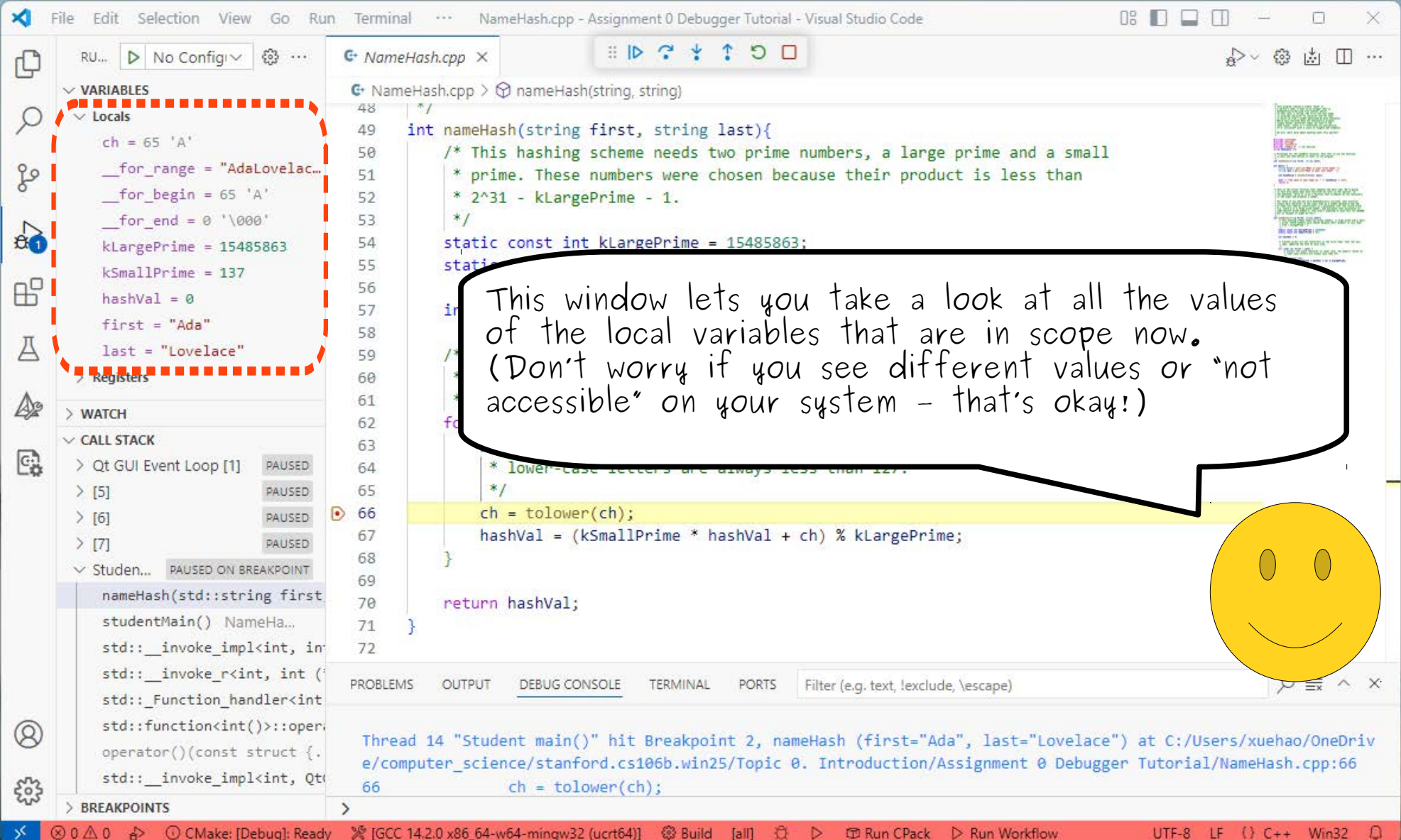
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68 }
69
70 return hashVal;
71 }
72
This window lets you take a look at all the values of the local variables that are in scope now. (Don't worry if you see different values or "not accessible" on your system - that's okay!)
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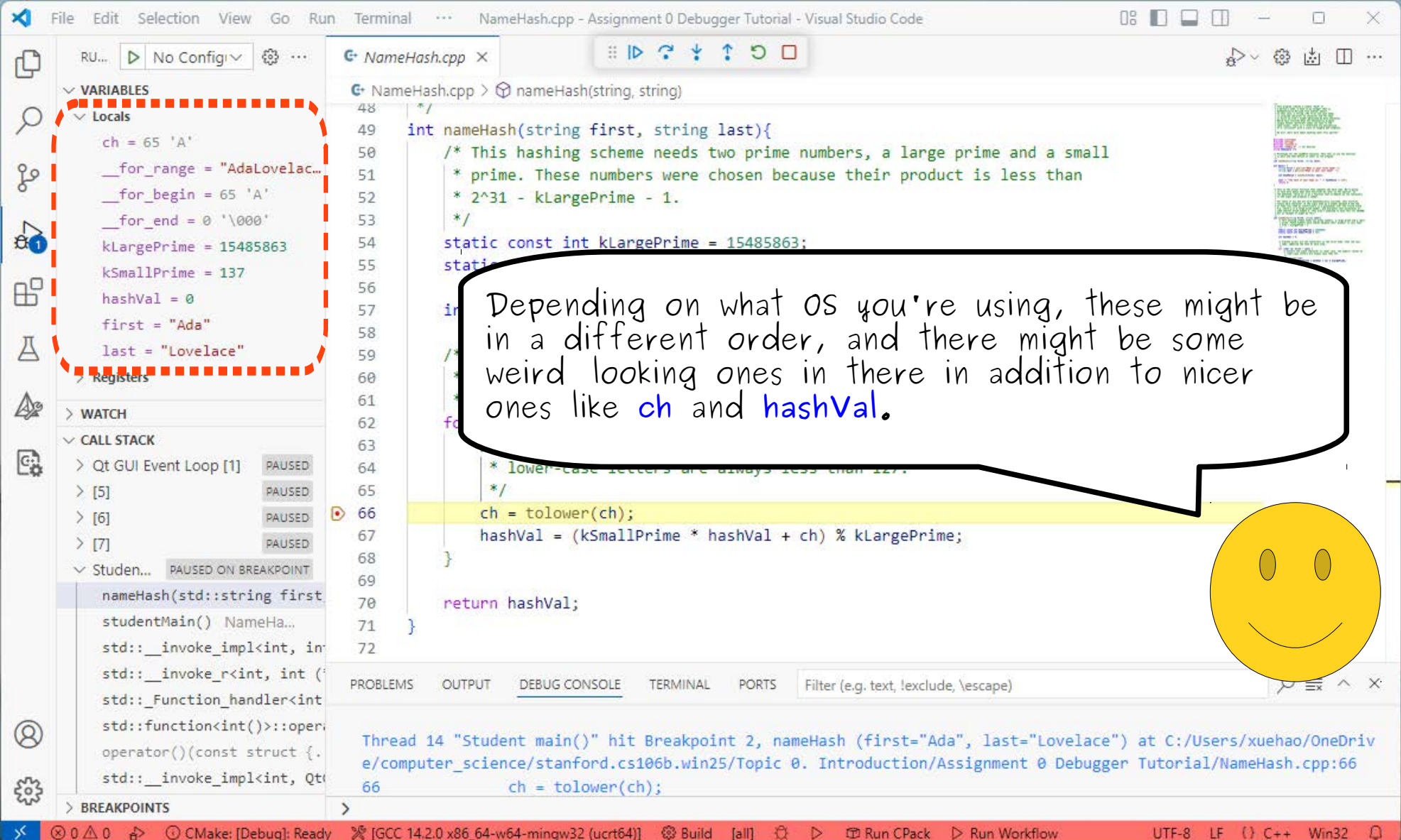
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71 }
Depending on what OS you're using, these might be in a different order, and there might be some weird looking ones in there in addition to nicer ones like ch and hashVal.
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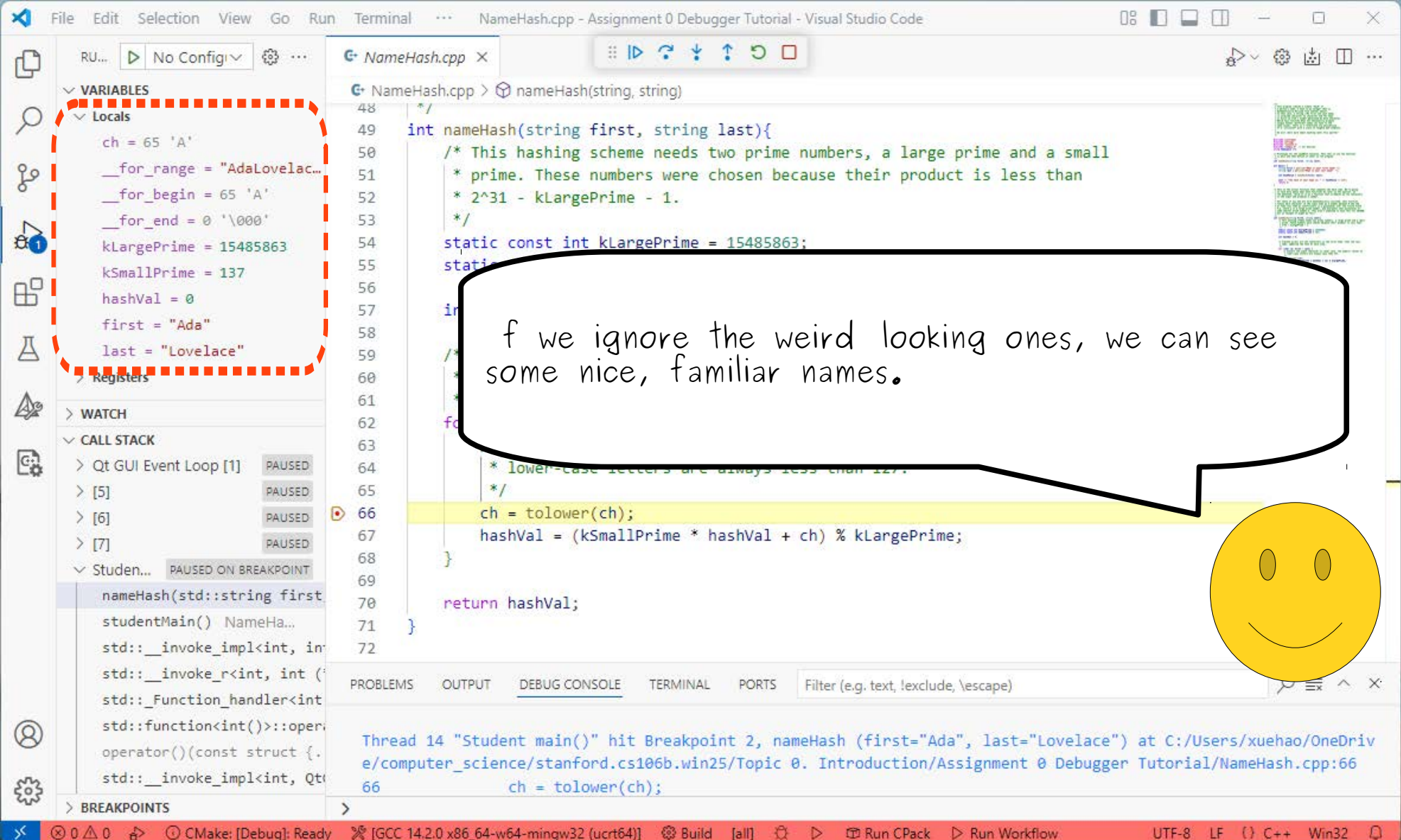
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70 return hashVal;
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f we ignore the weird looking ones, we can see some nice, familiar names.
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
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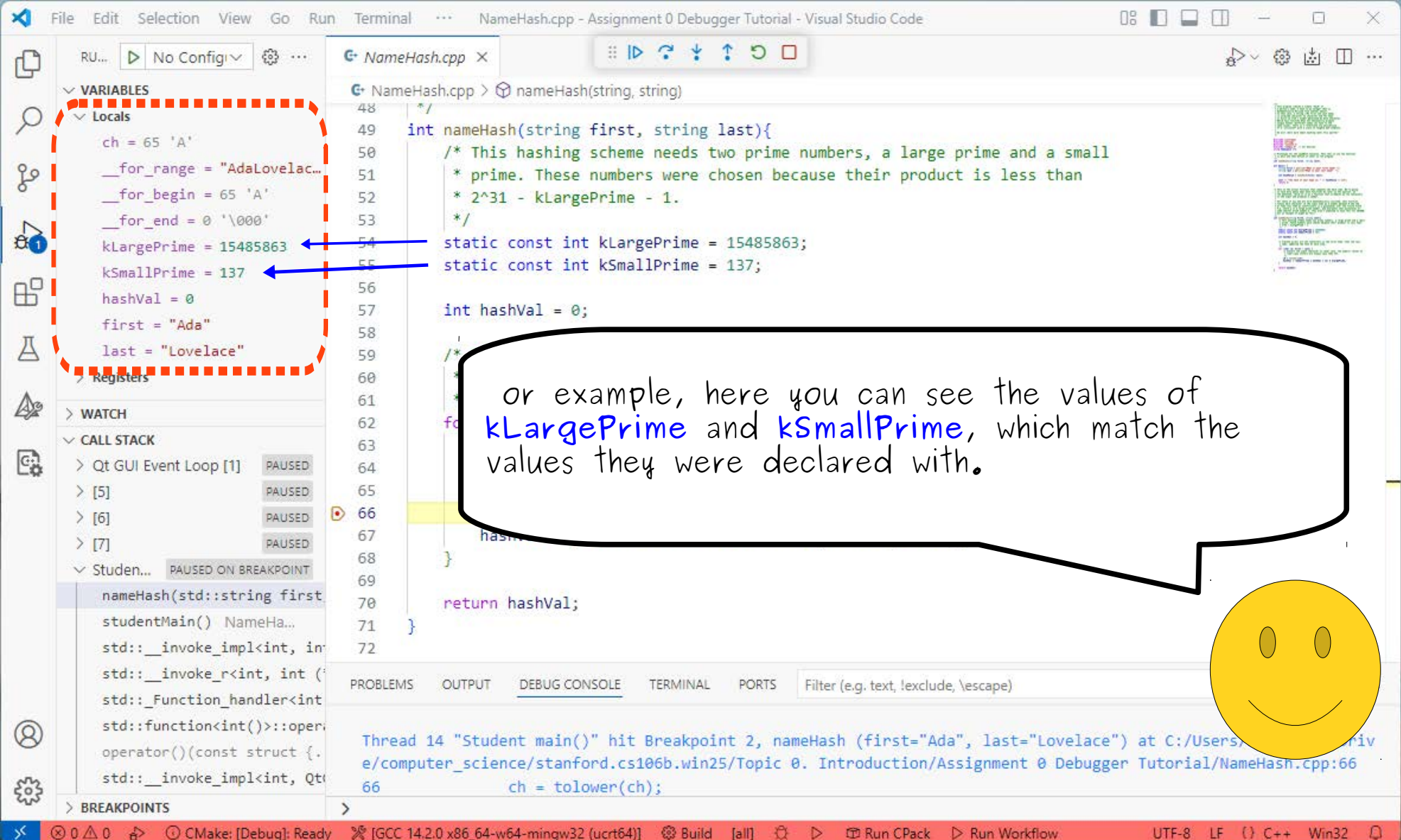
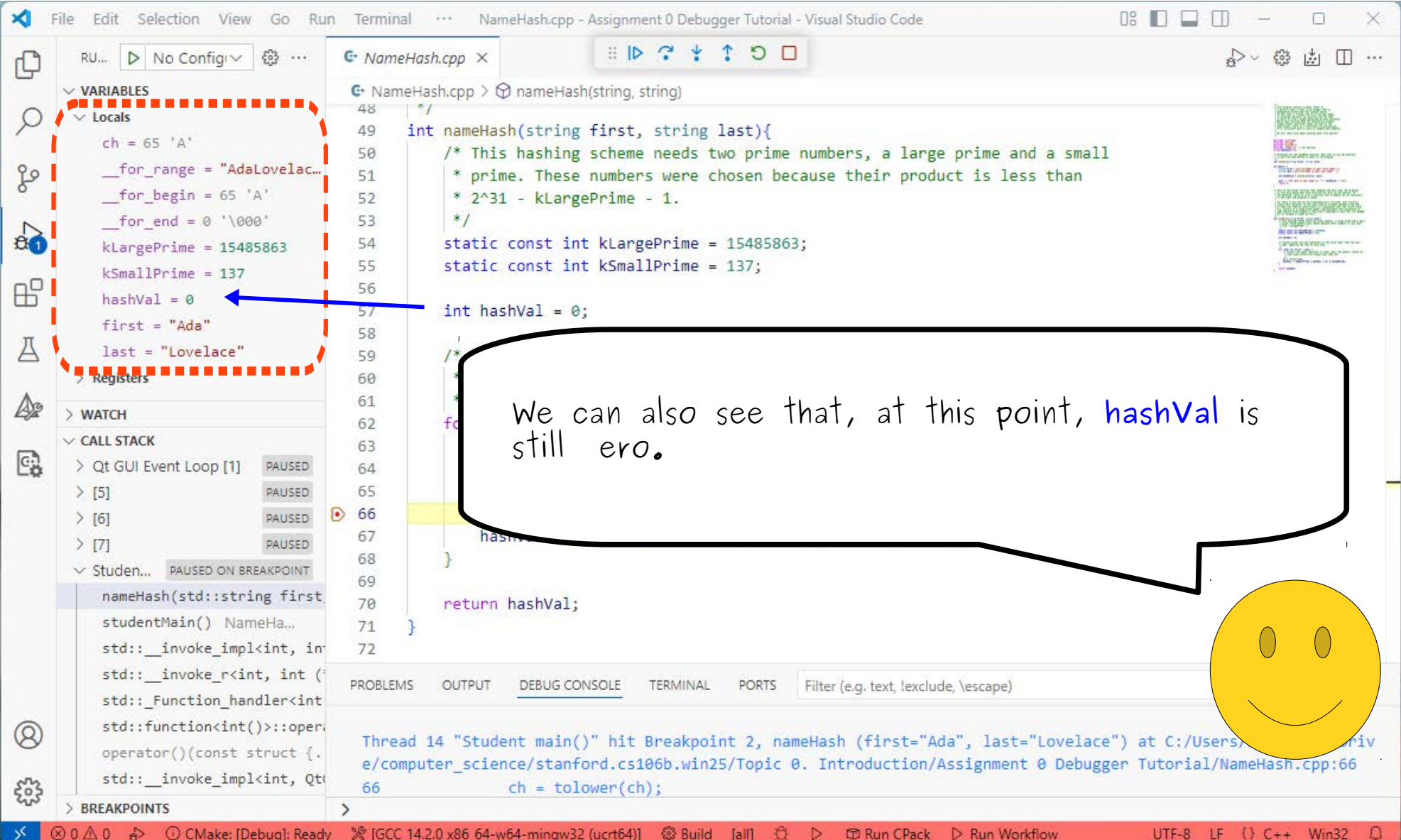
66 ch = tolower(ch);
CMake: [Debug]: Ready
[GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)]
Build [all]
Run CPack
Run Workflow
UTF-8 LF C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
No Config
VARIABLES
Locals
ch = 65 'A'
__for_range = "AdaLovelac...
__for_begin = 65 'A'
__for_end = 0 '\000'
kLargePrime = 15485863
kSmallPrime = 137
hashVal = 0
first = "Ada"
last = "Lovelace"
Registers
WATCH
CALL STACK
Qt GUI Event Loop [1] PAUSED
[5] PAUSED
[6] PAUSED
[7] PAUSED
Studen... PAUSED ON BREAKPOINT
nameHash(std::string first
studentMain() NameHa...
BREAKPOINTS
NameHash.cpp
NameHash.cpp > nameHash(string, string)
49 int nameHash(string first, string last){
50 /* This hashing scheme needs two prime numbers, a large prime and a small
51 * prime. These numbers were chosen because their product is less than
52 * 2^31 - kLargePrime - 1.
53 */
54 static const int kLargePrime = 15485863;
55 static const int kSmallPrime = 137;
56
57 int hashVal = 0;
70 return hashVal;
71 }
or example, here you can see the values of kLargePrime and kSmallPrime, which match the values they were declared with.
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/
e/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
CMake: [Debug]: Ready
[GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)]
Build [all]
Run CPack
Run Workflow
UTF-8 LF C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
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Locals
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__for_begin = 65 'A'
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std::__invoke_r<int, int (
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std::function<int()>::oper
operator()(const struct {.
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NameHash.cpp
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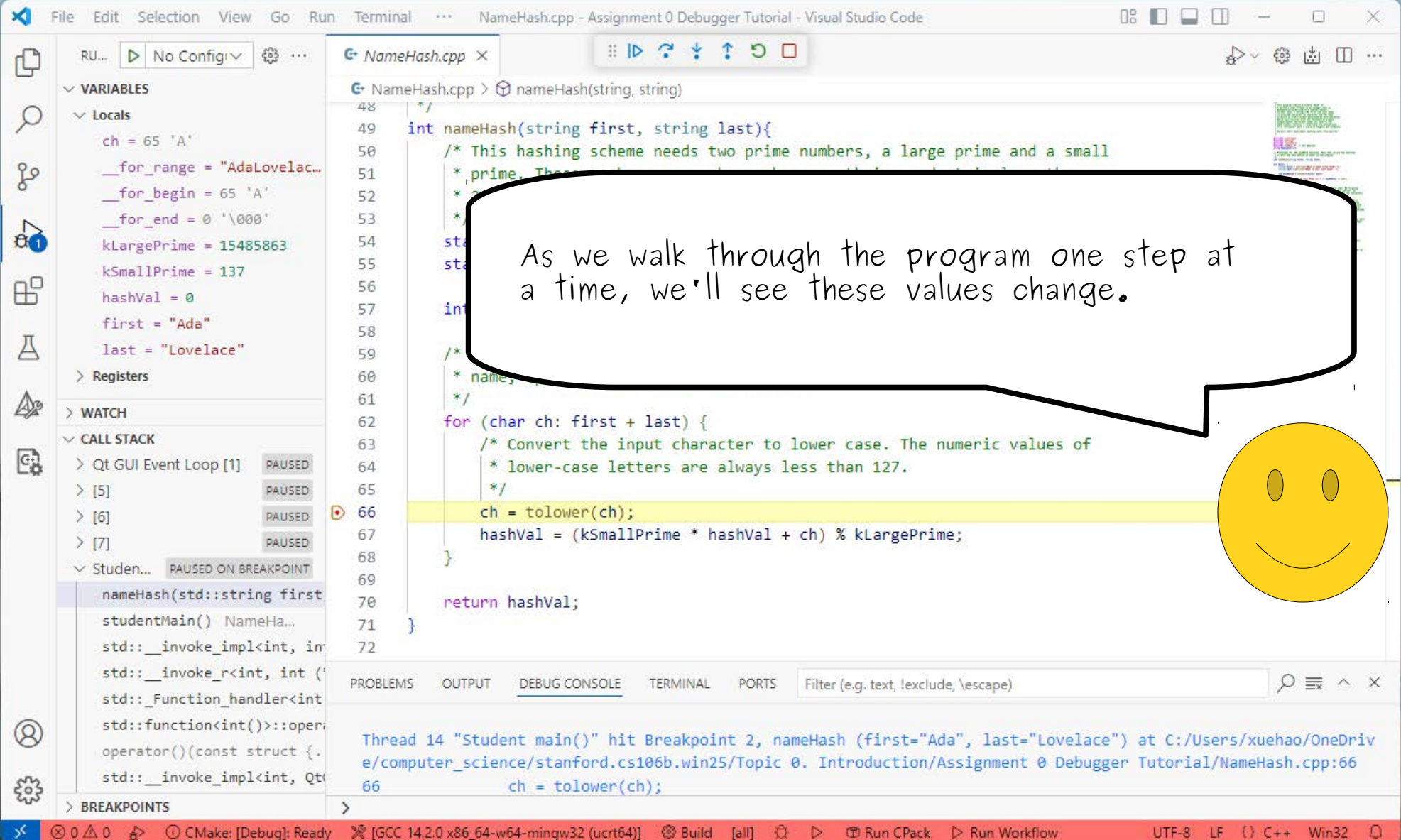
49 int nameHash(string first, string last){
50 /* This hashing scheme needs two prime numbers, a large prime and a small
51 * prime. These numbers were chosen because their product is less than
52 * 2^31 - kLargePrime - 1.
53 */
54 static const int kLargePrime = 15485863;
55 static const int kSmallPrime = 137;
56
57 int hashVal = 0;
58
59 /*
60
61
62 fo
63
64
65
66
67 hash
68 }
69
70 return hashVal;
71 }
72
We can also see that, at this point, hashVal is still zero.
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/ /Driv
e/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF {} C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
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VARIABLES
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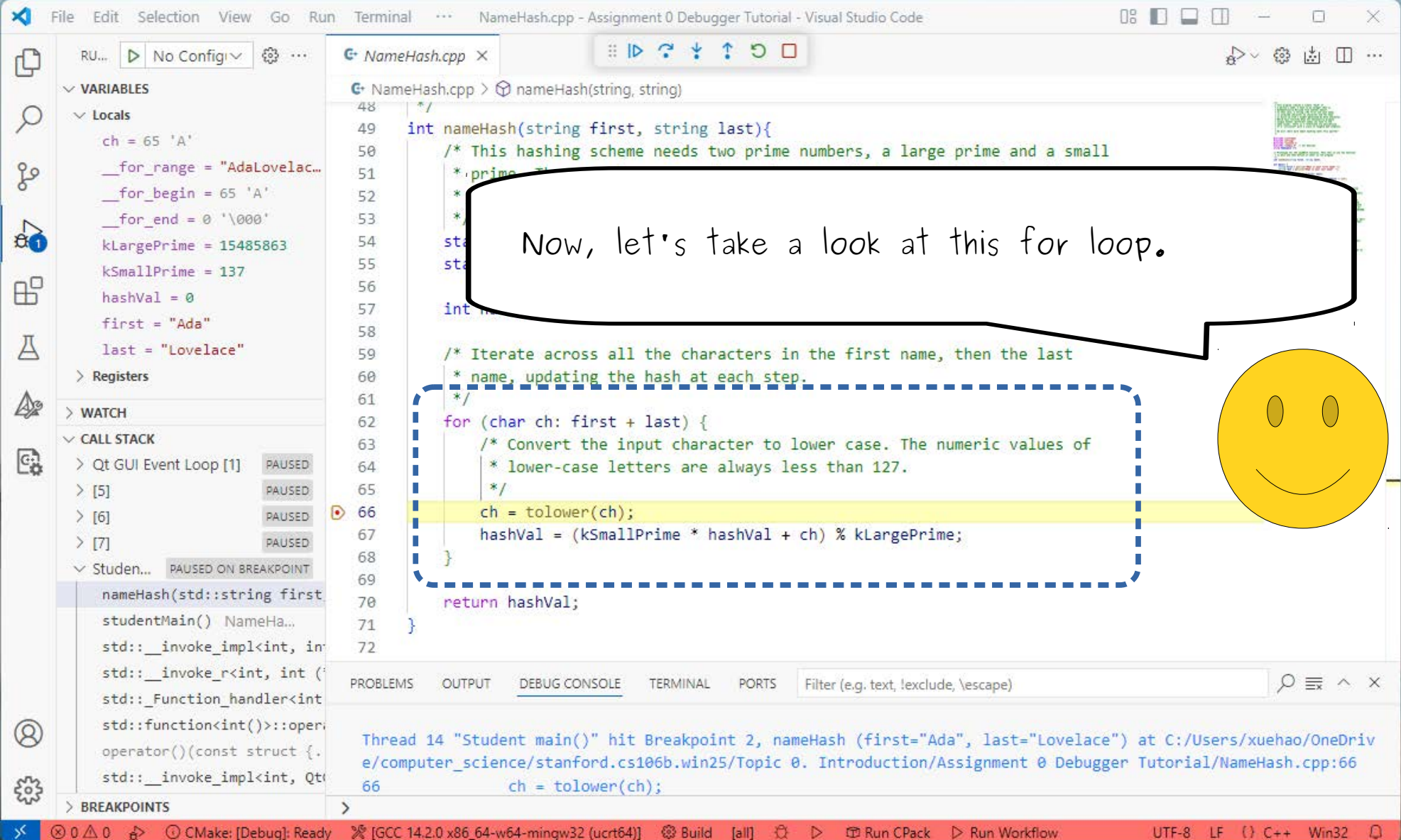
BREAKPOINTS
NameHash.cpp
NameHash.cpp > nameHash(string, string)
48 */
49 int nameHash(string first, string last){
50 /* This hashing scheme needs two prime numbers, a large prime and a small
51 * prime. Th
52 *
53 */
54 sta
55 sta
56
57 int
58
59 /*
60 * name
61 */
62 for (char ch: first + last) {
63 /* Convert the input character to lower case. The numeric values of
64 * lower-case letters are always less than 127.
65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
69
70 return hashVal;
71 }
72
As we walk through the program one step at a time, we'll see these values change.
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
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CALL STACK
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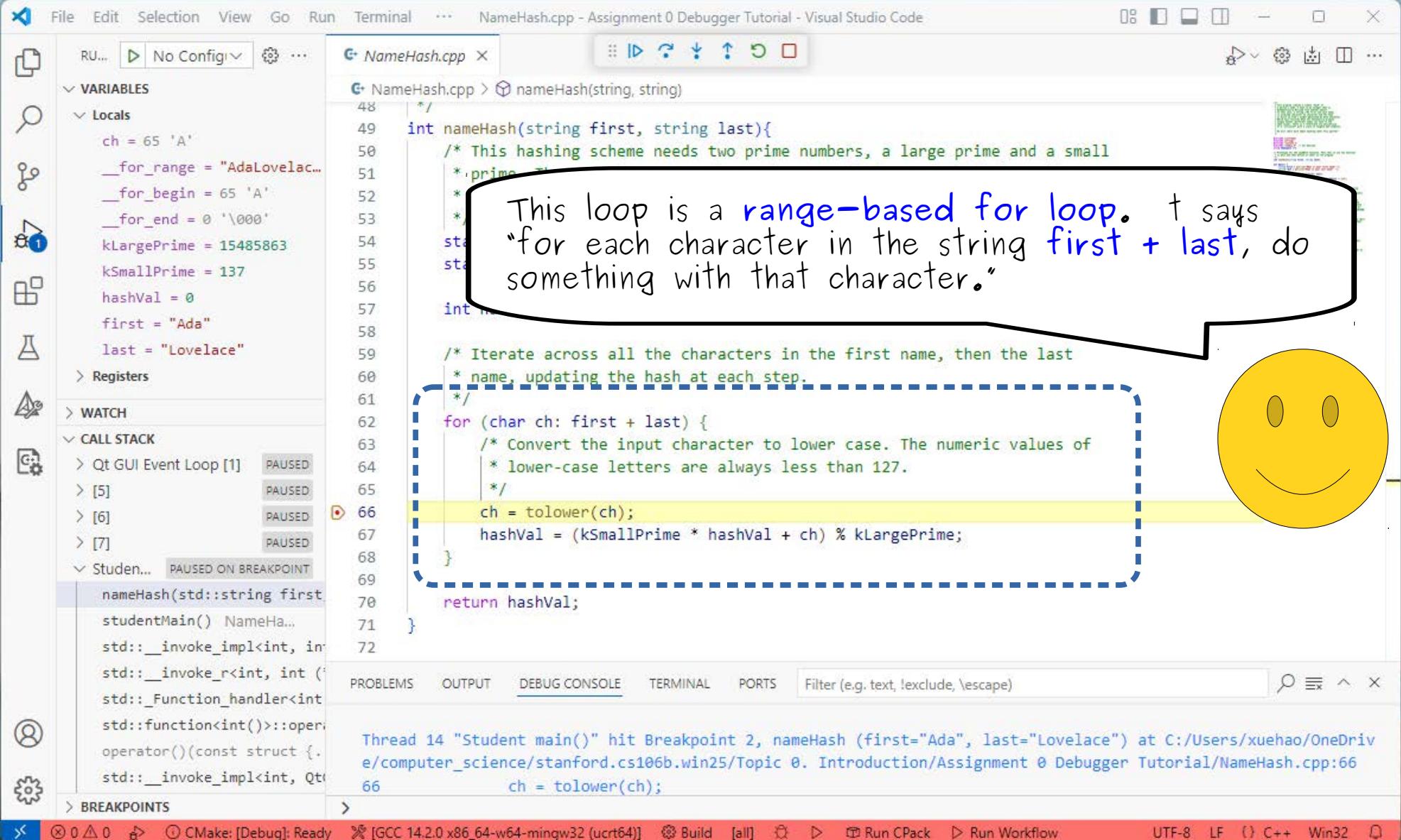
[5] PAUSED
[6] PAUSED
[7] PAUSED
Studen... PAUSED ON BREAKPOINT
nameHash(std::string first
studentMain() NameHa...
BREAKPOINTS
NameHash.cpp
NameHash.cpp > nameHash(string, string)
Now, let's take a look at this for loop.
/* Iterate across all the characters in the first name, then the last
* name, updating the hash at each step.
*/
for (char ch: first + last) {
/* Convert the input character to lower case. The numeric values of
* lower-case letters are always less than 127.
*/
ch = tolower(ch);
hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
}
return hashVal;
}
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
CMake: [Debug]: Ready
[GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)]
Build [all]
Run CPack
Run Workflow
UTF-8 LF C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
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Qt GUI Event Loop [1] PAUSED
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std::function<int()>::oper
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BREAKPOINTS
NameHash.cpp
NameHash.cpp > nameHash(string, string)
48 */
49 int nameHash(string first, string last){
50 /* This hashing scheme needs two prime numbers, a large prime and a small
51 * prime
52 *
53 */
54 sta
55 sta
56
57 int
58
59 /* Iterate across all the characters in the first name, then the last
60 * name, updating the hash at each step.
61 */
62 for (char ch: first + last) {
63 /* Convert the input character to lower case. The numeric values of
64 * lower-case letters are always less than 127.
65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
69
70 return hashVal;
71 }
72
This loop is a range-based for loop. It says "for each character in the string first + last, do something with that character."
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF {} C++ Win32

File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code

RU... No Config

VARIABLES

Locals

```
ch = 65 'A'
__for_range = "AdaLovelac…
__for_begin = 65 'A'
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kLargePrime = 15485863
kSmallPrime = 137
hashVal = 0
first = "Ada"
last = "Lovelace"
```

Registers

WATCH

CALL STACK

Qt GUI Event Loop [1] PAUSED
[5] PAUSED
[6] PAUSED
[7] PAUSED
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```
nameHash(std::string first
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std::__invoke_impl<int, in
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std::_Function_handler<int
std::function<int()>::oper
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std::__invoke_impl<int, Qt
```

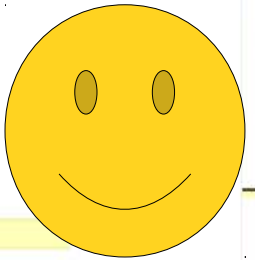
BREAKPOINTS

NameHash.cpp

NameHash.cpp > nameHash(string, string)

```
48  */
49  int nameHash(string first, string last){
50      /* This hashing scheme needs two prime numbers, a large prime and a small
51       * prime
52       *
53       */
54      sta
55      sta
56
57      int
58
59      /* Iterate across all the characters in the first name, then the last
60       * name, updating the hash at each step.
61       */
62      for (char ch: first + last) {
63          /* Convert the input character to lower case. The numeric values of
64           * lower-case letters are always less than 127.
65           */
66          ch = tolower(ch);
67          hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68      }
69
70      return hashVal;
71  }
72
```

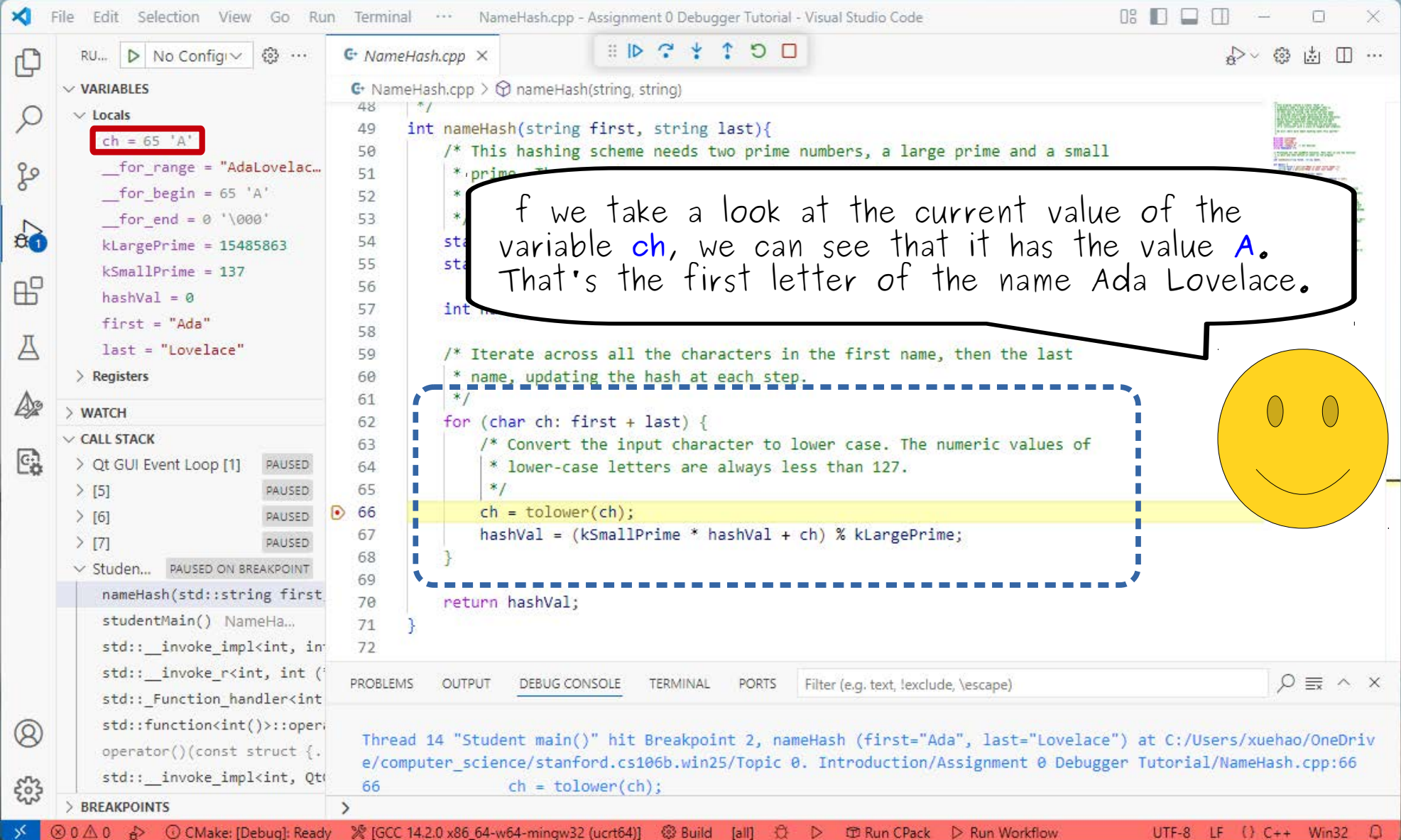
emember (from a while back) that we entered the name Ada Lovelace?



PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS Filter (e.g. text, !exclude, \escape)

```
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66              ch = tolower(ch);
```

⊗ 0 ⚠ 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF {} C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
VARIABLES
Locals
ch = 65 'A'
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CALL STACK
Qt GUI Event Loop [1] PAUSED
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nameHash(std::string first
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std::__invoke_impl<int, in
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operator()(const struct {.
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BREAKPOINTS
NameHash.cpp
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48 */
49 int nameHash(string first, string last){
50 /* This hashing scheme needs two prime numbers, a large prime and a small
51 * prime
52 *
53 */
54 sta
55 sta
56
57 int
58
59 /* Iterate across all the characters in the first name, then the last
60 * name, updating the hash at each step.
61 */
62 for (char ch: first + last) {
63 /* Convert the input character to lower case. The numeric values of
64 * lower-case letters are always less than 127.
65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
69
70 return hashVal;
71 }
72
If we take a look at the current value of the variable ch, we can see that it has the value A. That's the first letter of the name Ada Lovelace.
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
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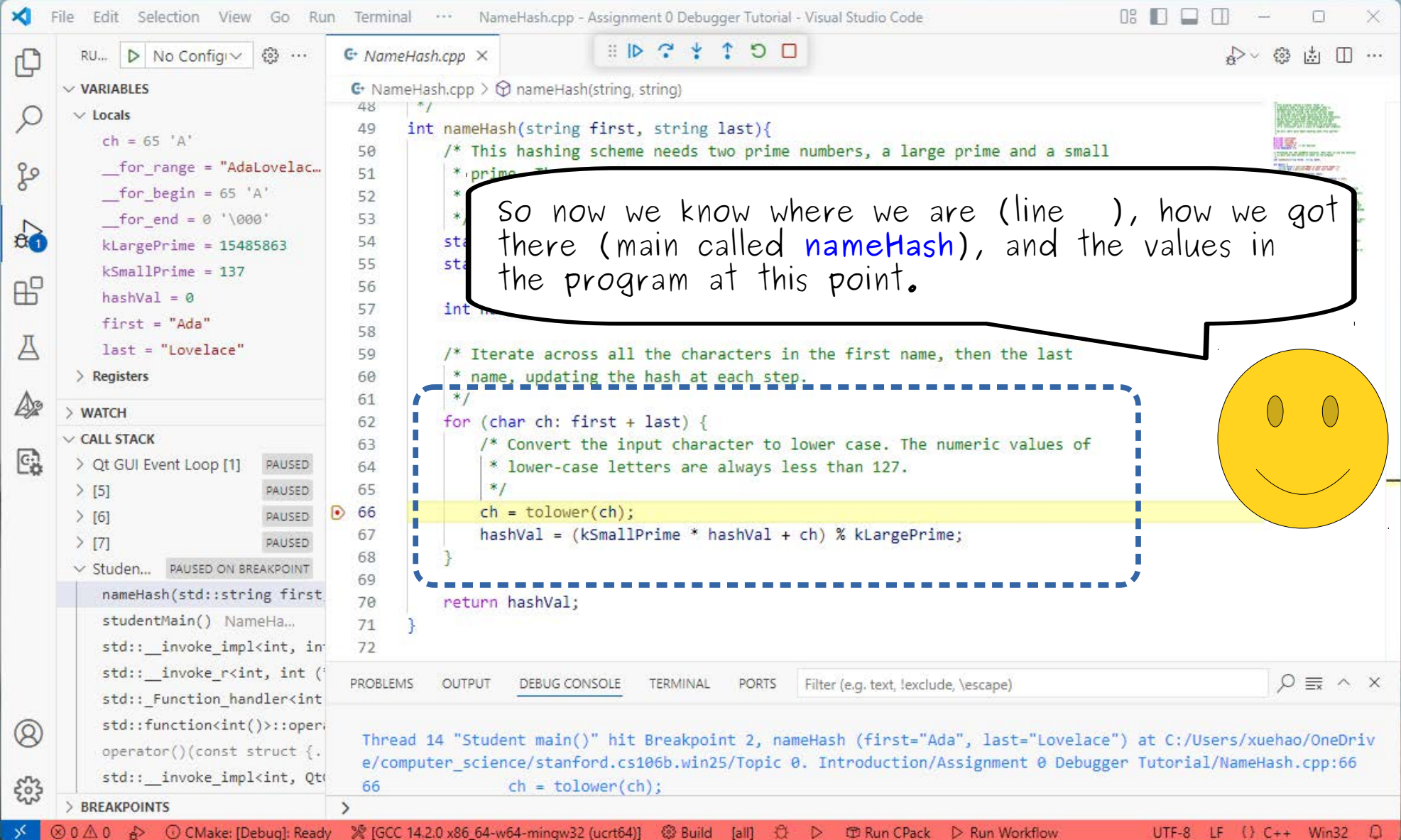
File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
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NameHash.cpp
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49 int nameHash(string first, string last){
50 /* This hashing scheme needs two prime numbers, a large prime and a small
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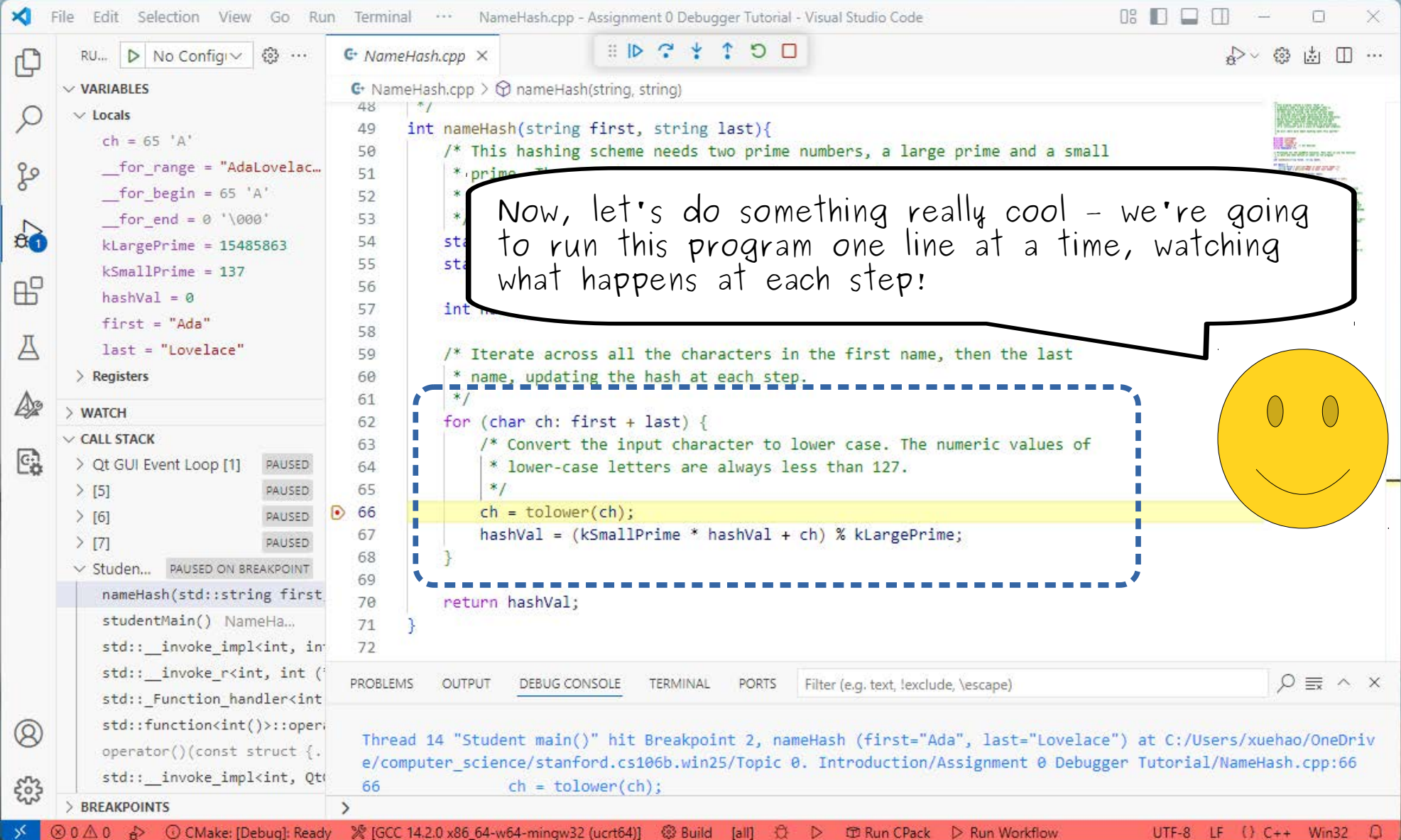
59 /* Iterate across all the characters in the first name, then the last
60 * name, updating the hash at each step.
61 */
62 for (char ch: first + last) {
63 /* Convert the input character to lower case. The numeric values of
64 * lower-case letters are always less than 127.
65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
69
70 return hashVal;
71 }
72
So now we know where we are (line), how we got there (main called nameHash), and the values in the program at this point.
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF {} C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
No Config
NameHash.cpp
NameHash.cpp > nameHash(string, string)
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CALL STACK
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[5] PAUSED
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[7] PAUSED
Studen... PAUSED ON BREAKPOINT
nameHash(std::string first
studentMain() NameHa...
BREAKPOINTS
Now, let's do something really cool - we're going to run this program one line at a time, watching what happens at each step!
49 int nameHash(string first, string last){
50 /* This hashing scheme needs two prime numbers, a large prime and a small
59 /* Iterate across all the characters in the first name, then the last
60 * name, updating the hash at each step.
61 */
62 for (char ch: first + last) {
63 /* Convert the input character to lower case. The numeric values of
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65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
70 return hashVal;
71 }
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
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Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
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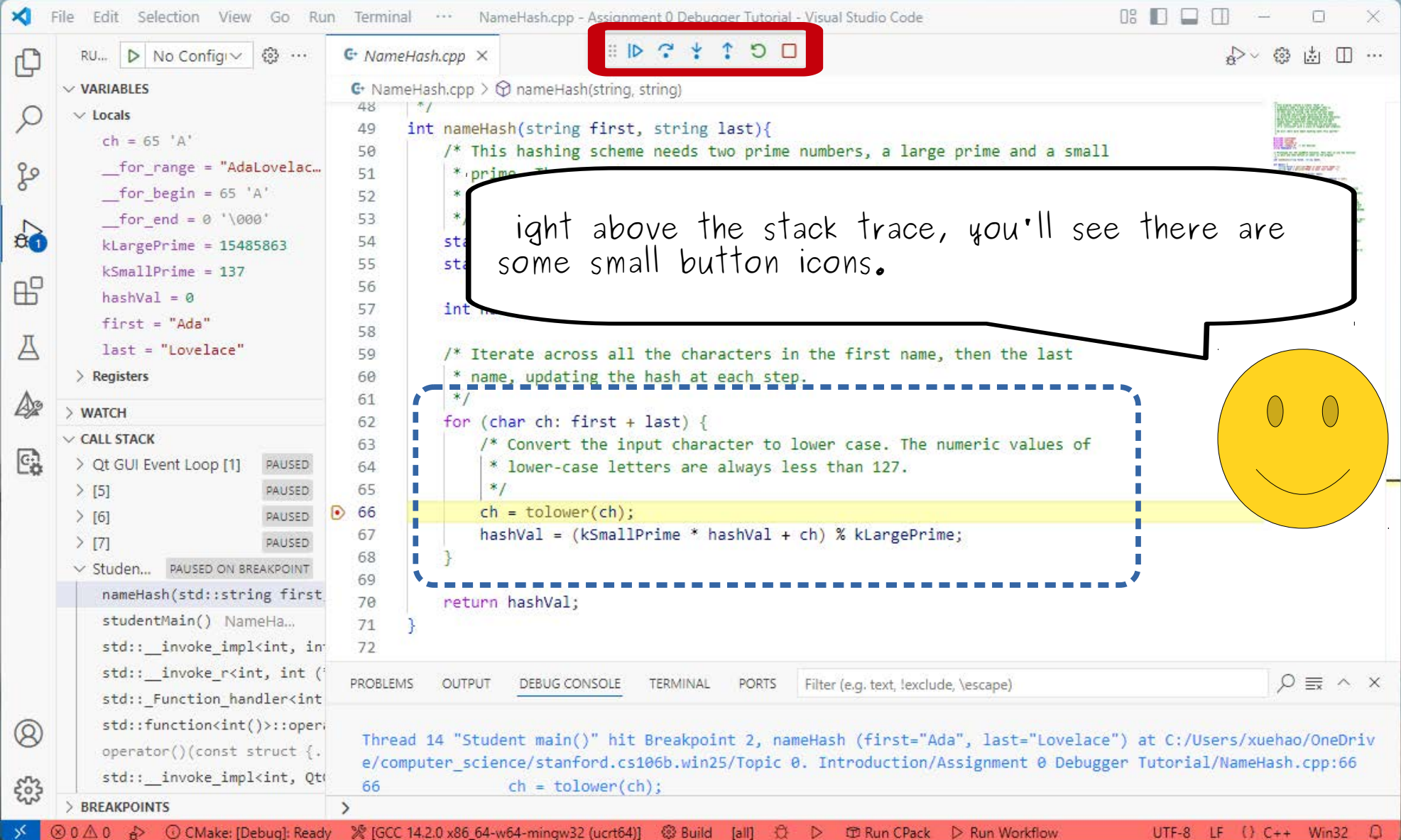
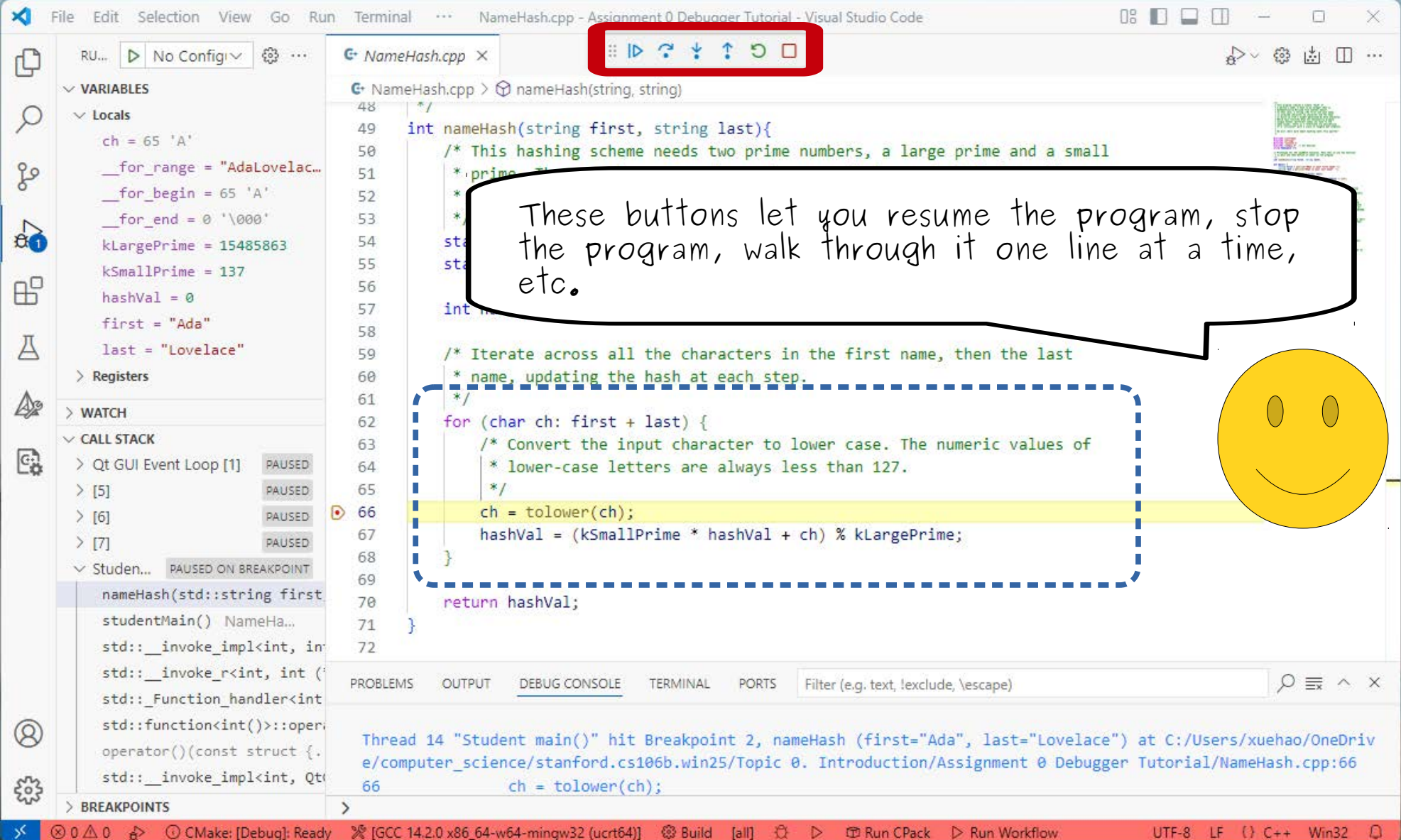
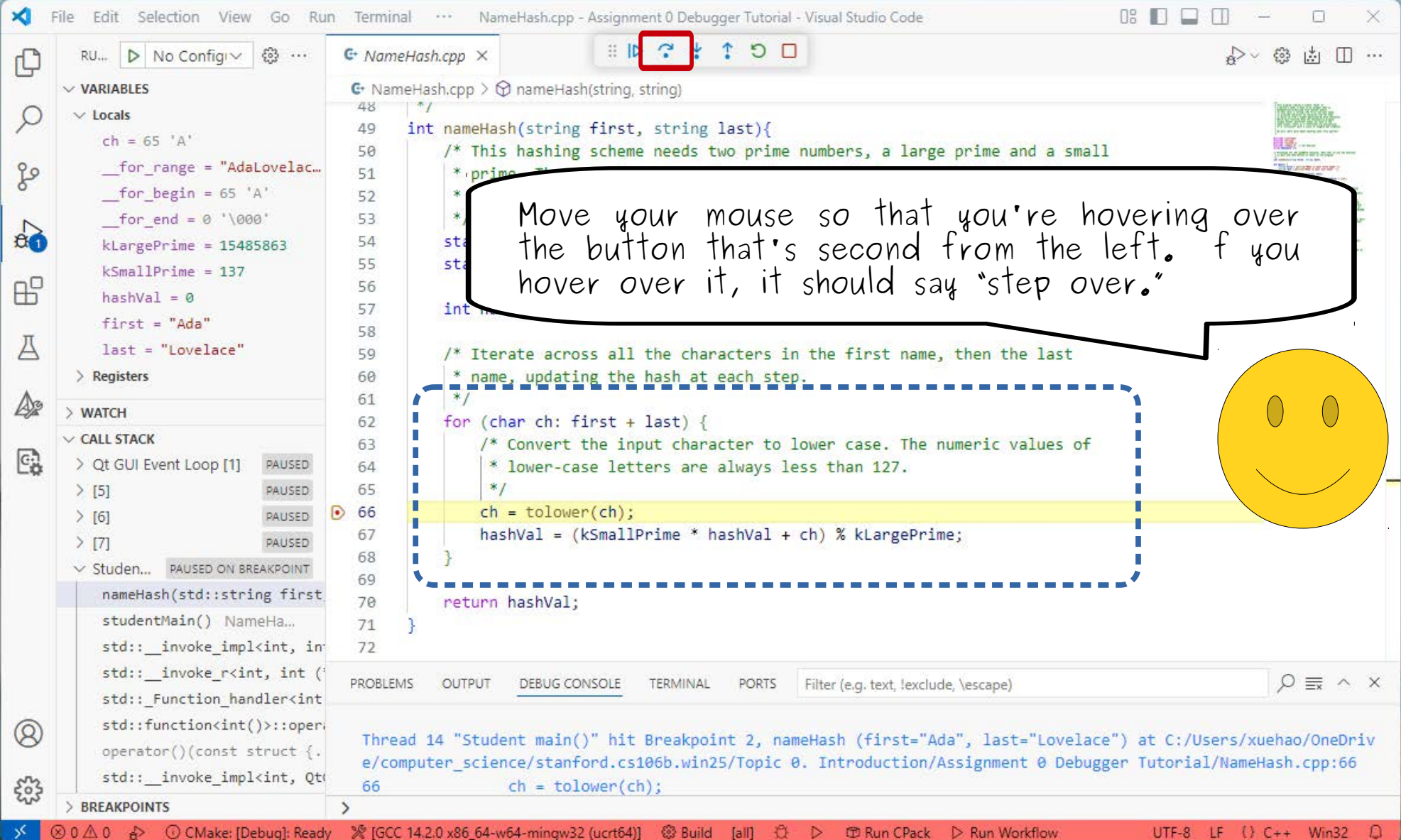
Build [all]
Run CPack
Run Workflow
UTF-8 LF C++ Win32


ight above the stack trace, you'll see there are some small button icons.


These buttons let you resume the program, stop the program, walk through it one line at a time, etc.


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
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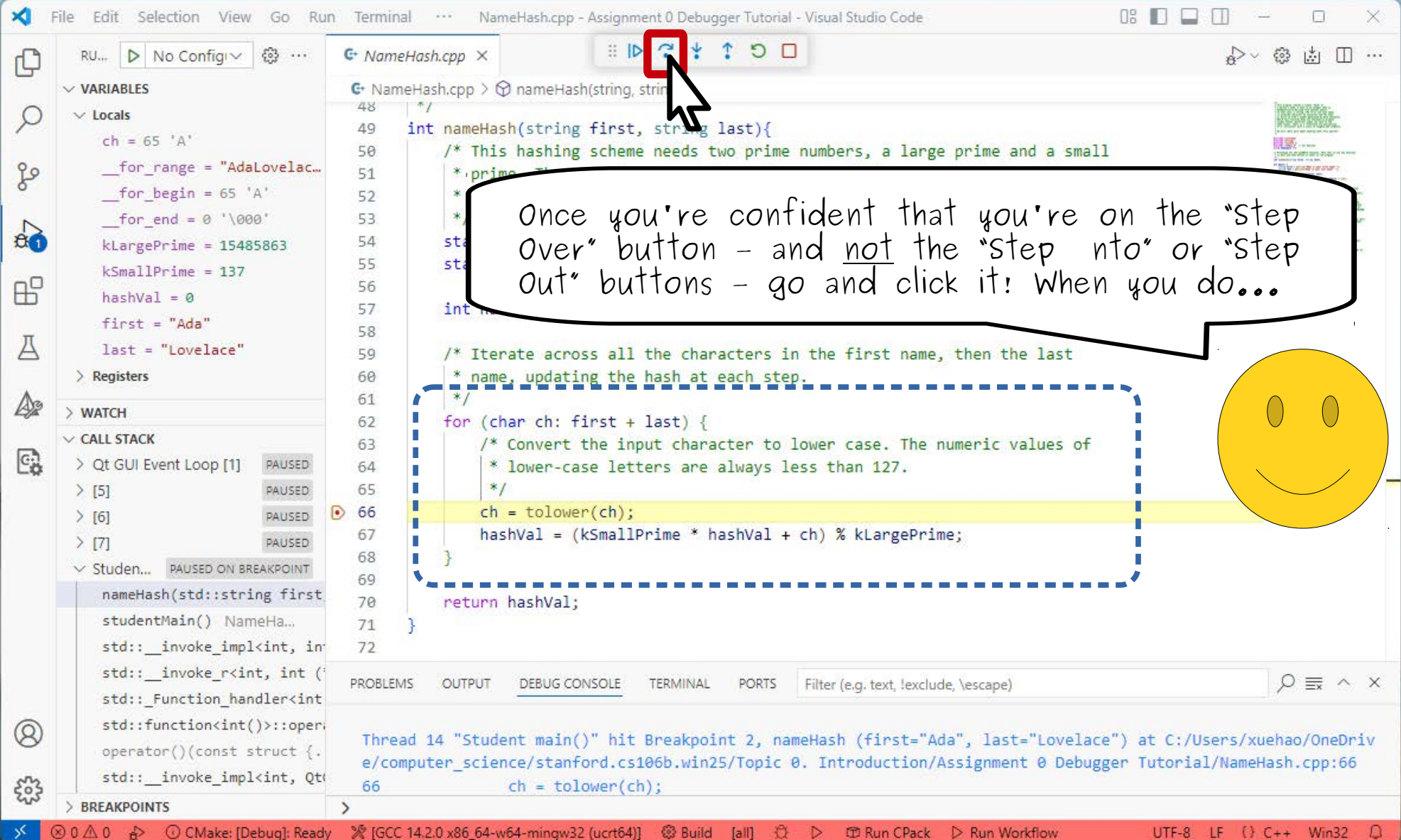
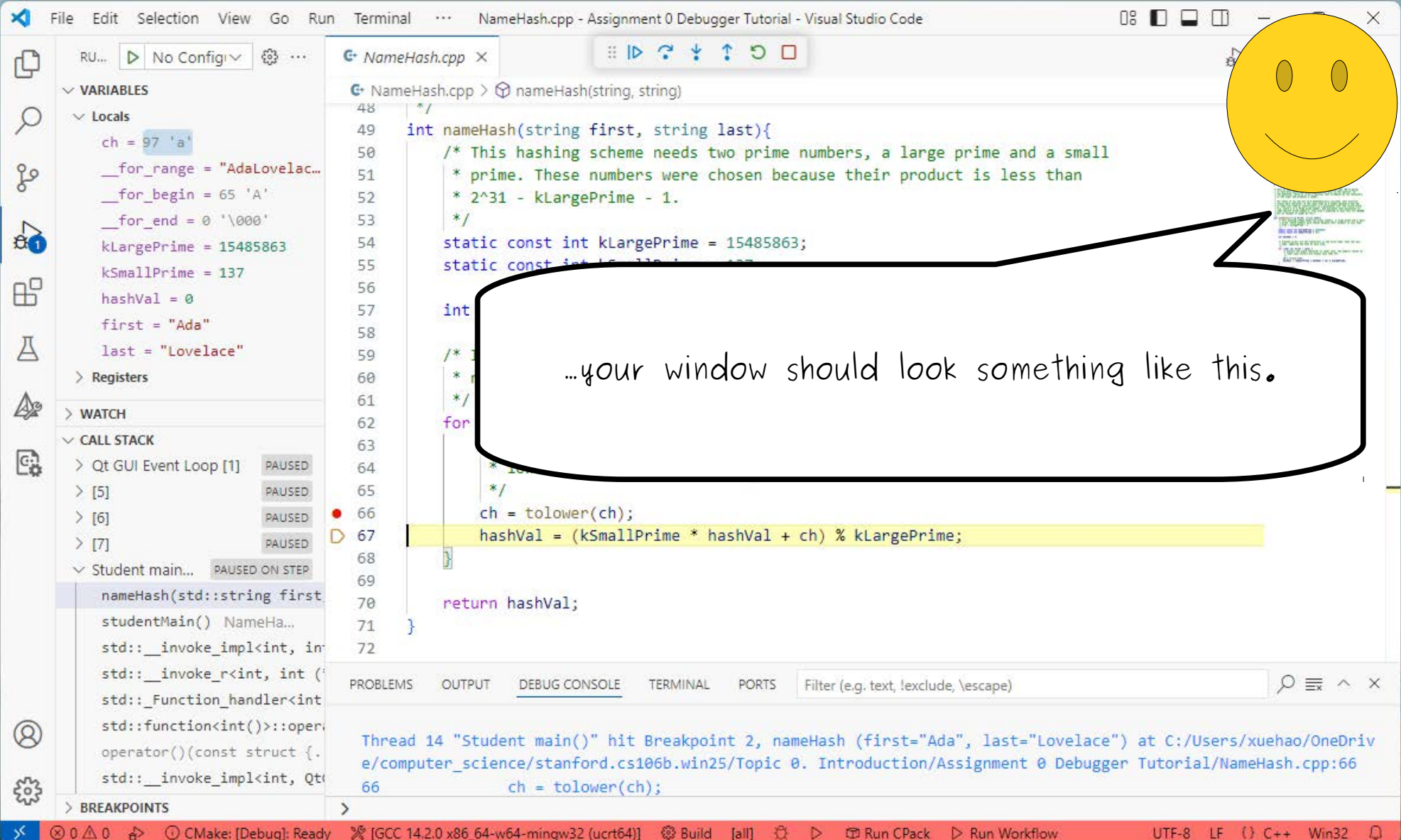
[5] PAUSED
[6] PAUSED
[7] PAUSED
Studen... PAUSED ON BREAKPOINT
nameHash(std::string first
studentMain() NameHa...
BREAKPOINTS
Move your mouse so that you're hovering over the button that's second from the left. f you hover over it, it should say "step over."
49 int nameHash(string first, string last){
50 /* This hashing scheme needs two prime numbers, a large prime and a small
59 /* Iterate across all the characters in the first name, then the last
60 * name, updating the hash at each step.
61 */
62 for (char ch: first + last) {
63 /* Convert the input character to lower case. The numeric values of
64 * lower-case letters are always less than 127.
65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
70 return hashVal;
71 }
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
CMake: [Debug]: Ready
[GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)]
Build [all]
Run CPack
Run Workflow
UTF-8 LF C++ Win32


Once you're confident that you're on the "Step Over" button - and not the "Step Into" or "Step Out" buttons - go and click it! When you do...


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
VARIABLES
Locals
ch = 97 'a'
__for_range = "AdaLovelac…
__for_begin = 65 'A'
__for_end = 0 '\000'
kLargePrime = 15485863
kSmallPrime = 137
hashVal = 0
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Registers
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59 /*
60 *
61 */
62 for
63
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65 */
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67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
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70 return hashVal;
71 }
72
…your window should look something like this.
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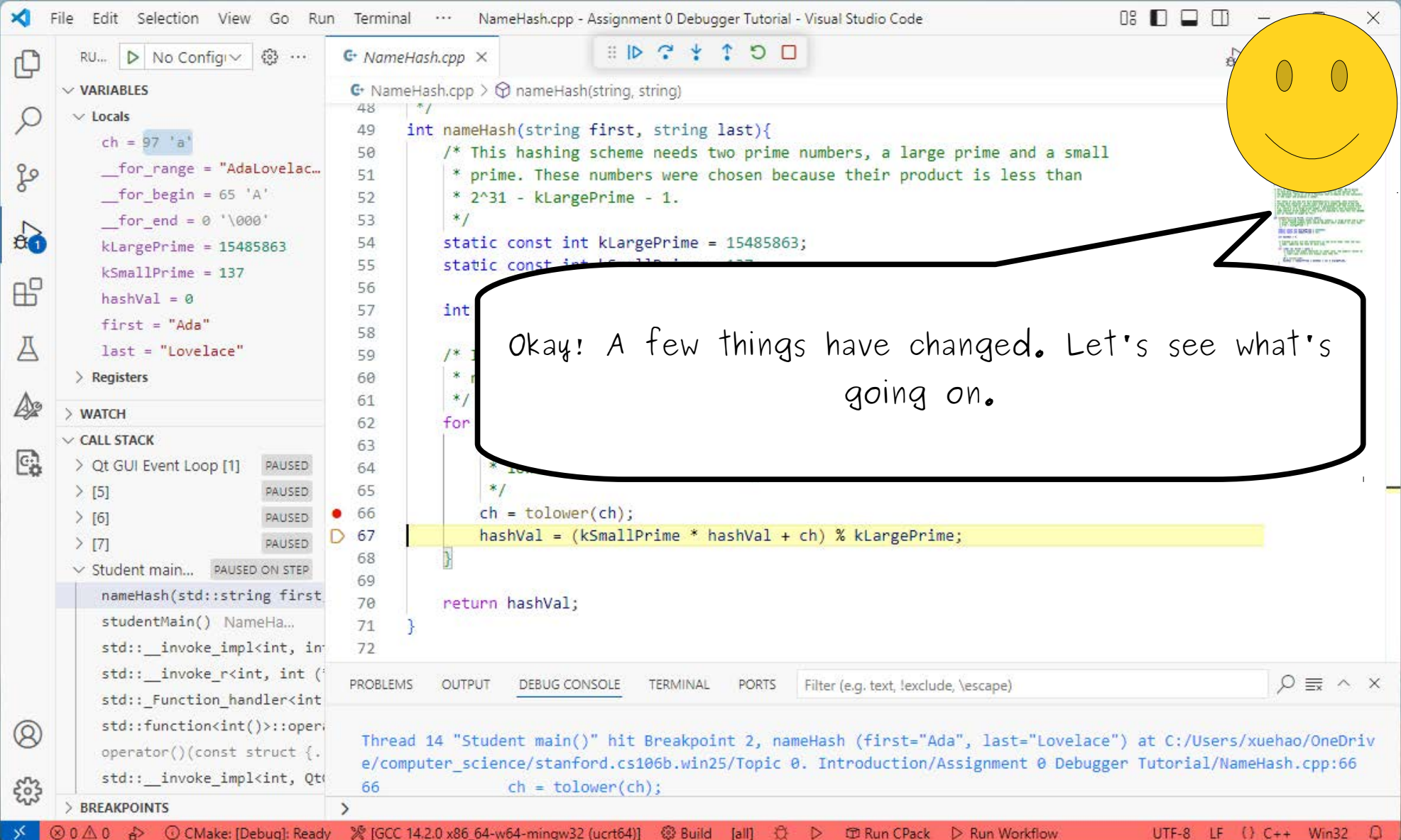
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69
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72
Okay! A few things have changed. Let's see what's going on.
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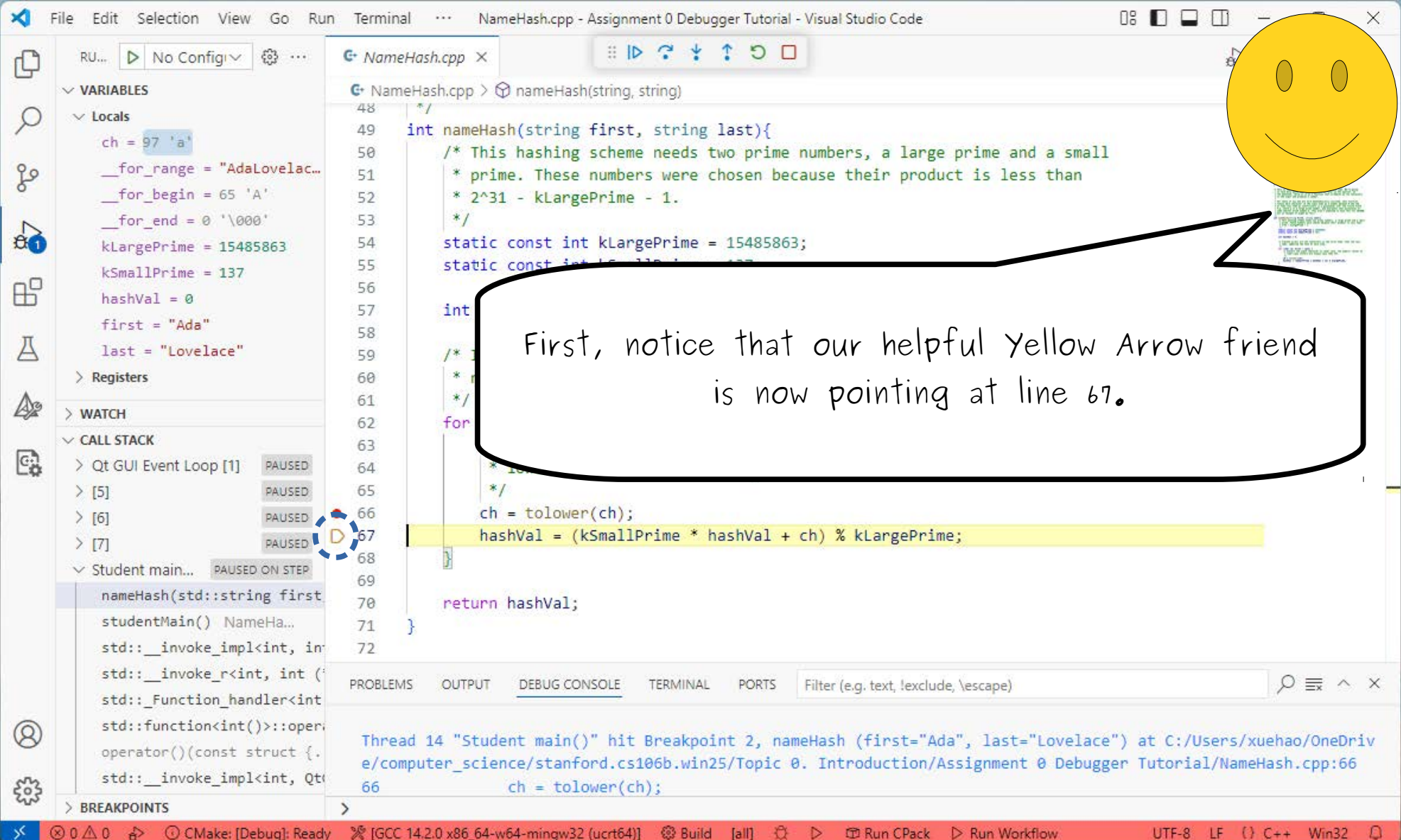
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First, notice that our helpful Yellow Arrow friend is now pointing at line 67.
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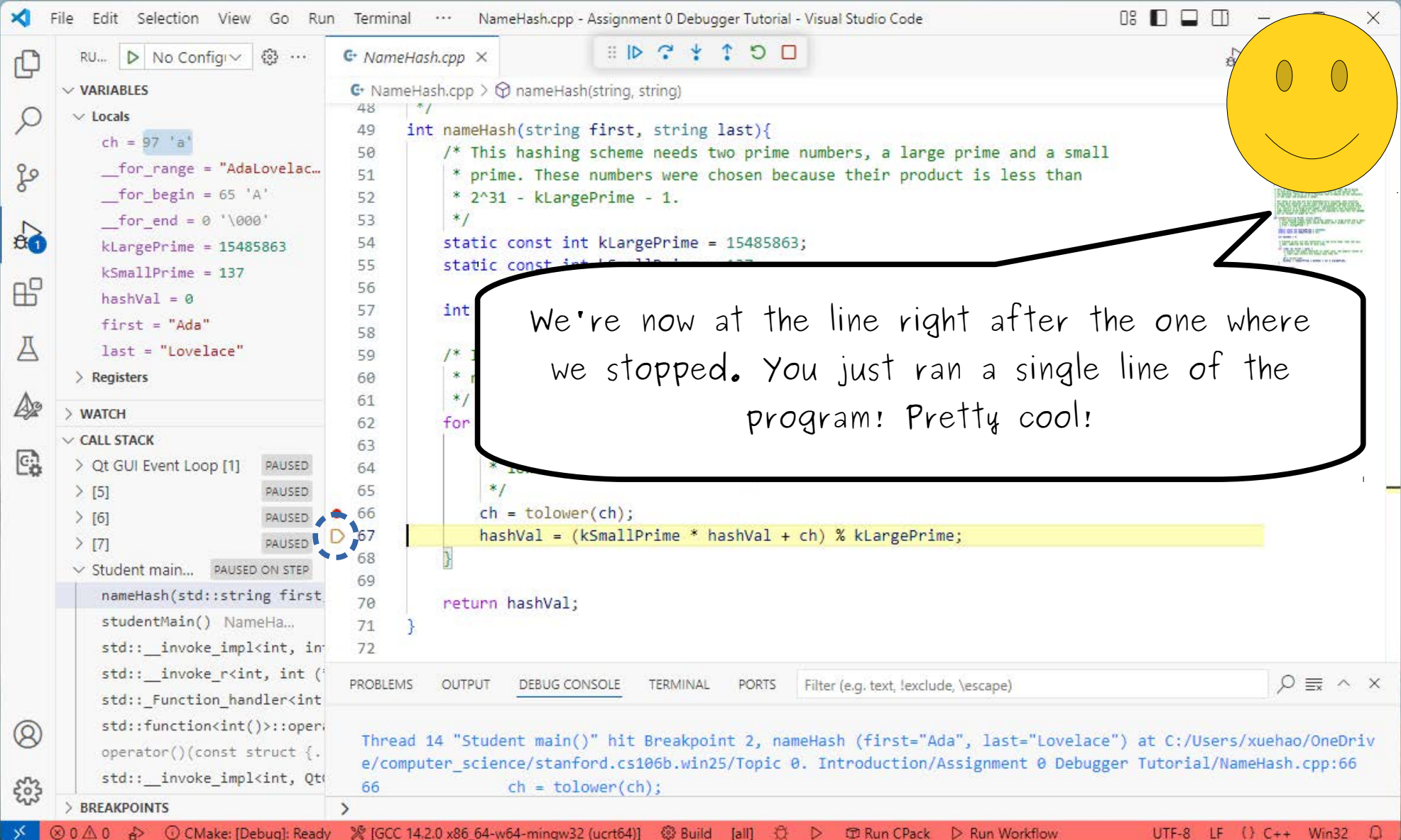
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68 }
69
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71 }
72
We're now at the line right after the one where we stopped. You just ran a single line of the program! Pretty cool!
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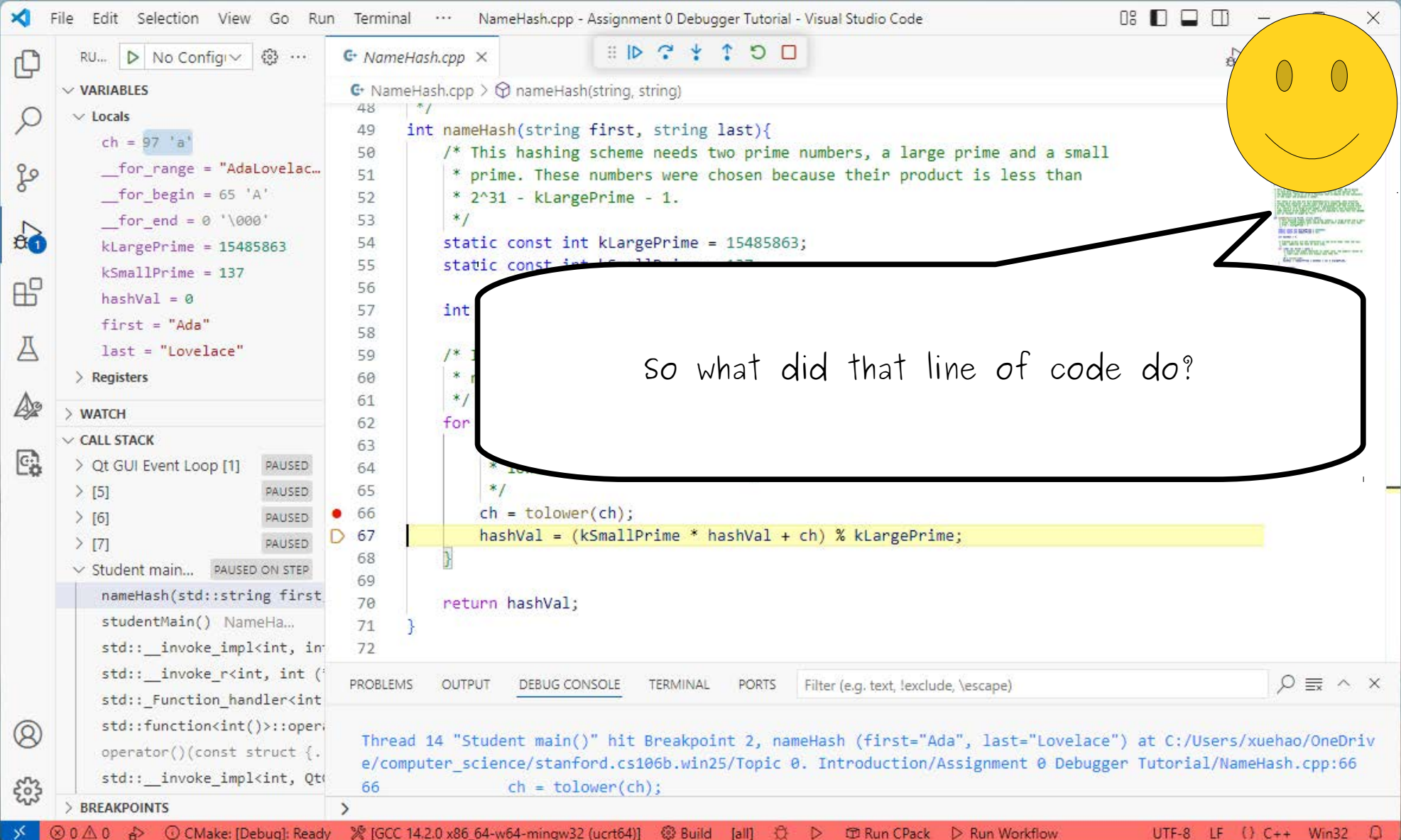
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so what did that line of code do?
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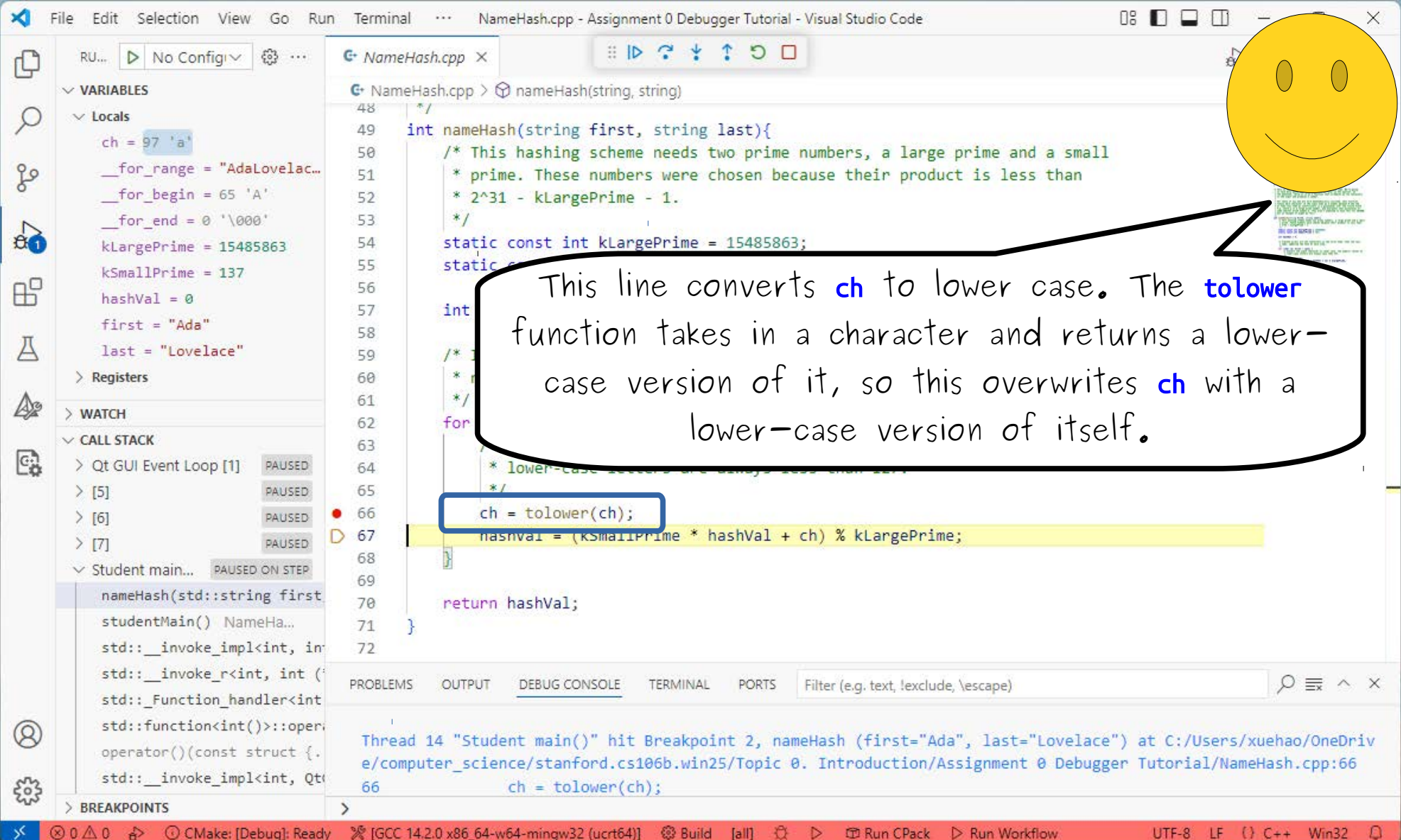
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62 for
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64 * lower-case letters are always less than 127.
65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
69
70 return hashVal;
71 }
72
This line converts ch to lower case. The tolower function takes in a character and returns a lower-case version of it, so this overwrites ch with a lower-case version of itself.
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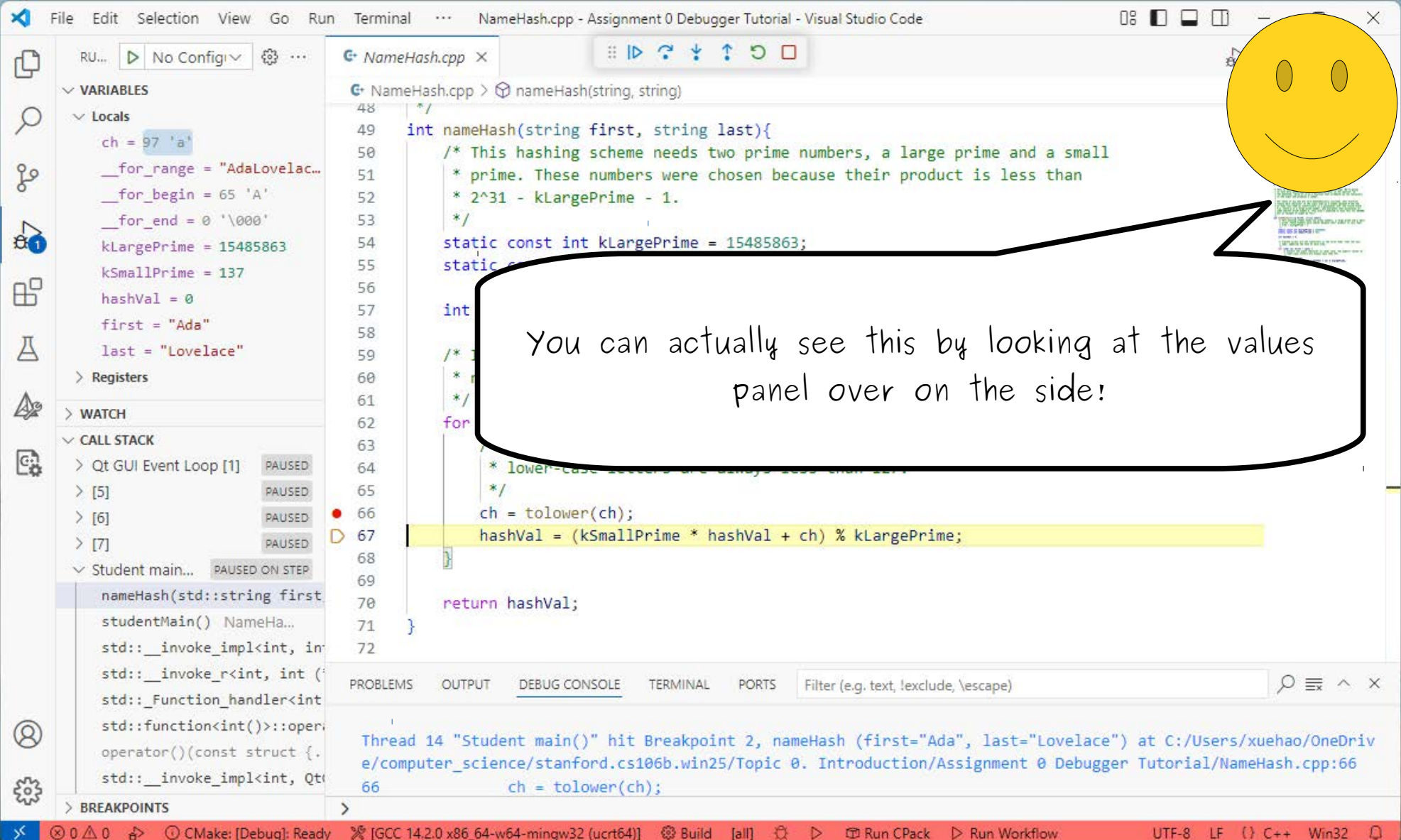
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66 ch = tolower(ch);
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68 }
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You can actually see this by looking at the values panel over on the side!
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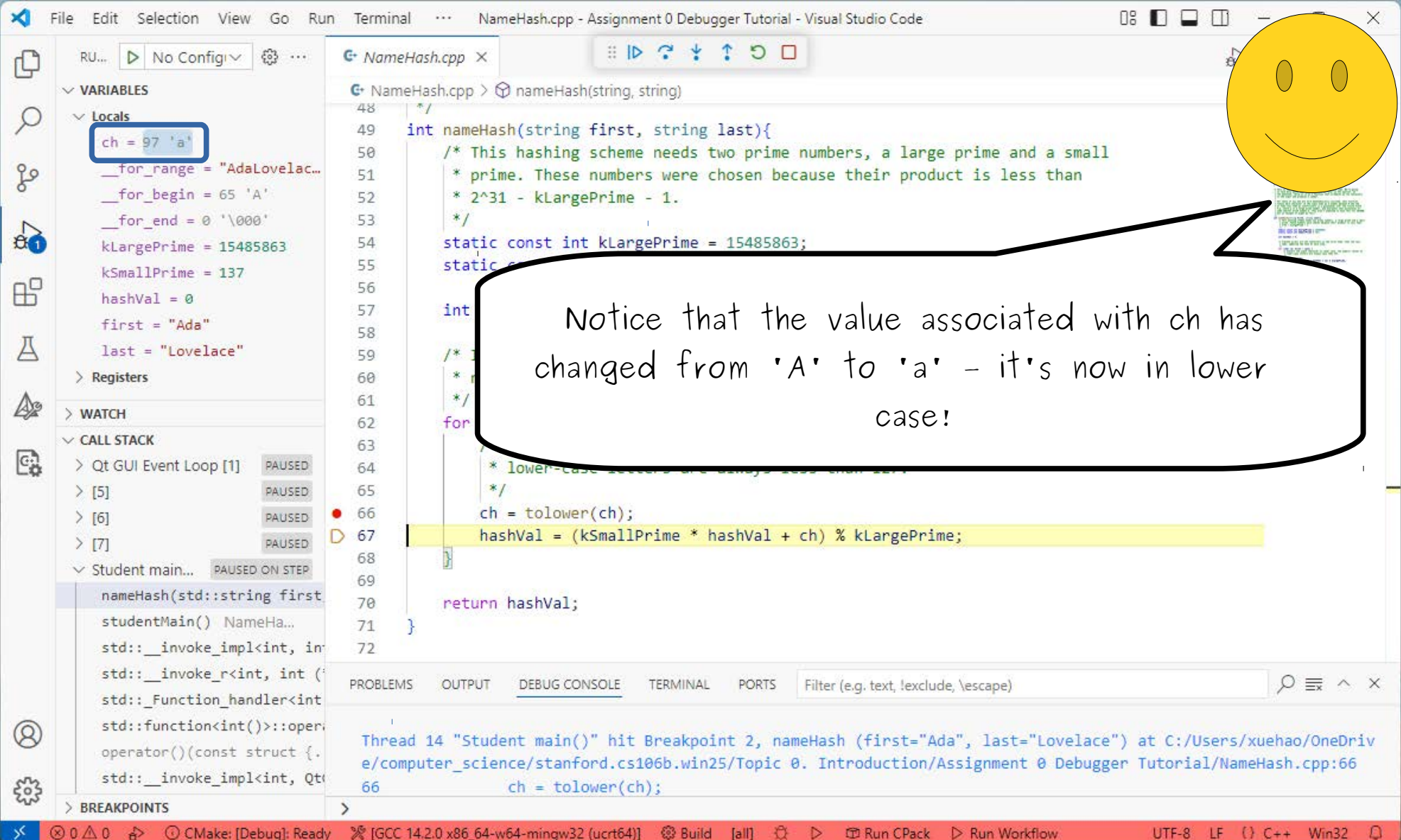
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66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
70 return hashVal;
71 }
Notice that the value associated with ch has changed from 'A' to 'a' - it's now in lower case!
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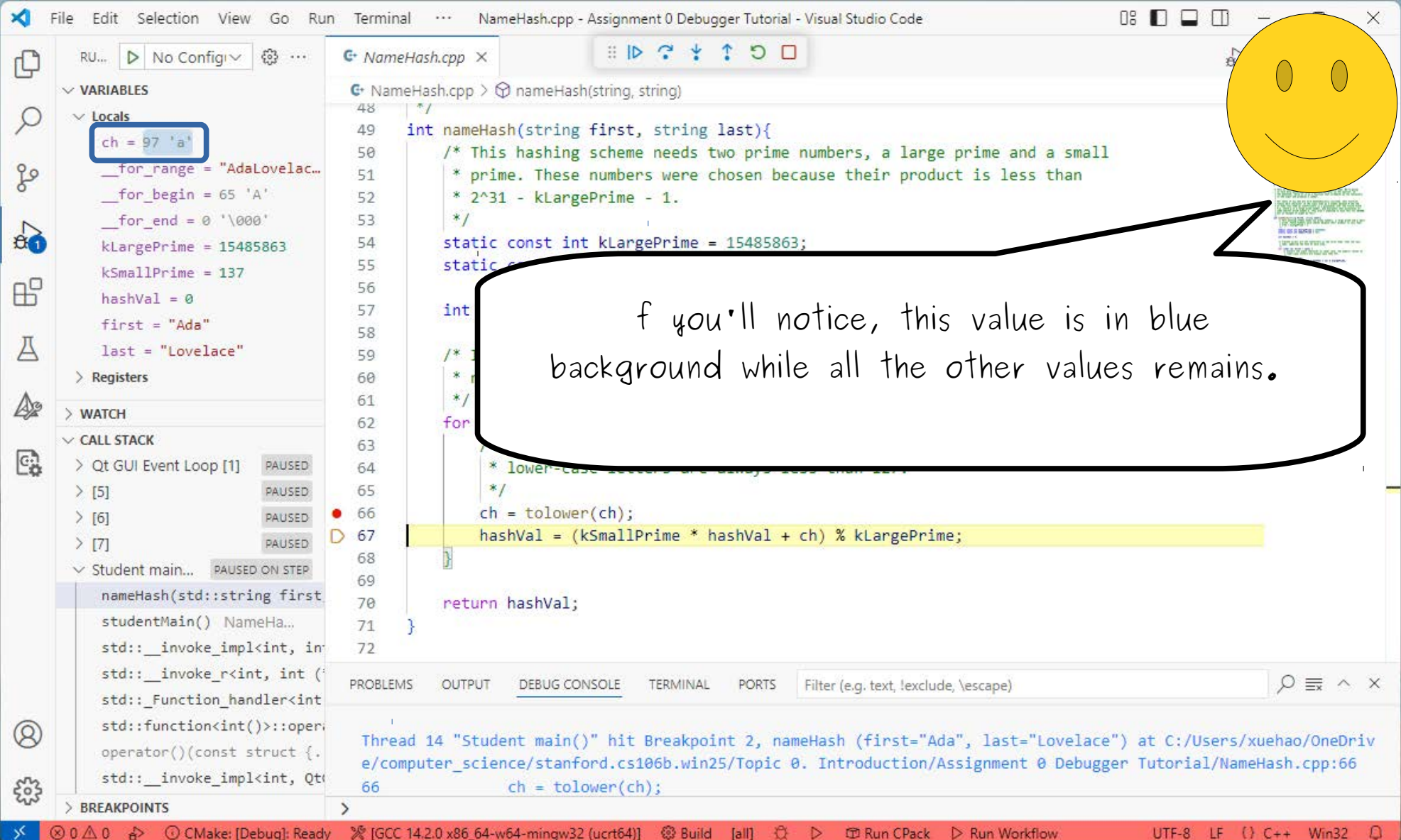
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70 return hashVal;
71 }
f you'll notice, this value is in blue
background while all the other values remains.
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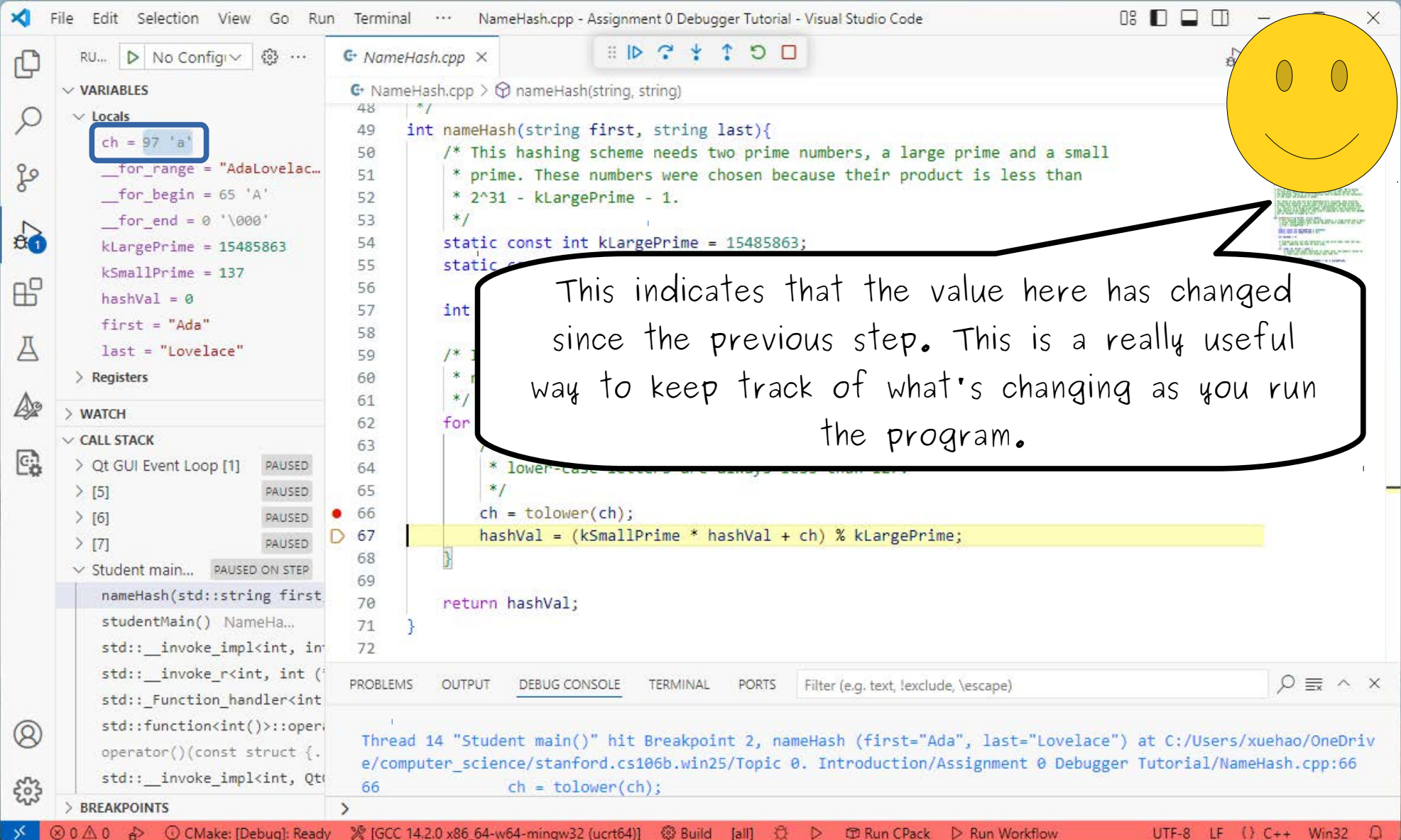
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66 ch = tolower(ch);
This indicates that the value here has changed since the previous step. This is a really useful way to keep track of what's changing as you run the program.
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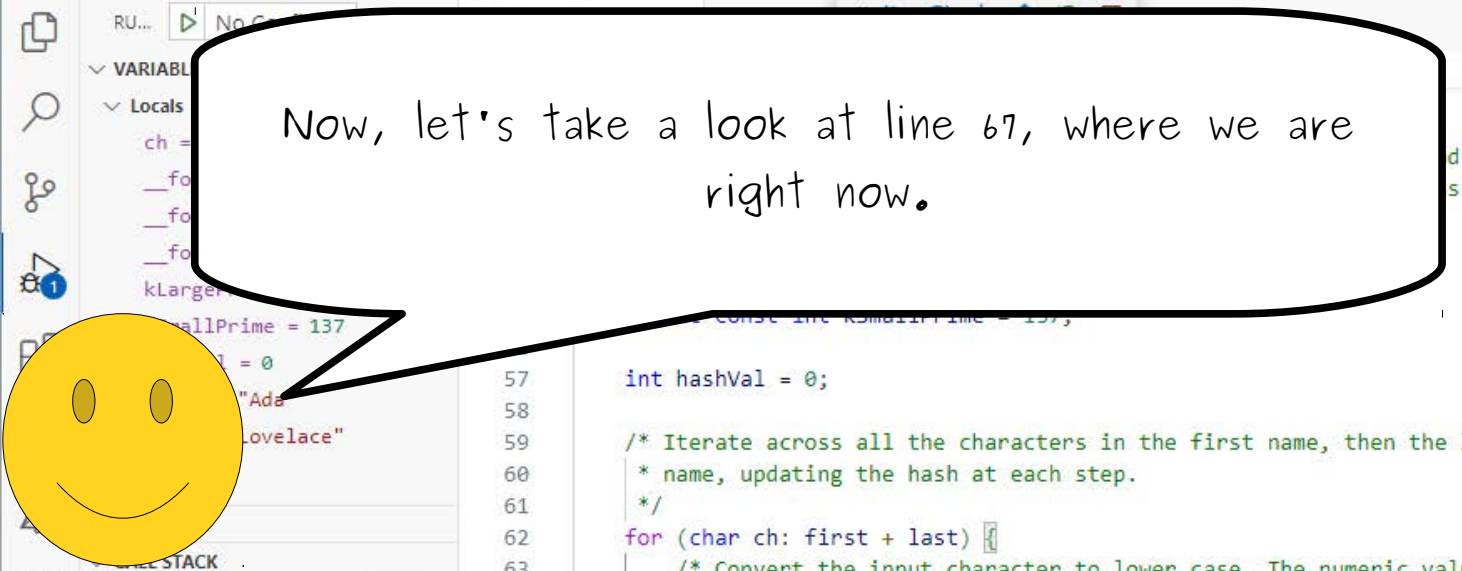

File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code

```
57      int hashVal = 0;
58
59      /* Iterate across all the characters in the first name, then the last
60       * name, updating the hash at each step.
61       */
62      for (char ch: first + last) {
63          /* Convert the input character to lower case. The numeric values of
64           * lower-case letters are always less than 127.
65           */
66          ch = tolower(ch);
67          hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68      }
69
70      return hashVal;
71  }
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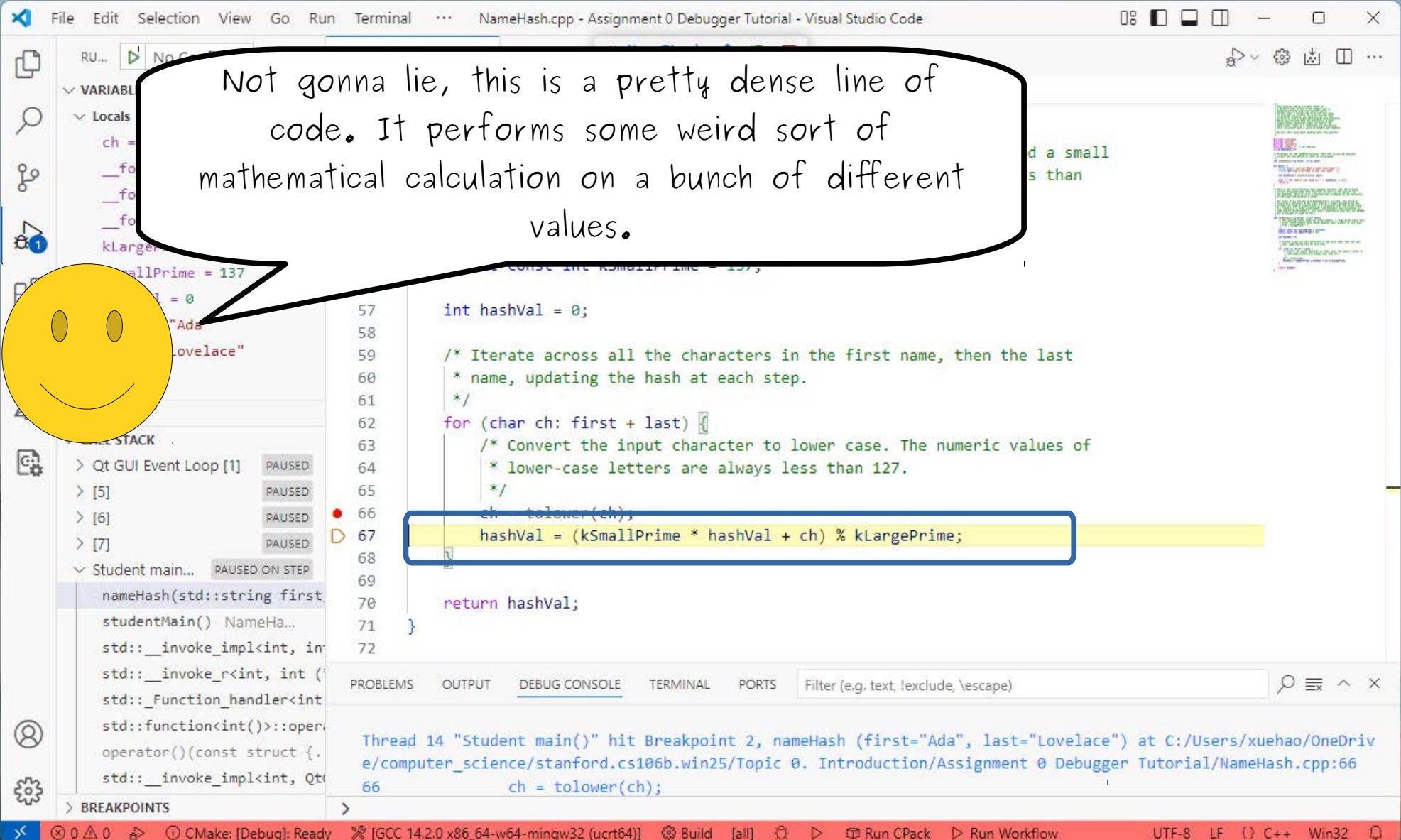
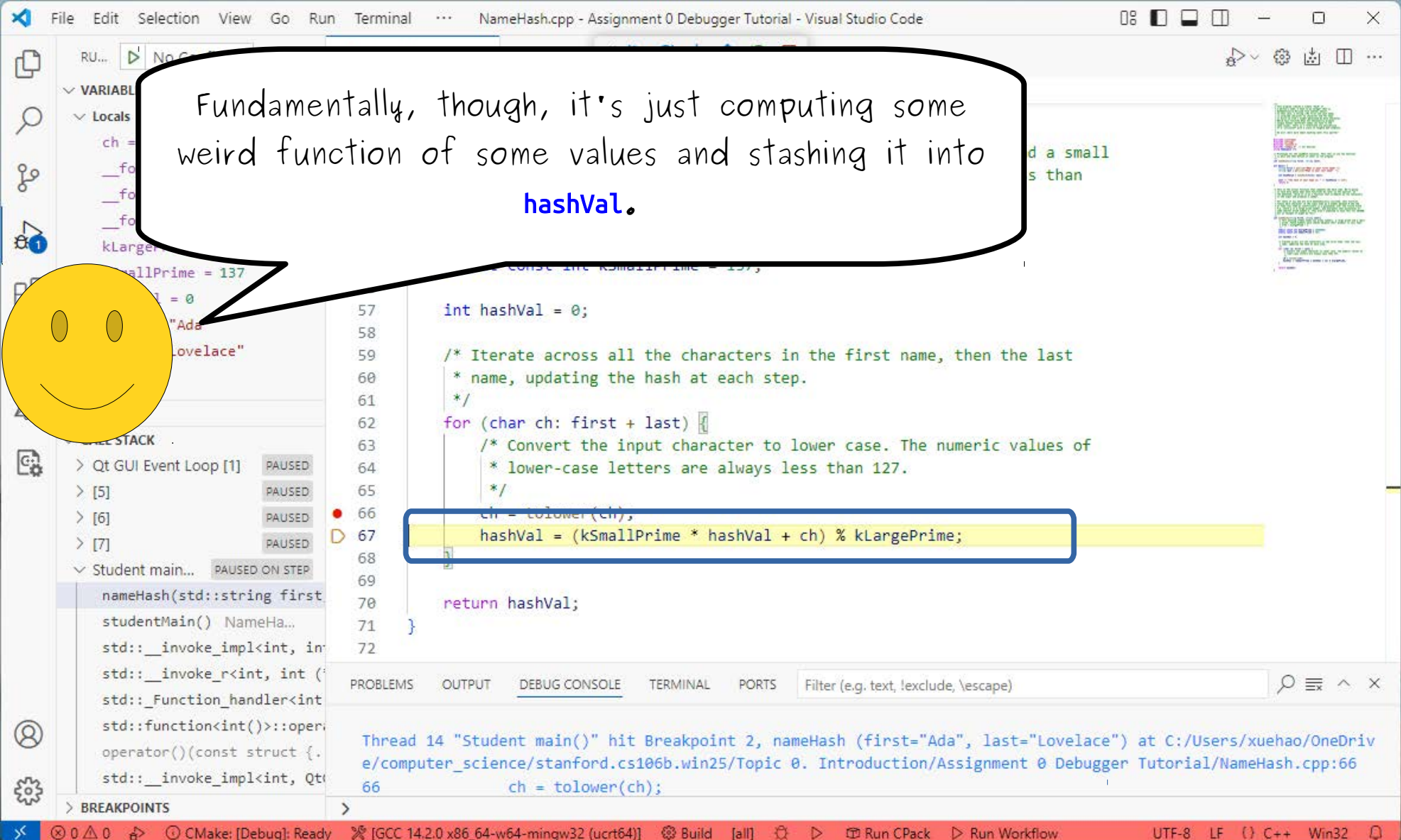
```
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66              ch = tolower(ch);
```

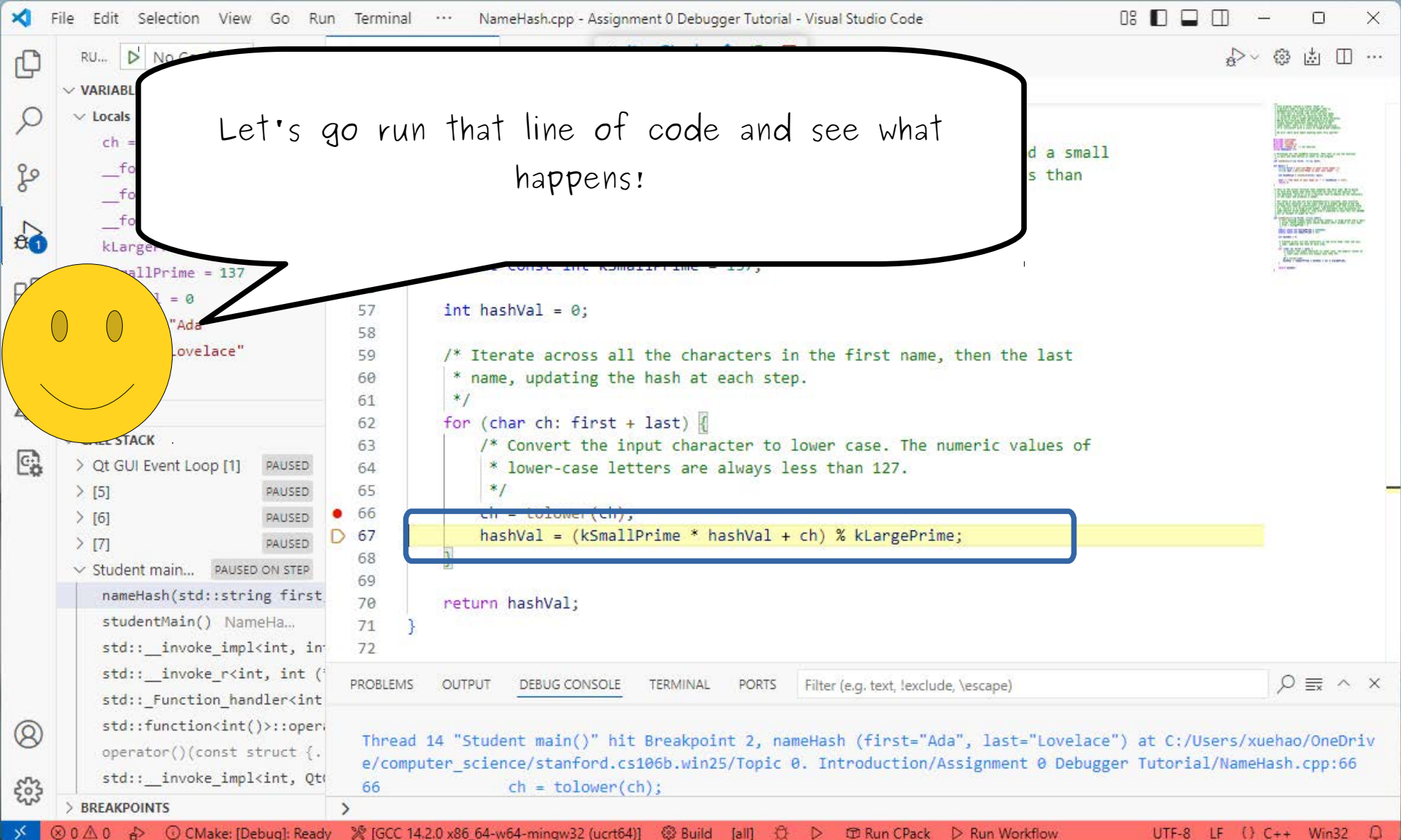
Qt GUI Event Loop [1] PAUSED
[5] PAUSED
[6] PAUSED
[7] PAUSED
Student main... PAUSED ON STEP
nameHash(std::string first
studentMain() NameHa...
std::__invoke_impl<int, in
std::__invoke_r<int, int (
std::_Function_handler<int
std::function<int()>::oper
operator()(const struct {.
std::__invoke_impl<int, Qt

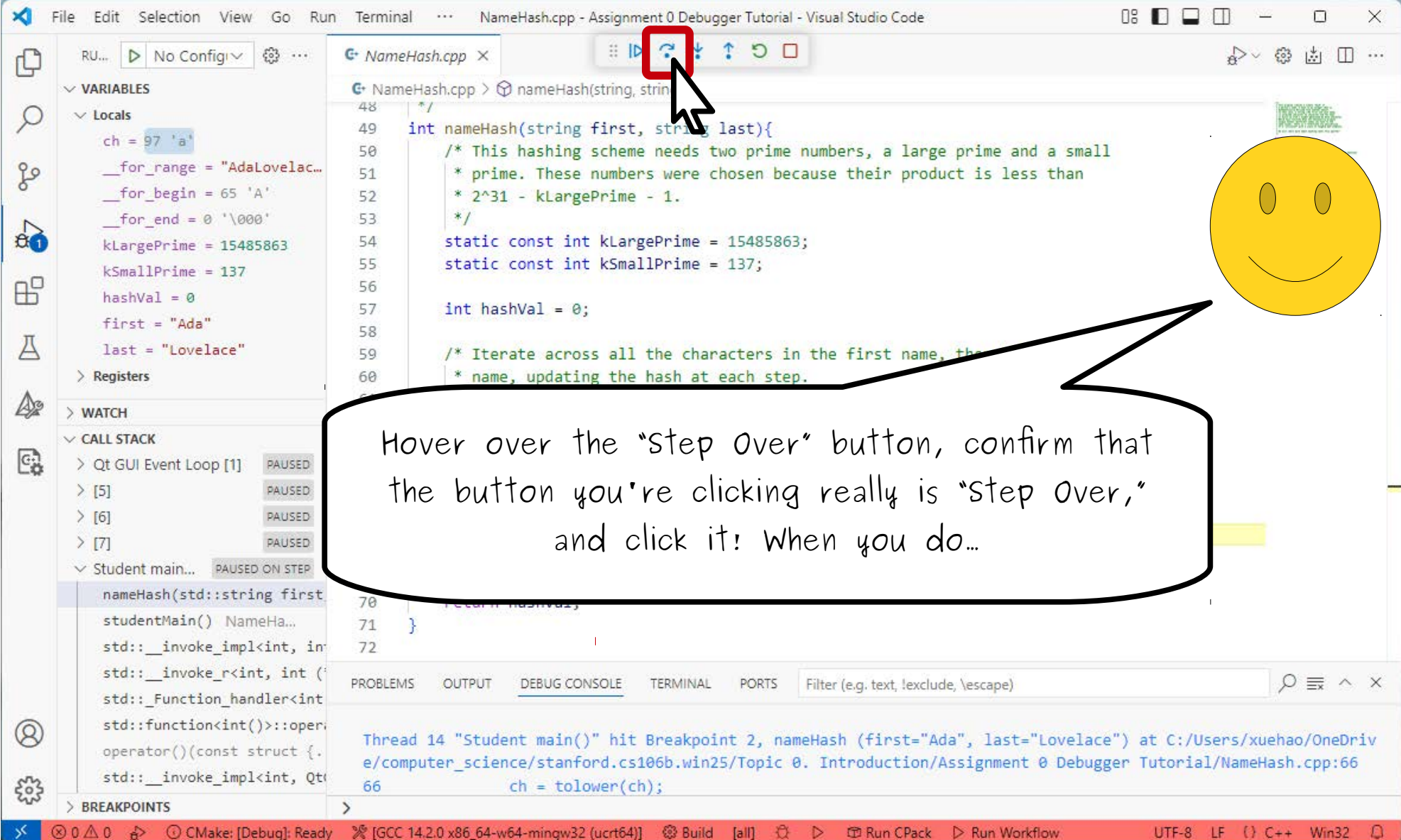
BREAKPOINTS

0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF C++ Win32


Not gonna lie, this is a pretty dense line of code. It performs some weird sort of mathematical calculation on a bunch of different values.
File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
VARIABLES
Locals
CALL STACK
Qt GUI Event Loop [1] PAUSED
[5] PAUSED
[6] PAUSED
[7] PAUSED
Student main... PAUSED ON STEP
nameHash(std::string first
studentMain() NameHa...
BREAKPOINTS
int hashVal = 0;
/* Iterate across all the characters in the first name, then the last
* name, updating the hash at each step.
*/
for (char ch: first + last) {
/* Convert the input character to lower case. The numeric values of
* lower-case letters are always less than 127.
*/
ch = tolower(ch);
hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
}
return hashVal;
}
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
CMake: [Debug]: Ready
[GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)]
Build [all]
Run CPack
Run Workflow
UTF-8 LF C++ Win32


Fundamentally, though, it's just computing some weird function of some values and stashing it into hashVal.


Let's go run that line of code and see what happens!


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
No Config
NameHash.cpp
VARIABLES
Locals
ch = 97 'a'
__for_range = "AdaLovelac…
__for_begin = 65 'A'
__for_end = 0 '\000'
kLargePrime = 15485863
kSmallPrime = 137
hashVal = 0
first = "Ada"
last = "Lovelace"
Registers
WATCH
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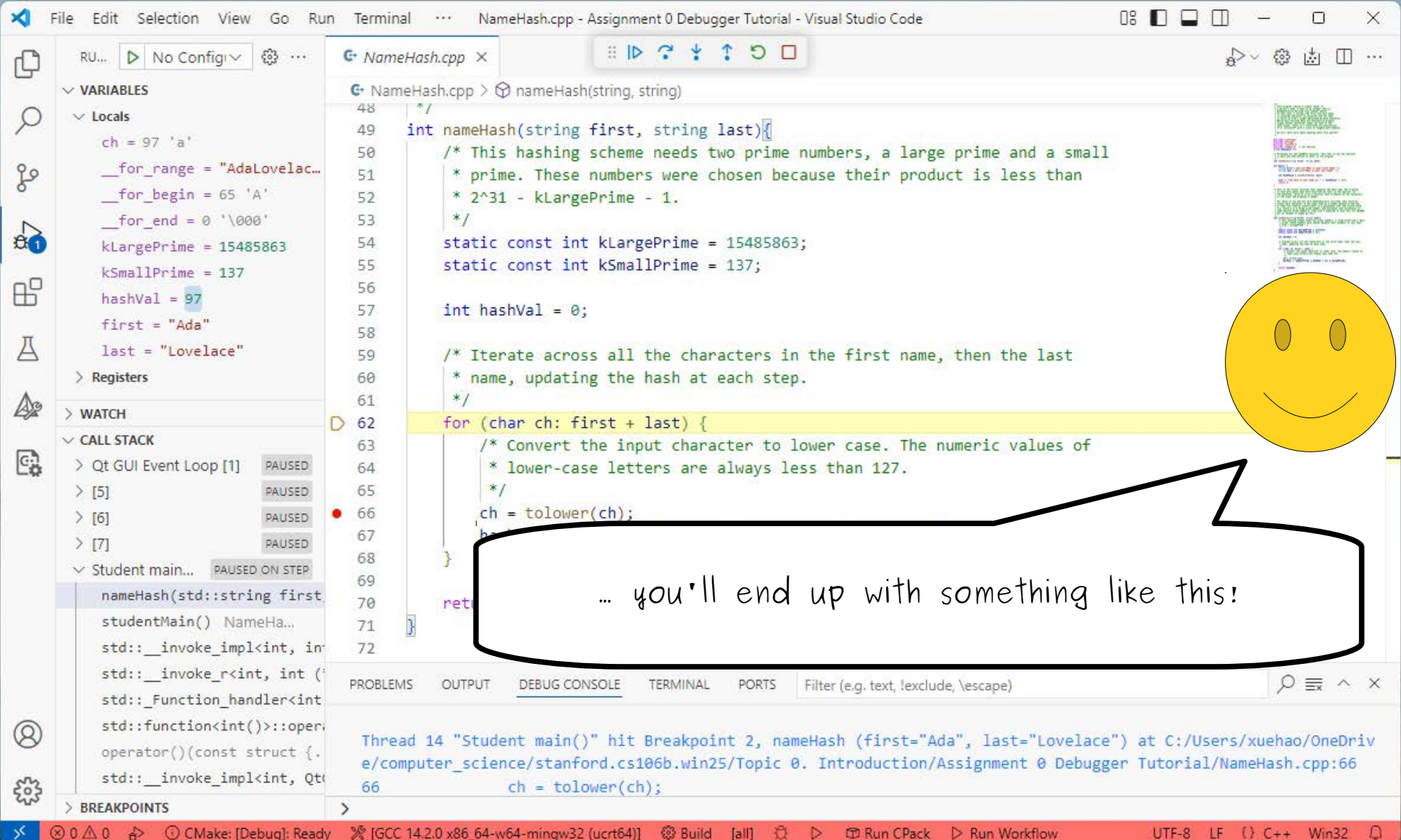
nameHash(std::string first
studentMain() NameHa...
BREAKPOINTS
NameHash.cpp > nameHash(string, strin
48 */
49 int nameHash(string first, string last){
50 /* This hashing scheme needs two prime numbers, a large prime and a small
51 * prime. These numbers were chosen because their product is less than
52 * 2^31 - kLargePrime - 1.
53 */
54 static const int kLargePrime = 15485863;
55 static const int kSmallPrime = 137;
56
57 int hashVal = 0;
58
59 /* Iterate across all the characters in the first name, th
60 * name, updating the hash at each step.
70 return hashVal;
71 }
72
Hover over the "Step Over" button, confirm that the button you're clicking really is "Step Over," and click it! When you do…
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
CMake: [Debug]: Ready
[GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)]
Build [all]
Run CPack
Run Workflow
UTF-8 LF C++ Win32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53 */
54 static const int kLargePrime = 15485863;
55 static const int kSmallPrime = 137;
57 int hashVal = 0;
59 /* Iterate across all the characters in the first name, then the last
60 * name, updating the hash at each step.
61 */
62 for (char ch: first + last) {
63 /* Convert the input character to lower case. The numeric values of
64 * lower-case letters are always less than 127.
65 */
66 ch = tolower(ch);
68 }
71 }
… you'll end up with something like this!
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
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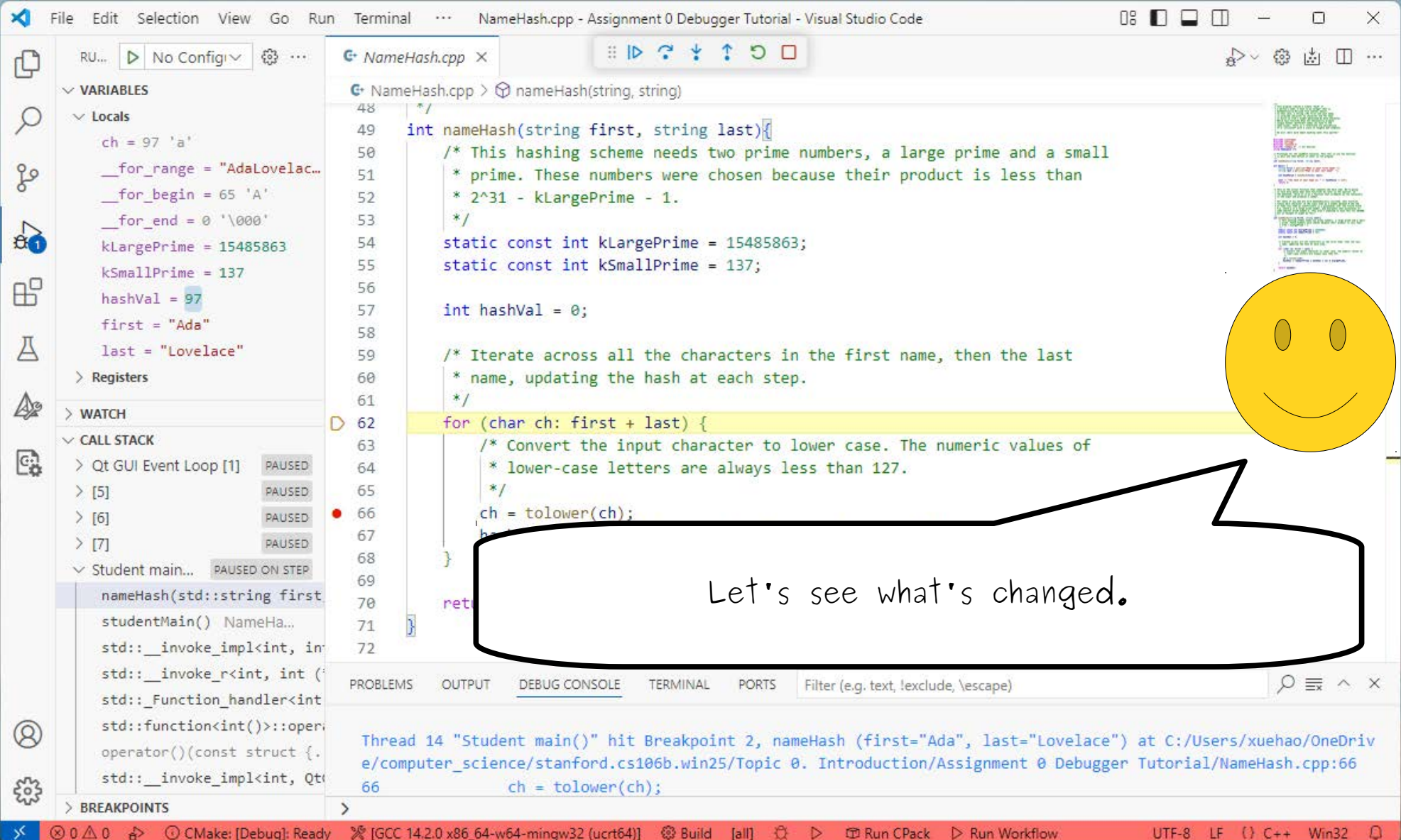
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operator()(const struct {.
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BREAKPOINTS
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int nameHash(string first, string last){
/* This hashing scheme needs two prime numbers, a large prime and a small
* prime. These numbers were chosen because their product is less than
* 2^31 - kLargePrime - 1.
*/
static const int kLargePrime = 15485863;
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int hashVal = 0;
/* Iterate across all the characters in the first name, then the last
* name, updating the hash at each step.
*/
for (char ch: first + last) {
/* Convert the input character to lower case. The numeric values of
* lower-case letters are always less than 127.
*/
ch = tolower(ch);
}
ret
}
Let's see what's changed.
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
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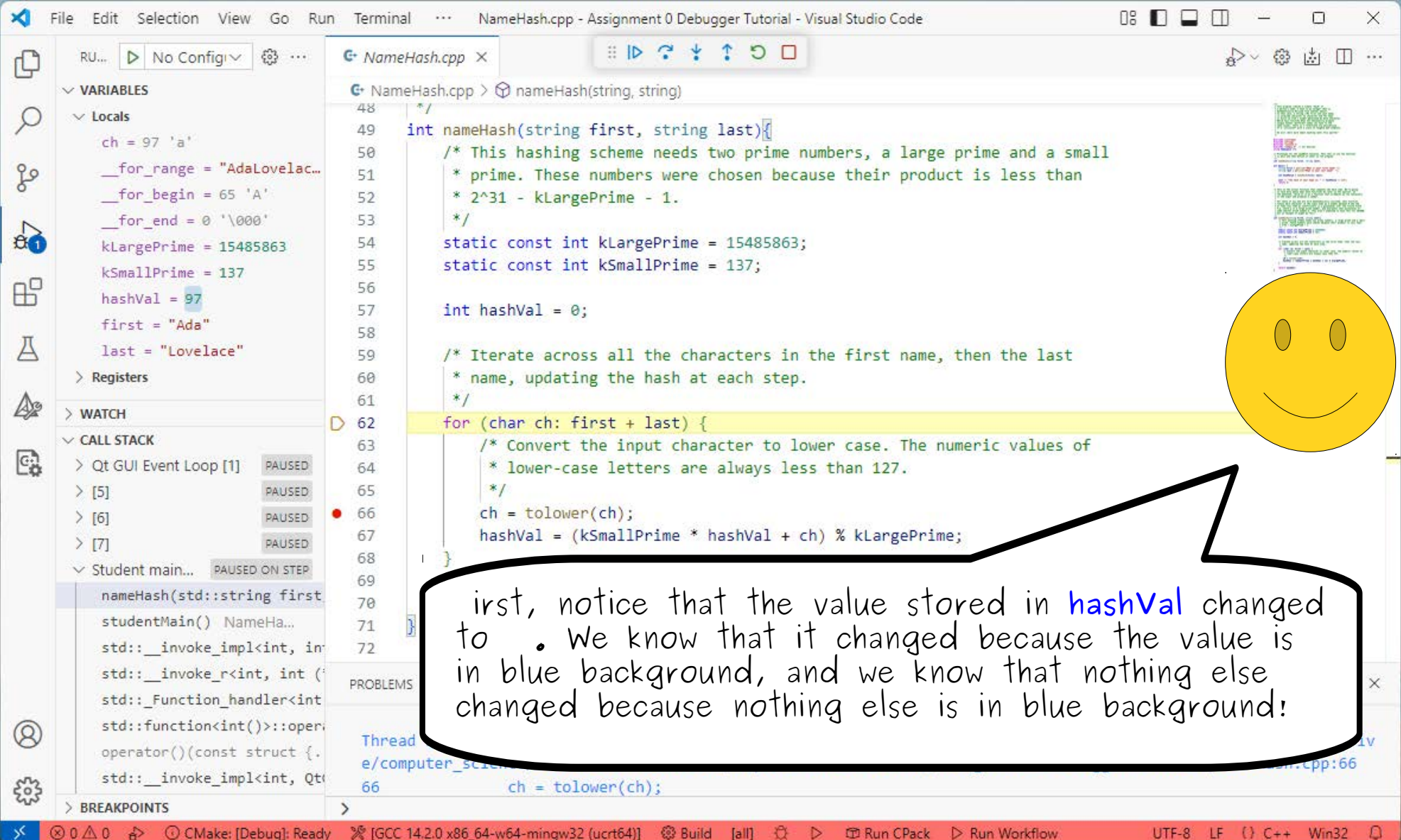
Run Workflow
UTF-8 LF C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
VARIABLES
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CALL STACK
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BREAKPOINTS
NameHash.cpp
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48 */
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56
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61 */
62 for (char ch: first + last) {
63 /* Convert the input character to lower case. The numeric values of
64 * lower-case letters are always less than 127.
65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
69
70
71 }
72
irst, notice that the value stored in hashVal changed to . We know that it changed because the value is in blue background, and we know that nothing else changed because nothing else is in blue background!
PROBLEMS
Thread
e/computer_sci
66 ch = tolower(ch);
.cpp:66
0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF C++ Win32

File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code

RU... No Config

VARIABLES

Locals

```
ch = 97 'a'
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kSmallPrime = 137
hashVal = 97
first = "Ada"
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```

Registers

WATCH

CALL STACK

Qt GUI Event Loop [1] PAUSED
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```

BREAKPOINTS

NameHash.cpp

NameHash.cpp > nameHash(string, string)

```
48  */
49  int nameHash(string first, string last){
50      /* This hashing scheme needs two prime numbers, a large prime and a small
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53       */
54      static const int kLargePrime = 15485863;
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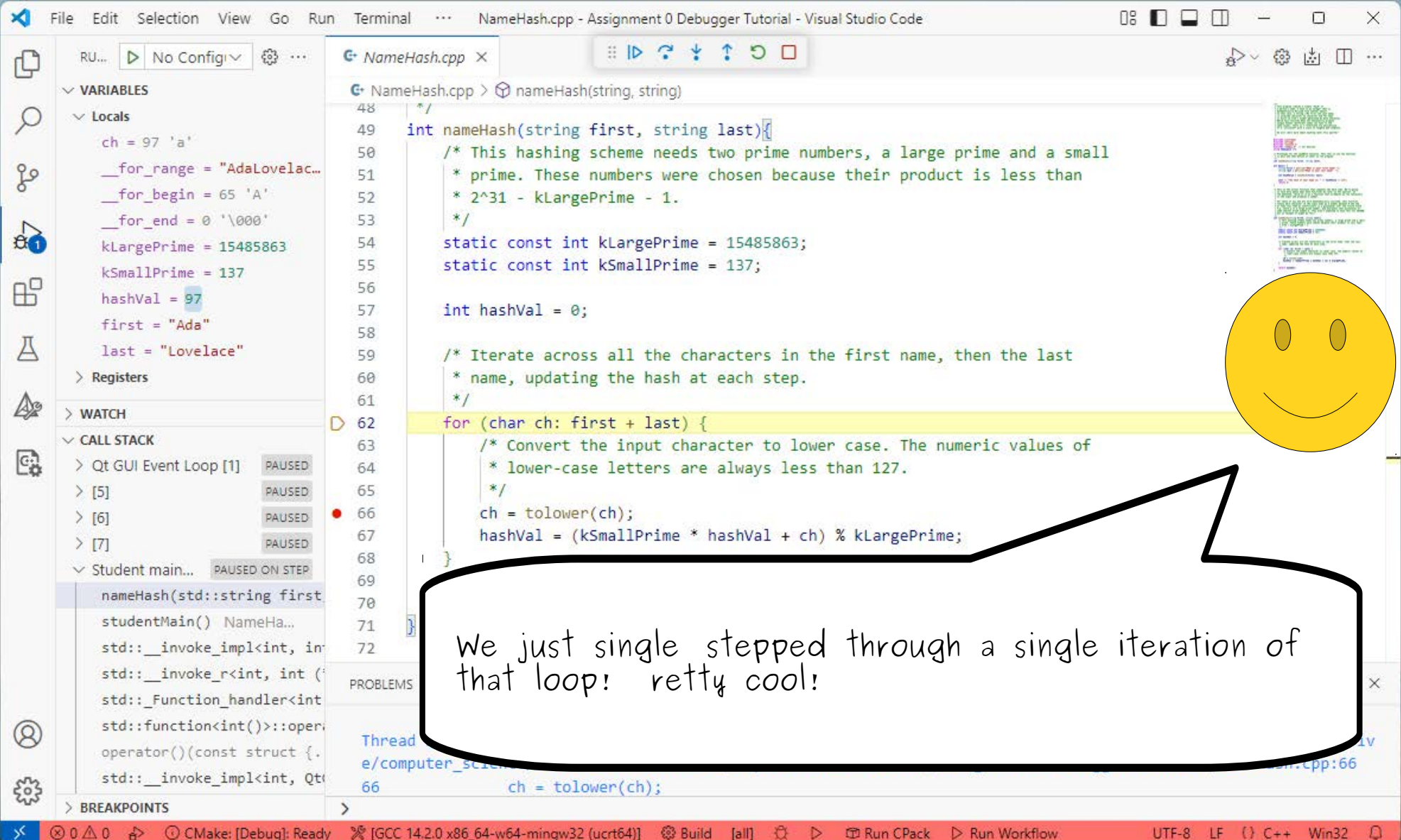
57      int hashVal = 0;
58
59      /* Iterate across all the characters in the first name, then the last
60       * name, updating the hash at each step.
61       */
62      for (char ch: first + last) {
63          /* Convert the input character to lower case. The numeric values of
64           * lower-case letters are always less than 127.
65           */
66          ch = tolower(ch);
67          hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68      }
69
70
71  }
72
```

Second, notice that we're back up at the top of the for loop, since that's where the yellow arrow is pointing. We ended up back here because this is the next line that gets executed.

PROBLEMS

```
Thread
e/computer_sci
66              ch = tolower(ch);
```

0 ⚠ 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF {} C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
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BREAKPOINTS
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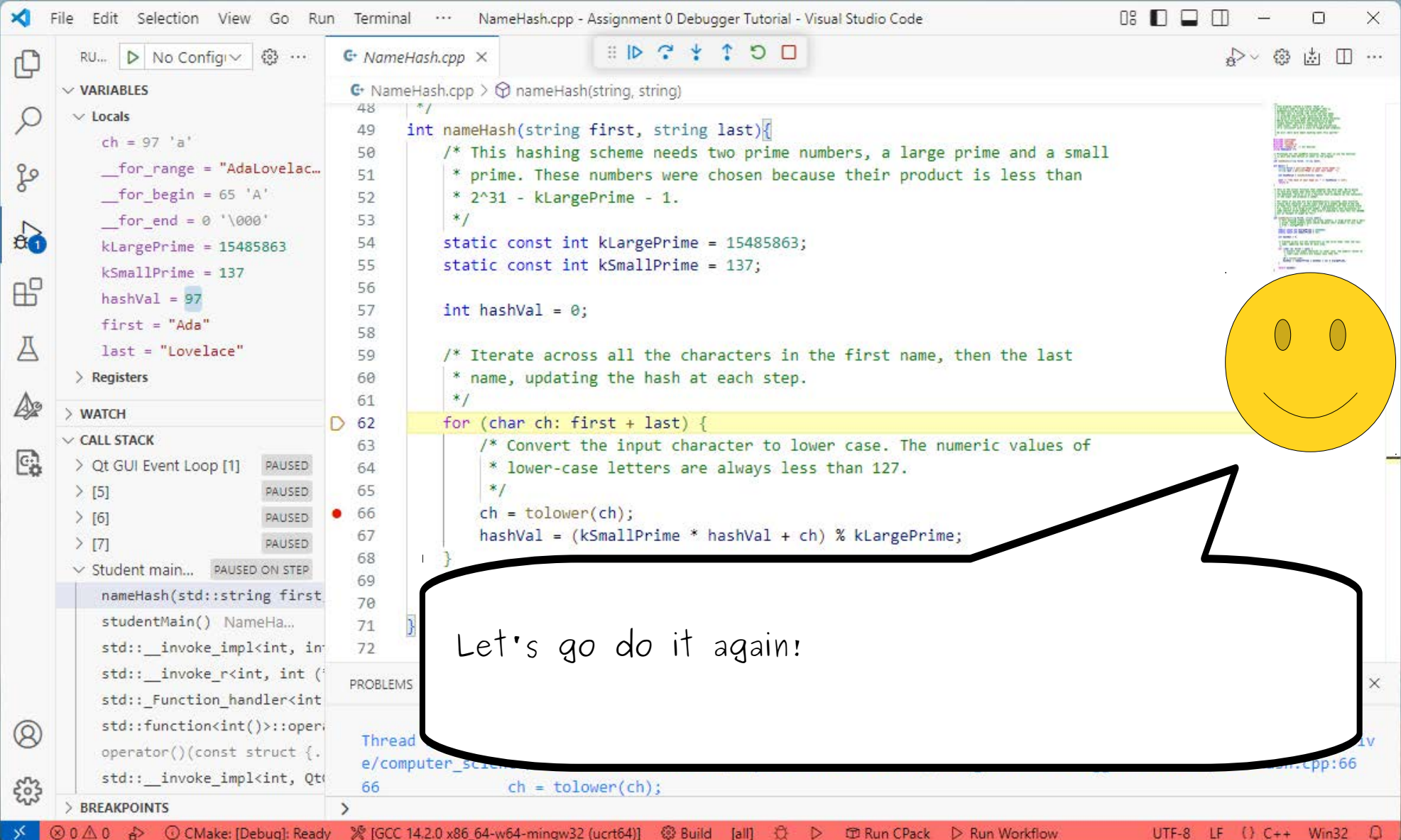
64 * lower-case letters are always less than 127.
65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
69
70
71 }
72
PROBLEMS
Thread
e/computer_scie
66 ch = tolower(ch);
.cpp:66
We just single stepped through a single iteration of that loop! retty cool!
0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF {} C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
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BREAKPOINTS
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56
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60 * name, updating the hash at each step.
61 */
62 for (char ch: first + last) {
63 /* Convert the input character to lower case. The numeric values of
64 * lower-case letters are always less than 127.
65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
69
70
71 }
72
Let's go do it again!
PROBLEMS
Thread
e/computer_scie
66 ch = tolower(ch);
.cpp:66
CMake: [Debug]: Ready
[GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)]
Build [all]
Run CPack
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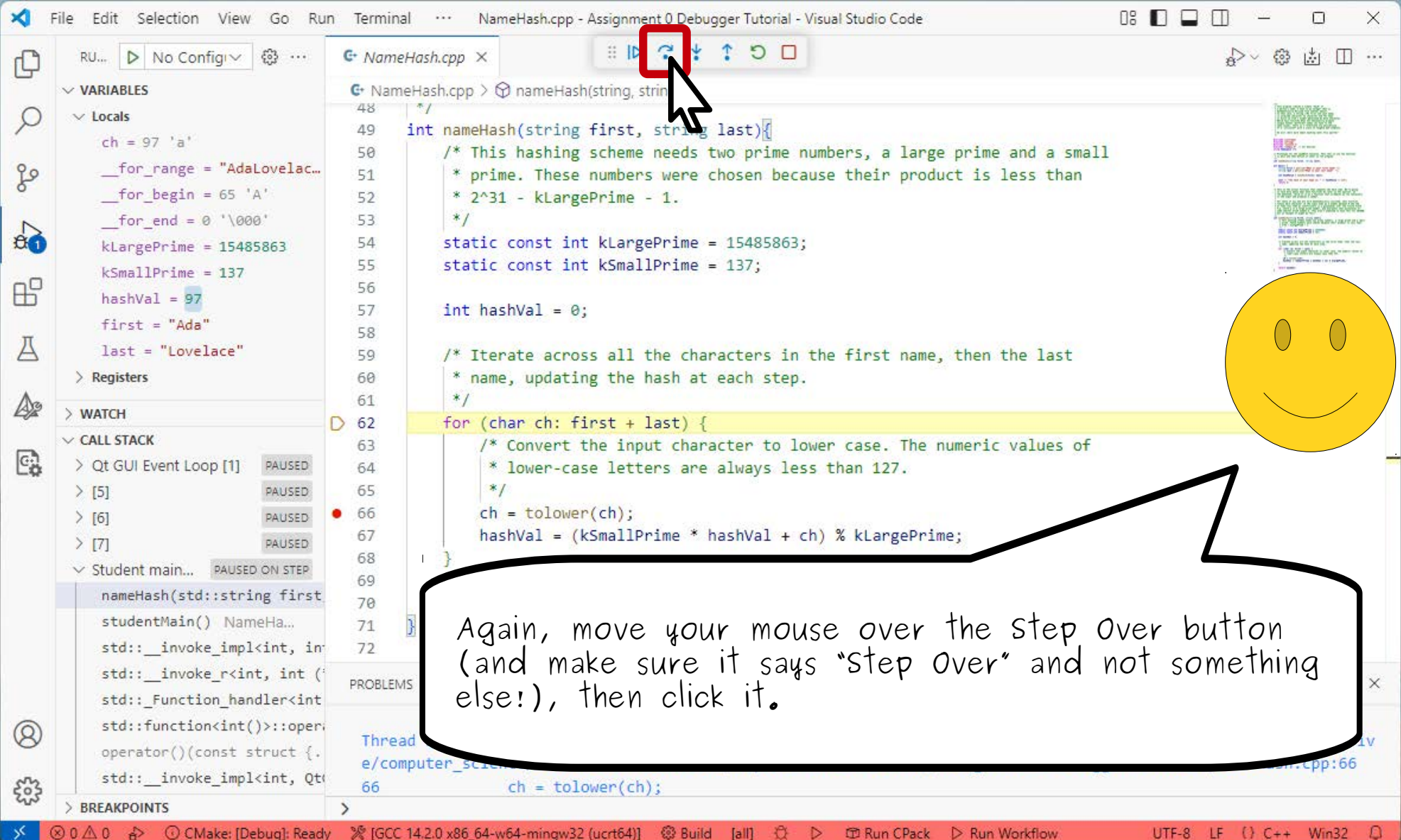
UTF-8 LF C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
No Config
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BREAKPOINTS
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*/
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static const int kSmallPrime = 137;
int hashVal = 0;
/* Iterate across all the characters in the first name, then the last
* name, updating the hash at each step.
*/
for (char ch: first + last) {
/* Convert the input character to lower case. The numeric values of
* lower-case letters are always less than 127.
*/
ch = tolower(ch);
hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
}
}
PROBLEMS
Thread
66 ch = tolower(ch);
Again, move your mouse over the Step Over button (and make sure it says "Step Over" and not something else!), then click it.
CMake: [Debug]: Ready
[GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)]
Build [all]
Run CPack
Run Workflow
UTF-8 LF C++ Win32

File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code

RU... No Config

VARIABLES

Locals

ch = 100 'd'
__for_range = "AdaLovelac…
__for_begin = 100 'd'
__for_end = 0 '\000'
kLargePrime = 15485863
kSmallPrime = 137
hashVal = 97
first = "Ada"
last = "Lovelace"

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WATCH

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BREAKPOINTS

NameHash.cpp

NameHash.cpp > nameHash(string, string)

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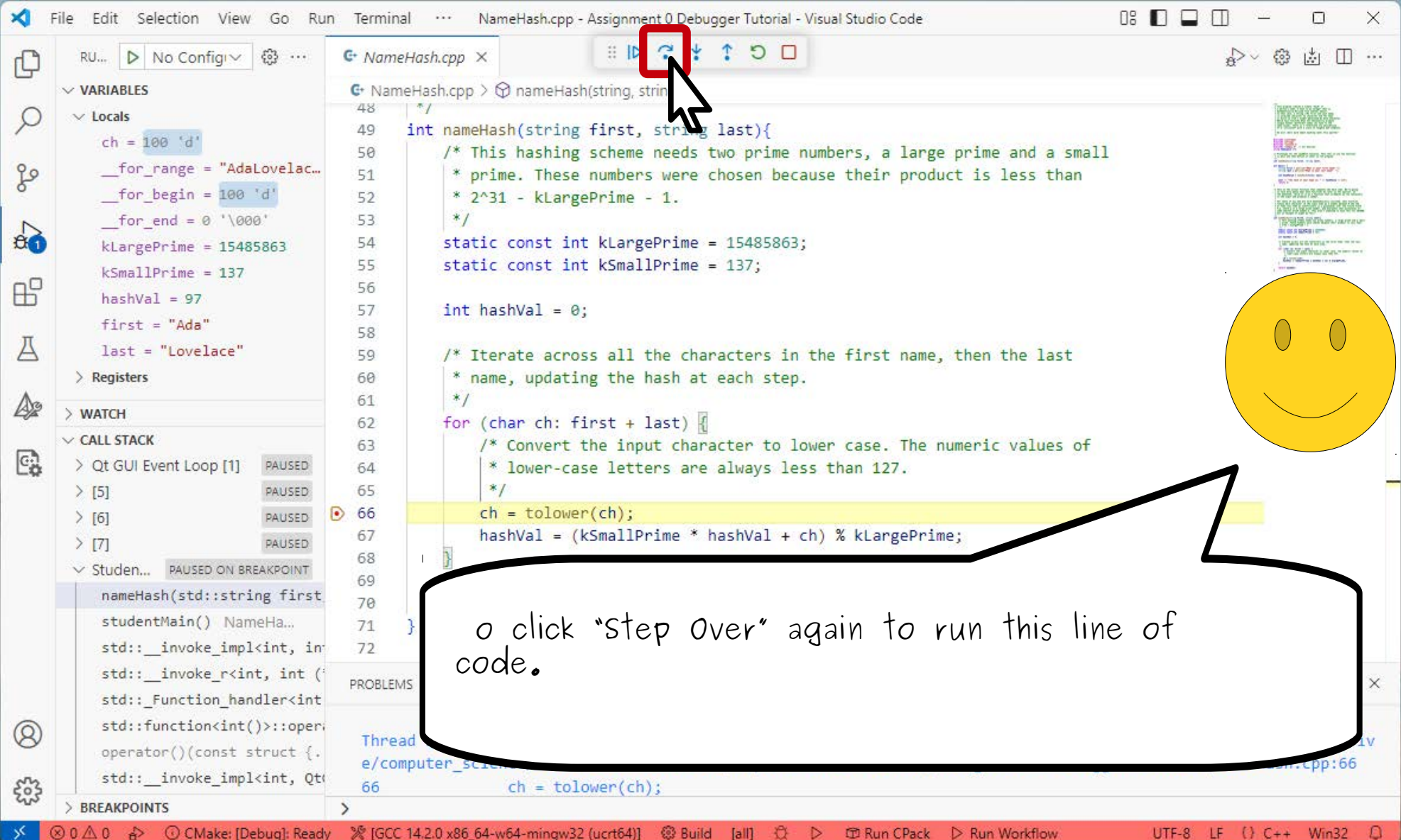
65           */
66          ch = tolower(ch);
67          hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68      }
69
70
71  }
72
```

Now we're here! Notice that ch now has the value 'd', which is the second letter of the name Ada.

PROBLEMS

Thread
e/computer_sci
66 ch = tolower(ch);

0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF {} C++ Win32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54 static const int kLargePrime = 15485863;
55 static const int kSmallPrime = 137;
56
57 int hashVal = 0;
58
59 /* Iterate across all the characters in the first name, then the last
60 * name, updating the hash at each step.
61 */
62 for (char ch: first + last) {
63 /* Convert the input character to lower case. The numeric values of
64 * lower-case letters are always less than 127.
65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
71 }
PROBLEMS
Thread
66 ch = tolower(ch);
o click "Step Over" again to run this line of code.
0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF C++ Win32

File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code

RU... No Config

VARIABLES

Locals

```
ch = 100 'd'
__for_range = "AdaLovelac…
__for_begin = 100 'd'
__for_end = 0 '\000'
kLargePrime = 15485863
kSmallPrime = 137
hashVal = 97
first = "Ada"
last = "Lovelace"
```

Registers

WATCH

CALL STACK

Qt GUI Event Loop [1]	PAUSED
[5]	PAUSED
[6]	PAUSED
[7]	PAUSED
Student main...	PAUSED ON STEP

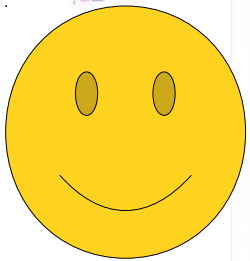
```
nameHash(std::string first
studentMain() NameHa...
std::__invoke_impl<int, in
std::__invoke_r<int, int (
std::_Function_handler<int
std::function<int()>::oper
operator()(const struct {.
std::__invoke_impl<int, Qt
```

BREAKPOINTS

NameHash.cpp

NameHash.cpp > nameHash(string, string)

```
48  */
49  int nameHash(string first, string last){
50      /* This hashing scheme needs two prime numbers, a large prime and a small
51       * prime. These numbers were chosen because their product is less than
52       * 2^31 - kLargePrime - 1.
53       */
54      static const int kLargePrime = 15485863;
55      static const int kSmallPrime = 137;
56
57      int hashVal = 0;
58
59      /* Iterate across all the characters in the first name, then the last
60       * name, updating the hash at each step.
61       */
62      for (char ch: first + last) {
63          /* Convert the input character to lower case. The numeric values of
64           * lower-case letters are always less than 127.
65           */
66          ch = tolower(ch);
67          hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68      }
69
70
71  }
72
```

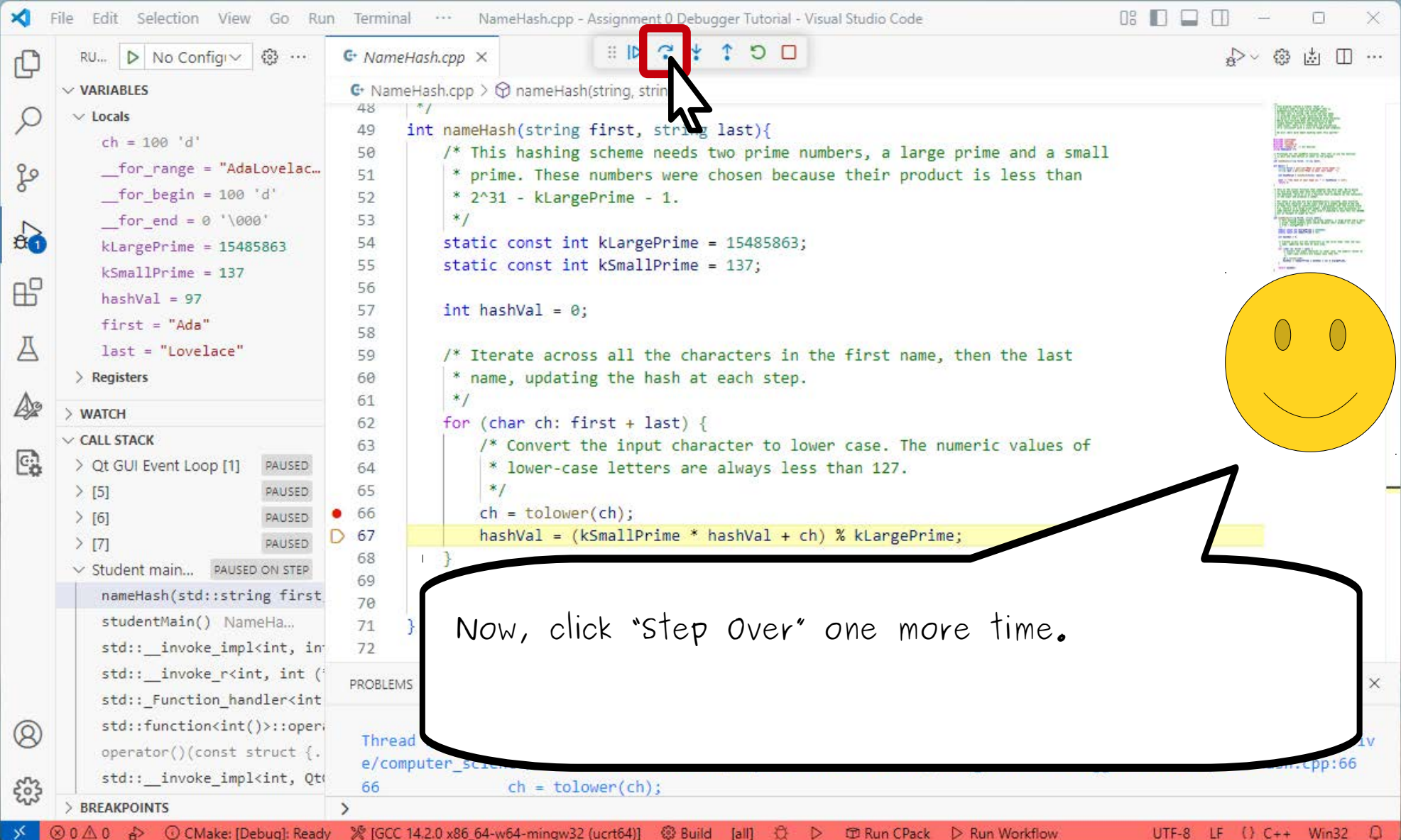


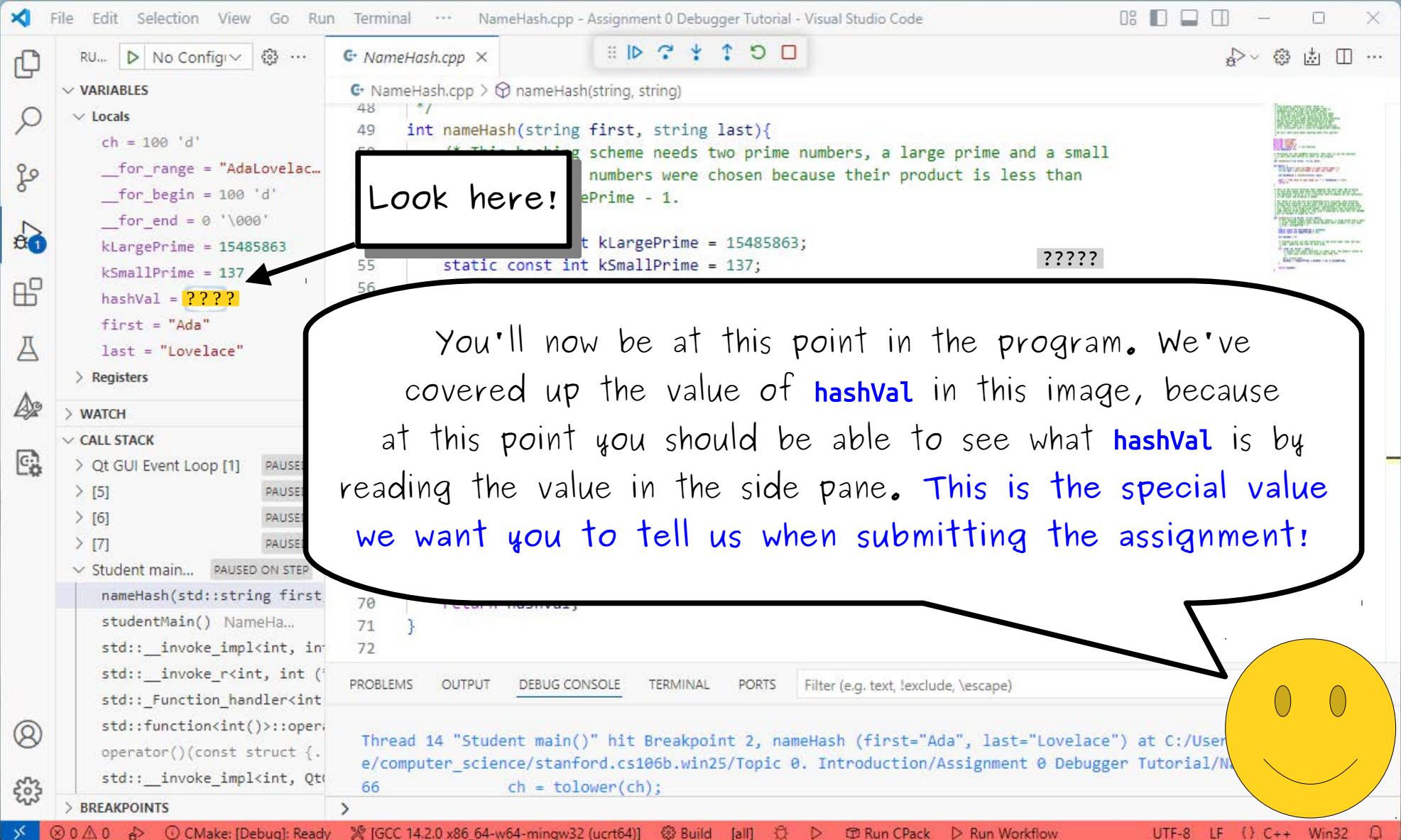
You should be here now. Notice that none of the values changed. That makes sense, since all we did was convert a lower case 'd' to a lower case 'd'.

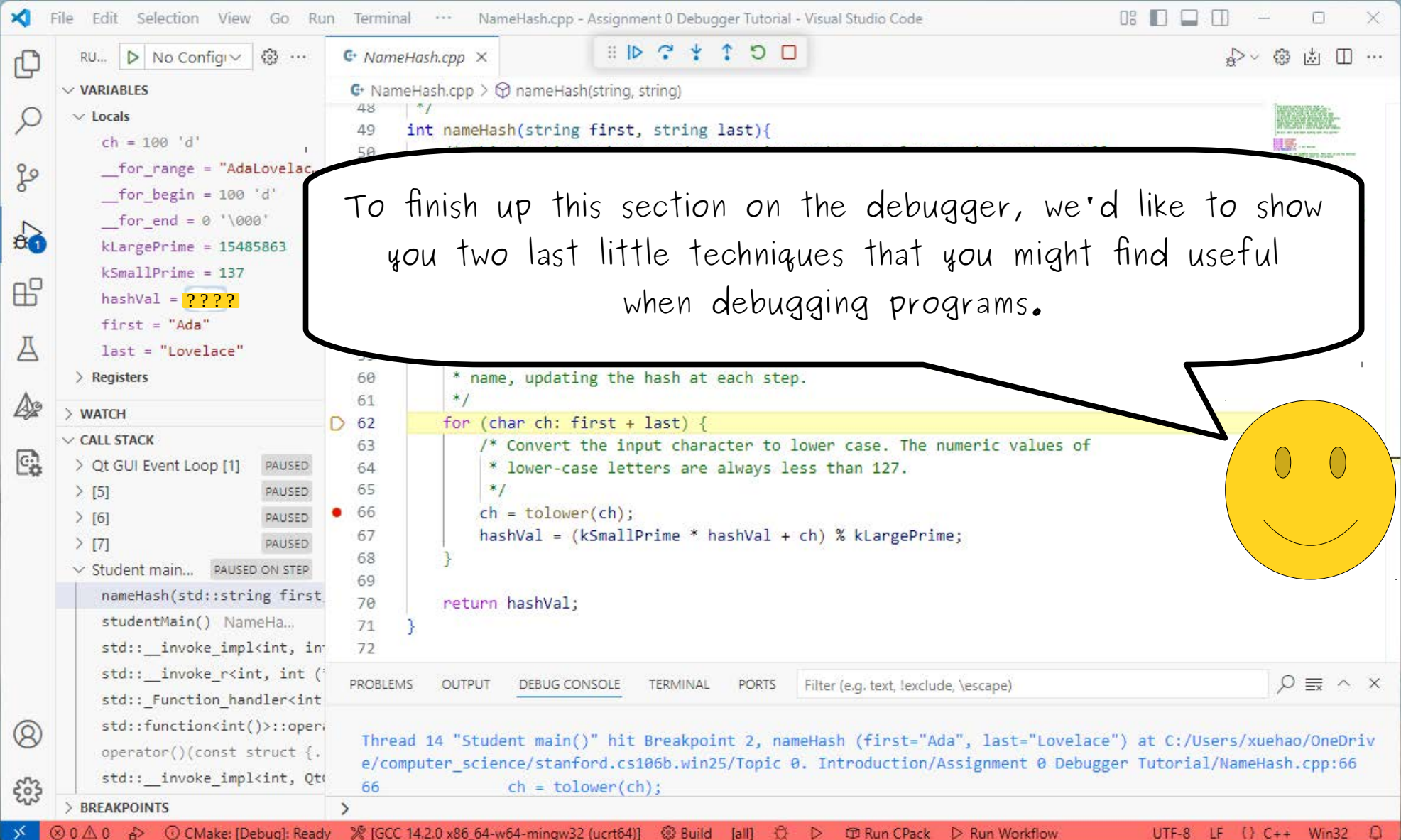
PROBLEMS

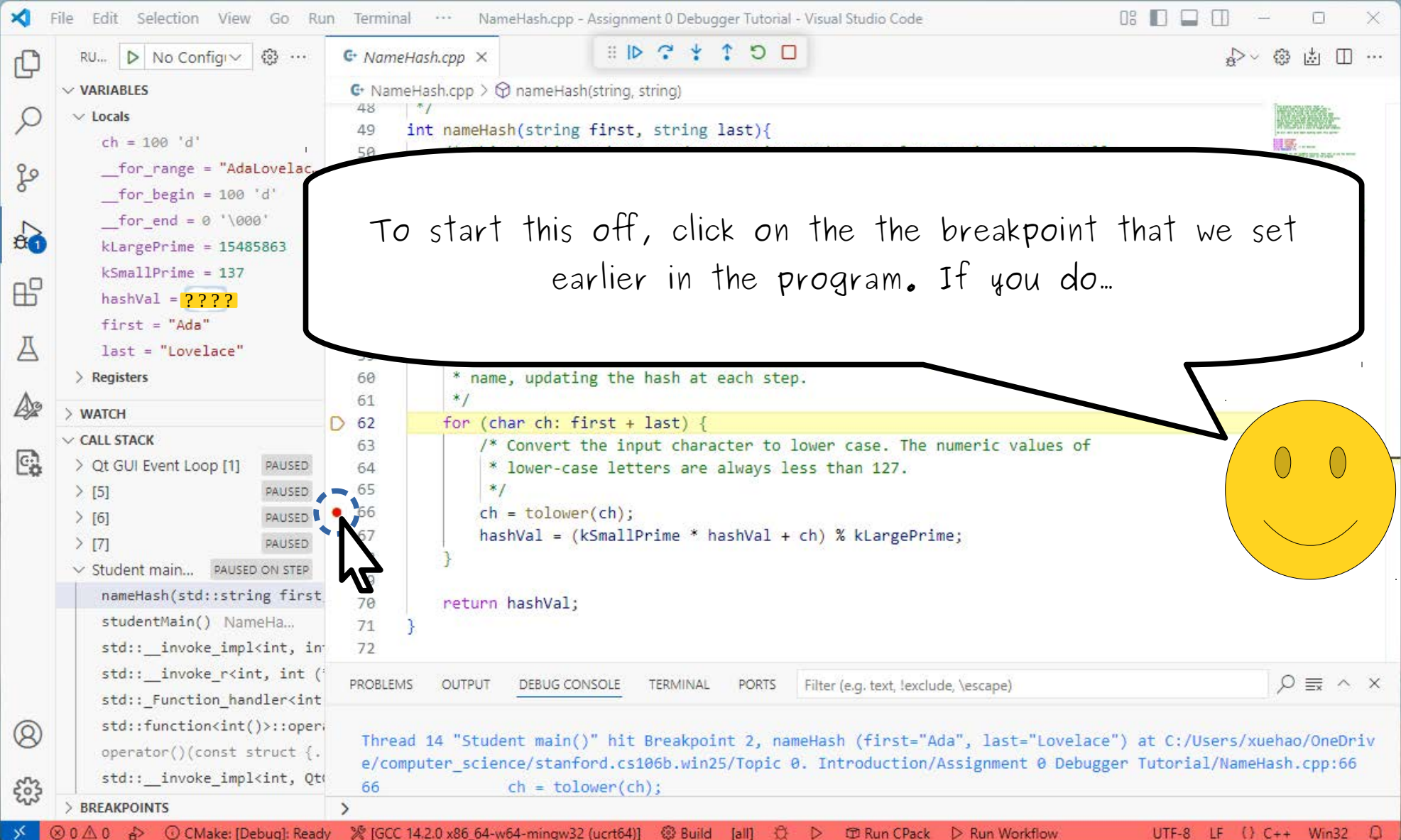
```
Thread
e/computer_sci
66              ch = tolower(ch);
```

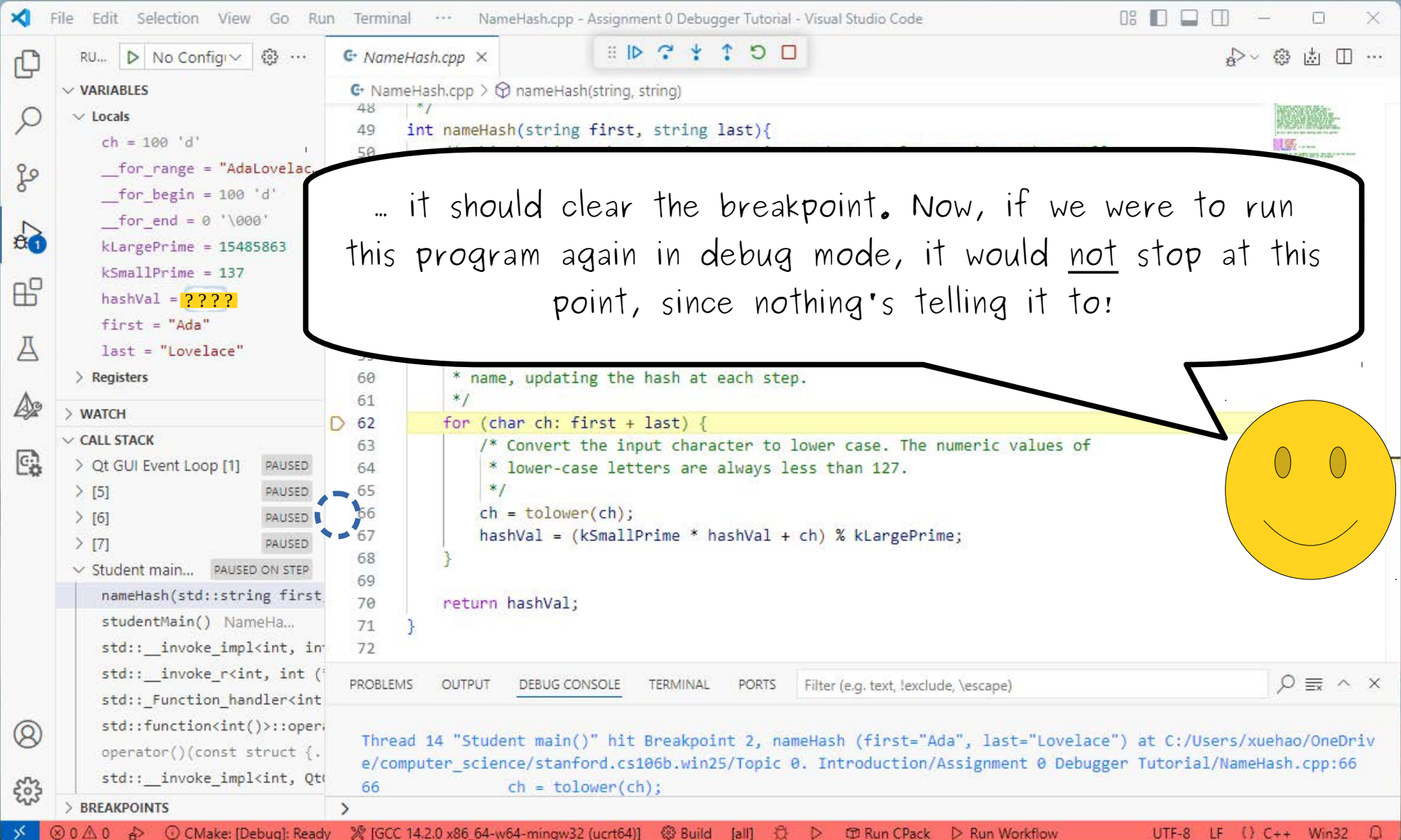
0 ⚠ 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF {} C++ Win32


File Edit Selection View Go Run Terminal ···
NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
VARIABLES
Locals
ch = 100 'd'
__for_range = "AdaLovelac...
__for_begin = 100 'd'
__for_end = 0 '\000'
kLargePrime = 15485863
kSmallPrime = 137
hashVal = 97
first = "Ada"
last = "Lovelace"
Registers
WATCH
CALL STACK
Qt GUI Event Loop [1] PAUSED
[5] PAUSED
[6] PAUSED
[7] PAUSED
Student main... PAUSED ON STEP
nameHash(std::string first
studentMain() NameHa...
BREAKPOINTS
NameHash.cpp
NameHash.cpp > nameHash(string, strin
48 */
49 int nameHash(string first, string last){
50 /* This hashing scheme needs two prime numbers, a large prime and a small
51 * prime. These numbers were chosen because their product is less than
52 * 2^31 - kLargePrime - 1.
53 */
54 static const int kLargePrime = 15485863;
55 static const int kSmallPrime = 137;
56
57 int hashVal = 0;
58
59 /* Iterate across all the characters in the first name, then the last
60 * name, updating the hash at each step.
61 */
62 for (char ch: first + last) {
63 /* Convert the input character to lower case. The numeric values of
64 * lower-case letters are always less than 127.
65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
69
70
71 }
72
Now, click "Step Over" one more time.
PROBLEMS
Thread
66 ch = tolower(ch);
CMake: [Debug]: Ready
[GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)]
Build [all]
Run CPack
Run Workflow
UTF-8 LF C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
VARIABLES
Locals
ch = 100 'd'
__for_range = "AdaLovelac…
__for_begin = 100 'd'
__for_end = 0 '\000'
kLargePrime = 15485863
kSmallPrime = 137
hashVal = ????
first = "Ada"
last = "Lovelace"
Registers
WATCH
CALL STACK
Qt GUI Event Loop [1] PAUSE
[5] PAUSE
[6] PAUSE
[7] PAUSE
Student main... PAUSED ON STEP
nameHash(std::string first
studentMain() NameHa...
std::__invoke_impl<int, in
std::__invoke_r<int, int (
std::_Function_handler<int
std::function<int()>::oper
operator()(const struct {.
std::__invoke_impl<int, Qt
BREAKPOINTS
NameHash.cpp
NameHash.cpp > nameHash(string, string)
48 */
49 int nameHash(string first, string last){
numbers were chosen because their product is less than
ePrime - 1.
t kLargePrime = 15485863;
55 static const int kSmallPrime = 137;
?????
70
71 }
72
Look here!
You'll now be at this point in the program. We've covered up the value of hashVal in this image, because at this point you should be able to see what hashVal is by reading the value in the side pane. This is the special value we want you to tell us when submitting the assignment!
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/User
e/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/N
66 ch = tolower(ch);
0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
VARIABLES
Locals
ch = 100 'd'
__for_range = "AdaLovelac
__for_begin = 100 'd'
__for_end = 0 '\000'
kLargePrime = 15485863
kSmallPrime = 137
hashVal = ????
first = "Ada"
last = "Lovelace"
Registers
WATCH
CALL STACK
Qt GUI Event Loop [1] PAUSED
[5] PAUSED
[6] PAUSED
[7] PAUSED
Student main... PAUSED ON STEP
nameHash(std::string first
studentMain() NameHa...
std::__invoke_impl<int, in
std::__invoke_r<int, int (
std::_Function_handler<int
std::function<int()>::oper
operator()(const struct {.
std::__invoke_impl<int, Qt
BREAKPOINTS
NameHash.cpp
NameHash.cpp > nameHash(string, string)
48 */
49 int nameHash(string first, string last){
To finish up this section on the debugger, we'd like to show you two last little techniques that you might find useful when debugging programs.
60 * name, updating the hash at each step.
61 */
62 for (char ch: first + last) {
63 /* Convert the input character to lower case. The numeric values of
64 * lower-case letters are always less than 127.
65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
69
70 return hashVal;
71 }
72
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
VARIABLES
Locals
ch = 100 'd'
__for_range = "AdaLovelac
__for_begin = 100 'd'
__for_end = 0 '\000'
kLargePrime = 15485863
kSmallPrime = 137
hashVal = ????
first = "Ada"
last = "Lovelace"
Registers
WATCH
CALL STACK
Qt GUI Event Loop [1] PAUSED
[5] PAUSED
[6] PAUSED
[7] PAUSED
Student main... PAUSED ON STEP
nameHash(std::string first
studentMain() NameHa...
std::__invoke_impl<int, in
std::__invoke_r<int, int (
std::_Function_handler<int
std::function<int()>::oper
operator()(const struct {.
std::__invoke_impl<int, Qt
BREAKPOINTS
NameHash.cpp
NameHash.cpp > nameHash(string, string)
48 */
49 int nameHash(string first, string last){
To start this off, click on the the breakpoint that we set earlier in the program. If you do...
60 * name, updating the hash at each step.
61 */
62 for (char ch: first + last) {
63 /* Convert the input character to lower case. The numeric values of
64 * lower-case letters are always less than 127.
65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
70 return hashVal;
71 }
72
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
VARIABLES
Locals
ch = 100 'd'
__for_range = "AdaLovelac
__for_begin = 100 'd'
__for_end = 0 '\000'
kLargePrime = 15485863
kSmallPrime = 137
hashVal = ????
first = "Ada"
last = "Lovelace"
Registers
WATCH
CALL STACK
Qt GUI Event Loop [1] PAUSED
[5] PAUSED
[6] PAUSED
[7] PAUSED
Student main... PAUSED ON STEP
nameHash(std::string first
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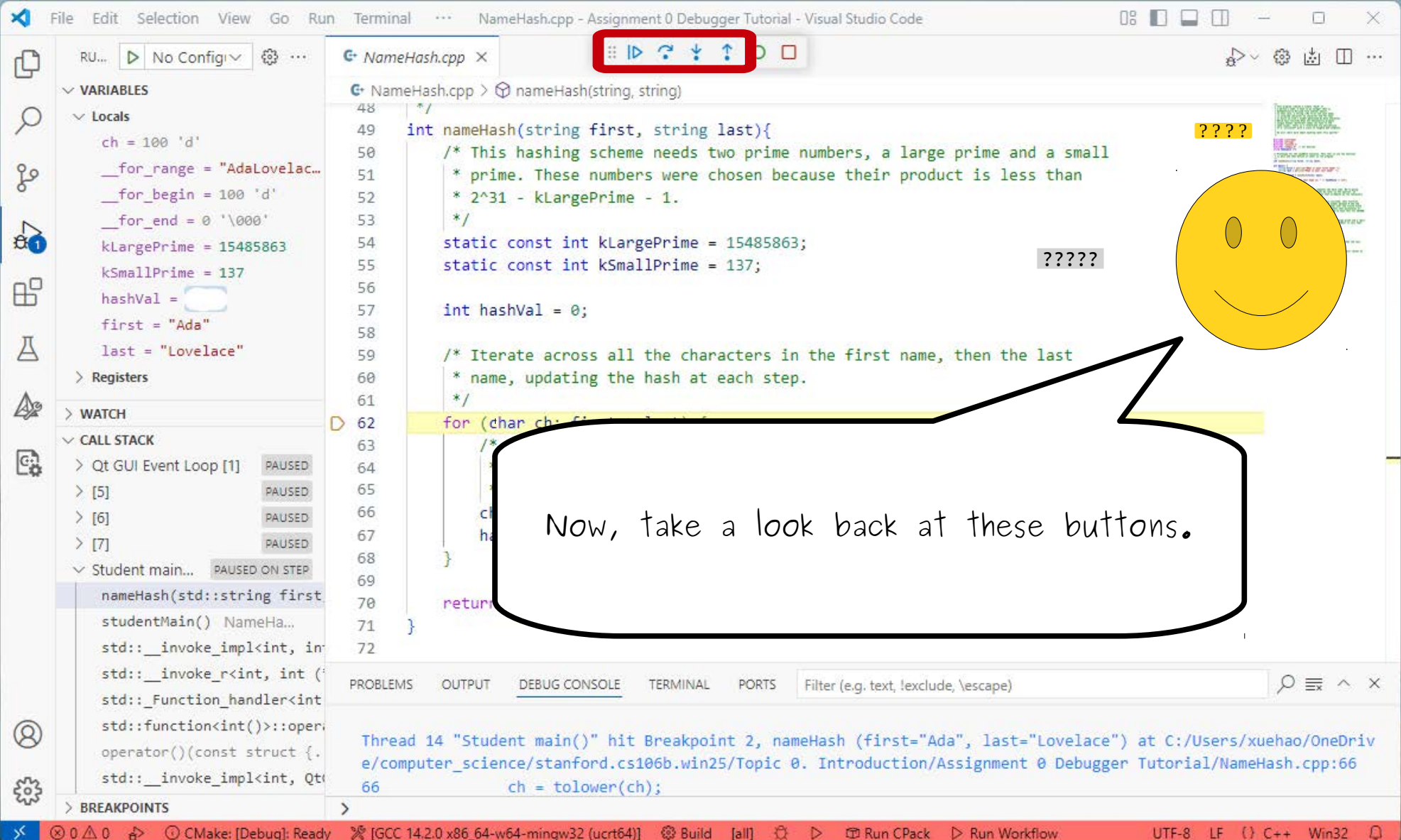
std::__invoke_impl<int, in
std::__invoke_r<int, int (
std::_Function_handler<int
std::function<int()>::oper
operator()(const struct {.
std::__invoke_impl<int, Qt
BREAKPOINTS
NameHash.cpp
NameHash.cpp > nameHash(string, string)
48 */
49 int nameHash(string first, string last){
60 * name, updating the hash at each step.
61 */
62 for (char ch: first + last) {
63 /* Convert the input character to lower case. The numeric values of
64 * lower-case letters are always less than 127.
65 */
66 ch = tolower(ch);
67 hashVal = (kSmallPrime * hashVal + ch) % kLargePrime;
68 }
69
70 return hashVal;
71 }
72
… it should clear the breakpoint. Now, if we were to run this program again in debug mode, it would not stop at this point, since nothing's telling it to!
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
VARIABLES
Locals
ch = 100 'd'
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__for_begin = 100 'd'
__for_end = 0 '\000'
kLargePrime = 15485863
kSmallPrime = 137
hashVal =
first = "Ada"
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Registers
WATCH
CALL STACK
Qt GUI Event Loop [1] PAUSED
[5] PAUSED
[6] PAUSED
[7] PAUSED
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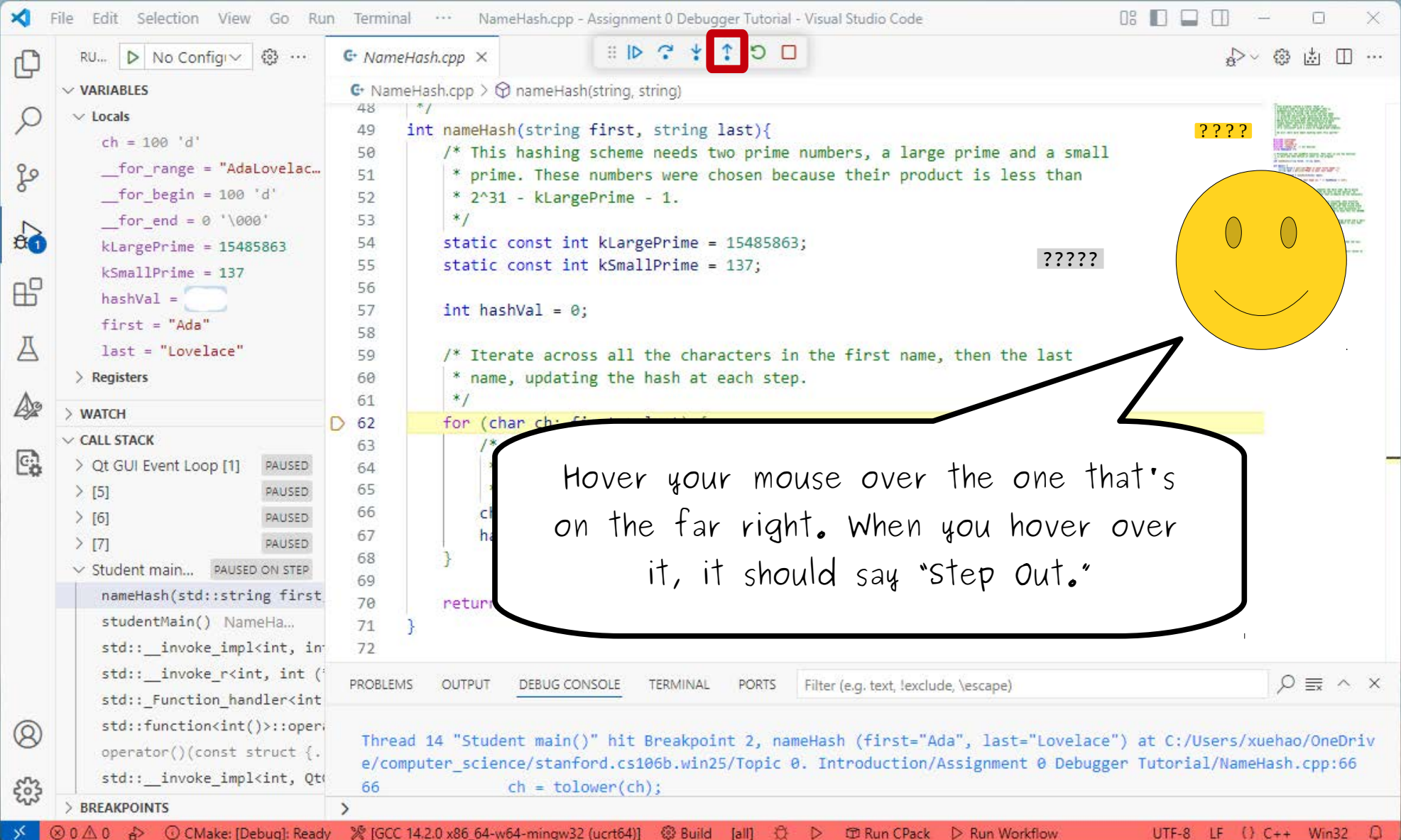
std::__invoke_impl<int, in
std::__invoke_r<int, int (
std::_Function_handler<int
std::function<int()>::oper
operator()(const struct {.
std::__invoke_impl<int, Qt
BREAKPOINTS
NameHash.cpp
NameHash.cpp > nameHash(string, string)
48 */
49 int nameHash(string first, string last){
50 /* This hashing scheme needs two prime numbers, a large prime and a small
51 * prime. These numbers were chosen because their product is less than
52 * 2^31 - kLargePrime - 1.
53 */
54 static const int kLargePrime = 15485863;
55 static const int kSmallPrime = 137;
56
57 int hashVal = 0;
58
59 /* Iterate across all the characters in the first name, then the last
60 * name, updating the hash at each step.
61 */
62 for (char ch:
63 /*
64
65
66 ch
67 ha
68 }
69
70 return
71 }
72
????
?????
Now, take a look back at these buttons.
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF {} C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
VARIABLES
Locals
ch = 100 'd'
__for_range = "AdaLovelac...
__for_begin = 100 'd'
__for_end = 0 '\000'
kLargePrime = 15485863
kSmallPrime = 137
hashVal =
first = "Ada"
last = "Lovelace"
Registers
WATCH
CALL STACK
Qt GUI Event Loop [1] PAUSED
[5] PAUSED
[6] PAUSED
[7] PAUSED
Student main... PAUSED ON STEP
nameHash(std::string first
studentMain() NameHa...
std::__invoke_impl<int, in
std::__invoke_r<int, int (
std::_Function_handler<int
std::function<int()>::oper
operator()(const struct {.
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BREAKPOINTS
NameHash.cpp
NameHash.cpp > nameHash(string, string)
48 */
49 int nameHash(string first, string last){
50 /* This hashing scheme needs two prime numbers, a large prime and a small
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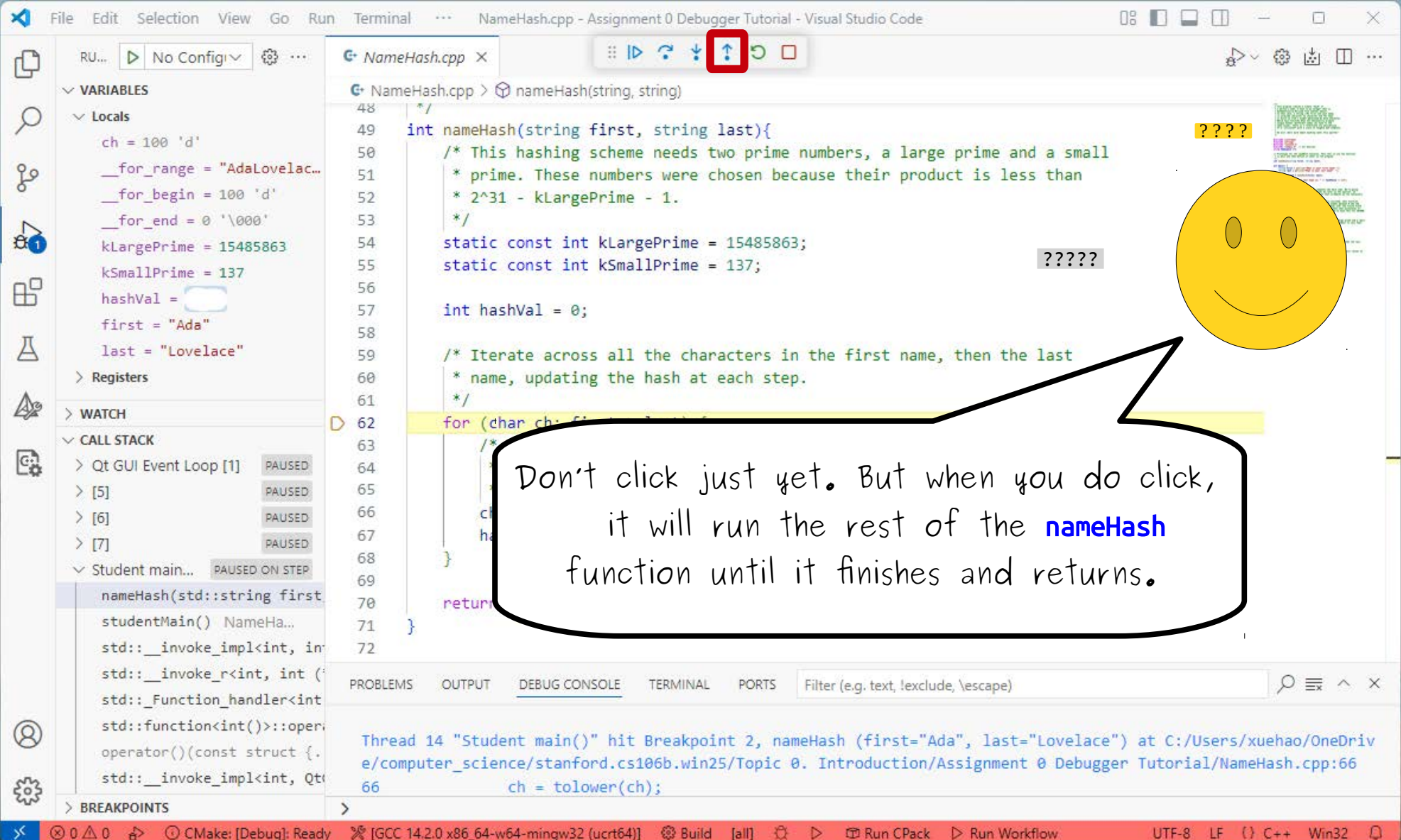
52 * 2^31 - kLargePrime - 1.
53 */
54 static const int kLargePrime = 15485863;
55 static const int kSmallPrime = 137;
56
57 int hashVal = 0;
58
59 /* Iterate across all the characters in the first name, then the last
60 * name, updating the hash at each step.
61 */
62 for (char ch:
63 /*
64
65
66 ch
67 ha
68 }
69
70 return
71 }
72
????
?????
Hover your mouse over the one that's on the far right. When you hover over it, it should say "Step Out."
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
VARIABLES
Locals
ch = 100 'd'
__for_range = "AdaLovelac...
__for_begin = 100 'd'
__for_end = 0 '\000'
kLargePrime = 15485863
kSmallPrime = 137
hashVal =
first = "Ada"
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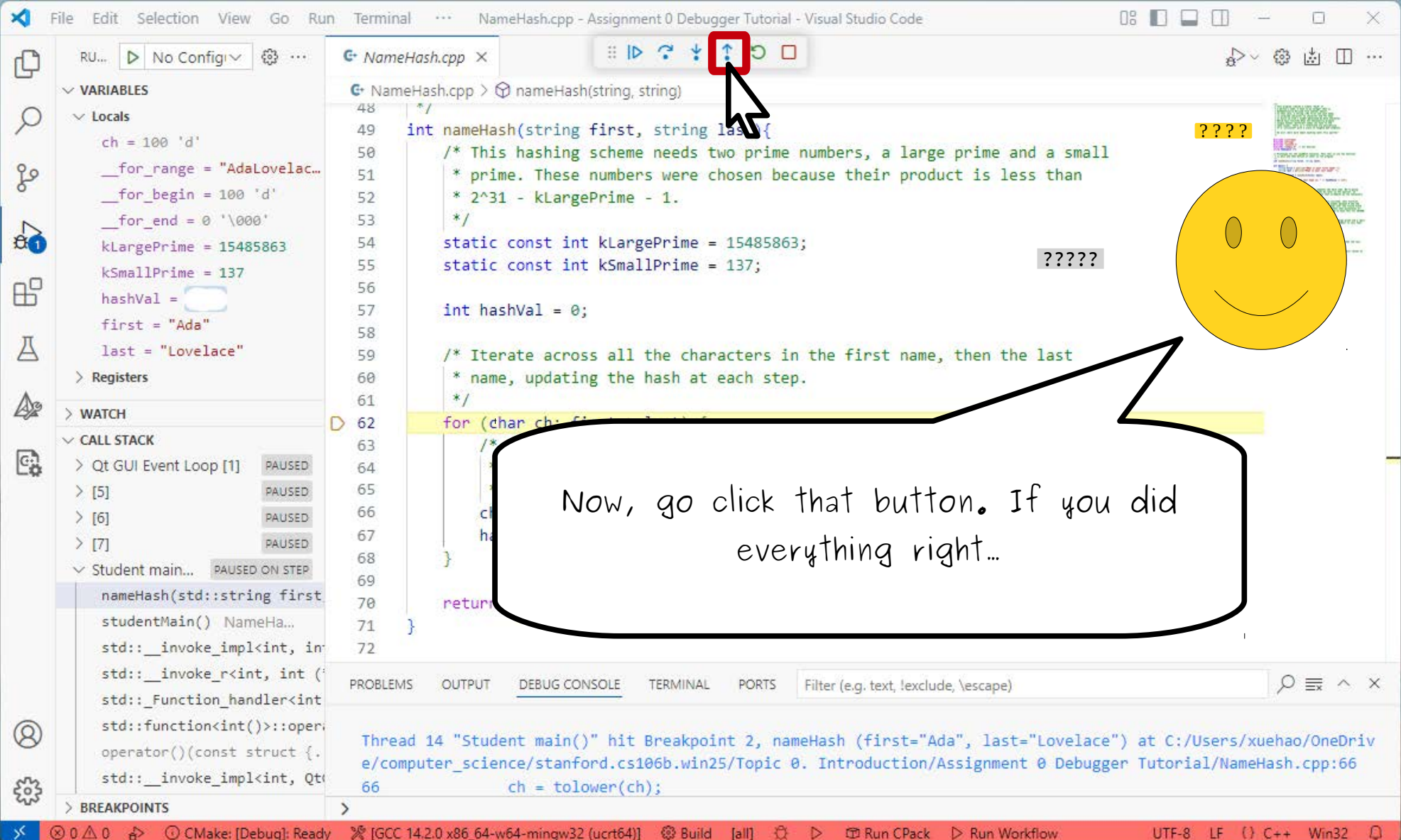
Registers
WATCH
CALL STACK
Qt GUI Event Loop [1] PAUSED
[5] PAUSED
[6] PAUSED
[7] PAUSED
Student main... PAUSED ON STEP
nameHash(std::string first
studentMain() NameHa...
std::__invoke_impl<int, in
std::__invoke_r<int, int (
std::_Function_handler<int
std::function<int()>::oper
operator()(const struct {.
std::__invoke_impl<int, Qt
BREAKPOINTS
NameHash.cpp
NameHash.cpp > nameHash(string, string)
48 */
49 int nameHash(string first, string last){
50 /* This hashing scheme needs two prime numbers, a large prime and a small
51 * prime. These numbers were chosen because their product is less than
52 * 2^31 - kLargePrime - 1.
53 */
54 static const int kLargePrime = 15485863;
55 static const int kSmallPrime = 137;
56
57 int hashVal = 0;
58
59 /* Iterate across all the characters in the first name, then the last
60 * name, updating the hash at each step.
61 */
62 for (char ch:
63 /*
64
65
66 ch
67 ha
68 }
69
70 return
71 }
72
????
?????
Don't click just yet. But when you do click, it will run the rest of the nameHash function until it finishes and returns.
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
VARIABLES
Locals
ch = 100 'd'
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__for_begin = 100 'd'
__for_end = 0 '\000'
kLargePrime = 15485863
kSmallPrime = 137
hashVal =
first = "Ada"
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Registers
WATCH
CALL STACK
Qt GUI Event Loop [1] PAUSED
[5] PAUSED
[6] PAUSED
[7] PAUSED
Student main... PAUSED ON STEP
nameHash(std::string first
studentMain() NameHa...
std::__invoke_impl<int, in
std::__invoke_r<int, int (
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std::function<int()>::oper
operator()(const struct {.
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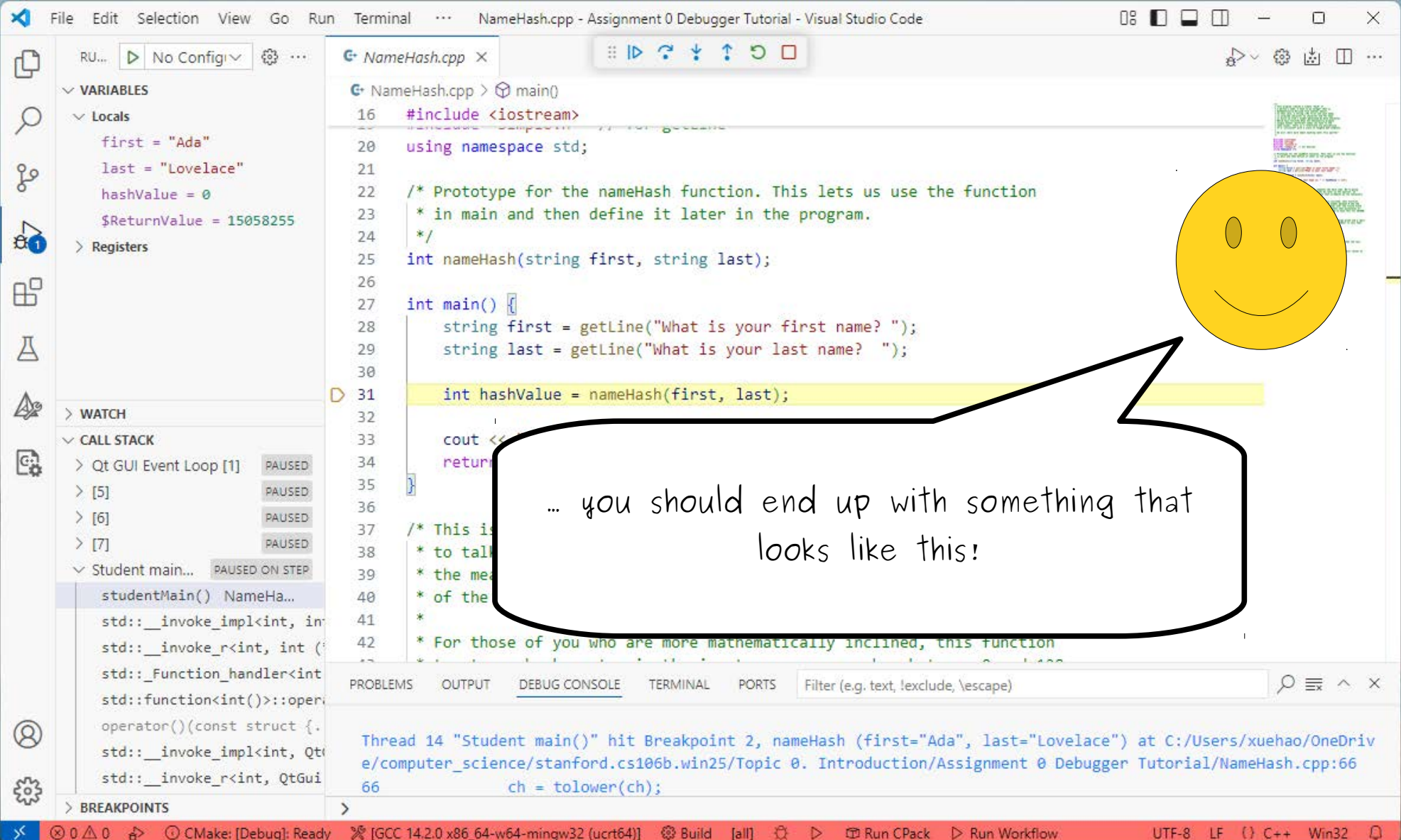
BREAKPOINTS
NameHash.cpp
NameHash.cpp > nameHash(string, string)
48 */
49 int nameHash(string first, string last){
50 /* This hashing scheme needs two prime numbers, a large prime and a small
51 * prime. These numbers were chosen because their product is less than
52 * 2^31 - kLargePrime - 1.
53 */
54 static const int kLargePrime = 15485863;
55 static const int kSmallPrime = 137;
56
57 int hashVal = 0;
58
59 /* Iterate across all the characters in the first name, then the last
60 * name, updating the hash at each step.
61 */
62 for (char ch:
63 /*
64
65
66 ch
67 ha
68 }
69
70 return
71 }
72
????
?????
Now, go click that button. If you did everything right...
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
CMake: [Debug]: Ready
[GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)]
Build [all]
Run CPack
Run Workflow
UTF-8 LF C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
No Config
VARIABLES
Locals
first = "Ada"
last = "Lovelace"
hashValue = 0
$ReturnValue = 15058255
Registers
WATCH
CALL STACK
Qt GUI Event Loop [1] PAUSED
[5] PAUSED
[6] PAUSED
[7] PAUSED
Student main... PAUSED ON STEP
studentMain() NameHa...
std::__invoke_impl<int, in
std::__invoke_r<int, int (
std::_Function_handler<int
std::function<int()>::oper
operator()(const struct {.
std::__invoke_impl<int, Qt
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BREAKPOINTS
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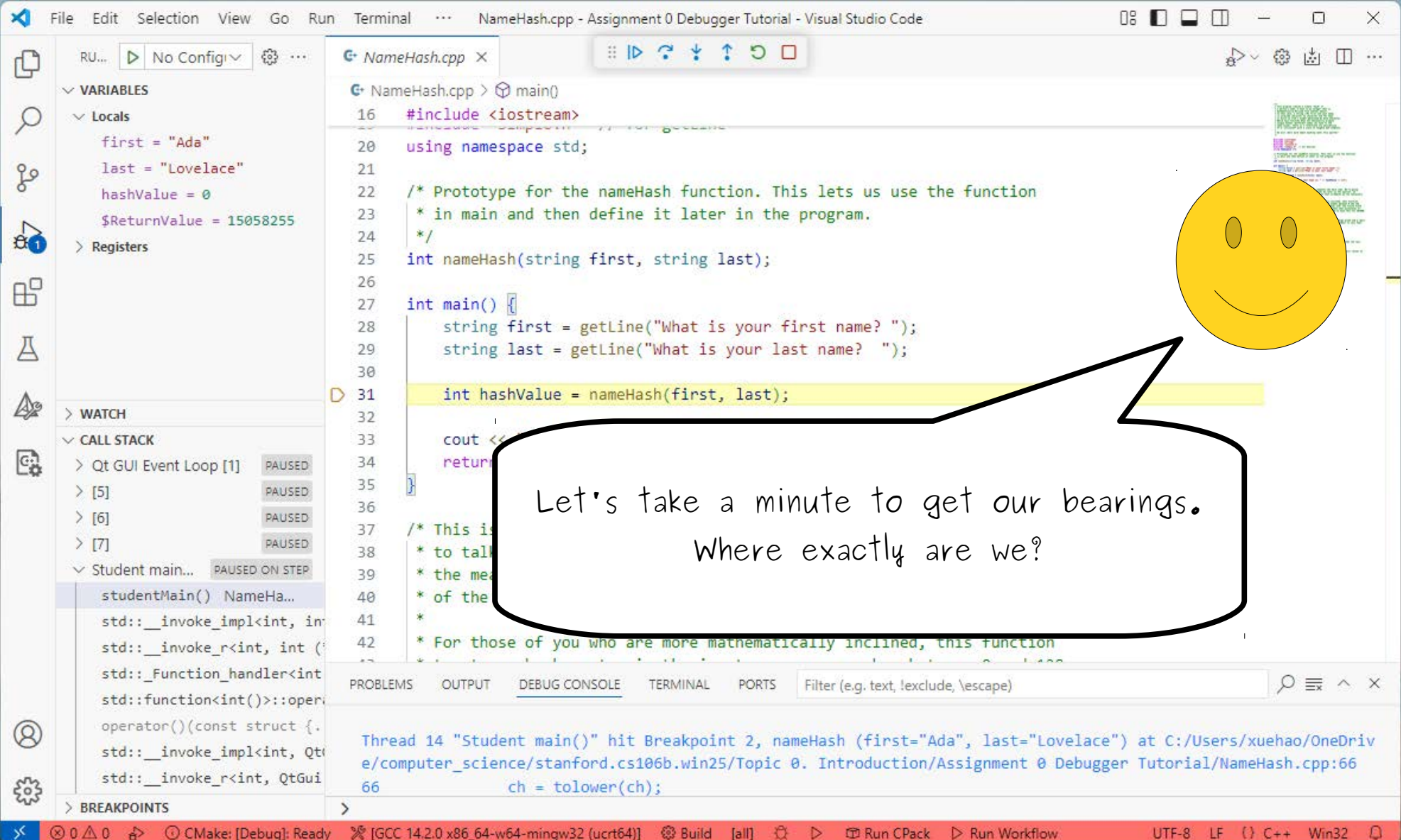
31 int hashValue = nameHash(first, last);
33 cout <<
34 return
35 }
37 /* This is
38 * to talk
39 * the mea
40 * of the
41 *
42 * For those of you who are more mathematically inclined, this function
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
… you should end up with something that looks like this!
CMake: [Debug]: Ready
[GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)]
Build [all]
Run CPack
Run Workflow
UTF-8 LF C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
VARIABLES
Locals
first = "Ada"
last = "Lovelace"
hashValue = 0
$ReturnValue = 15058255
Registers
WATCH
CALL STACK
Qt GUI Event Loop [1] PAUSED
[5] PAUSED
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Student main... PAUSED ON STEP
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std::__invoke_impl<int, in
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31 int hashValue = nameHash(first, last);
33 cout <<
34 return
35 }
37 /* This is
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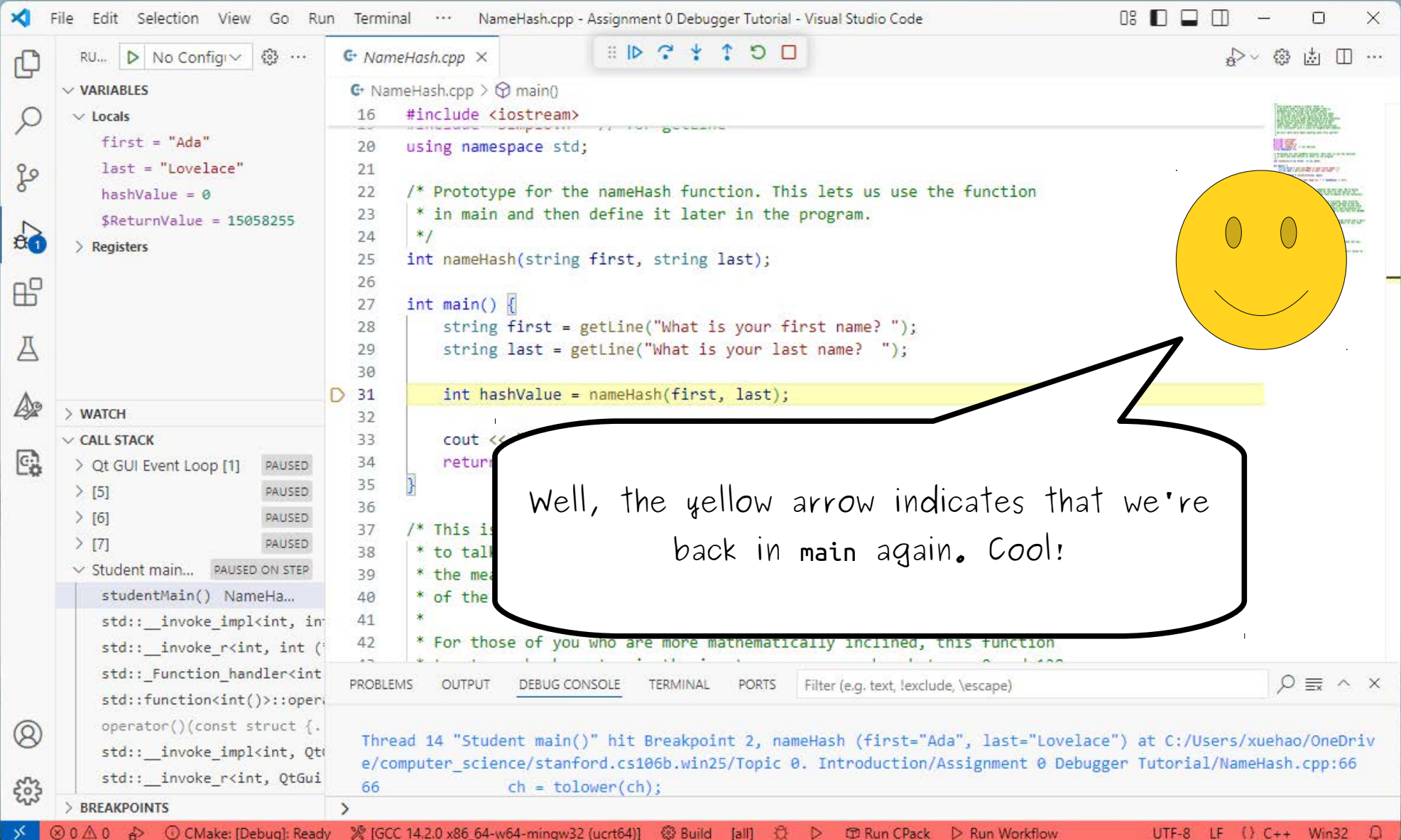
40 * of the
41 *
42 * For those of you who are more mathematically inclined, this function
Let's take a minute to get our bearings.
Where exactly are we?
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
0 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF {} C++ Win32


File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
RU... No Config
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30
31 int hashValue = nameHash(first, last);
32
33 cout <<
34 return
35 }
36
37 /* This is
38 * to talk
39 * the mea
40 * of the
41 *
42 * For those of you who are more mathematically inclined, this function
Well, the yellow arrow indicates that we're back in main again. Cool!
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
CMake: [Debug]: Ready
[GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)]
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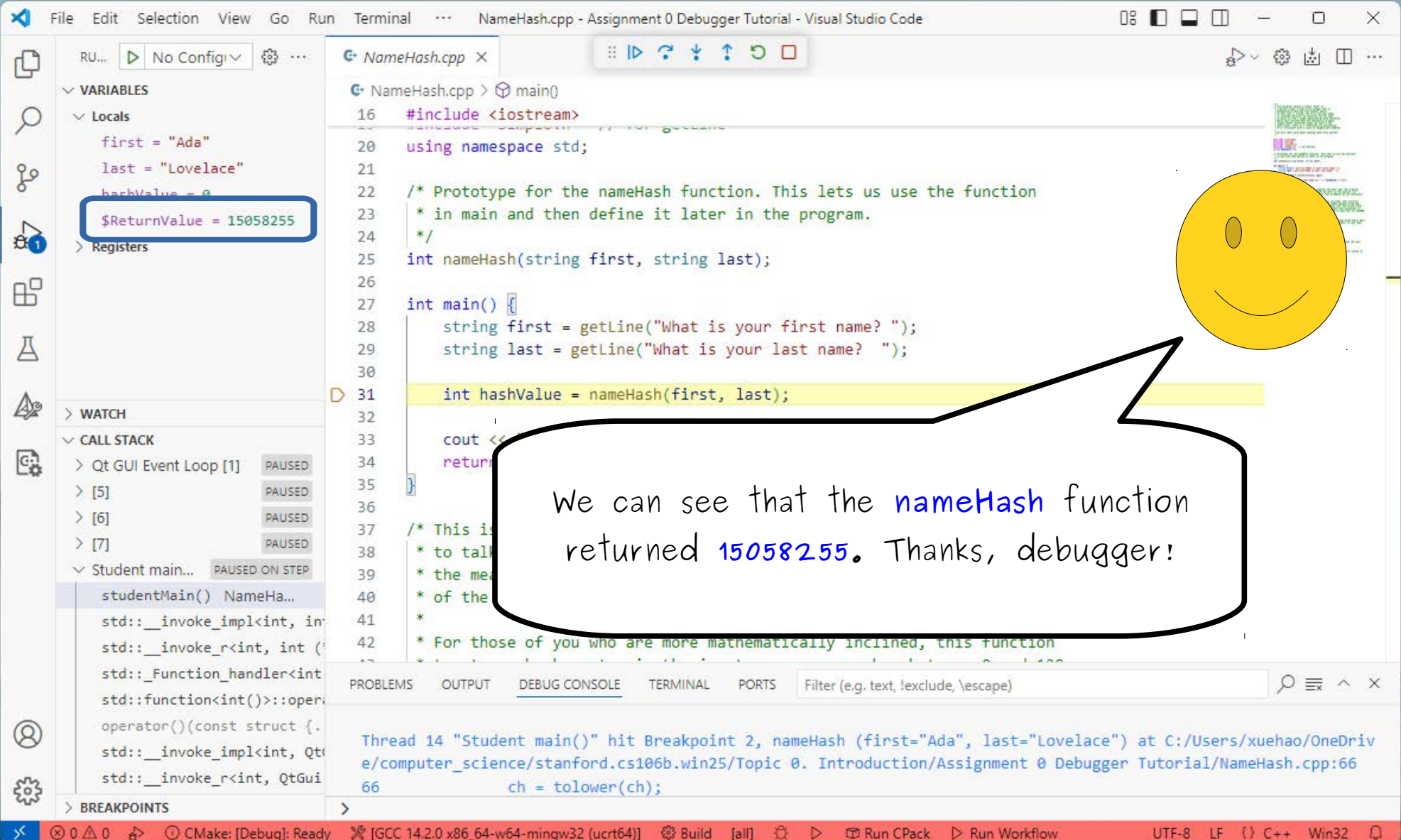
UTF-8 LF C++ Win32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VARIABLES
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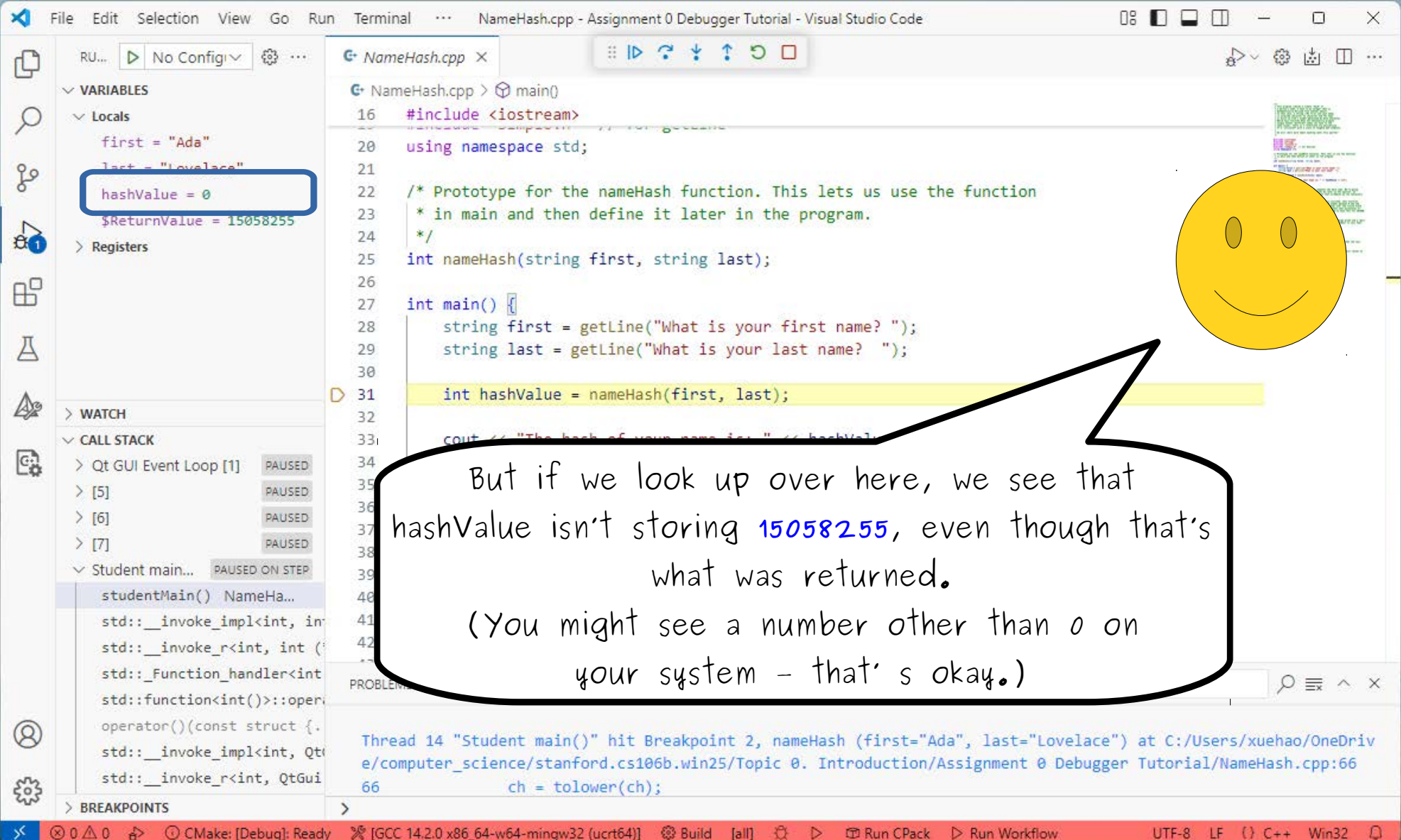
27 int main() {
28 string first = getLine("What is your first name? ");
29 string last = getLine("What is your last name? ");
31 int hashValue = nameHash(first, last);
42 * For those of you who are more mathematically inclined, this function
We can see that the nameHash function returned 15058255. Thanks, debugger!
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
CMake: [Debug]: Ready
[GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)]
Build [all]
Run CPack
Run Workflow
UTF-8 LF C++ Win32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25 int nameHash(string first, string last);
27 int main() {
28 string first = getLine("What is your first name? ");
29 string last = getLine("What is your last name? ");
31 int hashValue = nameHash(first, last);
But if we look up over here, we see that hashValue isn't storing 15058255, even though that's what was returned.
(You might see a number other than 0 on your system - that's okay.)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
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File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code

RU... No Config

VARIABLES

Locals

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hashValue = 0

$ReturnValue = 15058255

Registers

WATCH

CALL STACK

Qt GUI Event Loop [1] PAUSED

[5] PAUSED

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[7] PAUSED

Student main... PAUSED ON STEP

studentMain() NameHa...

std::__invoke_impl<int, in

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BREAKPOINTS

NameHash.cpp

NameHash.cpp > main()

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24   */
25  int nameHash(string first, string last);
26
27  int main() {
28      string first = getLine("What is your first name? ");
29      string last = getLine("What is your last name?  ");
30
31      int hashValue = nameHash(first, last);
32
33      cout << "The hash of your name is: " << hashVal
34
35
36
37
38
39
40
41
42
```

But it looks like we're setting hashValue equal to the number that was returned by the nameHash function. What's going on?

PROBLEMS

Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66

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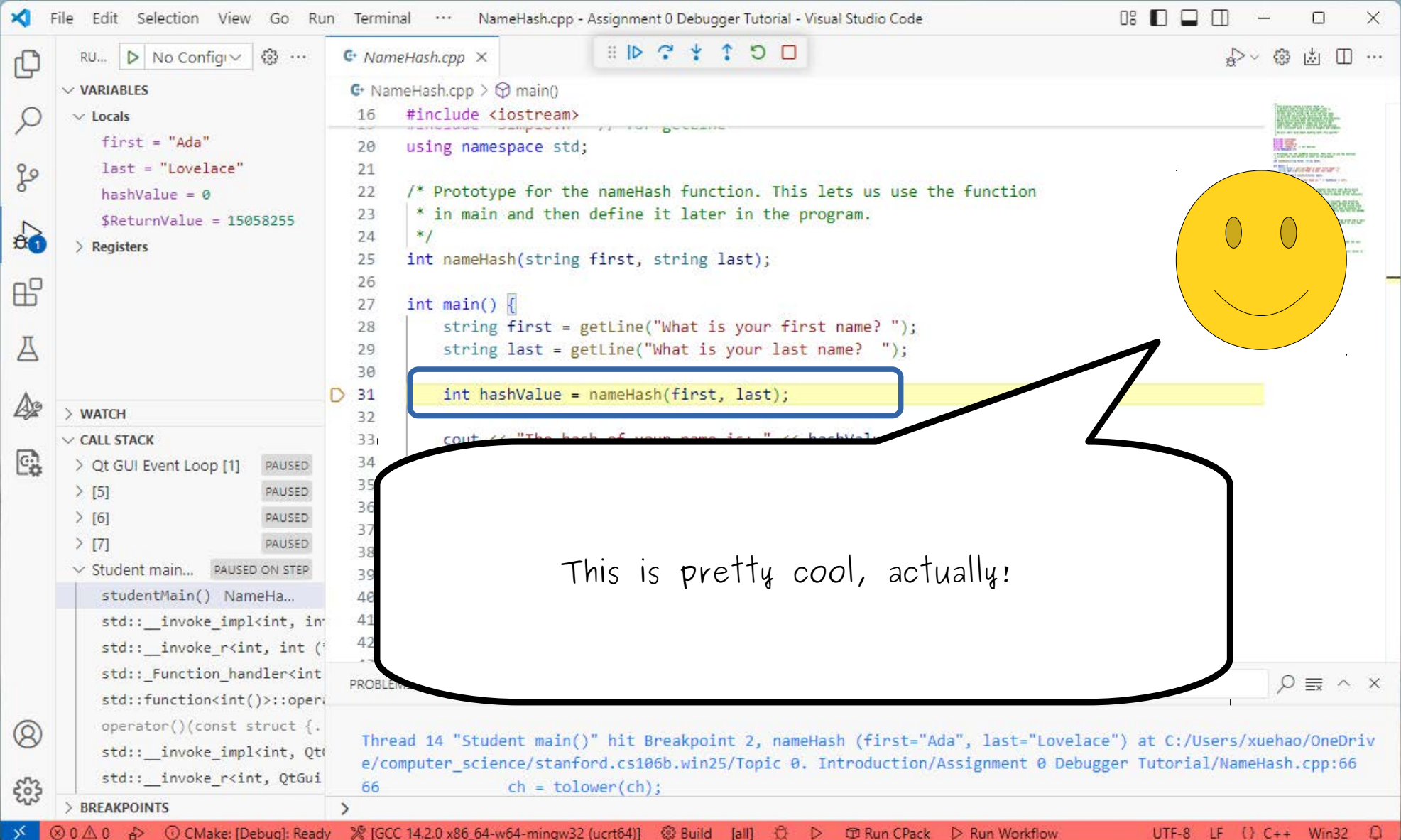
⊗ 0 ⚠ 0 CMake: [Debug]: Ready [GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)] Build [all] Run CPack Run Workflow UTF-8 LF {} C++ Win32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30
31 int hashValue = nameHash(first, last);
32
33
34
35
36
37
38
39
40
41
42
This is pretty cool, actually!
PROBLEMS
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
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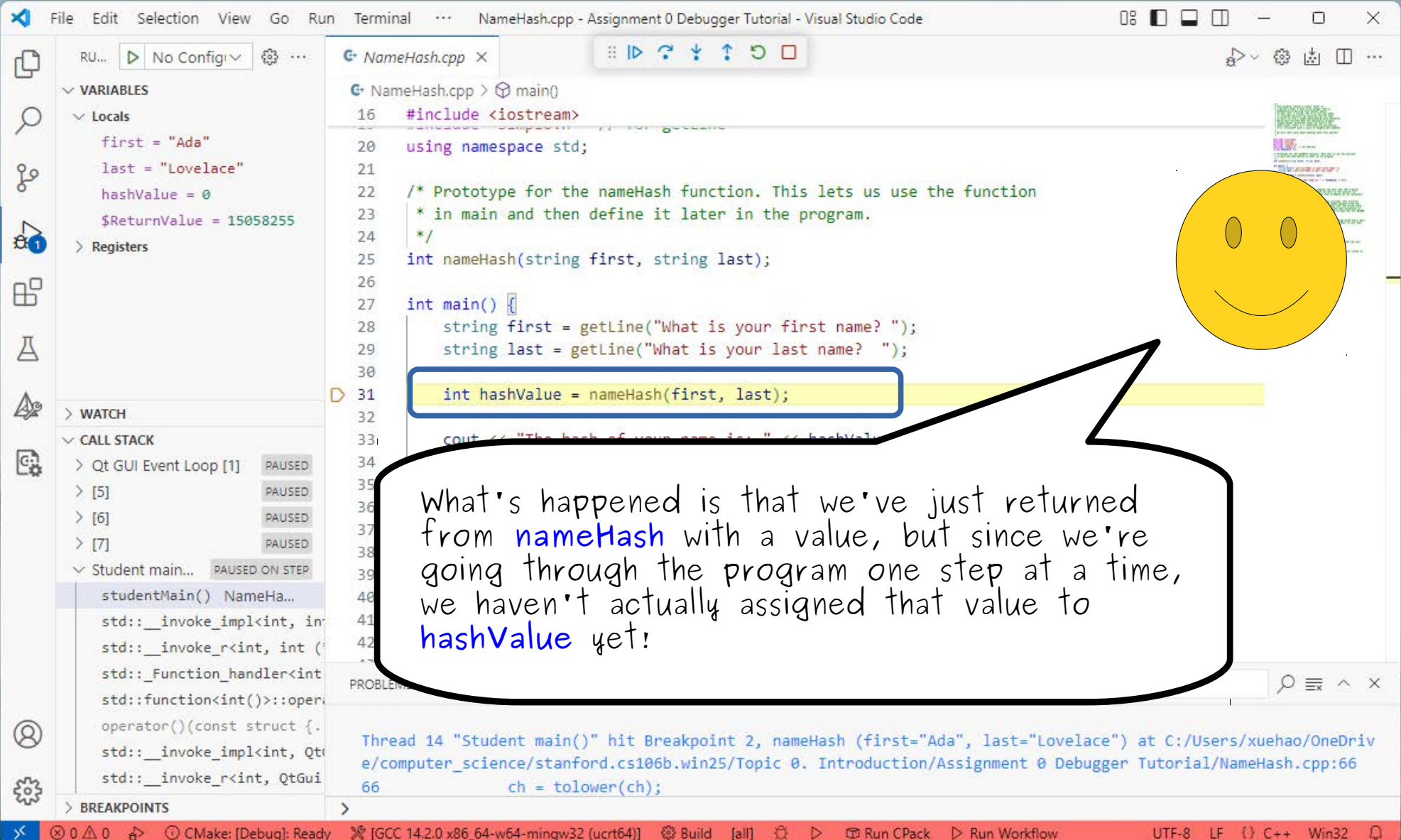
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27 int main() {
28 string first = getLine("What is your first name? ");
29 string last = getLine("What is your last name? ");
31 int hashValue = nameHash(first, last);
What's happened is that we've just returned from nameHash with a value, but since we're going through the program one step at a time, we haven't actually assigned that value to hashValue yet!
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
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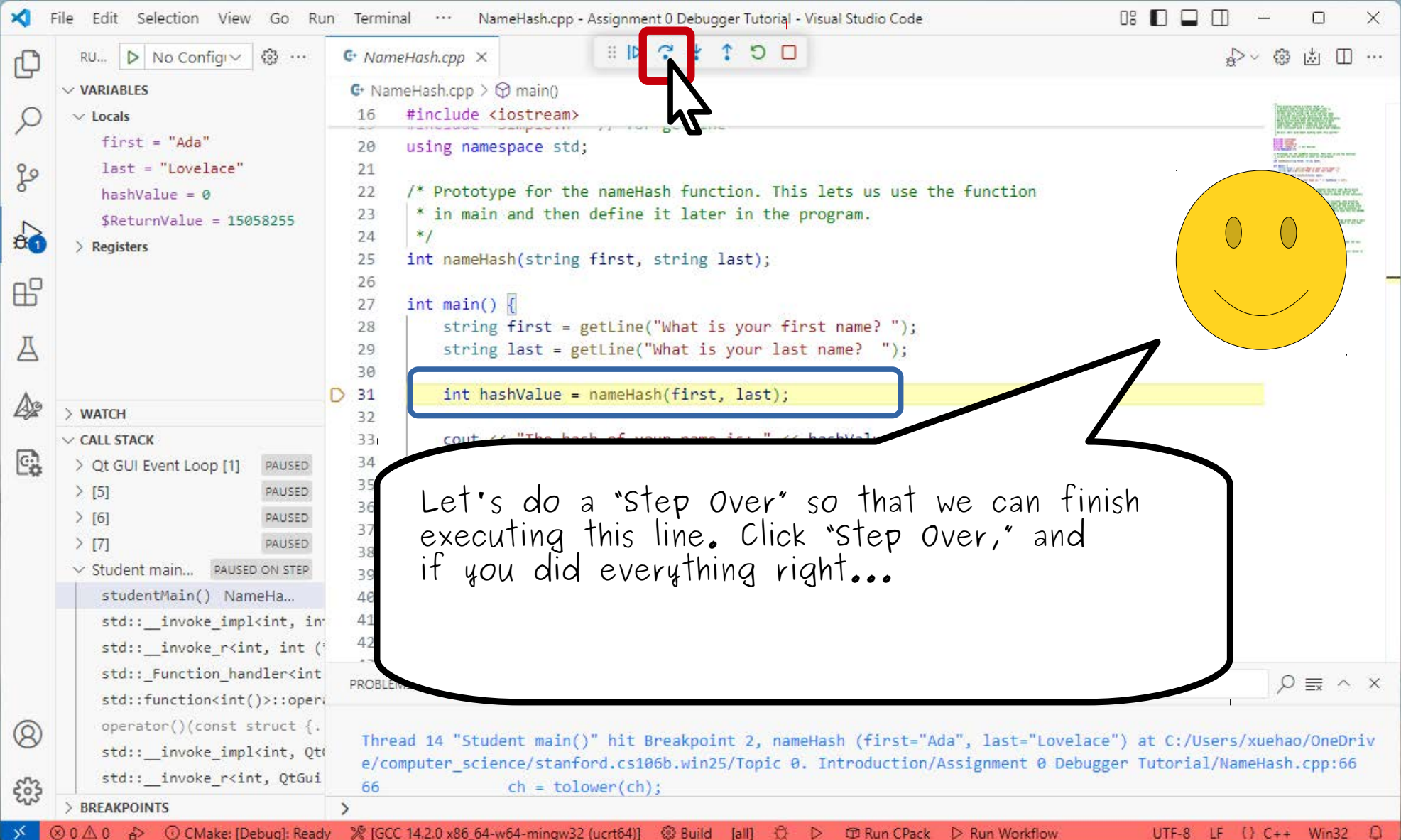
File Edit Selection View Go Run Terminal ··· NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
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27 int main() {
28 string first = getLine("What is your first name? ");
29 string last = getLine("What is your last name? ");
31 int hashValue = nameHash(first, last);
Let's do a "Step Over" so that we can finish executing this line. Click "Step Over," and if you did everything right...
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
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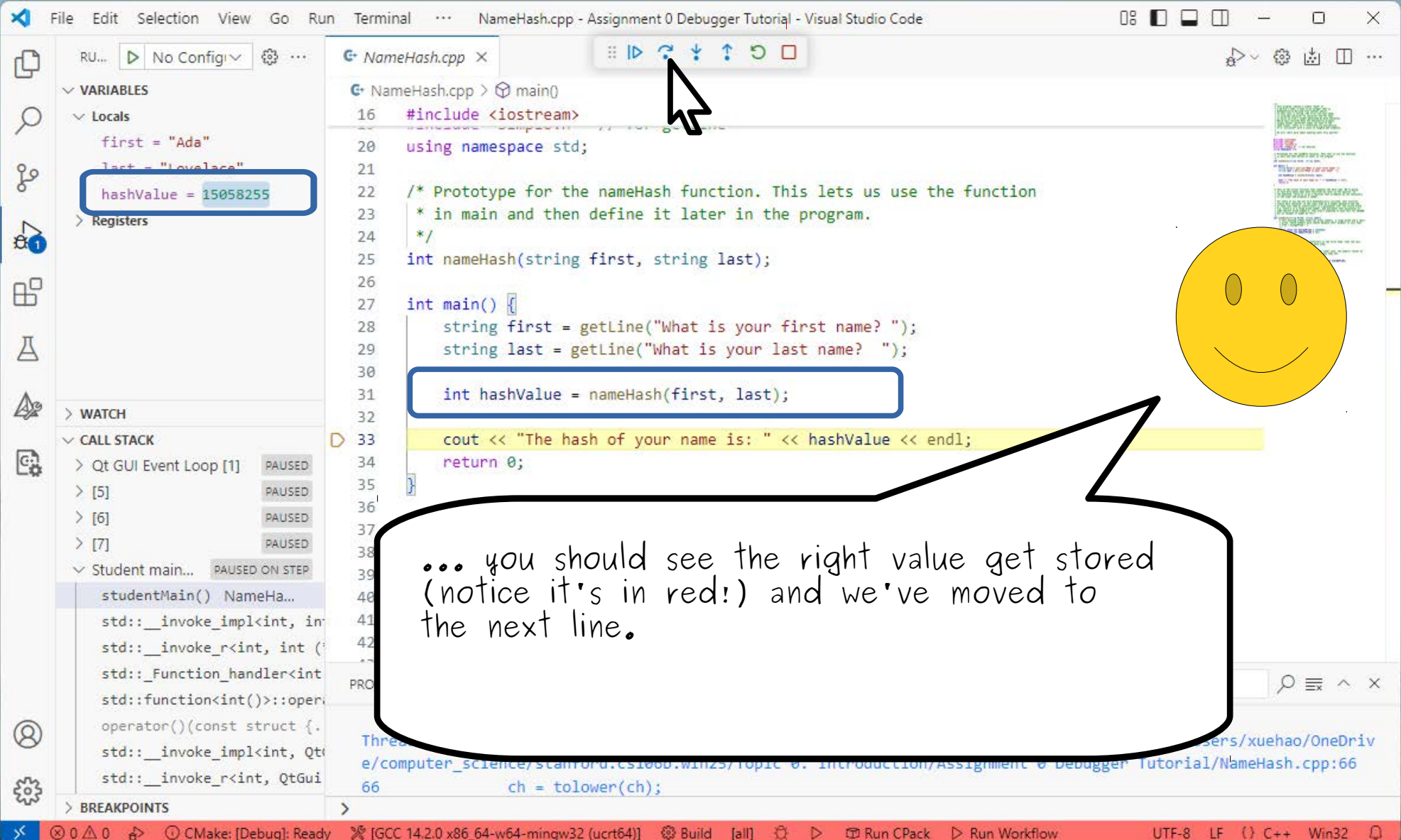
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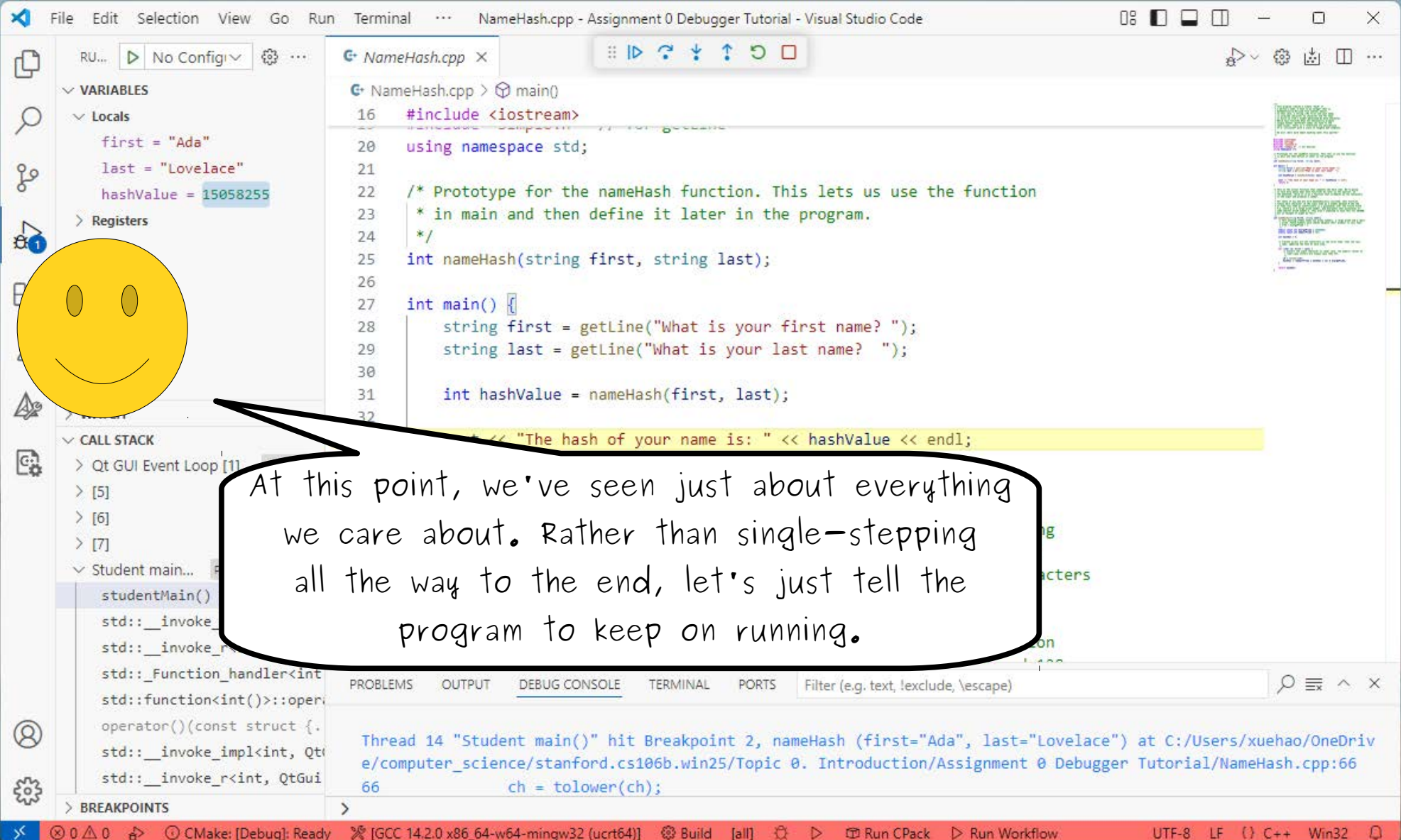
27 int main() {
28 string first = getLine("What is your first name? ");
29 string last = getLine("What is your last name? ");
31 int hashValue = nameHash(first, last);
33 cout << "The hash of your name is: " << hashValue << endl;
34 return 0;
35 }
... you should see the right value get stored (notice it's in red!) and we've moved to the next line.
66 ch = tolower(ch);
CMake: [Debug]: Ready
[GCC 14.2.0 x86_64-w64-mingw32 (ucrt64)]
Build [all]
Run CPack
Run Workflow
UTF-8 LF C++ Win32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Qt GUI Event Loop [1]
[5]
[6]
[7]
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studentMain()
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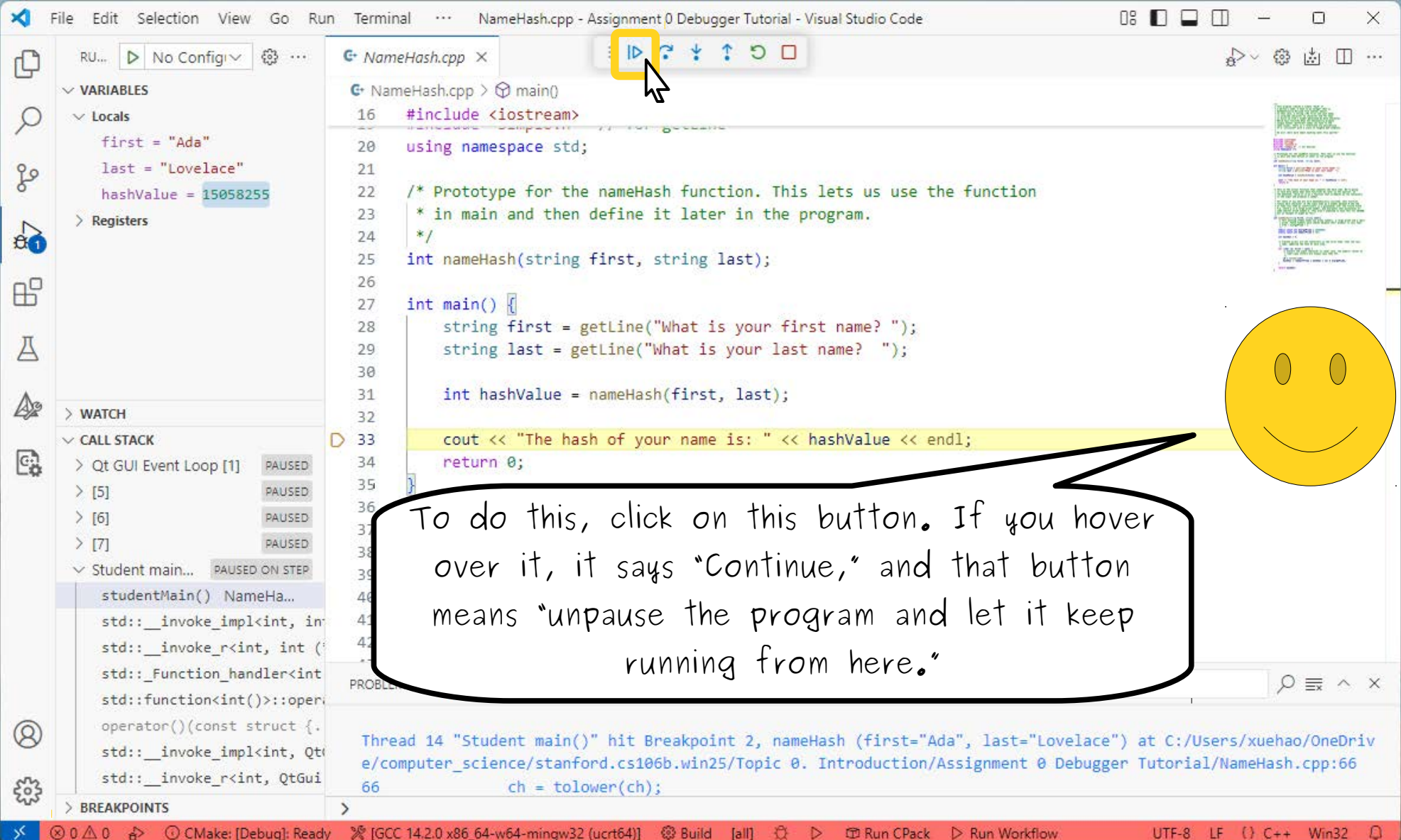
27 int main() {
28 string first = getLine("What is your first name? ");
29 string last = getLine("What is your last name? ");
31 int hashValue = nameHash(first, last);
<< "The hash of your name is: " << hashValue << endl;
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
66 ch = tolower(ch);
At this point, we've seen just about everything we care about. Rather than single-stepping all the way to the end, let's just tell the program to keep on running.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29 string last = getLine("What is your last name? ");
30
31 int hashValue = nameHash(first, last);
32
33 cout << "The hash of your name is: " << hashValue << endl;
34 return 0;
35 }
To do this, click on this button. If you hover over it, it says "Continue," and that button means "unpause the program and let it keep running from here."
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
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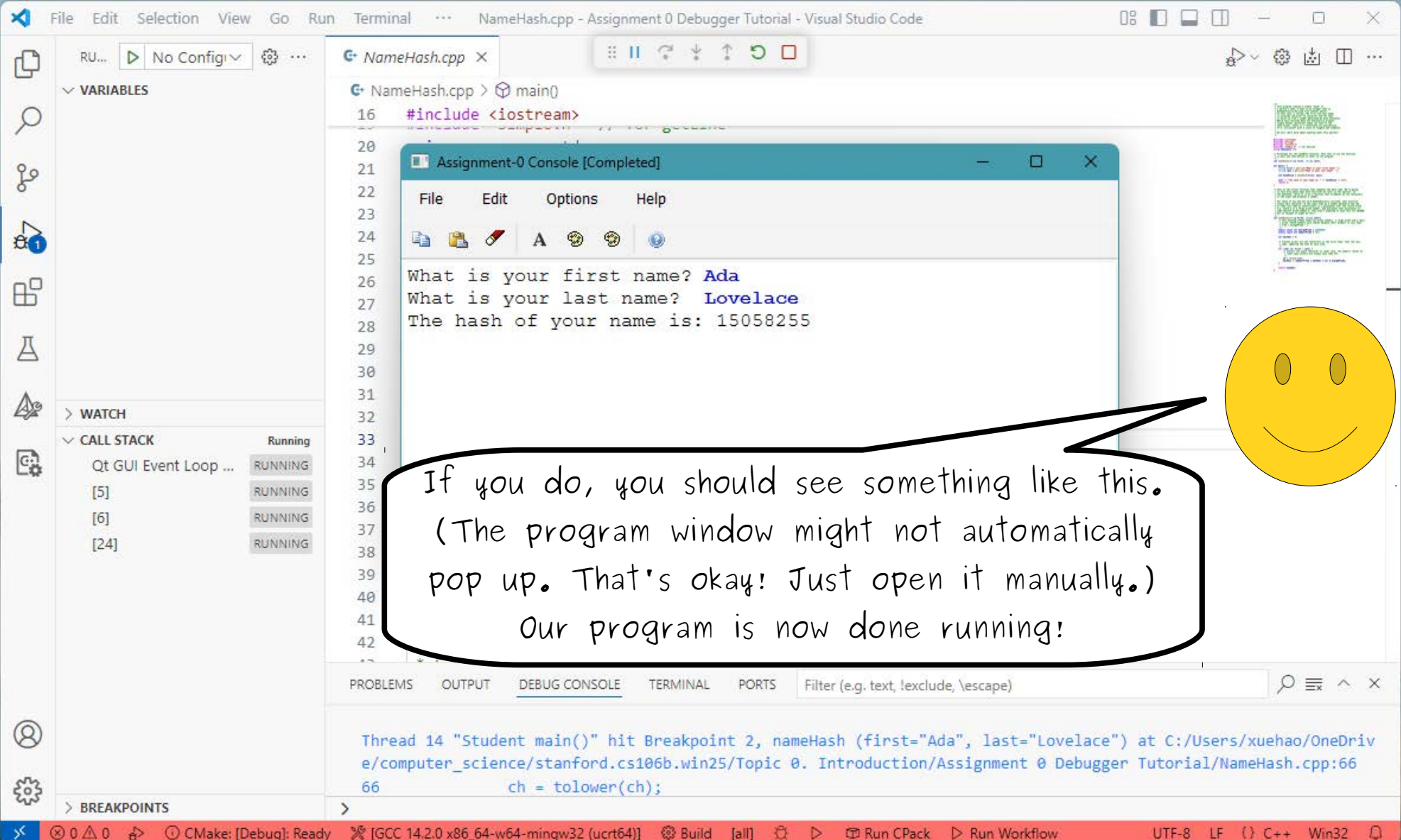
File Edit Selection View Go Run Terminal
NameHash.cpp - Assignment 0 Debugger Tutorial - Visual Studio Code
No Config
VARIABLES
WATCH
CALL STACK
Running
Qt GUI Event Loop ...
[5]
[6]
[24]
RUNNING
BREAKPOINTS
NameHash.cpp
main()
#include <iostream>
Assignment-0 Console [Completed]
File Edit Options Help
What is your first name? Ada
What is your last name? Lovelace
The hash of your name is: 15058255
If you do, you should see something like this.
(The program window might not automatically pop up. That's okay! Just open it manually.)
Our program is now done running!
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS
Filter (e.g. text, !exclude, \escape)
Thread 14 "Student main()" hit Breakpoint 2, nameHash (first="Ada", last="Lovelace") at C:/Users/xuehao/OneDrive/computer_science/stanford.cs106b.win25/Topic 0. Introduction/Assignment 0 Debugger Tutorial/NameHash.cpp:66
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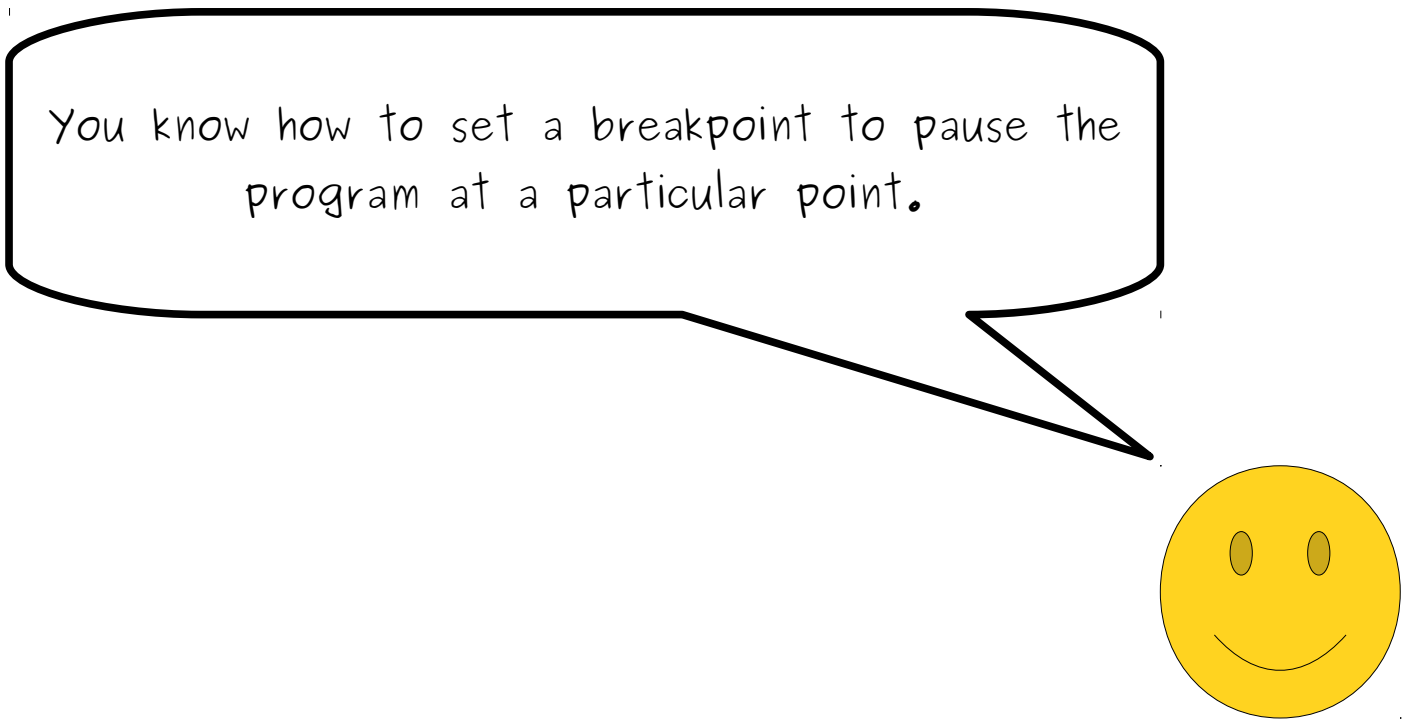
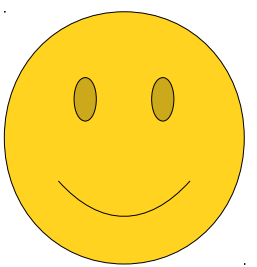
UTF-8 LF C++ Win32

So there you have it! You've now gotten more familiar with the debugger!

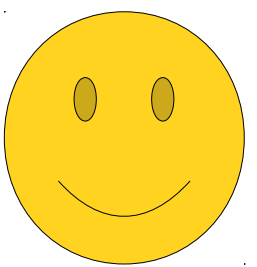

You know how to set a breakpoint to pause the program at a particular point.

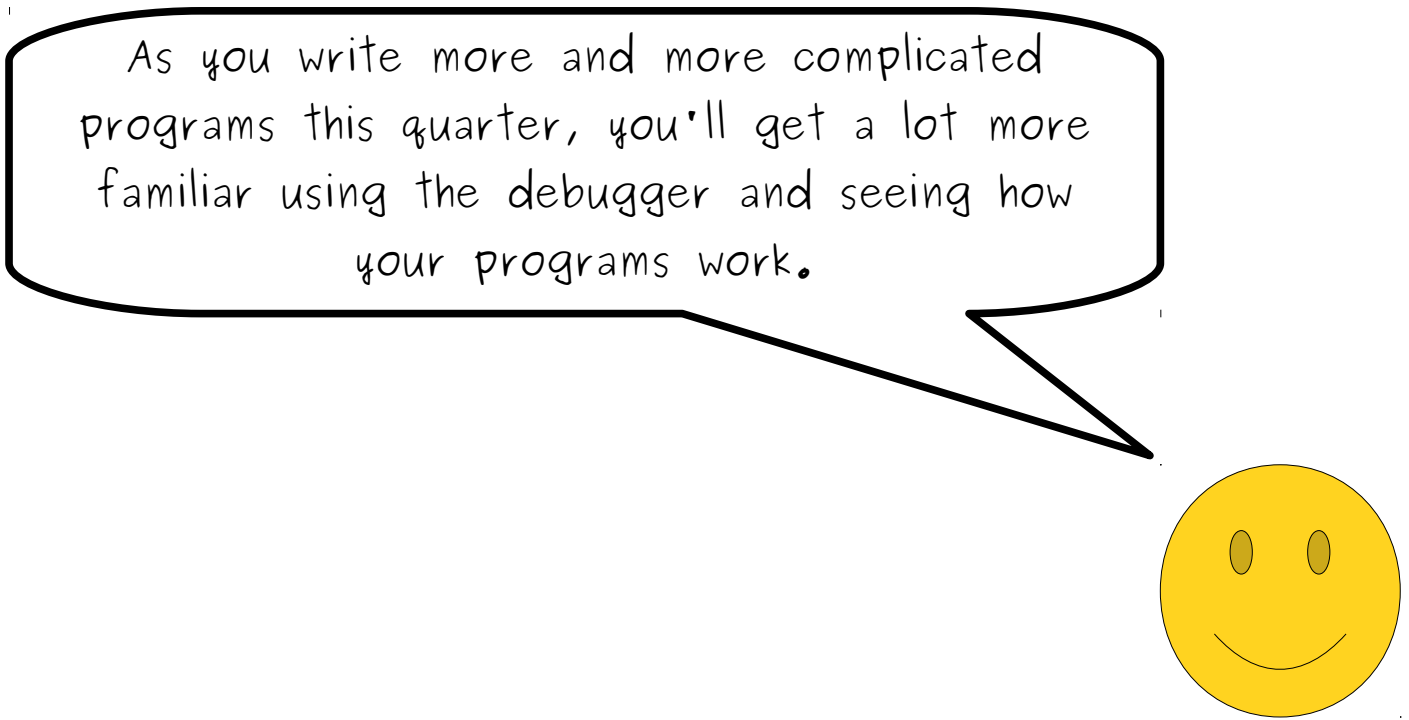
You know how to read the call stack and to see the values of local variables.

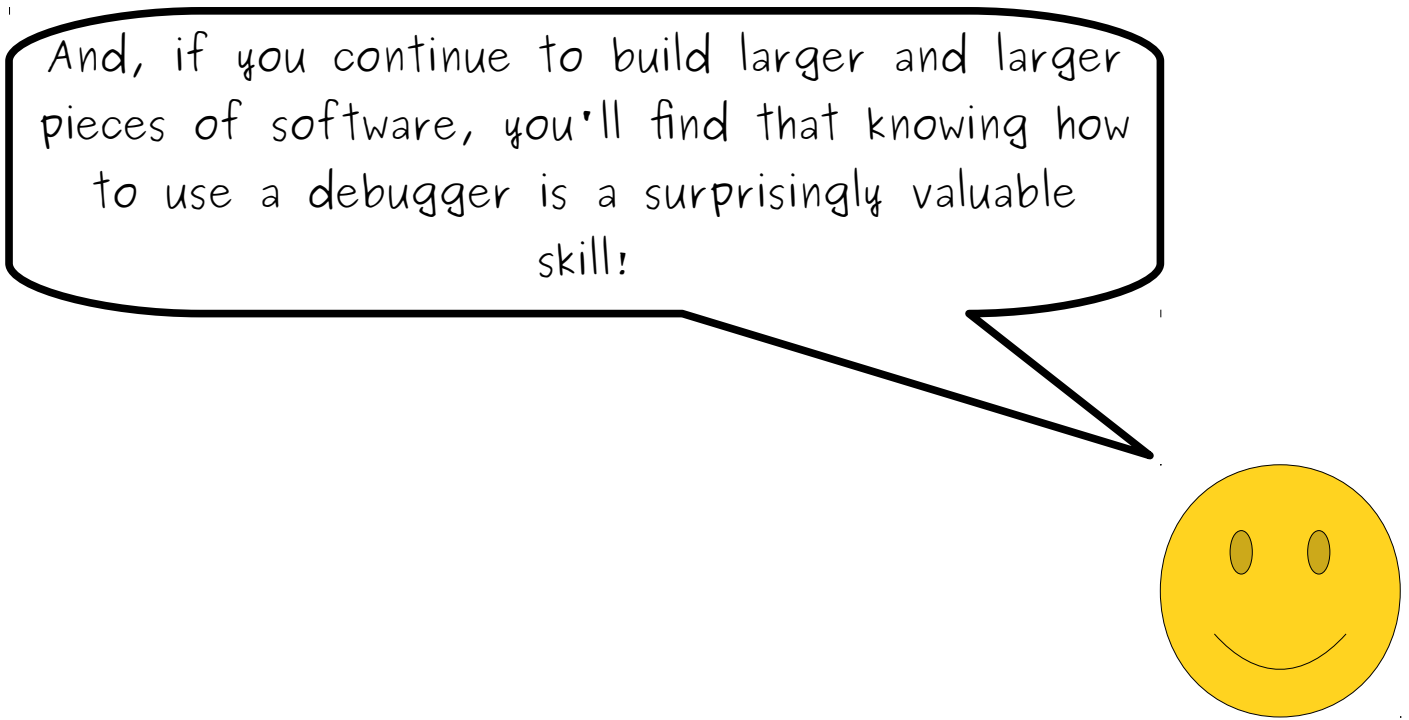


You know how to single-step the program and see what values change.

You know how to run a function to completion, and how to let the program keep on running.




As you write more and more complicated programs this quarter, you'll get a lot more familiar using the debugger and seeing how your programs work.


And, if you continue to build larger and larger pieces of software, you'll find that knowing how to use a debugger is a surprisingly valuable skill!


Hope this helps, and welcome to CS101B!