CE103 Algorithms and Programming I

Week-4

Introduction to Code Reusability and Automated Testing

During this course we will use entry level of shared library development and their tests and test automations. Also we will see TDD(Test Driven Development) approach.

During this course we will use **Windows OS, Eclipse and Visual Studio Commuity Edition** environments for examples.

Each example will include two function

"Hello <name>" printing function with name sayHelloTo(name) and

sum of two variable function for basic, sum = sum(a,b).

This sum function will add a to b and return result to sum variable.

We will locate them in library and use them from a console application, also we will create unit tests for testing their functionalities and return variables

Shared Library Development

C Programming (Static Library)

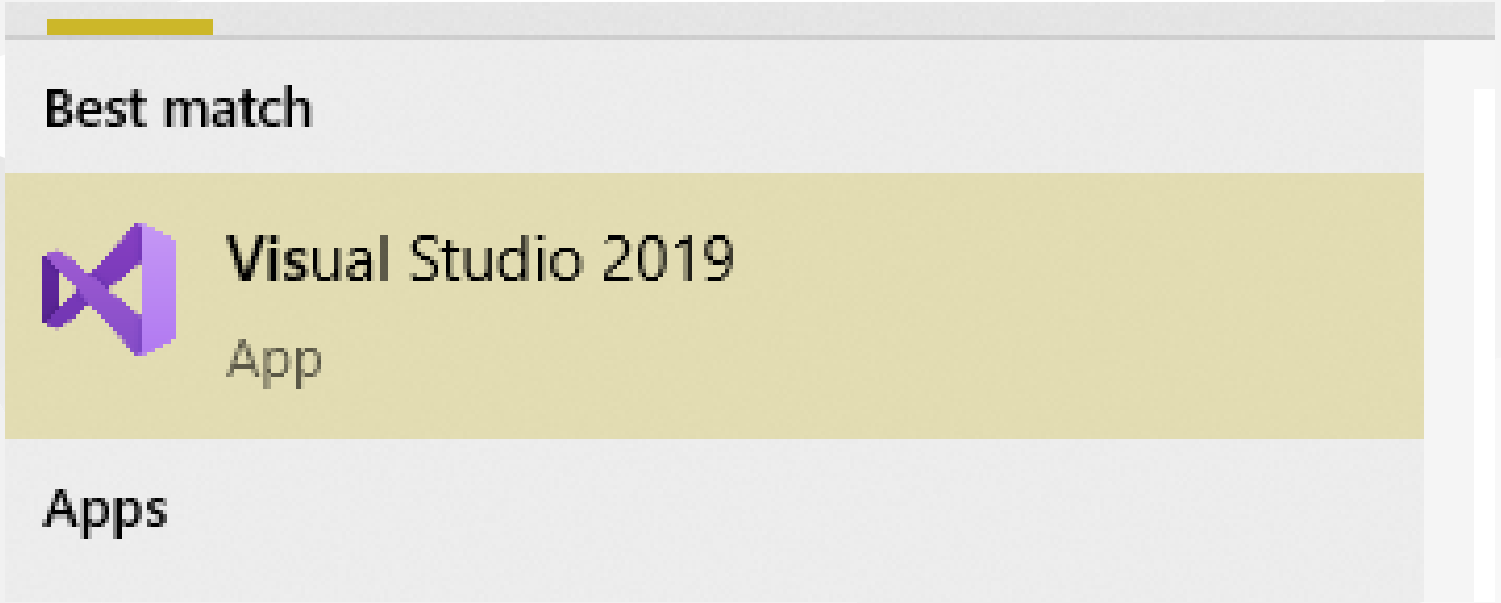
Visual Studio Community Edition

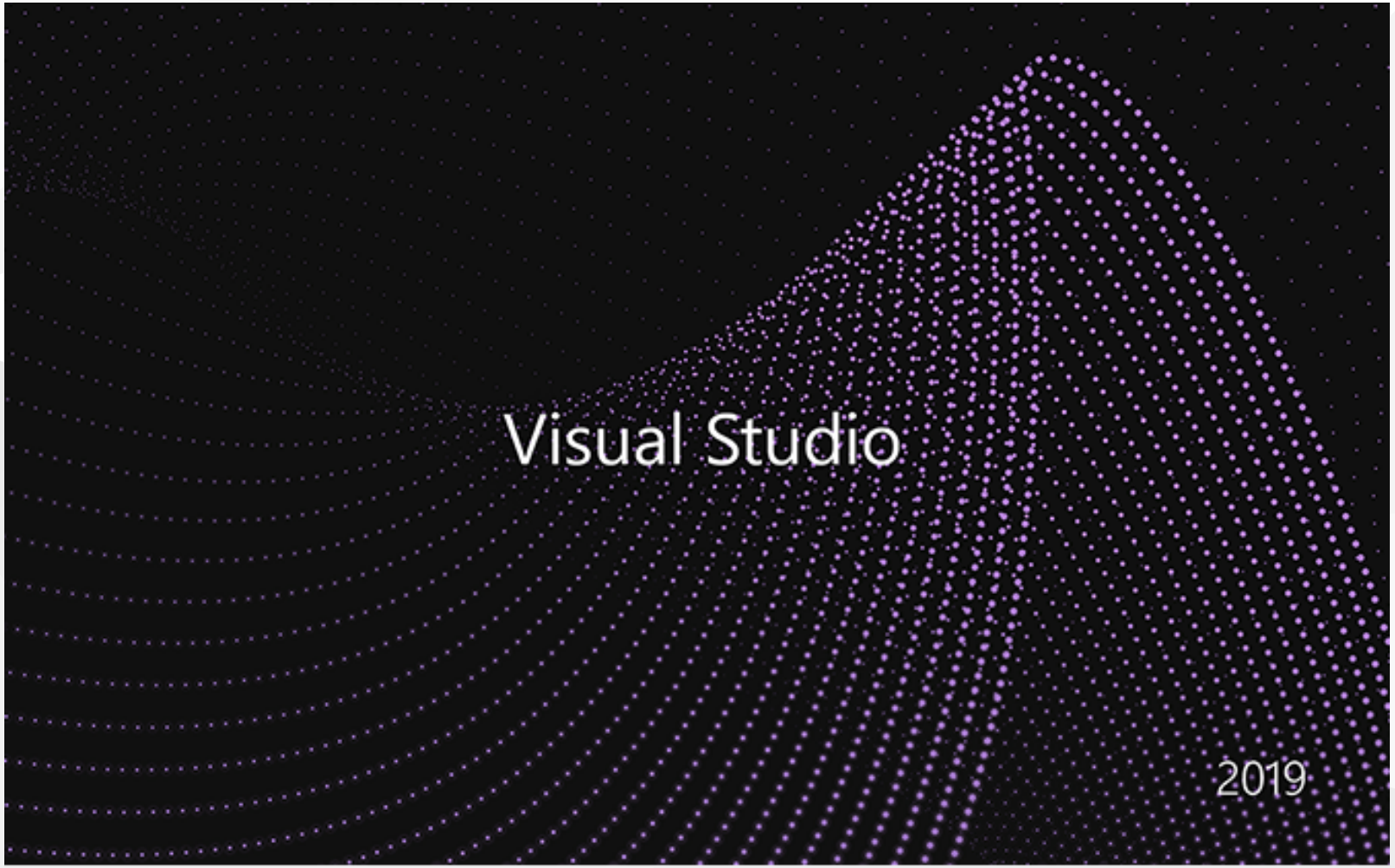
In this sample we will create **c-lib-sample** project that contains library, executable, unit tests and unit test runners.

First of all you install Visual Studio Community Edition from website

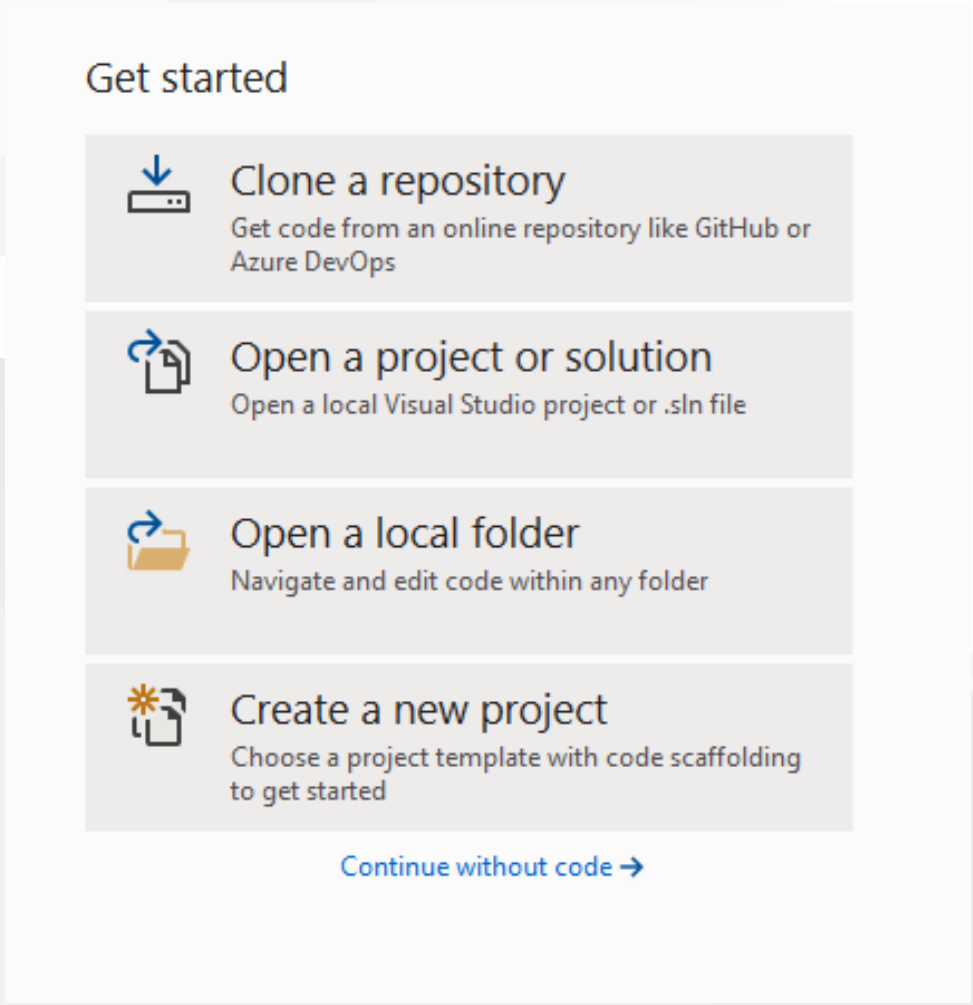
Visual Studio 2019 Community Edition - Son Ücretsiz Sürümü İndir

Open visual studio community edition and select create a new project

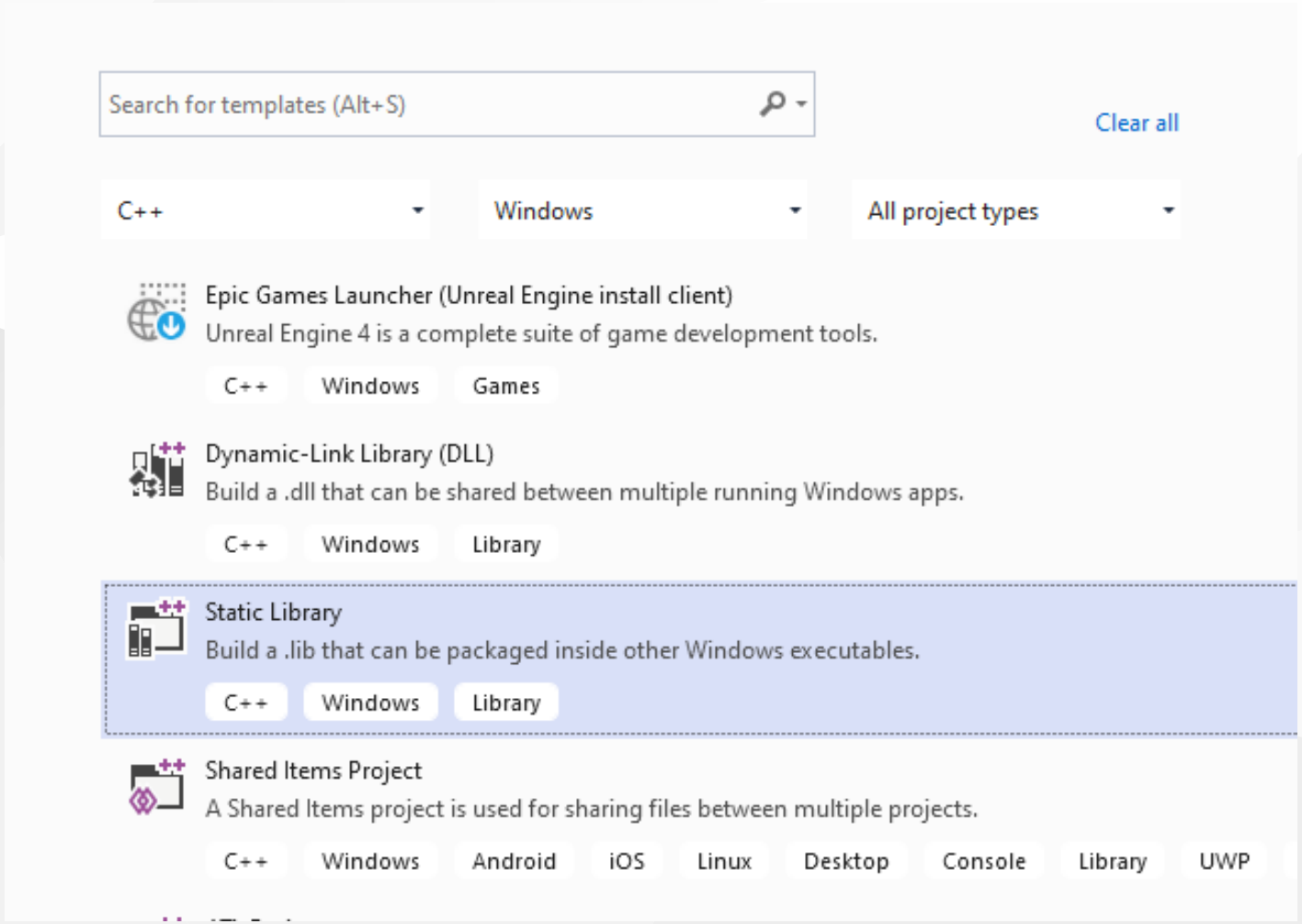



Visual Studio
2019

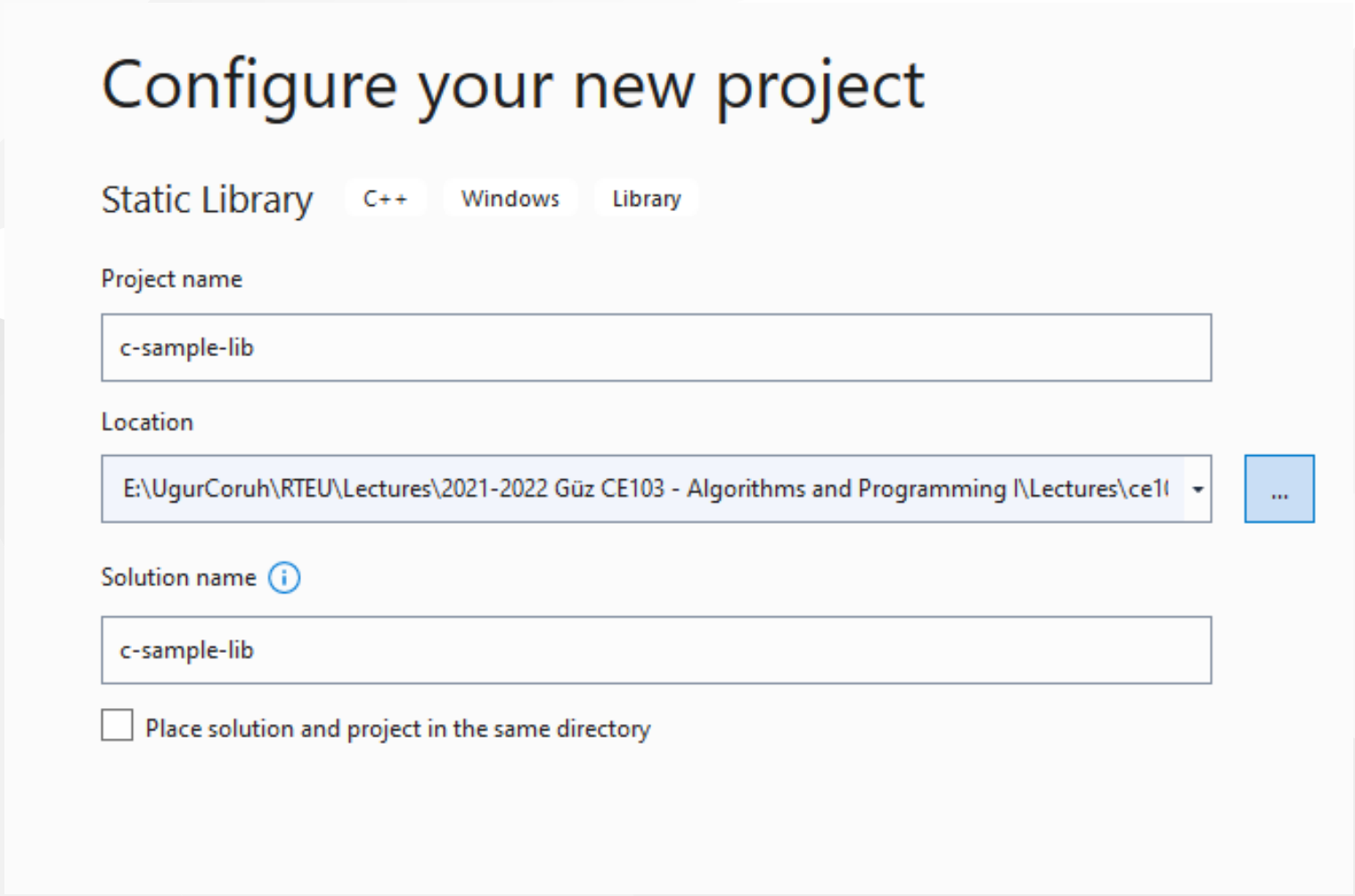
Select create a new project



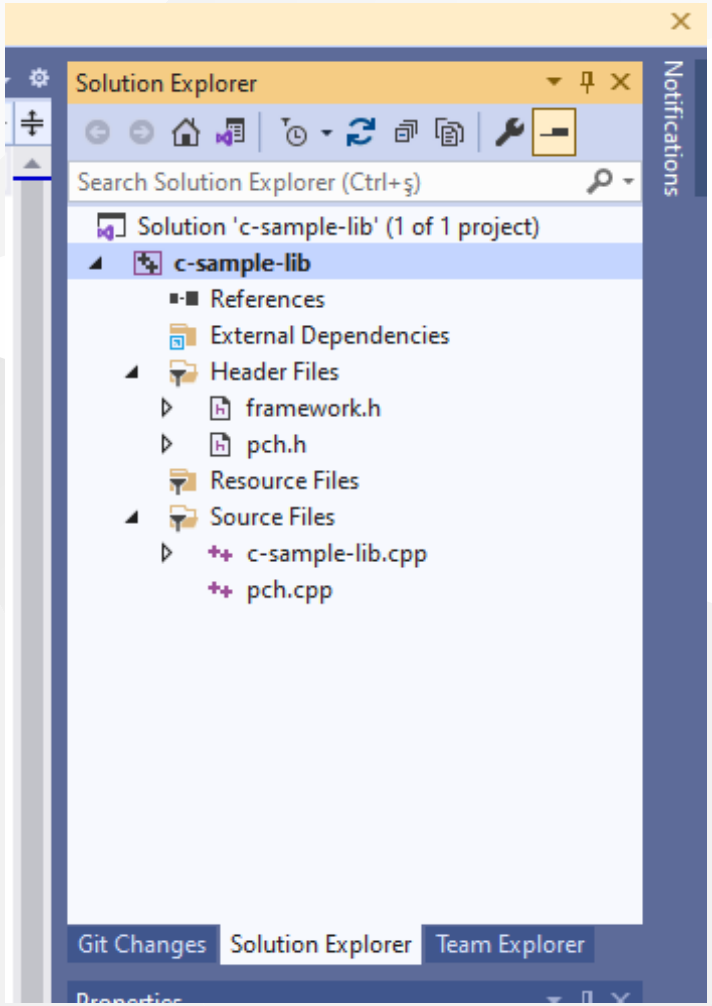
Select C++ static library from project list



Name static library project



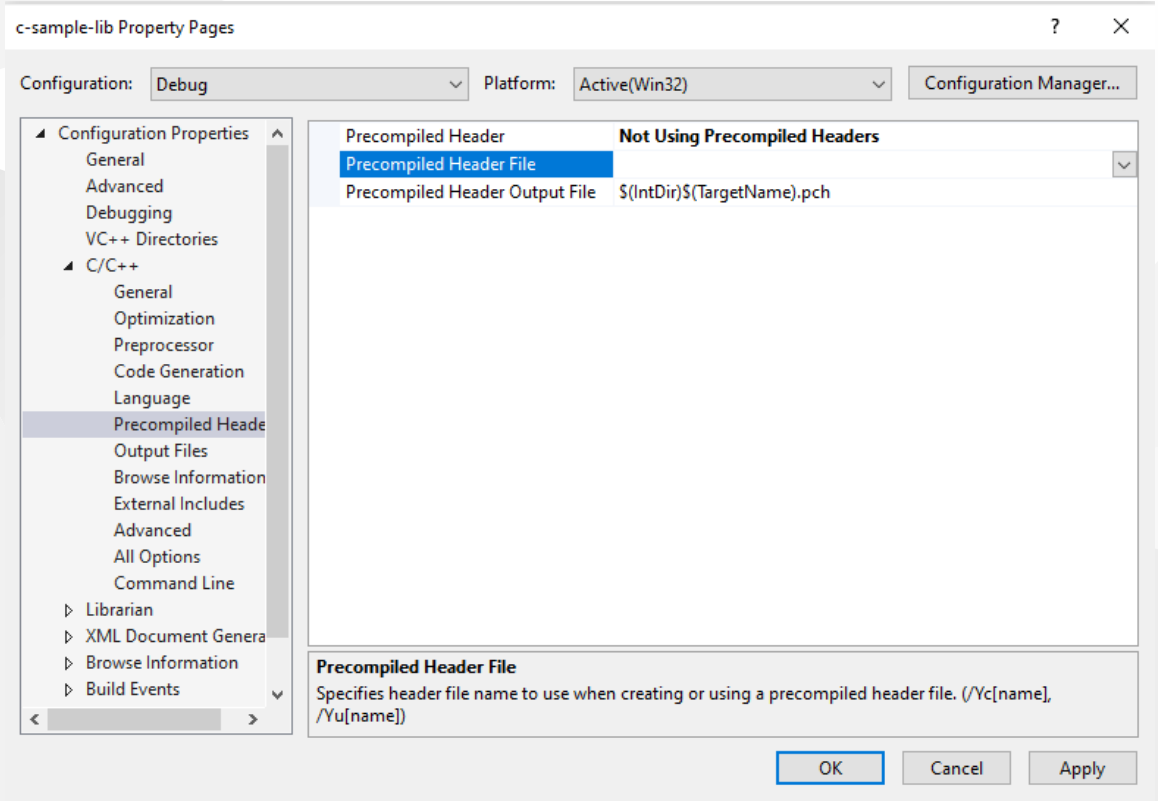
Default configuration come with C++ project types and setting



In the c-sample-lib.cpp you will sample function

```
void fncsamplelib()
{

}
```

Delete pch.h and pch.c files. Also disable use precompiled header settings from configurations and change to "Not Using Precomplied Headers", also you can delete precomplied Header File.



Customize library header name and update "framework.h" to "samplelib.h"

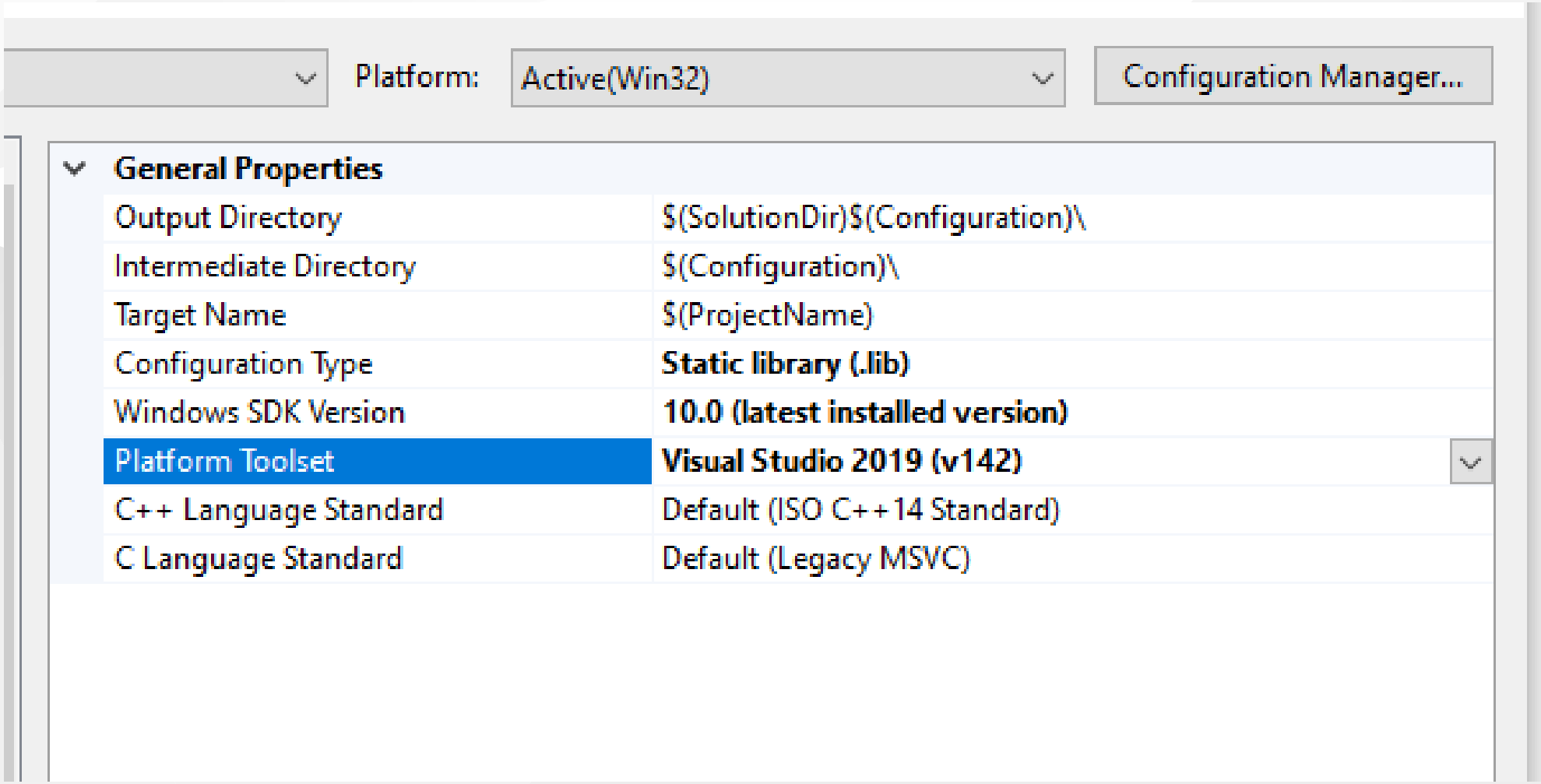
Insert your functions inside the c-sample-lib.c and update header files also.

```
// c-sample-lib.cpp : Defines the functions for the static library.
//

#include "samplelib.h"
#include "stdio.h"

/// <summary>
///
/// </summary>
/// <param name="name"></param>
void sayHelloTo(char* name){

    if (name != NULL){
        printf("Hello %s \n",name);
    }
    else {
        printf("Hello There\n");
    }
}

/// <summary>
///
/// </summary>
/// <param name="a"></param>
/// <param name="b"></param>
/// <returns></returns>
int sum(int a, int b){

    int c = 0;
    c = a + b;
    return c;
}
```

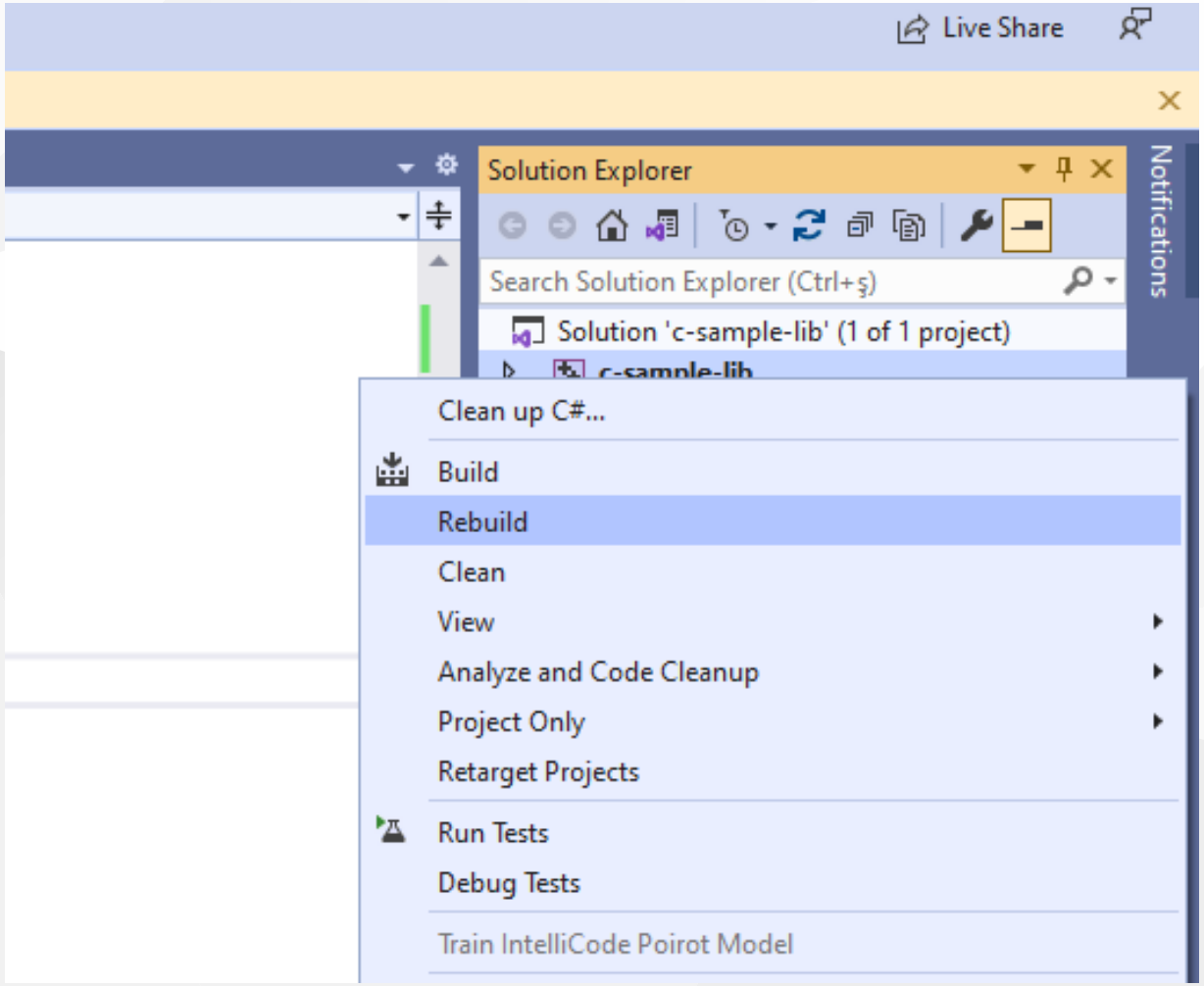
also update samplelib.h

```
#pragma once

#define WIN32_LEAN_AND_MEAN             // Exclude rarely-used stuff from Windows headers

void sayHelloTo(char* name);
int sum(int a, int b);
```

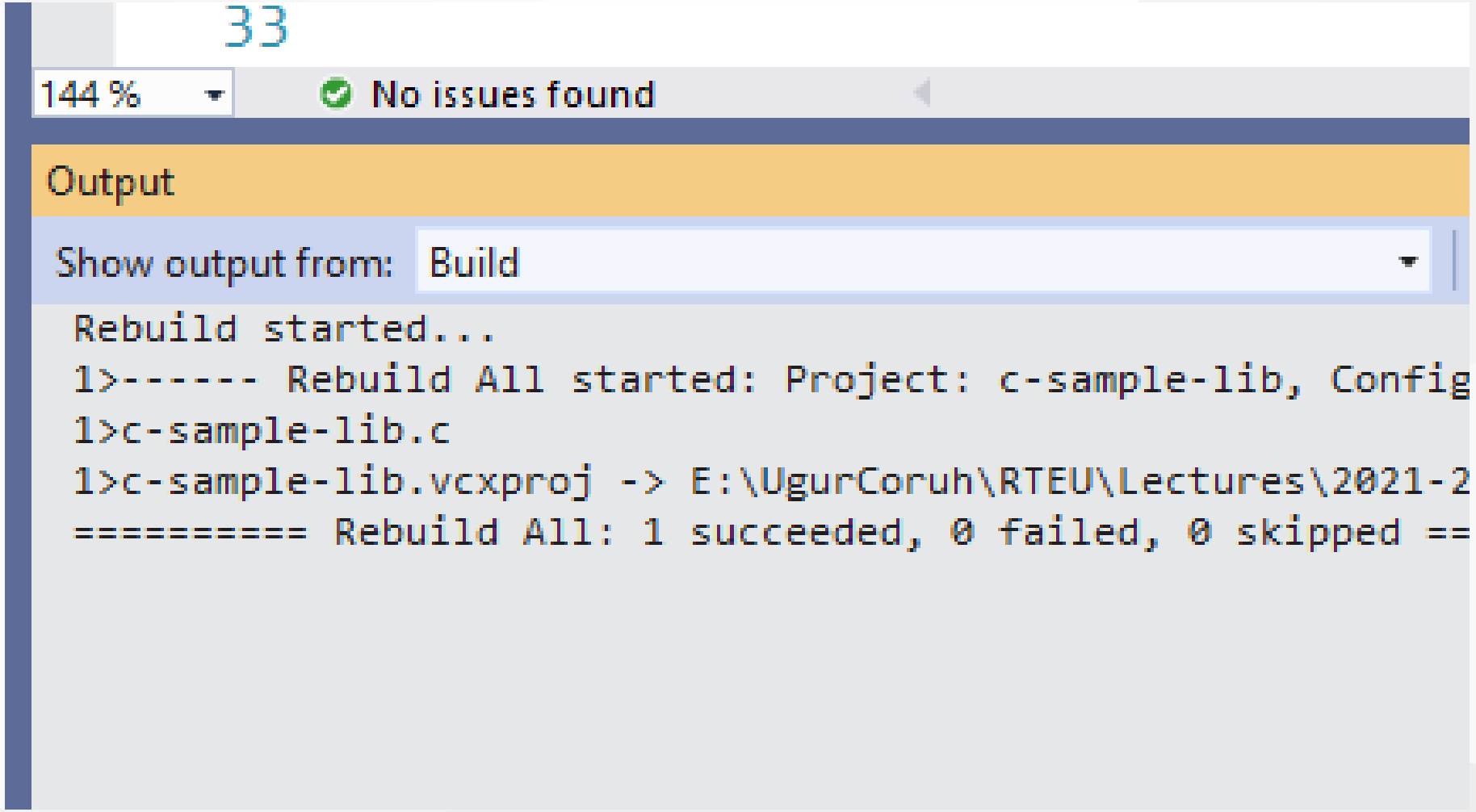
If you check configuration you will see that for C complier we are using Microsoft Environment and Toolkits



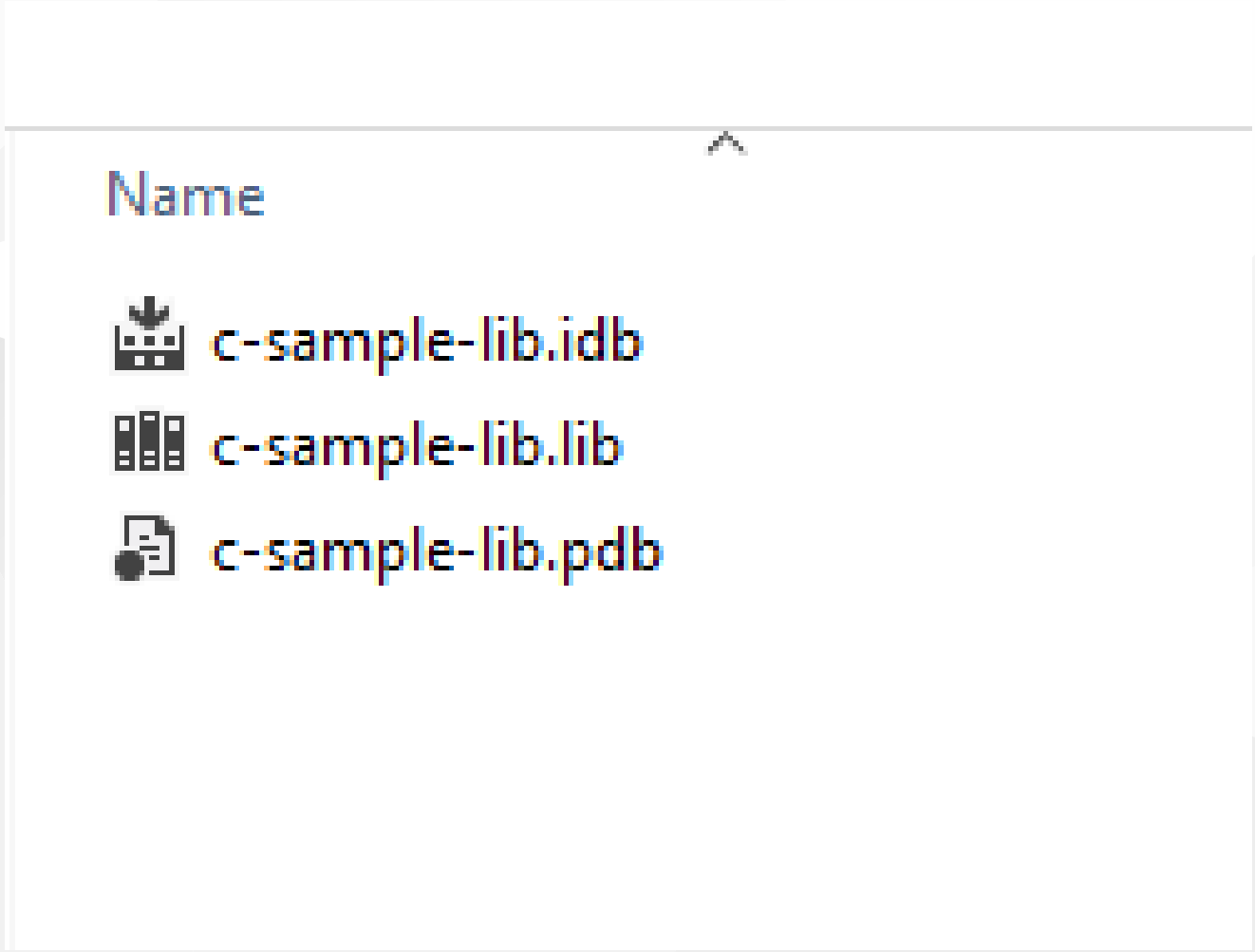
Now we can compile our library



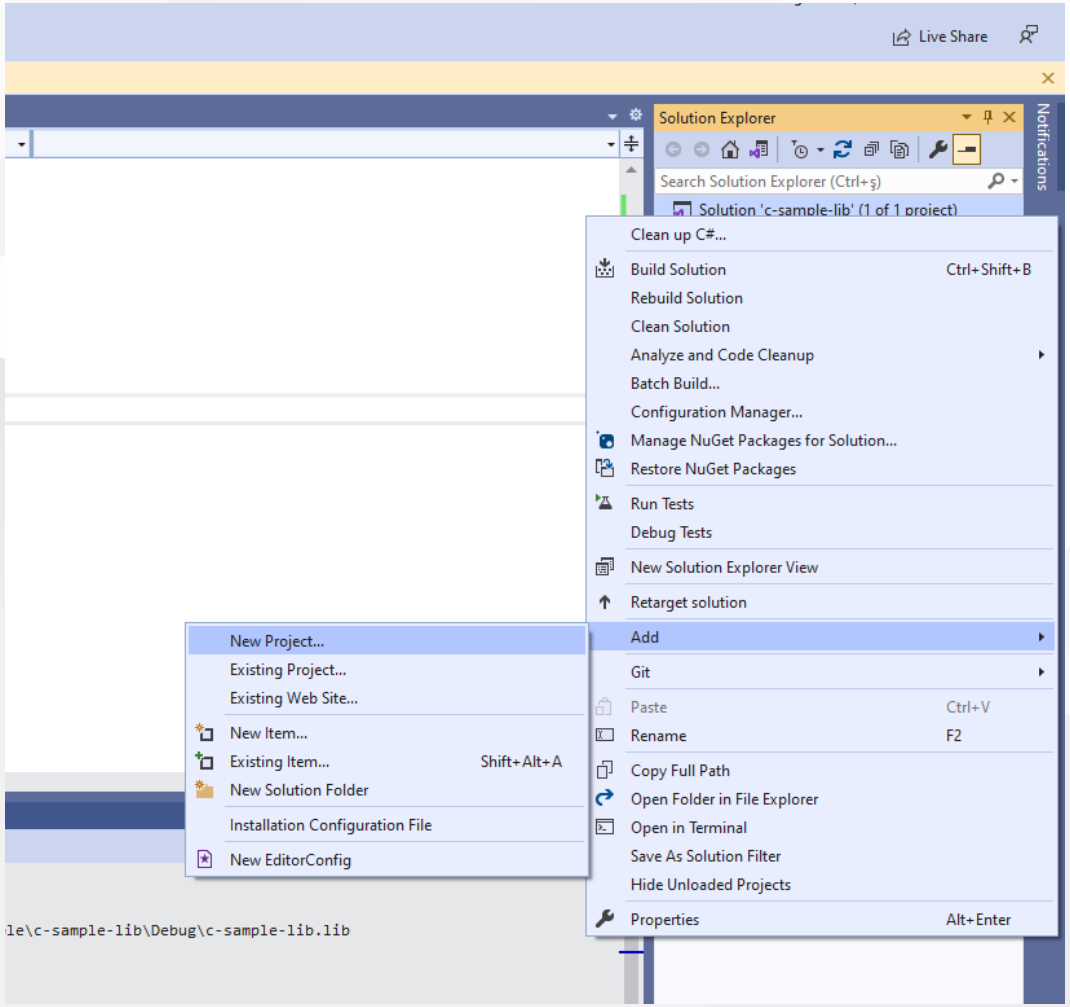
You can follow operation from output window



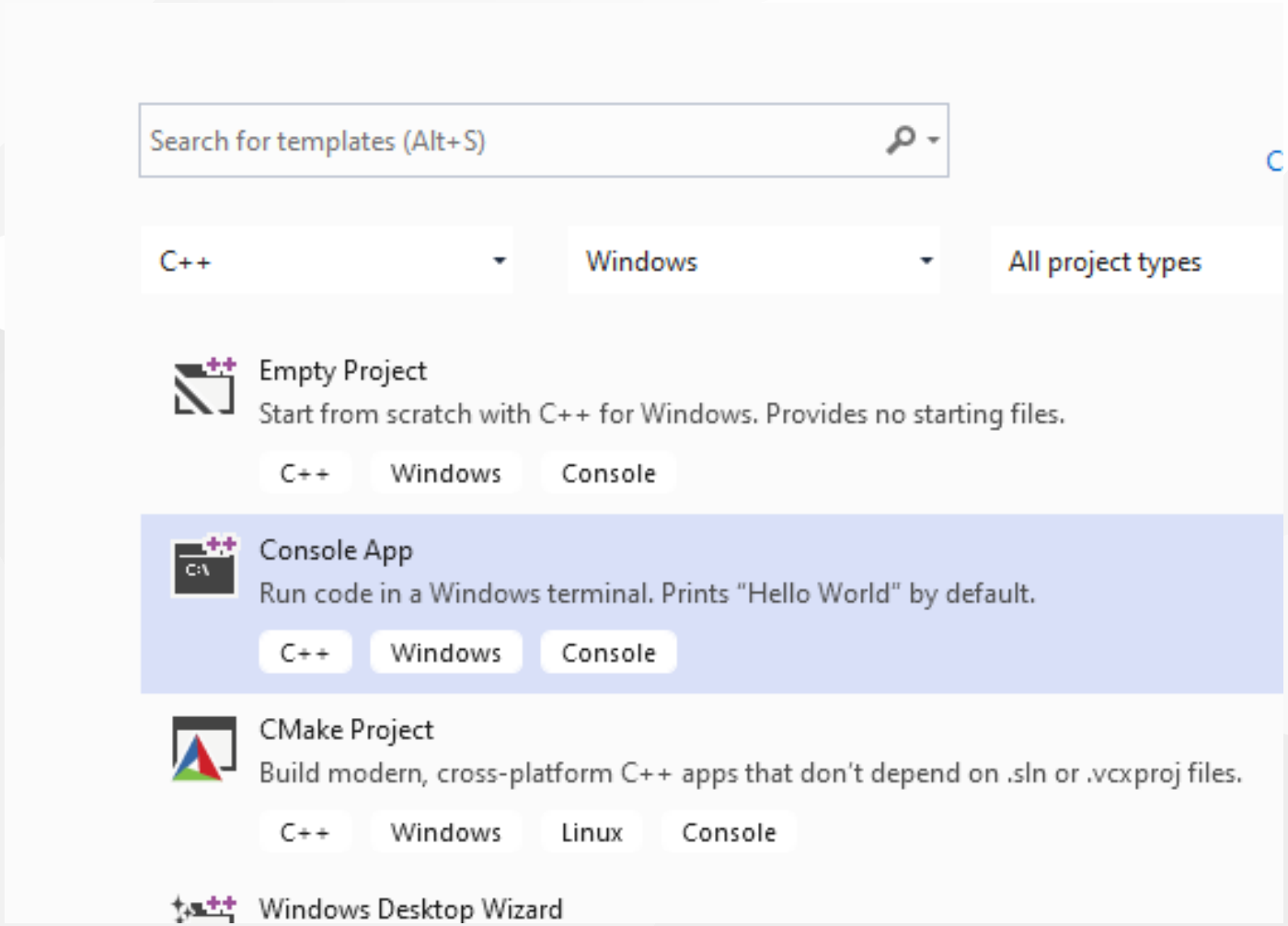
in debug folder we will see our output



now we will add a console application c-sample-app and use our library



select C++ Windows Console Application from list

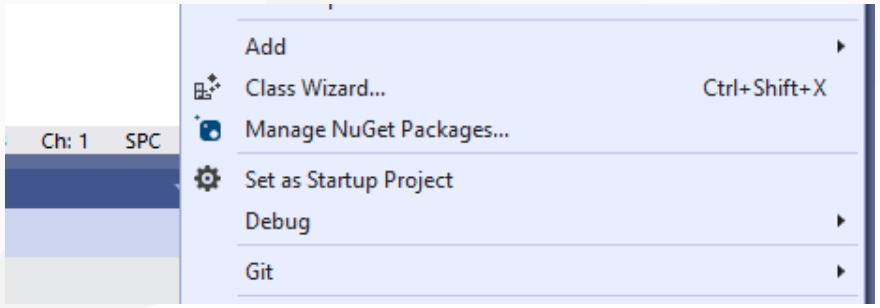


C++ Console Application Selection will generate a C++ console project we can change extension to C to compile our application as C application.

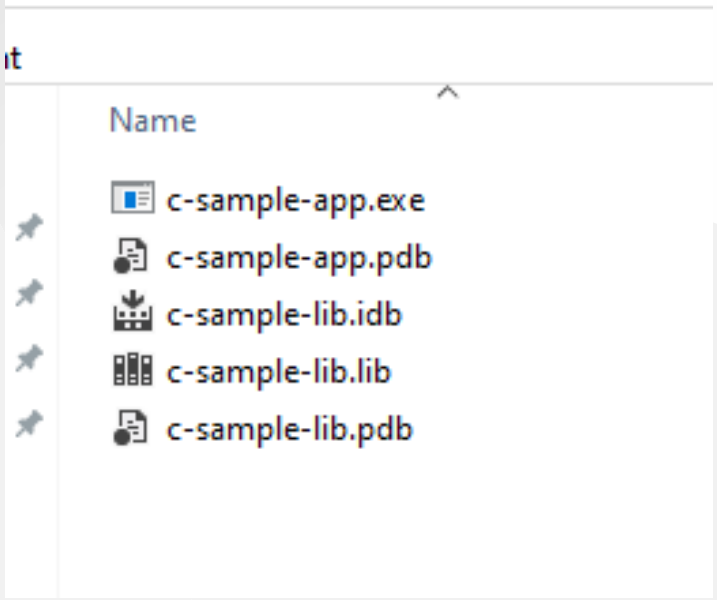
we will convert c-sample-app.c to following code

```c
#include <stdio.h>

/// <summary>
///
/// </summary>
/// <returns></returns>
int main()
{
    printf("Hello World!\n");
}
```

after conversion set c-sample-app as startup project and build it



this will create c-sample-app.exe in the same folder with c-sample-lib.lib library

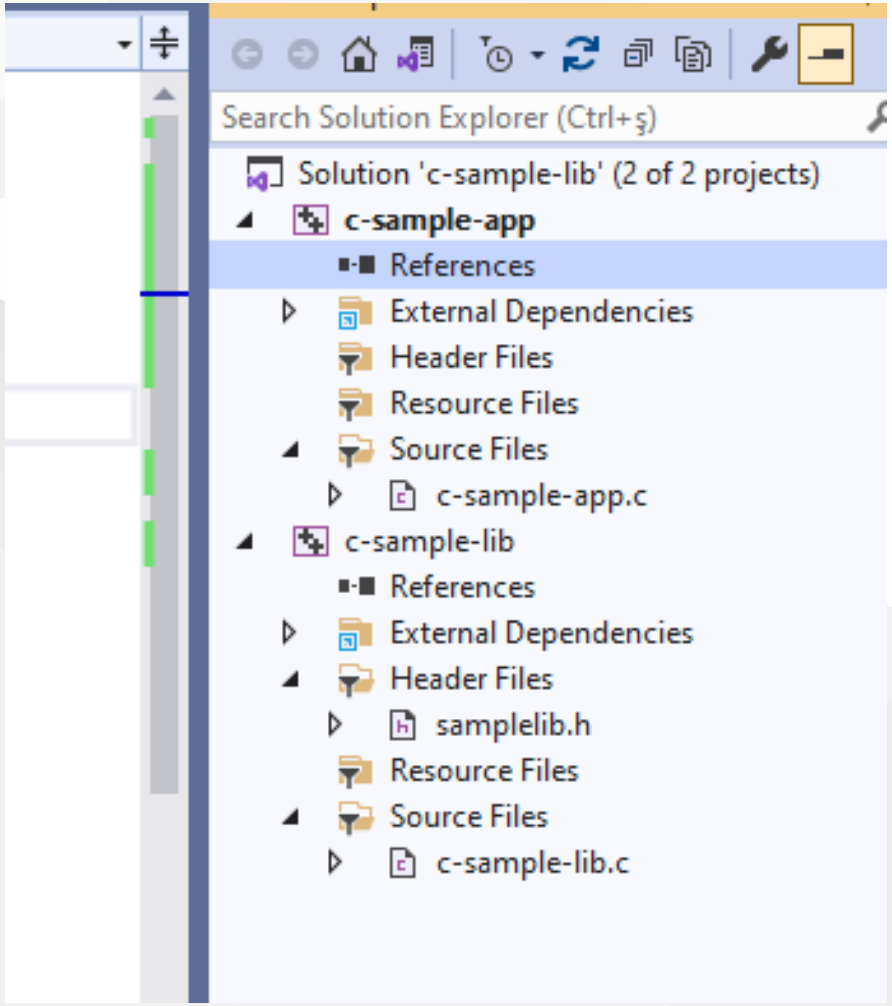


if we run application we will see only "Hello World"

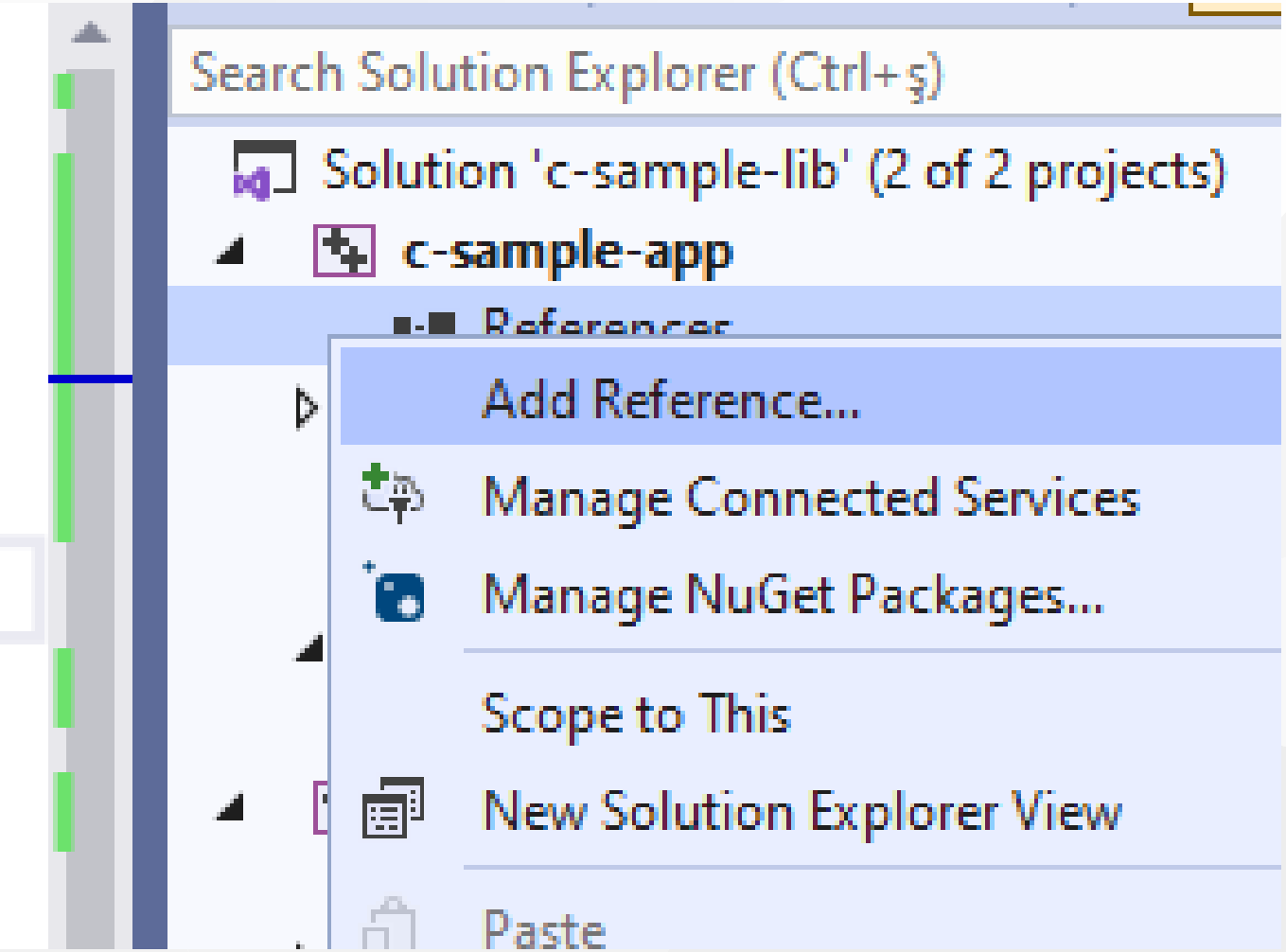
now we will see two options to add library as references in our application and use its functions.

First option

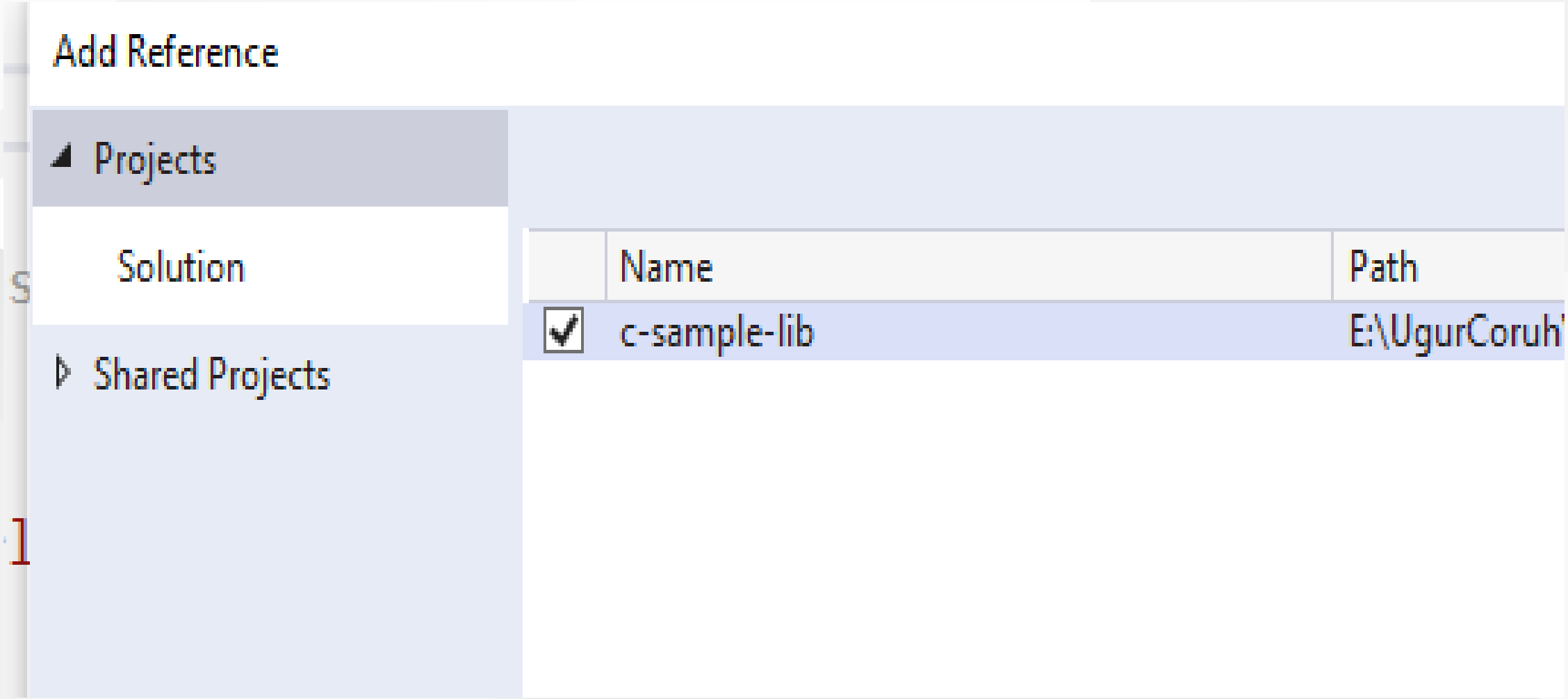
right click references for c-sample-app and add current library as reference



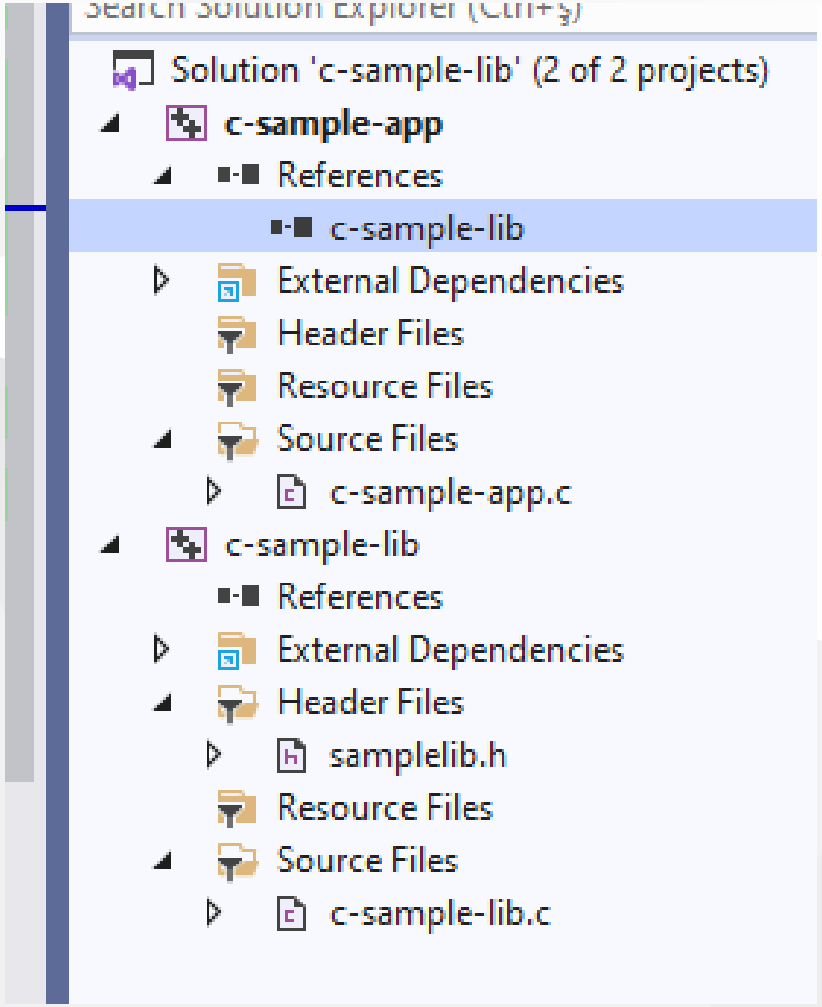
Select Add Reference



Browse for solution and select c-sample-lib



You can check added reference from references section

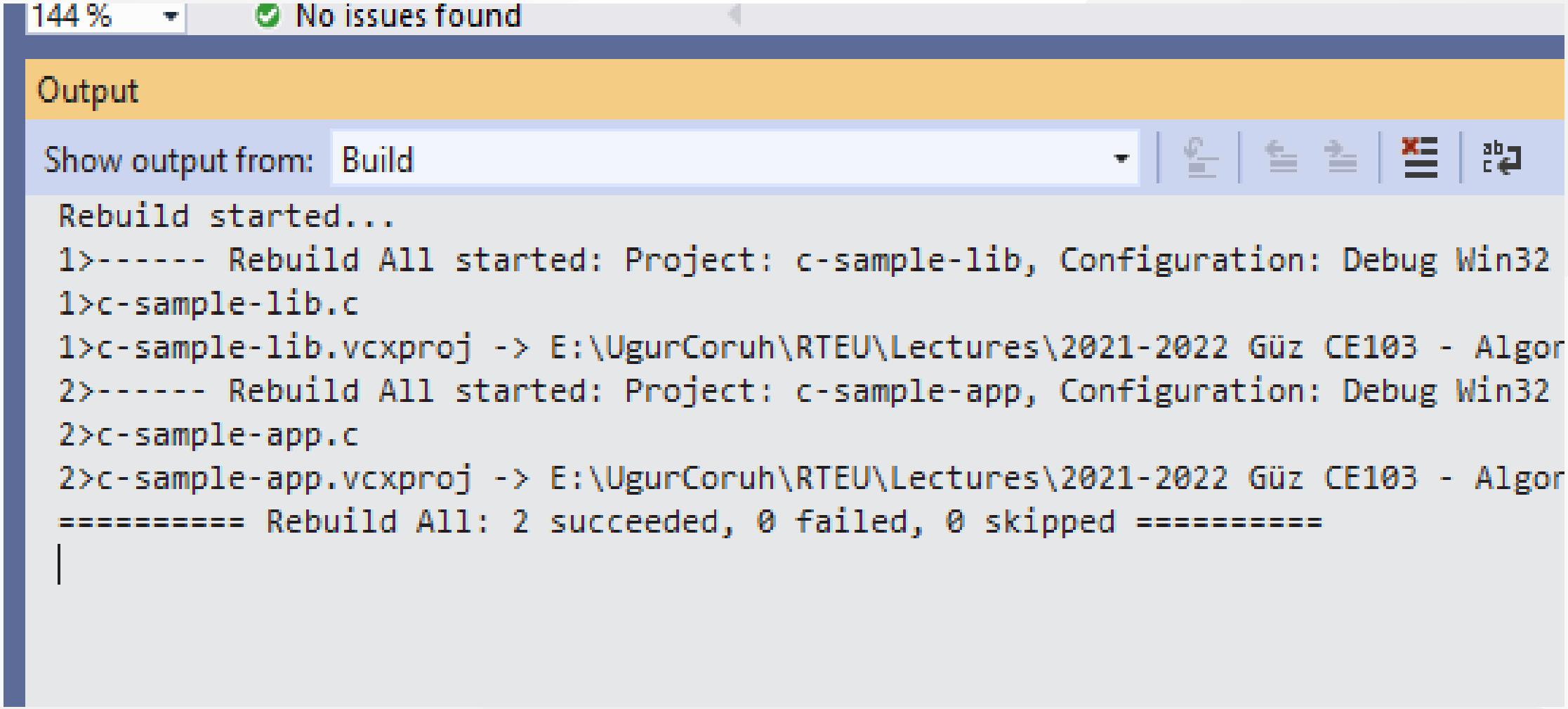


now we can include required headers from c-sample-lib folder and use it.

we can include required header with relative path as follow or with configuration

```
#include <stdio.h>
#include "..\c-sample-lib\samplelib.h"
/// <summary>
///
/// </summary>
/// <returns></returns>
int main()
{
    printf("Hello World!\n");
}
```

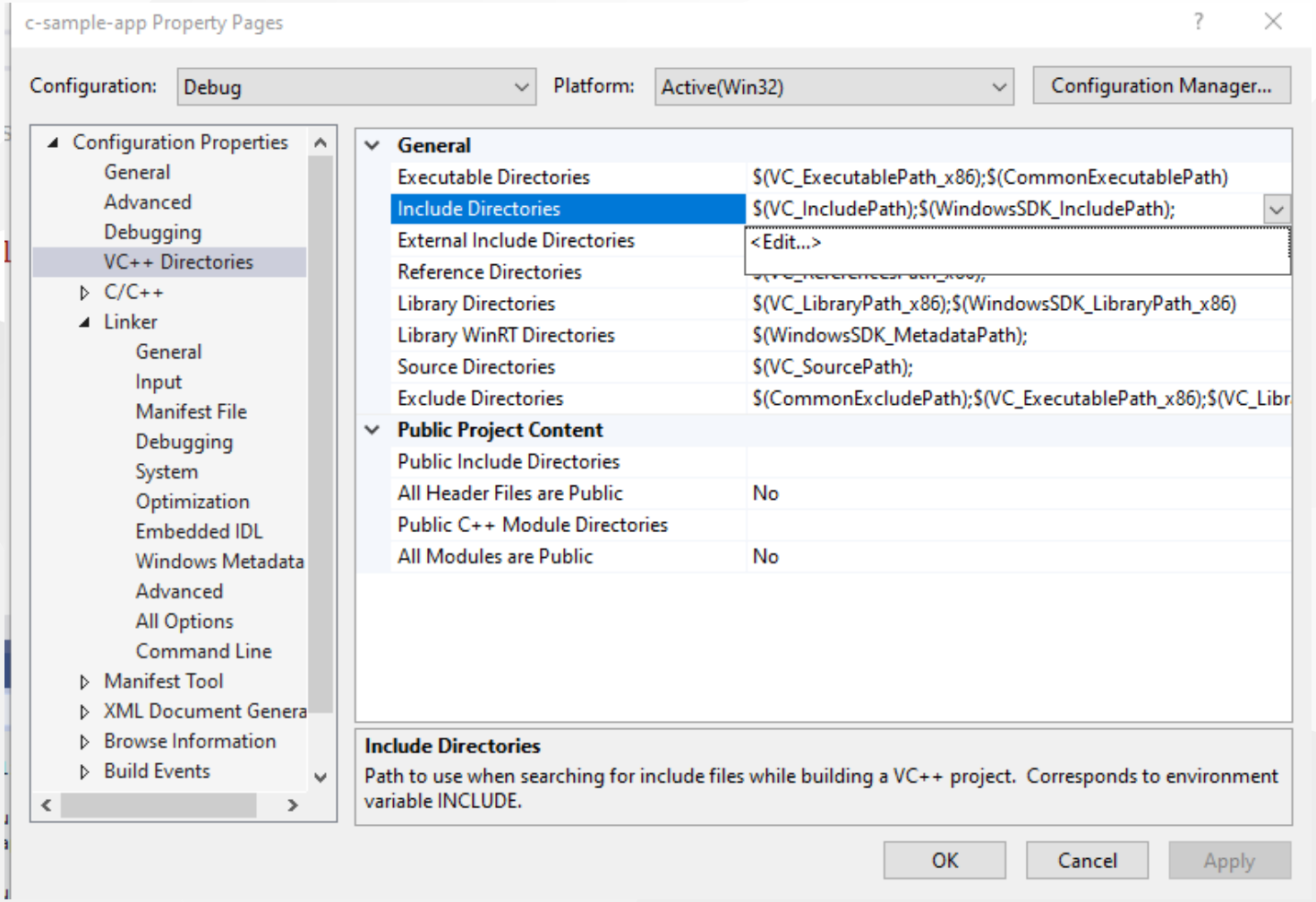
we can build our c-sample-app



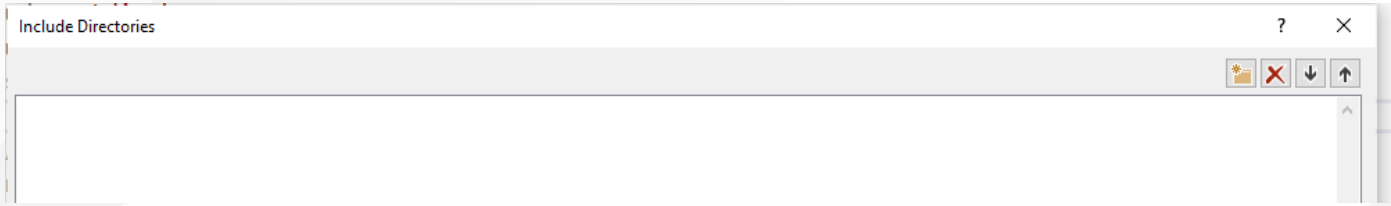
also we can only write header name

```
#include <samplelib.h>
```

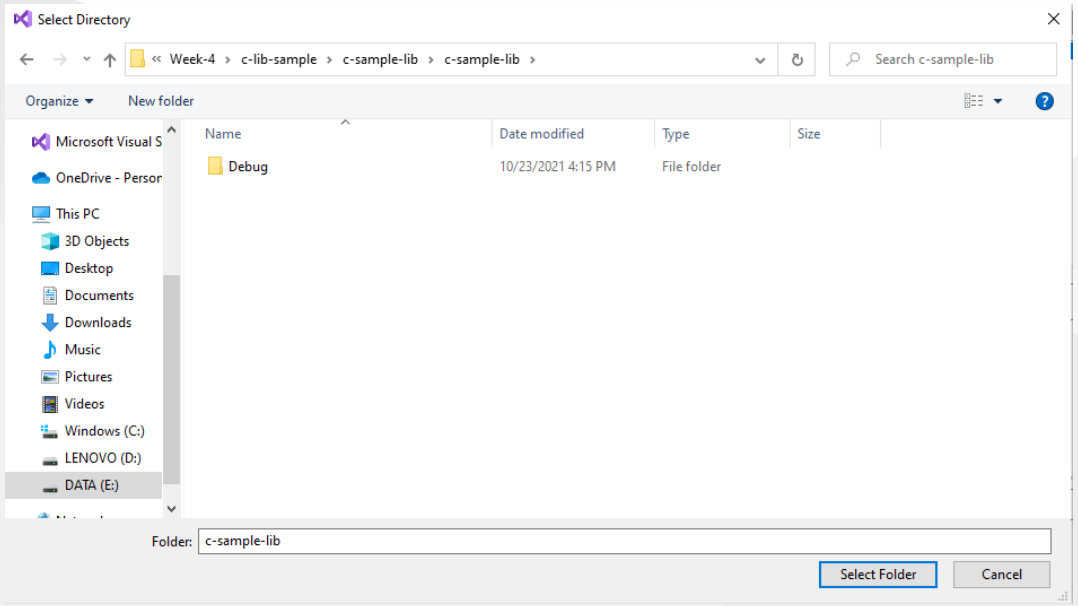
for this we need to configure include directories



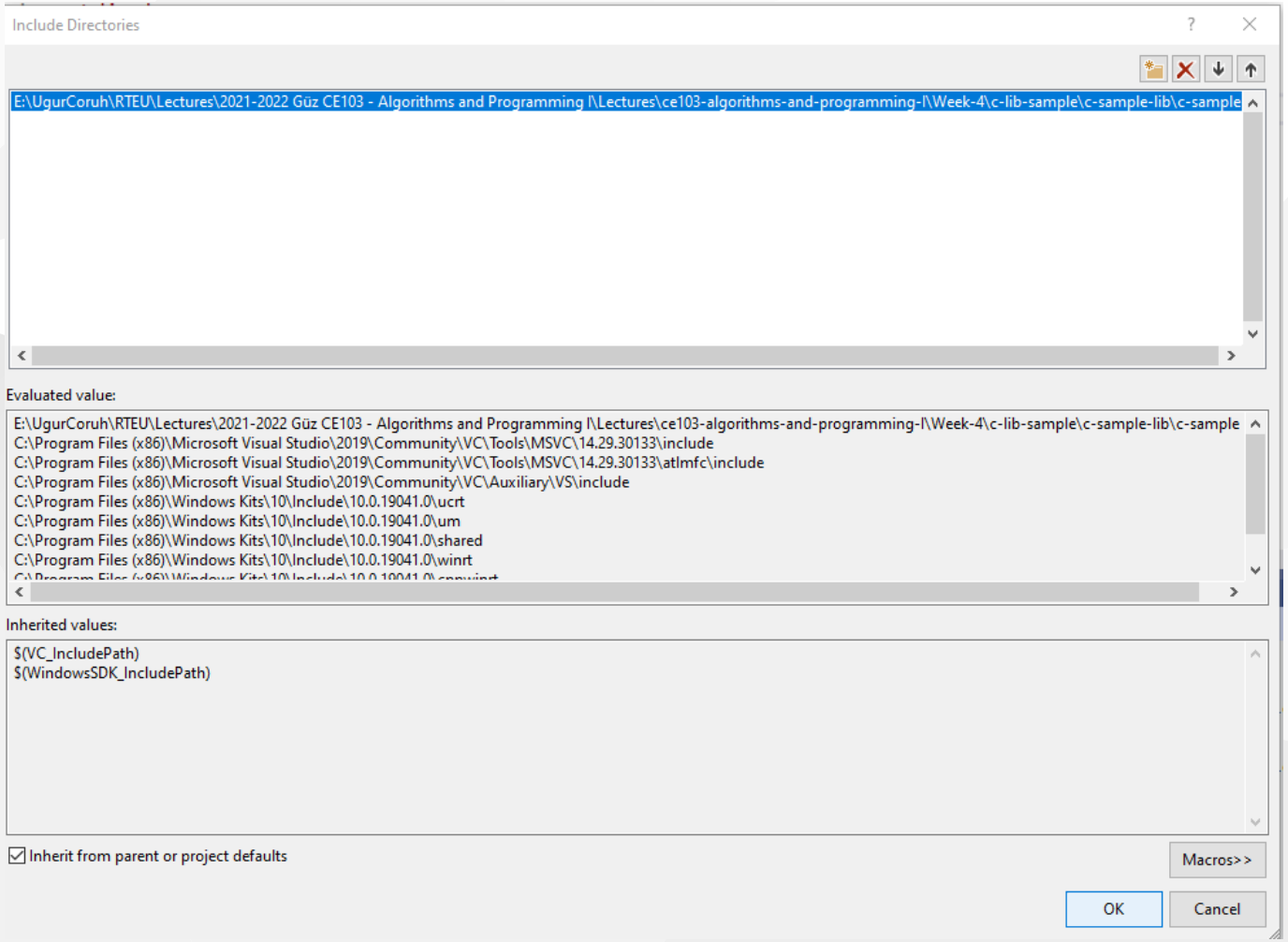
select c-sample-lib header file location



browse for folder



your full path will be added to your configuration

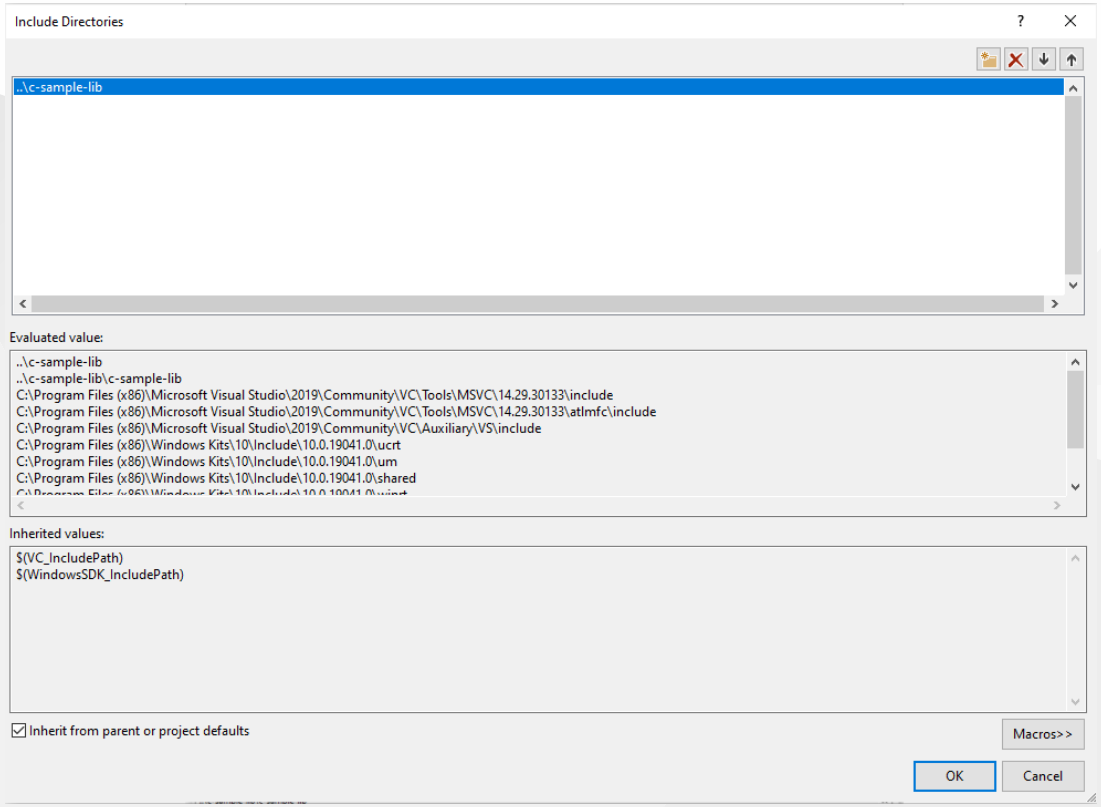


if you add header file paths to your configuration you can use header files by name in your source code

```
#include <stdio.h>
#include <samplelib.h>
/// <summary>
///
/// </summary>
/// <returns></returns>
int main()
{
    printf("Hello World!\n");
}
```

we can compile the following we don't have problems but here we need to configure relative paths for configuration open include library settings and update with relative path

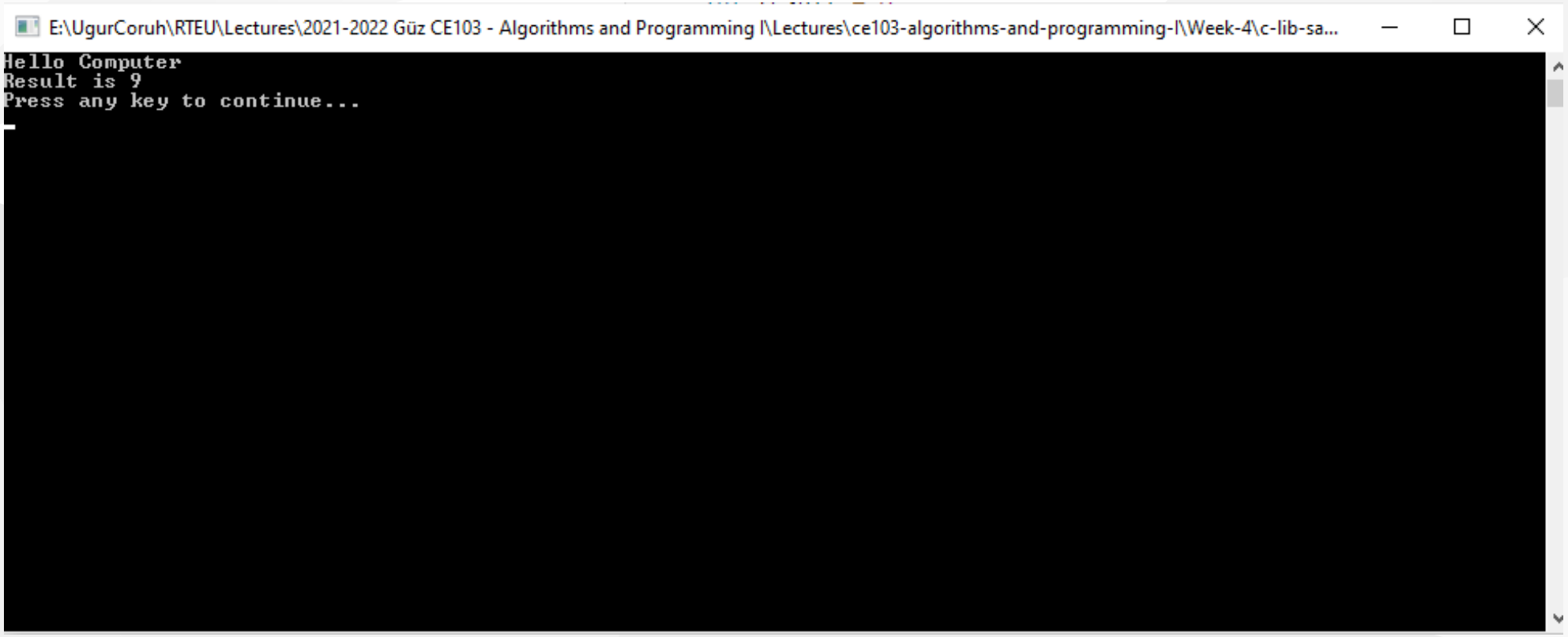
```
..\c-sample-lib
```



now we have portable source code configuration. we can call our functions and then we can update header and library folder configurations.

```
#include <stdio.h>
#include <samplelib.h>
/// <summary>
///
/// </summary>
/// <returns></returns>
int main()
{
    int result = 0;
    //printf("Hello World!\n");
    result = sum(5, 4);
    sayHelloTo("Computer");
    printf("Result is %d \n",result);
    printf("Press any key to continue...\n");
    getchar();
    return 0;
}
```

when you run you will see the following outputs, that mean we called library functions.



static library is a code sharing approach if you want to share your source code with your customers then you can share static libraries and header files together. Another case you can use a precompiled static library with you or this library can be part of any installation then if there is a installed app and static libraries are placed on system folder or any different location then you can use configuration files to set library path and included header paths

Now we can remove project from c-sample-app references but we will set library file in configuration

Before this copy static library and header files to a folder like that

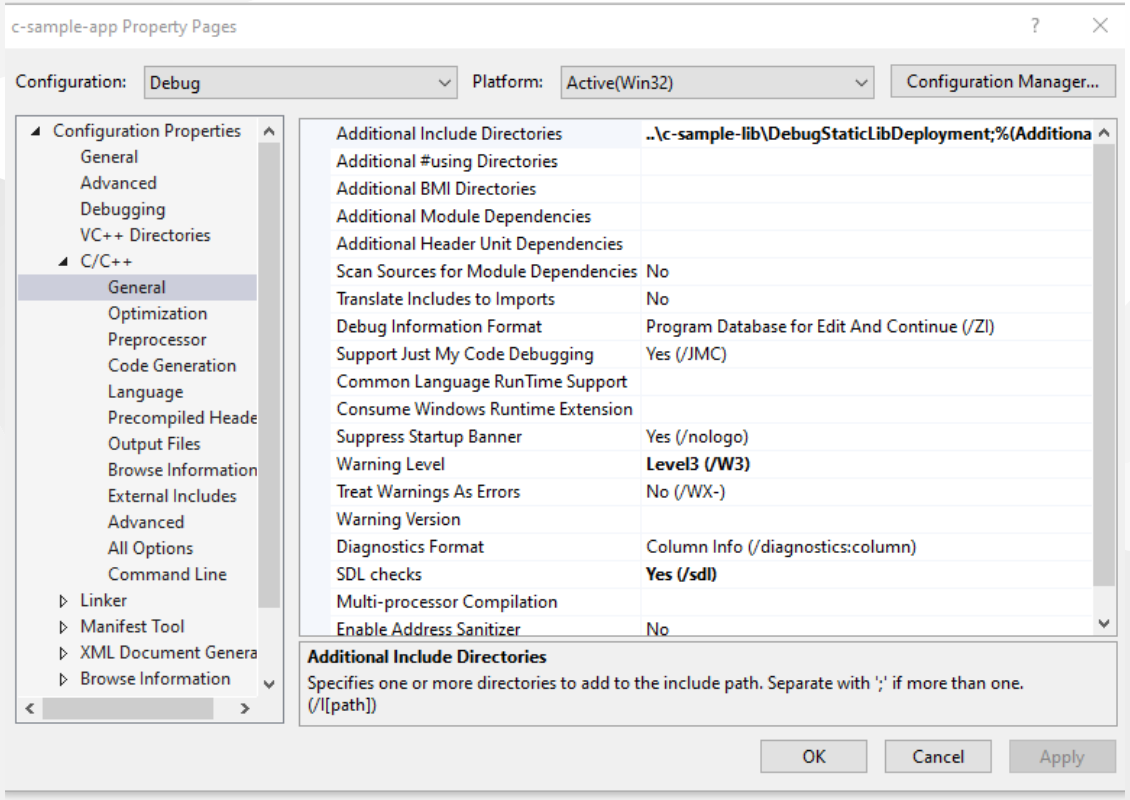
```
DebugStaticLibDeployment
```

- Set C/C++ -> General -> Additional Include Directories

There is a bug in configurations and relative path not finding headers so for this reason we will set full path but this is not a good practice for team working

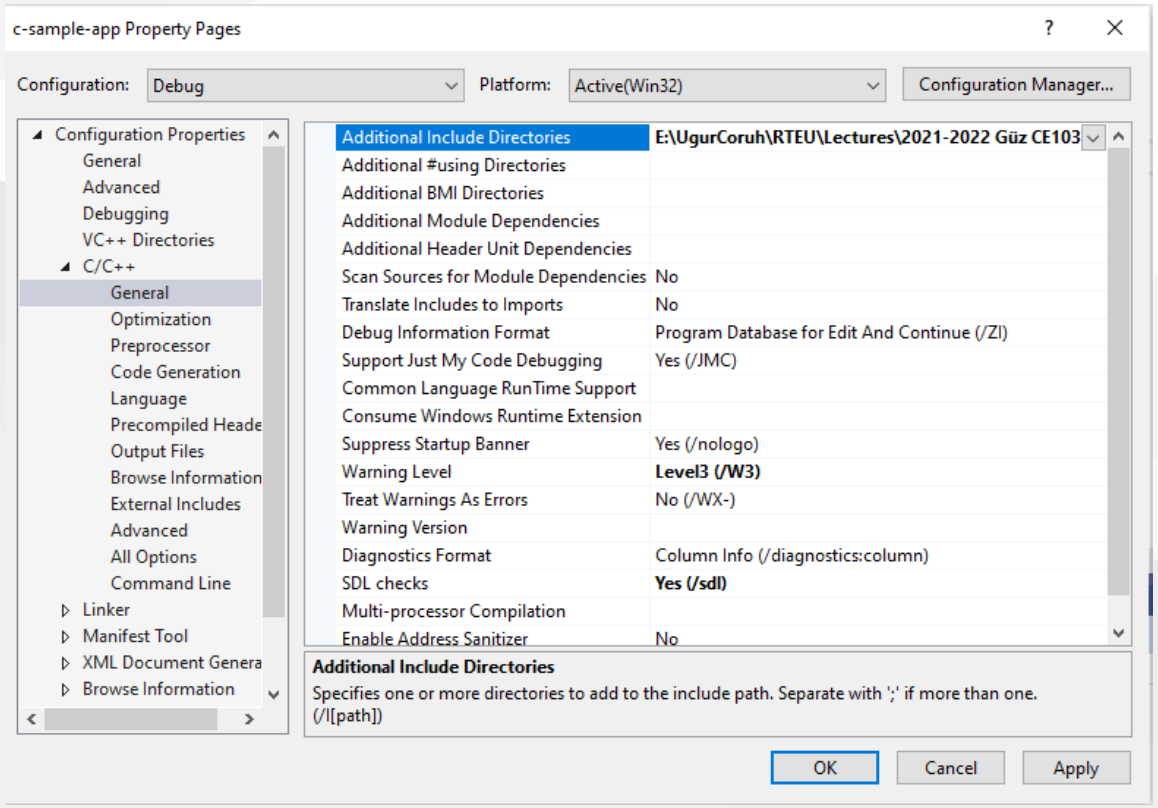
Not Working

```
..\c-sample-lib\DebugStaticLibDeployment
```



Working

```
E:\...\c-lib-sample\c-sample-lib\DebugStaticLibDeployment
```



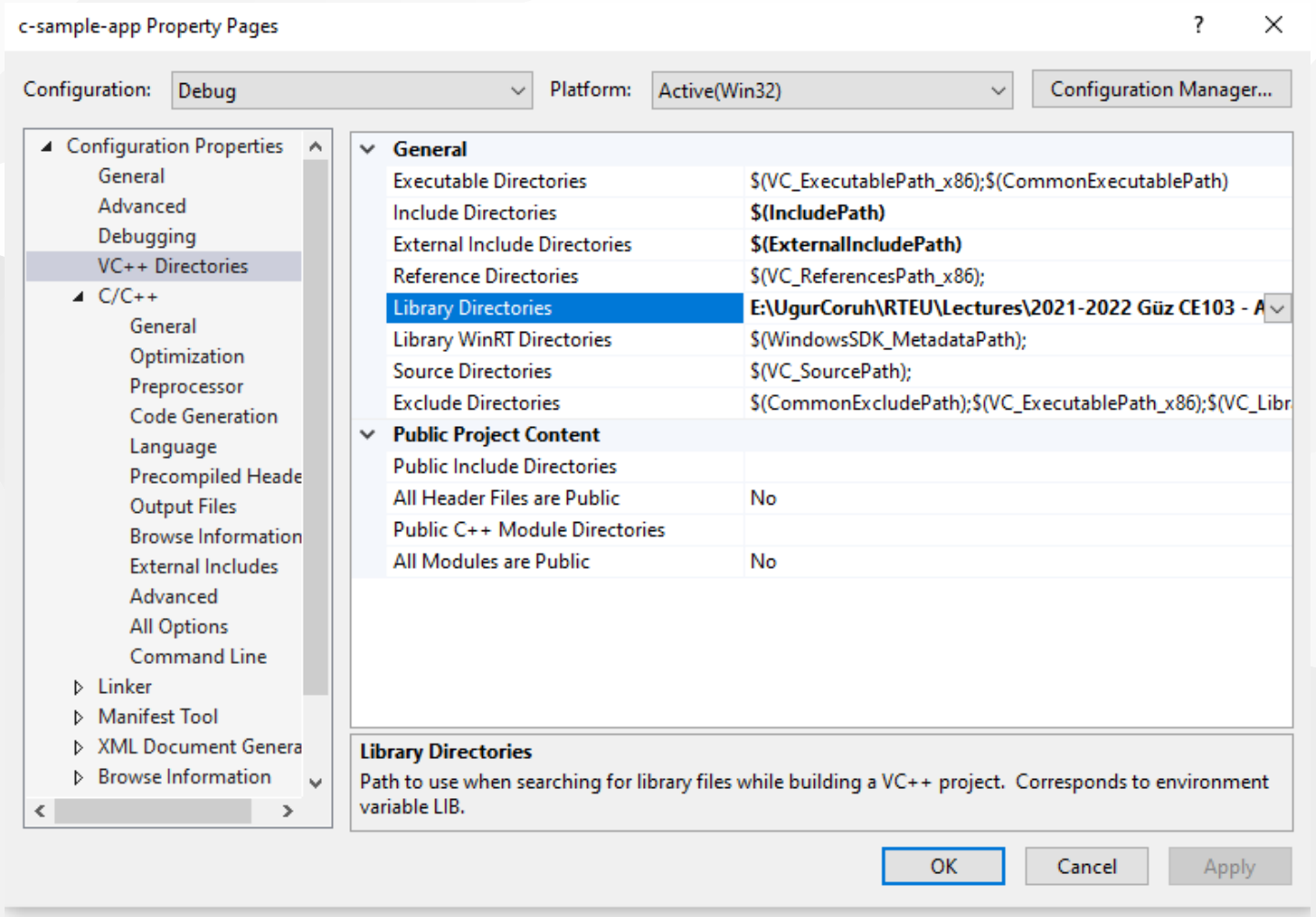
Now we will set library folder that our static library placed

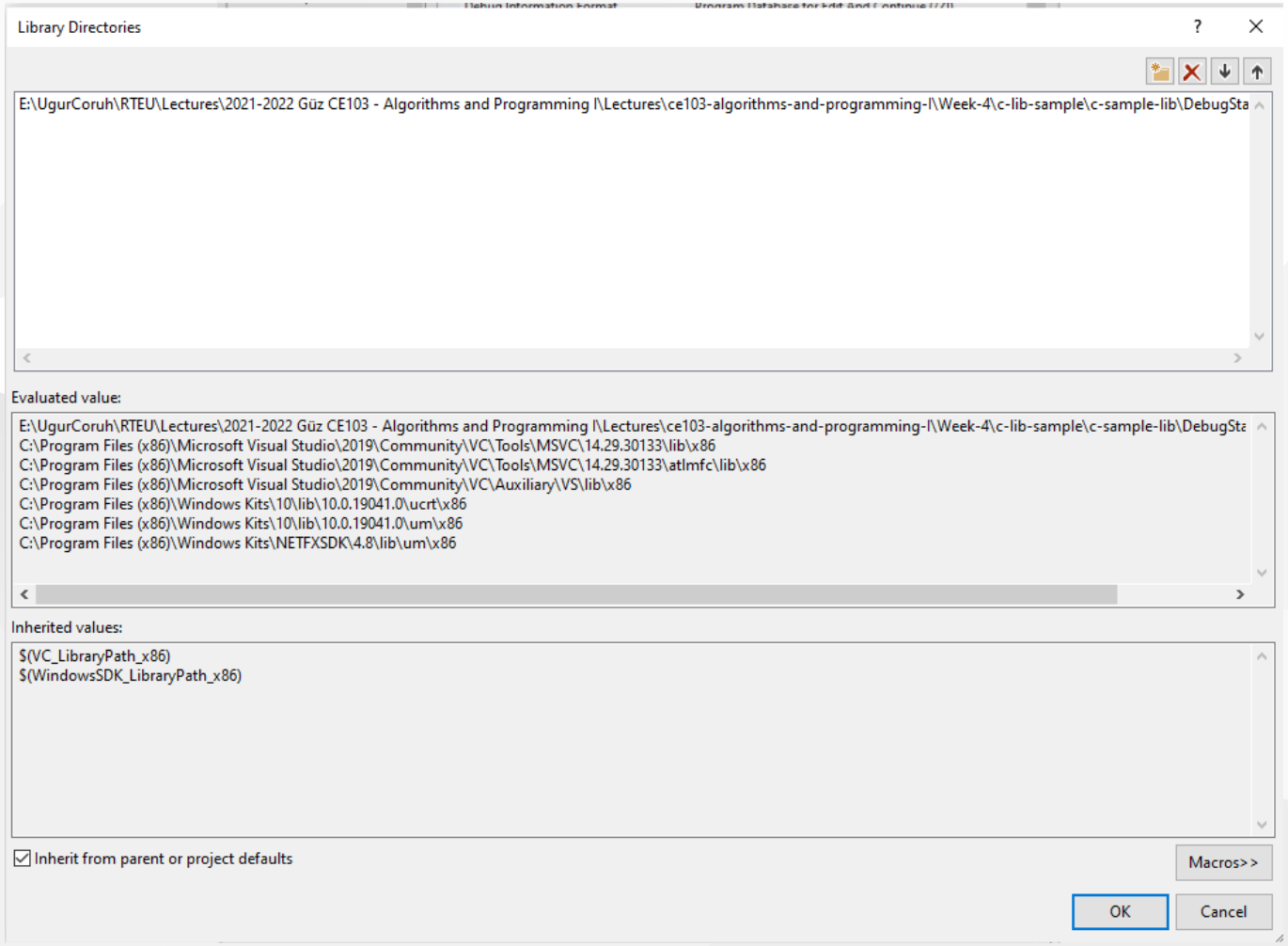
we will set VC++ Directories -> Library Directories

Here is the same issue if we use relative path it doesn't work we need to set full path for library folder

Working

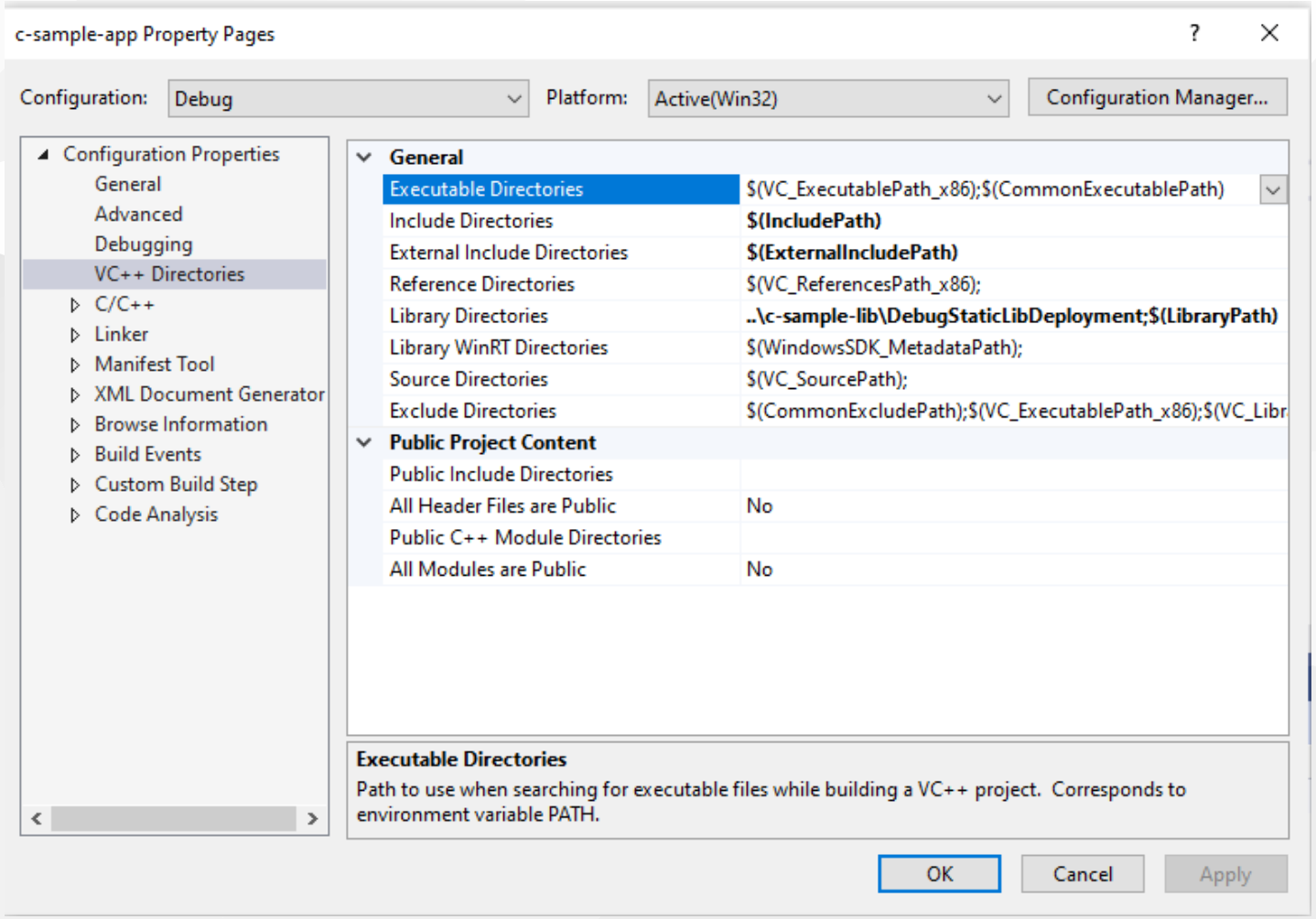
```
E:\...\c-lib-sample\c-sample-lib\DebugStaticLibDeployment
```

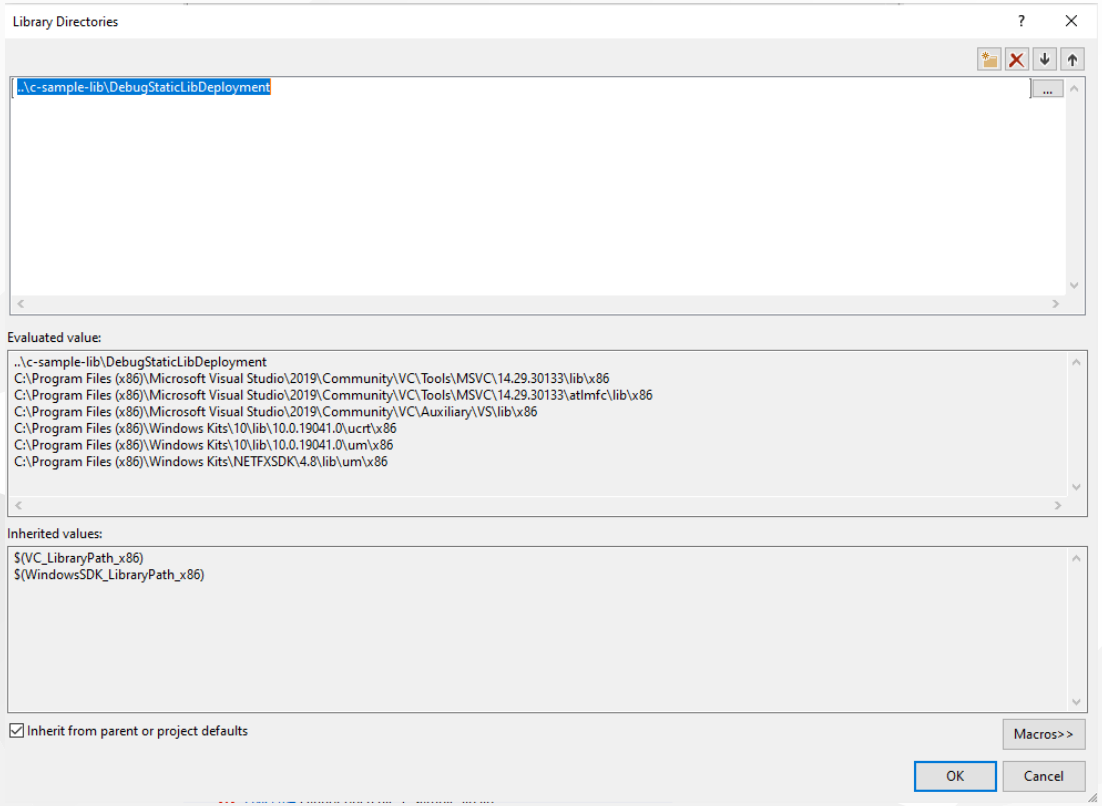


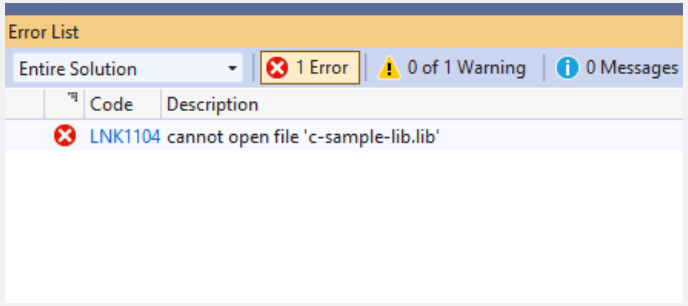

Library Directories
E:\UgurCoruh\RTEU\Lectures\2021-2022 Güz CE103 - Algorithms and Programming I\Lectures\ce103-algorithms-and-programming-I\Week-4\c-lib-sample\c-sample-lib\DebugSta
Evaluated value:
E:\UgurCoruh\RTEU\Lectures\2021-2022 Güz CE103 - Algorithms and Programming I\Lectures\ce103-algorithms-and-programming-I\Week-4\c-lib-sample\c-sample-lib\DebugSta
C:\Program Files (x86)\Microsoft Visual Studio\2019\Community\VC\Tools\MSVC\14.29.30133\lib\x86
C:\Program Files (x86)\Microsoft Visual Studio\2019\Community\VC\Tools\MSVC\14.29.30133\atlmfc\lib\x86
C:\Program Files (x86)\Microsoft Visual Studio\2019\Community\VC\Auxiliary\VS\lib\x86
C:\Program Files (x86)\Windows Kits\10\lib\10.0.19041.0\ucrt\x86
C:\Program Files (x86)\Windows Kits\10\lib\10.0.19041.0\um\x86
C:\Program Files (x86)\Windows Kits\NETFXSDK\4.8\lib\um\x86
Inherited values:
$(VC_LibraryPath_x86)
$(WindowsSDK_LibraryPath_x86)
Inherit from parent or project defaults
Macros>>
OK
Cancel

Not Working

```
..\c-sample-lib\DebugStaticLibDeployment
```

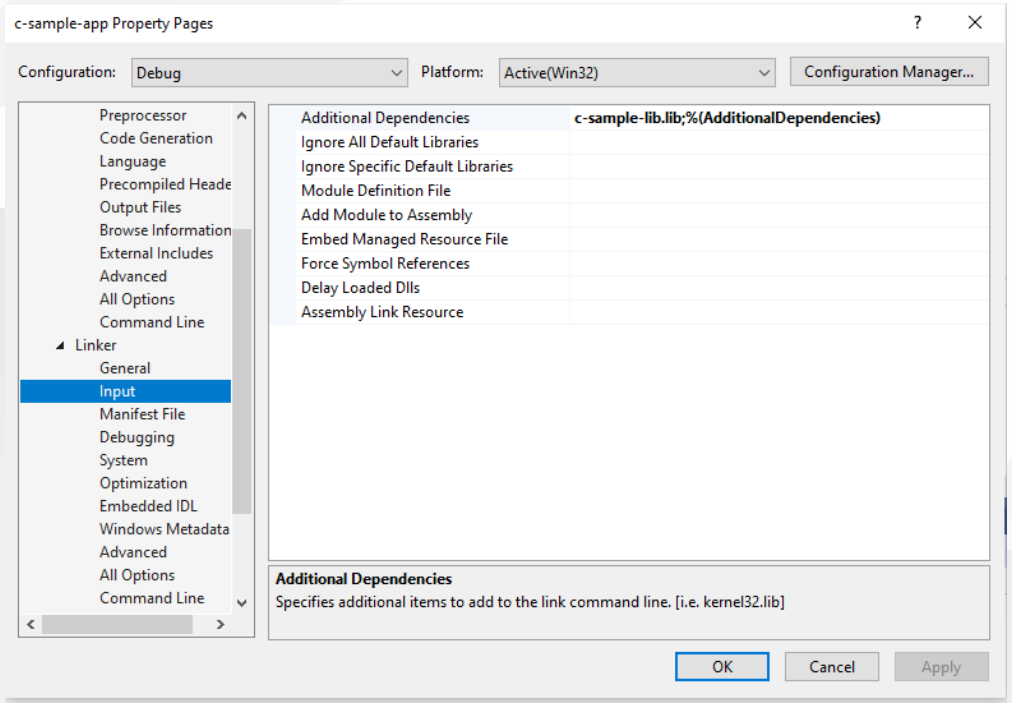



Library Directories
..\c-sample-lib\DebugStaticLibDeployment
Evaluated value:
..\c-sample-lib\DebugStaticLibDeployment
C:\Program Files (x86)\Microsoft Visual Studio\2019\Community\VC\Tools\MSVC\14.29.30133\lib\x86
C:\Program Files (x86)\Microsoft Visual Studio\2019\Community\VC\Tools\MSVC\14.29.30133\atlmfc\lib\x86
C:\Program Files (x86)\Microsoft Visual Studio\2019\Community\VC\Auxiliary\VS\lib\x86
C:\Program Files (x86)\Windows Kits\10\lib\10.0.19041.0\ucrt\x86
C:\Program Files (x86)\Windows Kits\10\lib\10.0.19041.0\um\x86
C:\Program Files (x86)\Windows Kits\NETFXSDK\4.8\lib\um\x86
Inherited values:
$(VC_LibraryPath_x86)
$(WindowsSDK_LibraryPath_x86)
Inherit from parent or project defaults
Macros>>
OK
Cancel


Error List
Entire Solution
1 Error
0 of 1 Warning
0 Messages
Code
Description
LNK1104 cannot open file 'c-sample-lib.lib'

If we set full path for both libraries and headers then we need to set library name for project

Linker->Input->Additional Dependencies

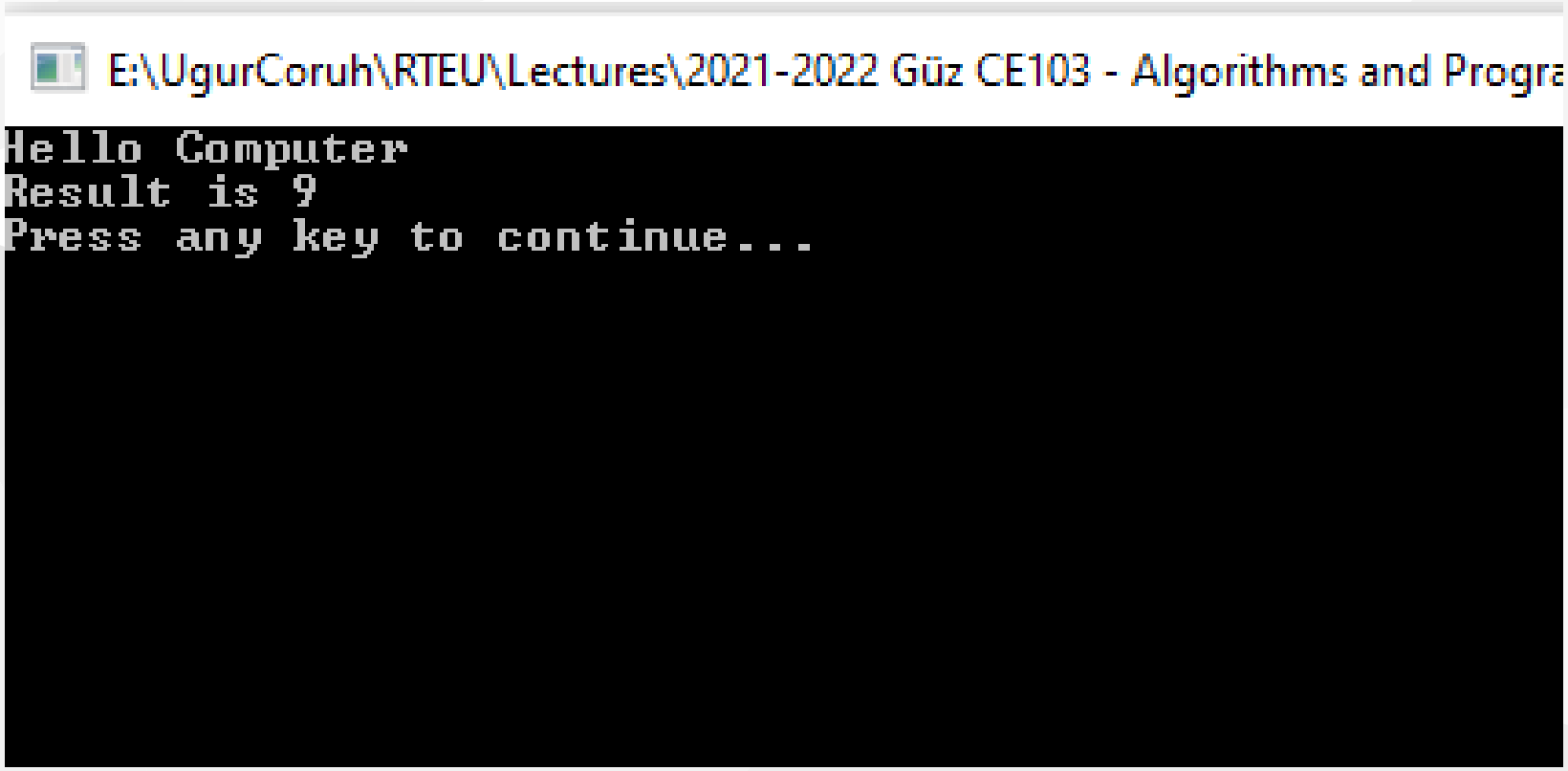


In this case we will compile c-sample-app and we do not need to compile c-sample-lib because we copied output files to different location and they are ready to use.

current source code will be like that nothing changed

```
#include <stdio.h>
#include <samplelib.h>

/// <summary>
///
/// </summary>
/// <returns></returns>
int main()
{
    int result = 0;
    //printf("Hello World!\n");
    result = sum(5, 4);
    sayHelloTo("Computer");
    printf("Result is %d \n",result);
    printf("Press any key to continue...\n");
    getchar();
    return 0;
}
```

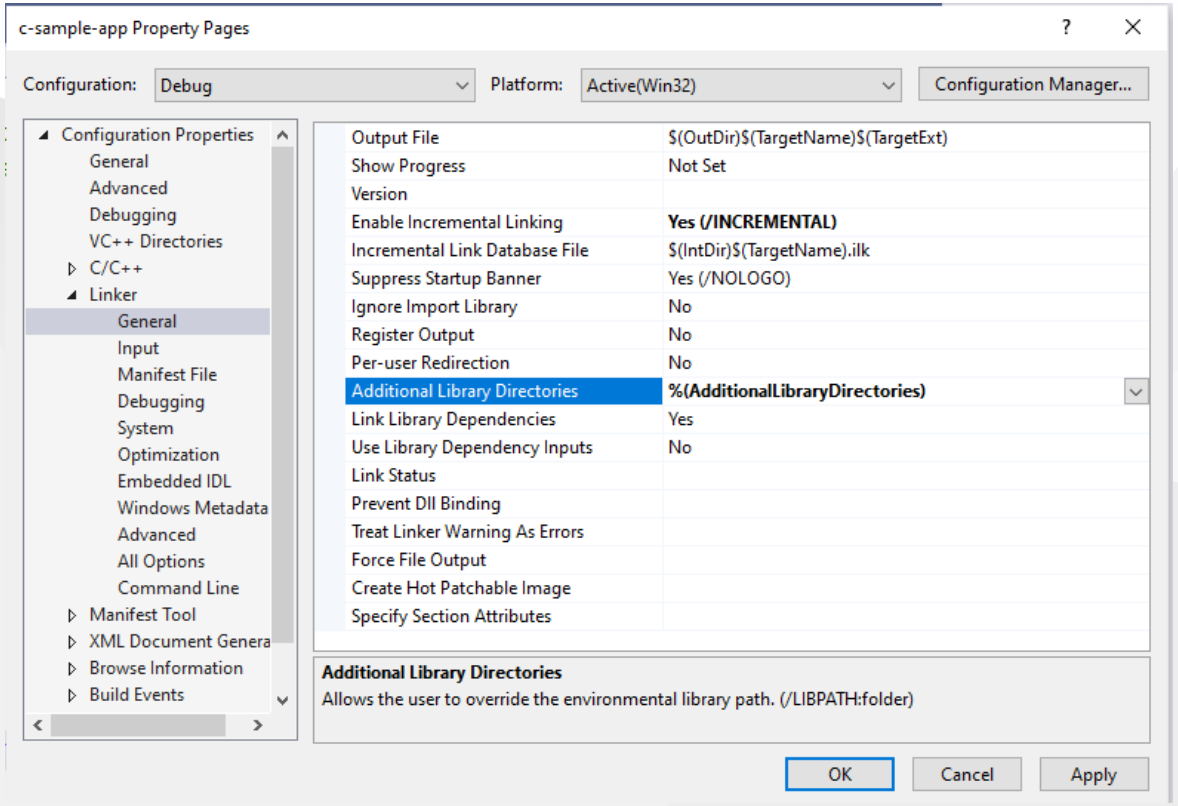
and output


E:\UgurCoruh\RTEU\Lectures\2021-2022 Güz CE103 - Algorithms and Progra
Hello Computer
Result is 9
Press any key to continue...

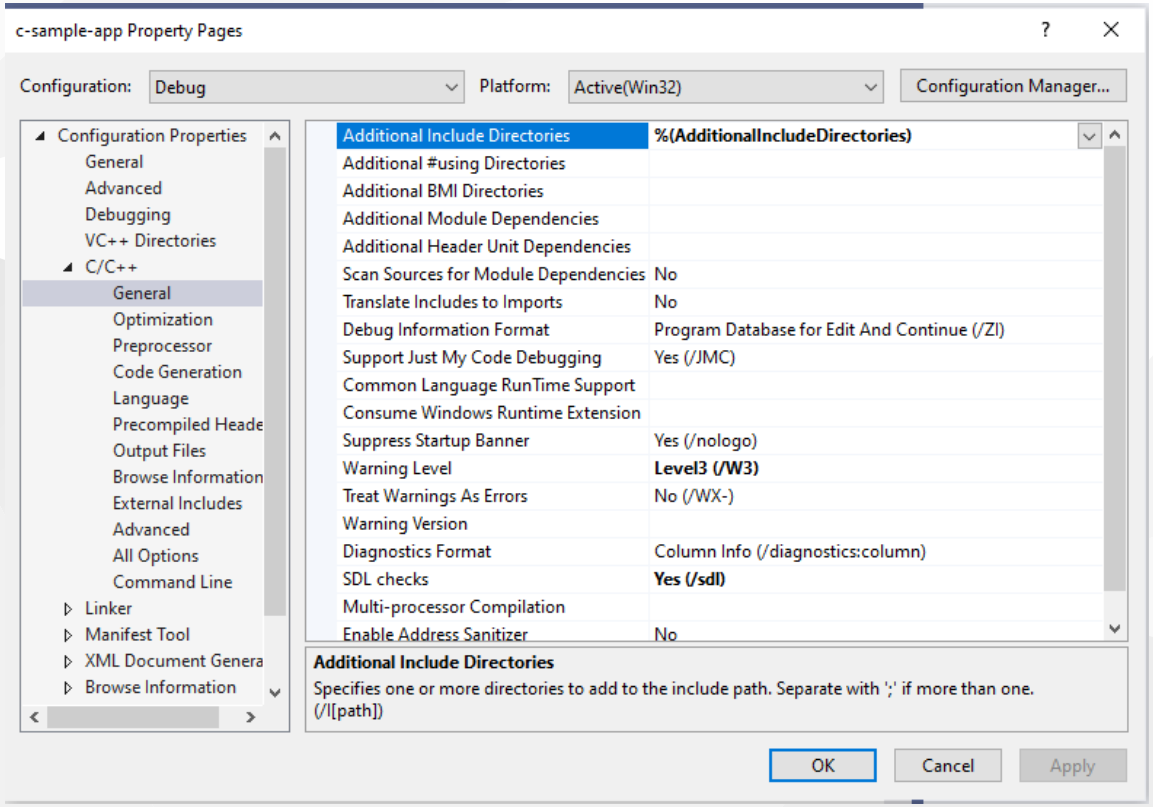
There is a option about portability that we can set for team works

We will remove all library related settings from configurations and we will write them in source code

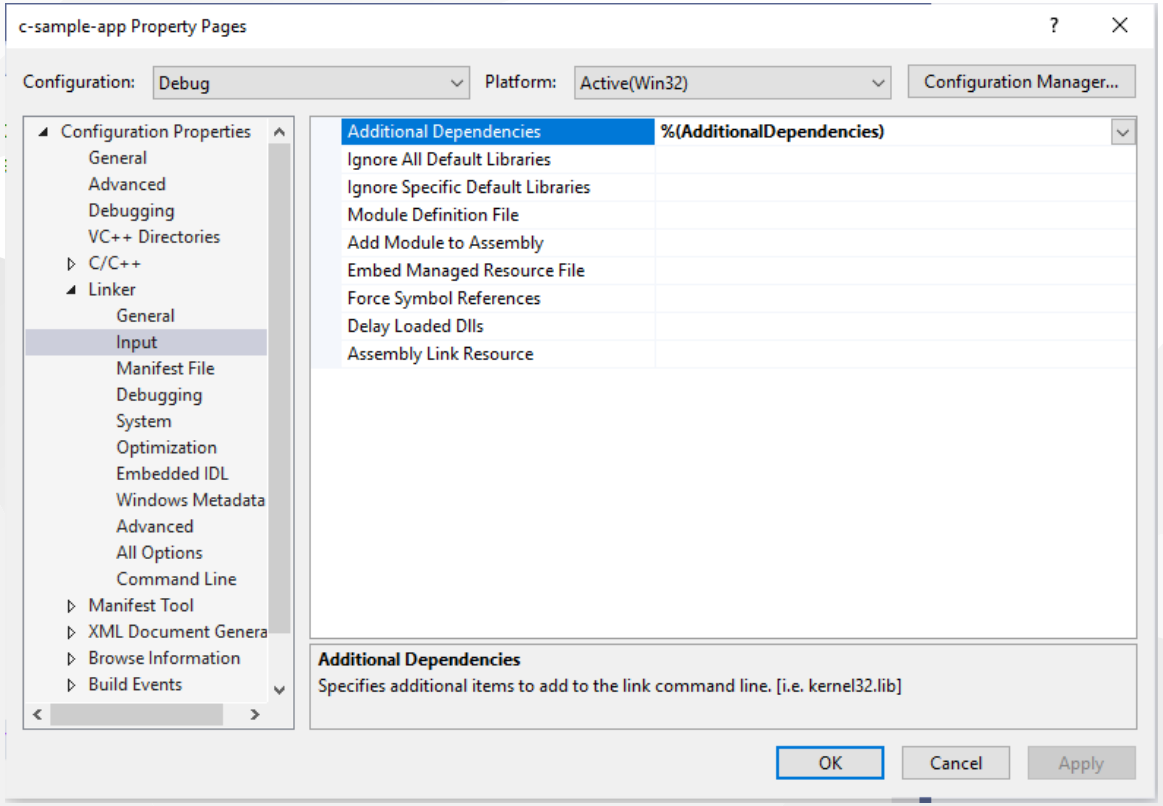
Clear linker->general->additional library directories



Clear C/C++ -> General -> Additional Include Directories



Clear Linker->Input->Additional Dependencies



Now we can set this configurations in source code as follow

```
#pragma comment(lib, "..\\DebugStaticLibDeployment\\c-sample-lib.lib")
#include "..\DebugStaticLibDeployment\samplelib.h"

#include <stdio.h>

/// <summary>
///
/// </summary>
/// <returns></returns>
int main()
{
    int result = 0;
    //printf("Hello World!\n");
    result = sum(5, 4);
    sayHelloTo("Computer");
    printf("Result is %d \n",result);
    printf("Press any key to continue...\n");
    getchar();
    return 0;
}
```

with this configuration if your friends download this code then they can run them with their environment without setting a path.

C++ Programming (Static Library)

Visual Studio Community Edition

All steps are similar with C programming above, but you do not need to delete pch.h

You should take care about compiled source codes

for example if your code is compiled for x86 then your application also should use the x86 configuration else x64 then library should be x64 complied version.

Source will look like the following

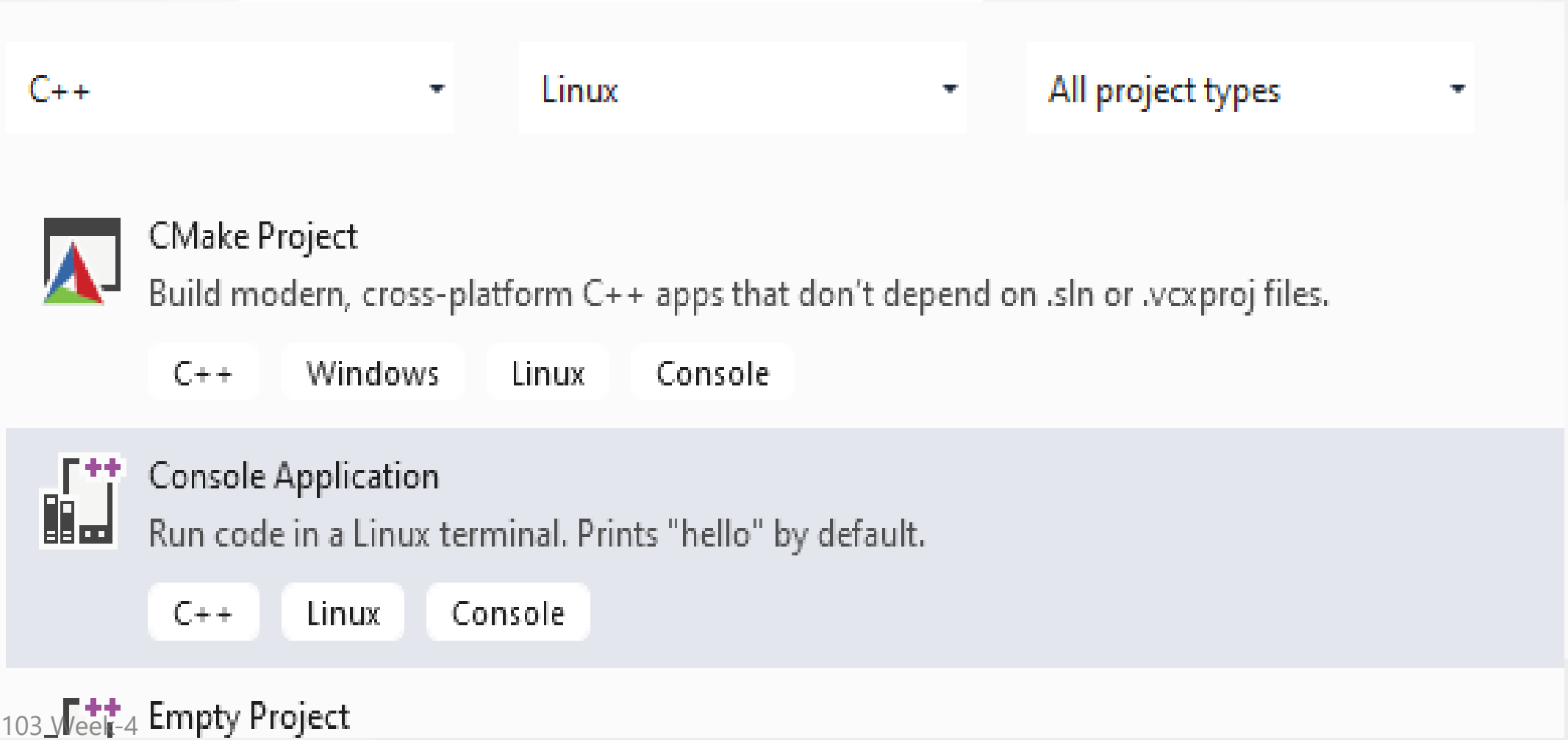
```
// cpp-sample-app.cpp : This file contains the 'main' function. Program execution begins and ends there.
//

#pragma comment(lib, "..\\DebugStaticLibDeployment\\cpp-sample-lib.lib")

#include "..\DebugStaticLibDeployment\samplelib.h"

#include <iostream>

int main()
{
    std::cout << "Hello World!\n";

    int result = 0;
    //printf("Hello World!\n");
    result = sum(5, 4);
    sayHelloTo("Computer");
    printf("Result is %d \n", result);
    printf("Press any key to continue...\n");
    getchar();
    return 0;

}
```

C/C++ WSL Option

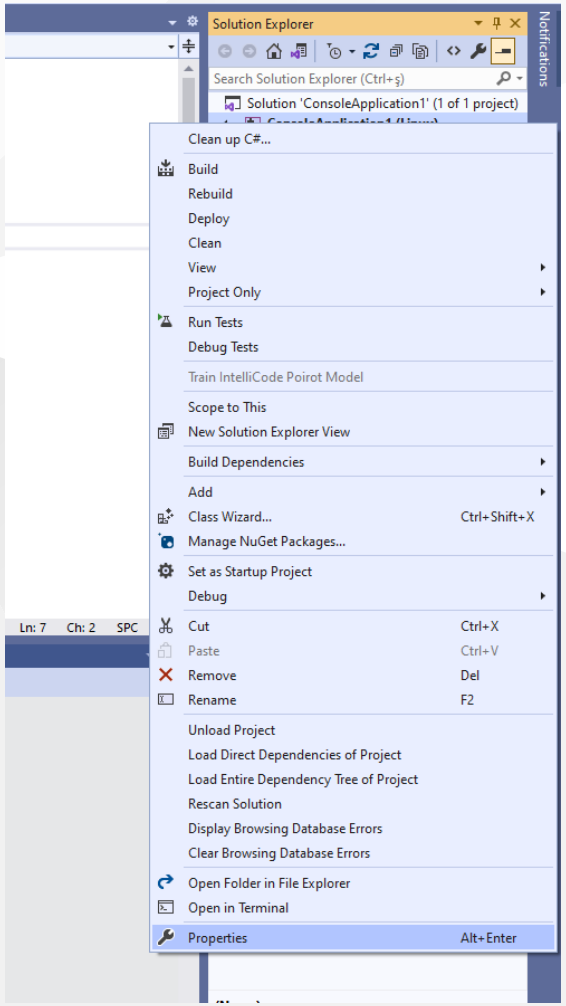
Install WSL

GitHub - ucoruh/ns3-wsl-win10-setup: ns3 windows 10 WSL2 setup and usage

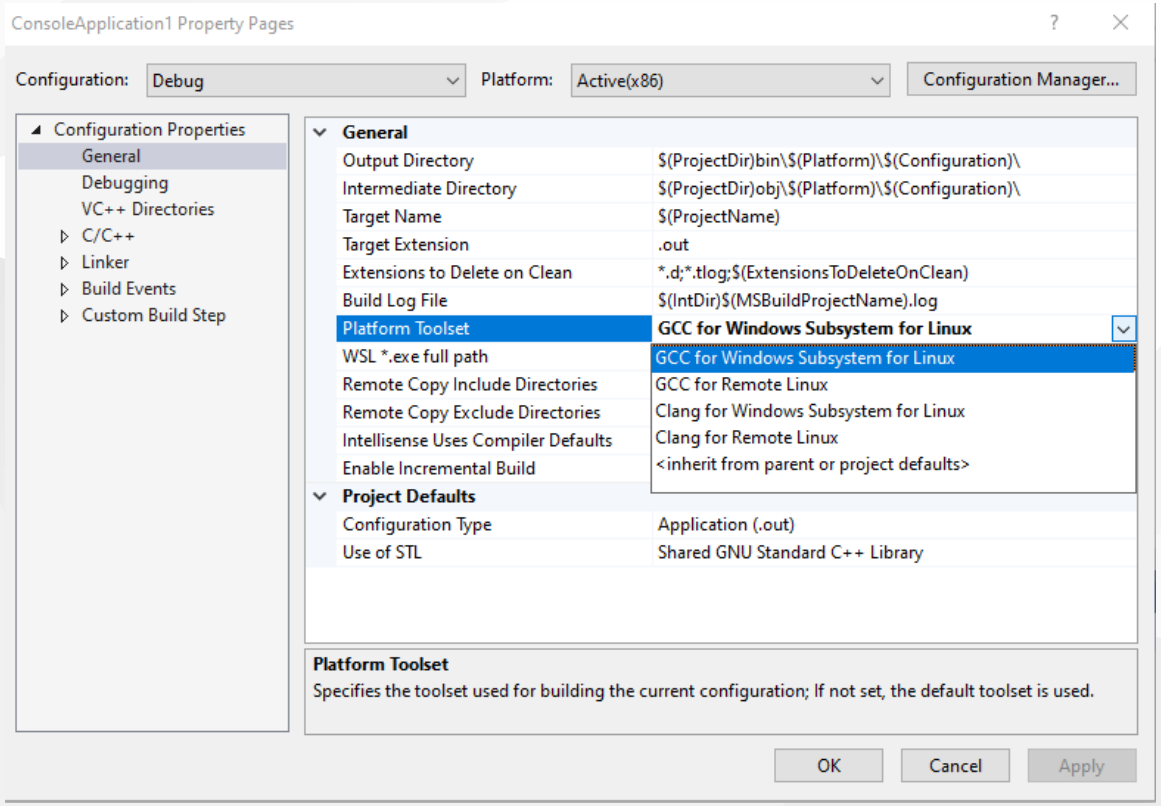
Create a Linux project



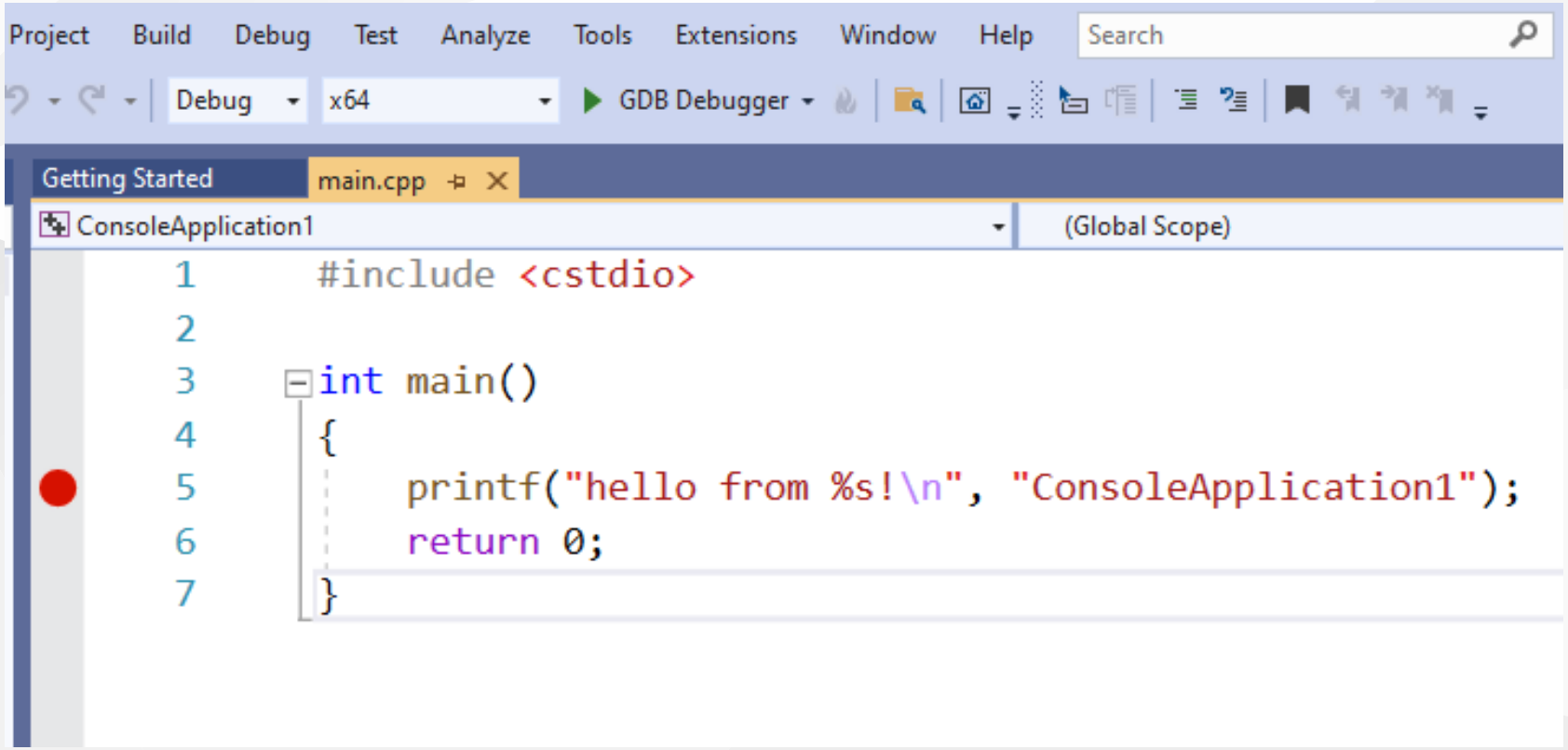
Configure Platform Toolset to WSL



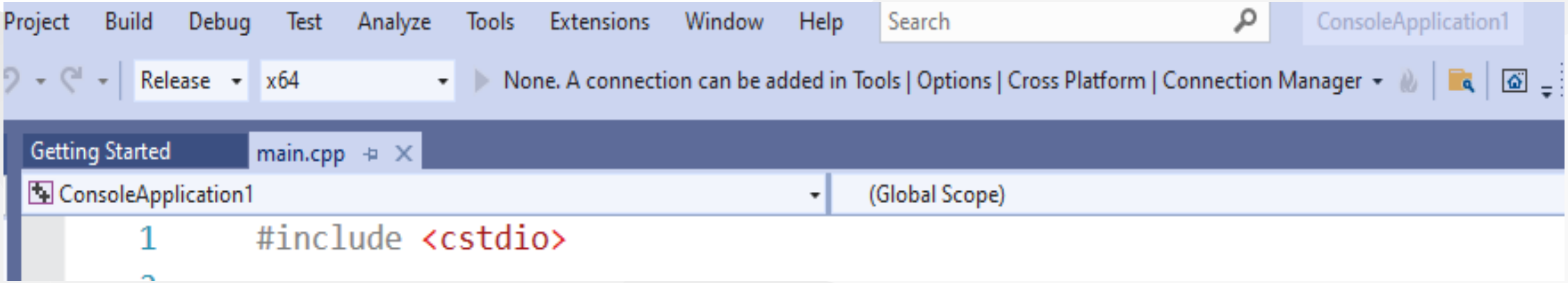
Select GCC for Windows Subsystem for Linux



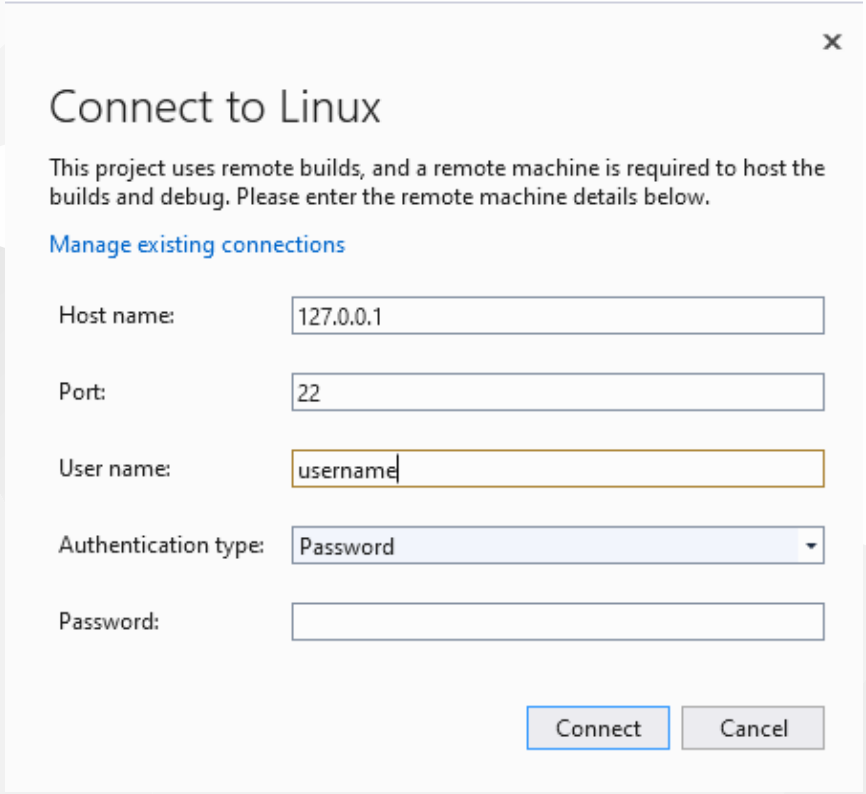
Put a breakpoint and run debugger



In the debugger for WSL you can use local WSL installation but if you want to run it on Release setting it require a SSH connection.



Configure SSH parameters



so you have to complete the following steps.

C/C++ Remote Linux Option over SSH

Enable SSH

SSH on Windows Subsystem for Linux (WSL) | Illuminia Studios

Connect to Remote WSL Environment

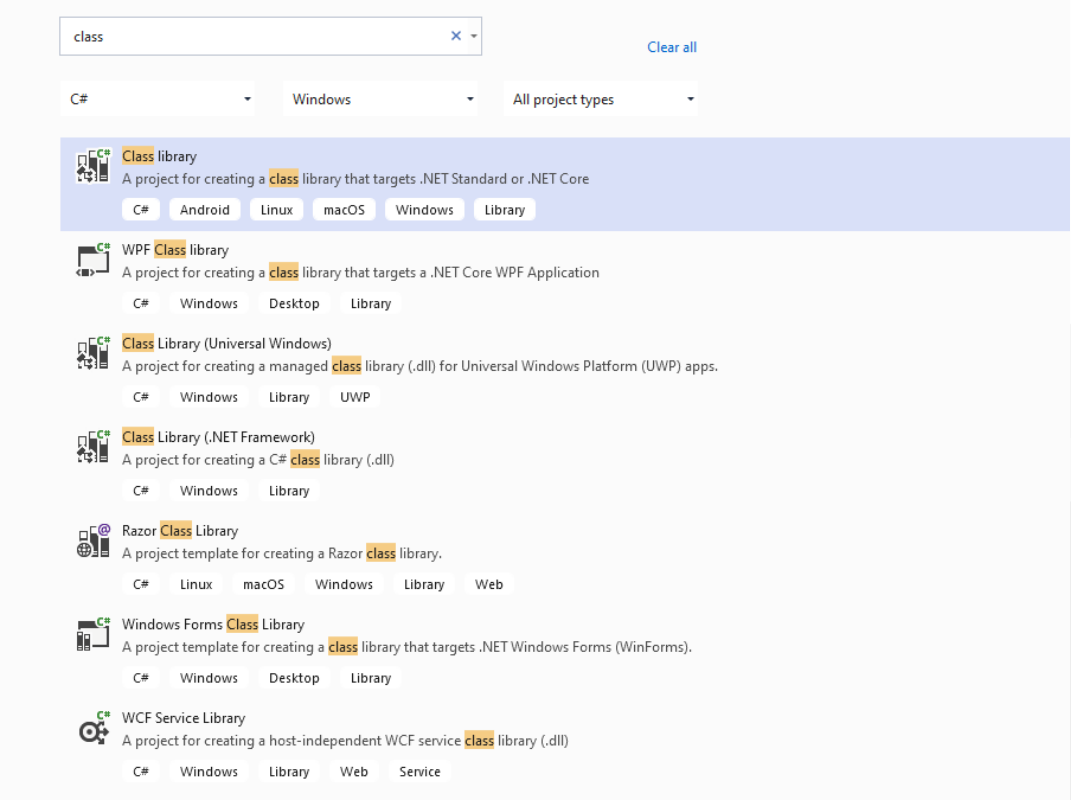
Bağlan hedef Linux sisteminize Visual Studio | Microsoft Docs

C# Programming (Dinamik Library)

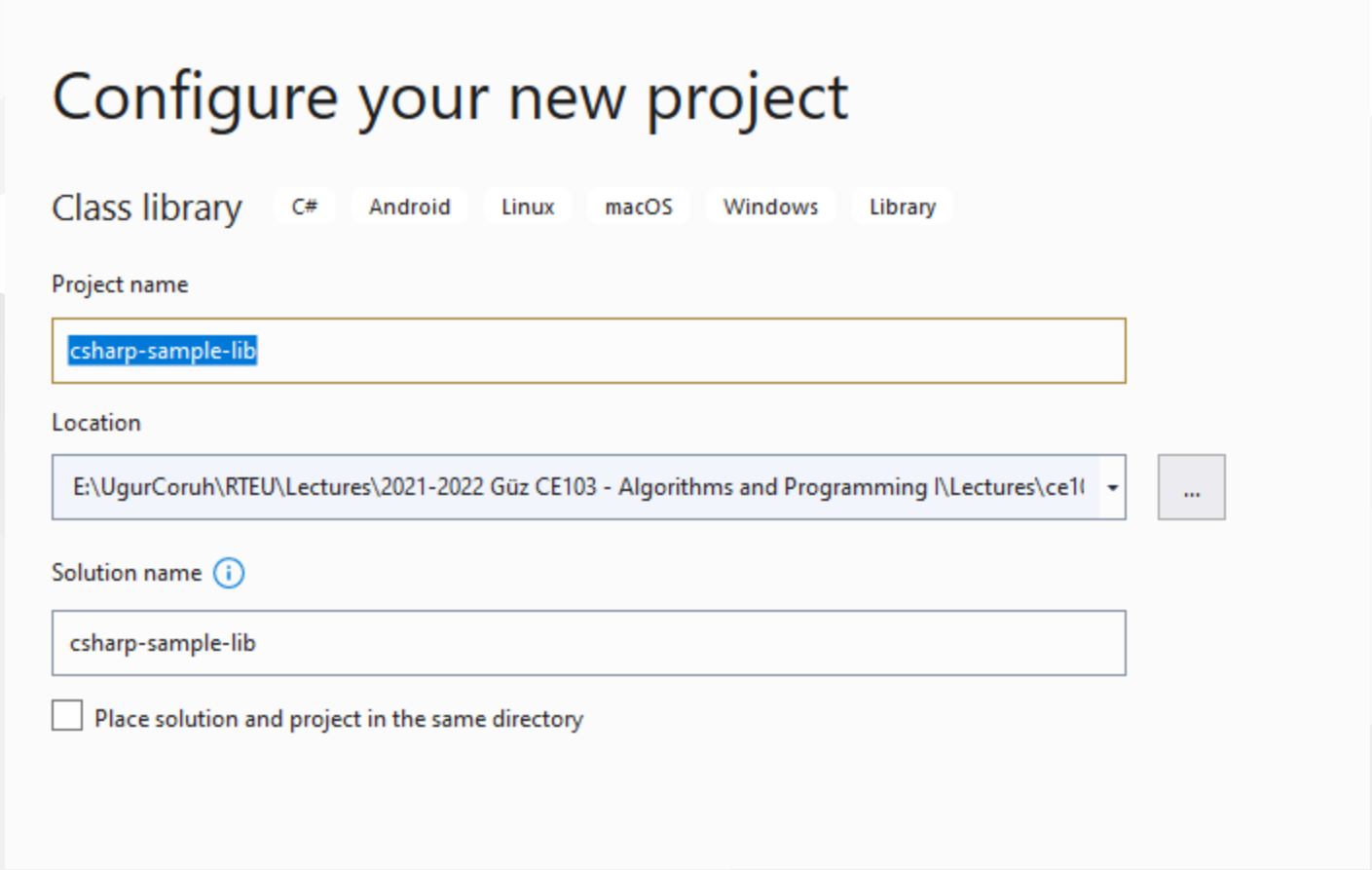
Visual Studio Community Edition

In C# project we will create class library we have several options

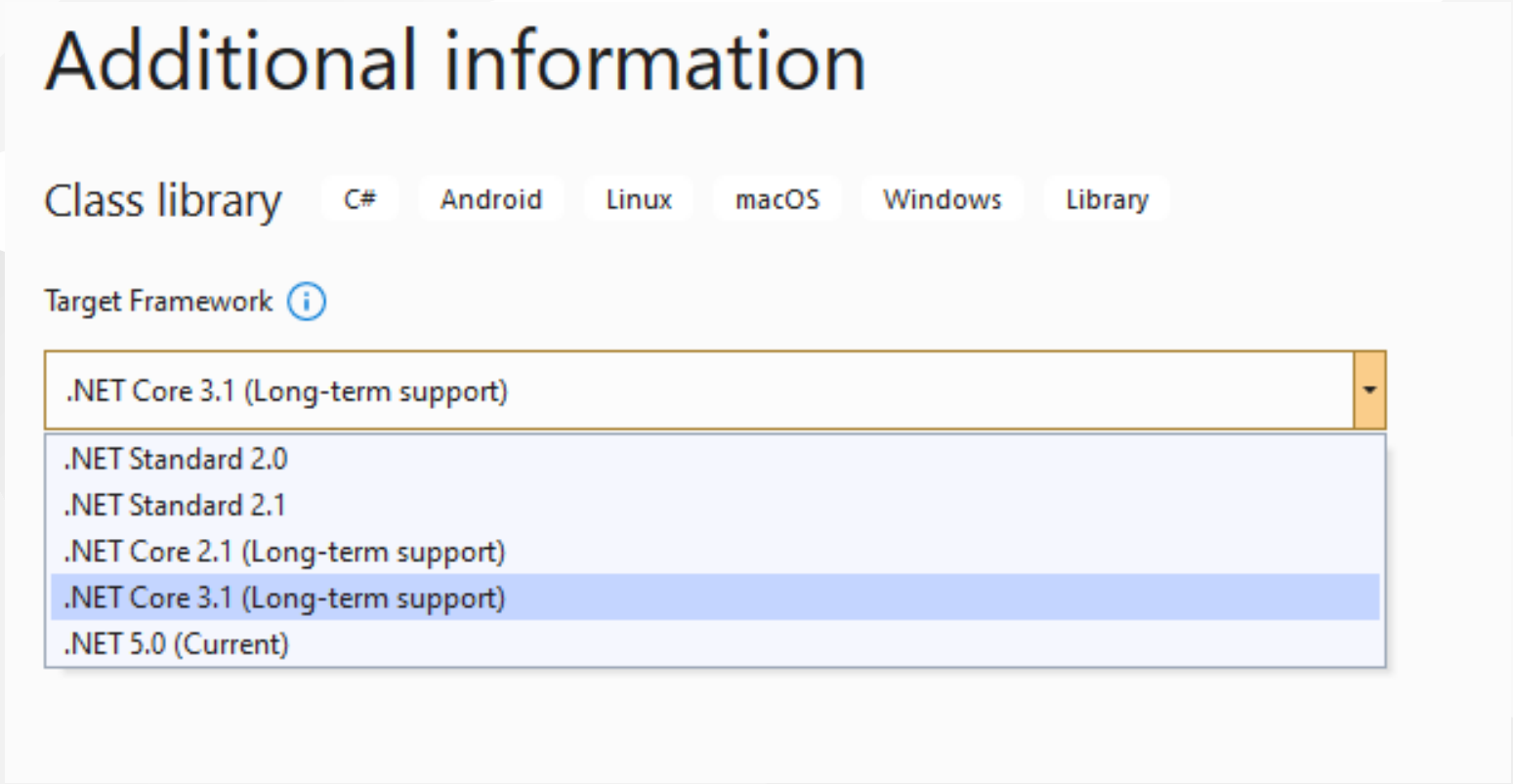
for this sample we will select .NET core that we can build cross platform library



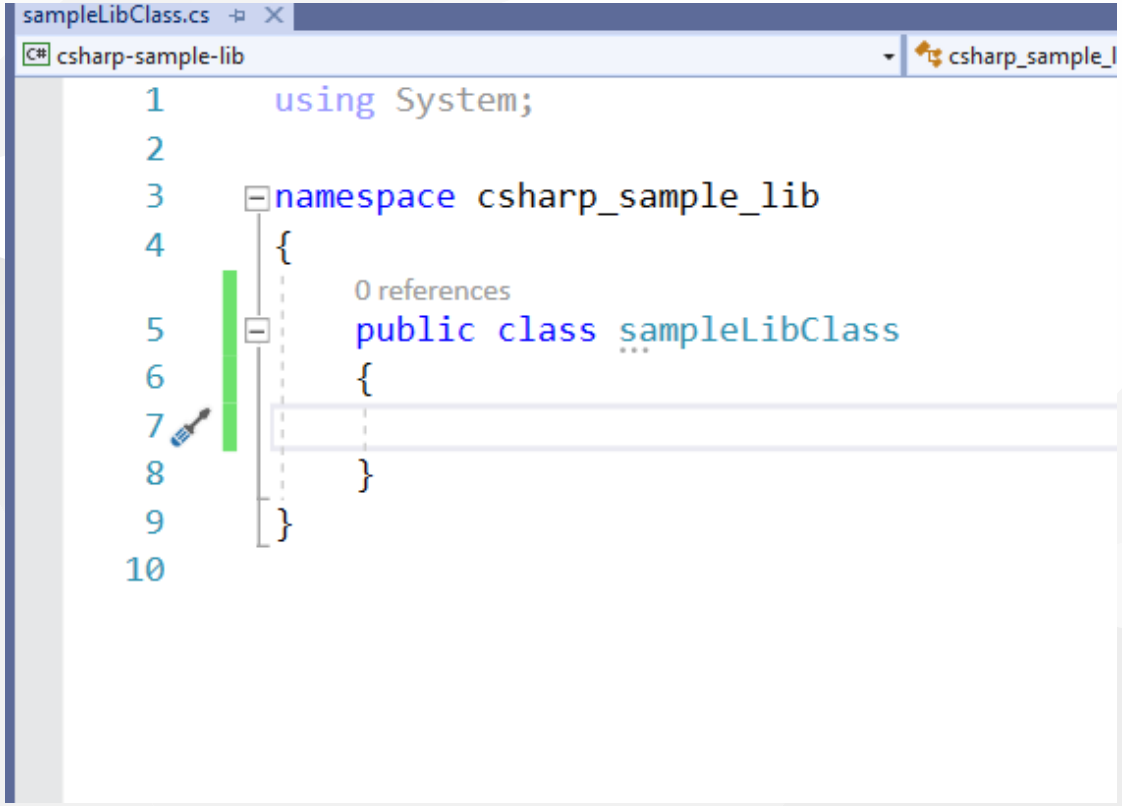
<mark>There is no static library option</mark>



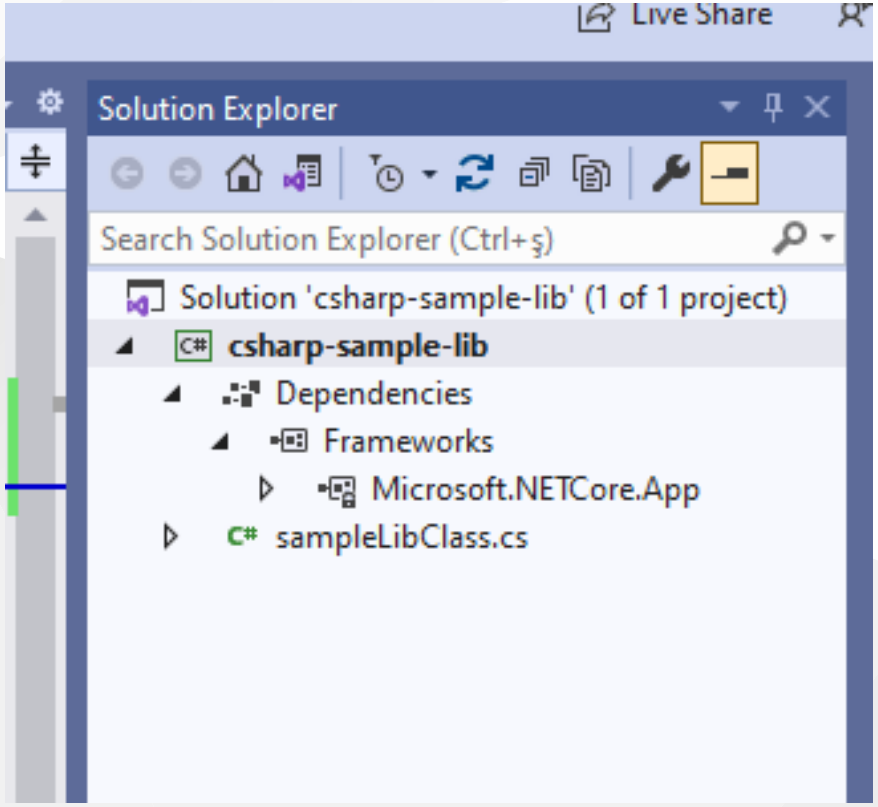
We will select .Net Core 3.1



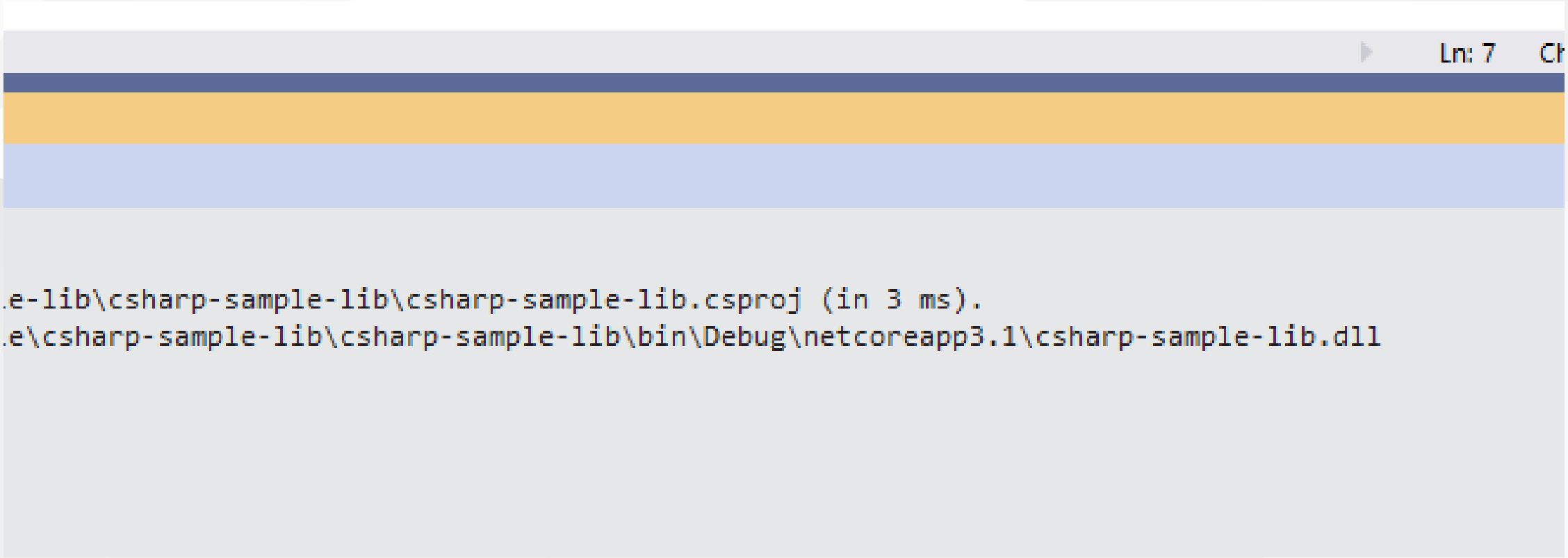
You will have default empty class library file



In the project you can see .NETcore reference

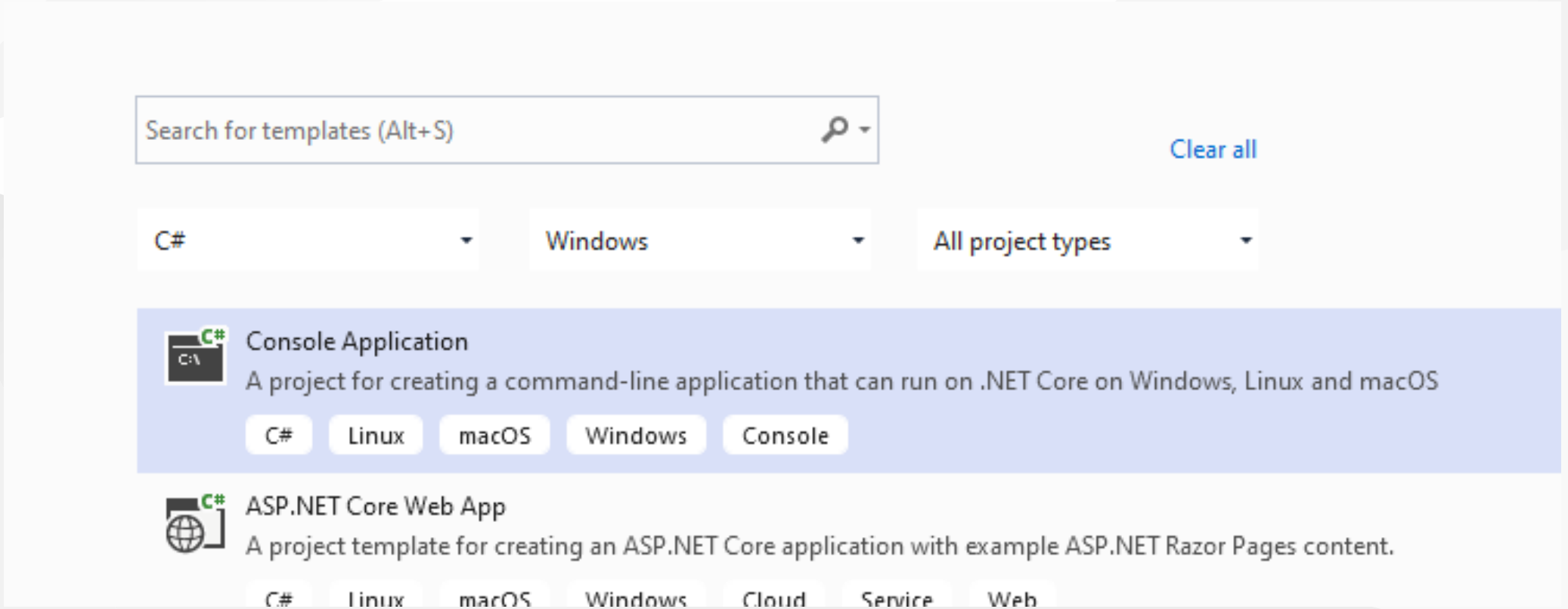


We can build empty class library that generate dll for our application

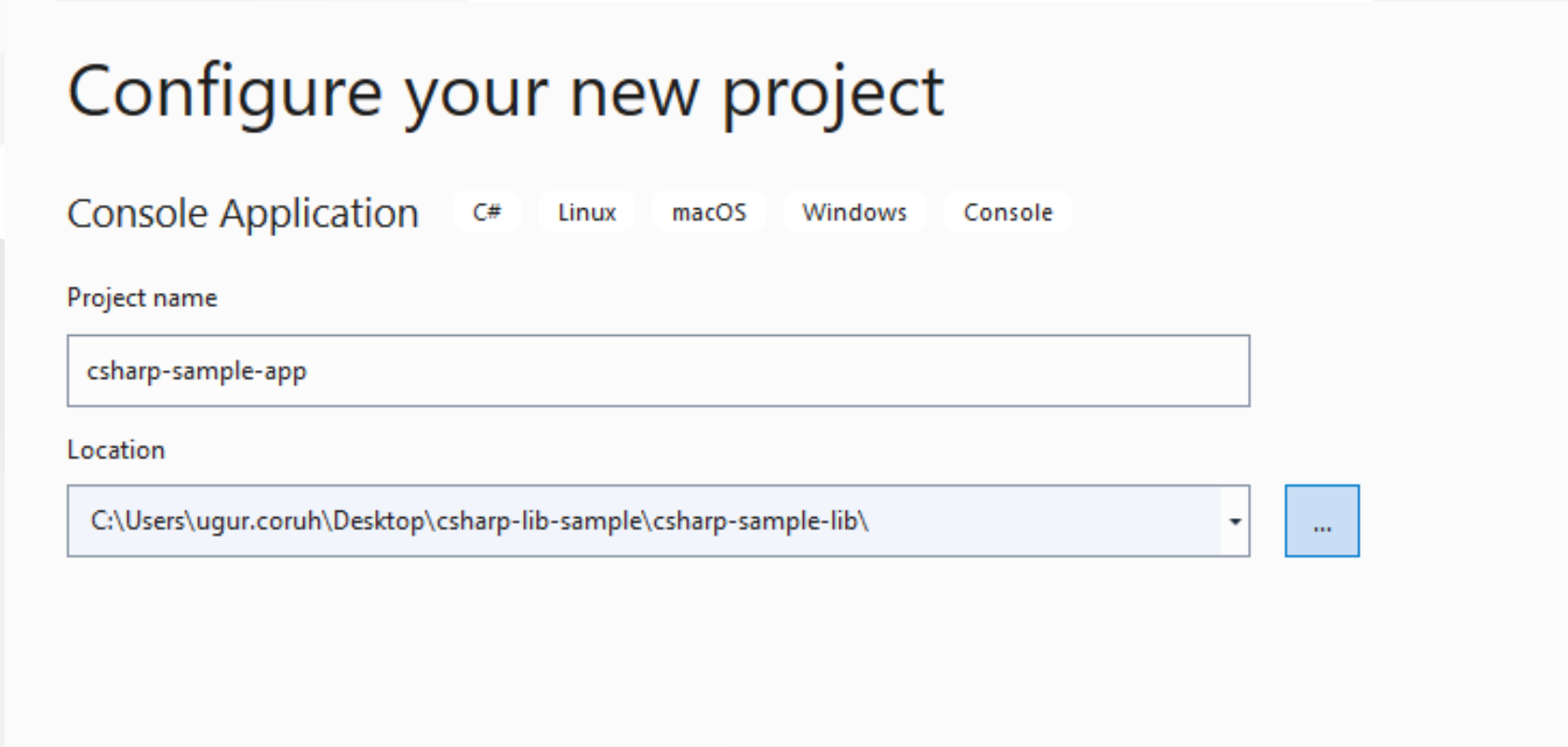


Now we will add Console Application but this will also use .NETCore

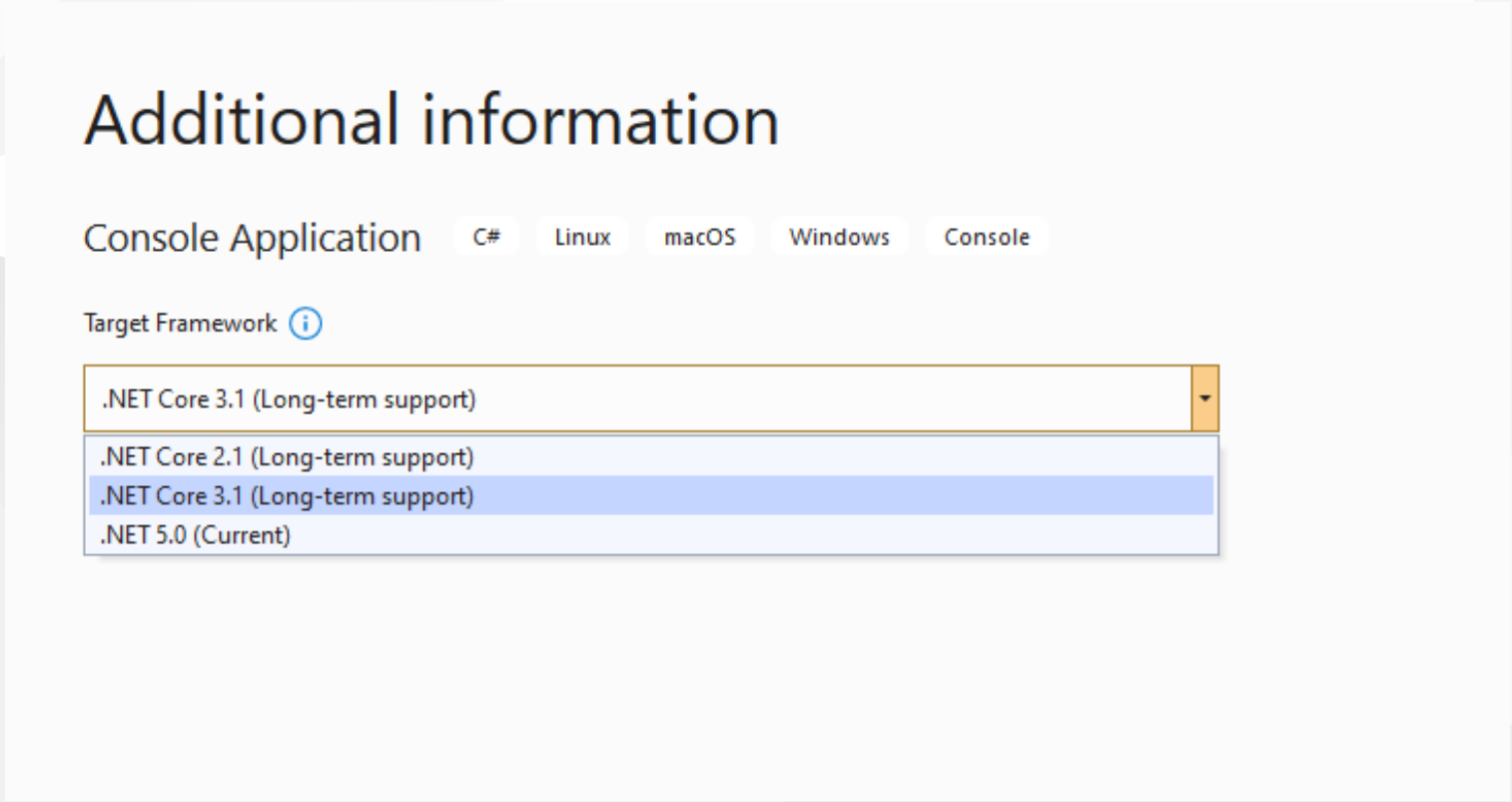
Select New Project



Name the project



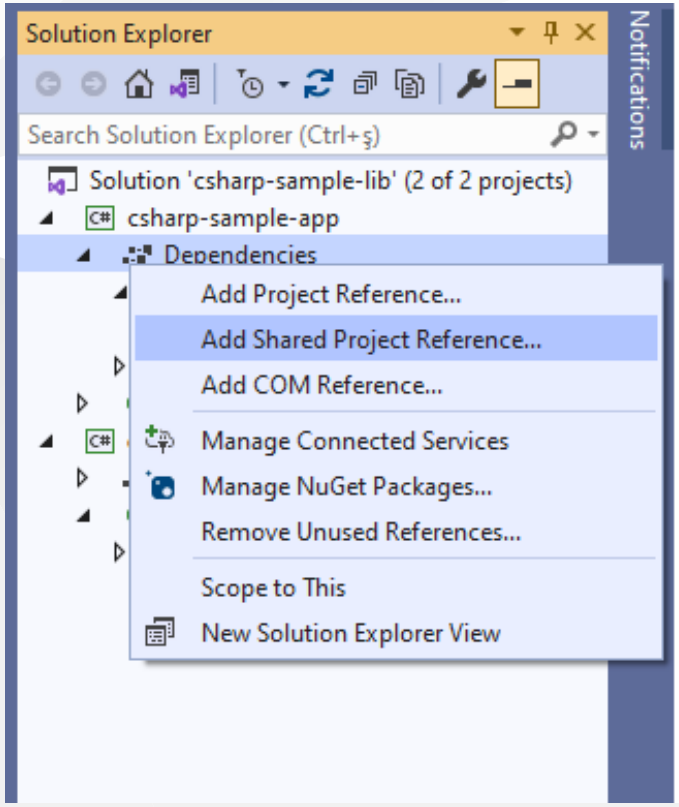
Select .NETCore framework



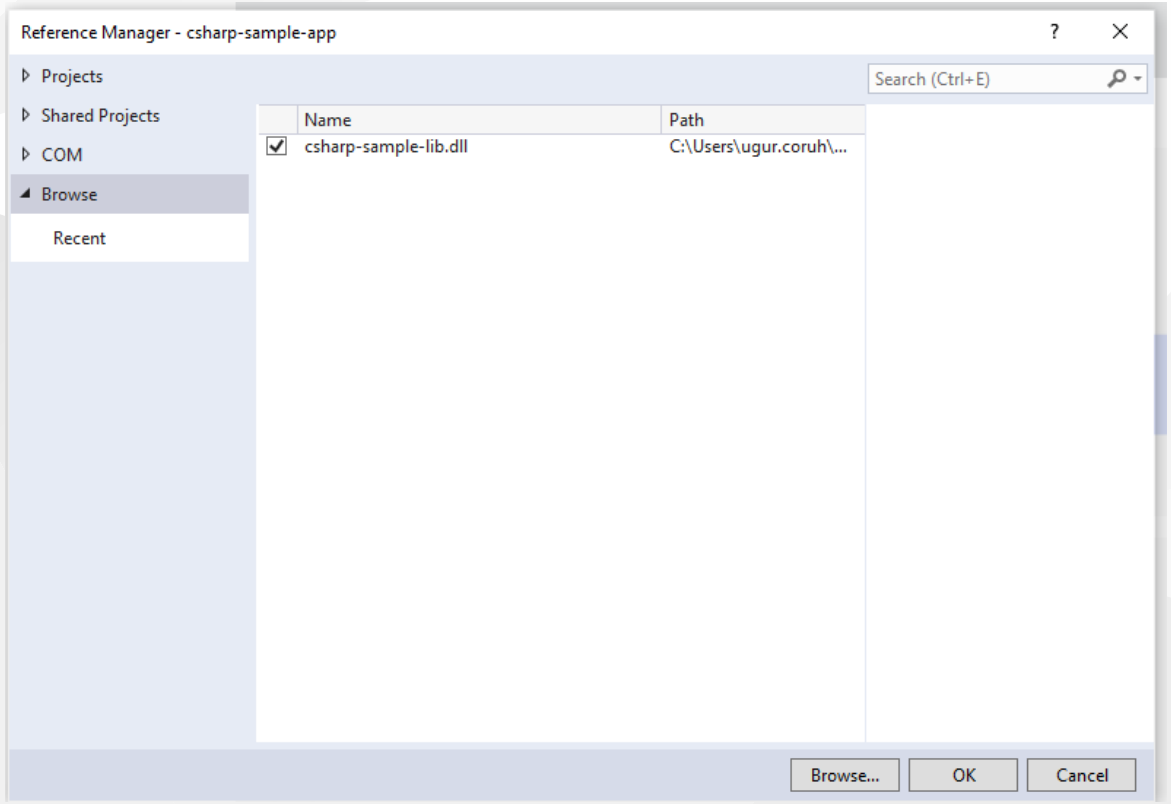
You will have the following sample main.cs file

```
using System;

namespace csharp_sample_app
{
    class Program
    {
        static void Main(string[] args)
        {
            Console.WriteLine("Hello World!");
        }
    }
}
```

Now we can link projects with adding references open reference section



browse for class library project output folder and select output dll file for console application



now we can update our library code and use it in console application

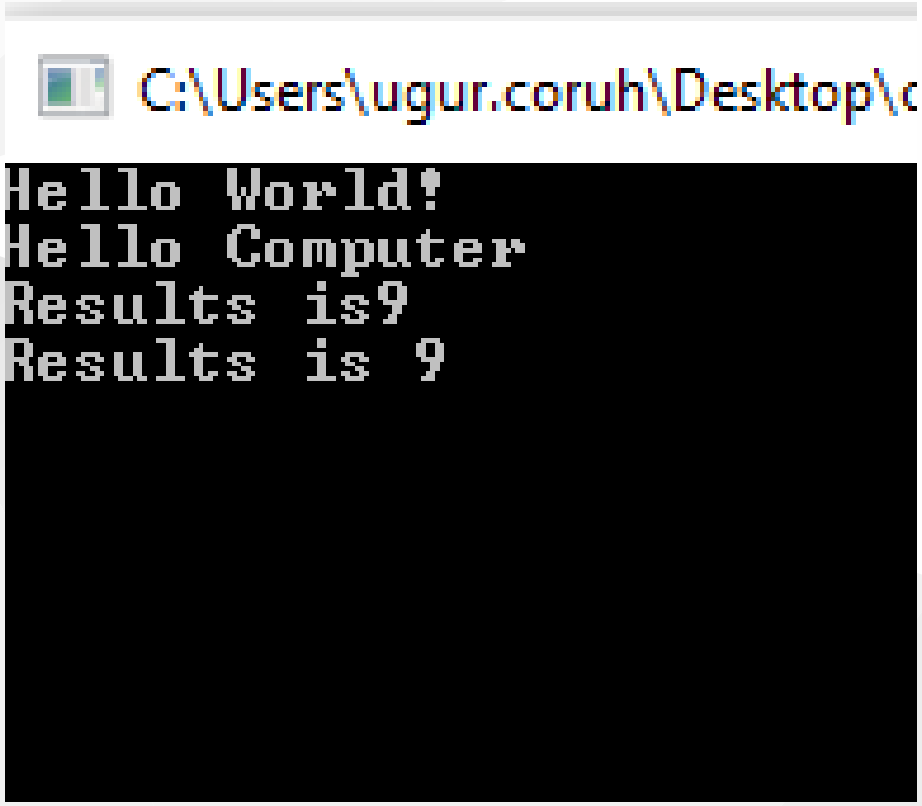
copy following sample to sampleLibClass file in the library

```
using System;

namespace csharp_sample_lib
{
    public class sampleLibClass
    {
        public static void sayHelloTo(string name)
        {
            if (!String.IsNullOrEmpty(name))
            {
                Console.WriteLine("Hello " + name);
            }
            else
            {
                Console.WriteLine("Hello There");
            }

        }

        public static int sum(int a, int b)
        {
            int c = 0;
            c = a + b;
            return c;
        }
    }
}
```

after this operation copy following sample to console application and build app then you can run

```
using csharp_sample_lib;
using System;

namespace csharp_sample_app
{
    class Program
    {
        static void Main(string[] args)
        {
            Console.WriteLine("Hello World!");

            sampleLibClass.sayHelloTo("Computer");
            int result = sampleLibClass.sum(5, 4);
            Console.WriteLine("Results is" + result);
            Console.WriteLine("Results is {0}", result);
            Console.Read();
        }
    }
}
```

You will see following output that mean we called DLL functions



Also we can publish this console application with dll for linux environment or others

for linux environment we should install .NETCore

follow the link below or commands that I shared with you as below for deployment

How to Install Dotnet Core on Ubuntu 20.04 – TecAdmin

Step 1 – Enable Microsoft PPA

```
 wget https://packages.microsoft.com/config/ubuntu/20.04/packages-microsoft-prod.deb
sudo dpkg -i packages-microsoft-prod.deb
```

Step 2 – Installing Dotnet Core SDK

```
sudo apt update
sudo apt install apt-transport-https
sudo apt install dotnet-sdk-3.1
```

Step 3 – Install Dotnet Core Runtime Only

To install .NET Core Runtime on Ubuntu 20.04 LTS system, execute the commands:

```
sudo apt update
```

To install the previous version of .Net core runtime 2.1, type:

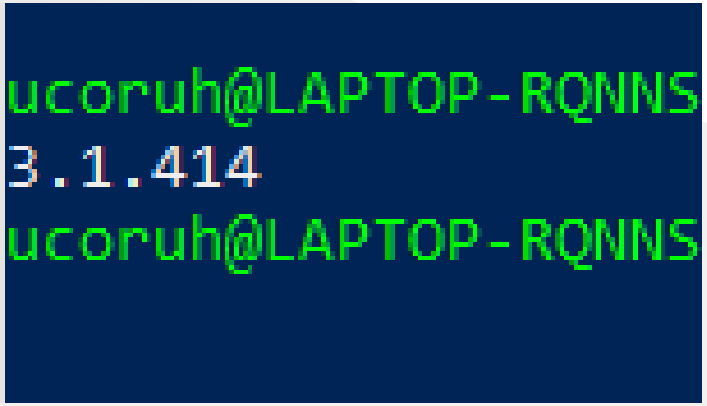
```
sudo apt install dotnet-runtime-2.1
```

Press “y” for any input prompted by the installer.

Step 4 – (Optional) Check .NET Core Version

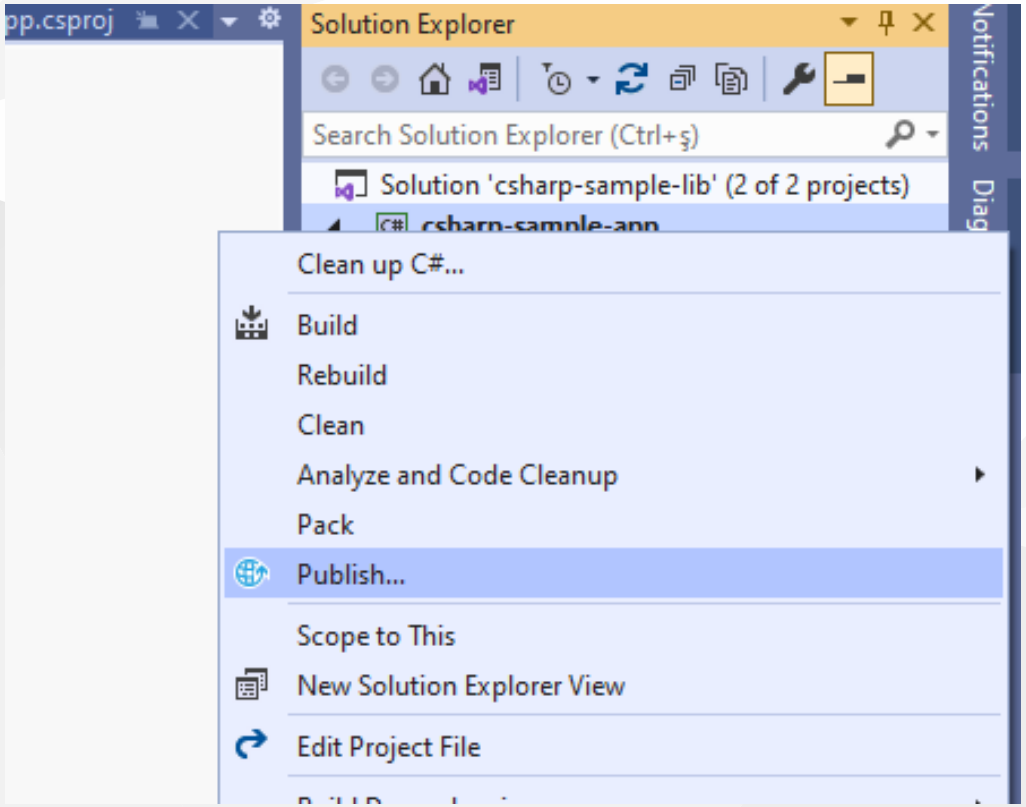
You can use dotnet command line utility to check installed version of .NET Core on your system. To check dotnet version, type:

```
dotnet --version
```

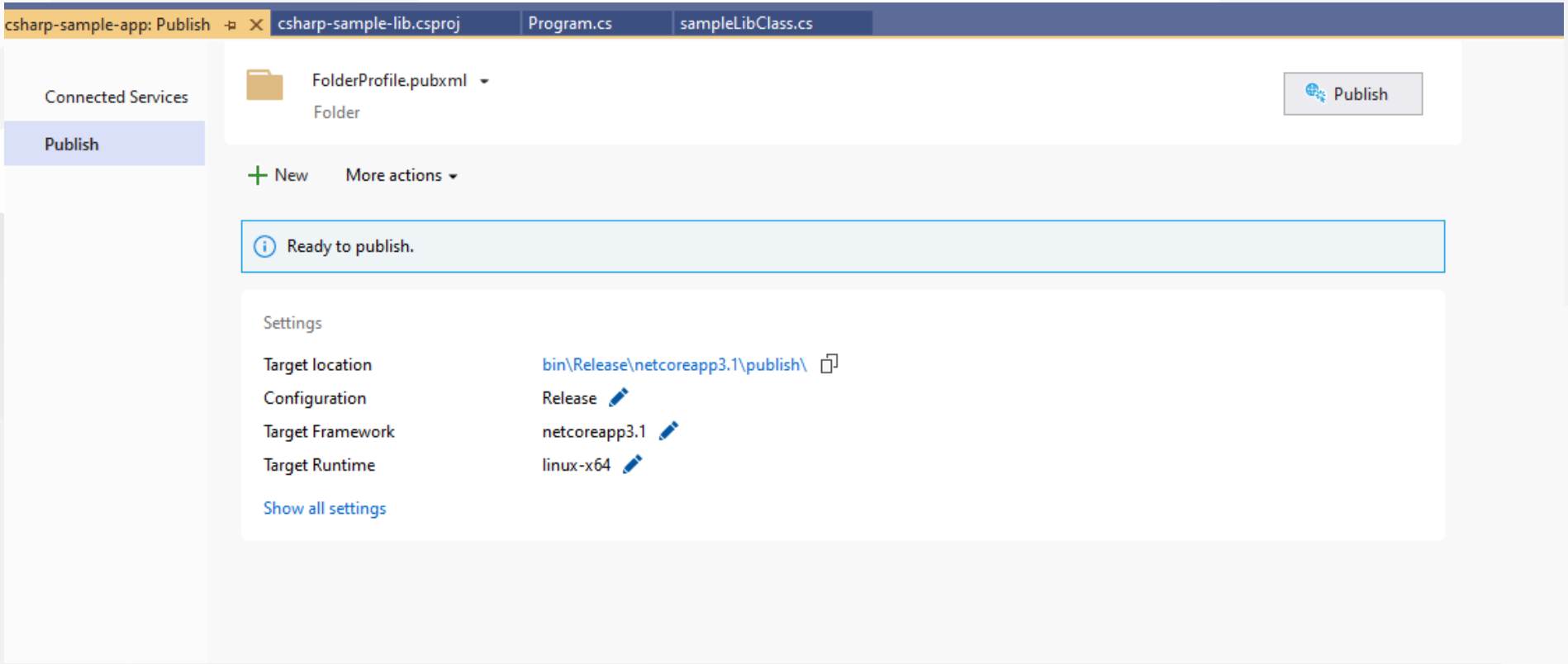


Now we will publish our application as single executable

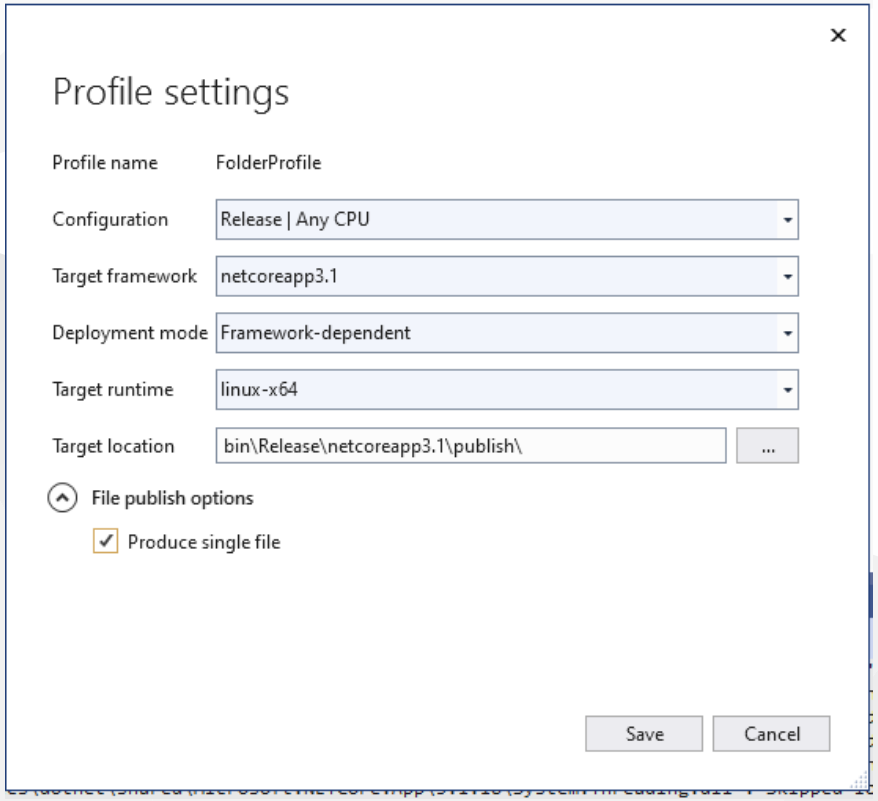
Open publish menu



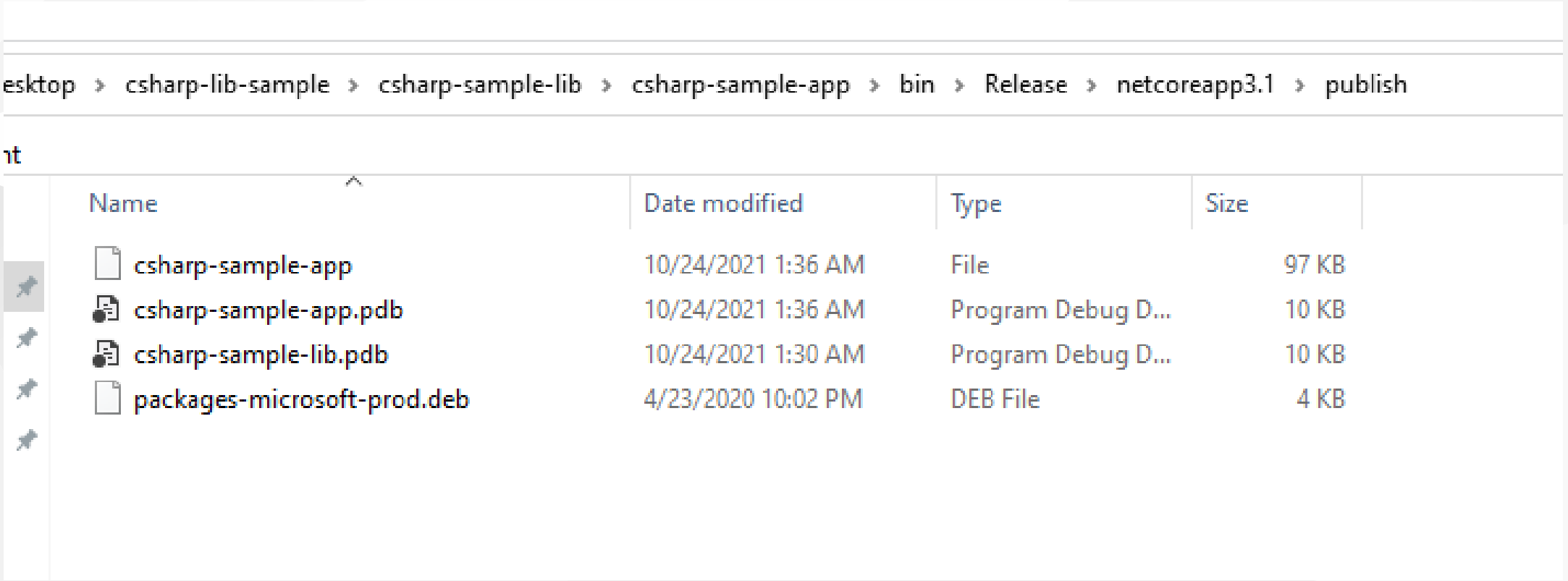
Select netcoreapp3.1 and Release for linux-x64



Select produce single file



After succesfull publish you will have linux binary that you can run with WSL



Open WSL and enter the path where this folder located

and run application as follow

```
Processing triggers for man-db (2.9.1-1) ...
ucoruh@LAPTOP-RQNNS9IG:/mnt/c/Users/ugur.coruh/Desktop/csharp-lib-sample/csharp-sample-lib/csharp-sample-app/bin/Release/netcoreapp3.1/publish$ dotnet --version
3.1.414
ucoruh@LAPTOP-RQNNS9IG:/mnt/c/Users/ugur.coruh/Desktop/csharp-lib-sample/csharp-sample-lib/csharp-sample-app/bin/Release/netcoreapp3.1/publish$ ./
csharp-sample-app           csharp-sample-app.pdb       csharp-sample-lib.pdb       packages-microsoft-prod.deb
ucoruh@LAPTOP-RQNNS9IG:/mnt/c/Users/ugur.coruh/Desktop/csharp-lib-sample/csharp-sample-lib/csharp-sample-app/bin/Release/netcoreapp3.1/publish$ ./csharp-sample-app
Hello World!
Hello Computer
Results is9
Results is 9
```

check dotnet --version and then run application

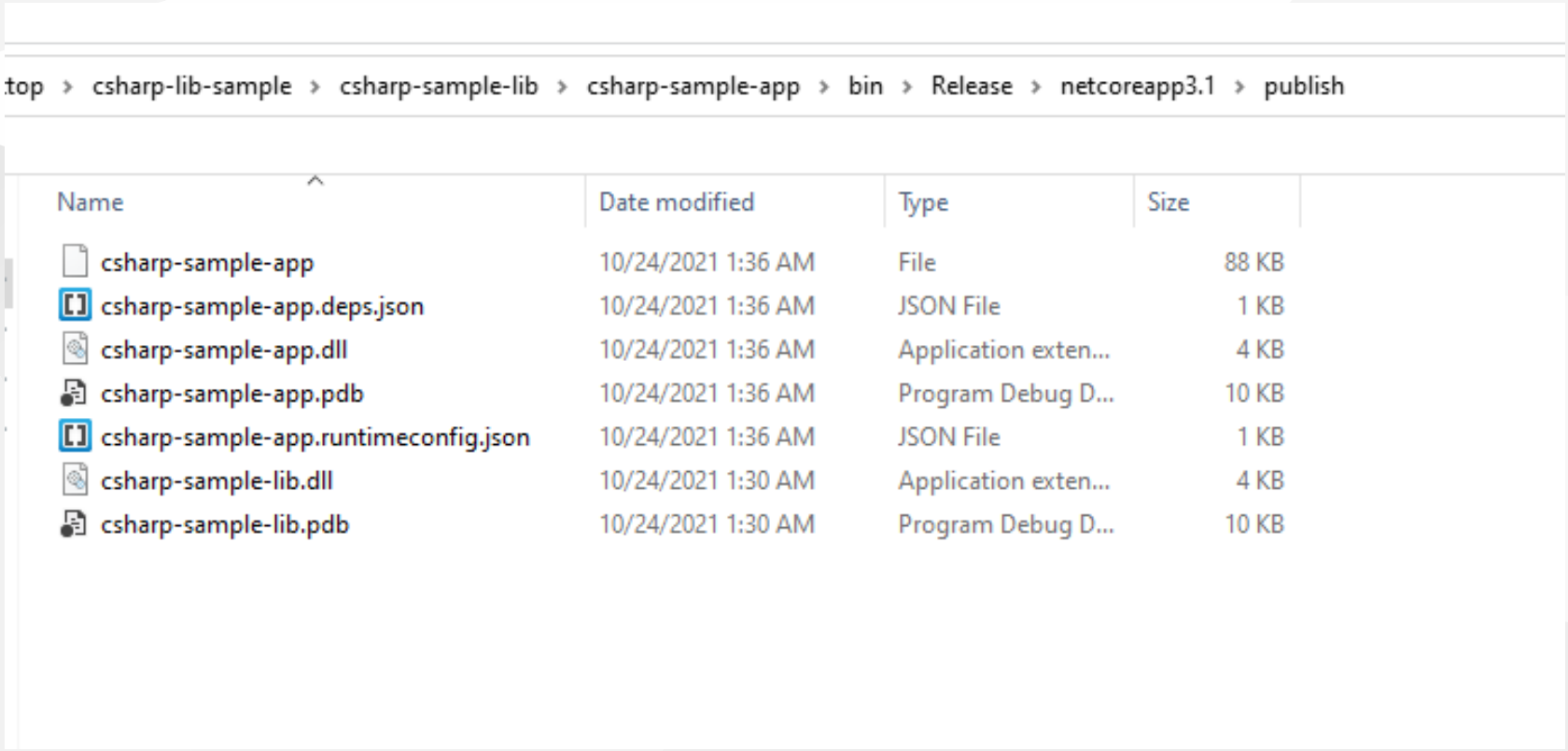
```
ublish$ dotnet --version

ublish$ ./

ublish$ ./csharp-sample-app
```

you will see similar output

```
ucoruh@LAPTOP-RQNNS9IG:/mnt/c/
csharp-sample-app
ucoruh@LAPTOP-RQNNS9IG:/mnt/c/
Hello World!
Hello Computer
Results is9
Results is 9
```

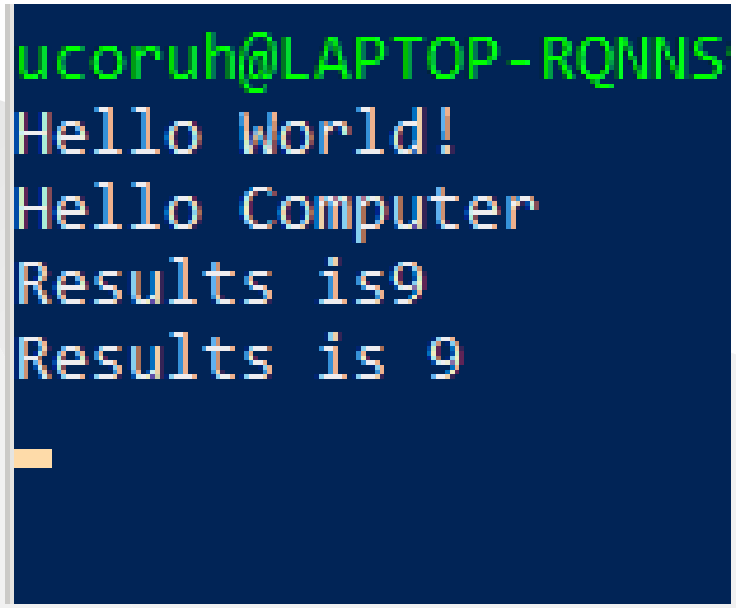
In this sample we created single application from settings lets try with shared library located option uncheck the "produce single file" option and publish again.

Then you will have the following outputs



If you run csharp-sample-app

you will have the same output

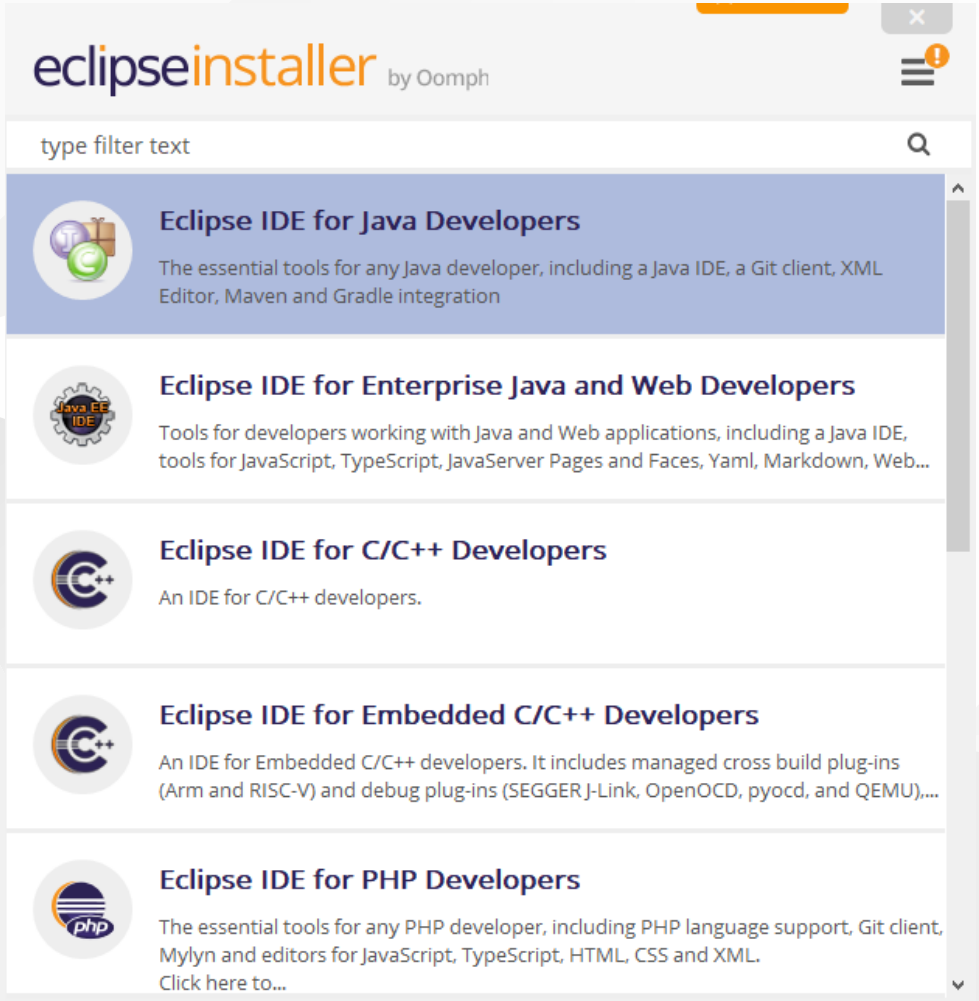


Java Programming

Eclipse IDE

You should download and install eclipse installer and then you should select Eclipse IDE for Java Developers

Eclipse Installer 2021-09 R | Eclipse Packages

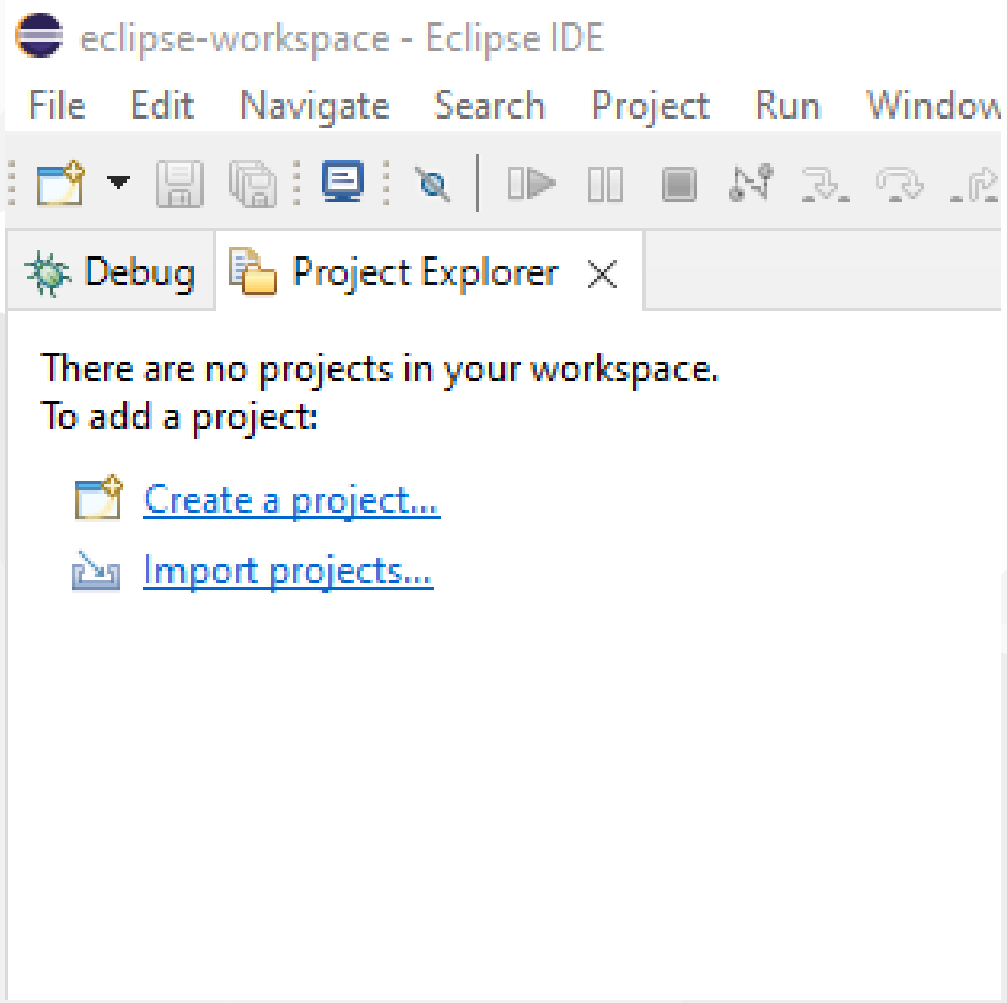

eclipseinstaller by Oomph
type filter text
Eclipse IDE for Java Developers
The essential tools for any Java developer, including a Java IDE, a Git client, XML Editor, Maven and Gradle integration
Eclipse IDE for Enterprise Java and Web Developers
Tools for developers working with Java and Web applications, including a Java IDE, tools for JavaScript, TypeScript, JavaServer Pages and Faces, Yaml, Markdown, Web...
Eclipse IDE for C/C++ Developers
An IDE for C/C++ developers.
Eclipse IDE for Embedded C/C++ Developers
An IDE for Embedded C/C++ developers. It includes managed cross build plug-ins (Arm and RISC-V) and debug plug-ins (SEGGER J-Link, OpenOCD, pyocd, and QEMU),...
Eclipse IDE for PHP Developers
The essential tools for any PHP developer, including PHP language support, Git client, Mylyn and editors for JavaScript, TypeScript, HTML, CSS and XML.
Click here to...


DONATE
eclipseinstaller by Oomph
Eclipse IDE for Java Developers
details
The essential tools for any Java developer, including a Java IDE, a Git client, XML Editor, Maven and Gradle integration.
Java 11+ VM
C:\Program Files\Java\jdk-16.0.1
Installation Folder
C:\Users\ugur.coruh\eclipse\java-2021-09
create start menu entry
create desktop shortcut
INSTALLING
Cancel Installation
BACK

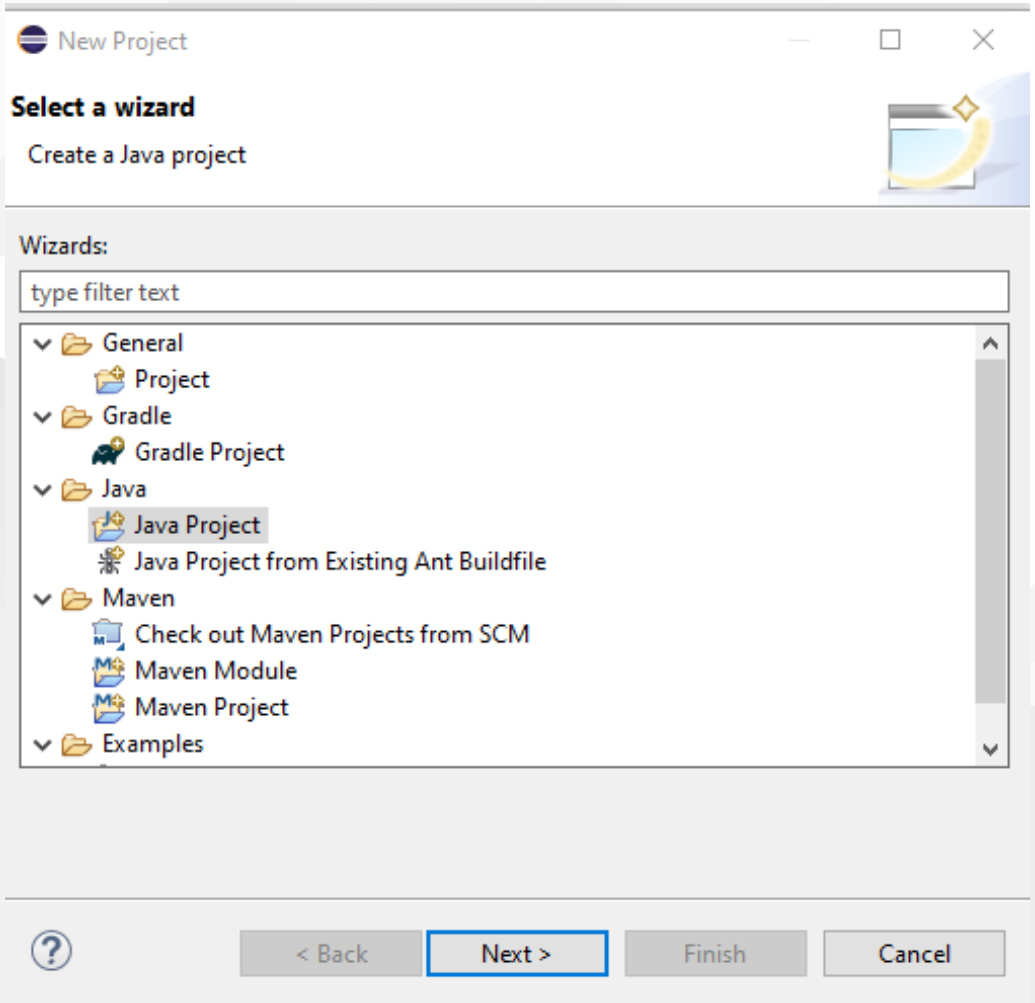

eclipse IDE
2021-09

select create a project

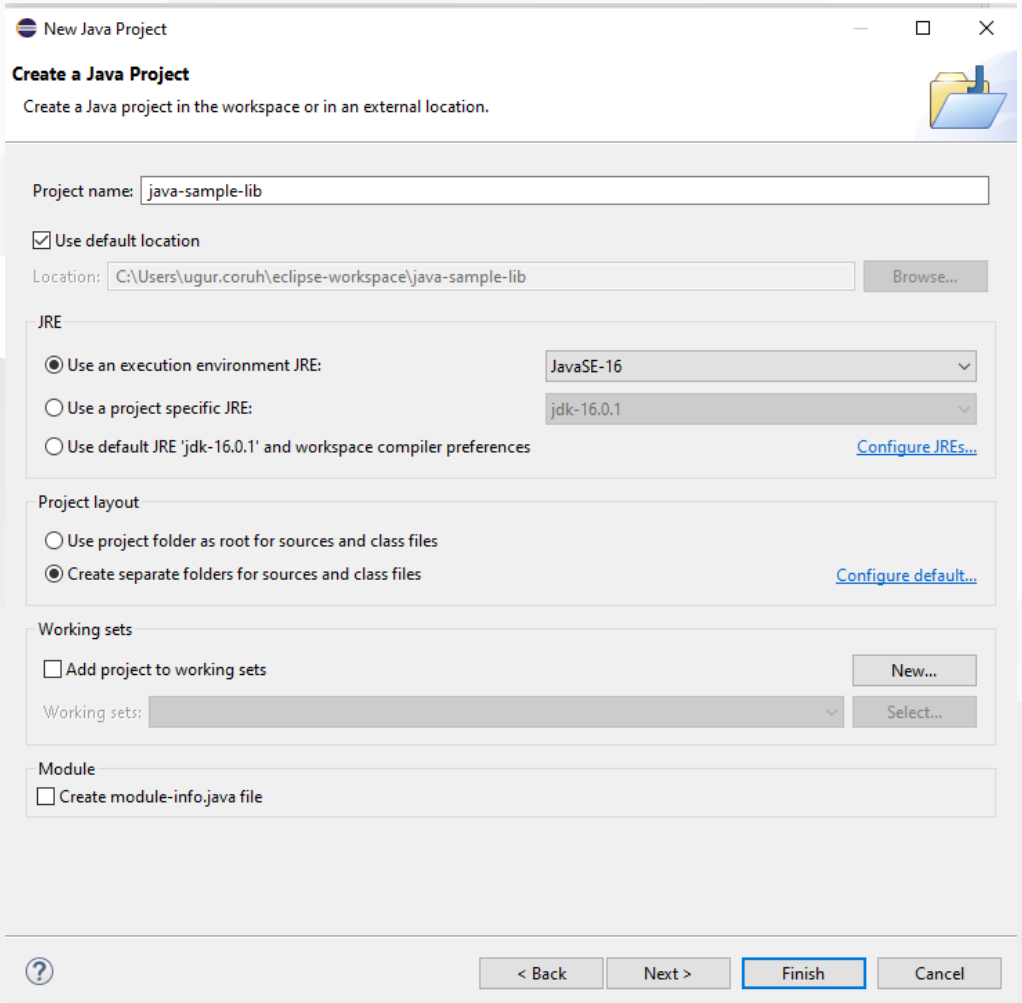
<TODO>



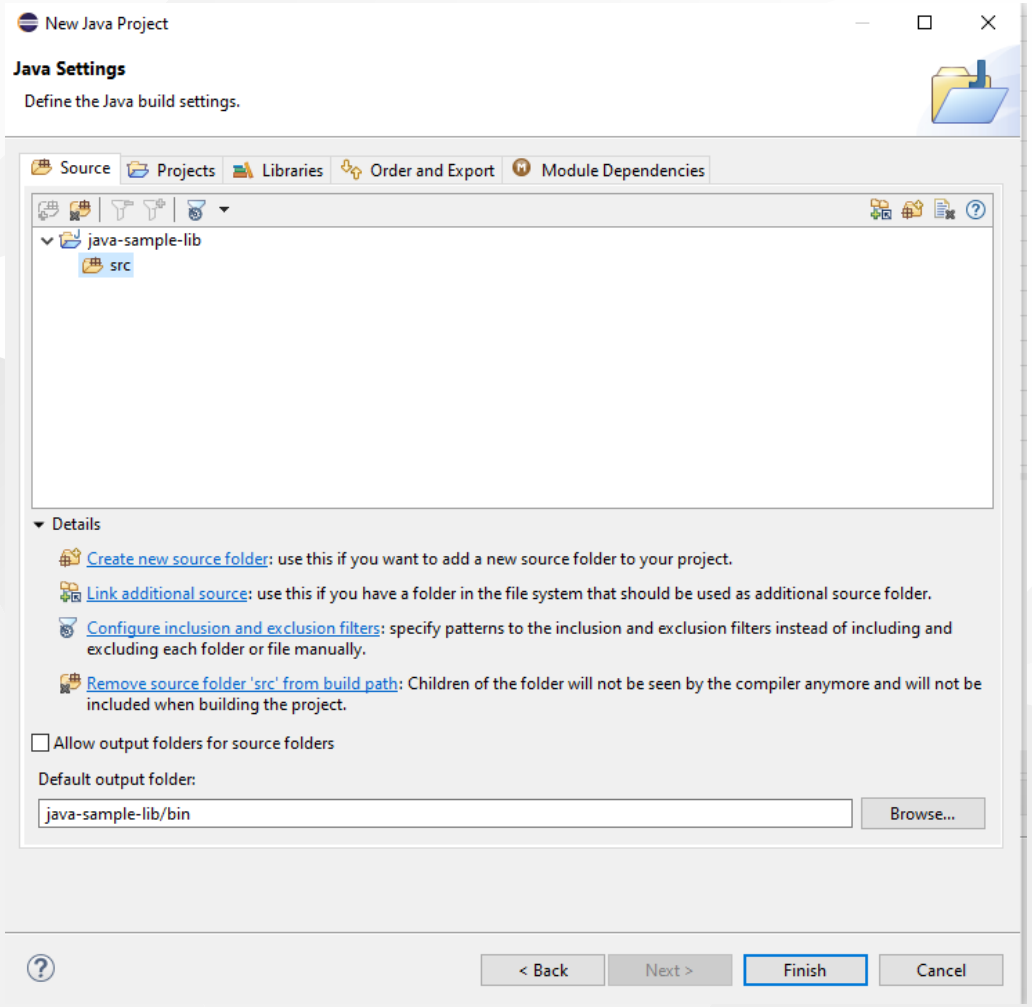
select java project



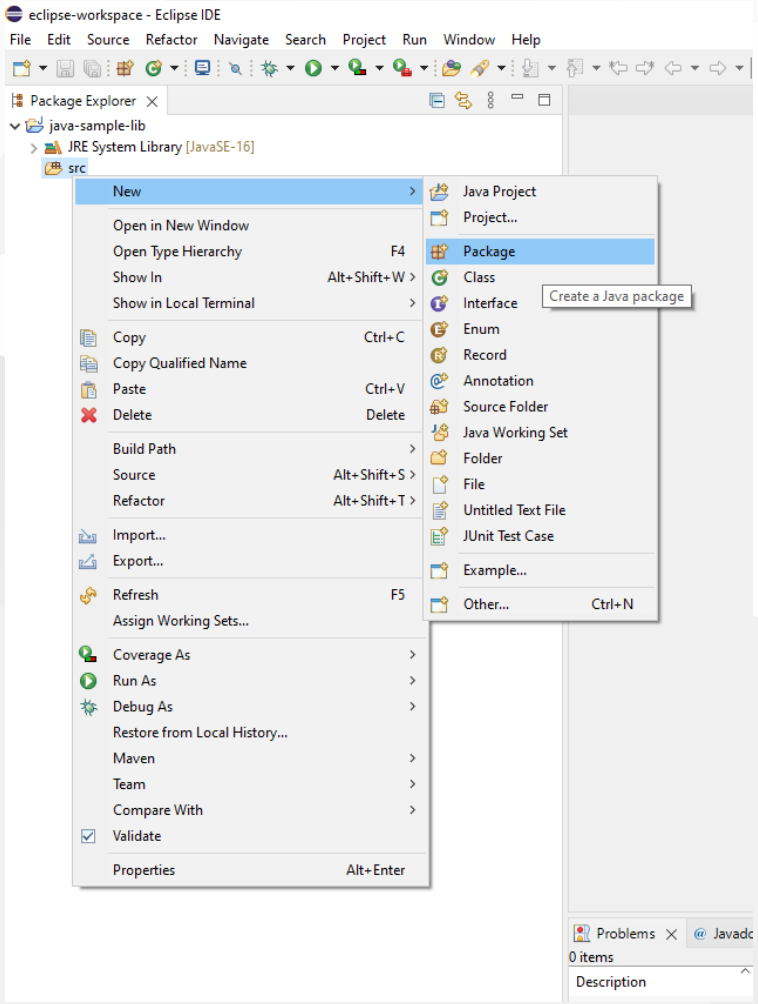
give project name



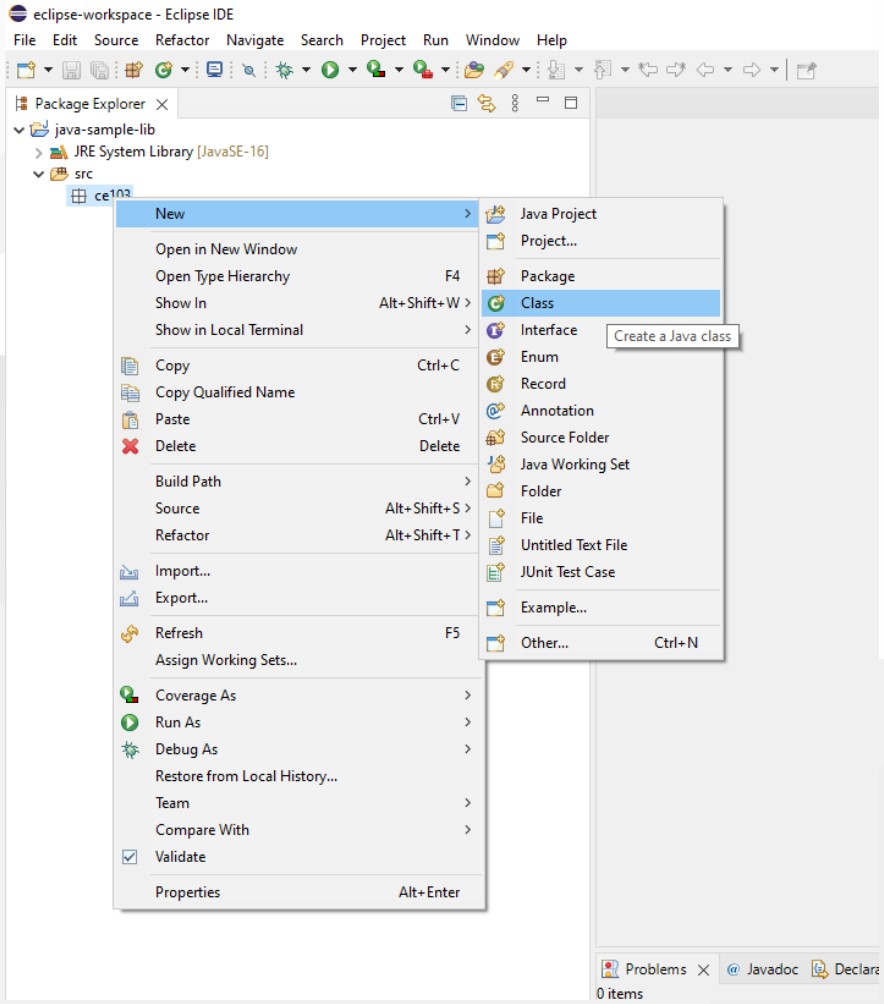
select finish



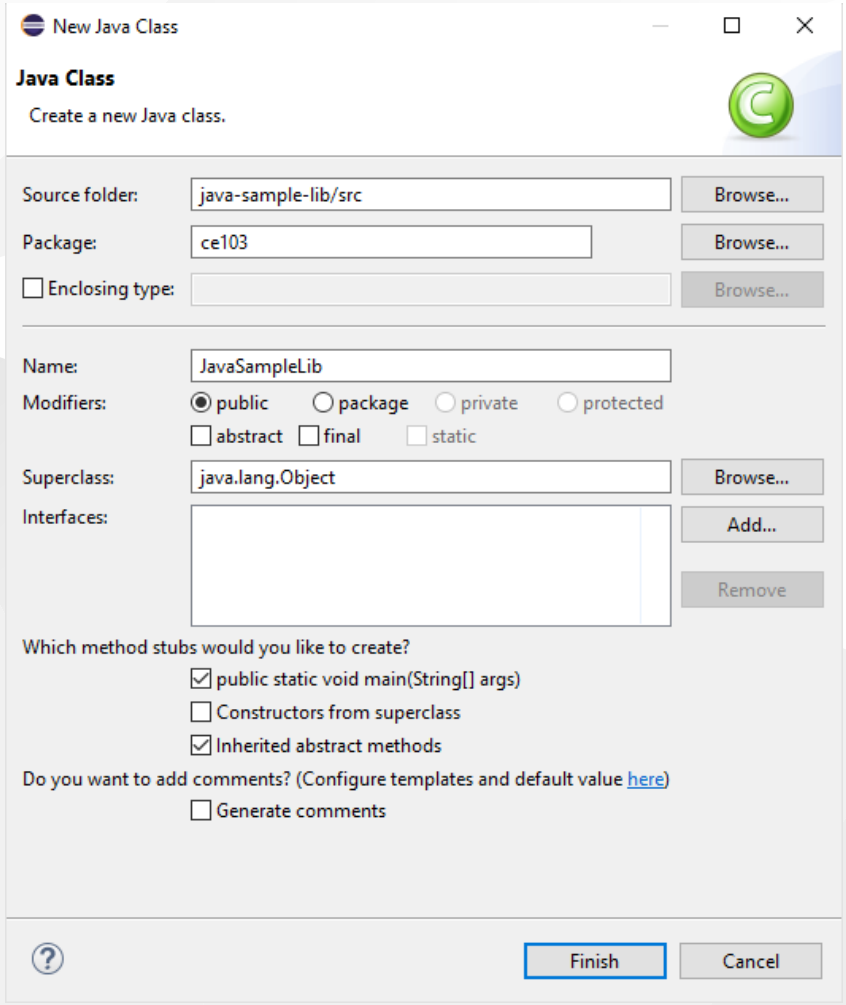
first we need to add a default package to keep everything organized



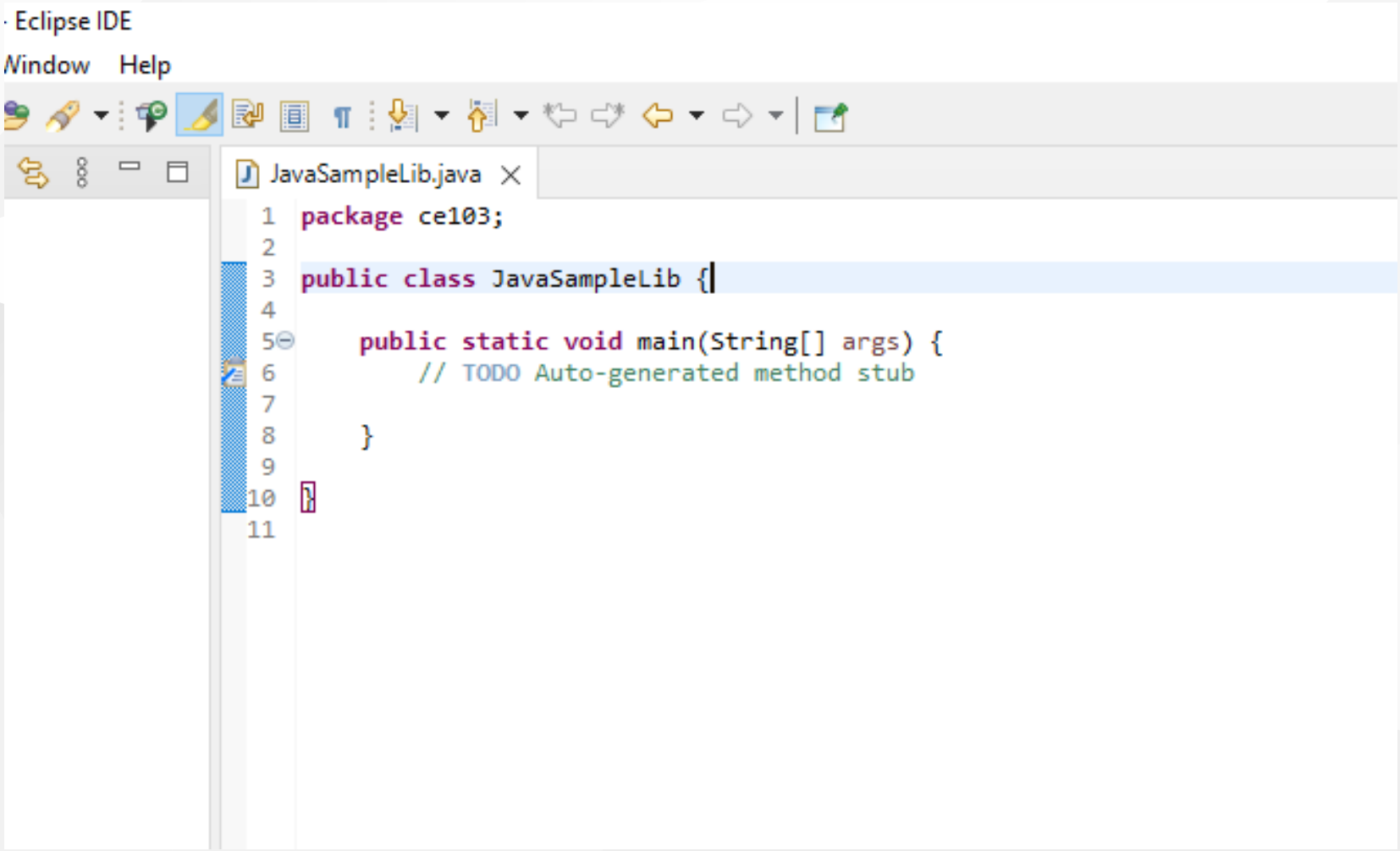
then we can create our class that includes our functions



give class a name



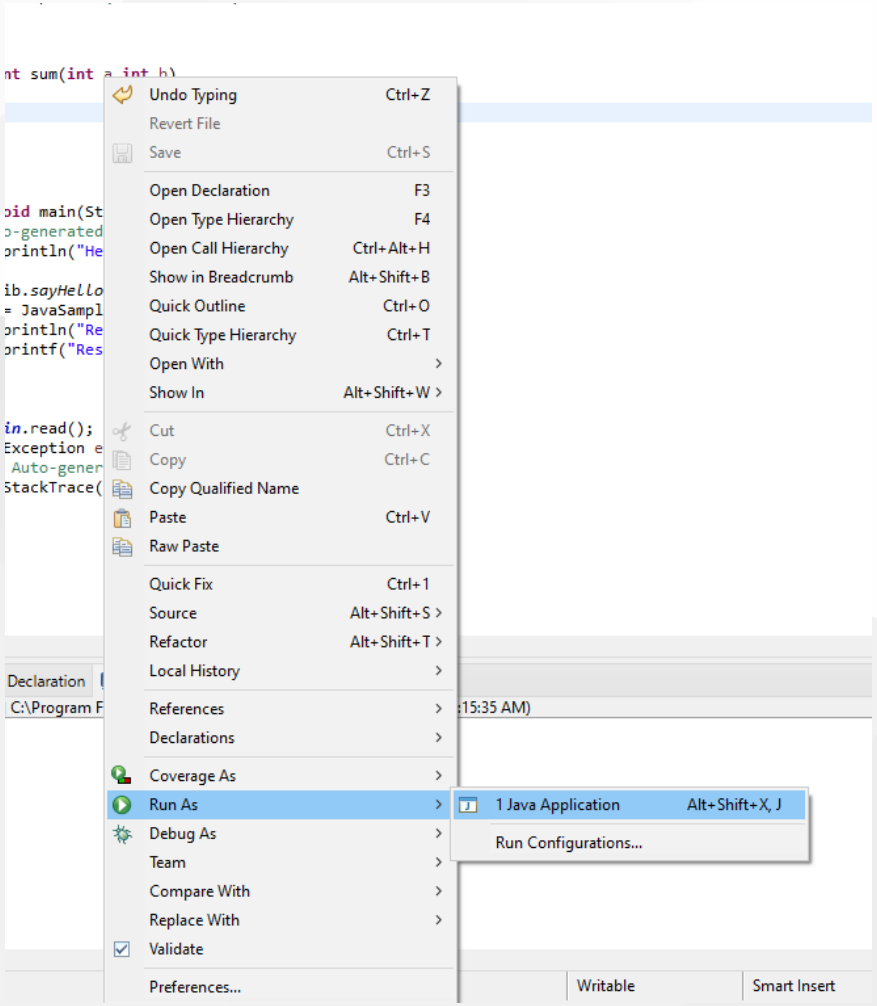
you will have following class with main



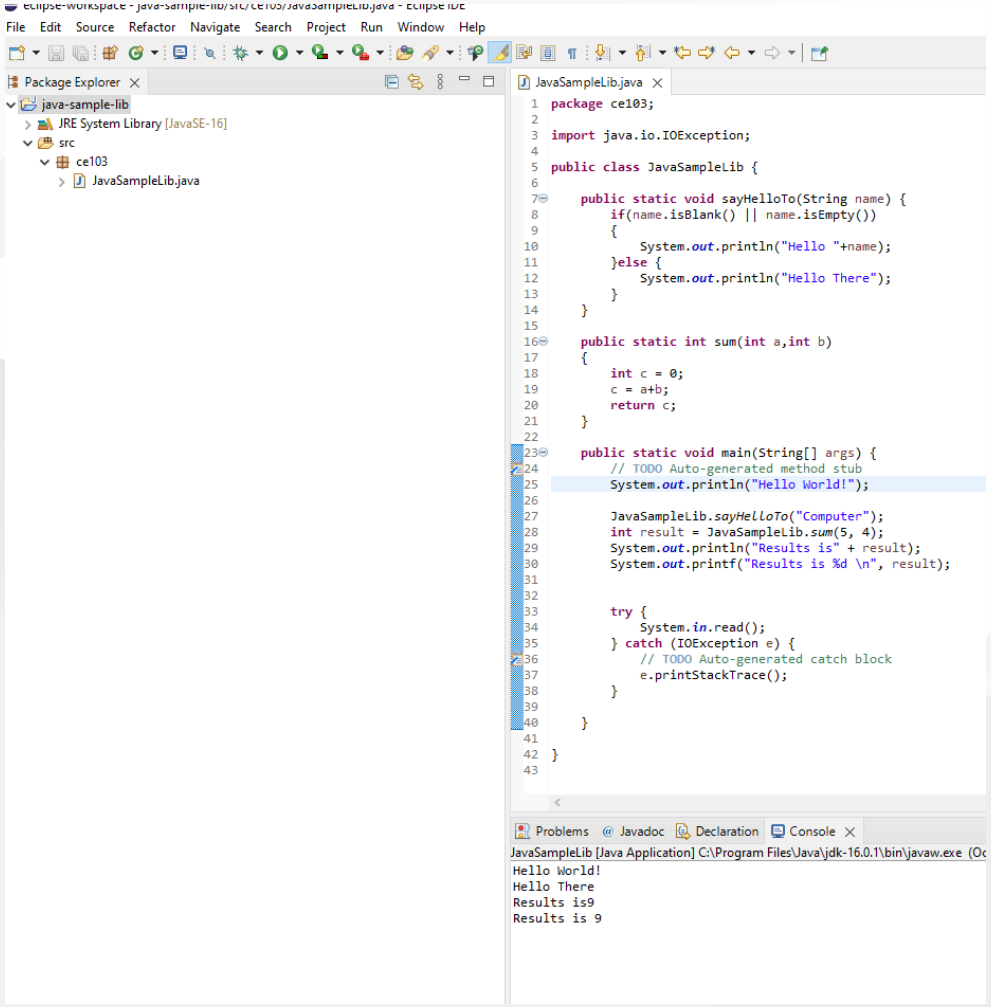
We will create sample java library with static functions as below.

```java
package ce103;

import java.io.IOException;

public class JavaSampleLib {

    public static void sayHelloTo(String name) {
        if(name.isBlank() || name.isEmpty())
        {
            System.out.println("Hello "+name);
        }else {
            System.out.println("Hello There");
        }
    }

    public static int sum(int a,int b)
    {
        int c = 0;
        c = a+b;
        return c;
    }

    public static void main(String[] args) {
        // TODO Auto-generated method stub
        System.out.println("Hello World!");

        JavaSampleLib.sayHelloTo("Computer");
        int result = JavaSampleLib.sum(5, 4);
        System.out.println("Results is" + result);
        System.out.printf("Results is %d \n", result);


        try {
            System.in.read();
        } catch (IOException e) {
            // TODO Auto-generated catch block
            e.printStackTrace();
        }

    }

}
```

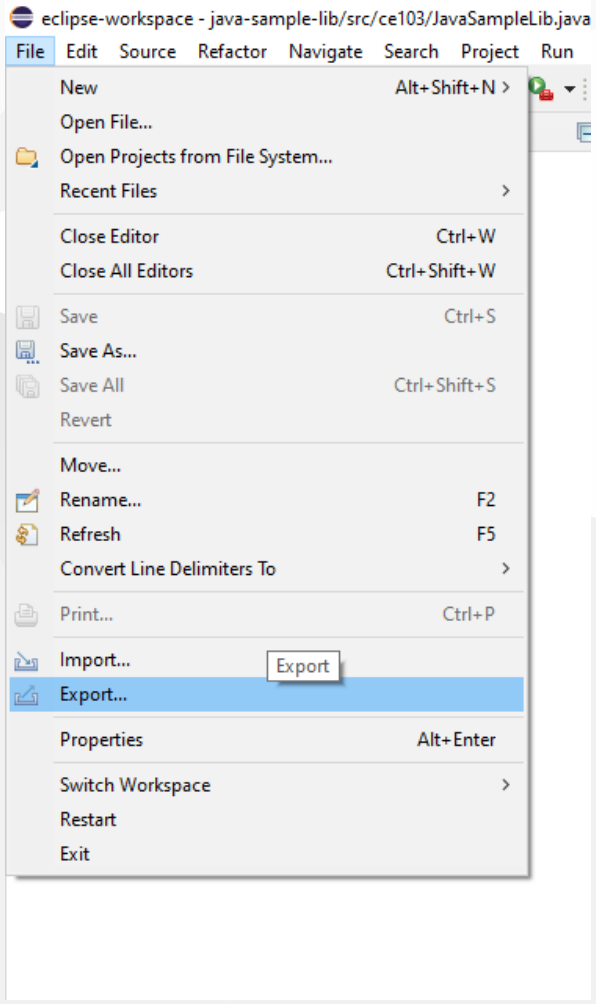
also we can add main method to run our library functions. If we run this file its process main function



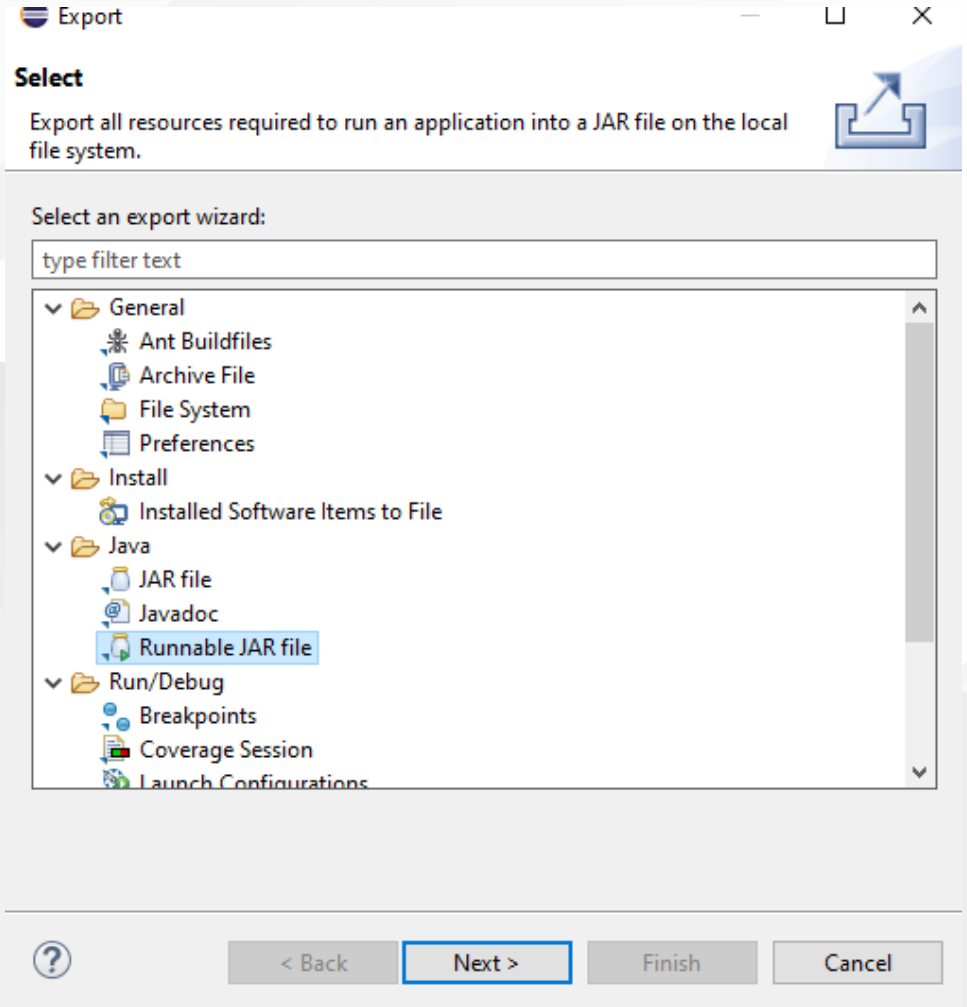
we can see output from console as below



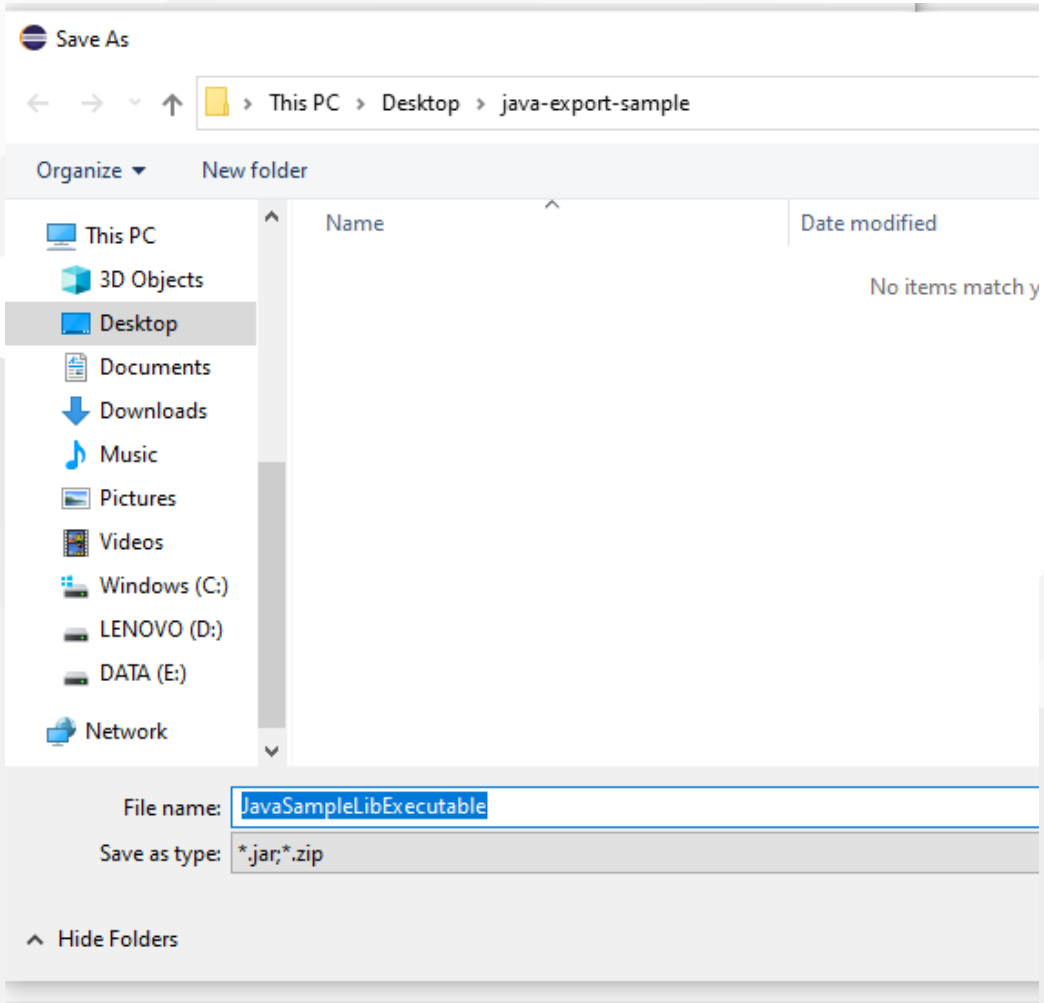
There is no exe files java runtime environment run class files but we can export this as an executable.



Select Java->Runnable JAR File

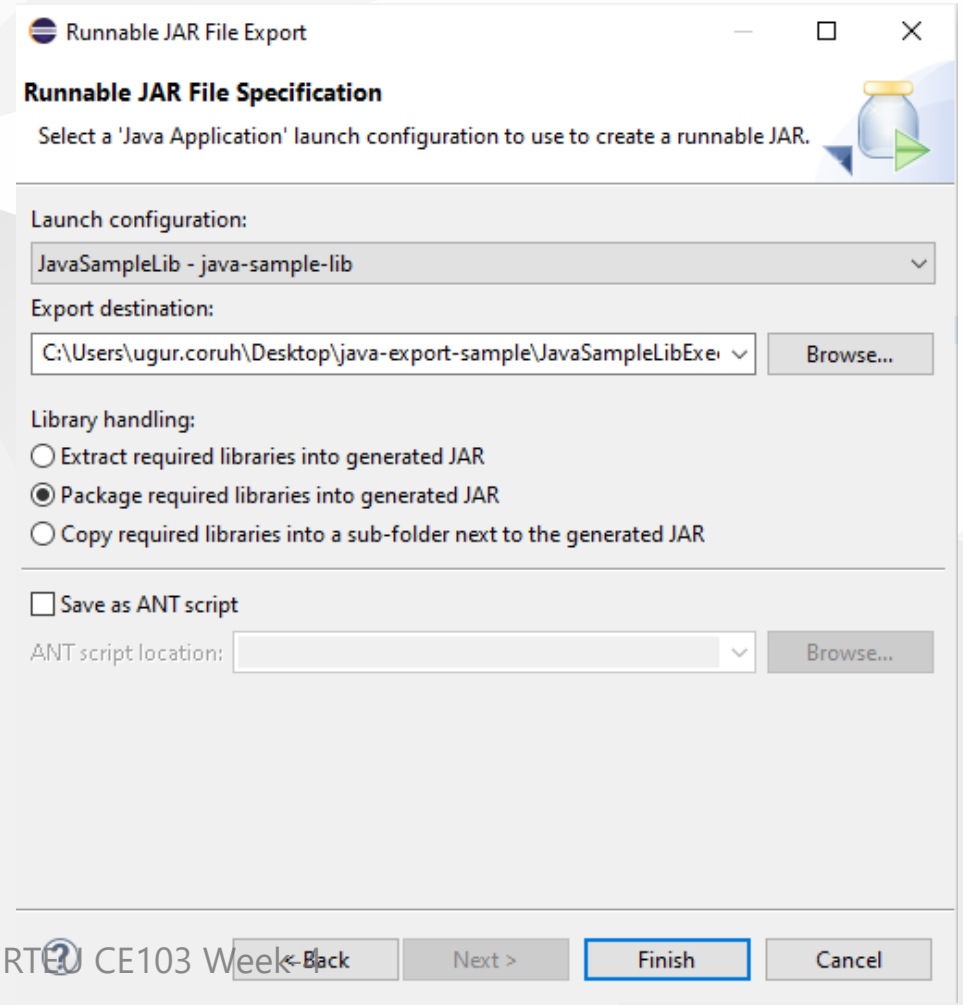


click next and set output path for jar file

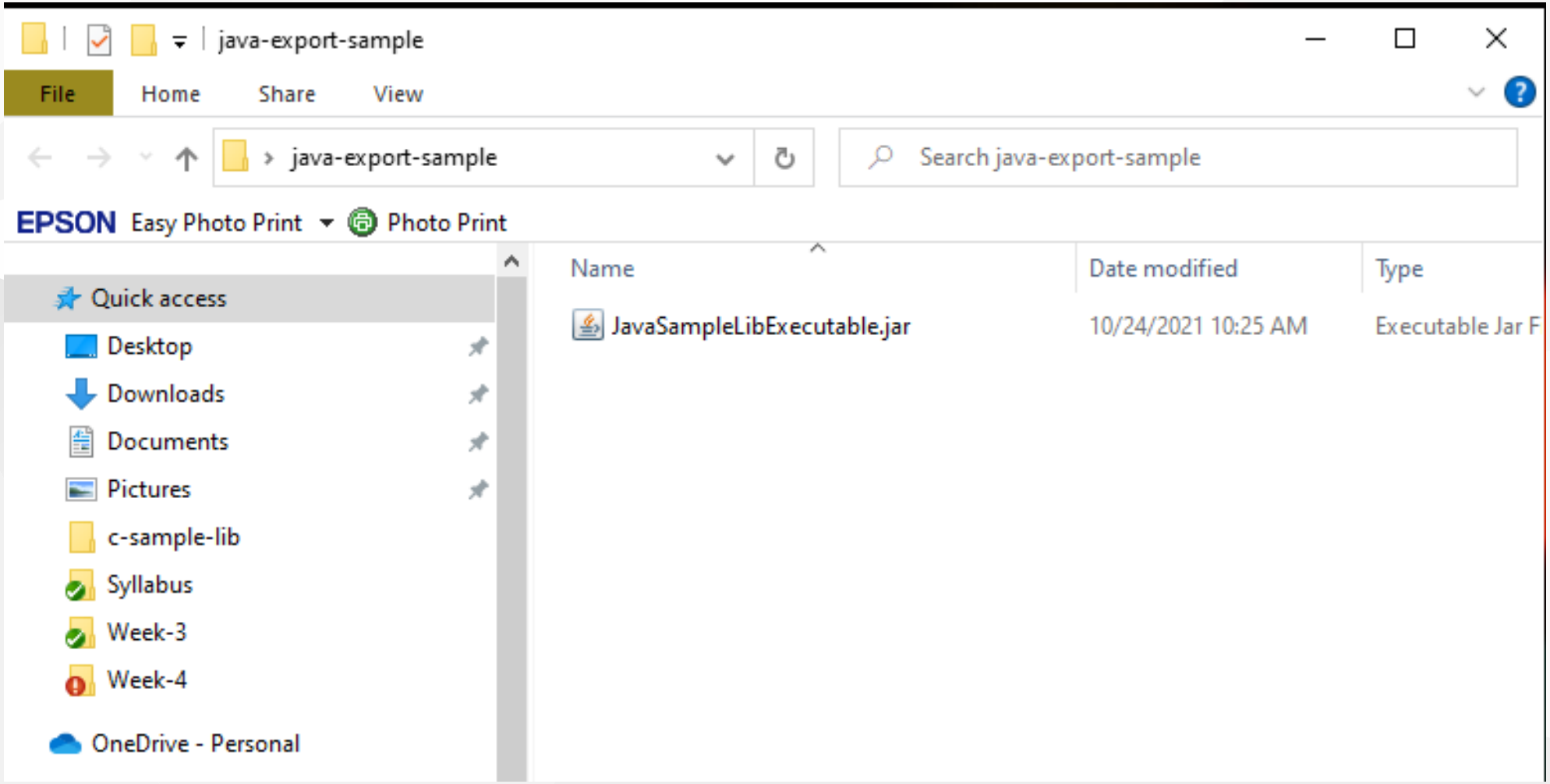


If our project has several external dependecy then we can extract this required files (jar, so, dll) in seperated folder or we can combine them and generate a single executable jar

Lets pack everthing together, Select launch configuration that has main function



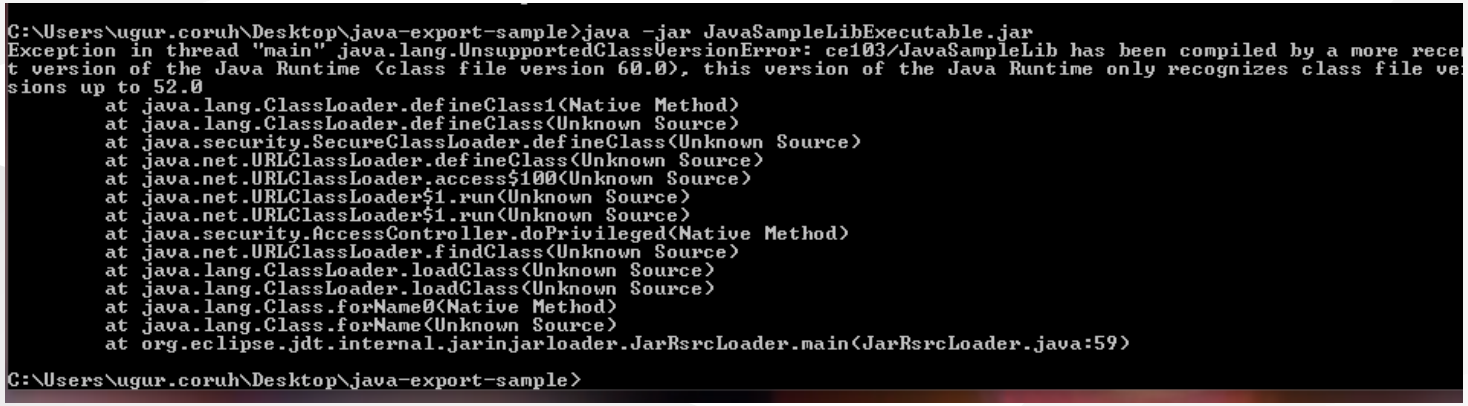
end of this operation we will have the following jar that we can by click



When you click application if cannot run then try command line to see problem

enter jar folder and run the following command

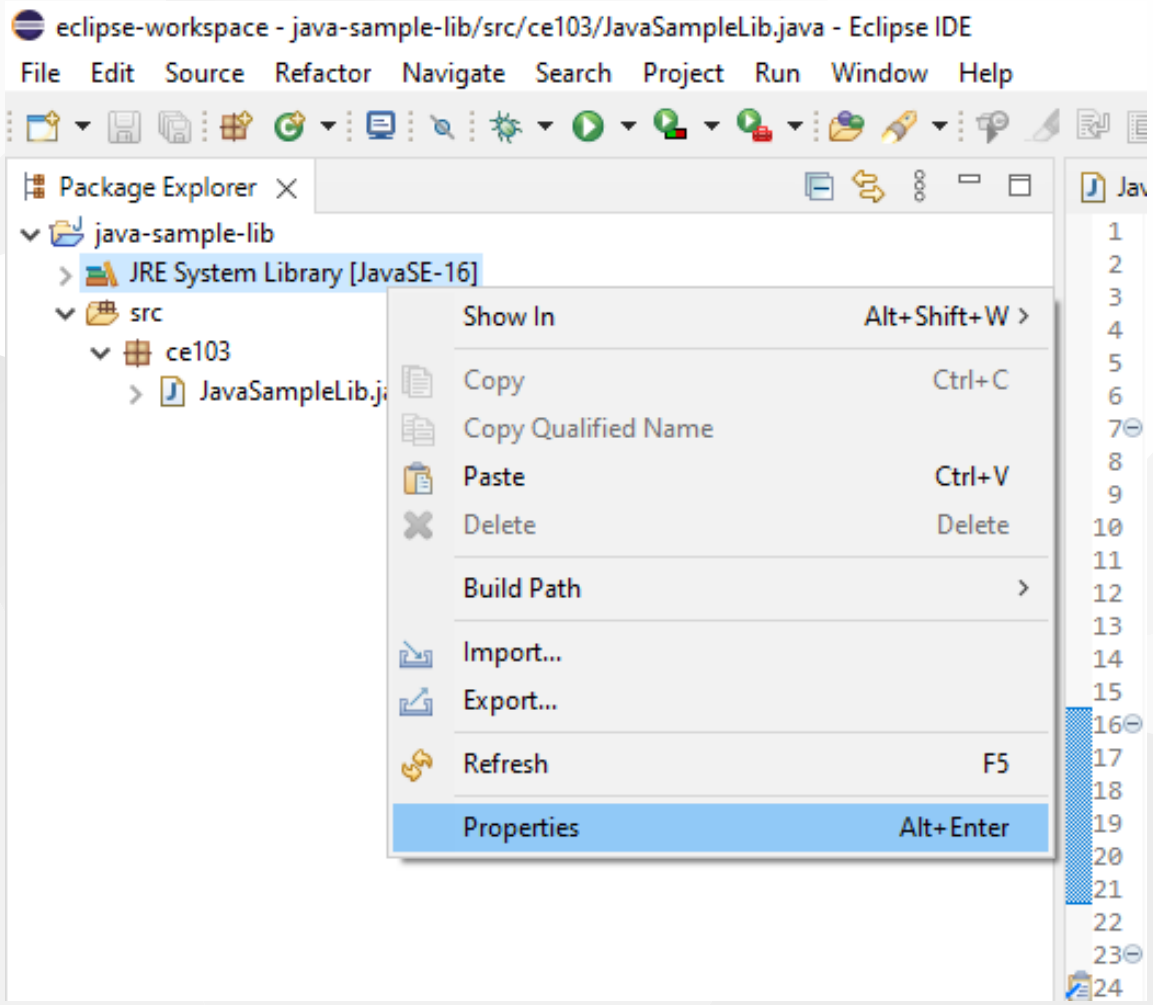
```
java -jar JavaSampleLibExecutable.jar
```



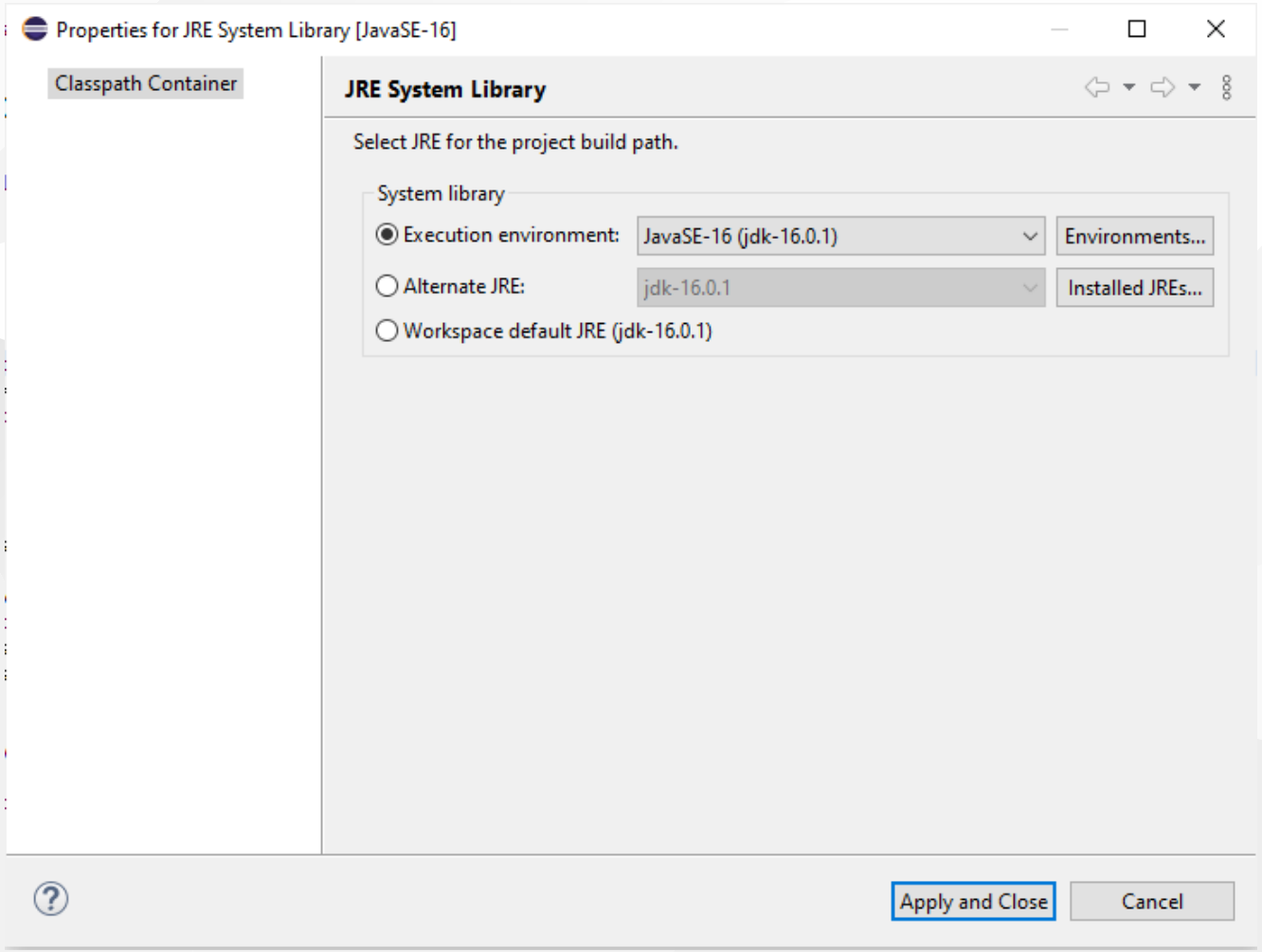
In my case eclipse build JDK is newer than that I installed and set for my OS

If we check version we can see problem Java version 1.8.0_231

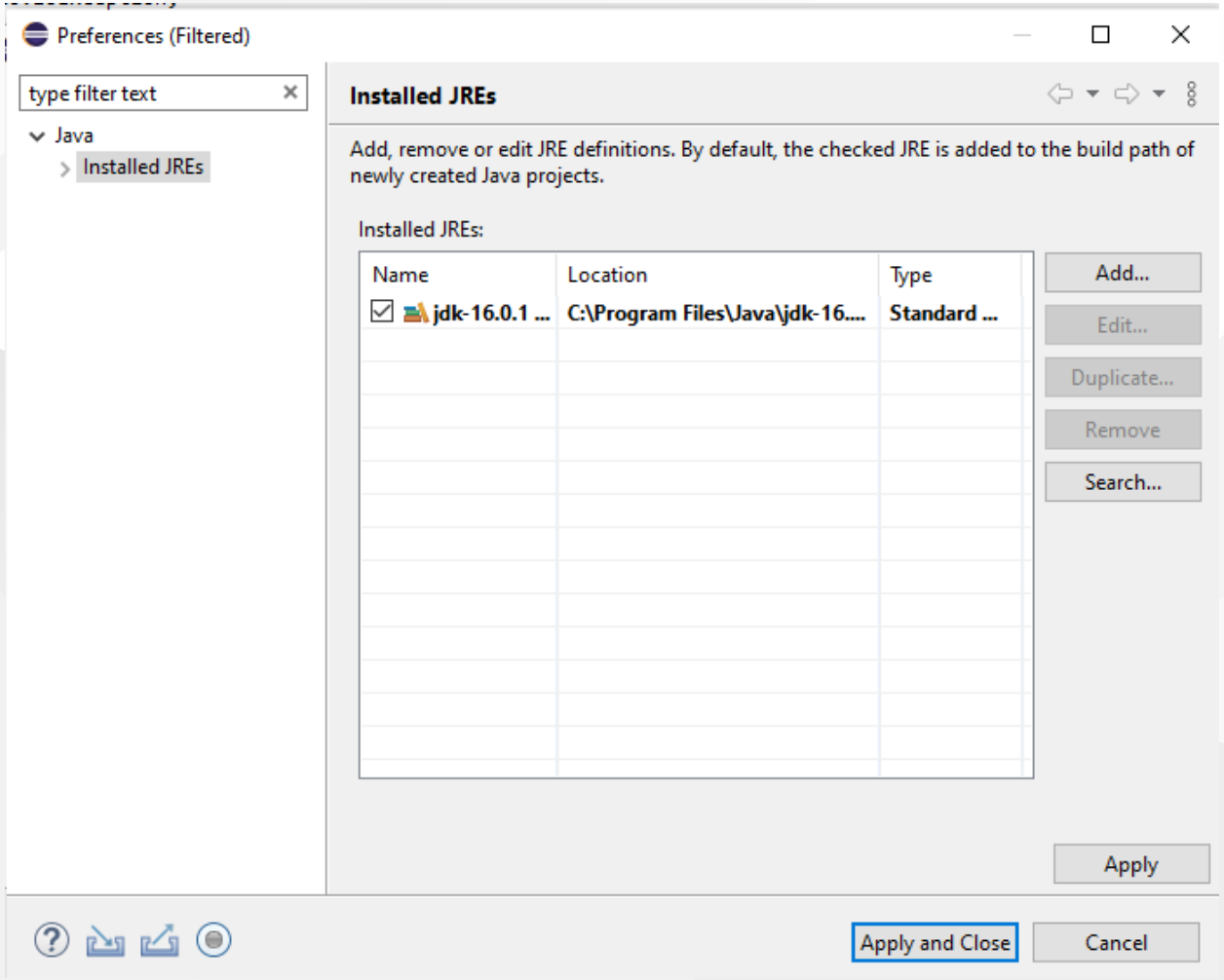
We can found installed and builded JDK for our application from Eclipse setting



select environments

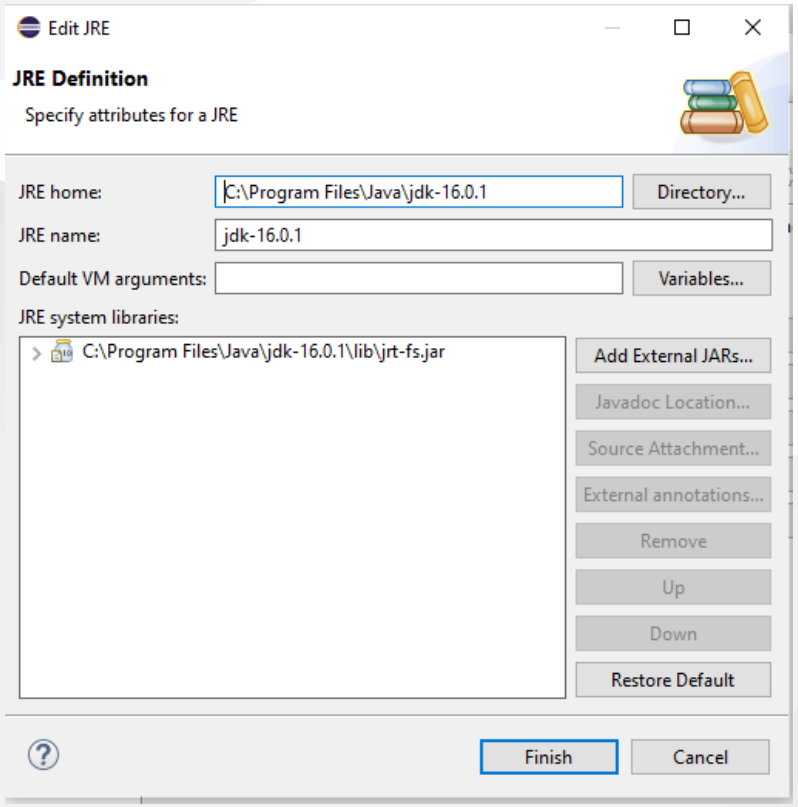


select installed JRE or JDK

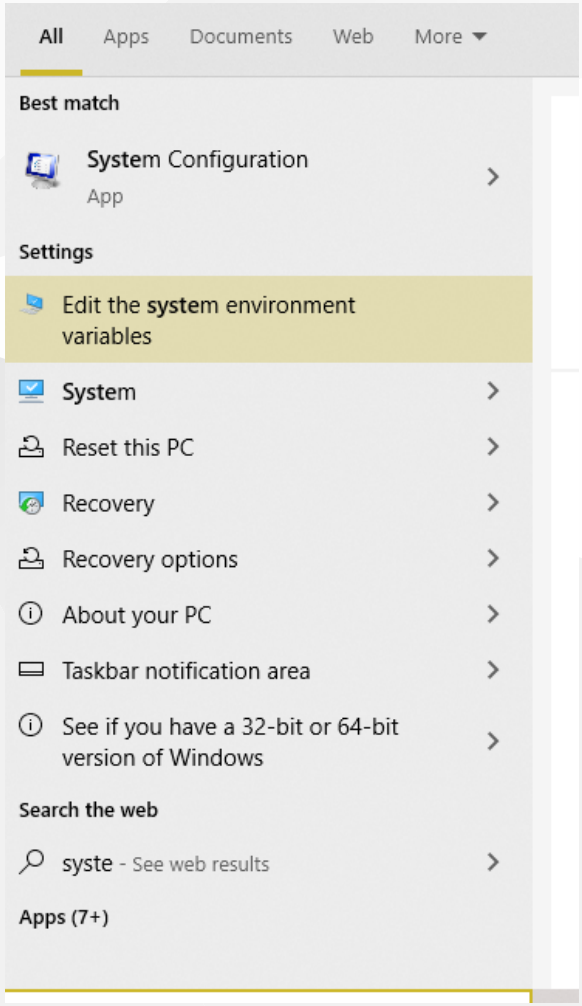


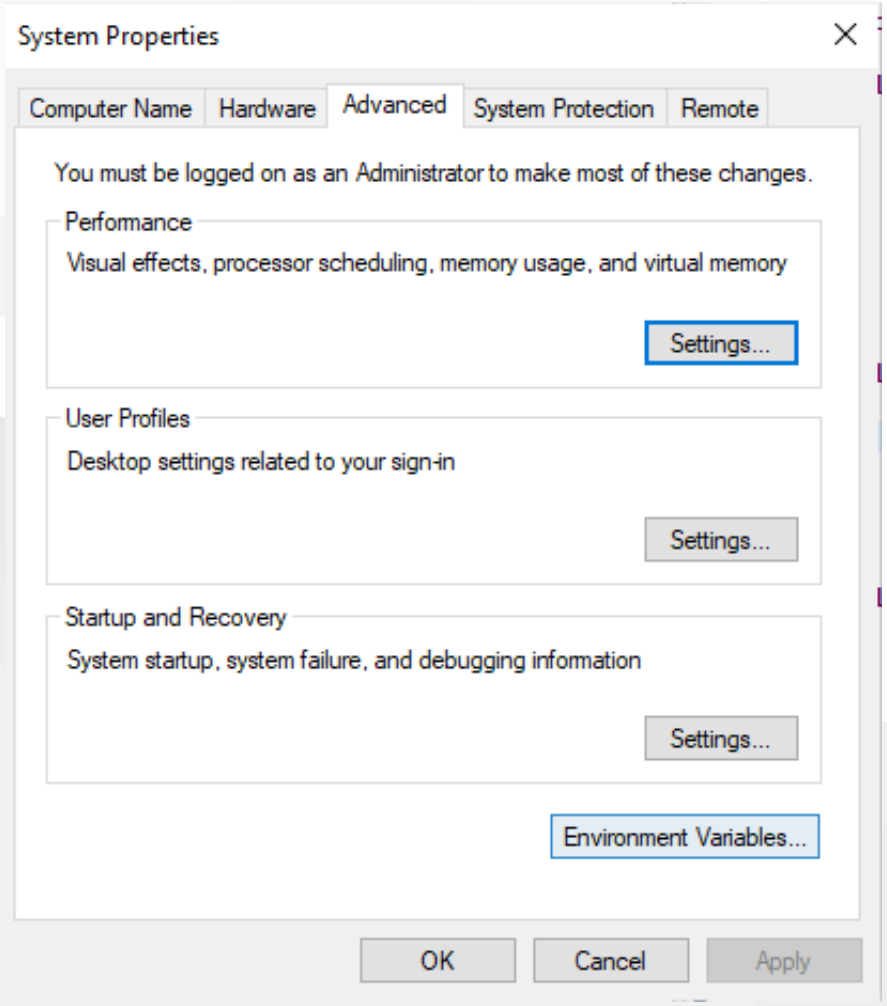
you can see installed JRE or JDK home

```
C:\Program Files\Java\jdk-16.0.1
```

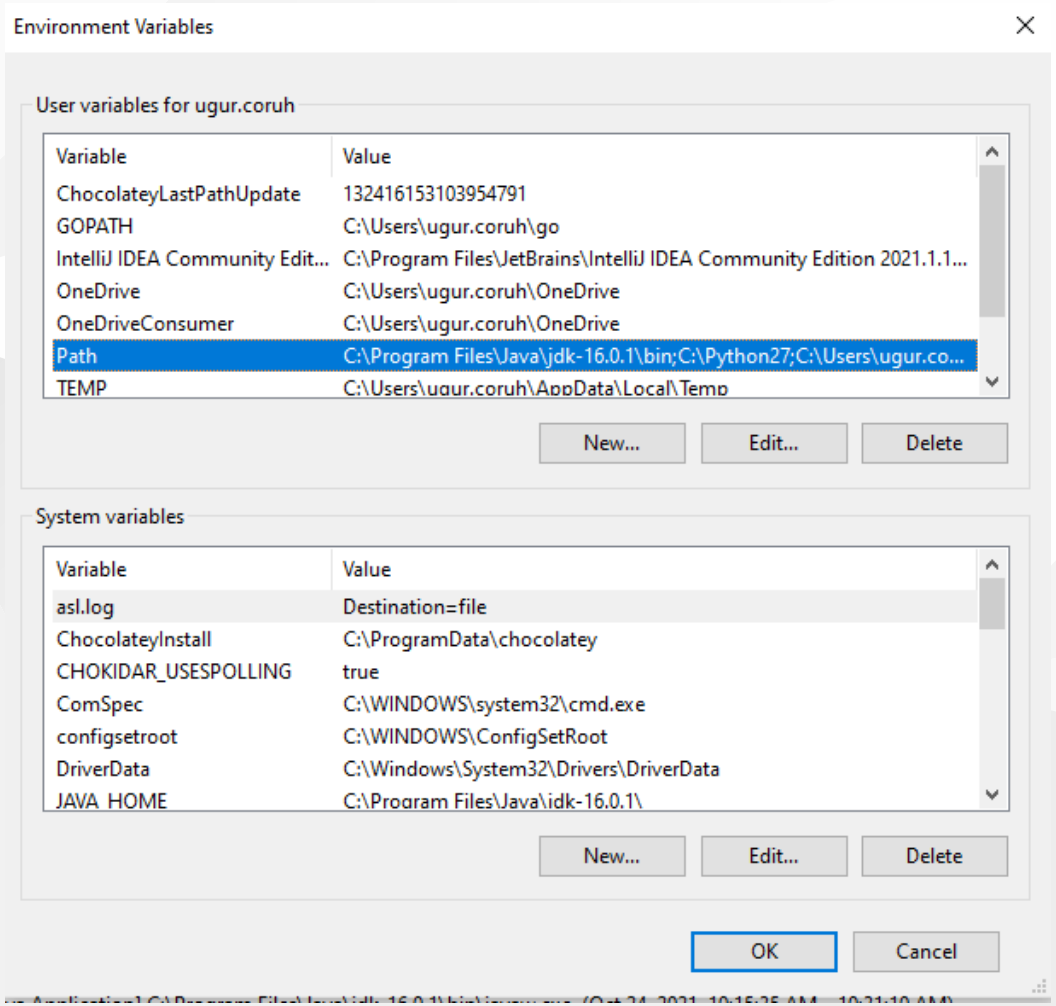


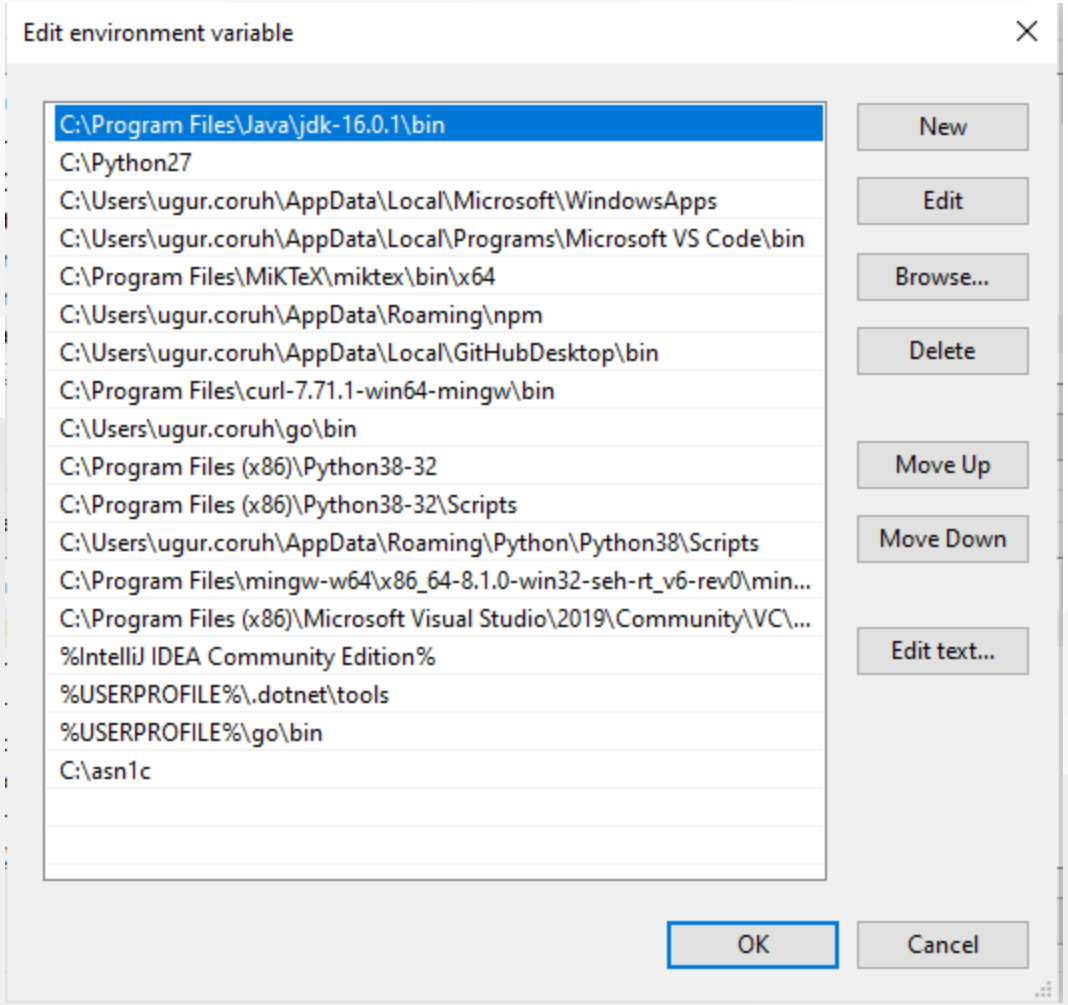
Open system environment to fix this problem



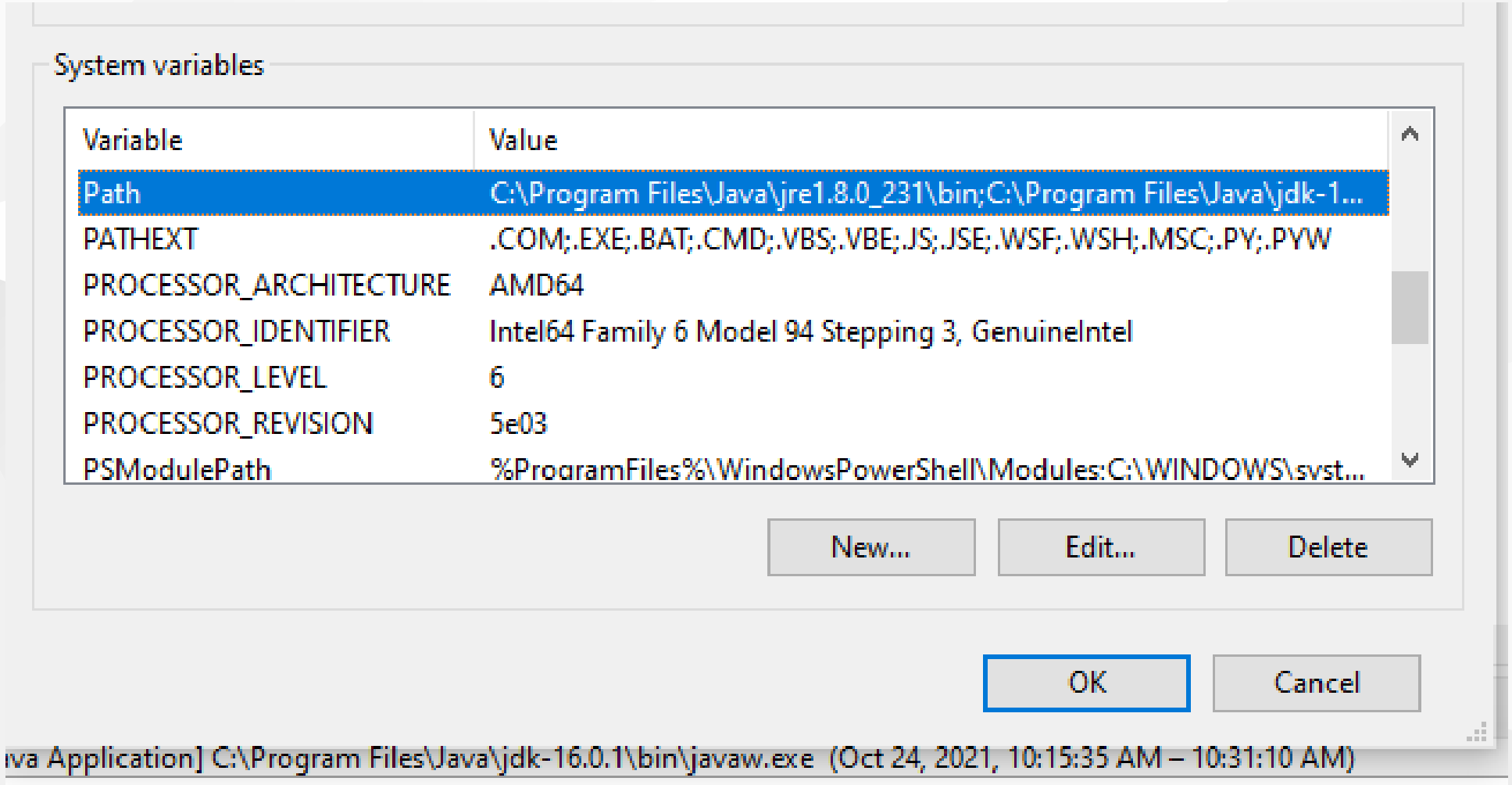

System Properties
Computer Name
Hardware
Advanced
System Protection
Remote
You must be logged on as an Administrator to make most of these changes.
Performance
Visual effects, processor scheduling, memory usage, and virtual memory
Settings...
User Profiles
Desktop settings related to your sign-in
Settings...
Startup and Recovery
System startup, system failure, and debugging information
Settings...
Environment Variables...
OK
Cancel
Apply

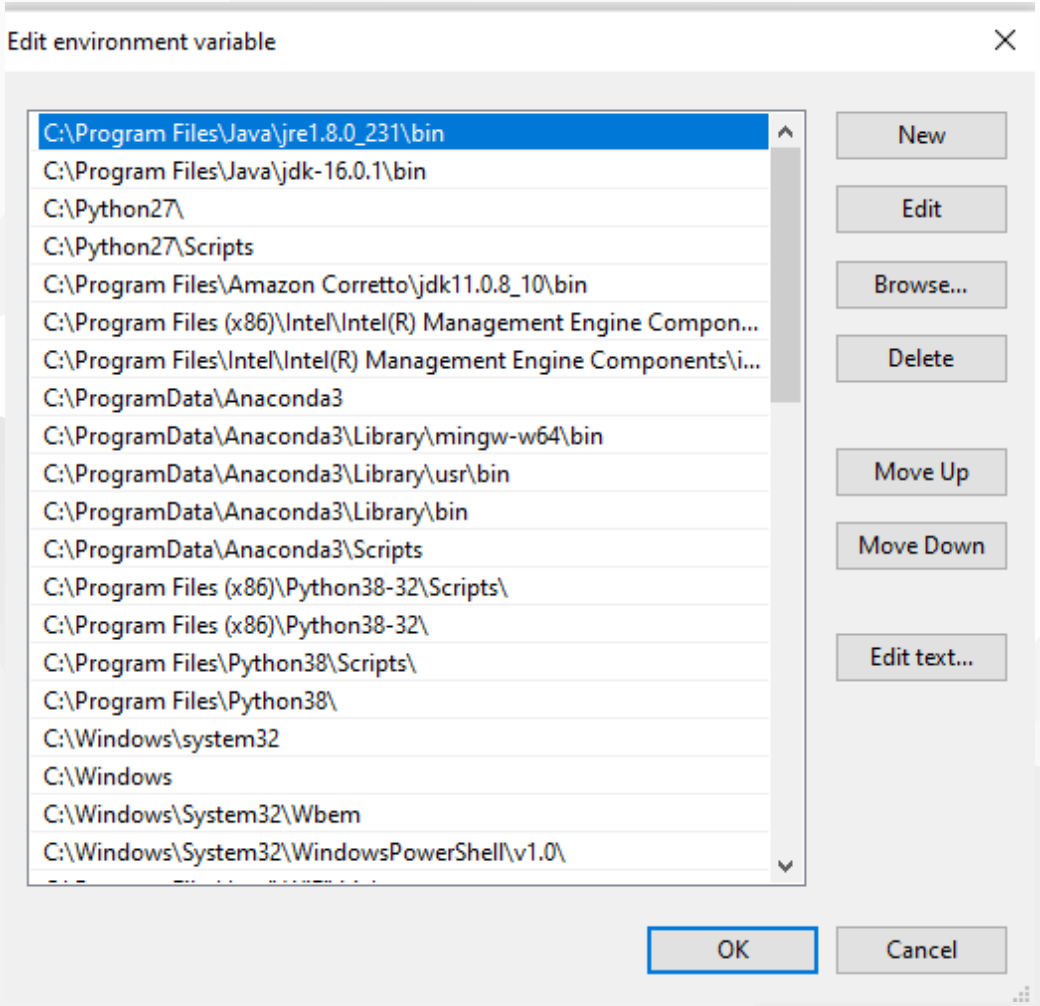
Check user settings first



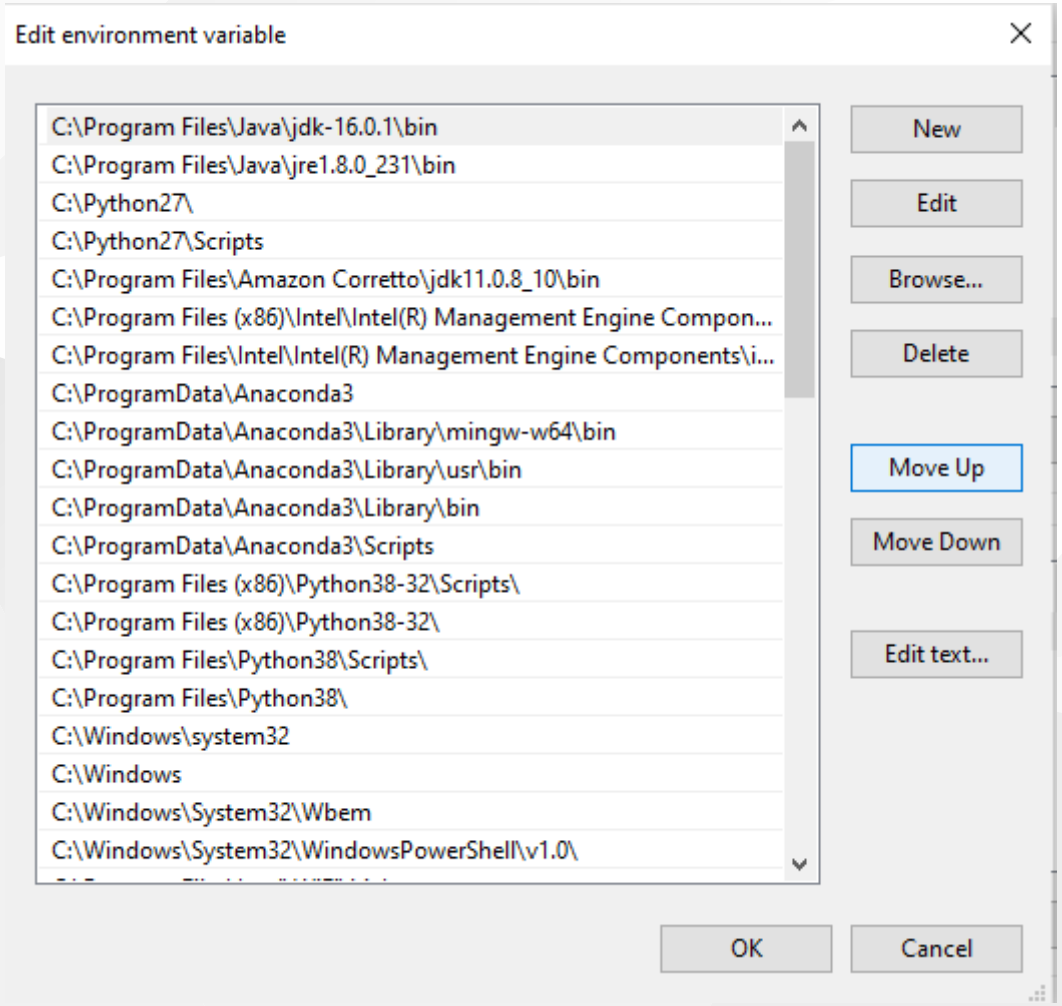

Edit environment variable
C:\Program Files\Java\jdk-16.0.1\bin
C:\Python27
C:\Users\ugur.coruh\AppData\Local\Microsoft\WindowsApps
C:\Users\ugur.coruh\AppData\Local\Programs\Microsoft VS Code\bin
C:\Program Files\MiKTeX\miktex\bin\x64
C:\Users\ugur.coruh\AppData\Roaming\npm
C:\Users\ugur.coruh\AppData\Local\GitHubDesktop\bin
C:\Program Files\curl-7.71.1-win64-mingw\bin
C:\Users\ugur.coruh\go\bin
C:\Program Files (x86)\Python38-32
C:\Program Files (x86)\Python38-32\Scripts
C:\Users\ugur.coruh\AppData\Roaming\Python\Python38\Scripts
C:\Program Files\mingw-w64\x86_64-8.1.0-win32-seh-rt_v6-rev0\min...
C:\Program Files (x86)\Microsoft Visual Studio\2019\Community\VC\...
%IntelliJ IDEA Community Edition%
%USERPROFILE%\.dotnet\tools
%USERPROFILE%\go\bin
C:\asn1c
New
Edit
Browse...
Delete
Move Up
Move Down
Edit text...
OK
Cancel

Check system settings

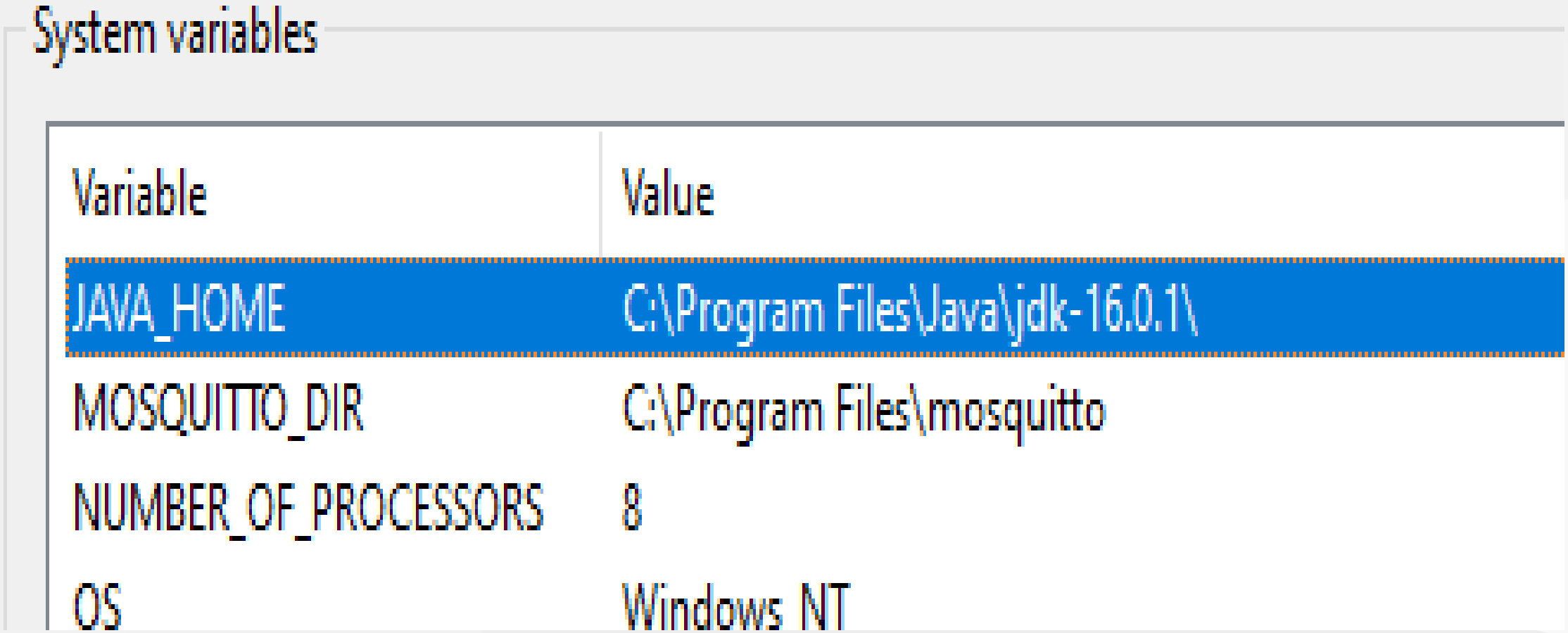



Edit environment variable
C:\Program Files\Java\jre1.8.0_231\bin
C:\Program Files\Java\jdk-16.0.1\bin
C:\Python27\
C:\Python27\Scripts
C:\Program Files\Amazon Corretto\jdk11.0.8_10\bin
C:\Program Files (x86)\Intel\Intel(R) Management Engine Compon...
C:\Program Files\Intel\Intel(R) Management Engine Components\i...
C:\ProgramData\Anaconda3
C:\ProgramData\Anaconda3\Library\mingw-w64\bin
C:\ProgramData\Anaconda3\Library\usr\bin
C:\ProgramData\Anaconda3\Library\bin
C:\ProgramData\Anaconda3\Scripts
C:\Program Files (x86)\Python38-32\Scripts\
C:\Program Files (x86)\Python38-32\
C:\Program Files\Python38\Scripts\
C:\Program Files\Python38\
C:\Windows\system32
C:\Windows
C:\Windows\System32\Wbem
C:\Windows\System32\WindowsPowerShell\v1.0\
New
Edit
Browse...
Delete
Move Up
Move Down
Edit text...
OK
Cancel

we will move up the JDK 16 configuration then command line will run first java



Also in system setting check JAVA_HOME

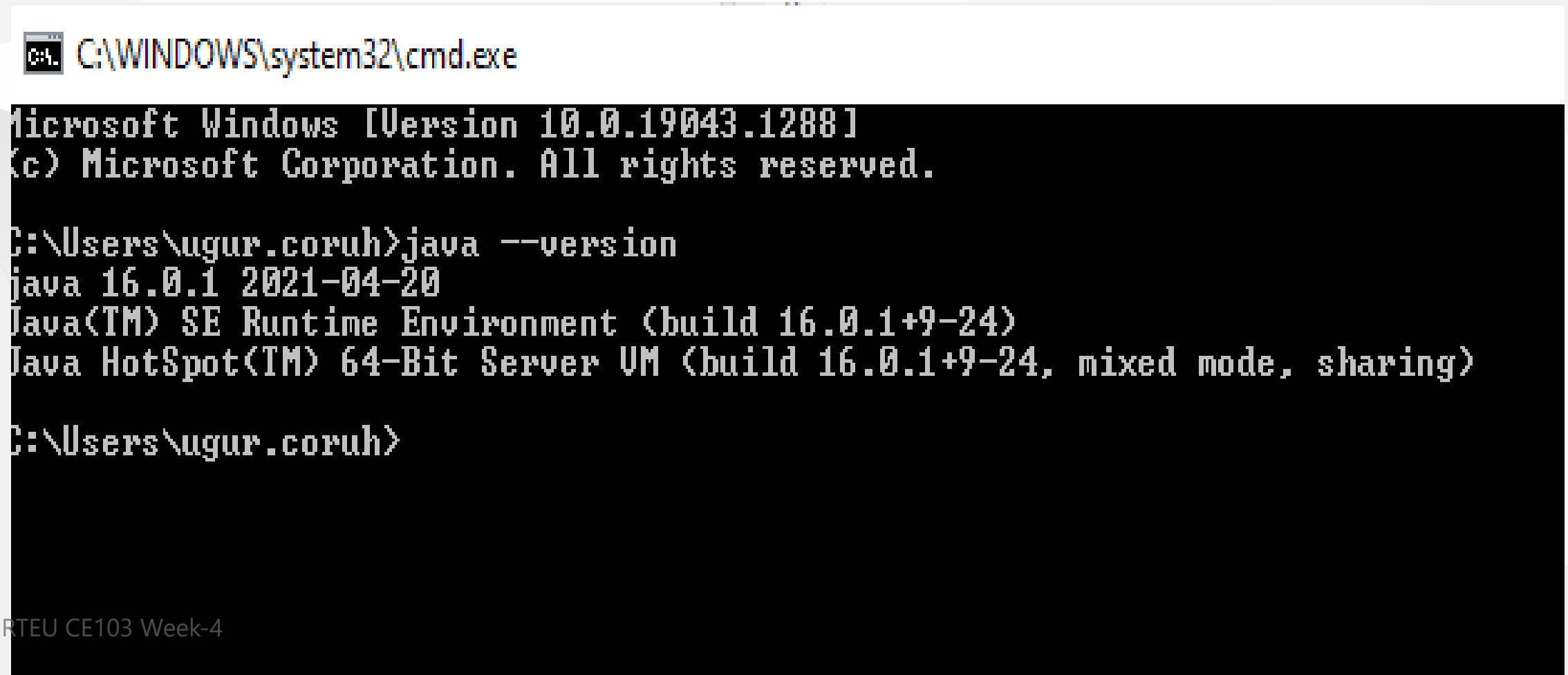


After this settings close current command line and open new one

write

```
java --version
```

if you see java version updated and 16.0.1 then settings are correct



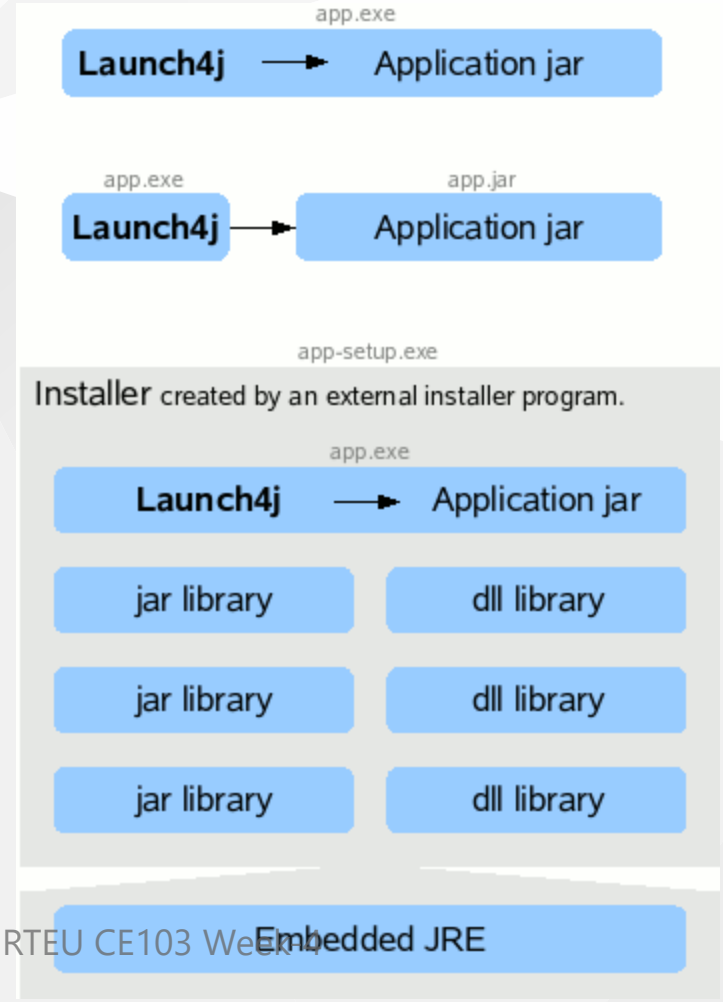
and now if we enter and run application as follow we will see output

```
C:\Users\ugur.coruh>cd Desktop

C:\Users\ugur.coruh\Desktop>cd java-export-sample

C:\Users\ugur.coruh\Desktop\java-export-sample>java -jar JavaSampleLibExecutable.jar
Hello World!
Hello There
Results is9
Results is 9
```

But when you click this jar its not running as you see so we have options to provide a clickable application there

Launch4j is an option here

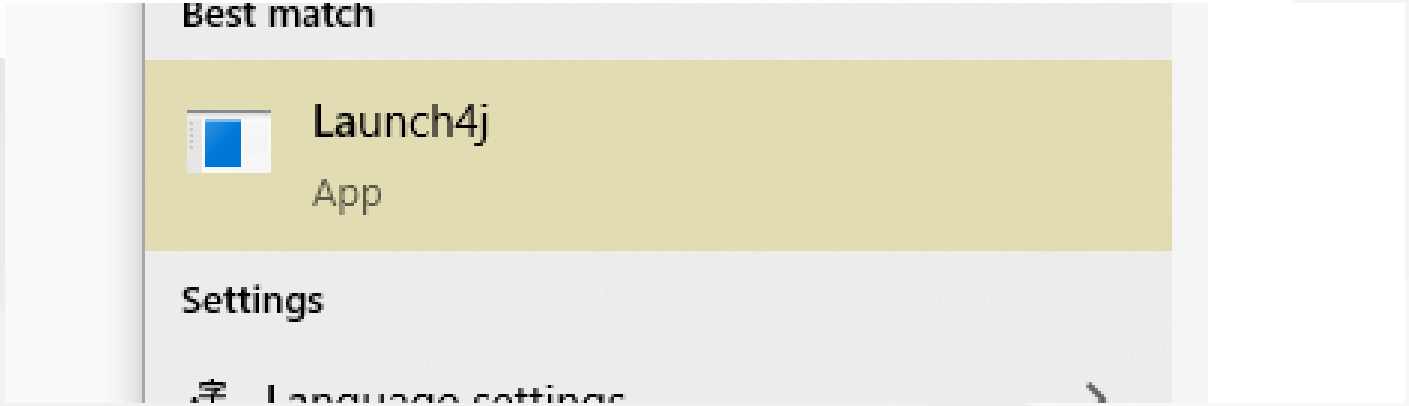
Launch4j - Cross-platform Java executable wrapper



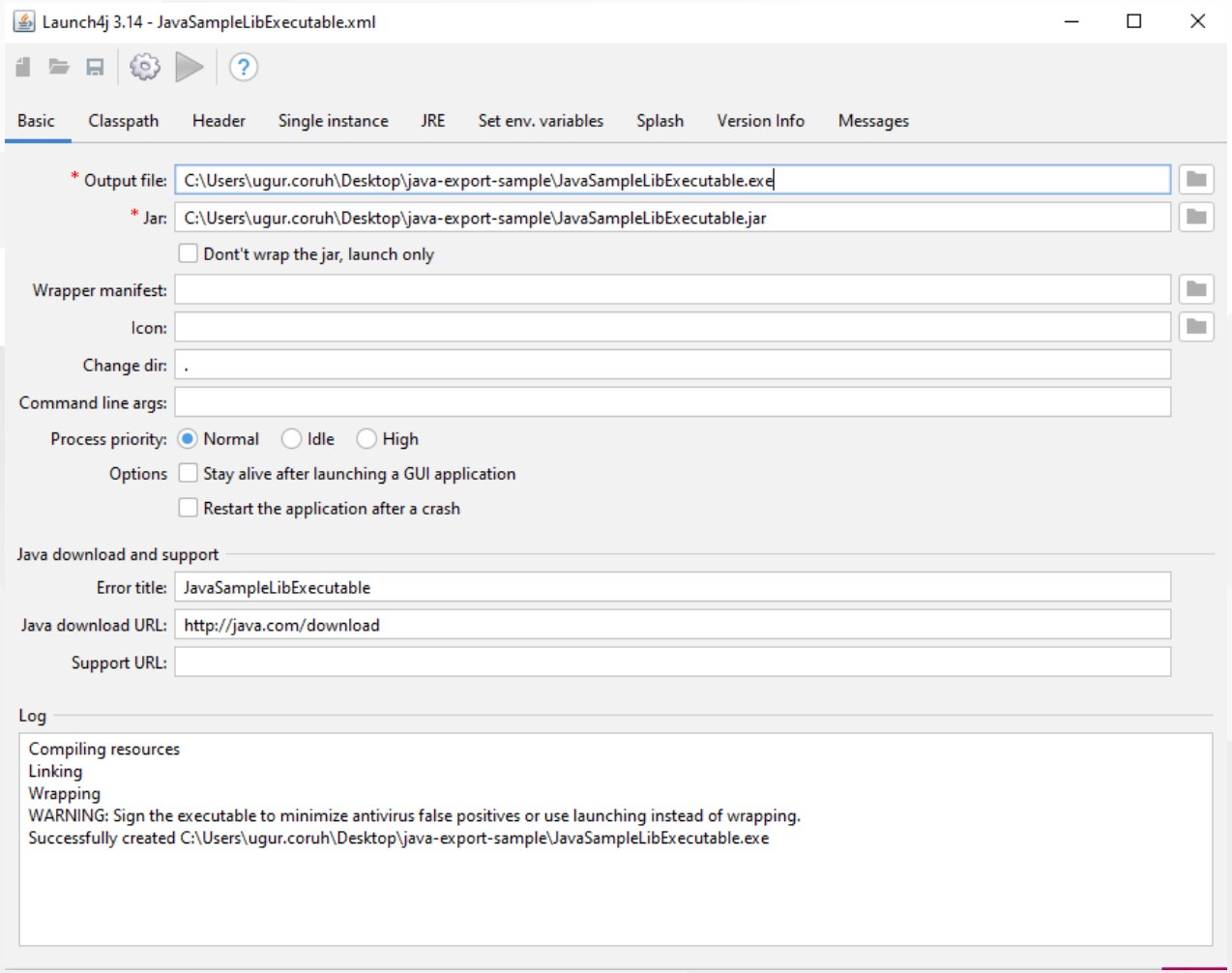
you can watch this tutorial also

How to convert jar to exe using Launch4J Full explanation - YouTube

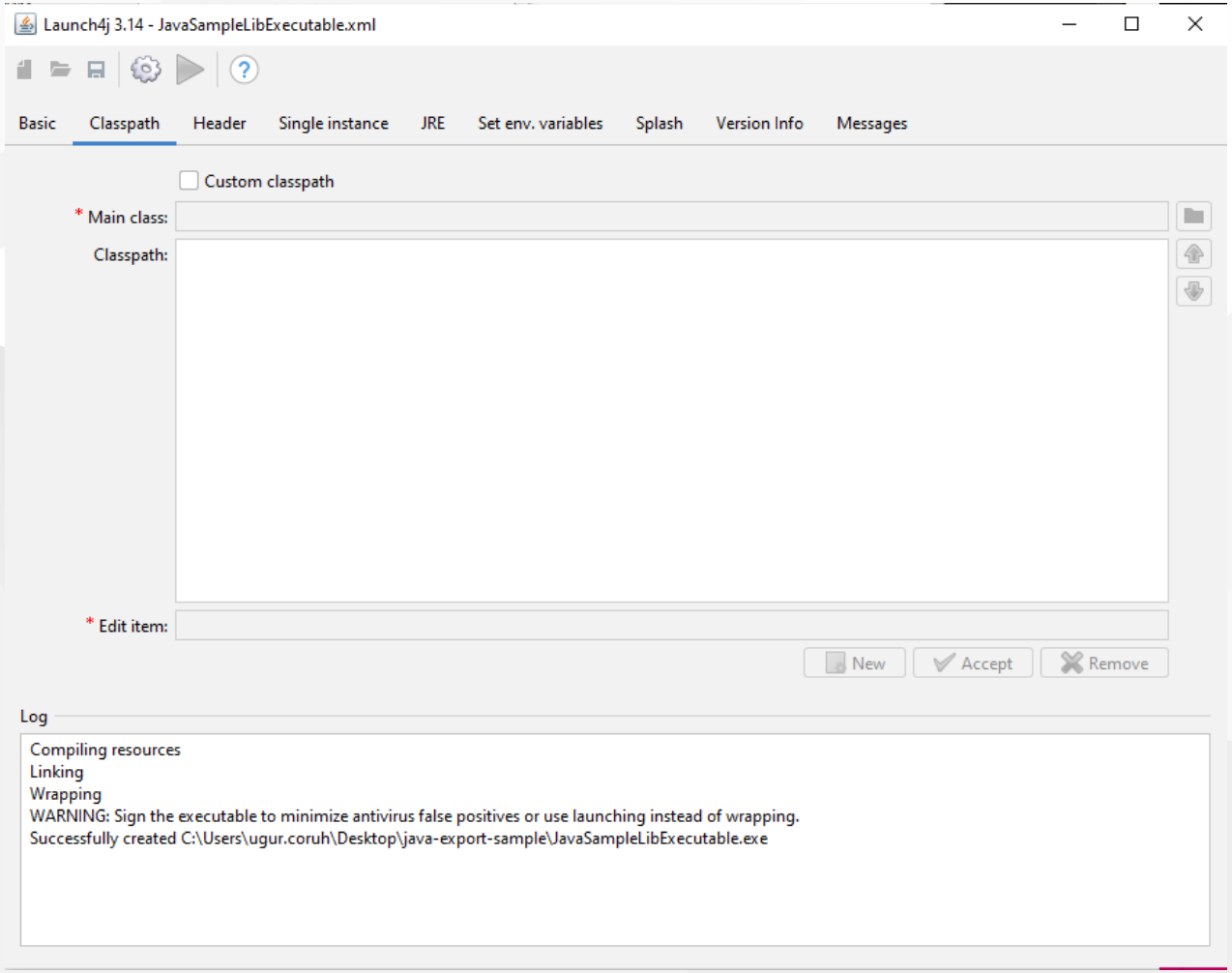
Download and install launch4j and open application



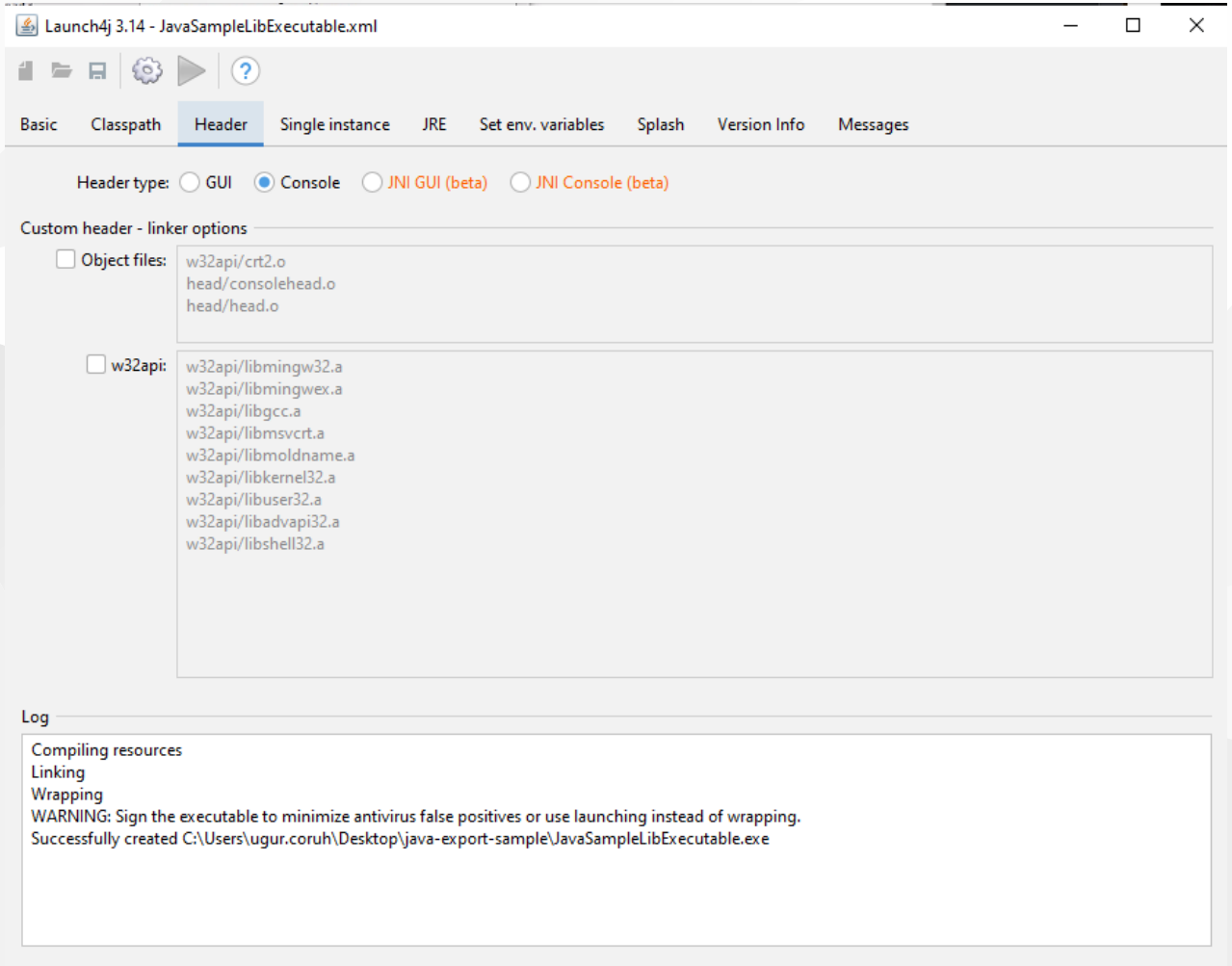
configure your application settings similar to below select jar file and exe output path



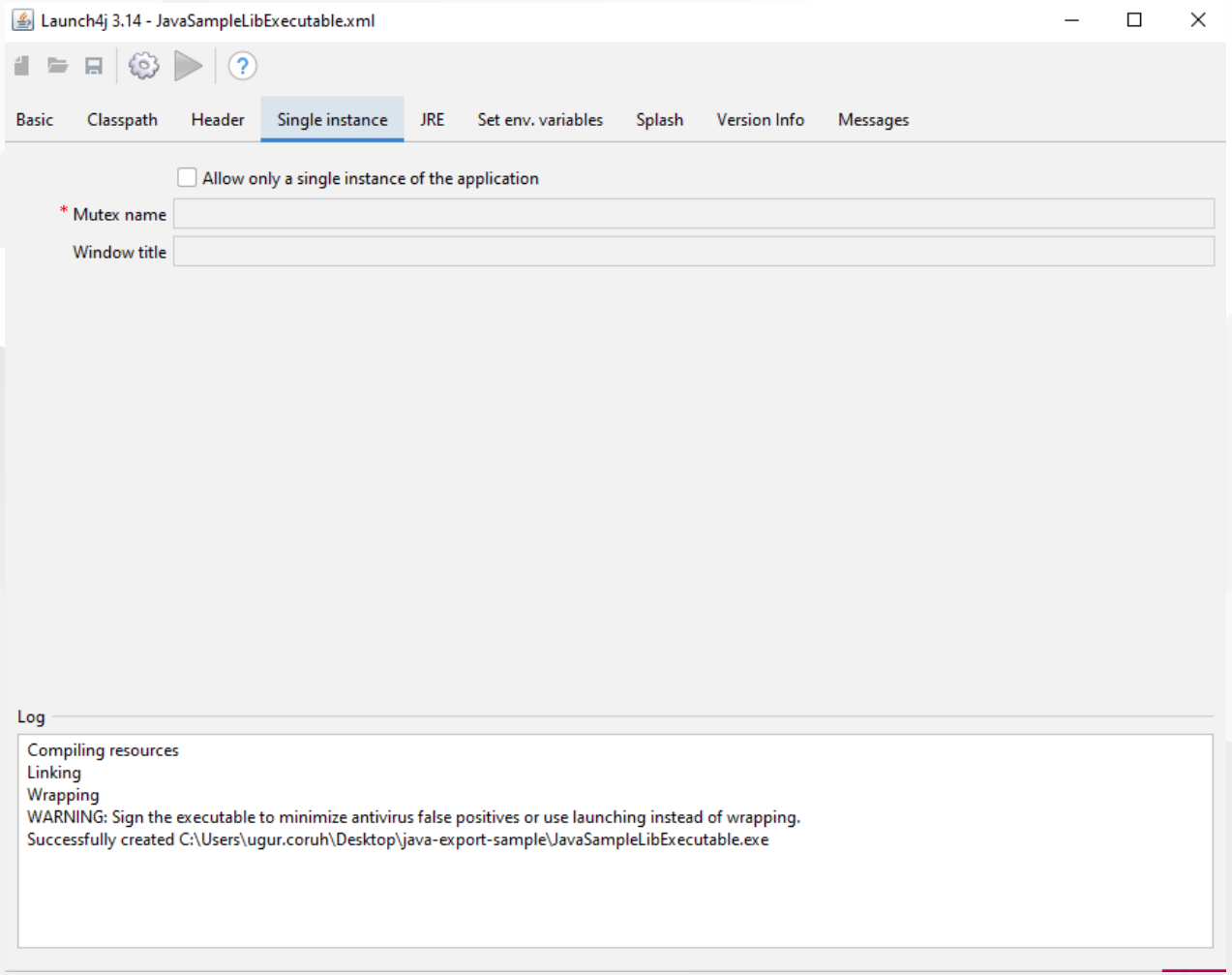
we can customize main class if have multiple main class



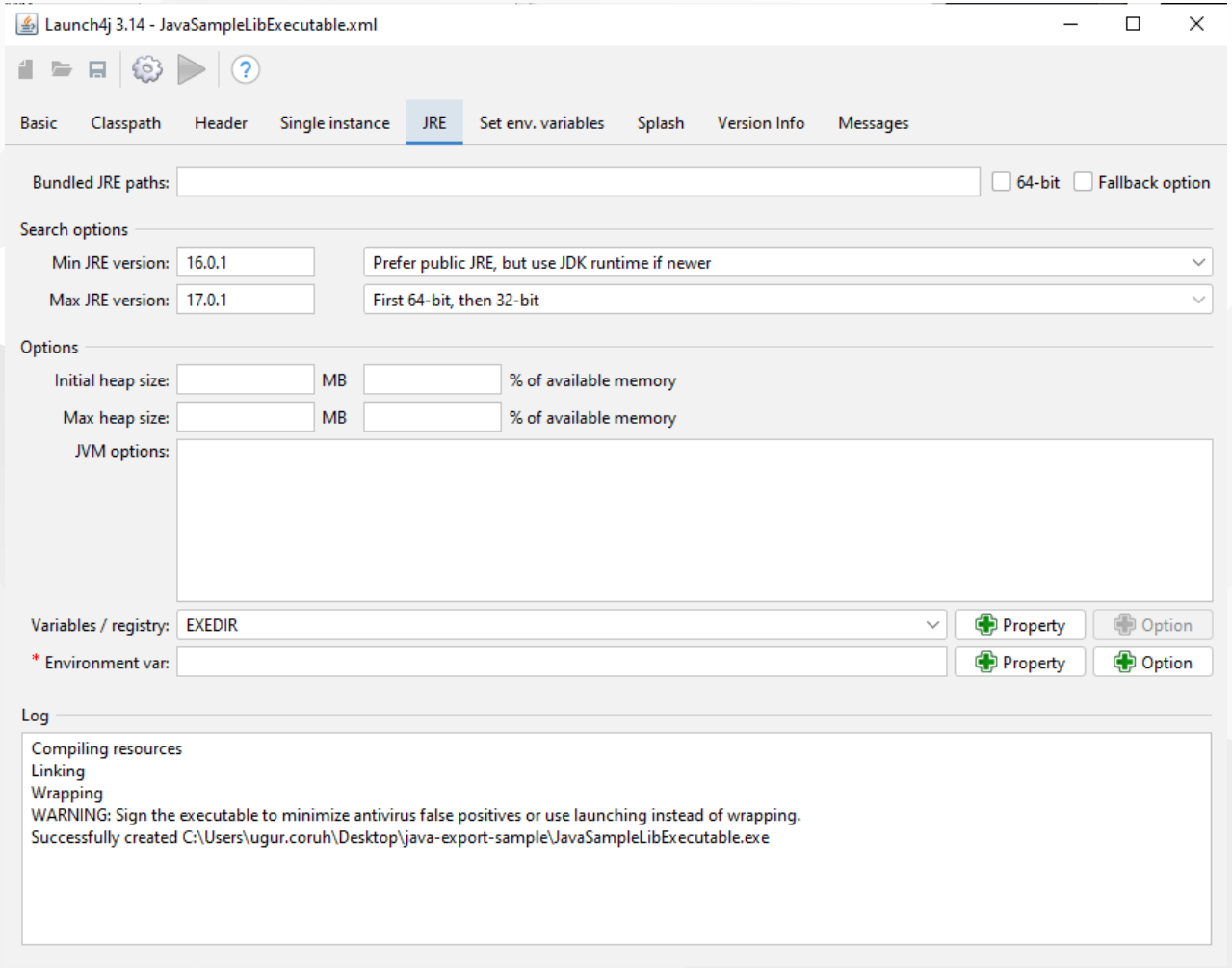
select console from setting for this application



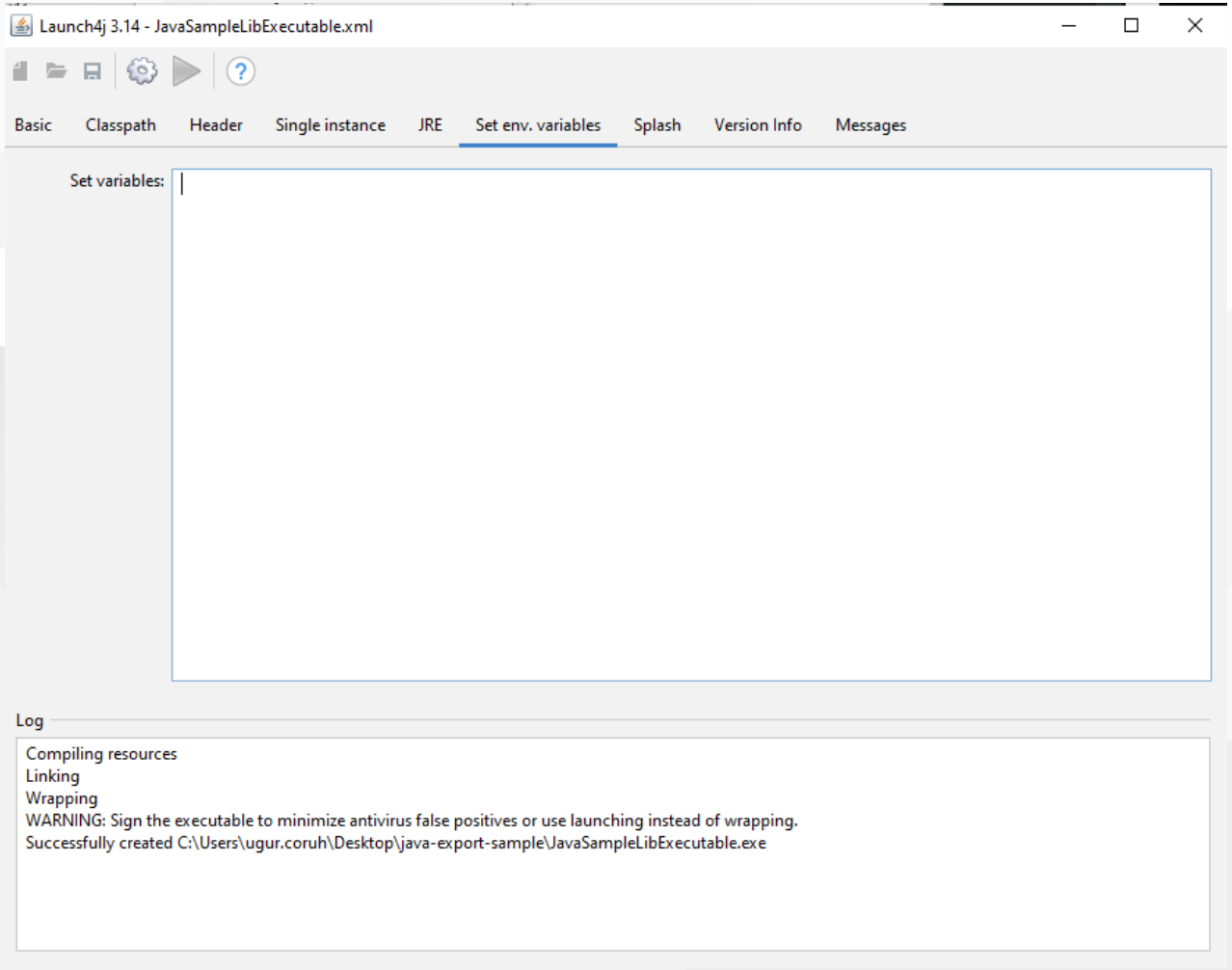
we can provide a single running application, this setting avoid to run multiple instances



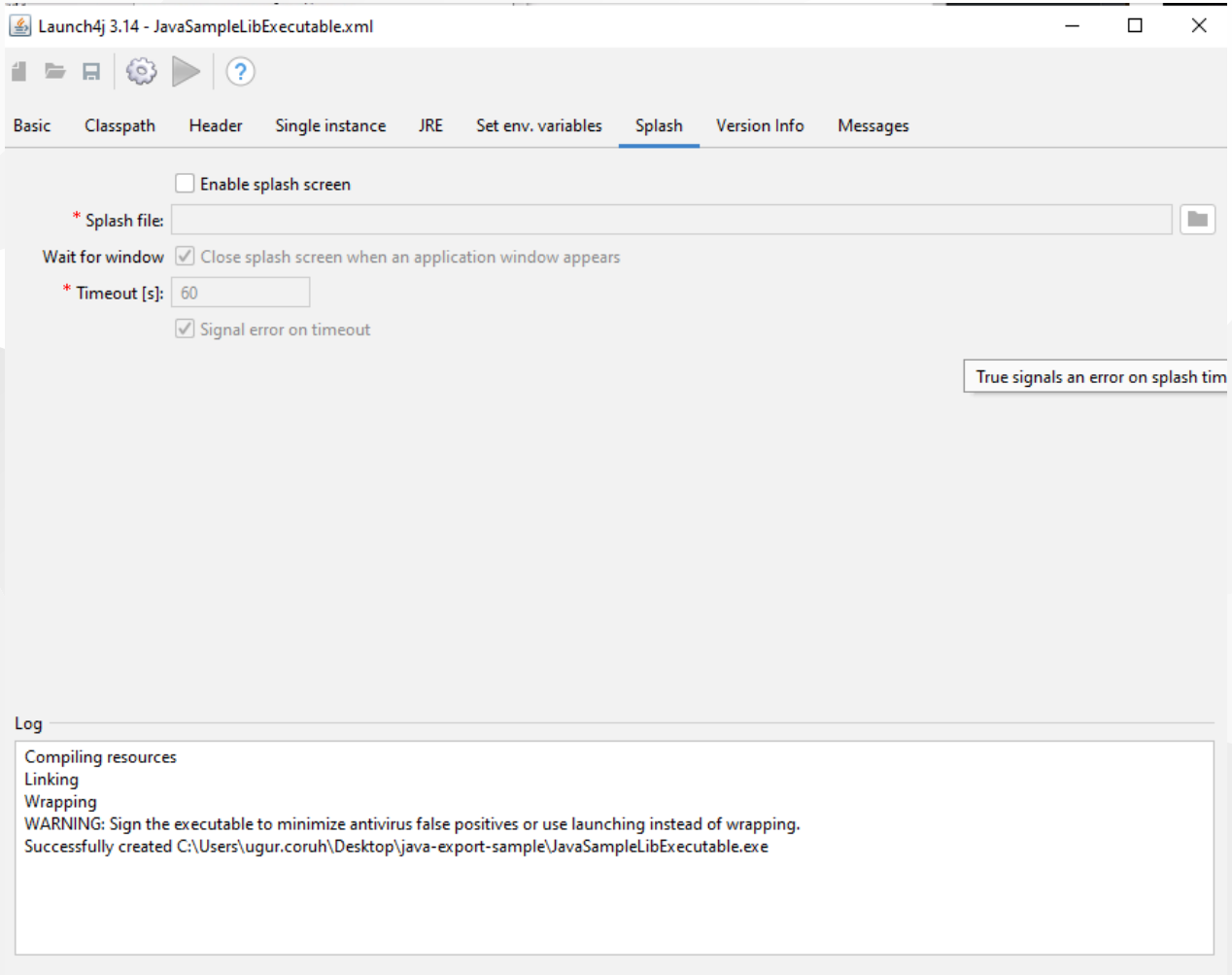
we need to set runtime environment versions



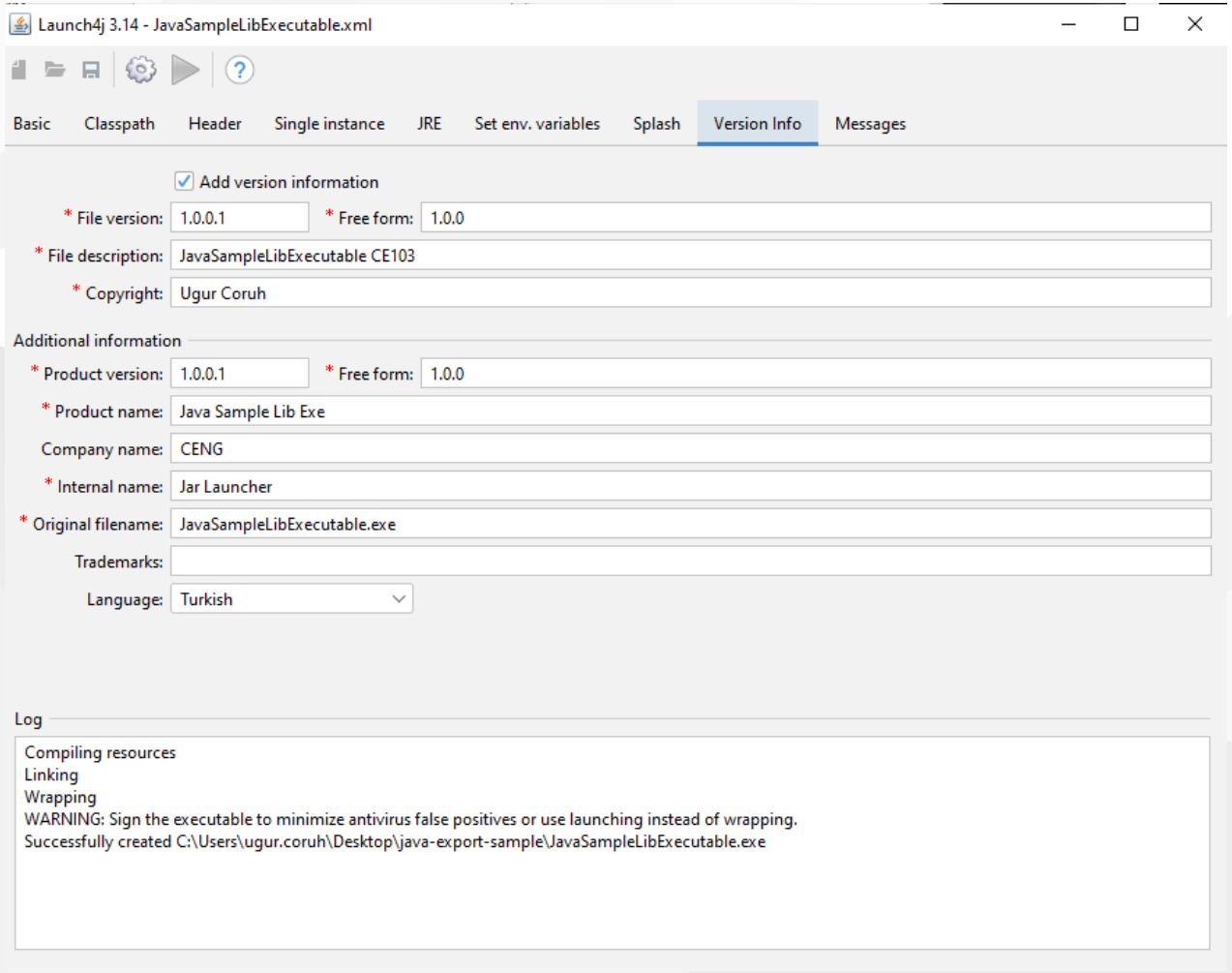
you can set system parameters before running application



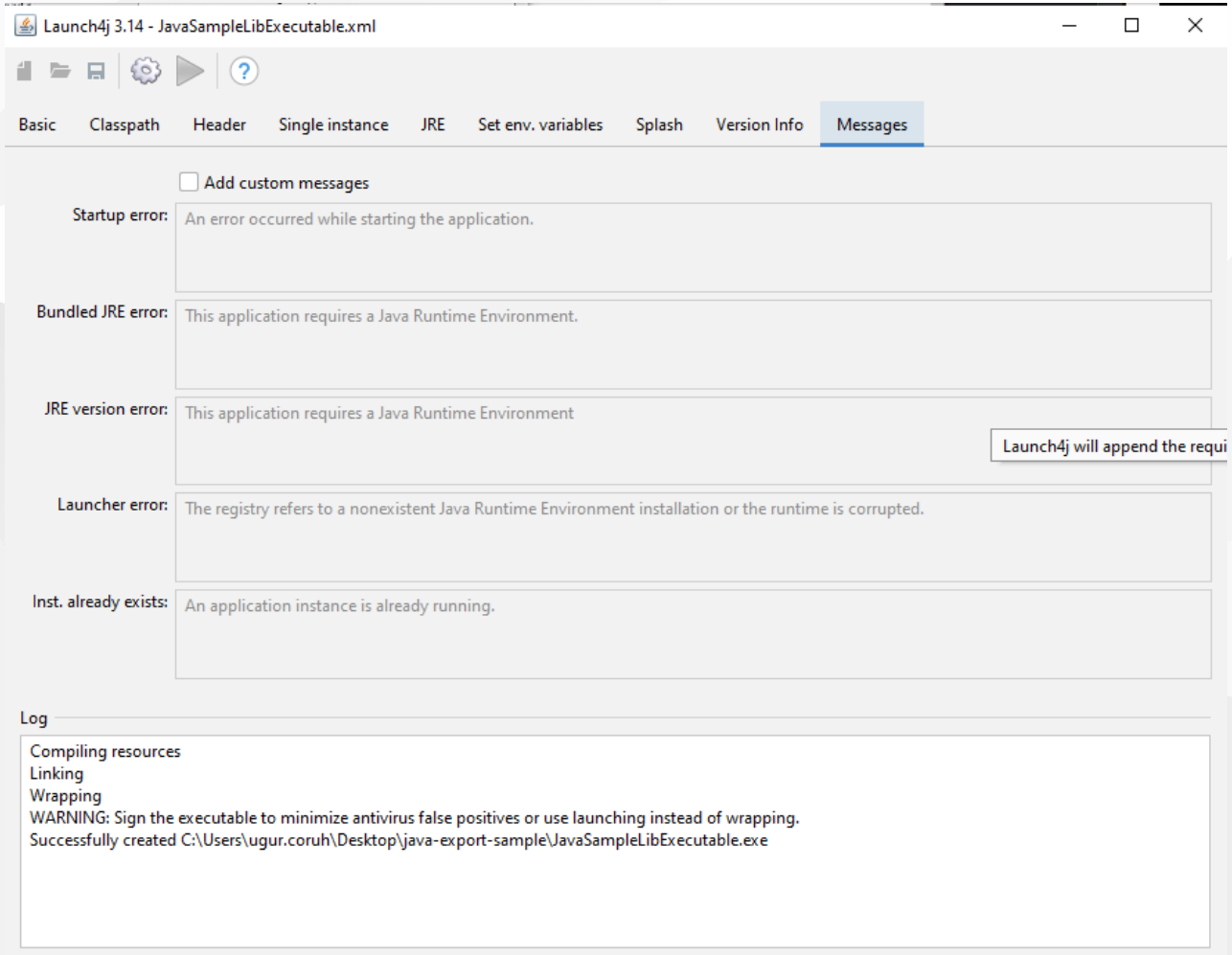
with splash screen you can show a splash screen image for your application



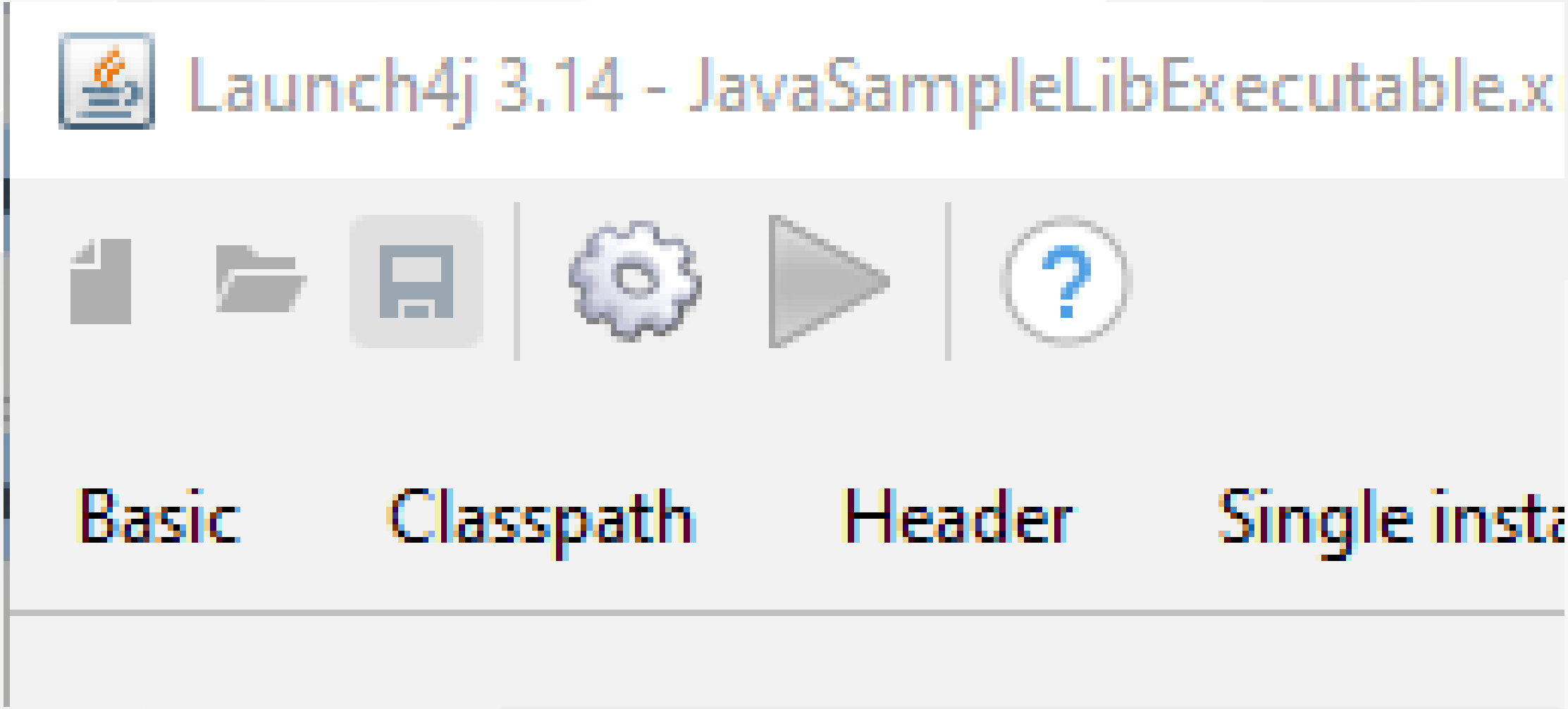
File attributes such as version product information is configured from version info tab



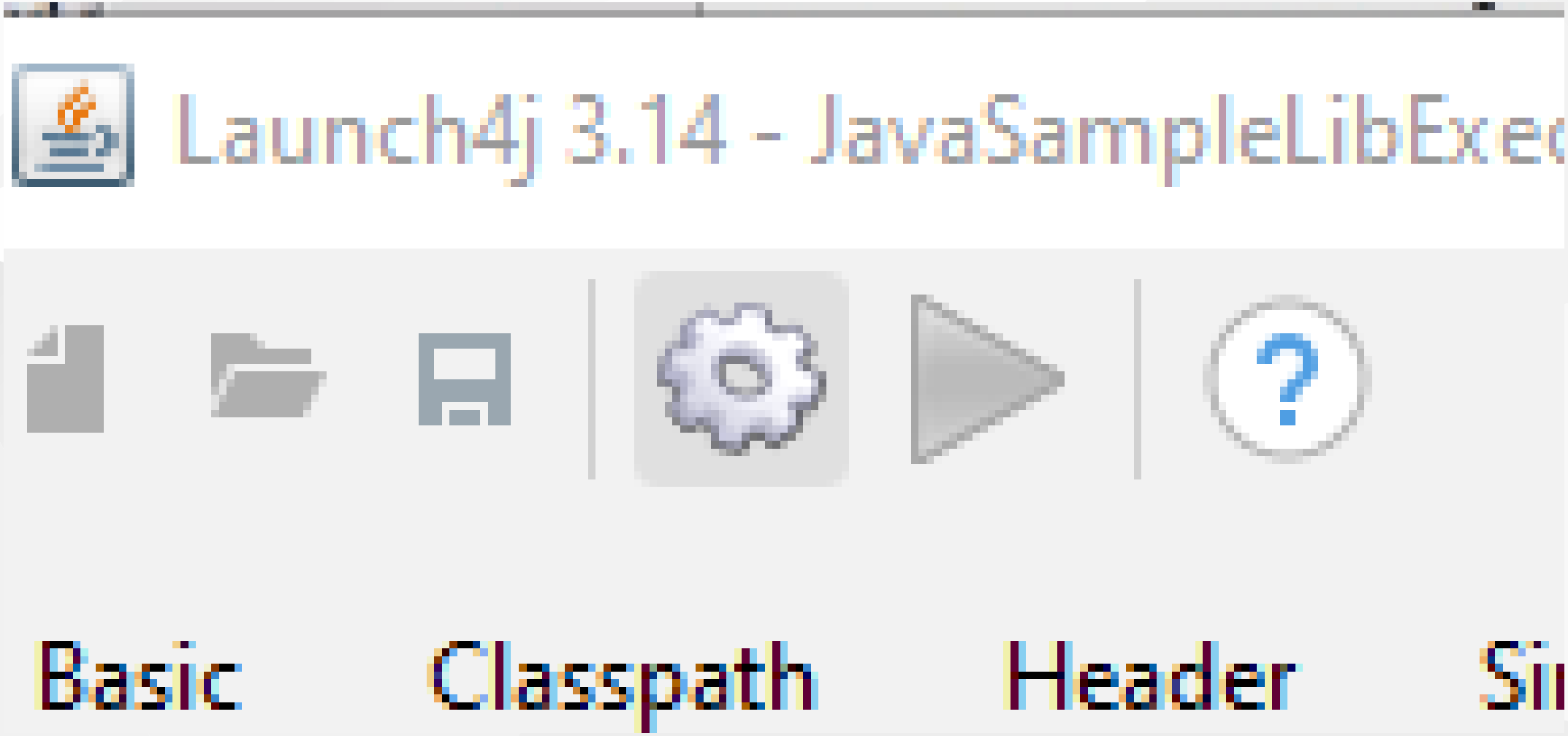
if your application runtime condition has an error then you can show this customized messages also



with this options save configuration file xml



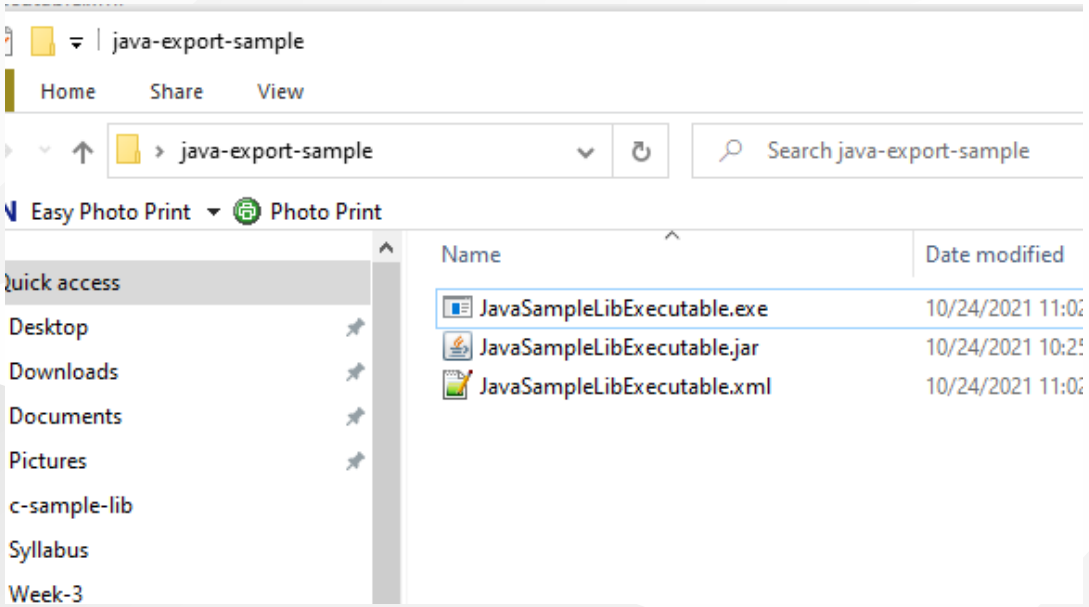
and compile settings

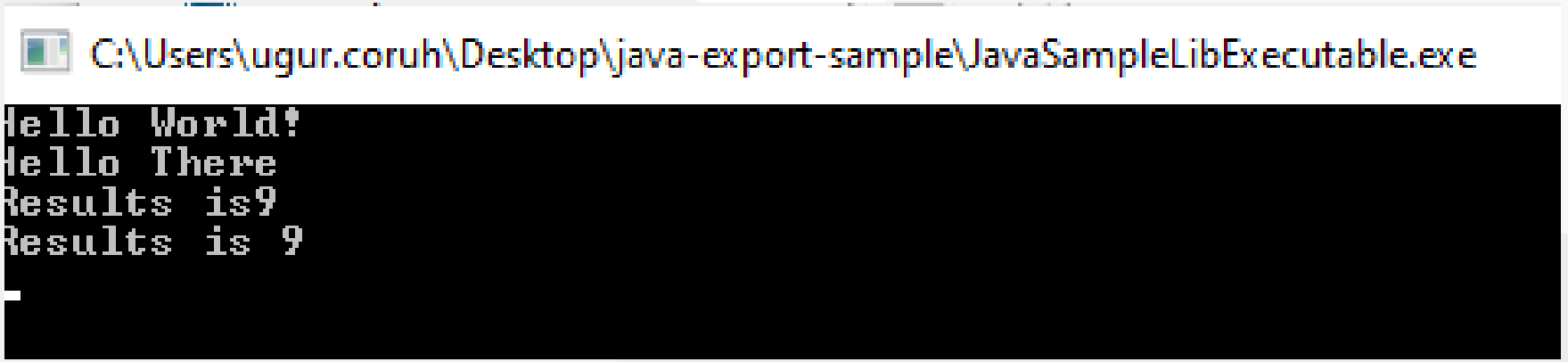


you will see generated output file in log screen

```
Compiling resources
Linking
Wrapping
WARNING: Sign the executable to minimize antivirus false positives or use launching instead of wrapping.
Successfully created C:\Users\ugur.coruh\Desktop\java-export-sample\JavaSampleLibExecutable.exe
```

now we can run exe by click

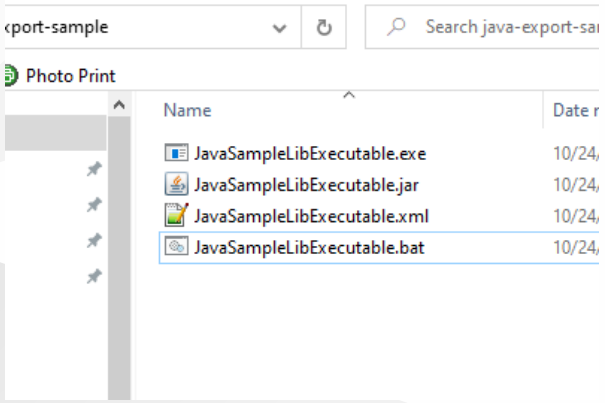




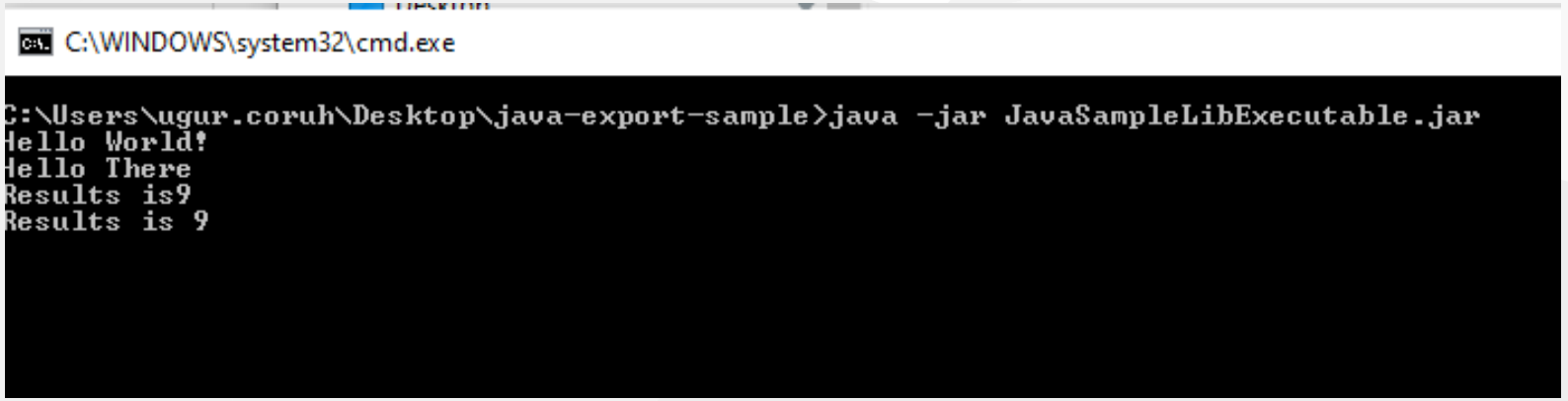
another option here adding a bat file to run current jar file

JavaSampleLibExecutable.bat

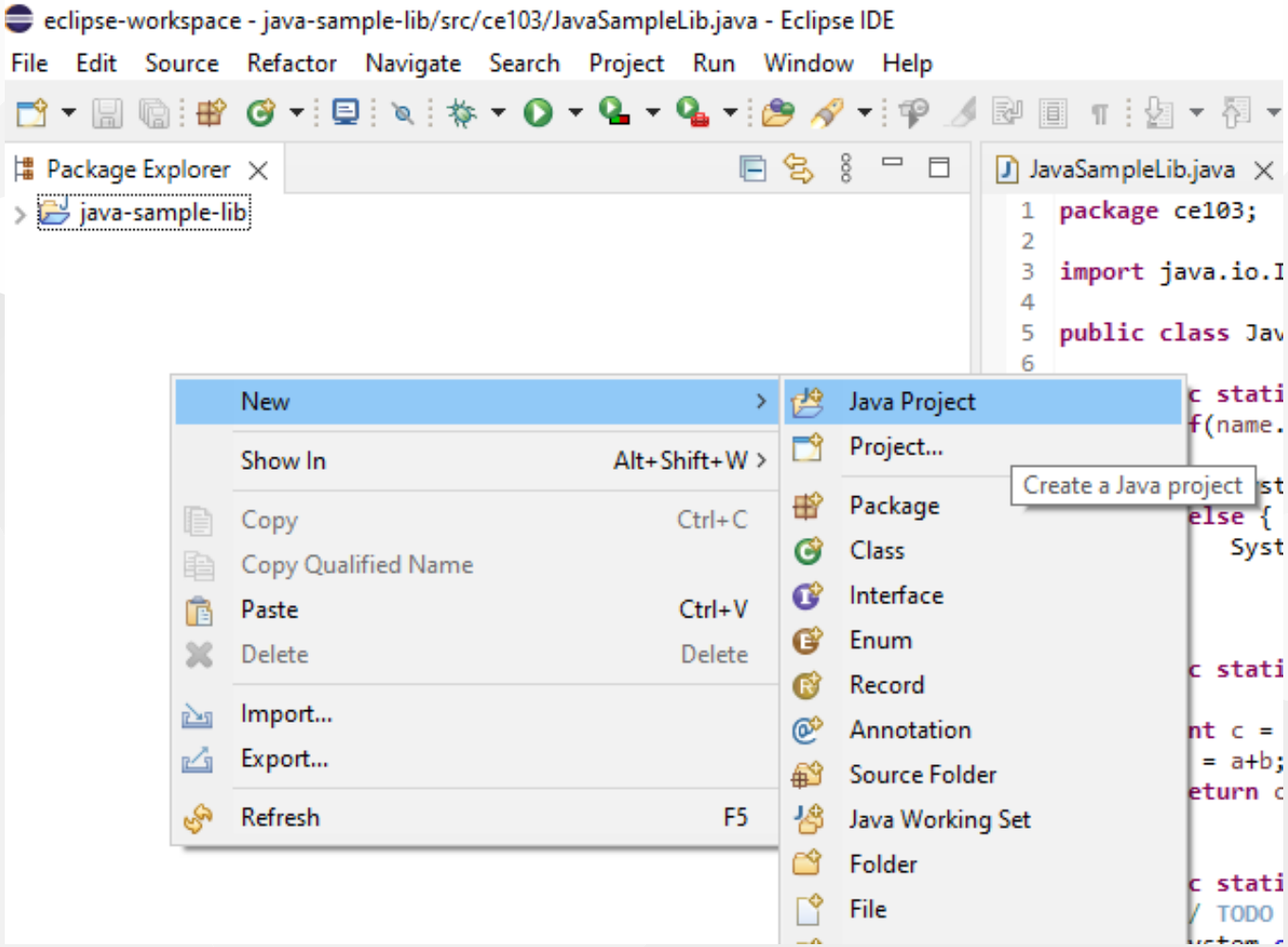
```
java -jar JavaSampleLibExecutable.jar
```

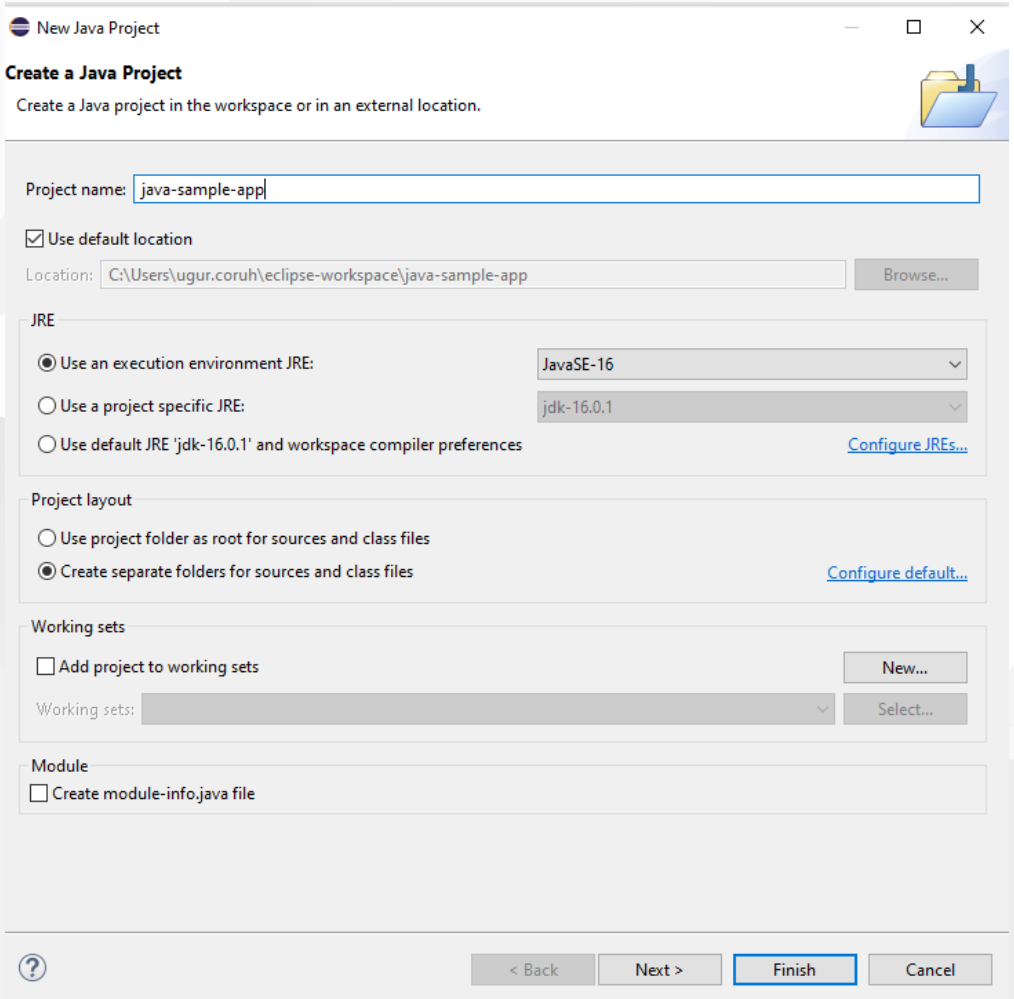


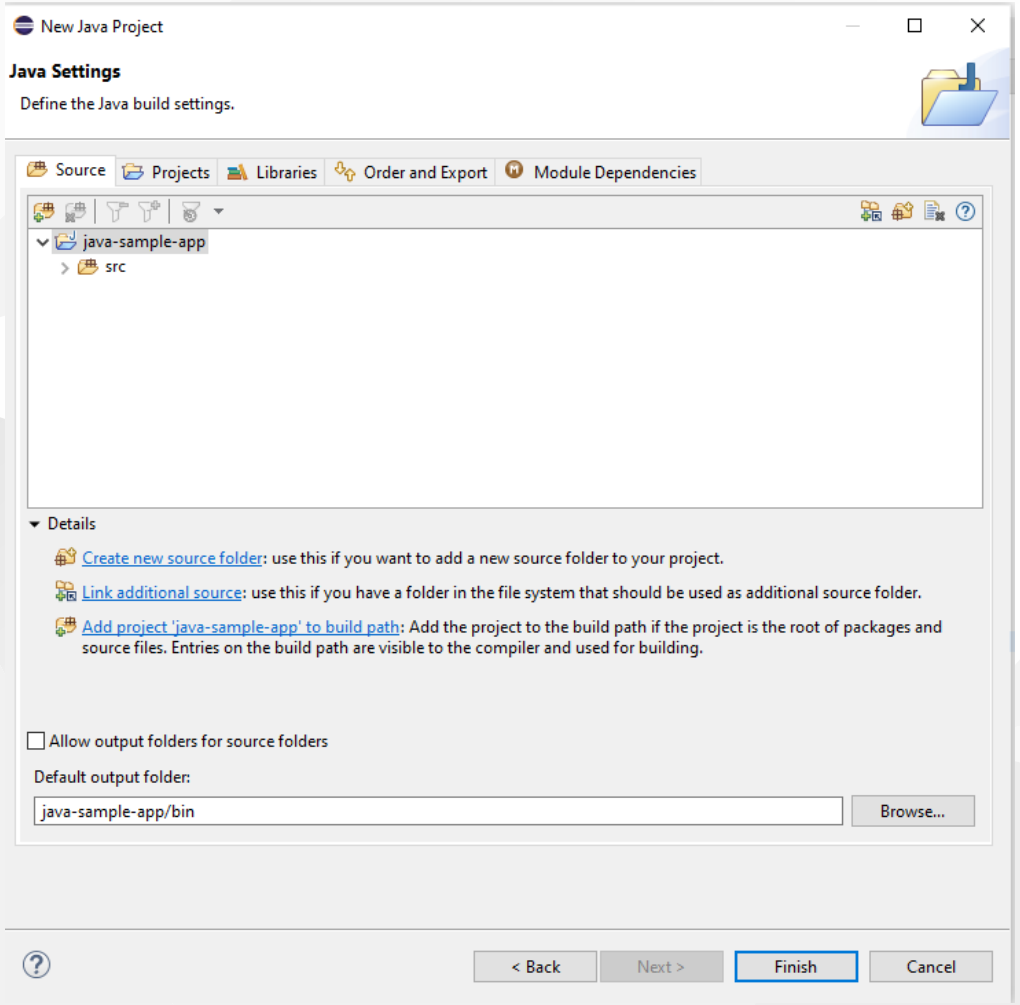
if we click bat file then we will automate command line task for current jar file



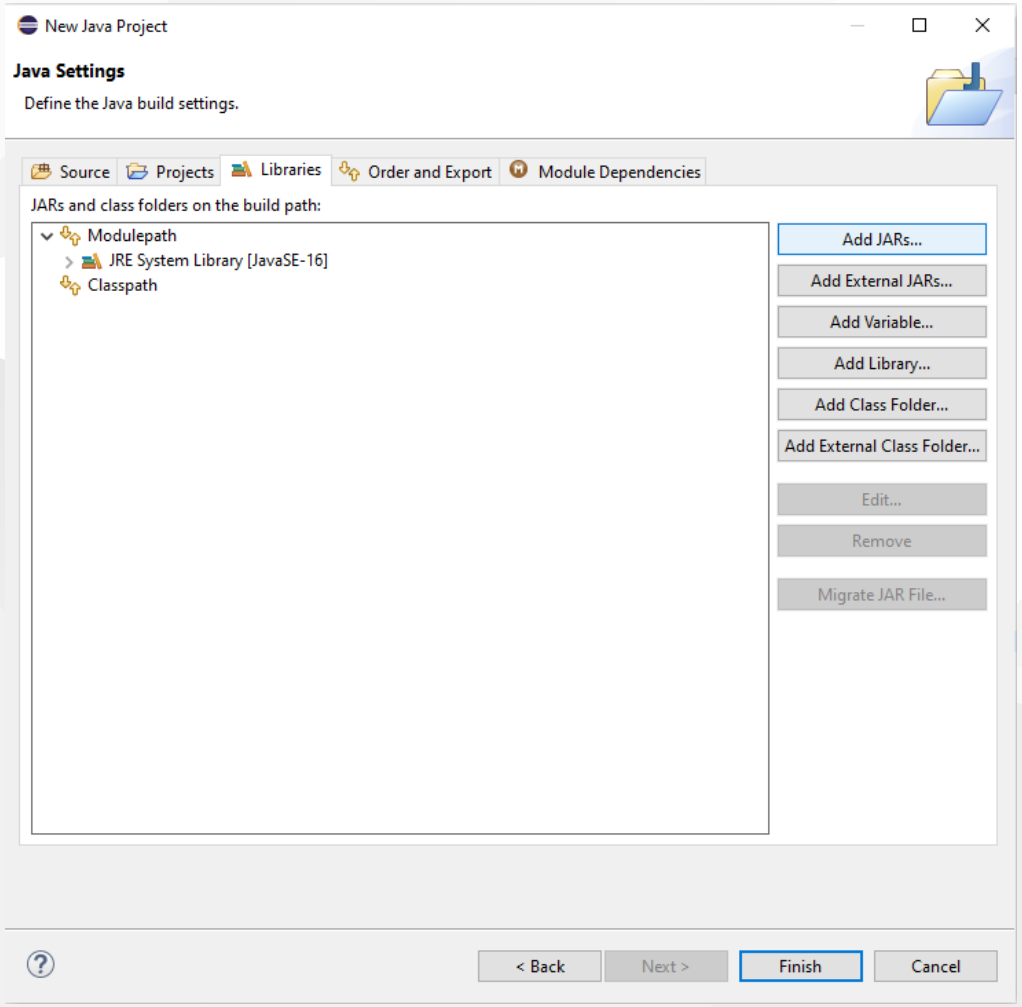
Now return back to our java library and create another console application that use library functions



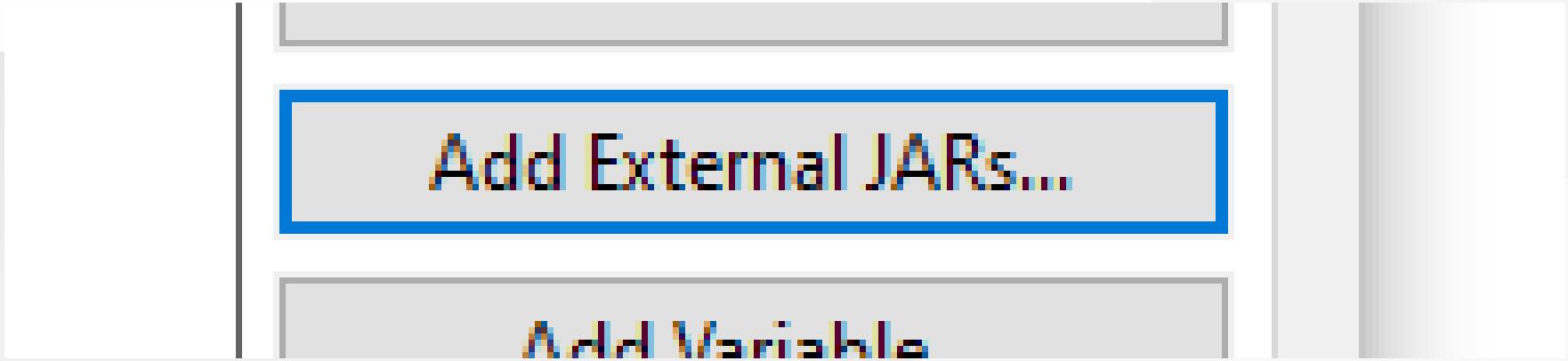

New Java Project
Create a Java Project
Create a Java project in the workspace or in an external location.
Project name: java-sample-app
Use default location
Location: C:\Users\ugur.coruh\eclipse-workspace\java-sample-app
Browse...
JRE
Use an execution environment JRE:
JavaSE-16
Use a project specific JRE:
jdk-16.0.1
Use default JRE 'jdk-16.0.1' and workspace compiler preferences
Configure JREs...
Project layout
Use project folder as root for sources and class files
Create separate folders for sources and class files
Configure default...
Working sets
Add project to working sets
New...
Working sets:
Select...
Module
Create module-info.java file
< Back
Next >
Finish
Cancel


New Java Project
Java Settings
Define the Java build settings.
Source
Projects
Libraries
Order and Export
Module Dependencies
java-sample-app
src
Details
Create new source folder: use this if you want to add a new source folder to your project.
Link additional source: use this if you have a folder in the file system that should be used as additional source folder.
Add project 'java-sample-app' to build path: Add the project to the build path if the project is the root of packages and source files. Entries on the build path are visible to the compiler and used for building.
Allow output folders for source folders
Default output folder:
java-sample-app/bin
Browse...
< Back
Next >
Finish
Cancel

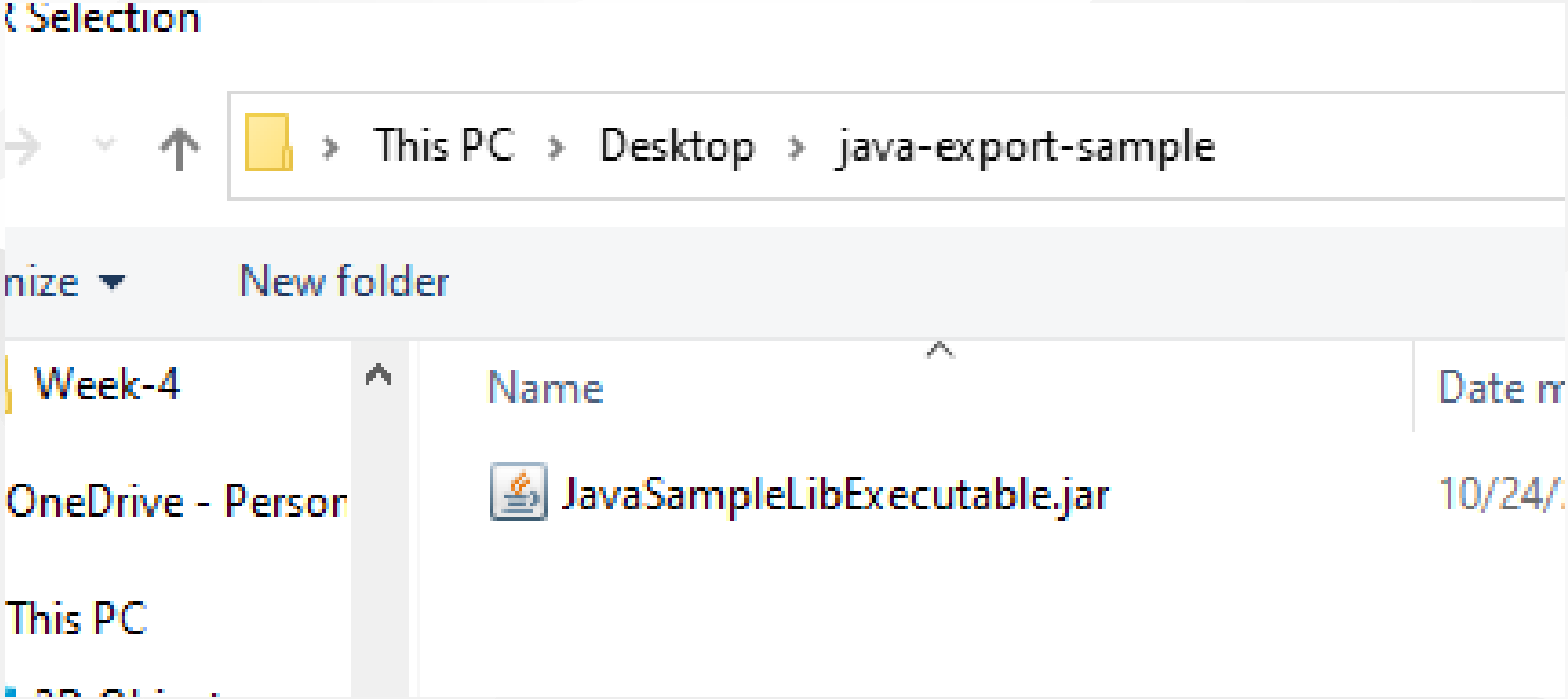
you can set libraries in this step from but our library should exported for our solution



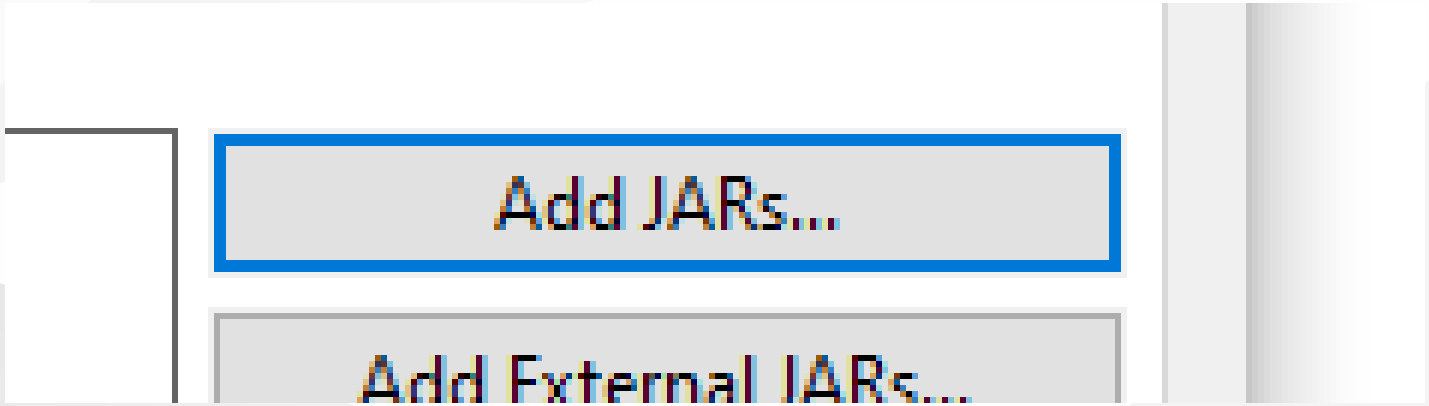
Select Add External JARs...

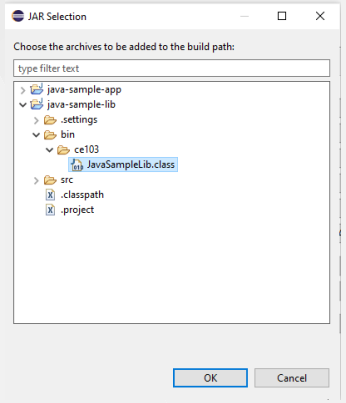


Open Exported jar folder and select

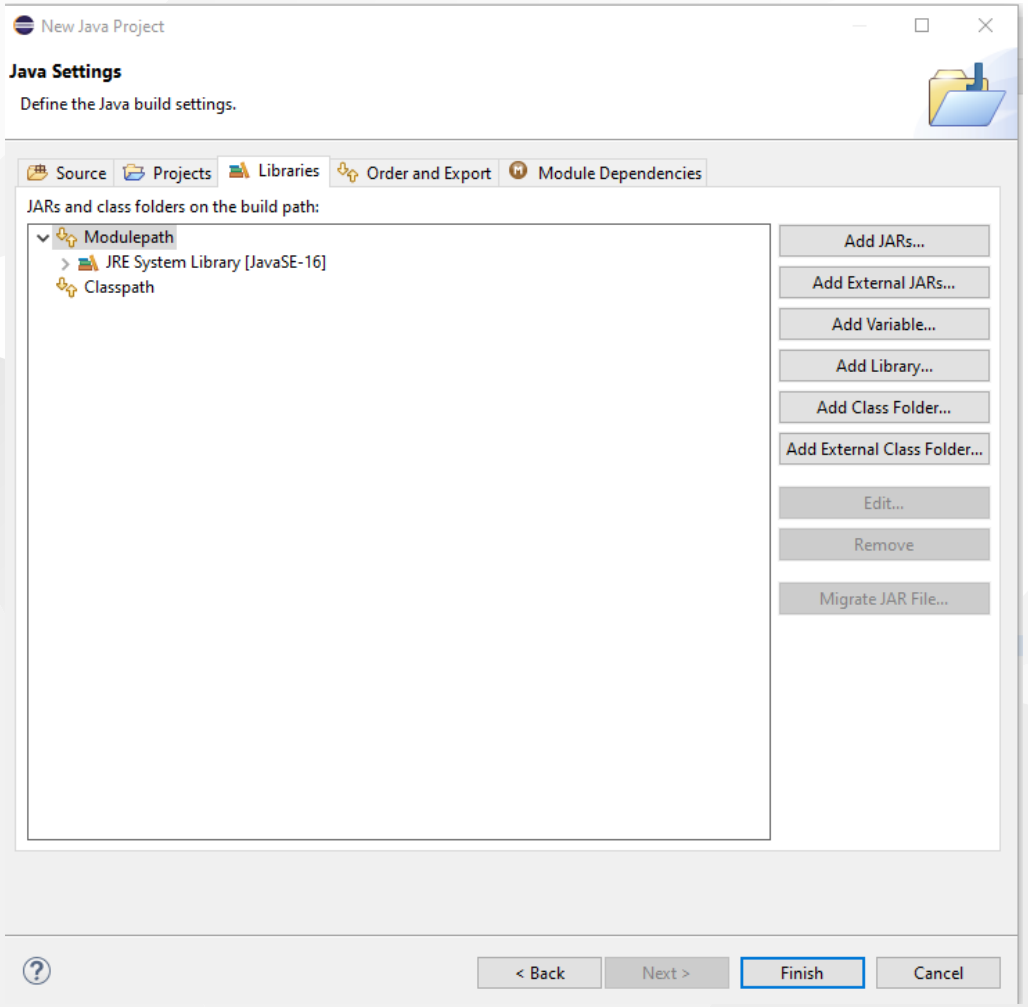


Or we can select by Add jar from current workspace

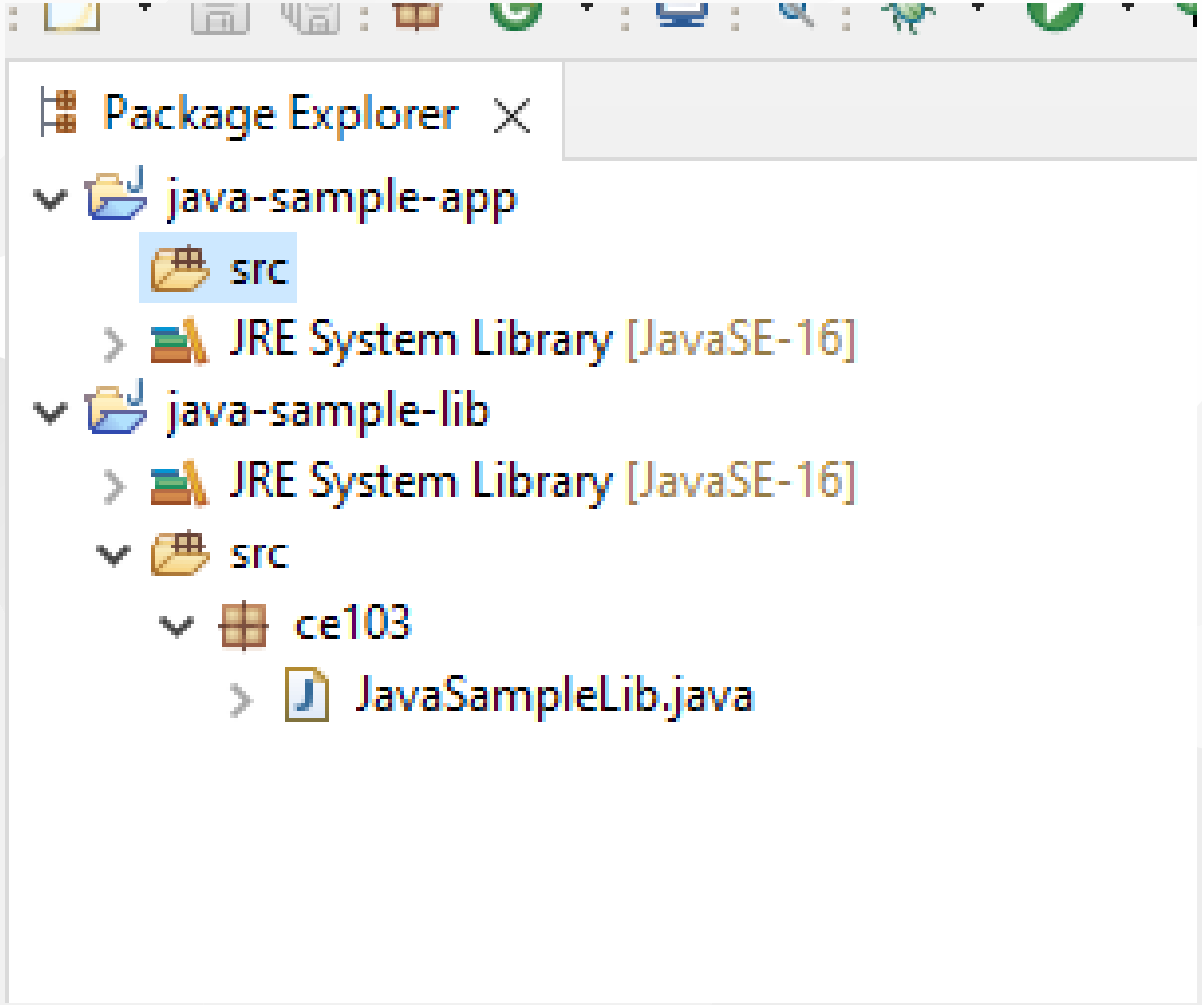




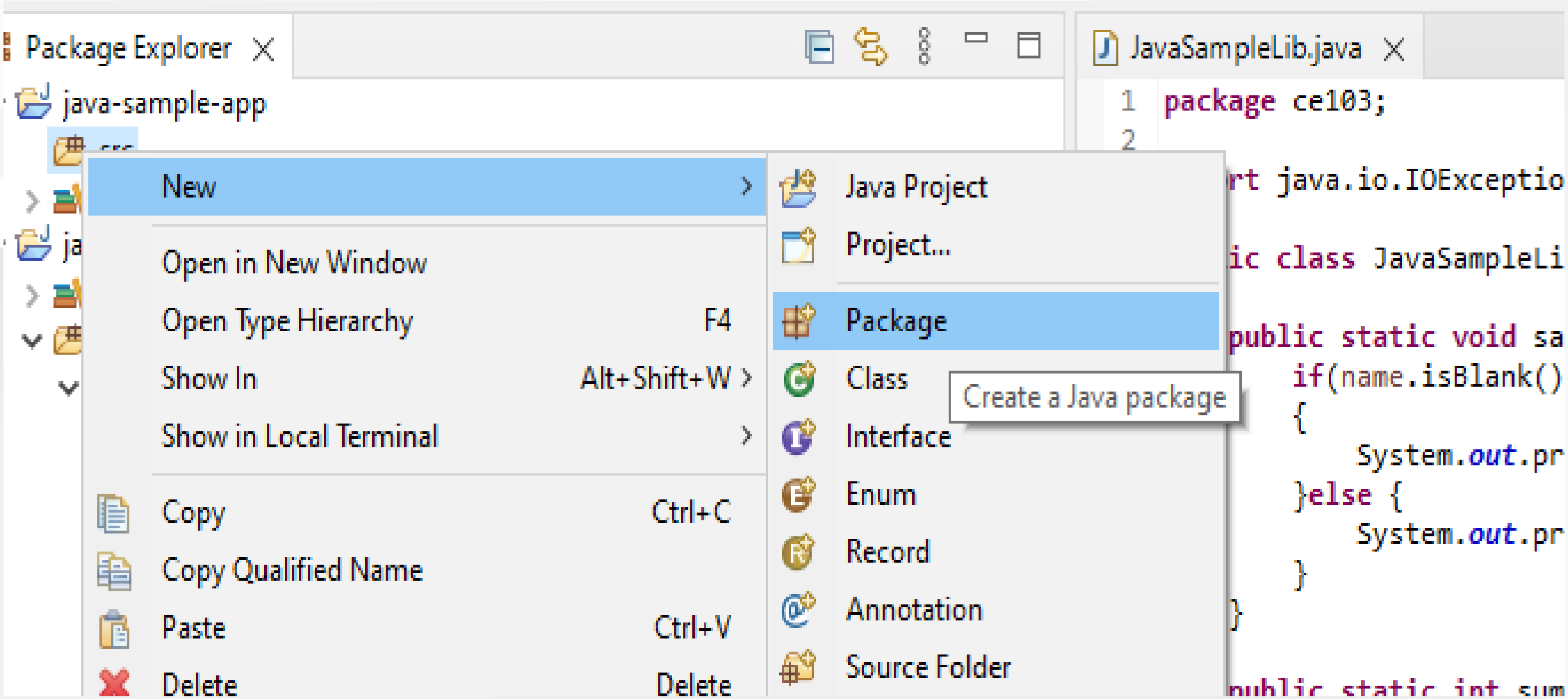
but in this step I won't add anything I'll add references later

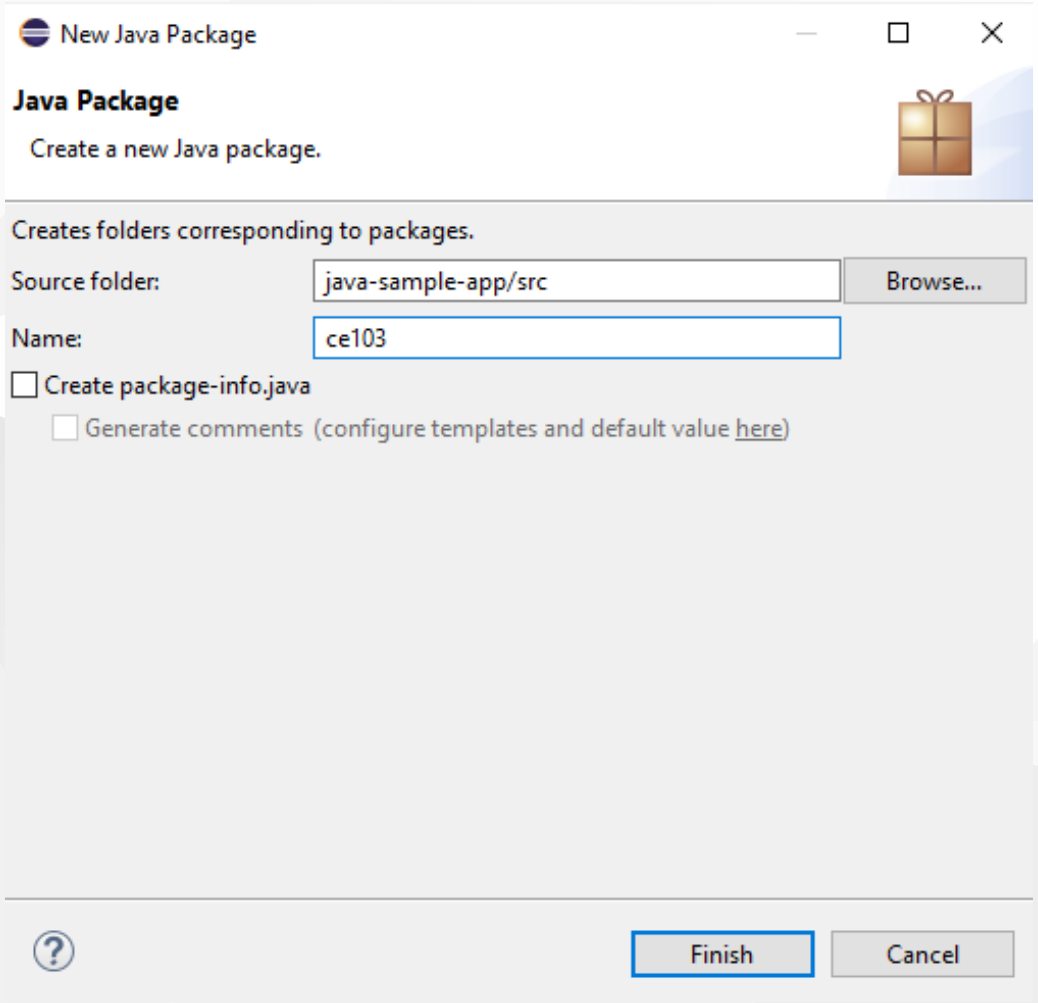


we will have the following project

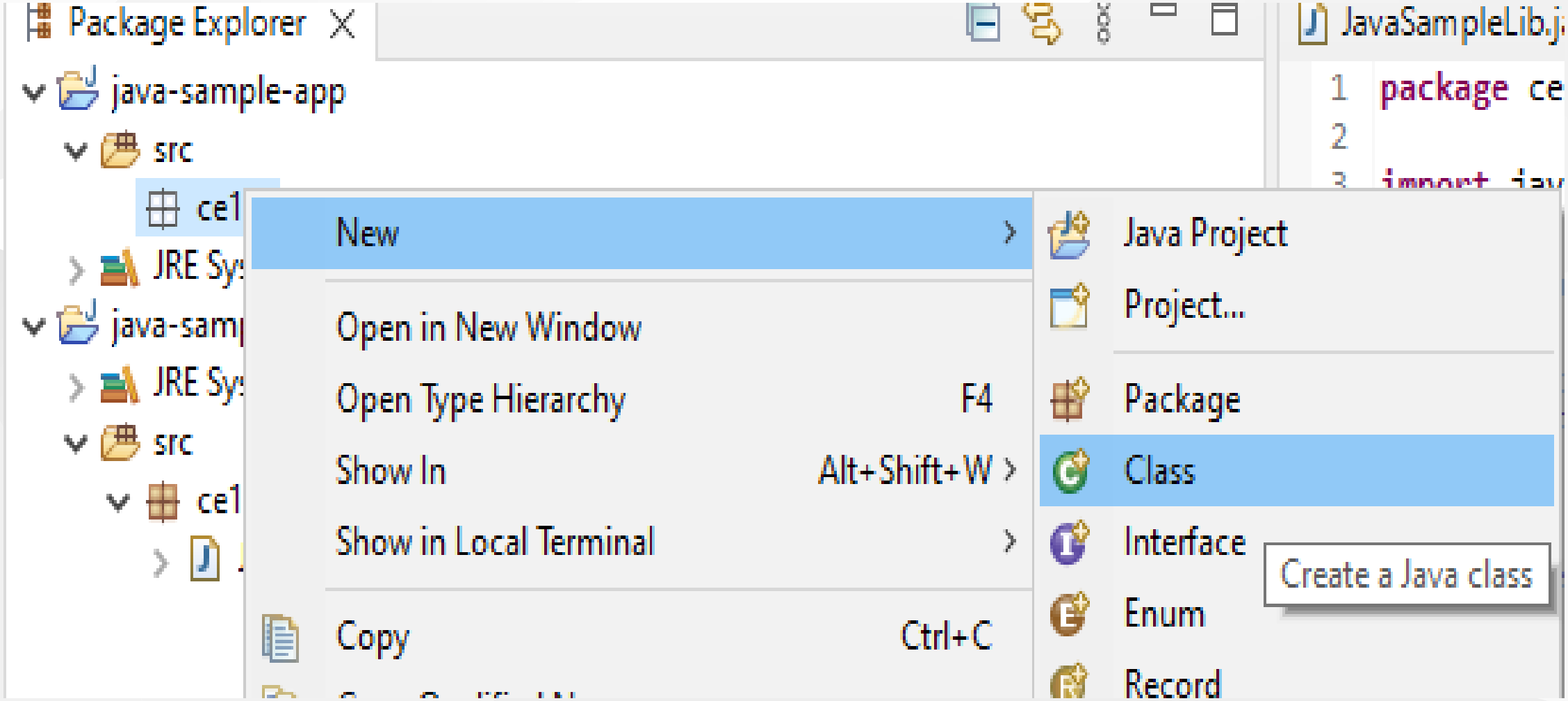


lets create a package

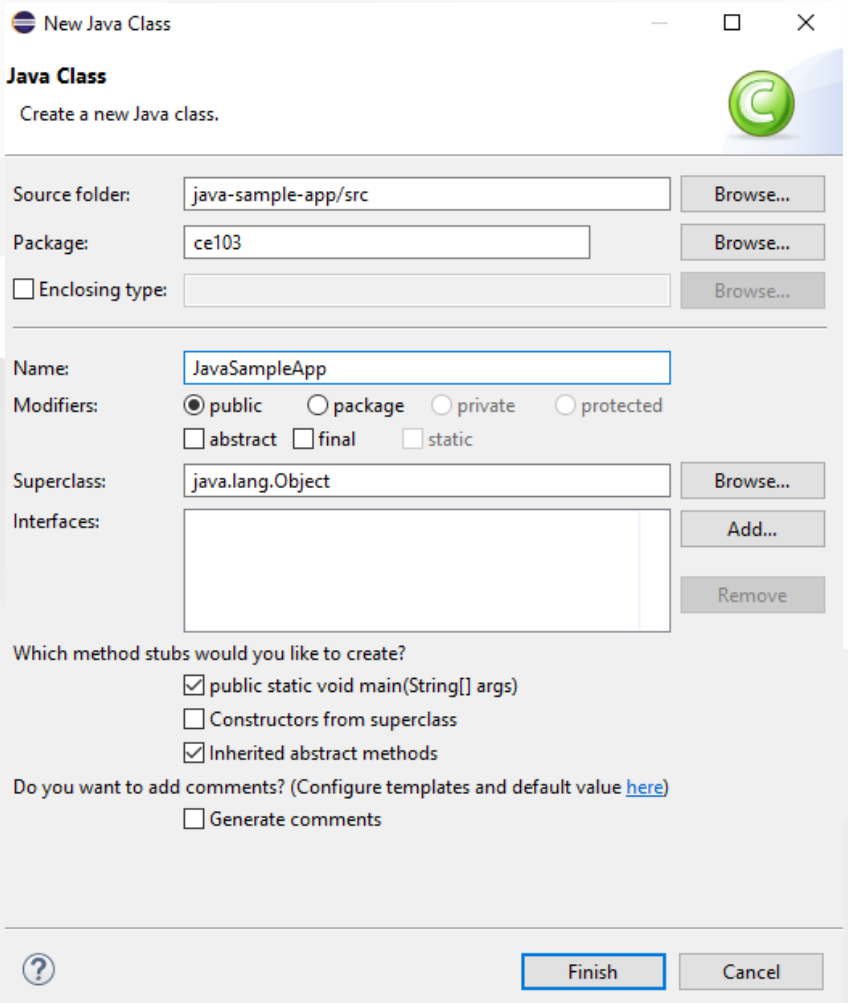


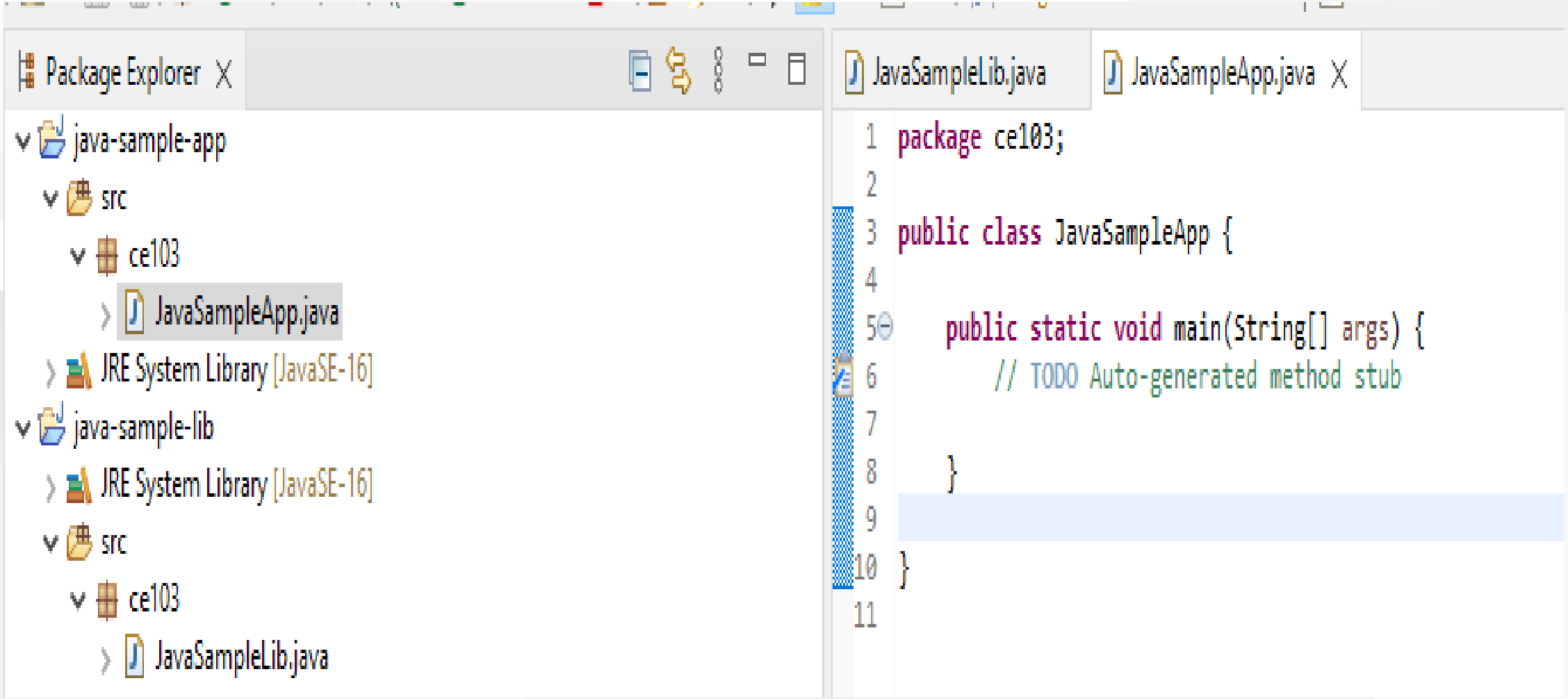

New Java Package
Java Package
Create a new Java package.
Creates folders corresponding to packages.
Source folder:
java-sample-app/src
Browse...
Name:
ce103
Create package-info.java
Generate comments (configure templates and default value here)
Finish
Cancel

and lets create a main class for our application

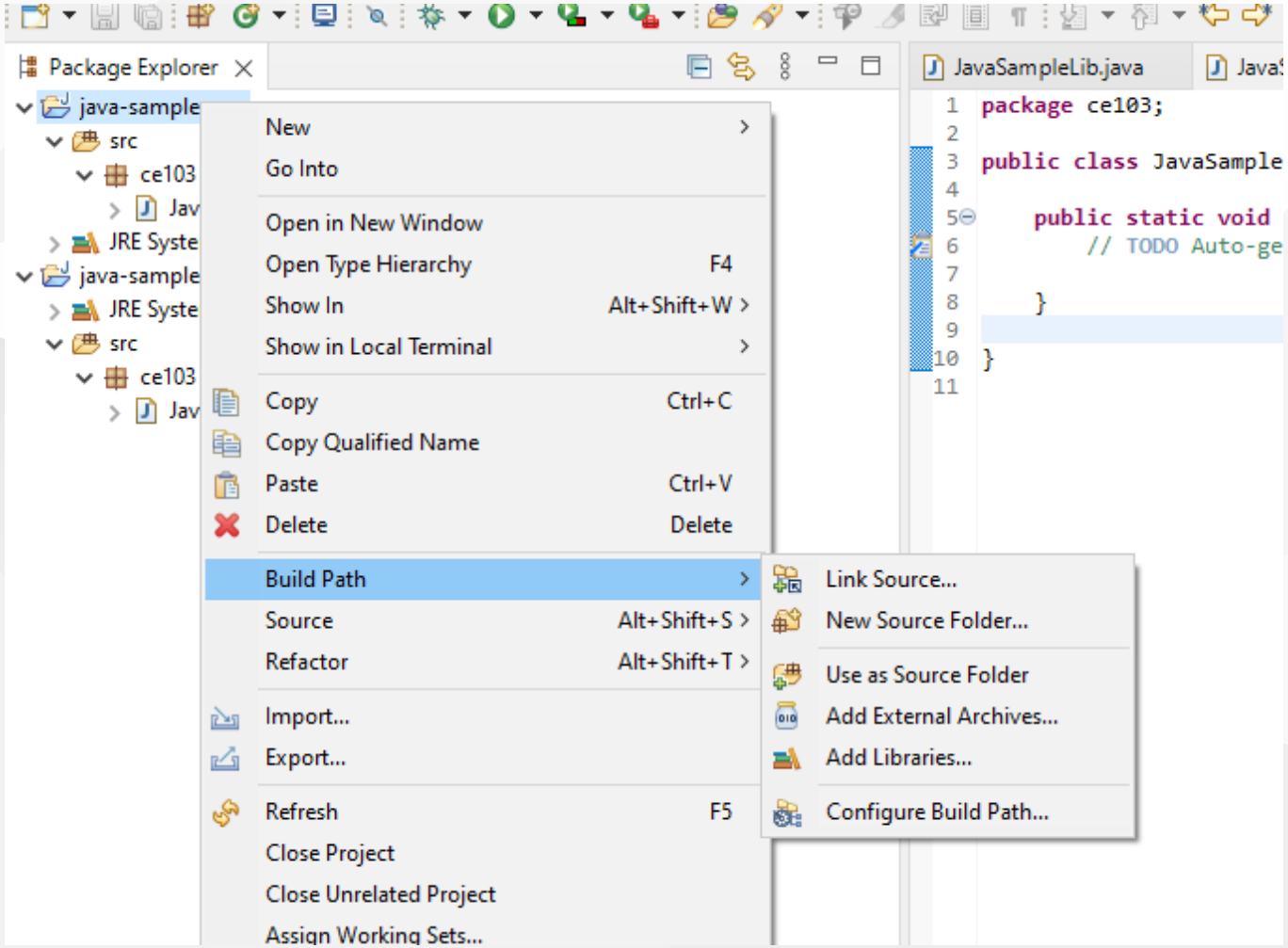


check create main function

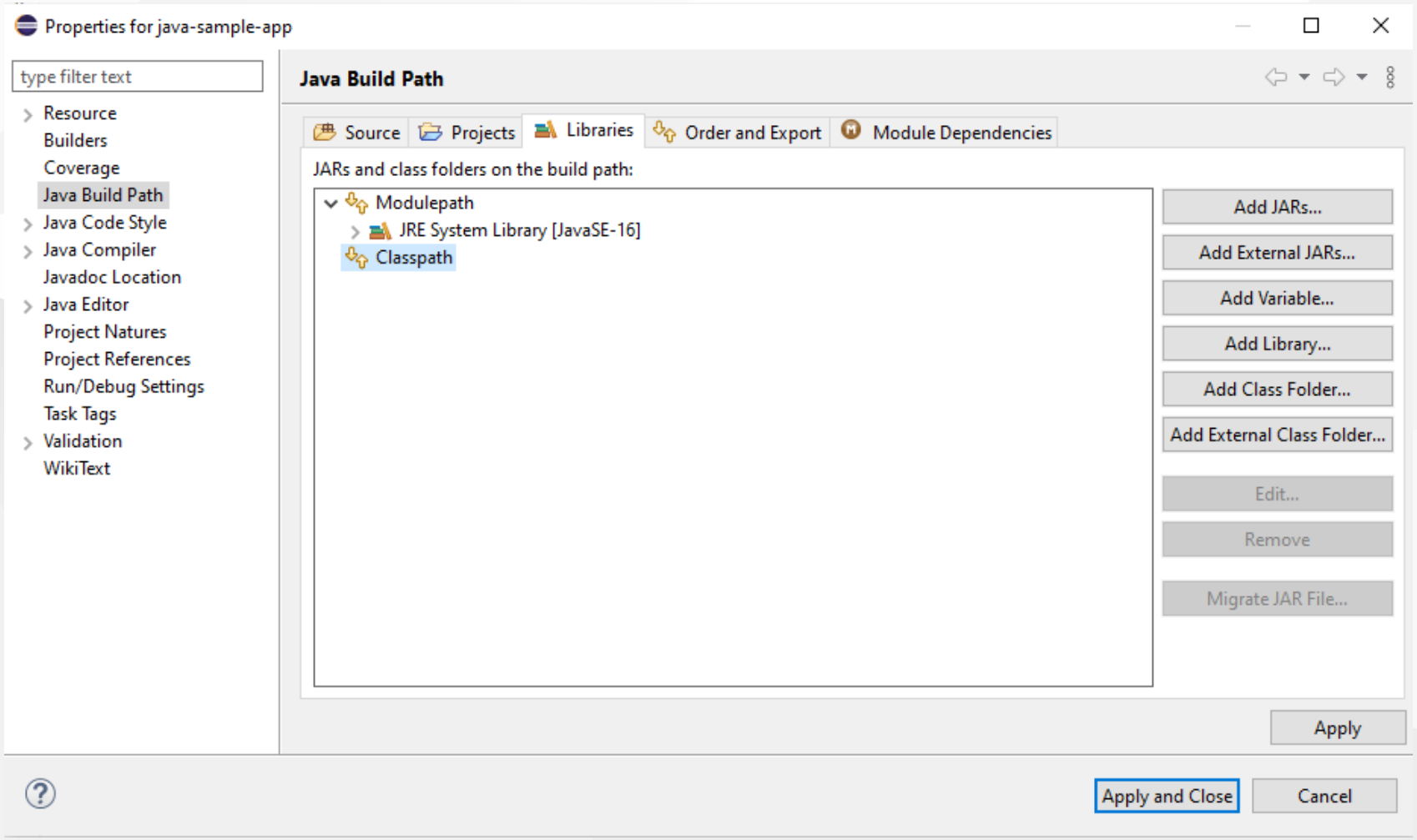



Package Explorer
java-sample-app
src
ce103
JavaSampleApp.java
JRE System Library [JavaSE-16]
java-sample-lib
JRE System Library [JavaSE-16]
src
ce103
JavaSampleLib.java
JavaSampleLib.java
JavaSampleApp.java
1 package ce103;
2
3 public class JavaSampleApp {
4
5 public static void main(String[] args) {
6 // TODO Auto-generated method stub
7
8 }
9
10 }
11

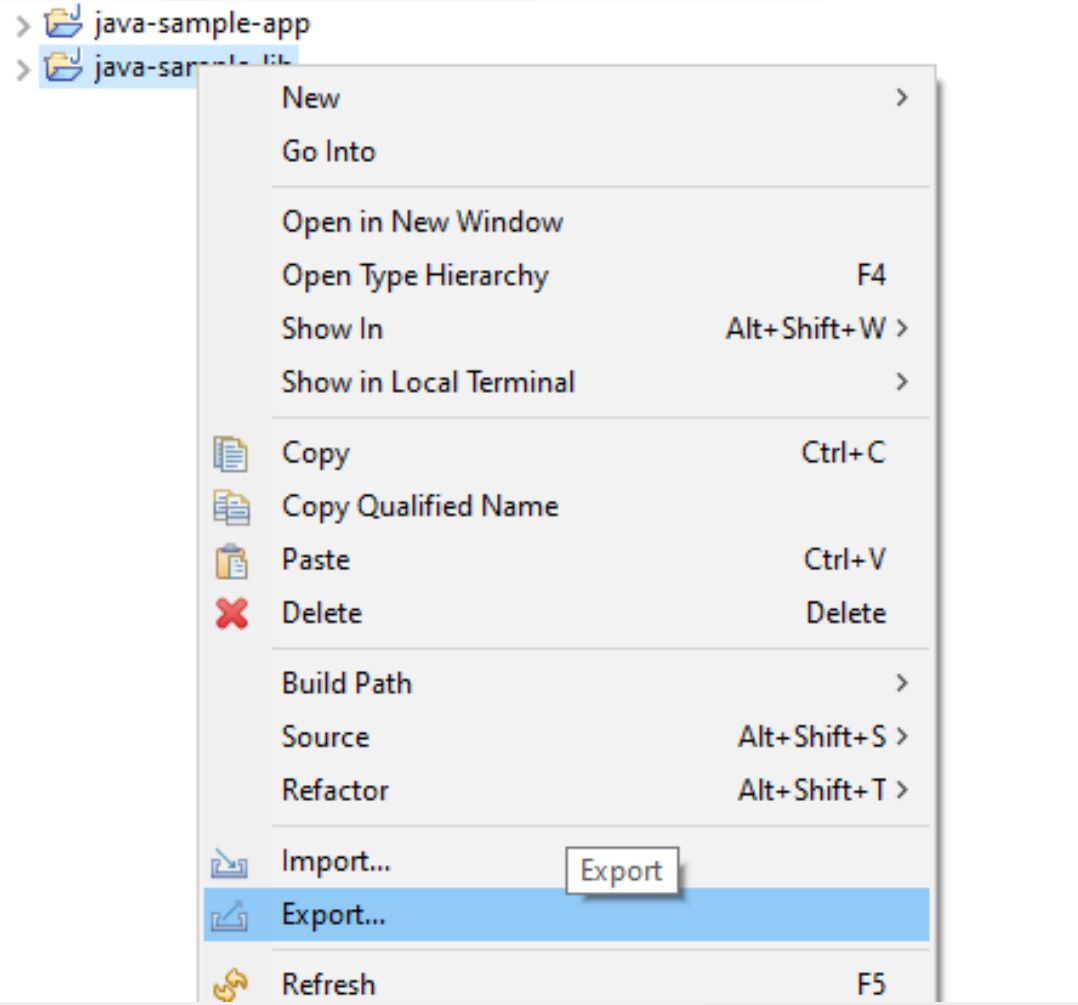
right click to project and add reference



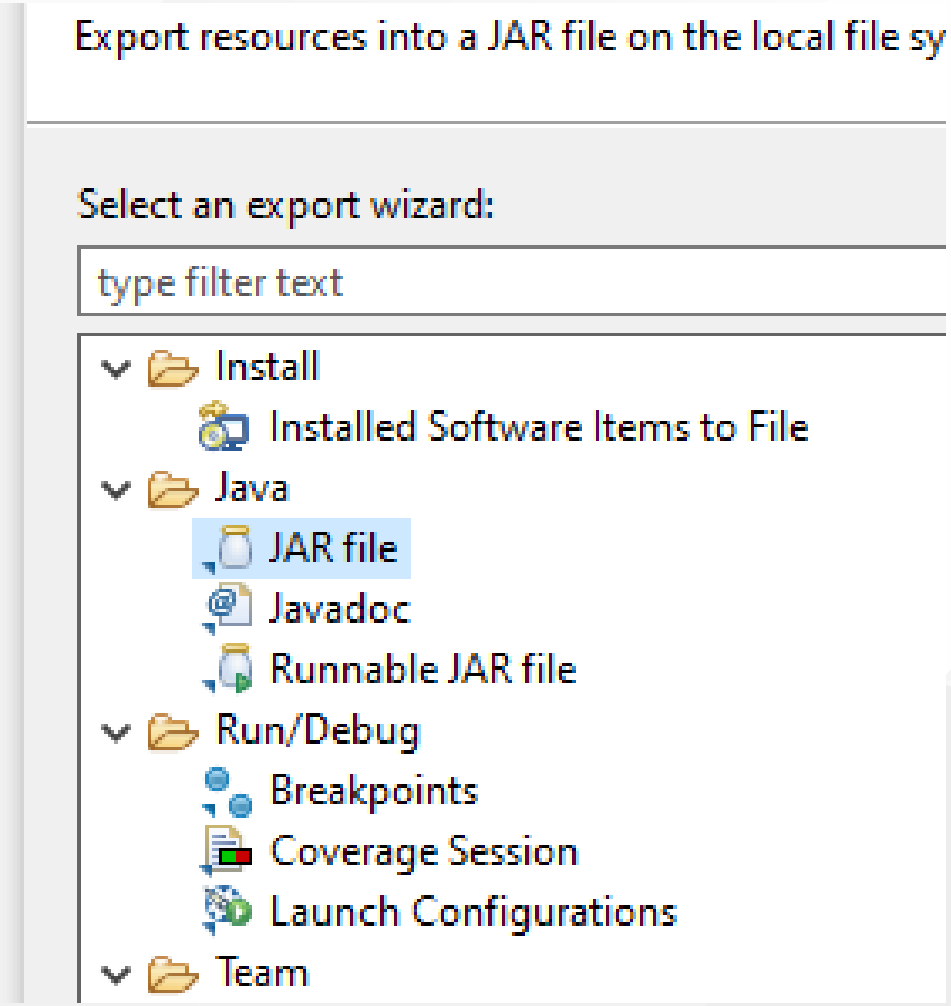
you can enter same configurations from project properties



Lets export our library as a JAR file and then add to our classpath

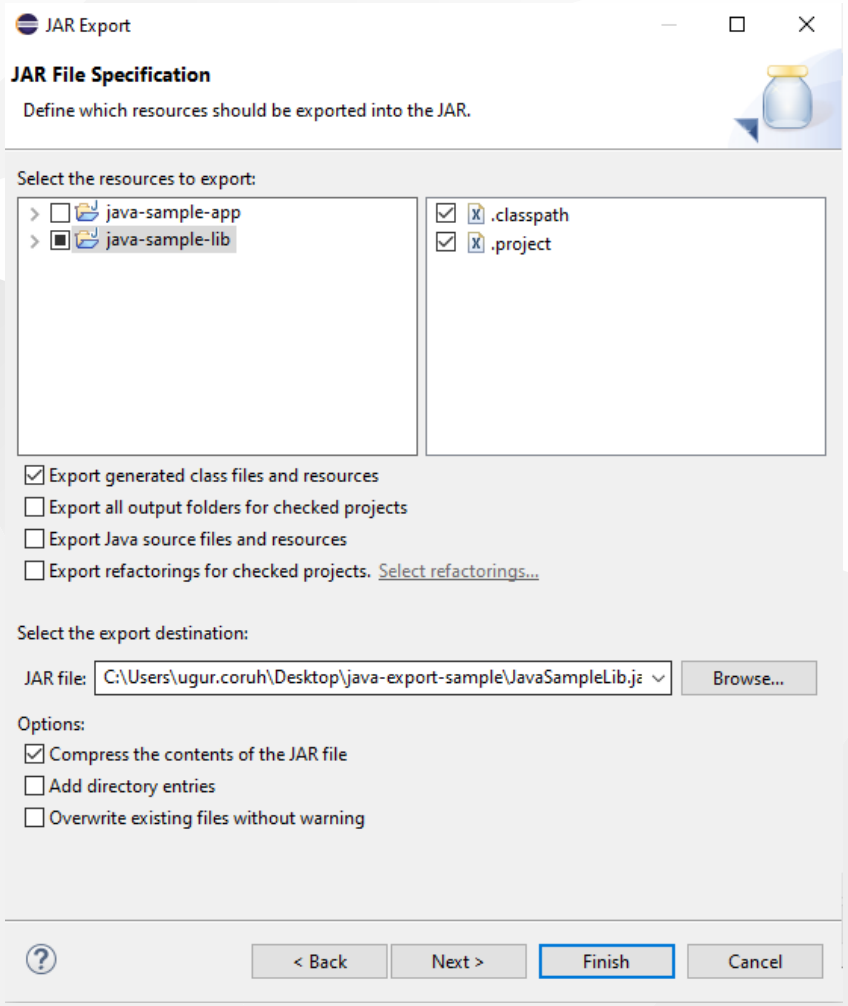


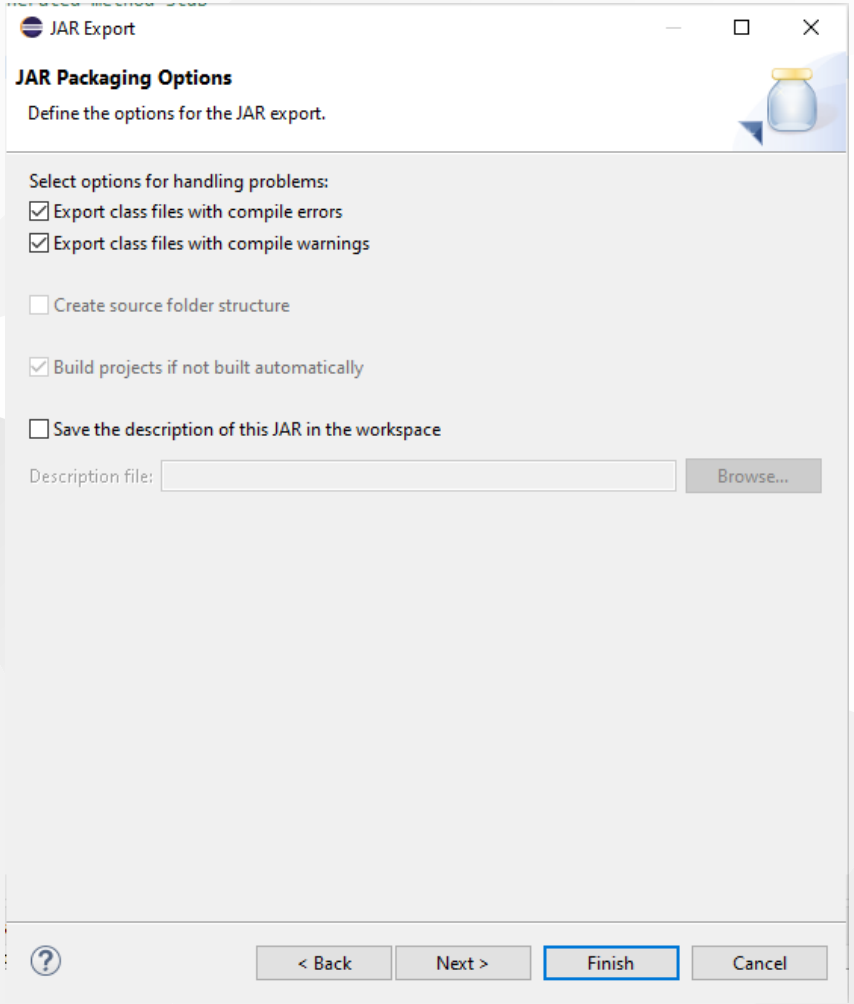
Select JAR file

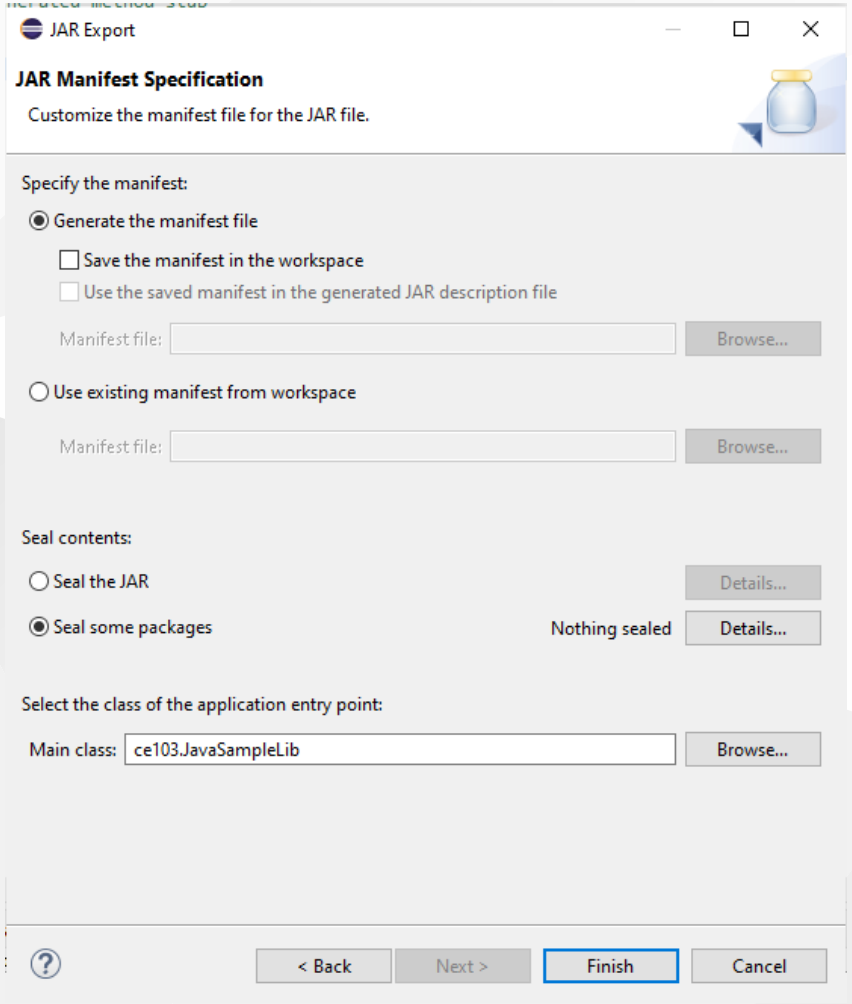


we configured output as

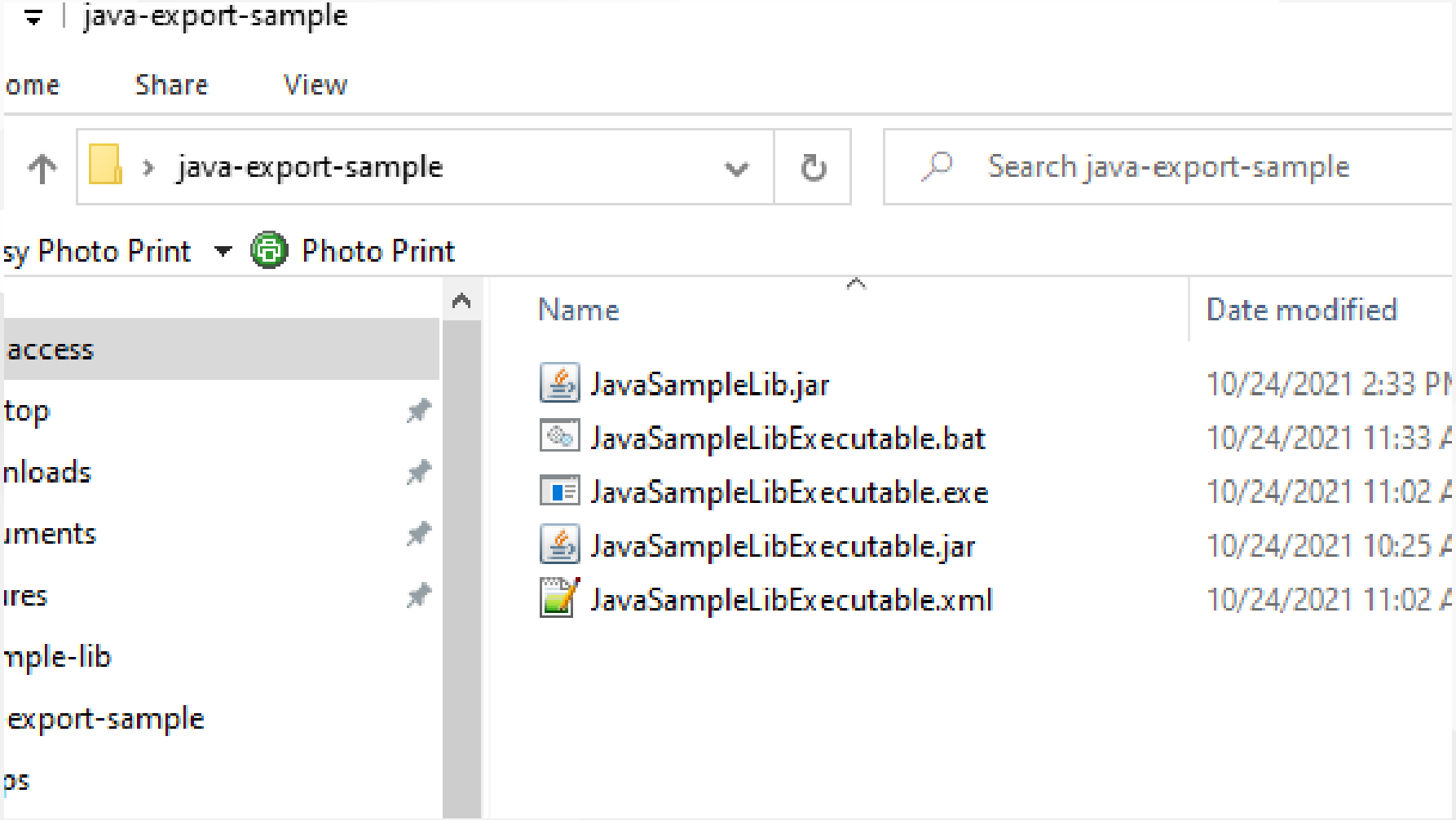
```
C:\Users\ugur.coruh\Desktop\java-export-sample\JavaSampleLib.jar
```




JAR Export
JAR Packaging Options
Define the options for the JAR export.
Select options for handling problems:
Export class files with compile errors
Export class files with compile warnings
Create source folder structure
Build projects if not built automatically
Save the description of this JAR in the workspace
Description file:
Browse...
< Back
Next >
Finish
Cancel

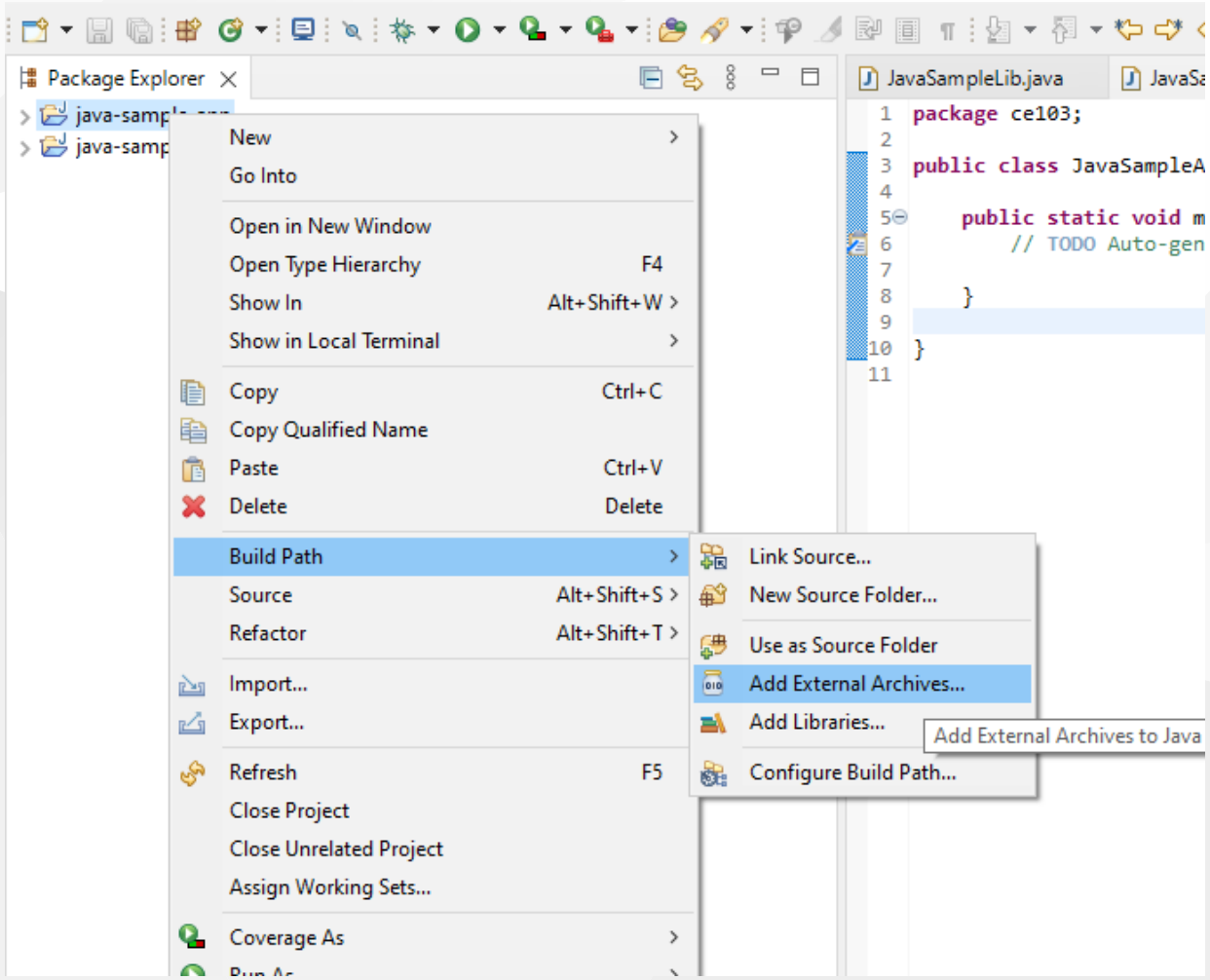

JAR Export
JAR Manifest Specification
Customize the manifest file for the JAR file.
Specify the manifest:
Generate the manifest file
Save the manifest in the workspace
Use the saved manifest in the generated JAR description file
Manifest file:
Browse...
Use existing manifest from workspace
Manifest file:
Browse...
Seal contents:
Seal the JAR
Details...
Seal some packages
Nothing sealed
Details...
Select the class of the application entry point:
Main class:
ce103.JavaSampleLib
Browse...
< Back
Next >
Finish
Cancel

In the same export folder now we have JavaSampleLib.jar

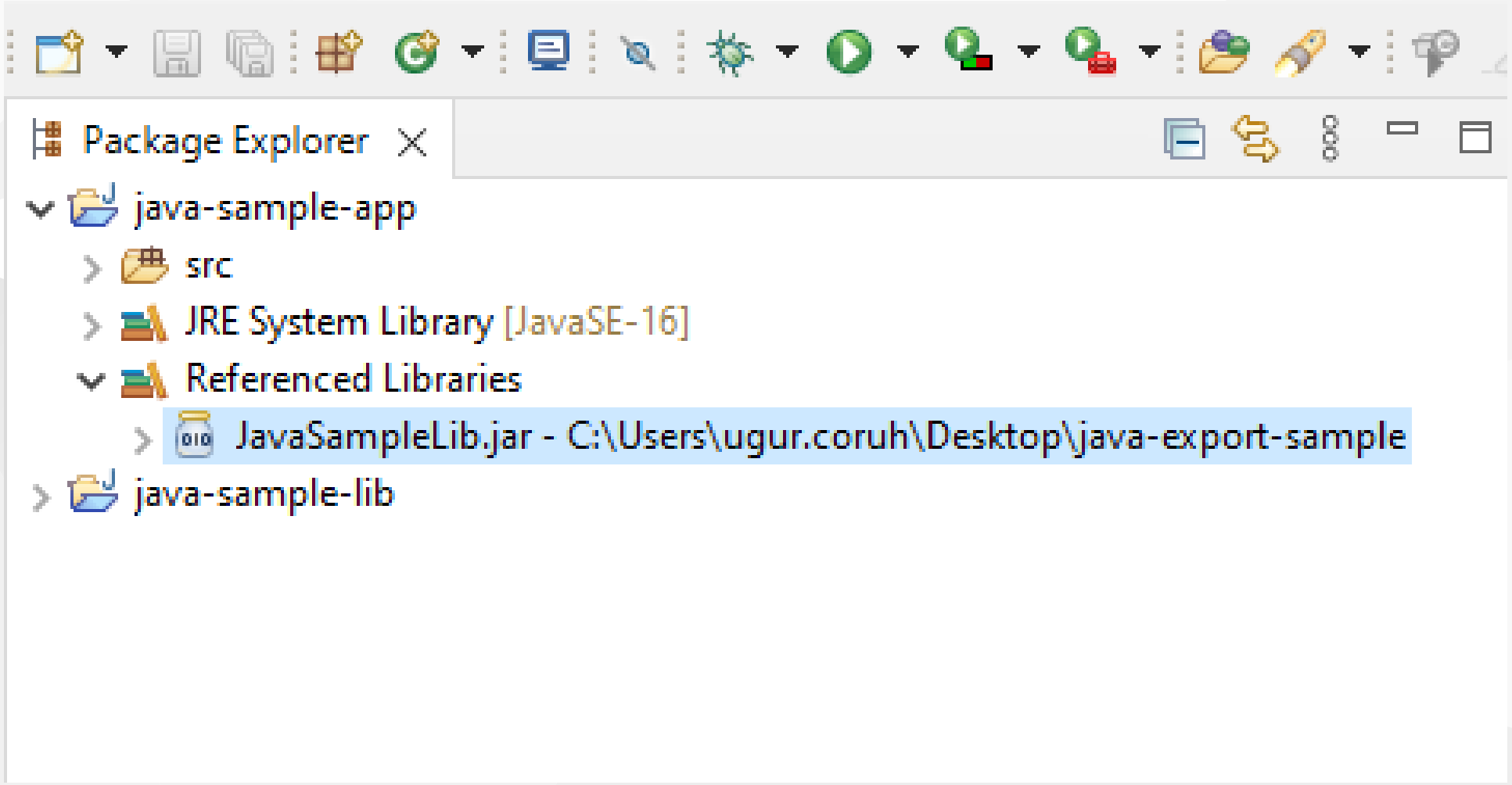


return back to java-sample-app and then add this jar file to our project

Build Path->Add External Archives



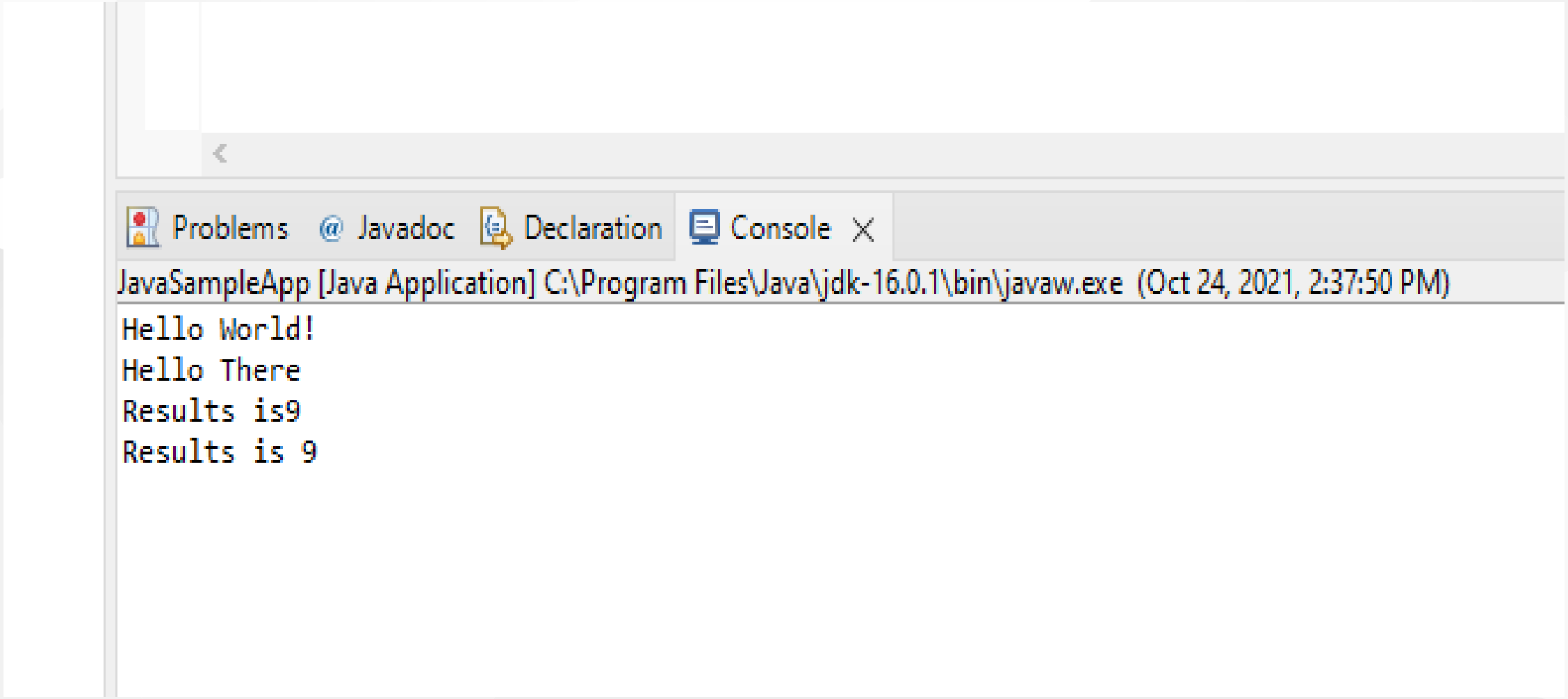
you will see its added to reference libraries



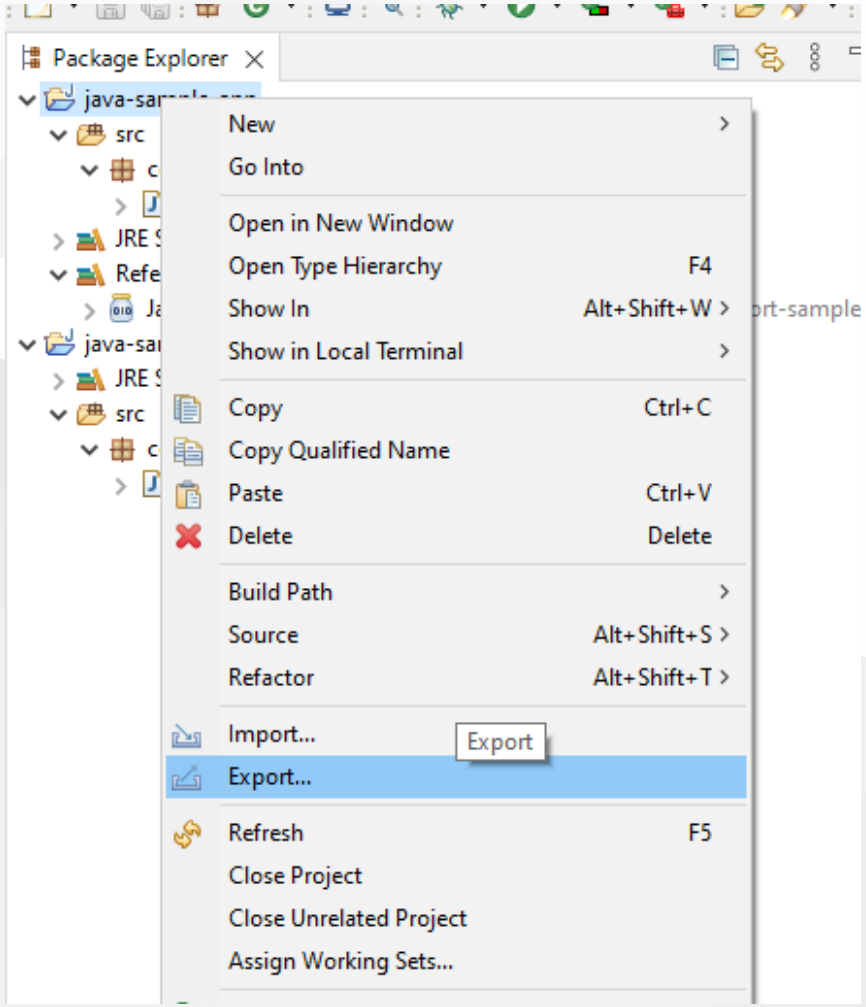
in our JavaSampleApp.java we can use the following source codes

```
package ce103;

import java.io.IOException;

public class JavaSampleApp {

    public static void main(String[] args) {
        // TODO Auto-generated method stub

        System.out.println("Hello World!");

        JavaSampleLib.sayHelloTo("Computer");
        int result = JavaSampleLib.sum(5, 4);
        System.out.println("Results is" + result);
        System.out.printf("Results is %d \n", result);


        try {
            System.in.read();
        } catch (IOException e) {
            // TODO Auto-generated catch block
            e.printStackTrace();
        }

    }

}
```

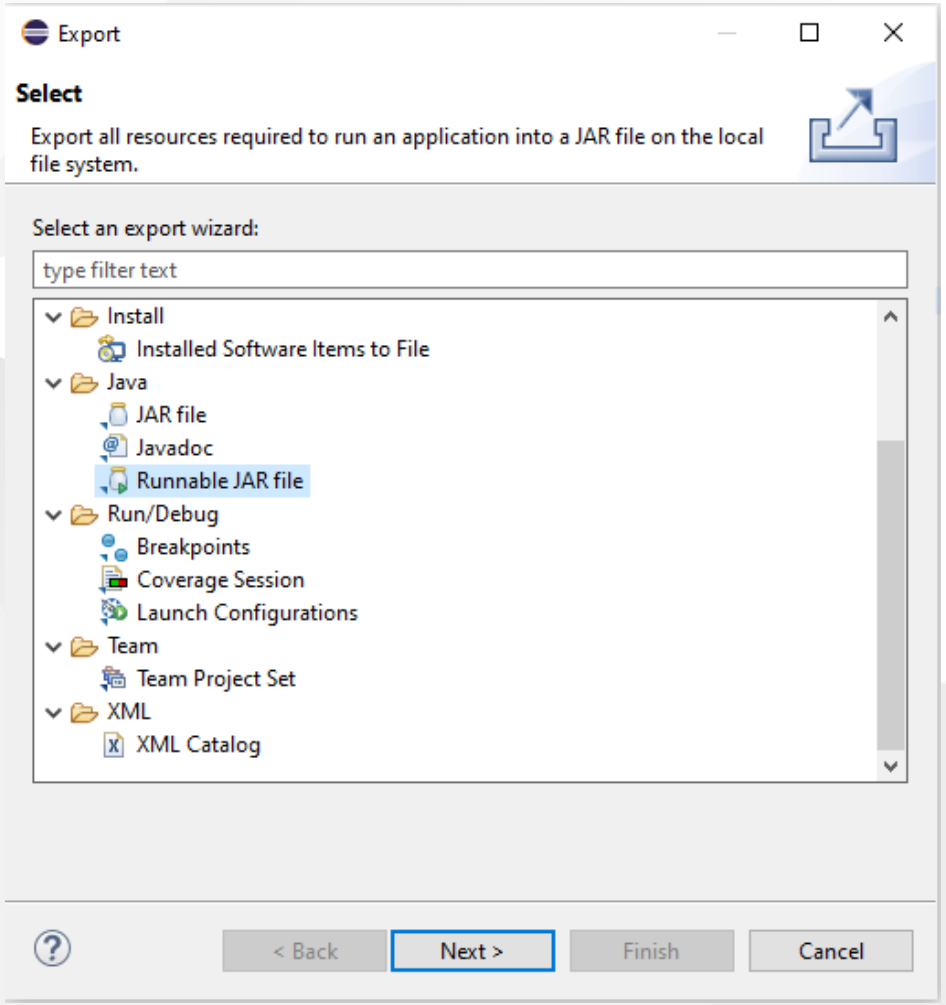
When we run application we will see similar output



Lets export this application with its dependent library

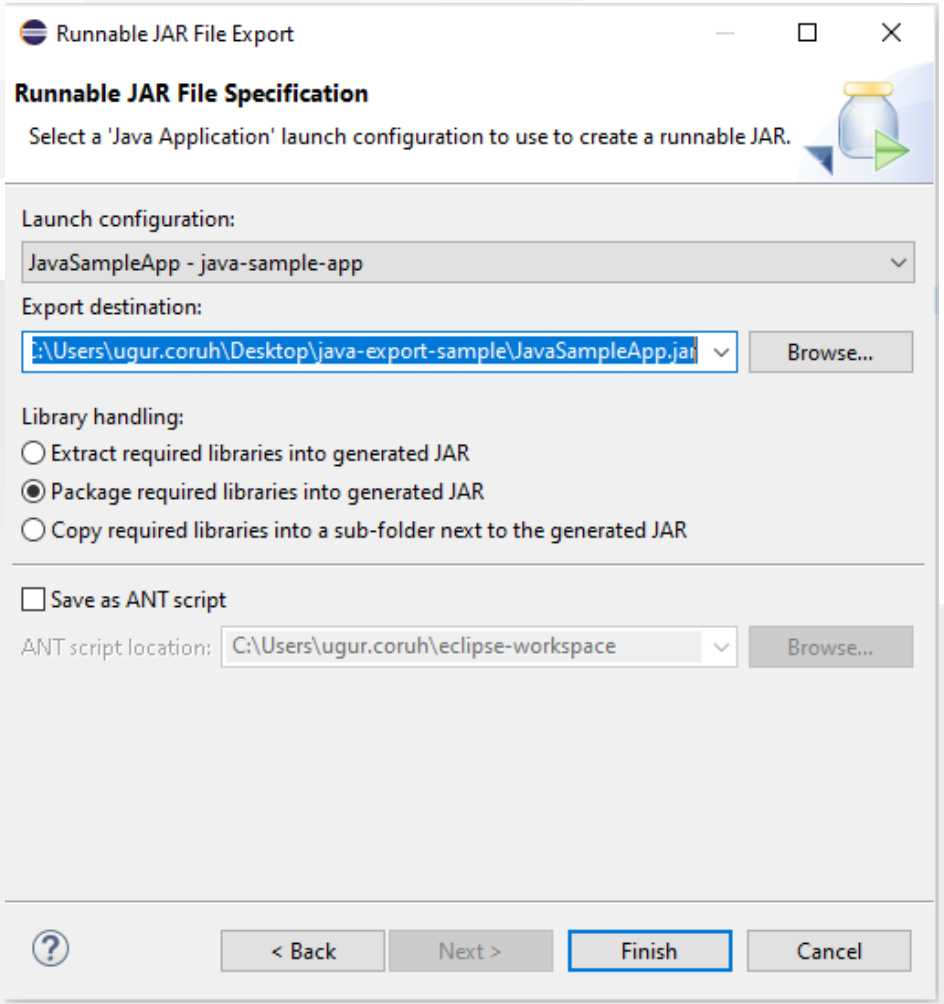


Select runnable jar



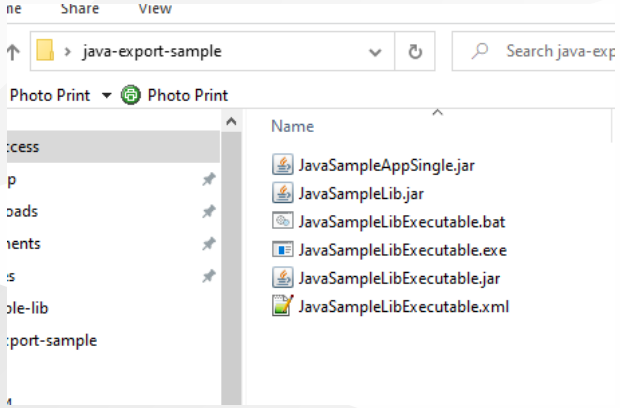
Set Launch configuration and Export destination

```
C:\Users\ugur.coruh\Desktop\java-export-sample\JavaSampleAppSingle.jar
```



In this option we will have single jar file

In the export folder we do not see reference libraries



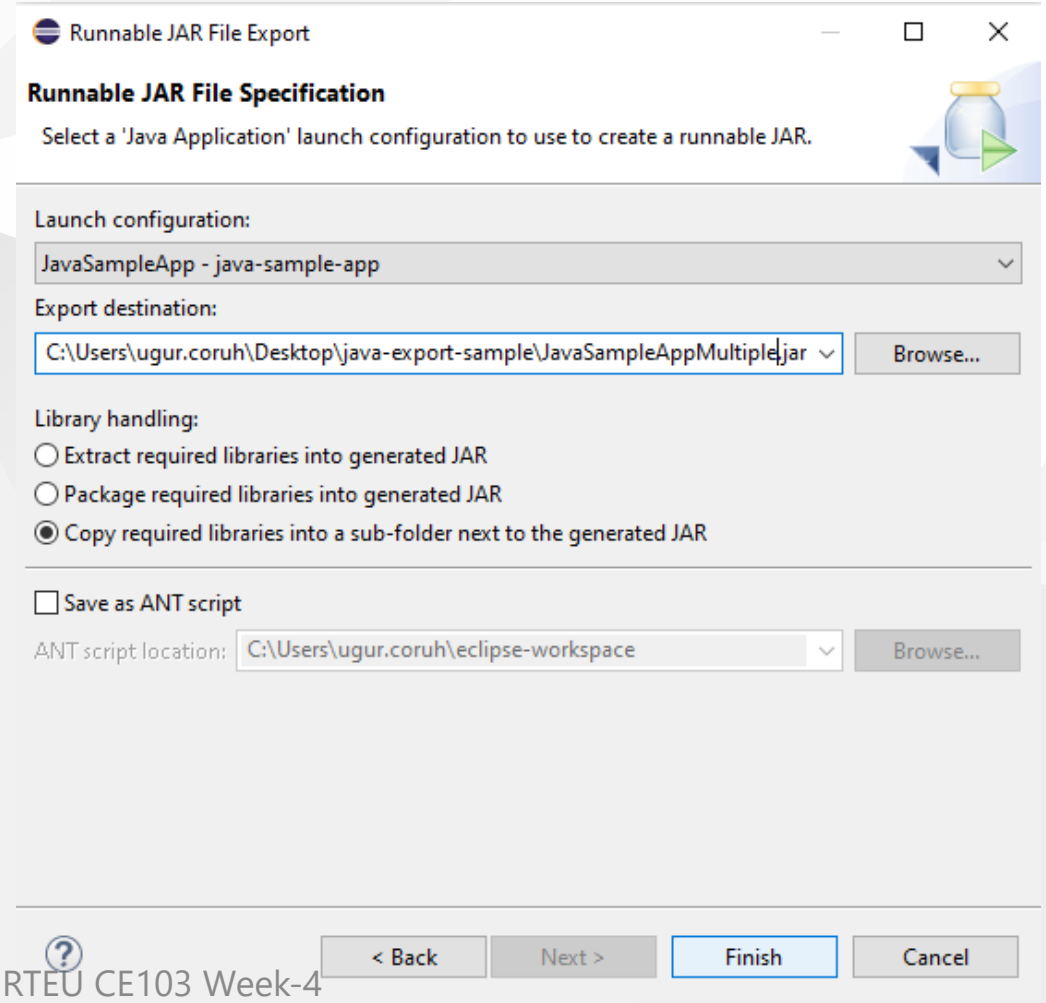
and we can run with command line

```
C:\Users\ugur.coruh\Desktop\java-export-sample>java -jar JavaSampleAppSingle.jar
Hello World!
Hello There
Results is9
Results is 9
```

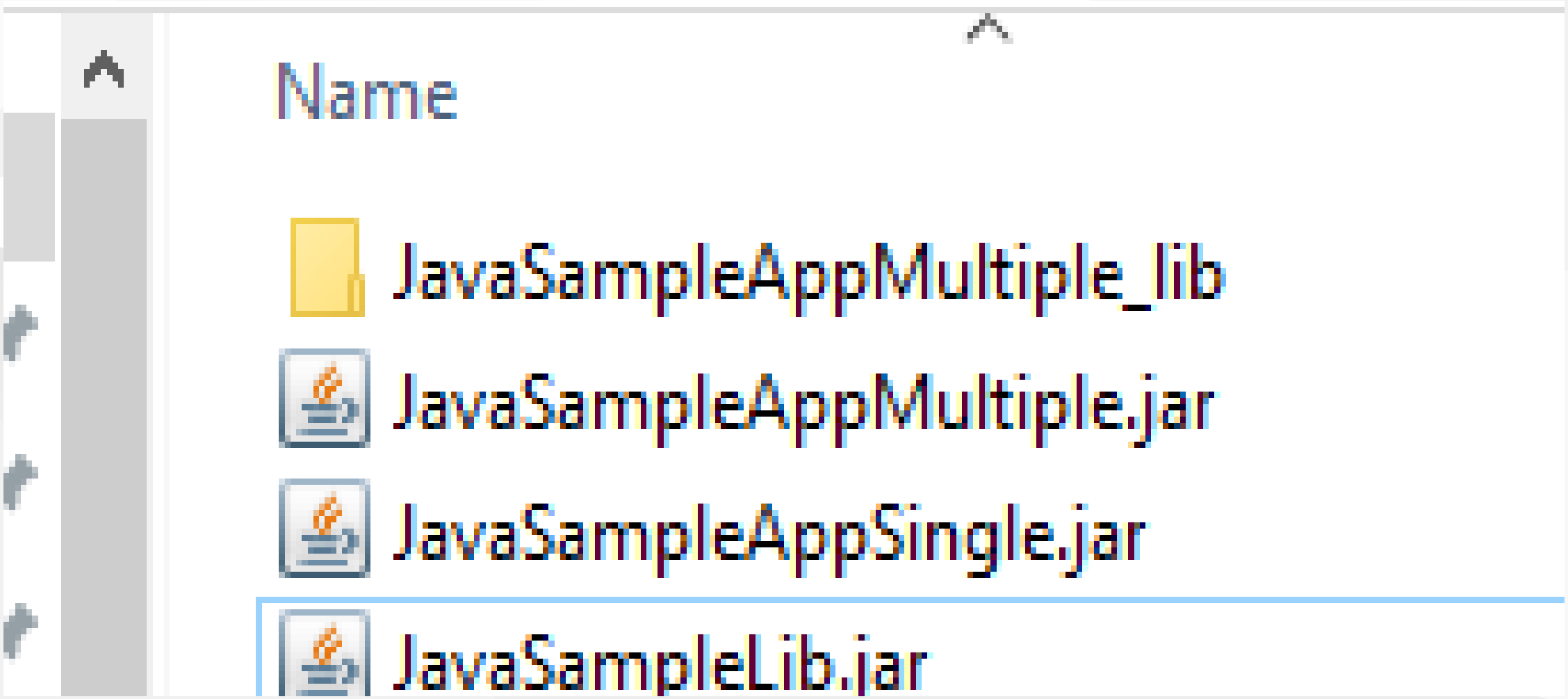
```
24
25      }
26
27  }
```

only change copy required libraries setting and then give a new name for new jar file and export

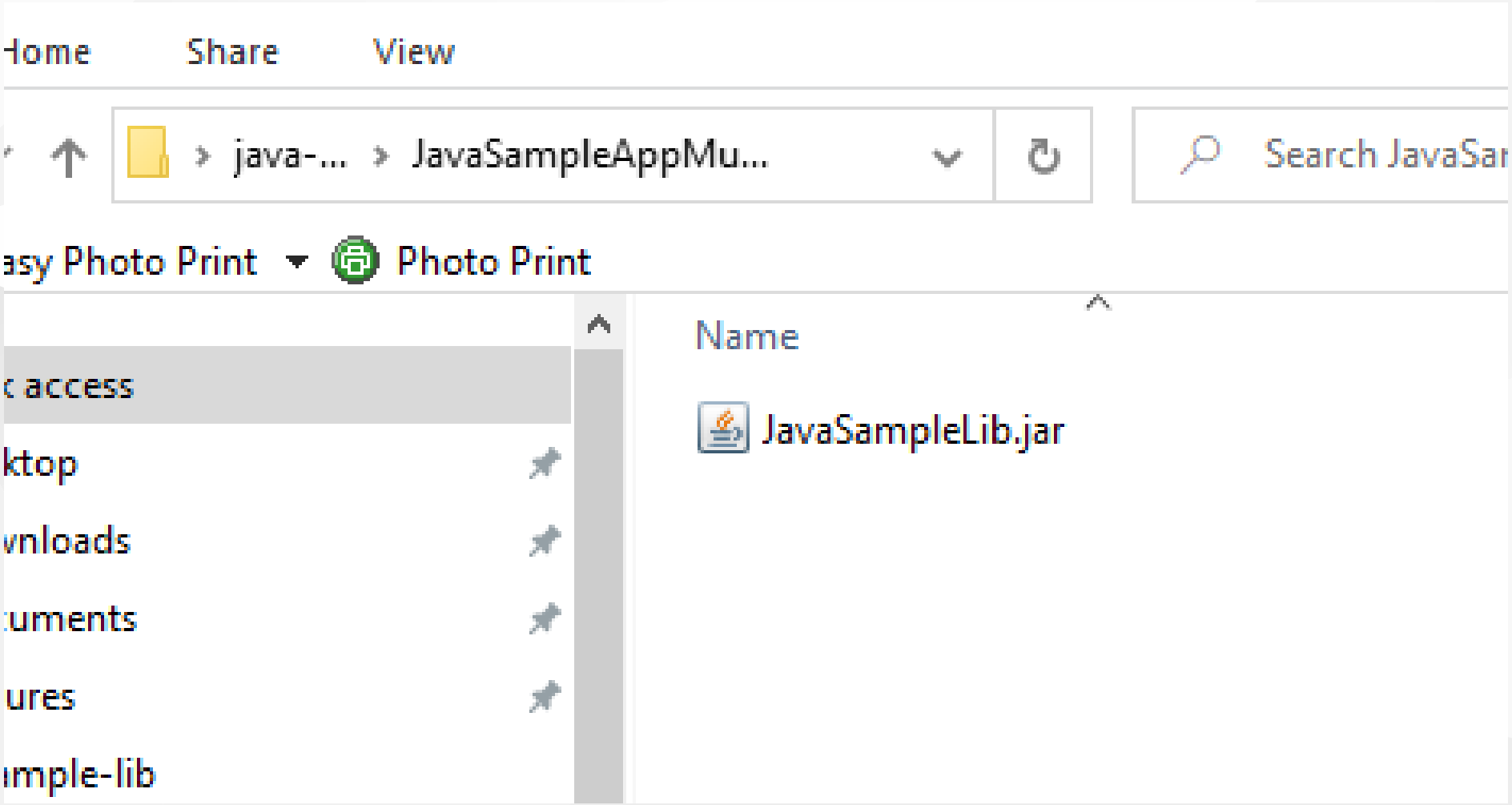
```
C:\Users\ugur.coruh\Desktop\java-export-sample\JavaSampleAppMultiple.jar
```



now we have a folder that contains our libraries referenced

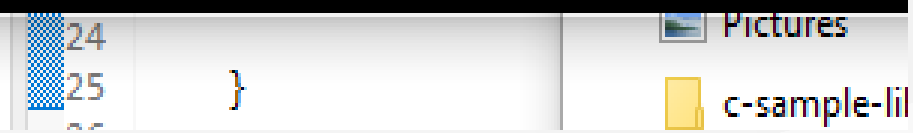


in this file we can find our library



if we test our application we will see it will work

```
C:\Users\ugur.coruh\Desktop\java-export-sample>java -jar JavaSampleAppMultiple.jar
Hello World!
Hello There
Results is9
Results is 9
```



if we delete JavaSampleLib.jar and then try running application we will get error

```
C:\Users\ugur.coruh\Desktop\java-export-sample>java -jar JavaSampleAppMultiple.jar
Hello World!
Exception in thread "main" java.lang.NoClassDefFoundError: ce103/JavaSampleLib
        at ce103.JavaSampleApp.main(JavaSampleApp.java:12)
Caused by: java.lang.ClassNotFoundException: ce103.JavaSampleLib
        at java.base/jdk.internal.loader.BuiltinClassLoader.loadClass(BuiltinClassLoader.java:636)
        at java.base/jdk.internal.loader.ClassLoaders$AppClassLoader.loadClass(ClassLoaders.java:182)
        at java.base/java.lang.ClassLoader.loadClass(ClassLoader.java:519)
        ... 1 more

C:\Users\ugur.coruh\Desktop\java-export-sample>
```

Program Testing

Unit Test Development

C Unit Tests

Visual Studio Community Edition

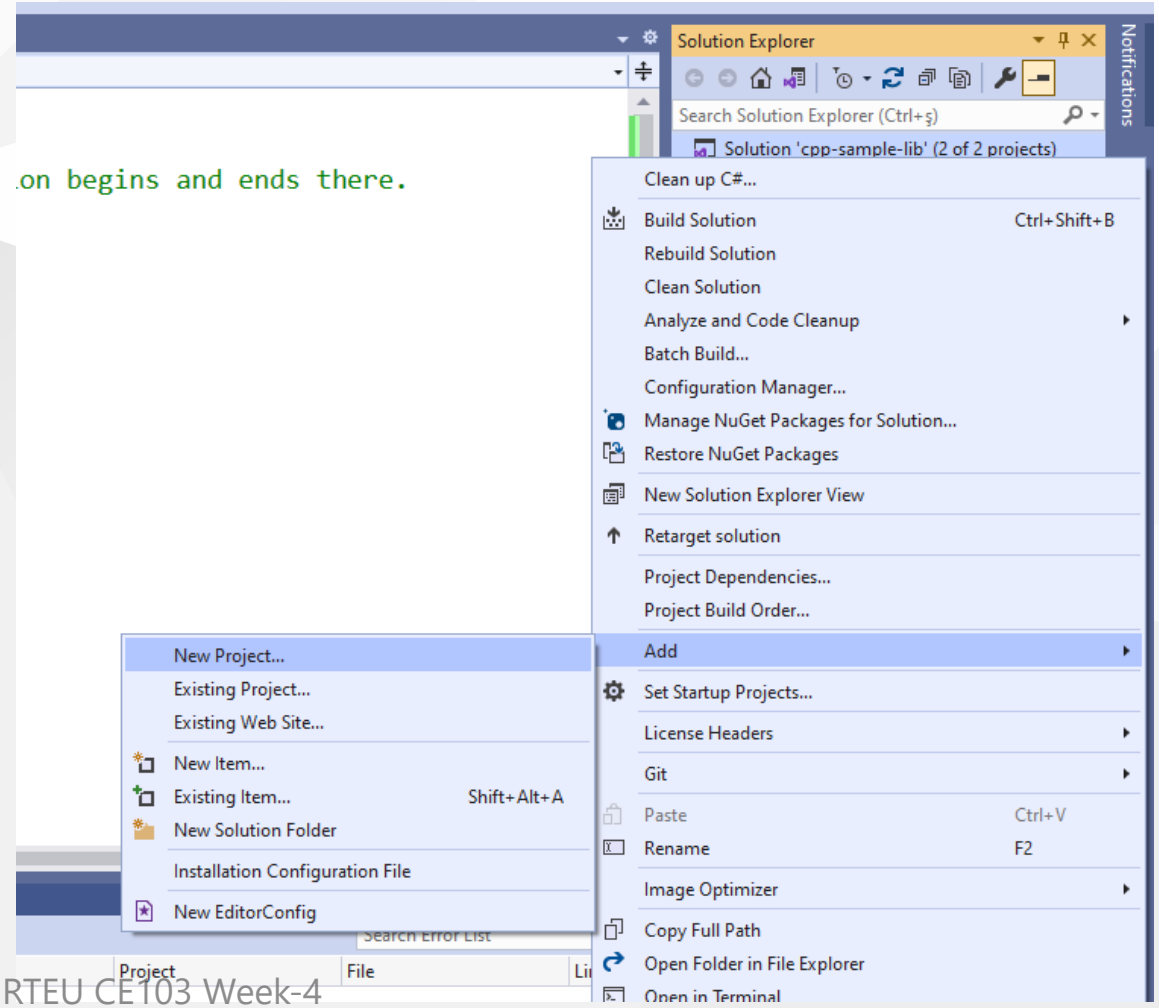
<TODO>

C++ Unit Tests

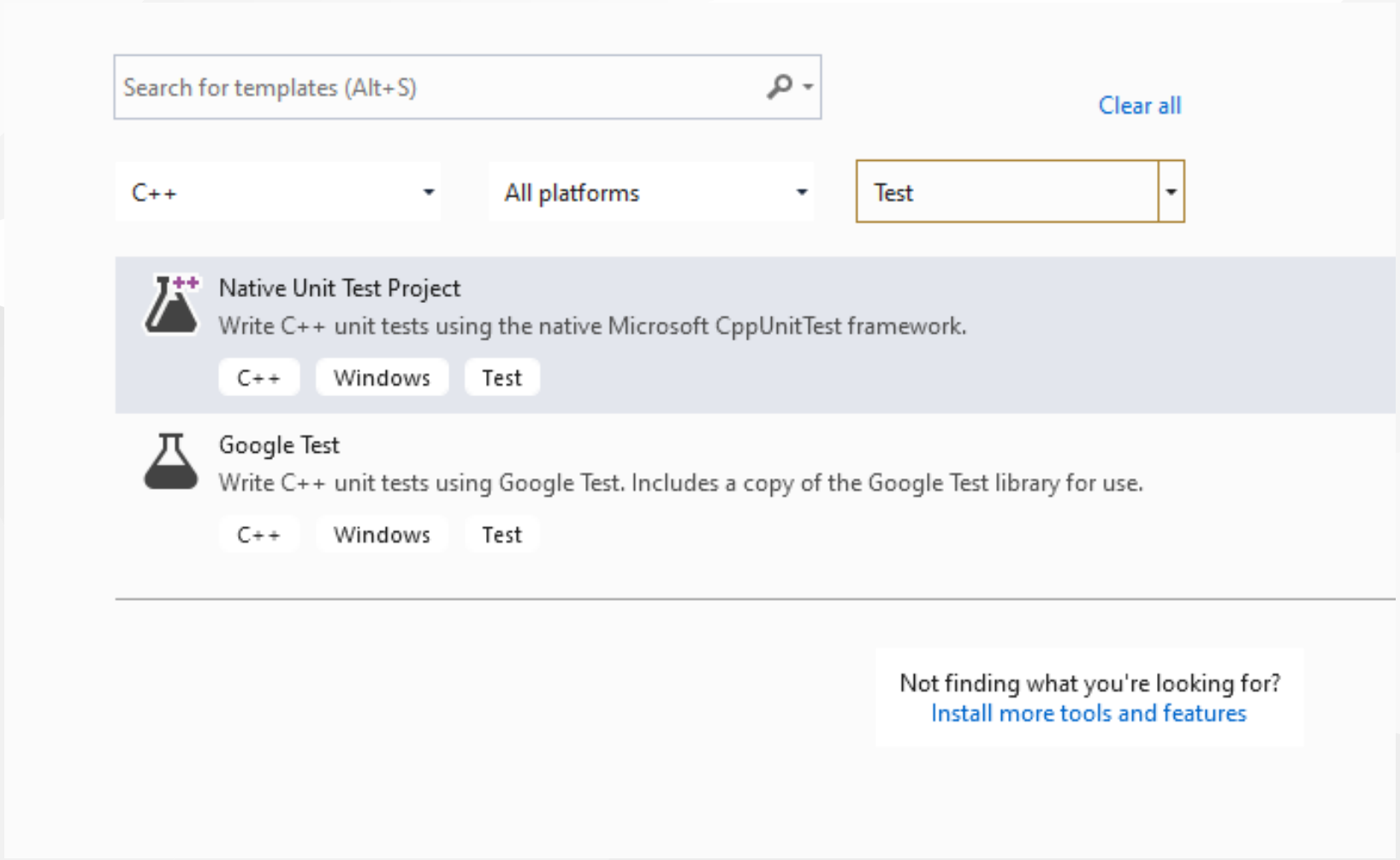
Visual Studio Community Edition

C/C++ için birim testleri yazma - Visual Studio (Windows) | Microsoft Docs

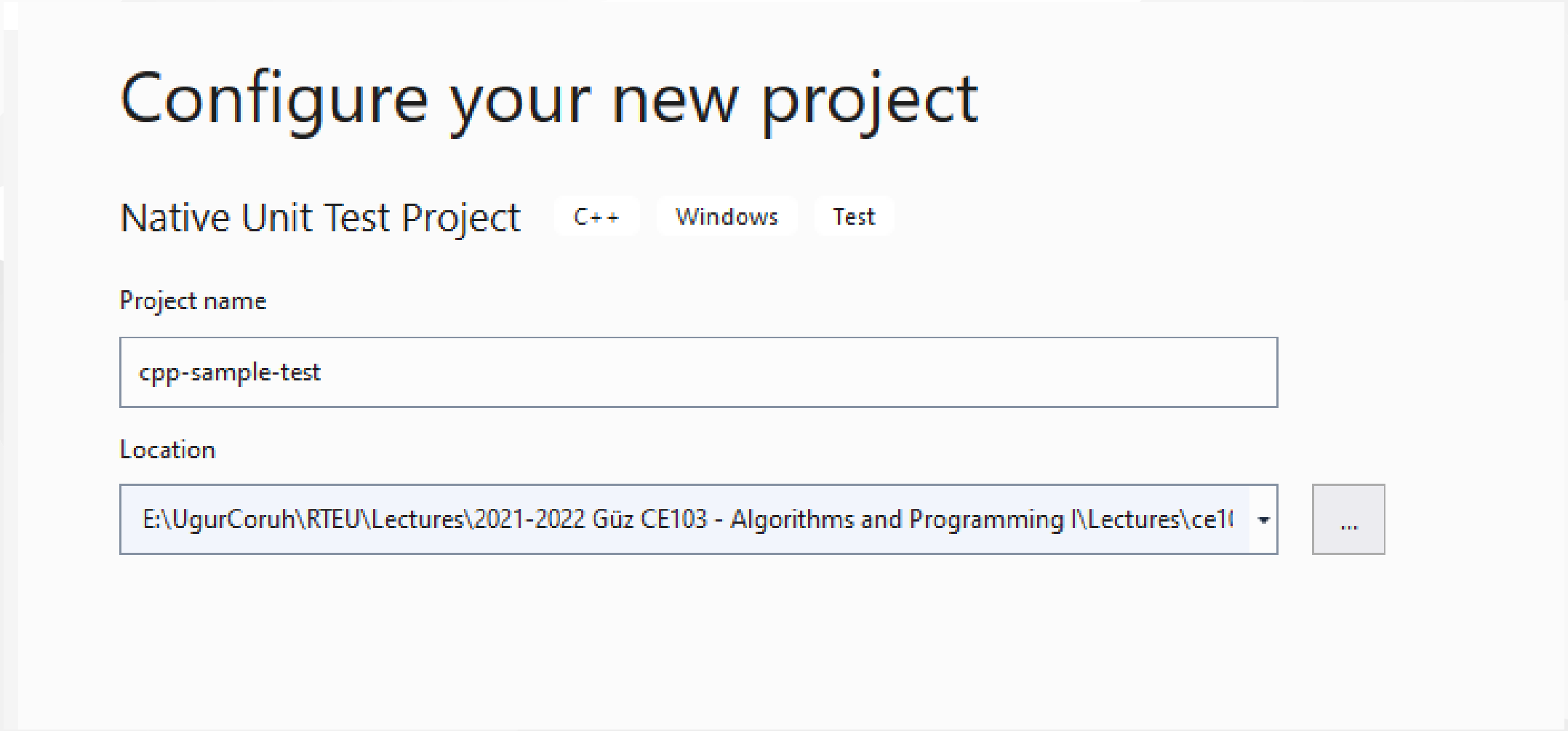
Use cpp-sample-lib project and add



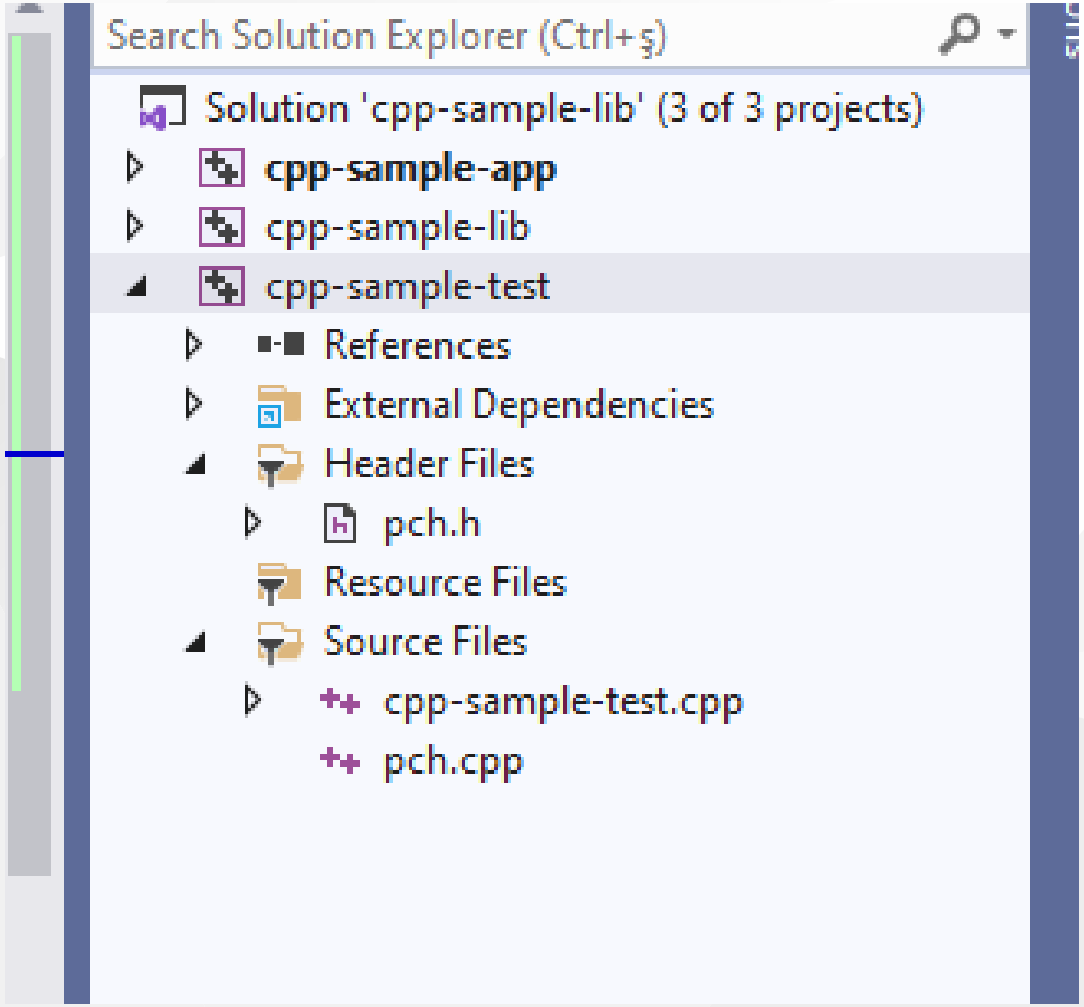
select Native Unit Test



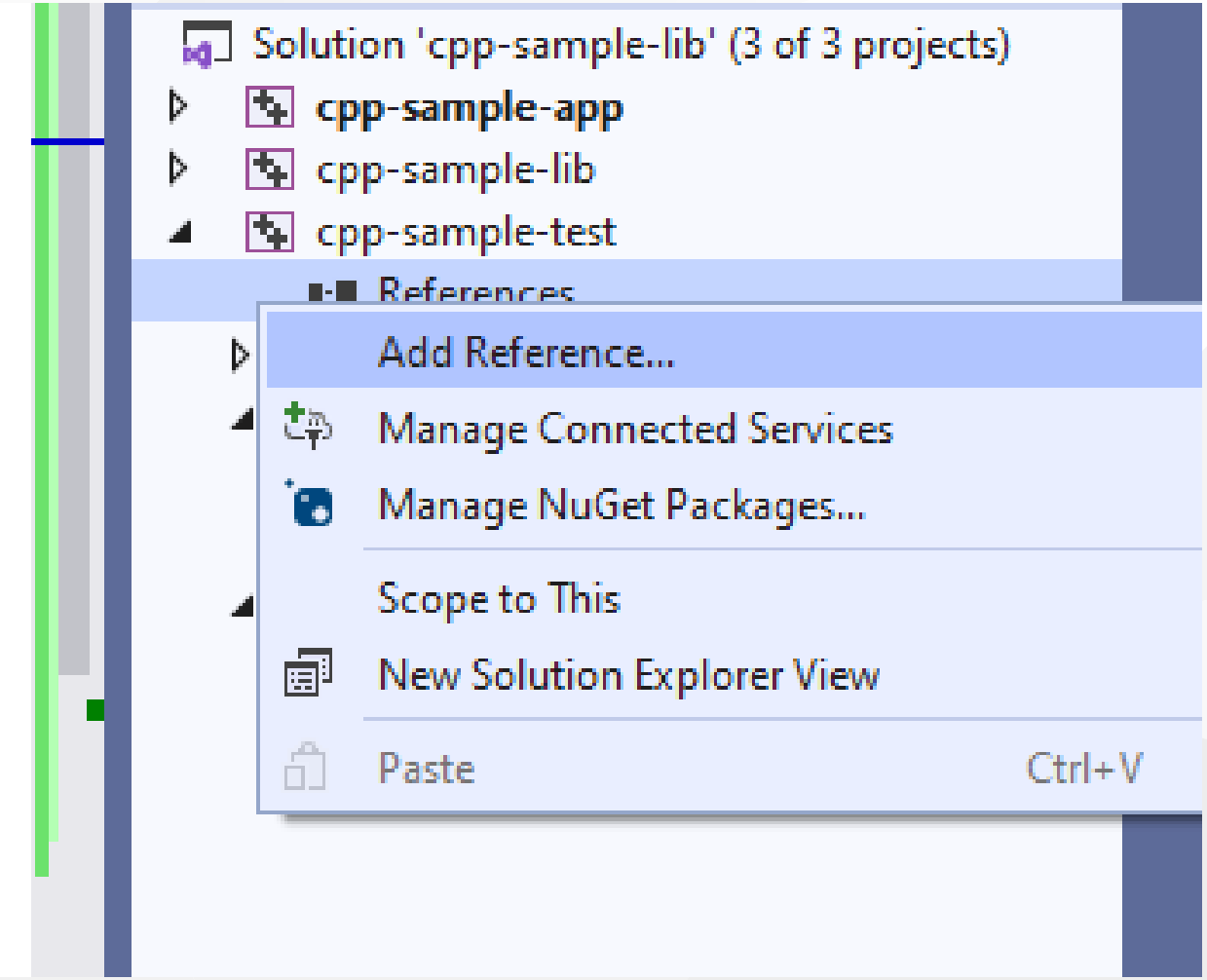
set project path and name



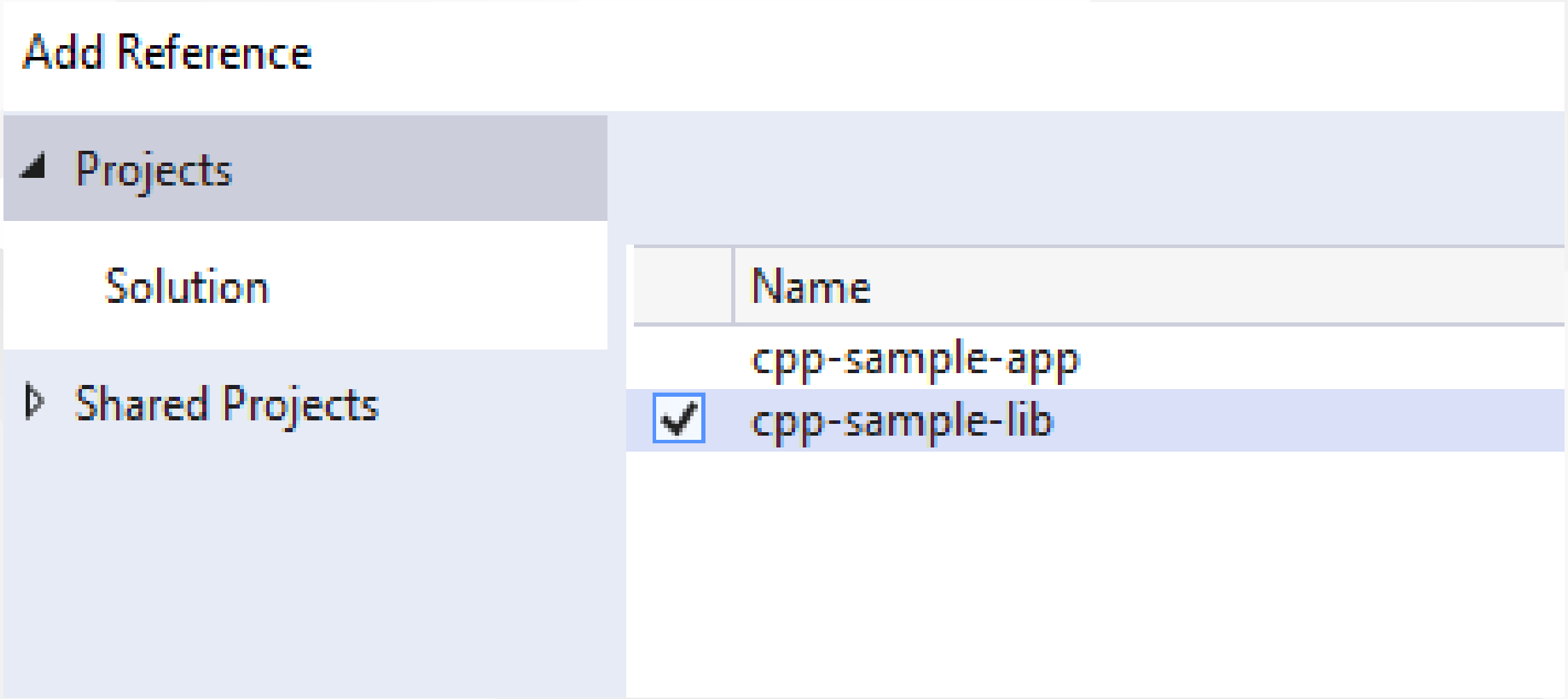
you will have cpp-sample-test project



add library project from references

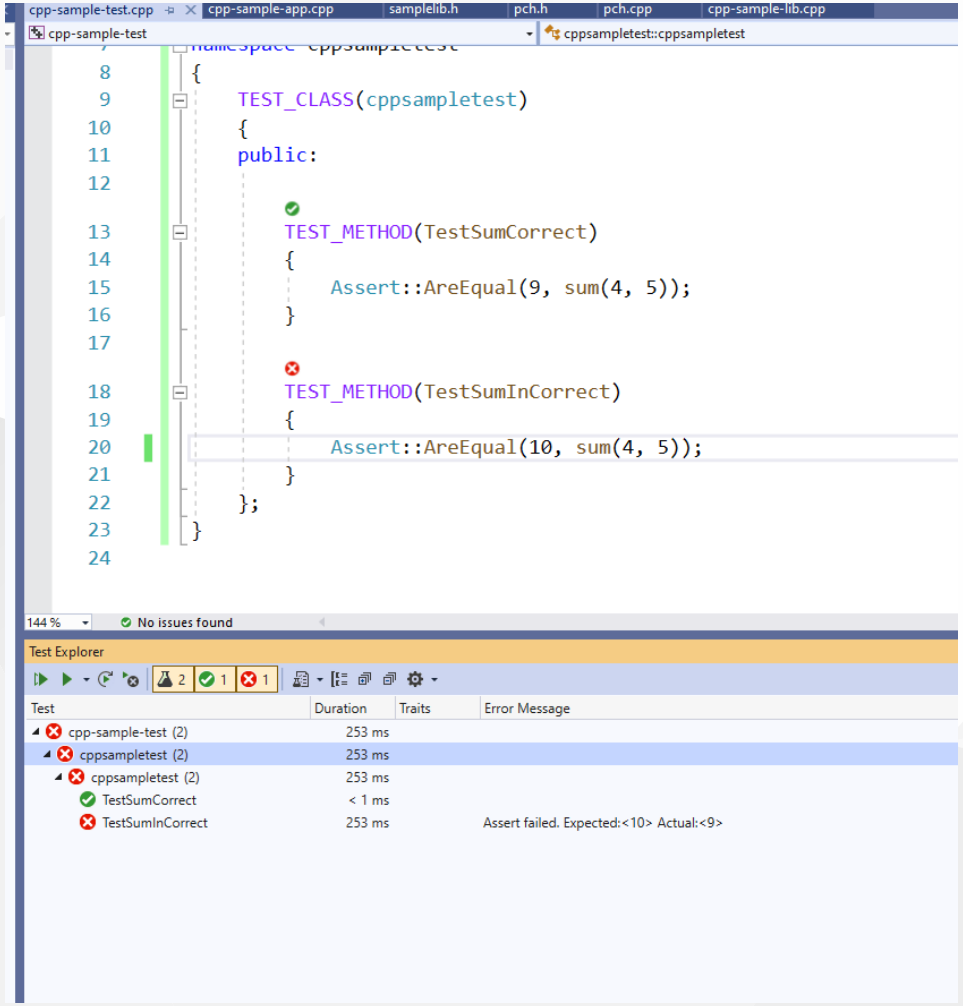


Add cpp-sample-lib to cpp-sample-test project



cpp-sample-test.cpp

```
#include "pch.h"
#include "CppUnitTest.h"
#include "..\cpp-sample-lib\samplelib.h"

using namespace Microsoft::VisualStudio::CppUnitTestFramework;

namespace cppsampletest
{
    TEST_CLASS(cppsampletest)
    {
    public:

        TEST_METHOD(TestSumCorrect)
        {
            Assert::AreEqual(9, sum(4, 5));
        }

        TEST_METHOD(TestSumInCorrect)
        {
            Assert::AreEqual(10, sum(4, 5));
        }
    };
}
```


cpp-sample-test.cpp
cpp-sample-app.cpp
samplelib.h
pch.h
pch.cpp
cpp-sample-lib.cpp
cpp-sample-test
cppsampletest::cppsampletest
{
TEST_CLASS(cppsampletest)
{
public:
TEST_METHOD(TestSumCorrect)
{
Assert::AreEqual(9, sum(4, 5));
}
TEST_METHOD(TestSumInCorrect)
{
Assert::AreEqual(10, sum(4, 5));
}
};
}
144 %
No issues found
Test Explorer
Test
Duration
Traits
Error Message
cpp-sample-test (2) 253 ms
cppsampletest (2) 253 ms
cppsampletest (2) 253 ms
TestSumCorrect < 1 ms
TestSumInCorrect 253 ms
Assert failed. Expected:<10> Actual:<9>

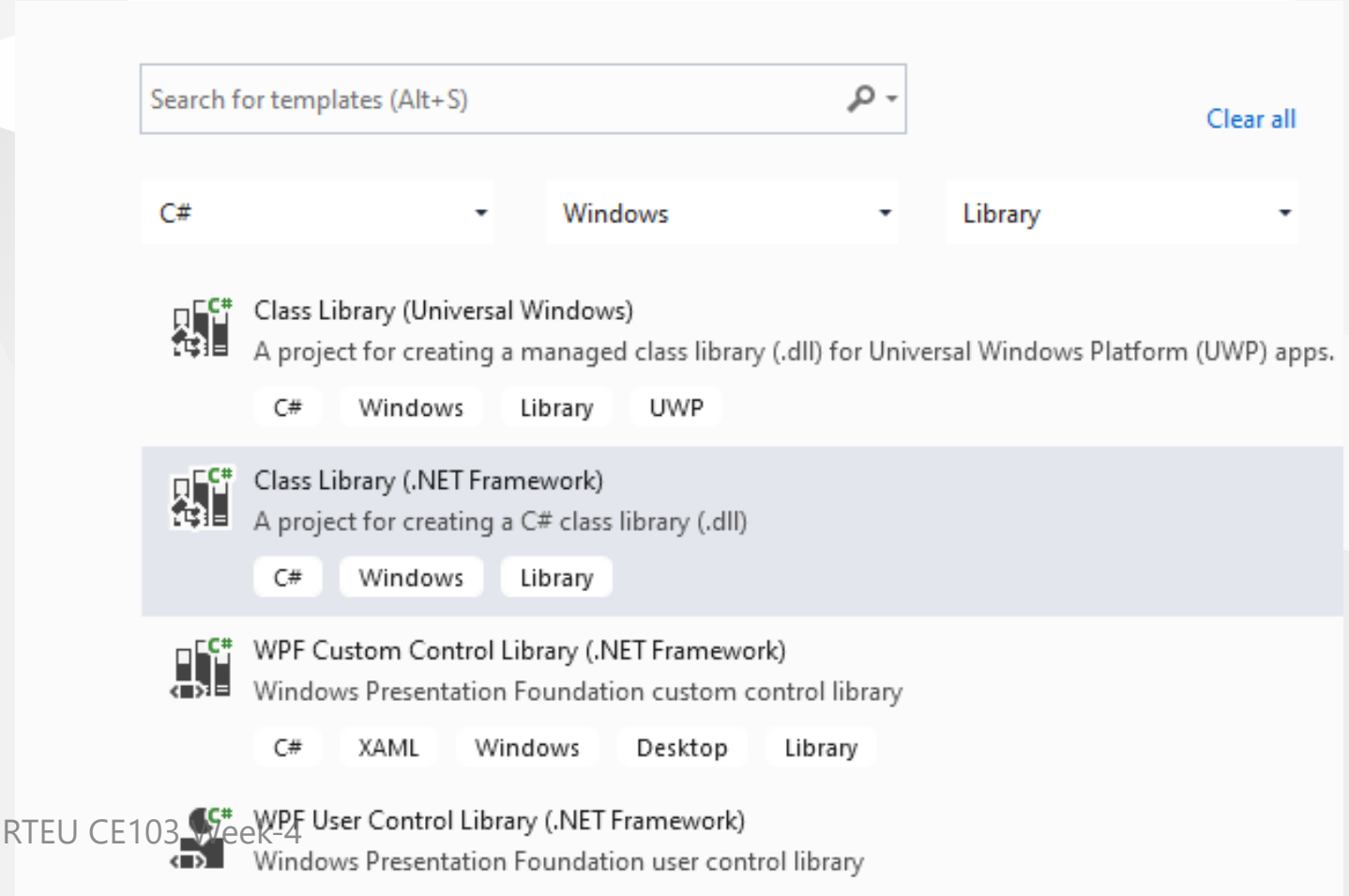
<TODO>

C# Unit Tests

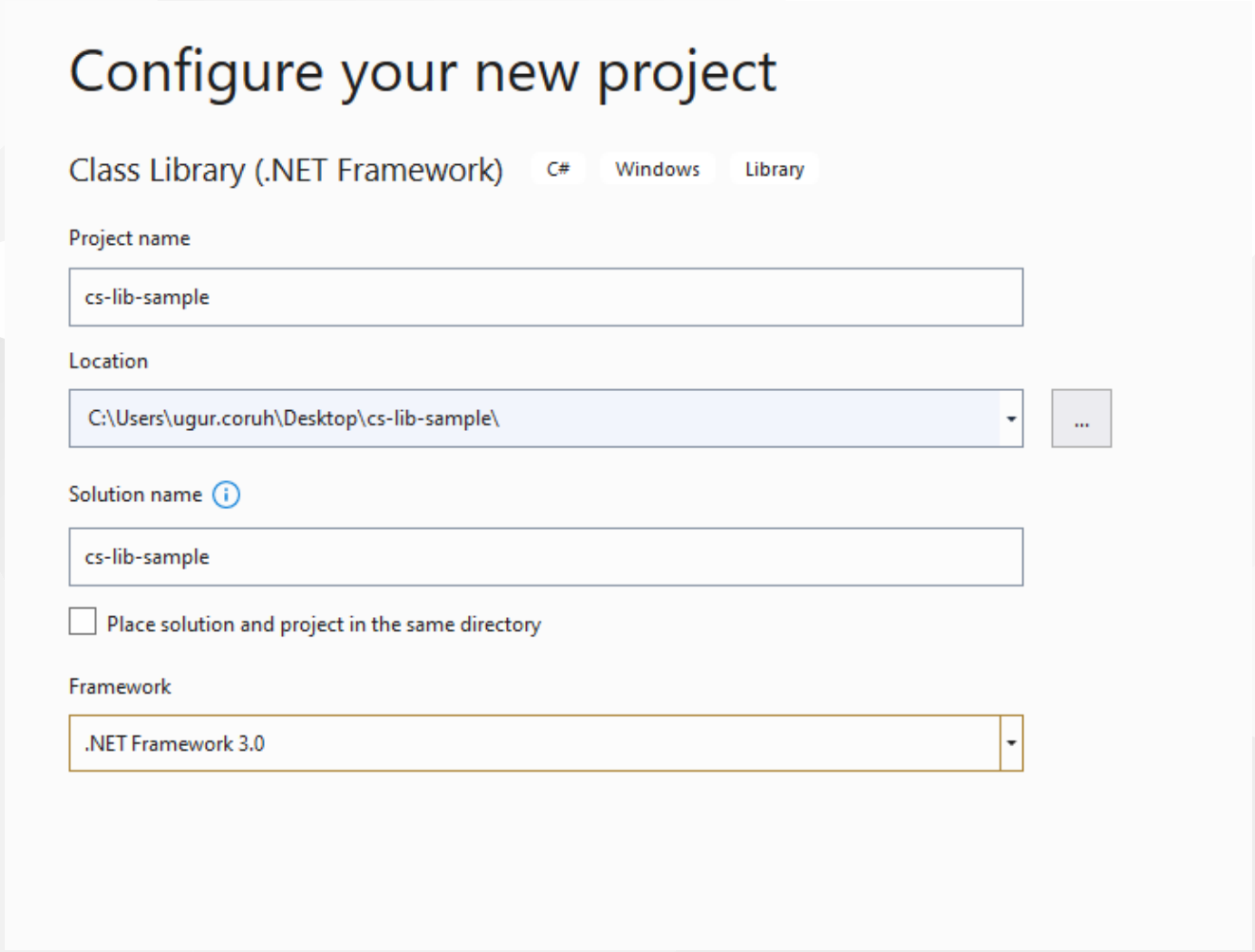
Install extension fine code coverage

https://marketplace.visualstudio.com/items?itemName=FortuneNgwenya.FineCodeCoverage

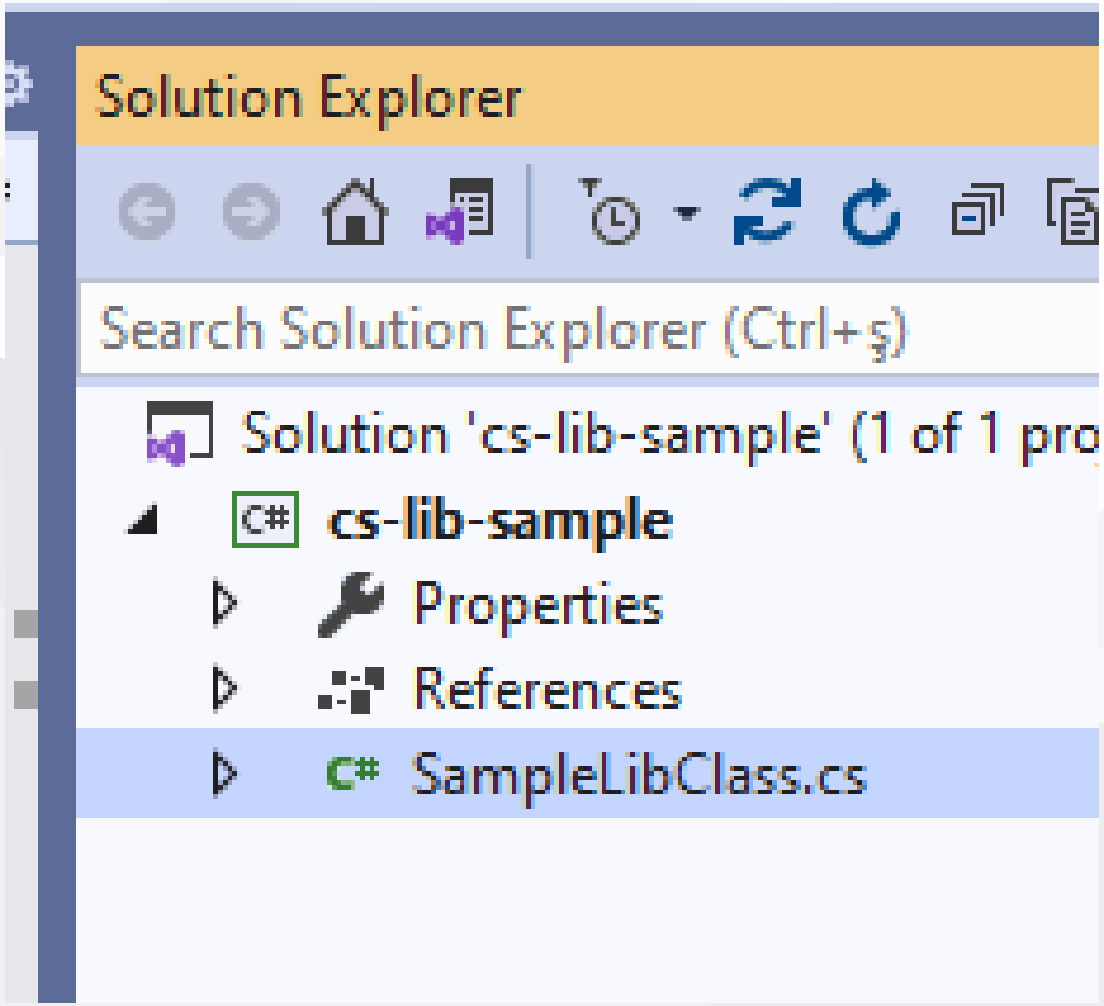
Create a .Net Framework Library



set project framework and path

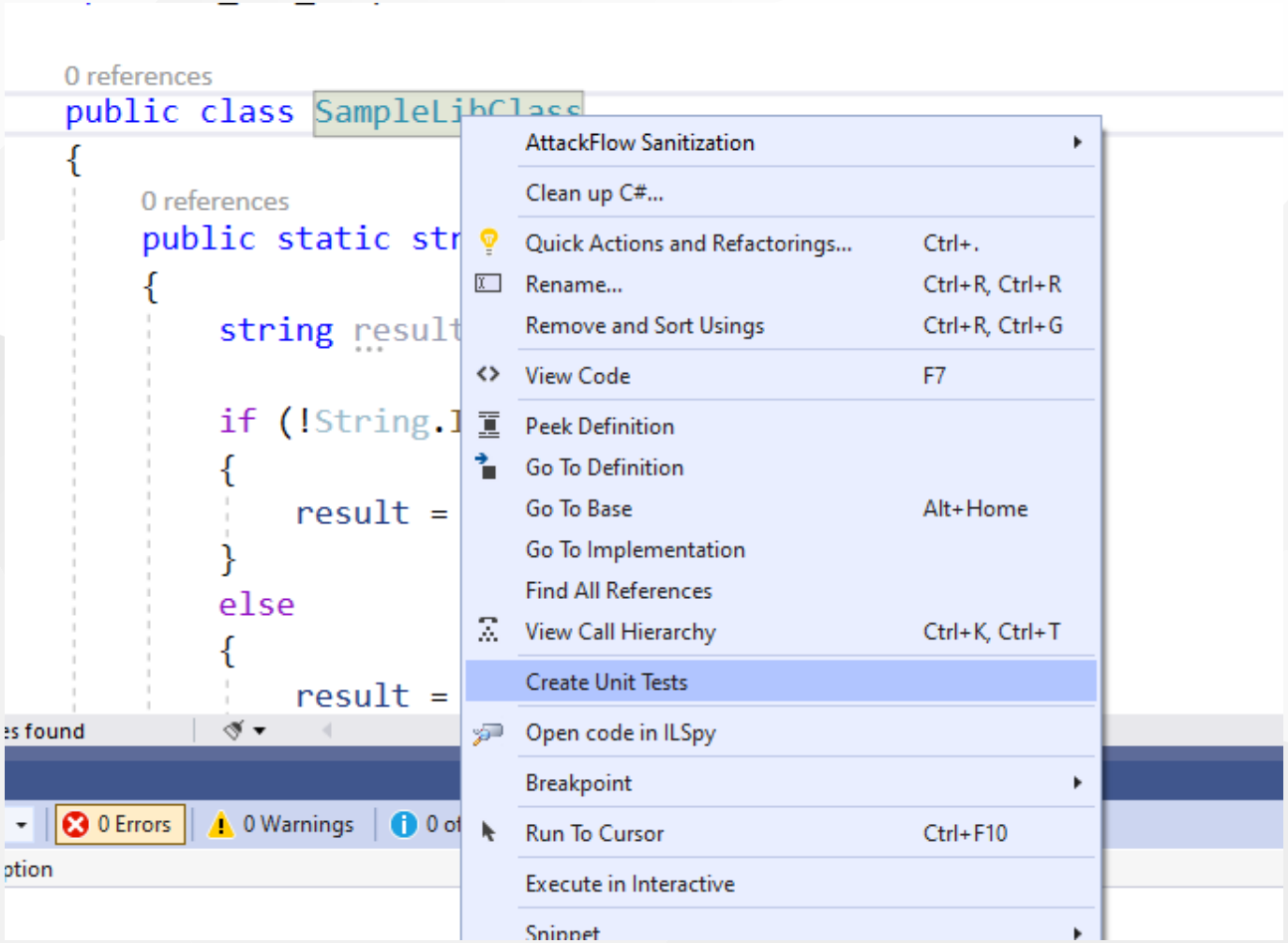


Create library functions

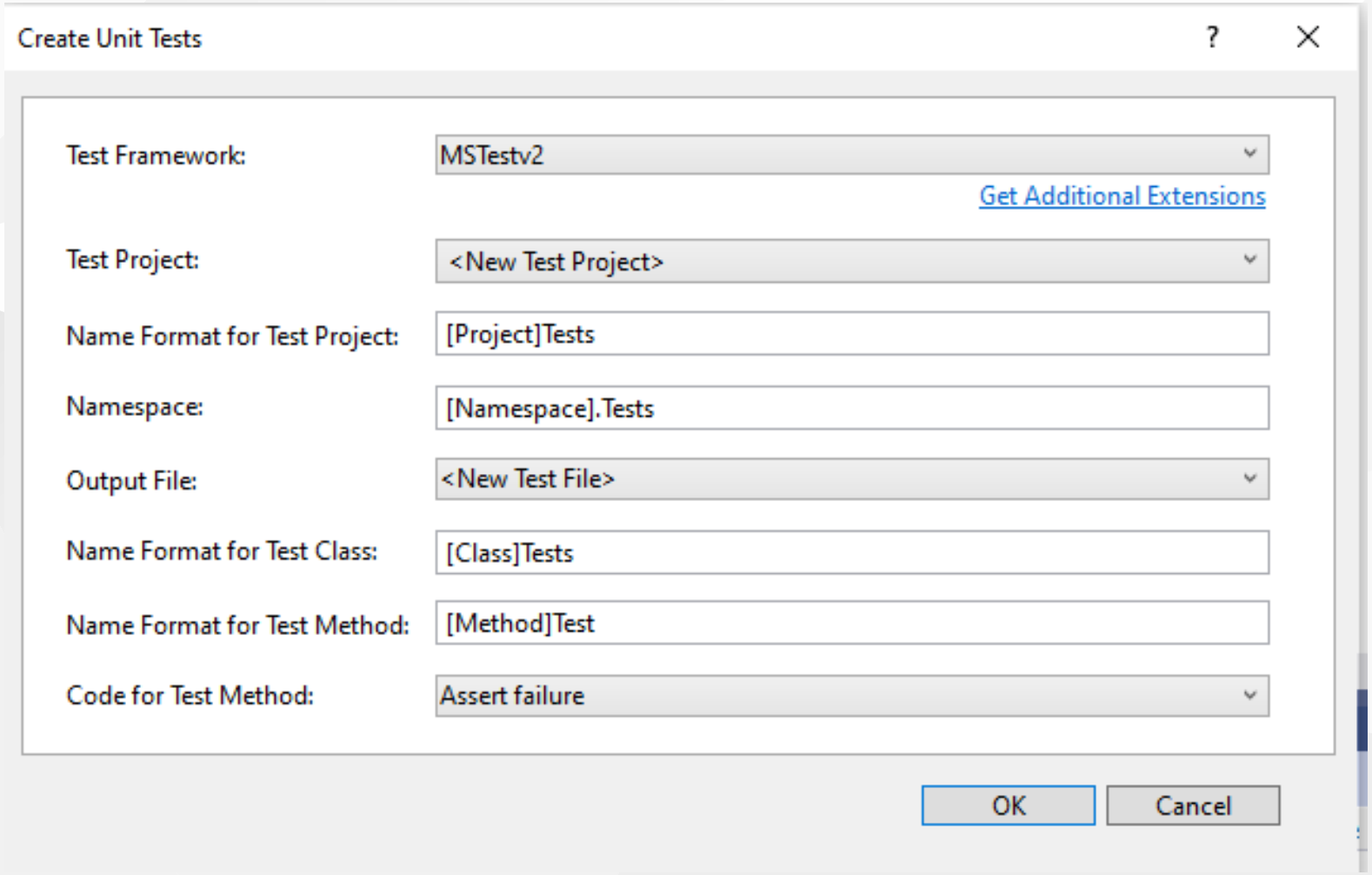


```
using System;
using System.Collections.Generic;
using System.Text;

namespace cs_lib_sample
{
    public class SampleLibClass
    {
        public static string sayHelloTo(string name)
        {
            string result = String.Empty;

            if (!String.IsNullOrEmpty(name))
            {
                result = "Hello " + name;
            }
            else
            {
                result = "Hello There";
            }

            Console.WriteLine(result);

            return result;
        }

        public static int sum(int a, int b)
        {
            int c = 0;
            c = a + b;
            return c;
        }

        public int multiply(int a, int b)
        {
            return a * b;
        }
    }
}
```

right click and then create unit test project



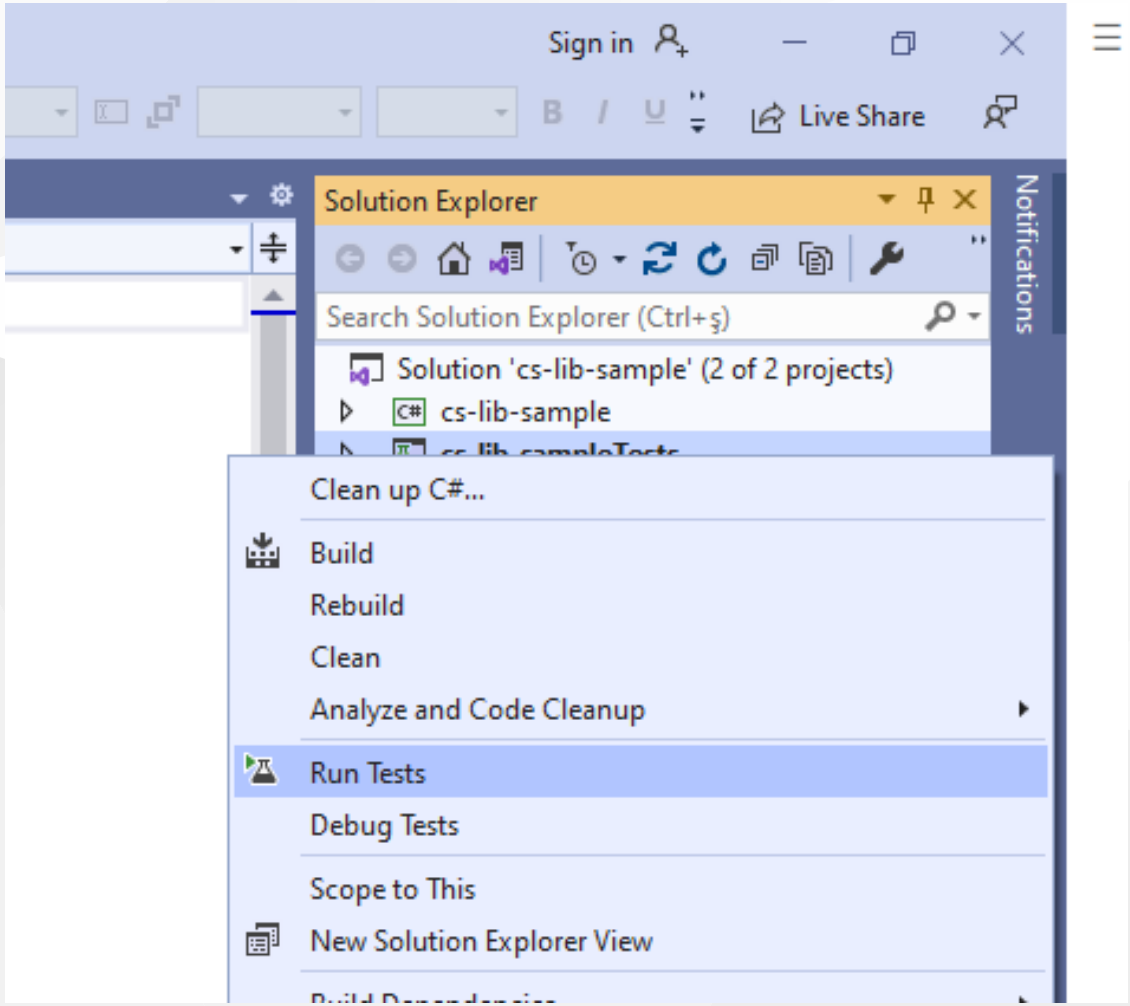
press OK


Create Unit Tests
Test Framework:
MSTestv2
Get Additional Extensions
Test Project:
<New Test Project>
Name Format for Test Project:
[Project]Tests
Namespace:
[Namespace].Tests
Output File:
<New Test File>
Name Format for Test Class:
[Class]Tests
Name Format for Test Method:
[Method]Test
Code for Test Method:
Assert failure
OK
Cancel

enter test code

```
using Microsoft.VisualStudio.TestTools.UnitTesting;
using cs_lib_sample;
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;

namespace cs_lib_sample.Tests
{
    [TestClass()]
    public class SampleLibClassTests
    {

        [TestMethod()]
        public void testSayHelloTo()
        {


            Assert.AreEqual("Hello Computer", SampleLibClass.sayHelloTo("Computer"), "Regular say hello should work");
        }
        [TestMethod()]
        public void testSayHelloToWrong()
        {
            Assert.AreEqual("Hello All", SampleLibClass.sayHelloTo("Computer"), "Regular say hello won't work");
        }


        [TestMethod()]
        public void testSumCorrect()
        {
            Assert.AreEqual(9, SampleLibClass.sum(4, 5), "Regular sum should work");
        }

        [TestMethod()]
        public void testSumWrong()
        {
            Assert.AreEqual(10, SampleLibClass.sum(4, 5), "Regular sum shouldn't work");
        }

        [TestMethod()]
        public void testMultiply()
        {
            SampleLibClass sampleLib = new SampleLibClass();

            Assert.AreEqual(20, sampleLib.multiply(4, 5), "Regular multiplication should work");
        }


    }
}
```

Run tests


Sign in
Live Share
Solution Explorer
Search Solution Explorer (Ctrl+ş)
Solution 'cs-lib-sample' (2 of 2 projects)
cs-lib-sample
Notifications
Clean up C#...
Build
Rebuild
Clean
Analyze and Code Cleanup
Run Tests
Debug Tests
Scope to This
New Solution Explorer View

you will code coverage and entered or passed branches

```
7   public class SampleLibClass
8   {
        2 references | 1/2 passing
9       public static string sayHelloTo(string name)
10      {
11          string result = String.Empty;
12
13          if (!String.IsNullOrEmpty(name))
14          {
15              result = "Hello " + name;
16          }
17          else
18          {
19              result = "Hello There";
20          }
21
22          Console.WriteLine(result);
23
24          return result;
25      }
26
        2 references | 1/2 passing
```

144 % | No issues found | Ln: 18 Ch: 14 SPC CRLF

Fine Code Coverage

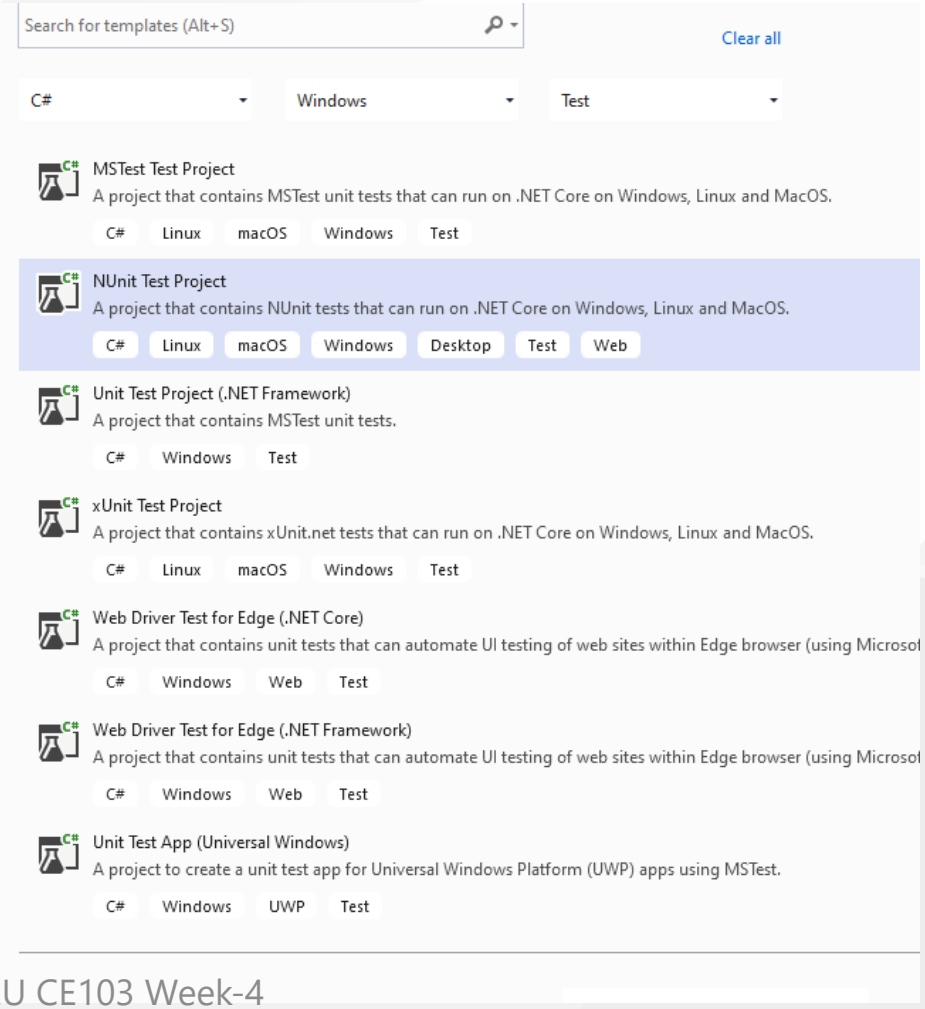
Coverage | Summary | Risk Hotspots | Rate & Review | Log Issue/Suggestion | Buy me a coffee

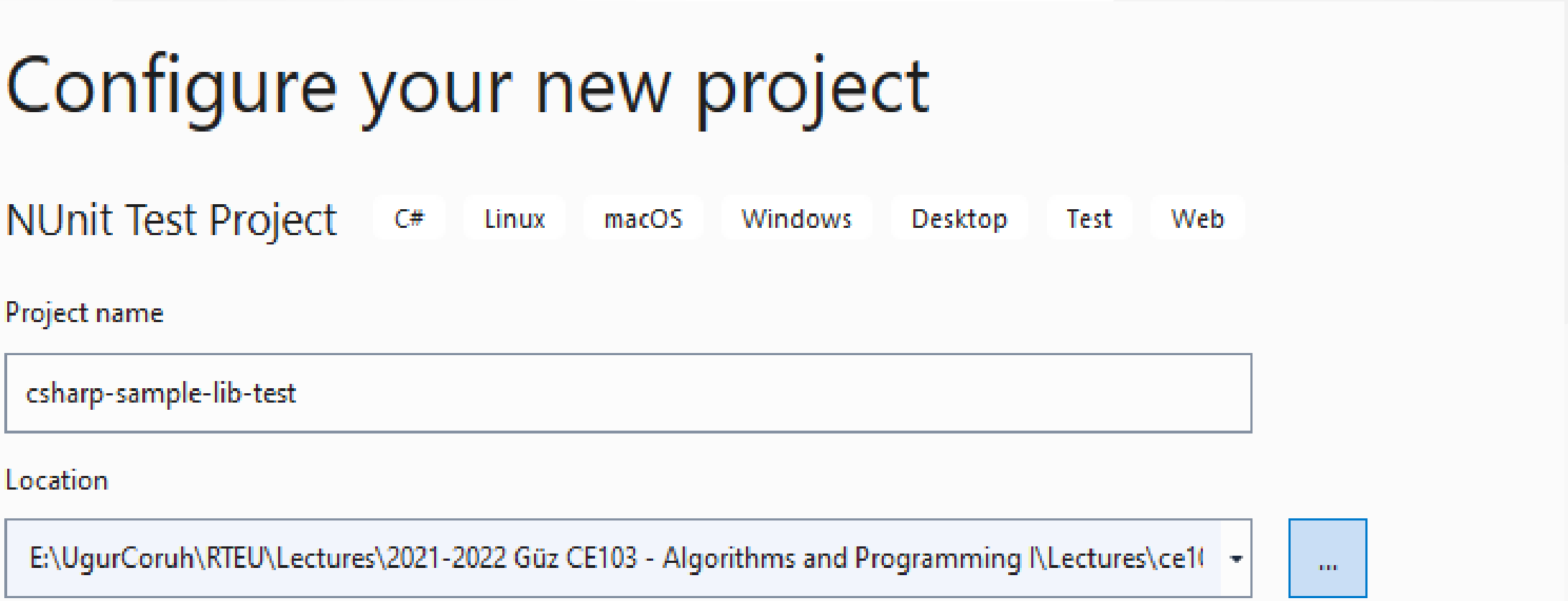
Name	Covered	Uncovered	Coverable	Total	Line coverage
– cs-lib-sample	**17**	**3**	**20**	**39**	**85%**
SampleLibClass	17	3	20	39	85%
– cs-lib-sampleTests	**14**	**2**	**16**	**51**	**87.5%**
SampleLibClassTests	14	2	16	51	87.5%

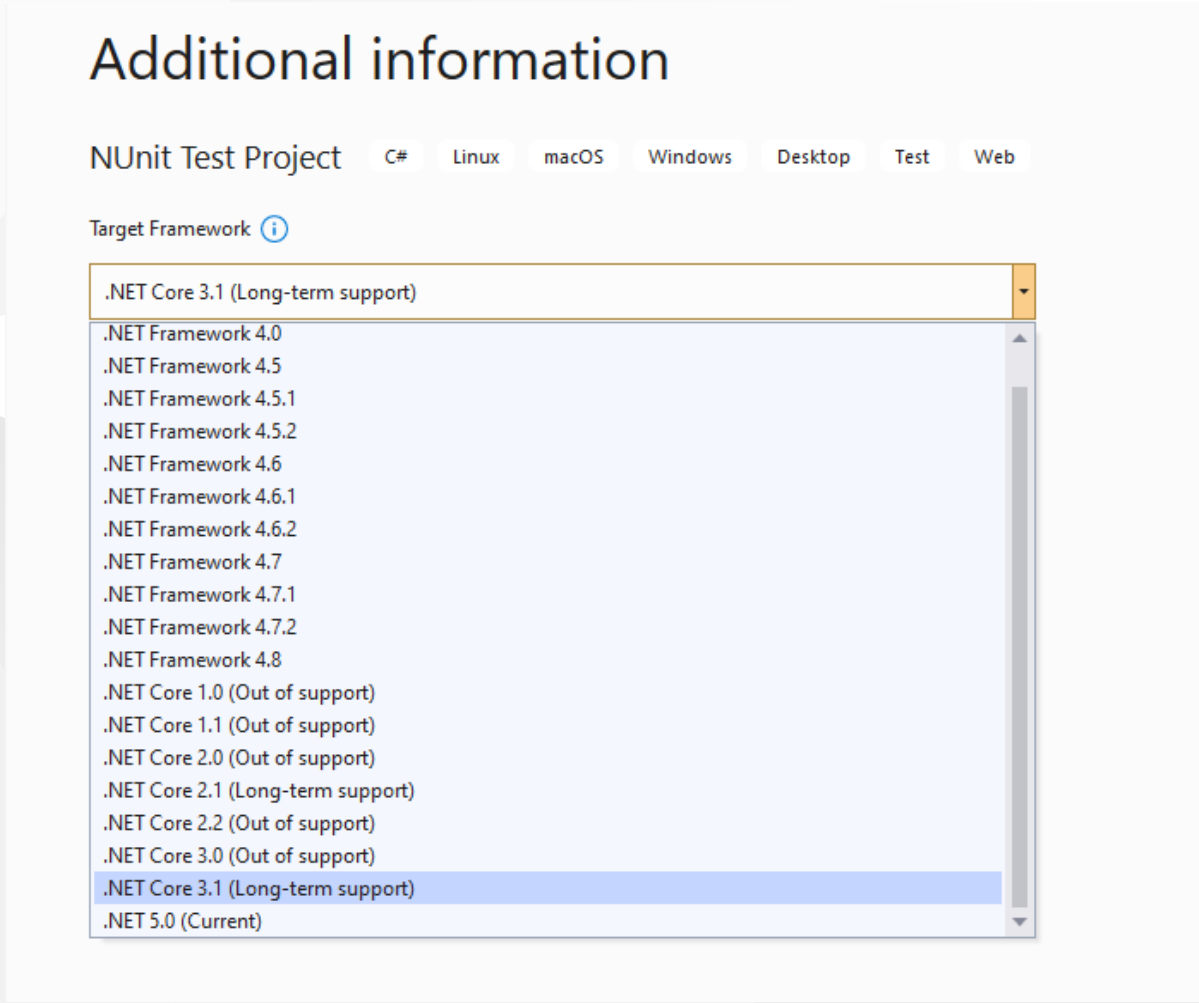
Visual Studio Community Edition (NUnit+.NETCore)

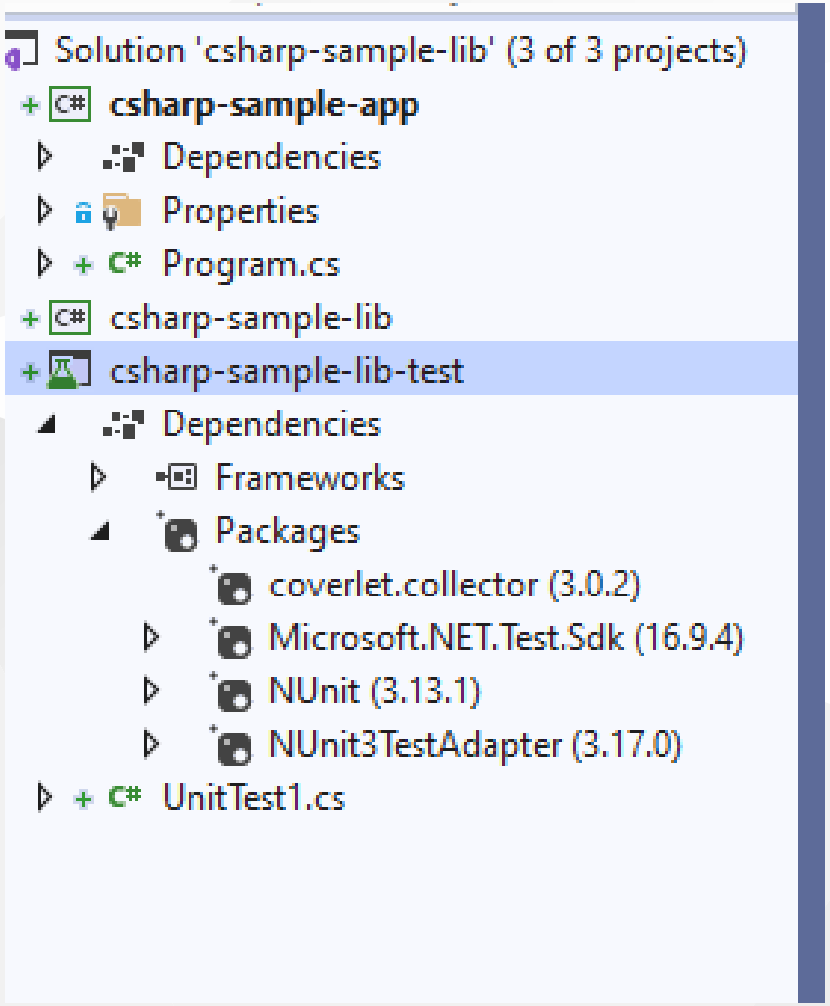
use cshar-sample-lib for this example

create and add a unit test project to solution

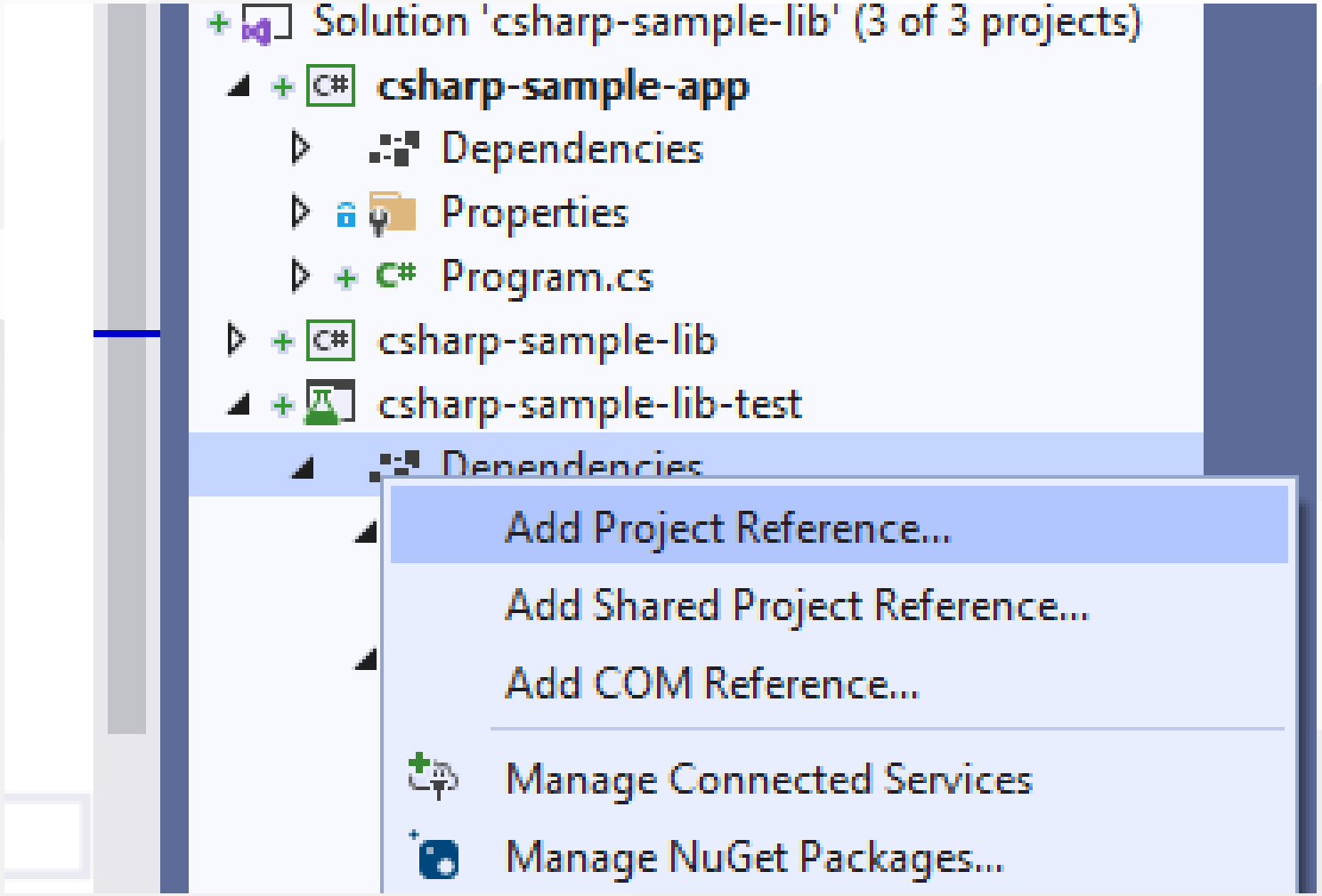


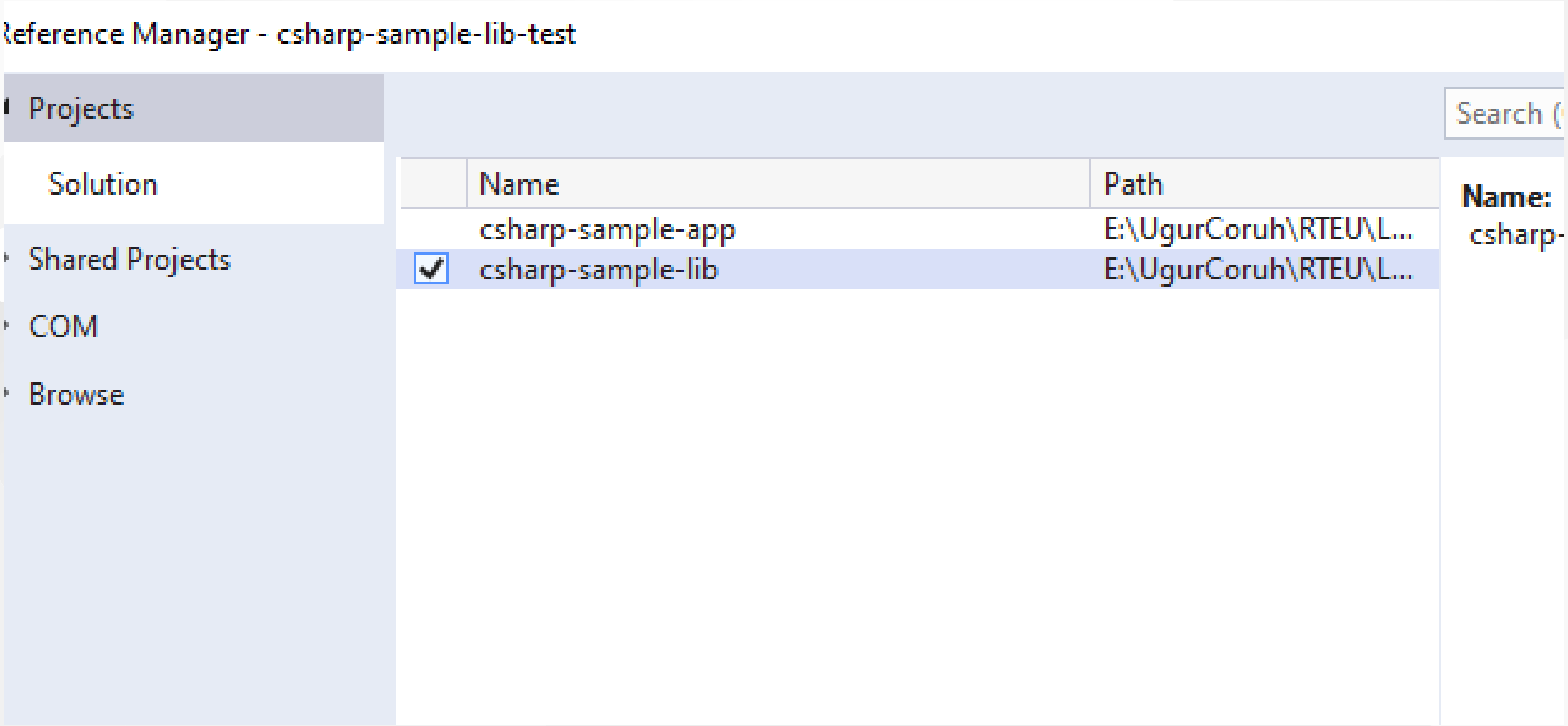

Configure your new project
NUnit Test Project
C#
Linux
macOS
Windows
Desktop
Test
Web
Project name
csharp-sample-lib-test
Location
E:\UgurCoruh\RTEU\Lectures\2021-2022 Güz CE103 - Algorithms and Programming I\Lectures\ce1(
...


Additional information
NUnit Test Project
C#
Linux
macOS
Windows
Desktop
Test
Web
Target Framework
.NET Core 3.1 (Long-term support)
.NET Framework 4.0
.NET Framework 4.5
.NET Framework 4.5.1
.NET Framework 4.5.2
.NET Framework 4.6
.NET Framework 4.6.1
.NET Framework 4.6.2
.NET Framework 4.7
.NET Framework 4.7.1
.NET Framework 4.7.2
.NET Framework 4.8
.NET Core 1.0 (Out of support)
.NET Core 1.1 (Out of support)
.NET Core 2.0 (Out of support)
.NET Core 2.1 (Long-term support)
.NET Core 2.2 (Out of support)
.NET Core 3.0 (Out of support)
.NET Core 3.1 (Long-term support)
.NET 5.0 (Current)


Solution 'csharp-sample-lib' (3 of 3 projects)
csharp-sample-app
Dependencies
Properties
Program.cs
csharp-sample-lib
csharp-sample-lib-test
Dependencies
Frameworks
Packages
coverlet.collector (3.0.2)
Microsoft.NET.Test.Sdk (16.9.4)
NUnit (3.13.1)
NUnit3TestAdapter (3.17.0)
UnitTest1.cs

Add project reference




eference Manager - csharp-sample-lib-test
Projects
Solution
Shared Projects
COM
Browse
Search (
Name
Path
csharp-sample-app
E:\UgurCoruh\RTEU\L...
csharp-sample-lib
E:\UgurCoruh\RTEU\L...
Name:
csharp-

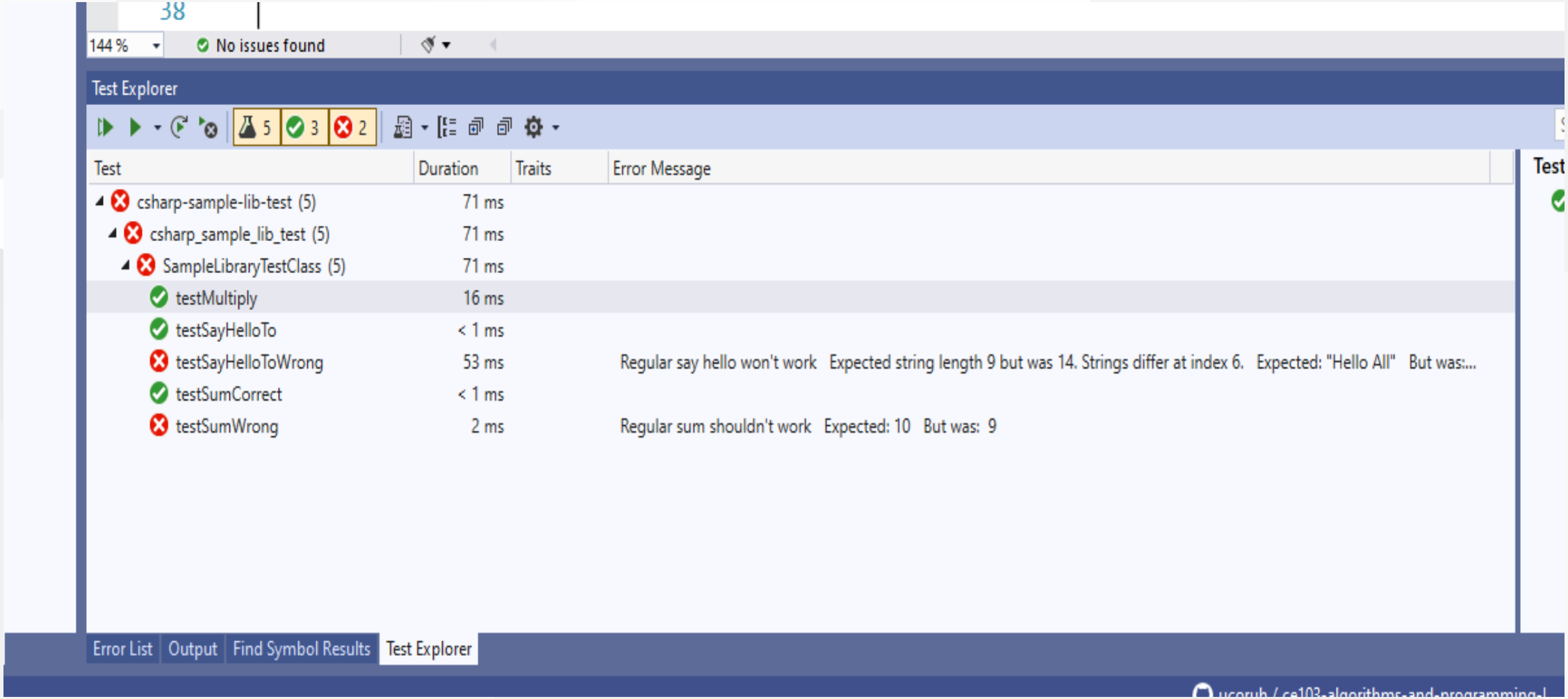
SampleLibraryTestClasss in NUnit Project

```
using csharp_sample_lib;
using NUnit.Framework;

namespace csharp_sample_lib_test
{
    public class SampleLibraryTestClass
    {
        sampleLibClass sampleLib;

        [SetUp]
        public void Setup()
        {
            sampleLib = new sampleLibClass();
        }

        [Test]
        public void testSayHelloTo()
        {
            Assert.AreEqual("Hello Computer", sampleLibClass.sayHelloTo("Computer"), "Regular say hello should work");
        }

        [Test]
        public void testSayHelloToWrong()
        {
            Assert.AreEqual("Hello All", sampleLibClass.sayHelloTo("Computer"), "Regular say hello won't work");
        }


        [Test]
        public void testSumCorrect()
        {
            Assert.AreEqual(9, sampleLibClass.sum(4, 5), "Regular sum should work");
        }

        [Test]
        public void testSumWrong()
        {
            Assert.AreEqual(10, sampleLibClass.sum(4, 5), "Regular sum shouldn't work");
        }

        [Test]
        public void testMultiply()
        {
            Assert.AreEqual(20, sampleLib.multiply(4, 5), "Regular multiplication should work");
        }
    }
}
```

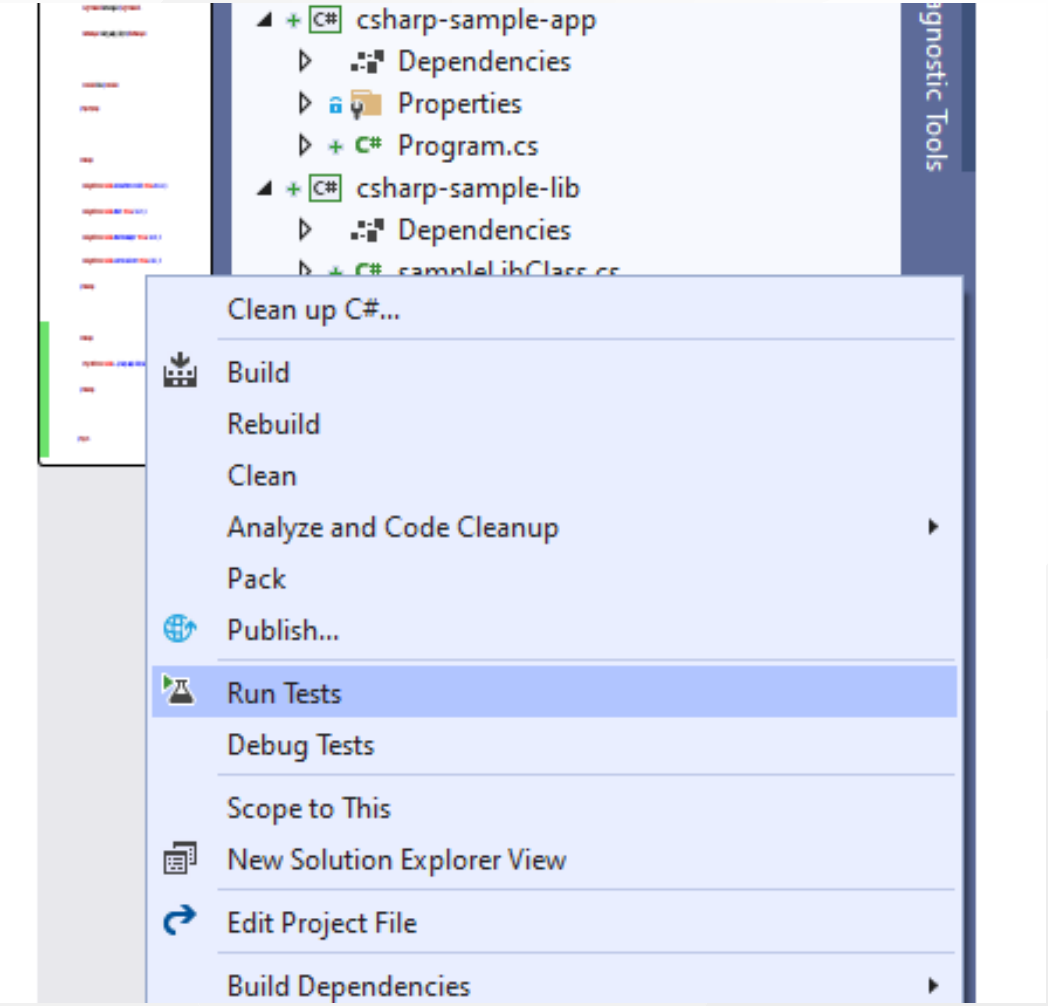
sample class library

```
using System;

namespace csharp_sample_lib
{
    public class sampleLibClass
    {
        public static string sayHelloTo(string name)
        {
            string result = String.Empty;

            if (!String.IsNullOrEmpty(name))
            {
                result = "Hello " + name;
            }
            else
            {
                result = "Hello There";
            }

            Console.WriteLine(result);

            return result;
        }

        public static int sum(int a, int b)
        {
            int c = 0;
            c = a + b;
            return c;
        }

        public int multiply(int a, int b)
        {
            return a * b;
        }
    }
}
```

Open test explorer and run tests

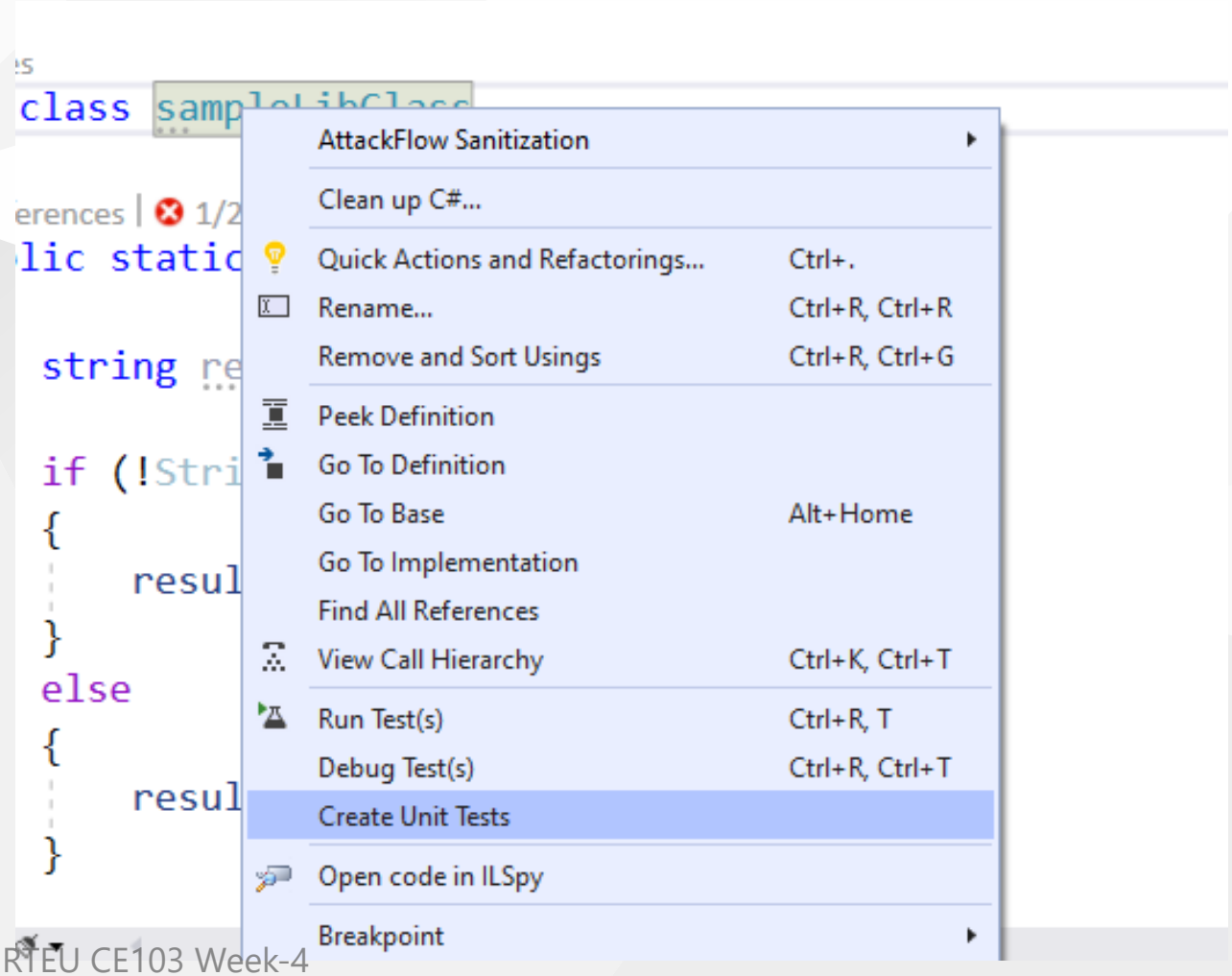


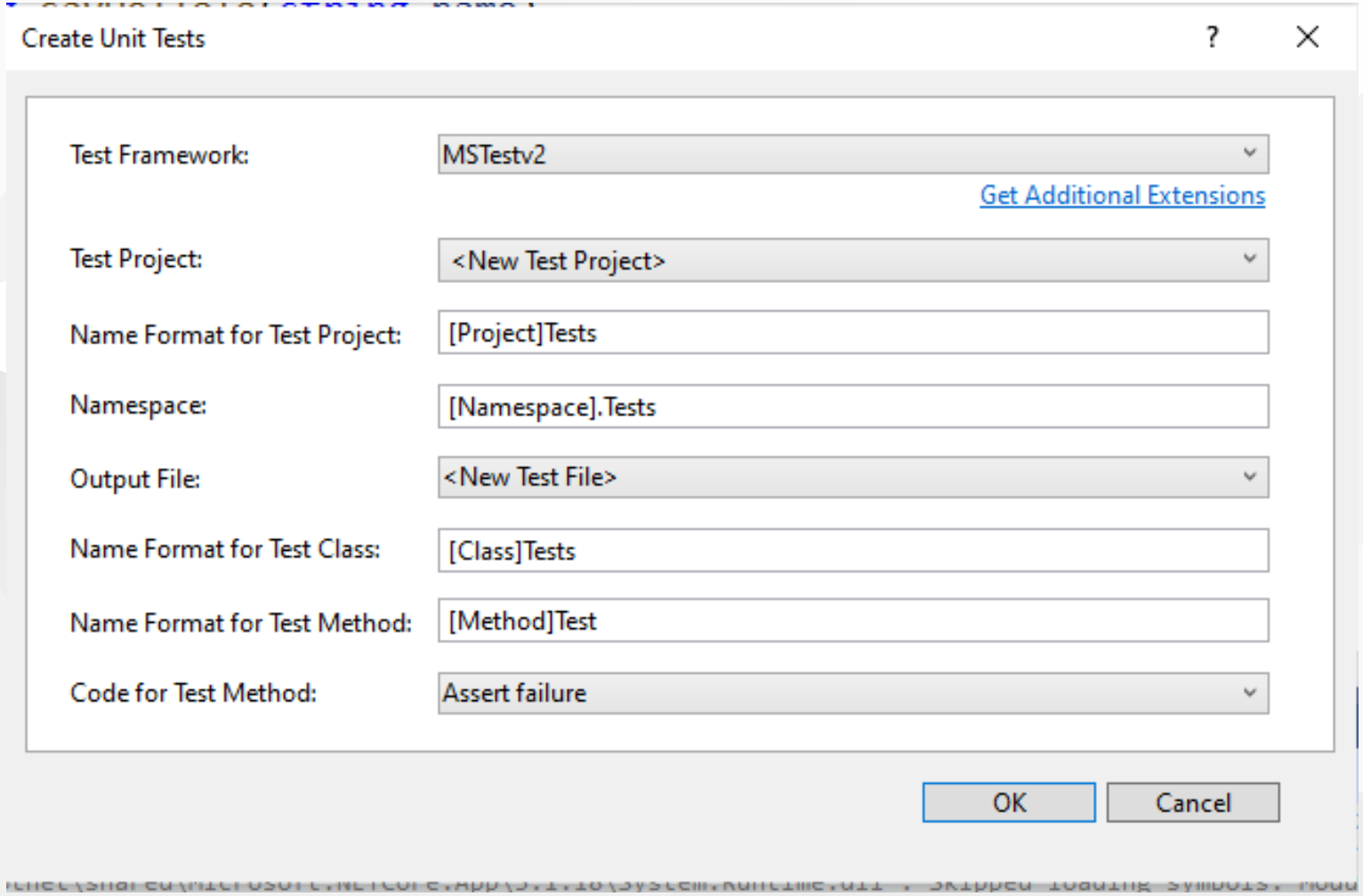
or you can run from project

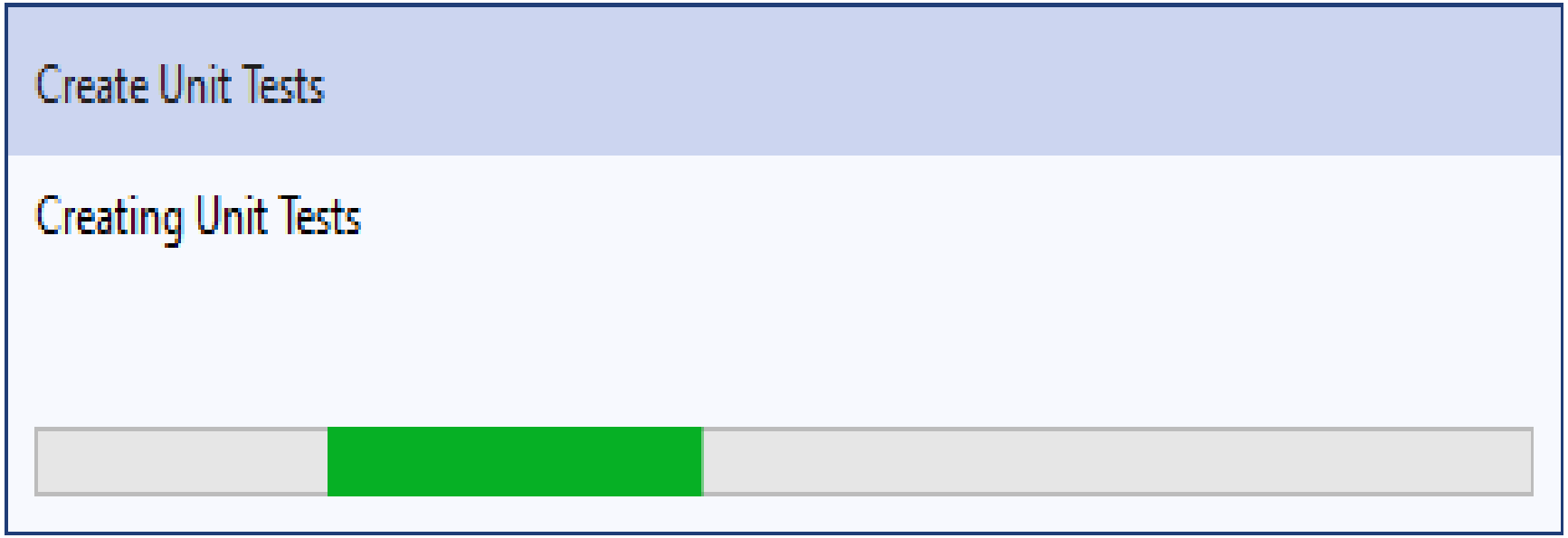


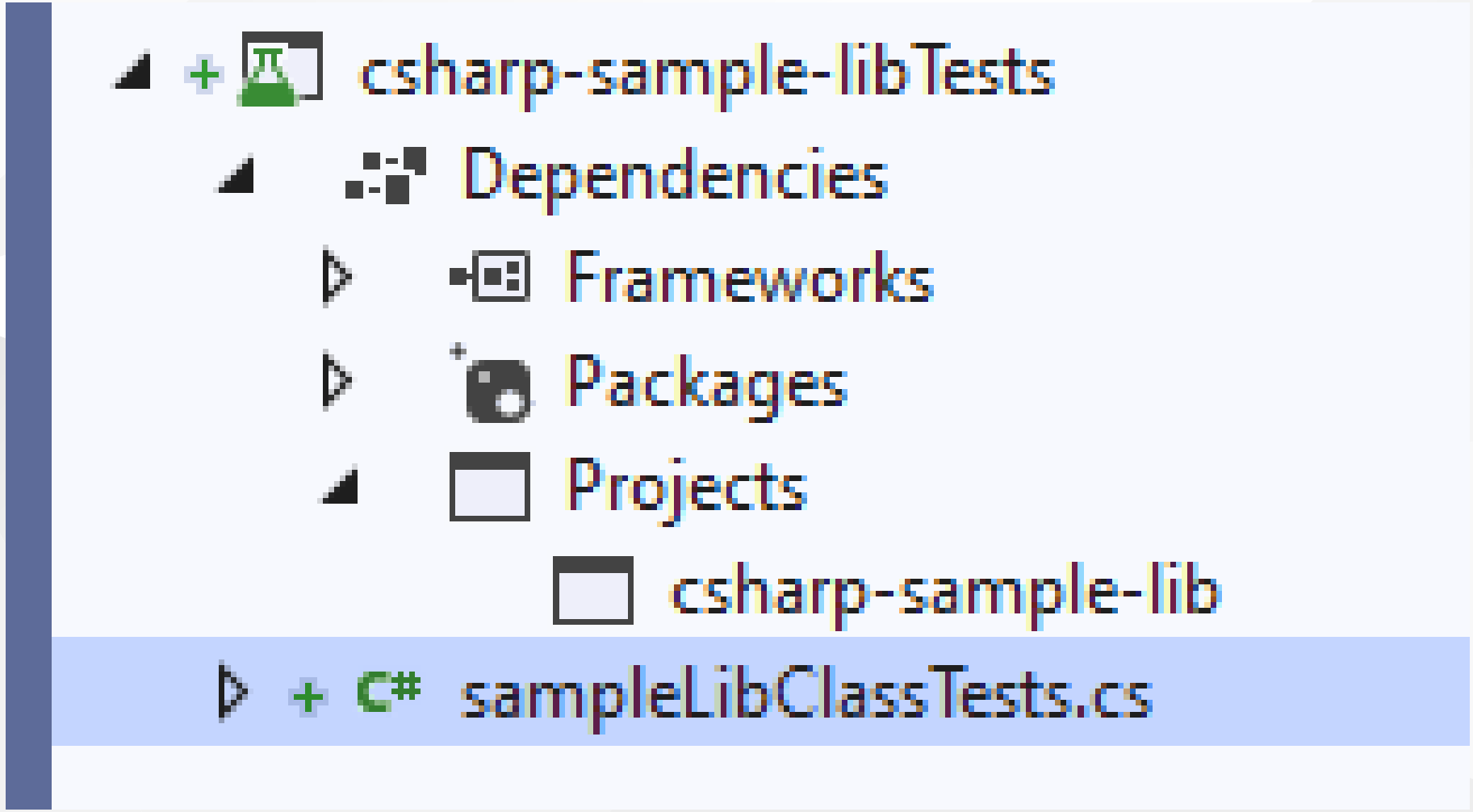
Also we can create unit test from library class,

right click the sampleLibClass and select create unit tests but this option do not provide nunit tests.




Create Unit Tests
Test Framework:
MSTestv2
Get Additional Extensions
Test Project:
<New Test Project>
Name Format for Test Project:
[Project]Tests
Namespace:
[Namespace].Tests
Output File:
<New Test File>
Name Format for Test Class:
[Class]Tests
Name Format for Test Method:
[Method]Test
Code for Test Method:
Assert failure
OK
Cancel

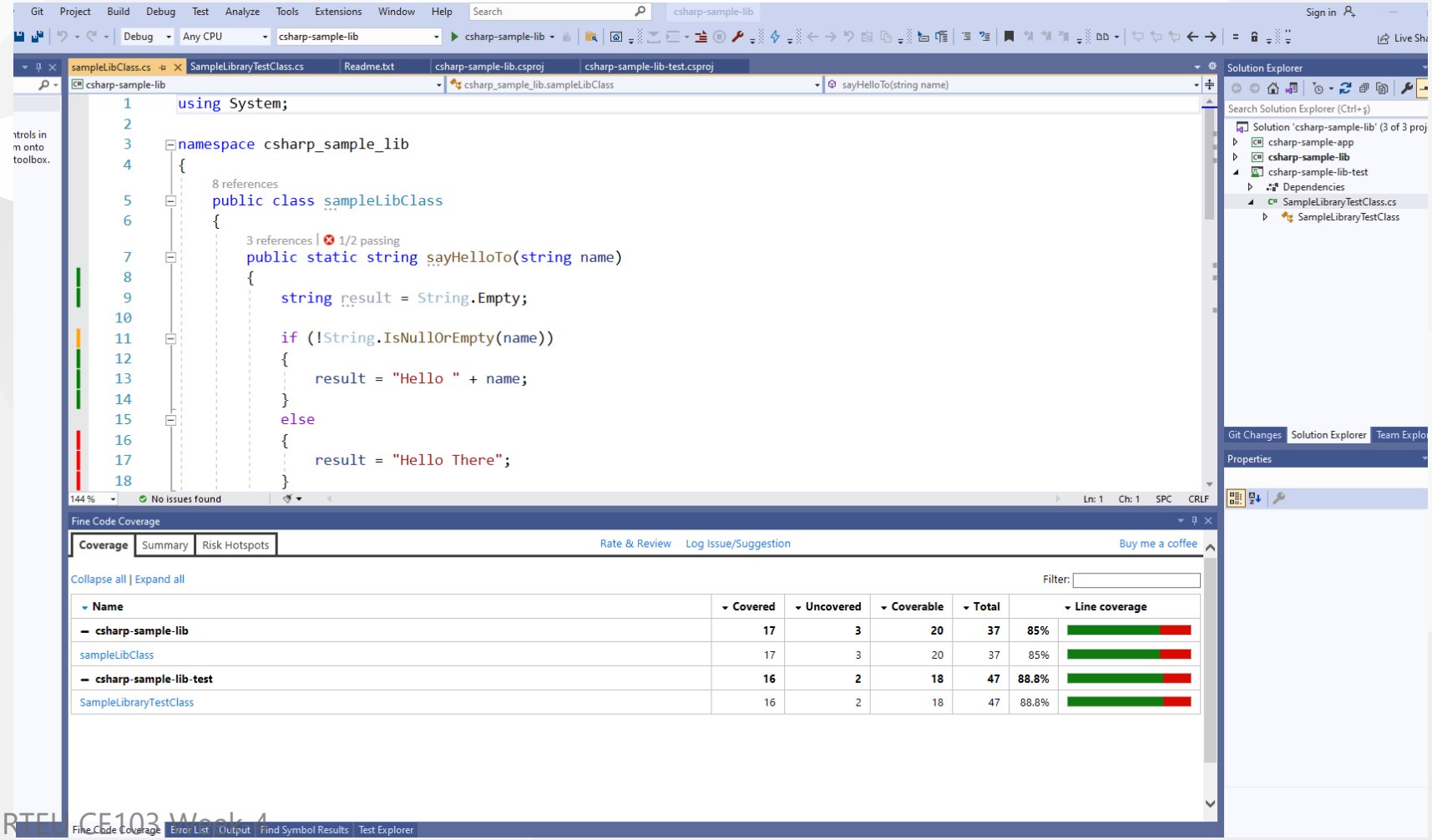

Create Unit Tests
Creating Unit Tests


csharp-sample-libTests
Dependencies
Frameworks
Packages
Projects
csharp-sample-lib
sampleLibClassTests.cs

```
using Microsoft.VisualStudio.TestTools.UnitTesting;
using csharp_sample_lib;
using System;
using System.Collections.Generic;
using System.Text;

namespace csharp_sample_lib.Tests
{
    [TestClass()]
    public class sampleLibClassTests
    {
        [TestMethod()]
        public void sayHelloToTest()
        {
            Assert.Fail();
        }

        [TestMethod()]
        public void sumTest()
        {
            Assert.Fail();
        }

        [TestMethod()]
        public void multiplyTest()
        {
            Assert.Fail();
        }
    }
}
```

we will not commit this changes and continue from nunit test project, the fine code coverage also work for nunit test but not provide inline highlighting

if we run tests we will have the following outputs



Inline code highlight is part of enterprise visual studio edition

Analyzing code coverage in Visual Studio - DEV Community

TL;DR

Additional information you can use OpenCover + Nunit Runner + Report Generator together to setup a code coverage report but it has complex batch running process. After a few try I decided to use fine code coverage but here is the usage not tested well.

First unit test runner tool doesn't support .Net Core

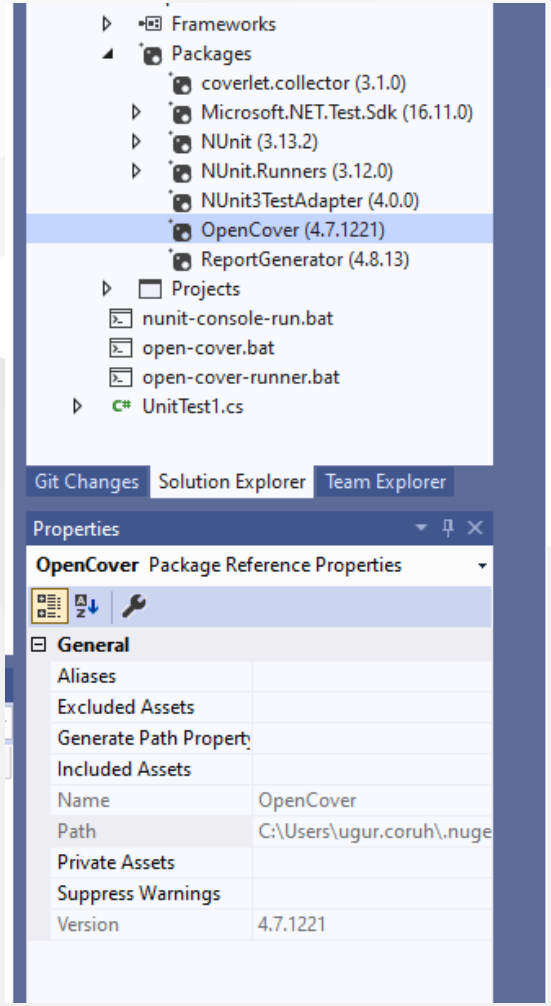
c# - The NUnit 3 driver encountered an error while executing reflected code (NUnit.Engine.NUnitEngineException) - Stack Overflow

Follow the instructions on the link

CMD OpenCover · sukhoi1/Useful-Notes Wiki · GitHub

Install OpenCover, ReportGenerator, Nunit,Runners packages then use the package installation folder to get tools that you need

Here is a sample for open cover, select package and copy path



Goto path and tools

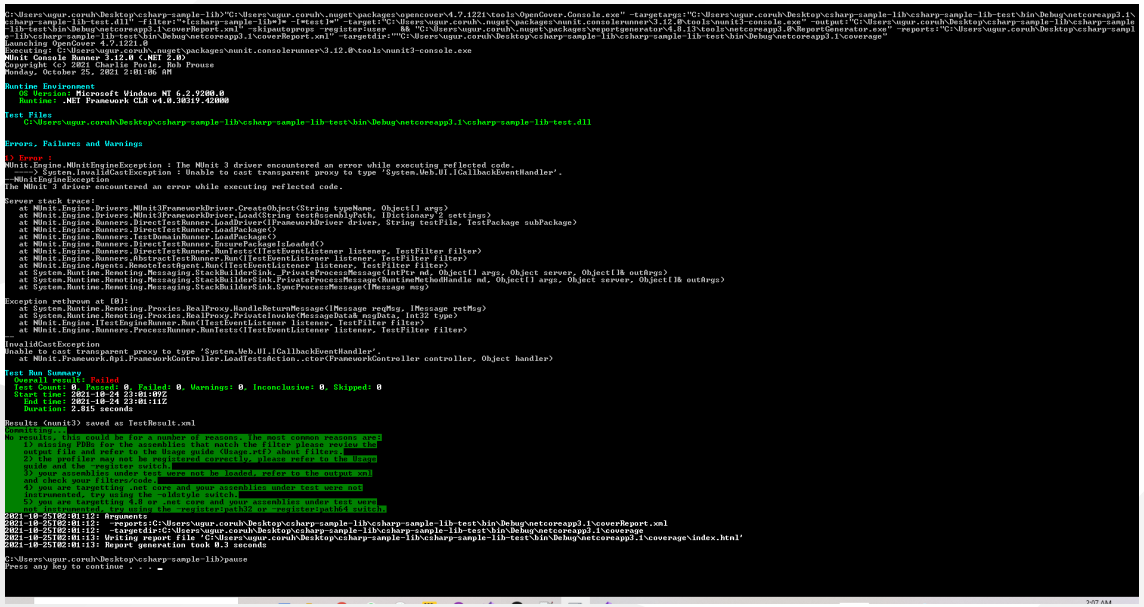
```
C:\Users\ugur.coruh\.nuget\packages\opencover\4.7.1221
```

You need to setup some batch similar with following

run-test-coverage.bat

```
set pathA=C:\Users\ugur.coruh\.nuget\packages\opencover\4.7.1221\tools
set pathB=C:\Users\ugur.coruh\.nuget\packages\nunit.consolerunner\3.12.0\tools
set pathC=C:\Users\ugur.coruh\.nuget\packages\reportgenerator\4.8.13\tools\netcoreapp3.0
set dllpath=C:\Users\ugur.coruh\Desktop\csharp-sample-lib\csharp-sample-lib-test\bin\Debug\netcoreapp3.1

"%pathA%\OpenCover.Console.exe" ^
-targetargs:"%dllpath%\csharp-sample-lib-test.dll" ^
-filter:"+[csharp-sample-lib*]* -[*test]*" ^
-target:"%pathB%\nunit3-console.exe" ^
-output:"%dllpath%\coverReport.xml" ^
-skipautoprops -register:user && "%pathC%\ReportGenerator.exe" -reports:"%dllpath%\coverReport.xml" -targetdir:""%dllpath%\coverage"
pause
```

but nunit3-console.exe gives error



```
   at NUnit.Engine.Runners.ProcessRunner.RunTests(ITestEventListener listener, TestFilter filter)
--
InvalidCastException
Unable to cast transparent proxy to type 'System.Web.UI.ICallbackEventHandler'.
   at NUnit.Framework.Api.FrameworkController.LoadTestsAction..ctor(FrameworkController controller, Object handler)

Test Run Summary
  Overall result: Failed
  Test Count: 0, Passed: 0, Failed: 0, Warnings: 0, Inconclusive: 0, Skipped: 0
  Start time: 2021-10-24 23:01:09Z
```

for this compatibility issues I prefer to use fine code coverage extension.

OpenCover related studies

Code coverage of manual or automated tests with OpenCover for .NET applications – Automation Rhapsody

Code coverage of .NET Core unit tests with OpenCover – Automation Rhapsody

Sample OpenCover report

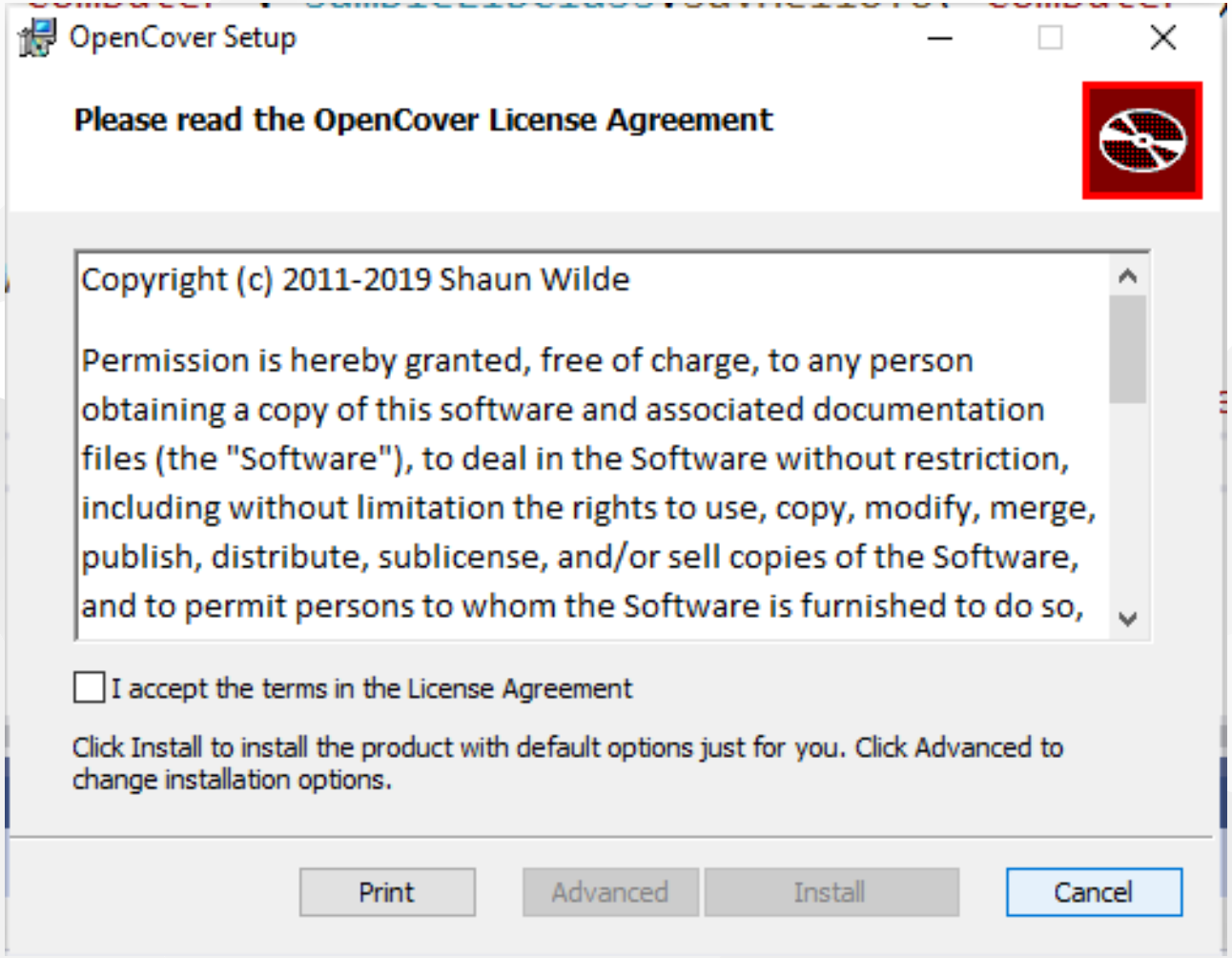
Summary - Coverage Report

Download and Setup OpenCover, NUnit Console, Report Generator without Package Manager

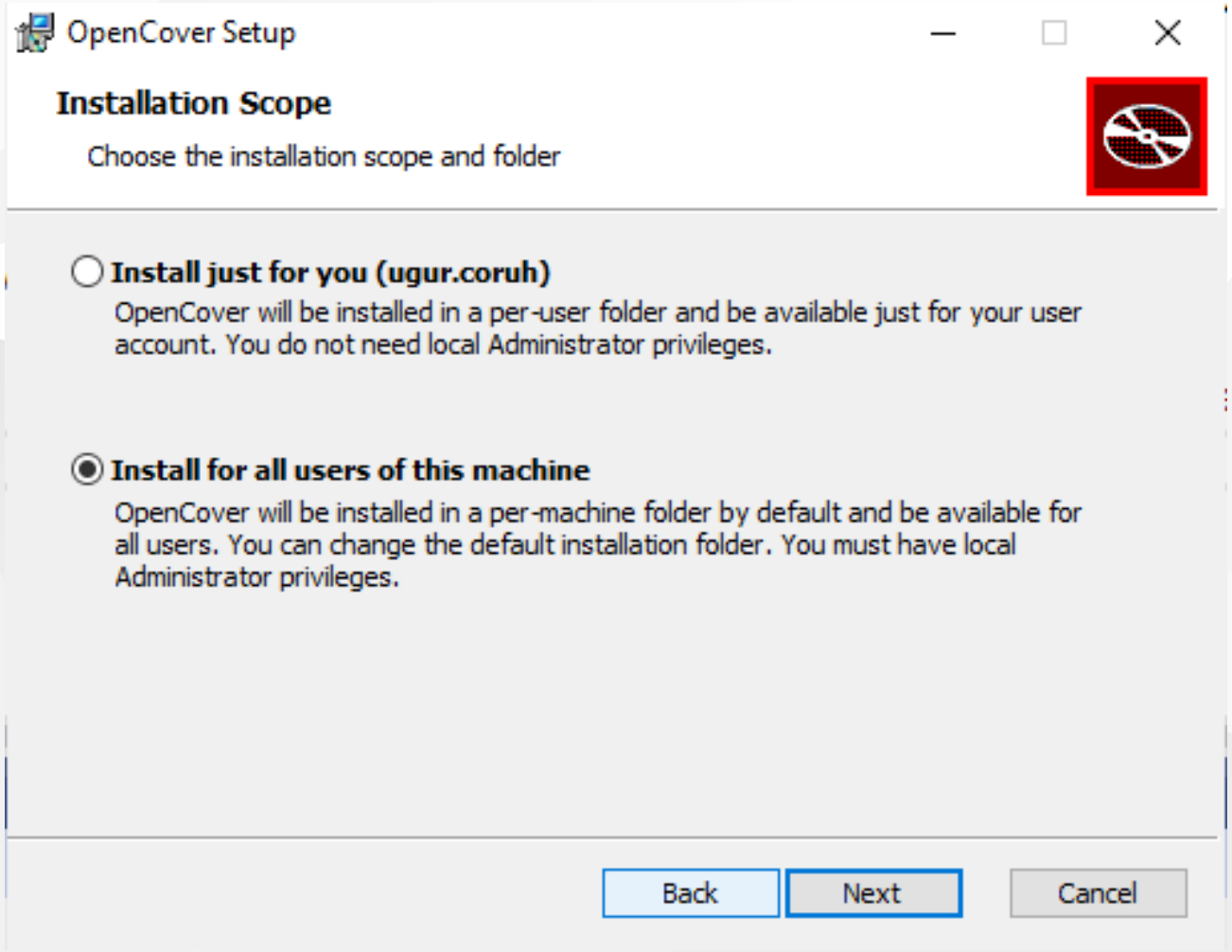
You can also download the tools from github project pages and install on your operating system,

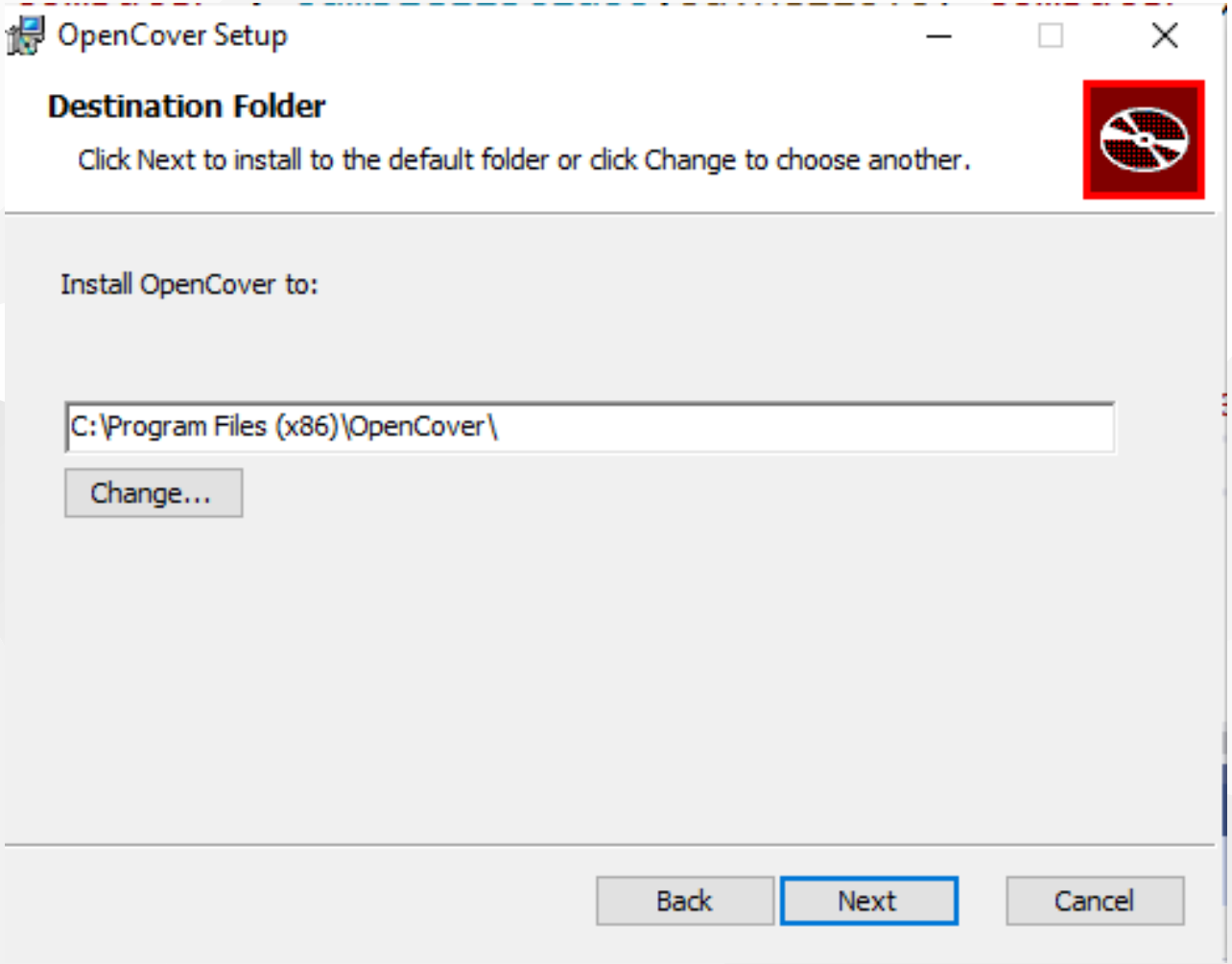
OpenCover

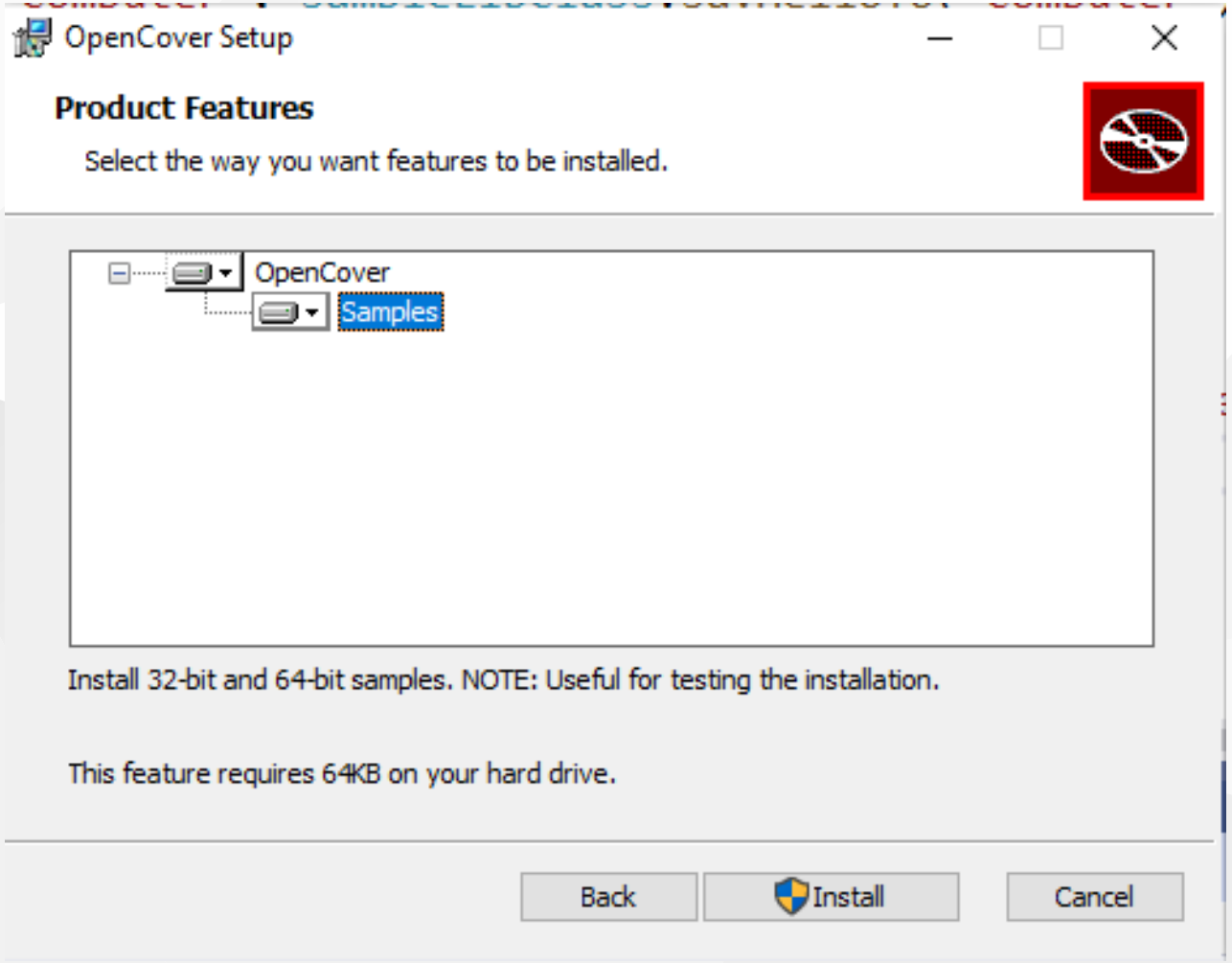
Releases · OpenCover/opencover · GitHub

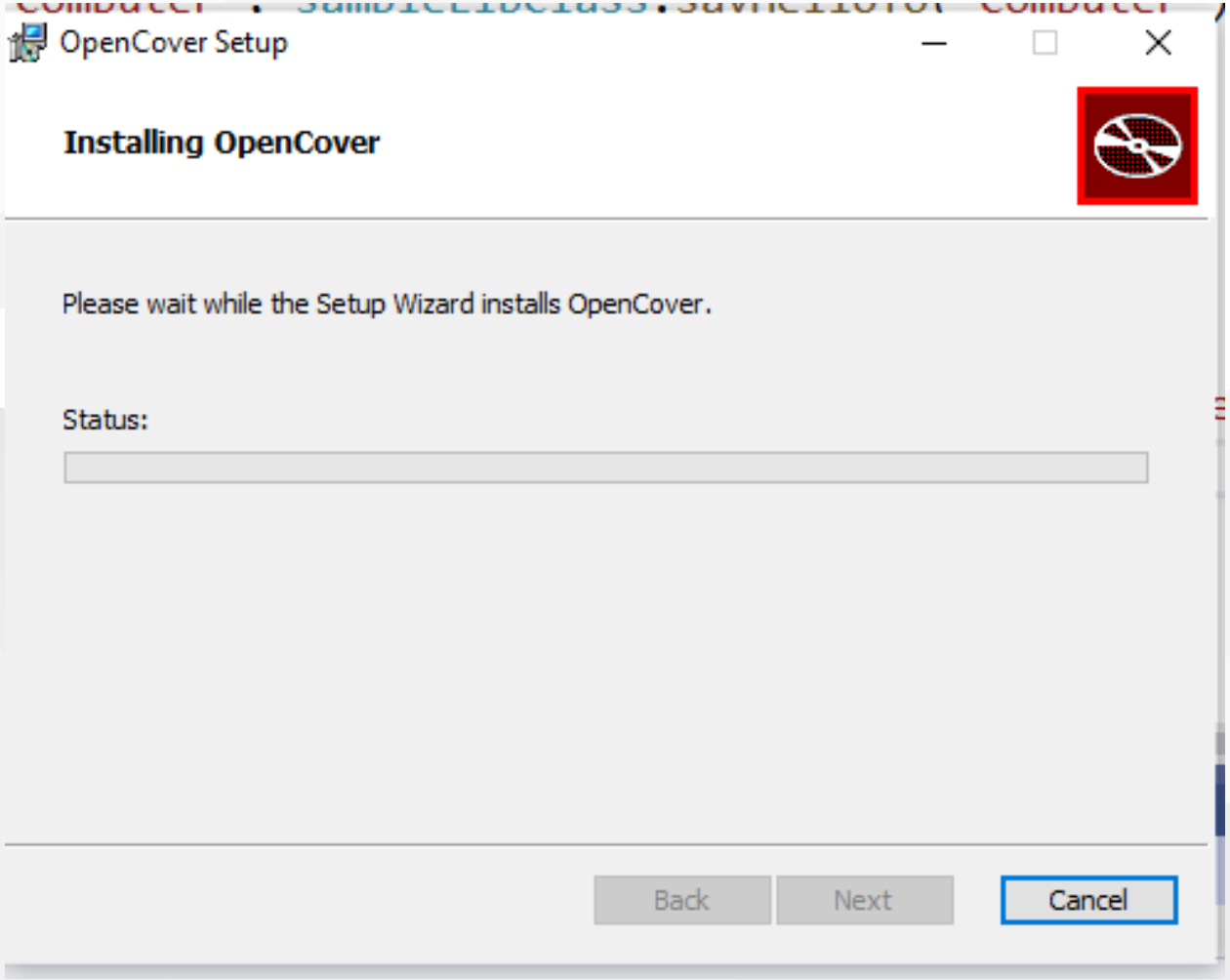

OpenCover Setup
Please read the OpenCover License Agreement
Copyright (c) 2011-2019 Shaun Wilde
Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so,
I accept the terms in the License Agreement
Click Install to install the product with default options just for you. Click Advanced to change installation options.
Print
Advanced
Install
Cancel

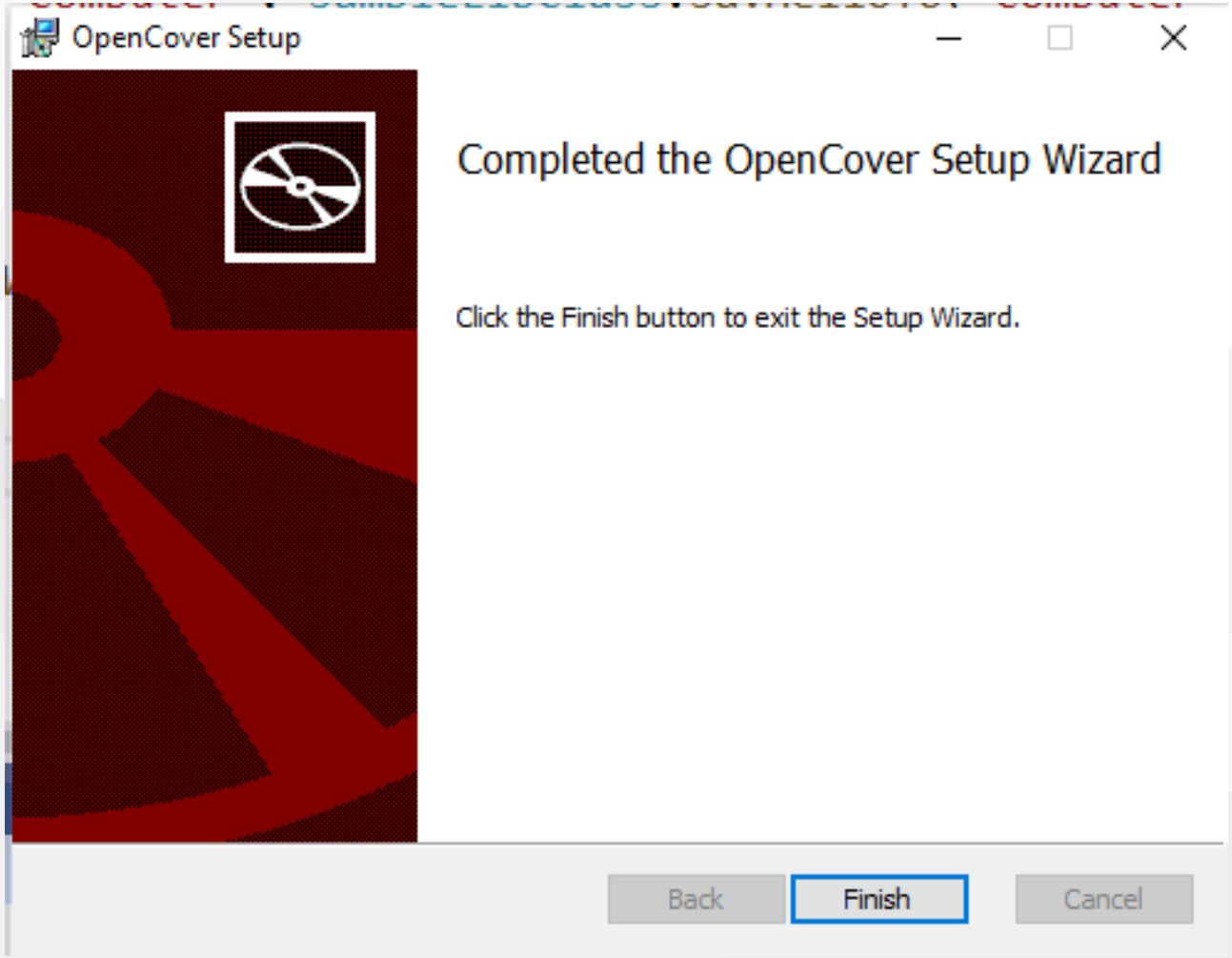
Select advanced and then install for all users

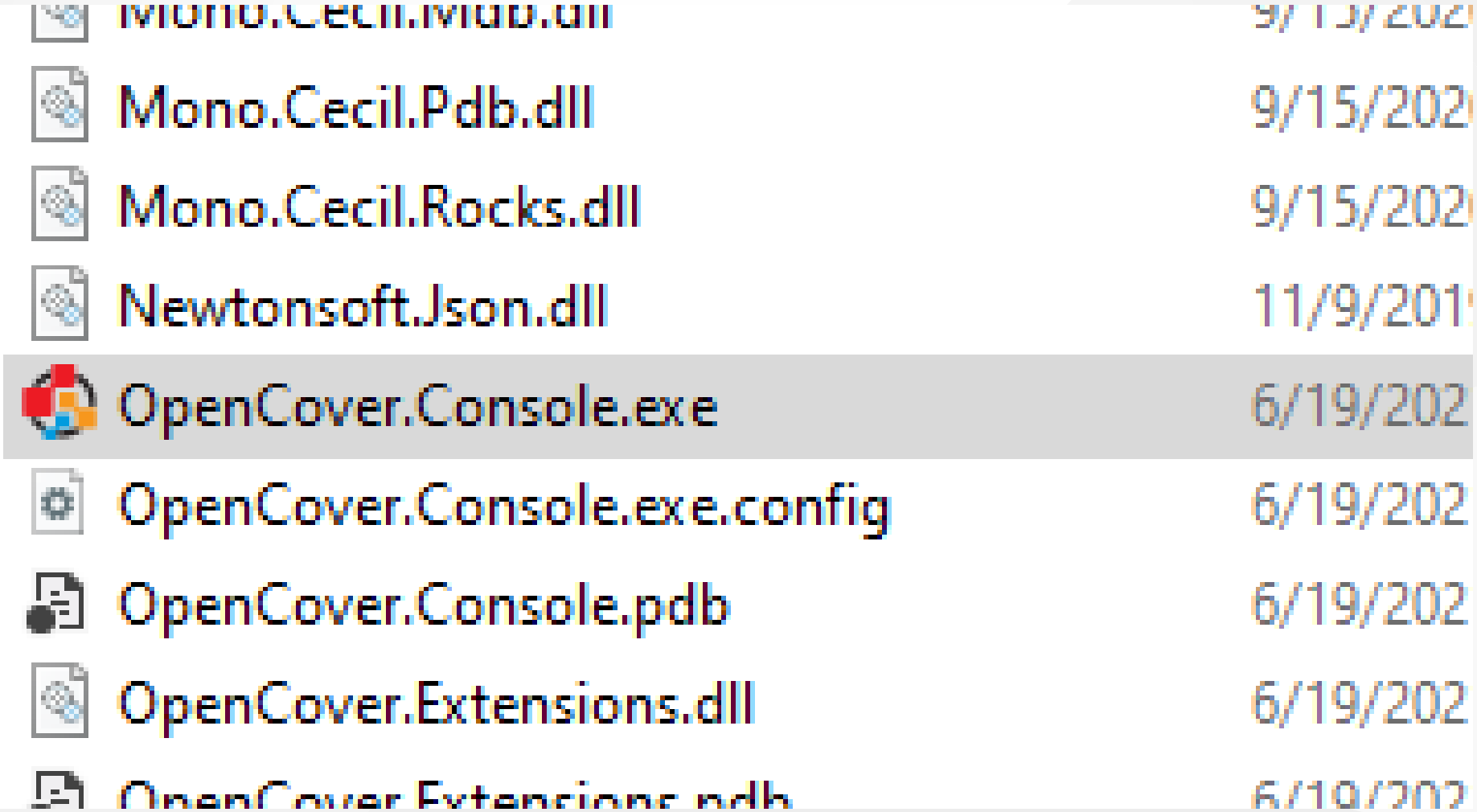


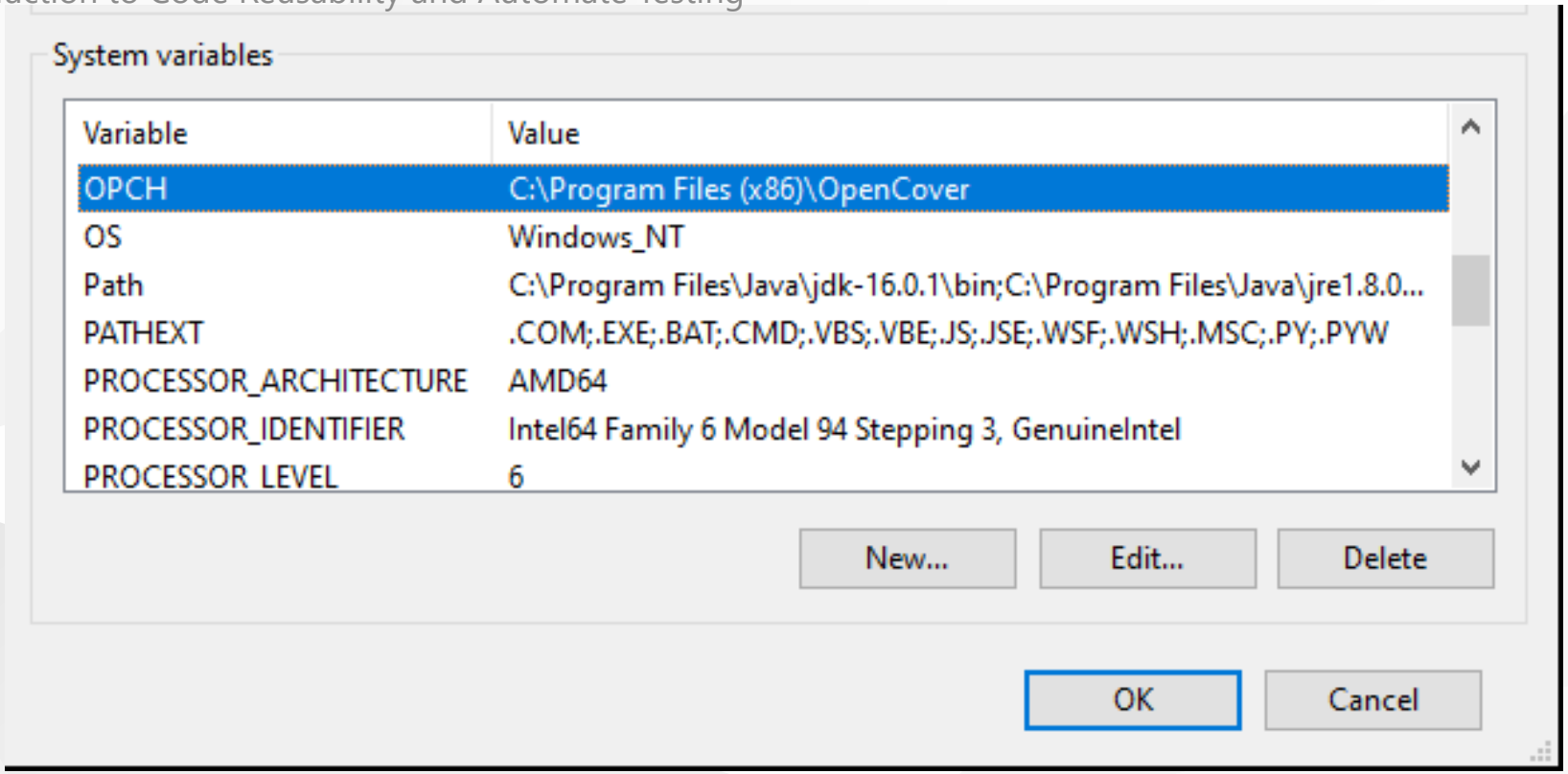

OpenCover Setup
Destination Folder
Click Next to install to the default folder or click Change to choose another.
Install OpenCover to:
C:\Program Files (x86)\OpenCover\
Change...
Back
Next
Cancel

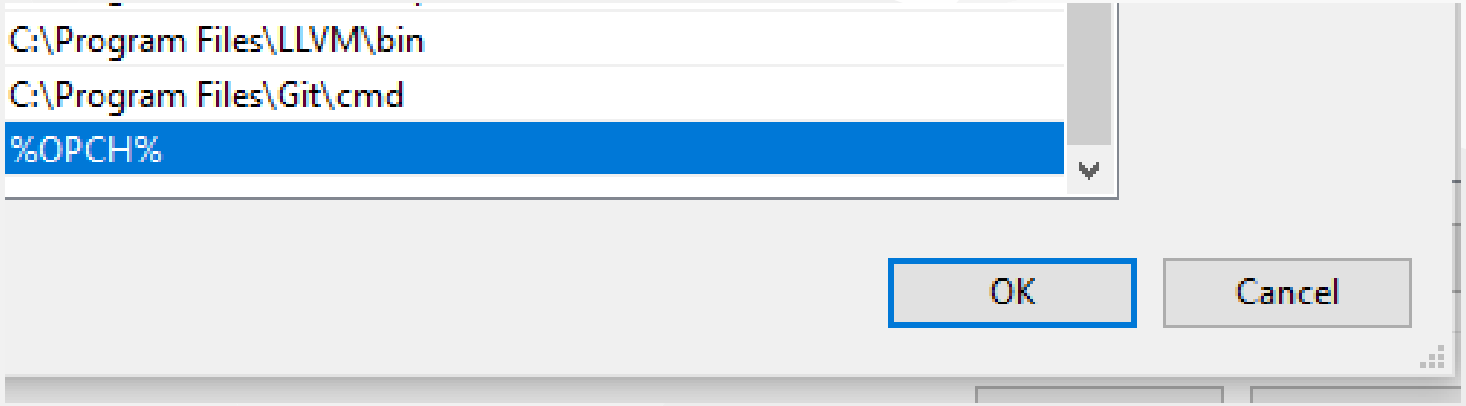

OpenCover Setup
Product Features
Select the way you want features to be installed.
OpenCover
Samples
Install 32-bit and 64-bit samples. NOTE: Useful for testing the installation.
This feature requires 64KB on your hard drive.
Back
Install
Cancel

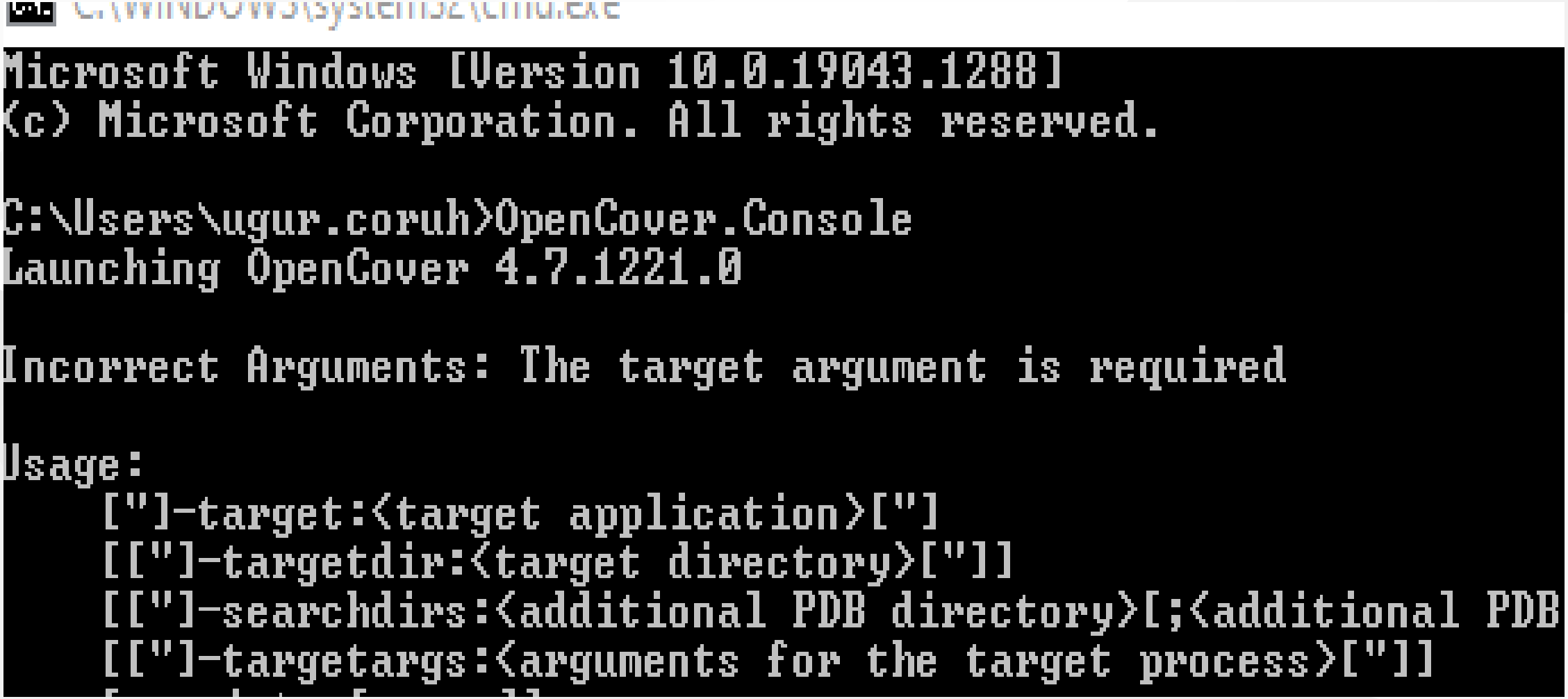

OpenCover Setup
Installing OpenCover
Please wait while the Setup Wizard installs OpenCover.
Status:
Back
Next
Cancel


OpenCover Setup
Completed the OpenCover Setup Wizard
Click the Finish button to exit the Setup Wizard.
Back
Finish
Cancel


Mono.Cecil.Pdb.dll
9/15/202
Mono.Cecil.Rocks.dll
9/15/202
Newtonsoft.Json.dll
11/9/201
OpenCover.Console.exe
6/19/202
OpenCover.Console.exe.config
6/19/202
OpenCover.Console.pdb
6/19/202
OpenCover.Extensions.dll
6/19/202

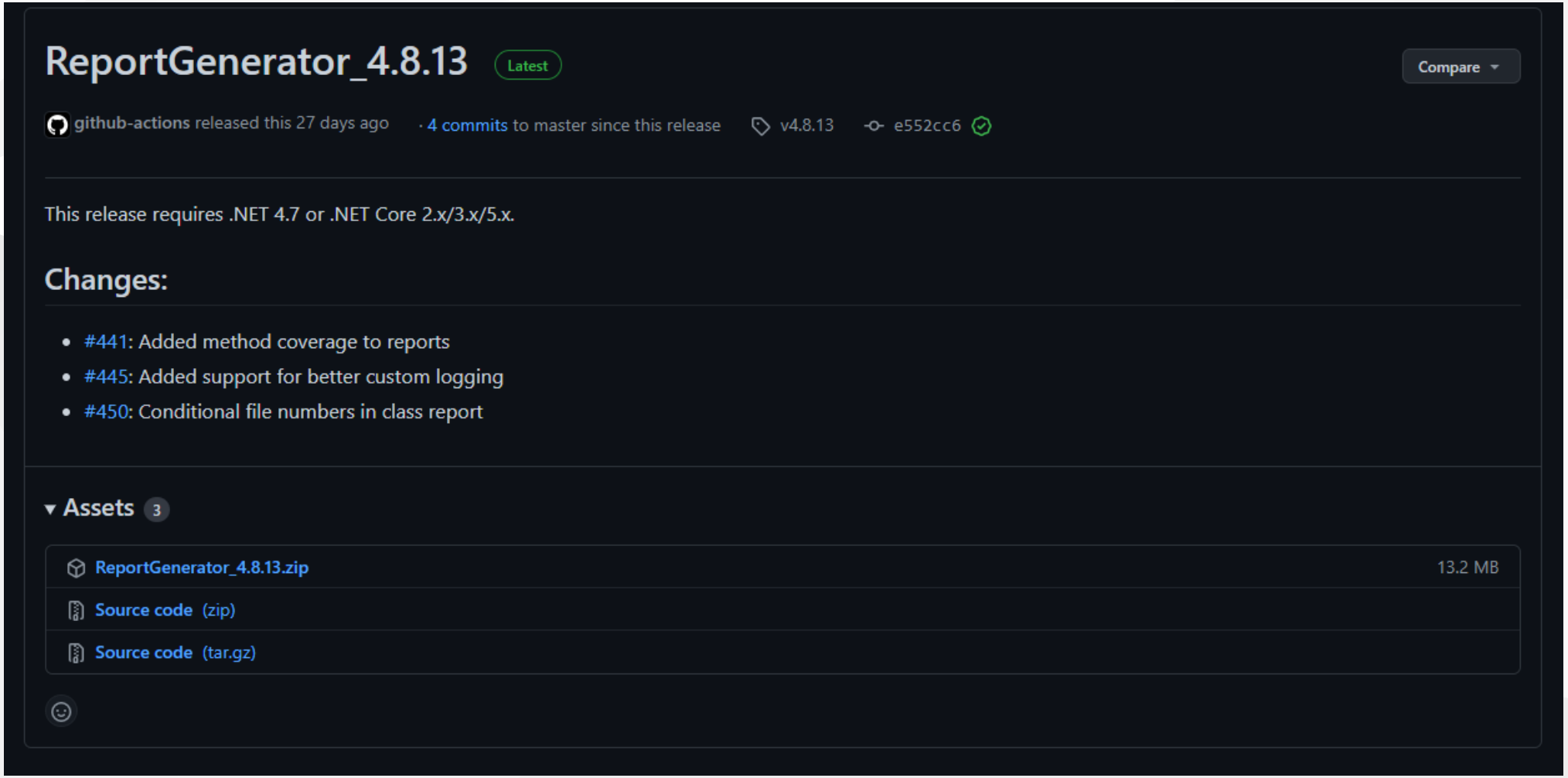

System variables
Variable
Value
OPCH
C:\Program Files (x86)\OpenCover
OS
Windows_NT
Path
C:\Program Files\Java\jdk-16.0.1\bin;C:\Program Files\Java\jre1.8.0...
PATHEXT
.COM;.EXE;.BAT;.CMD;.VBS;.VBE;.JS;.JSE;.WSF;.WSH;.MSC;.PY;.PYW
PROCESSOR_ARCHITECTURE
AMD64
PROCESSOR_IDENTIFIER
Intel64 Family 6 Model 94 Stepping 3, GenuineIntel
PROCESSOR_LEVEL
6
New...
Edit...
Delete
OK
Cancel

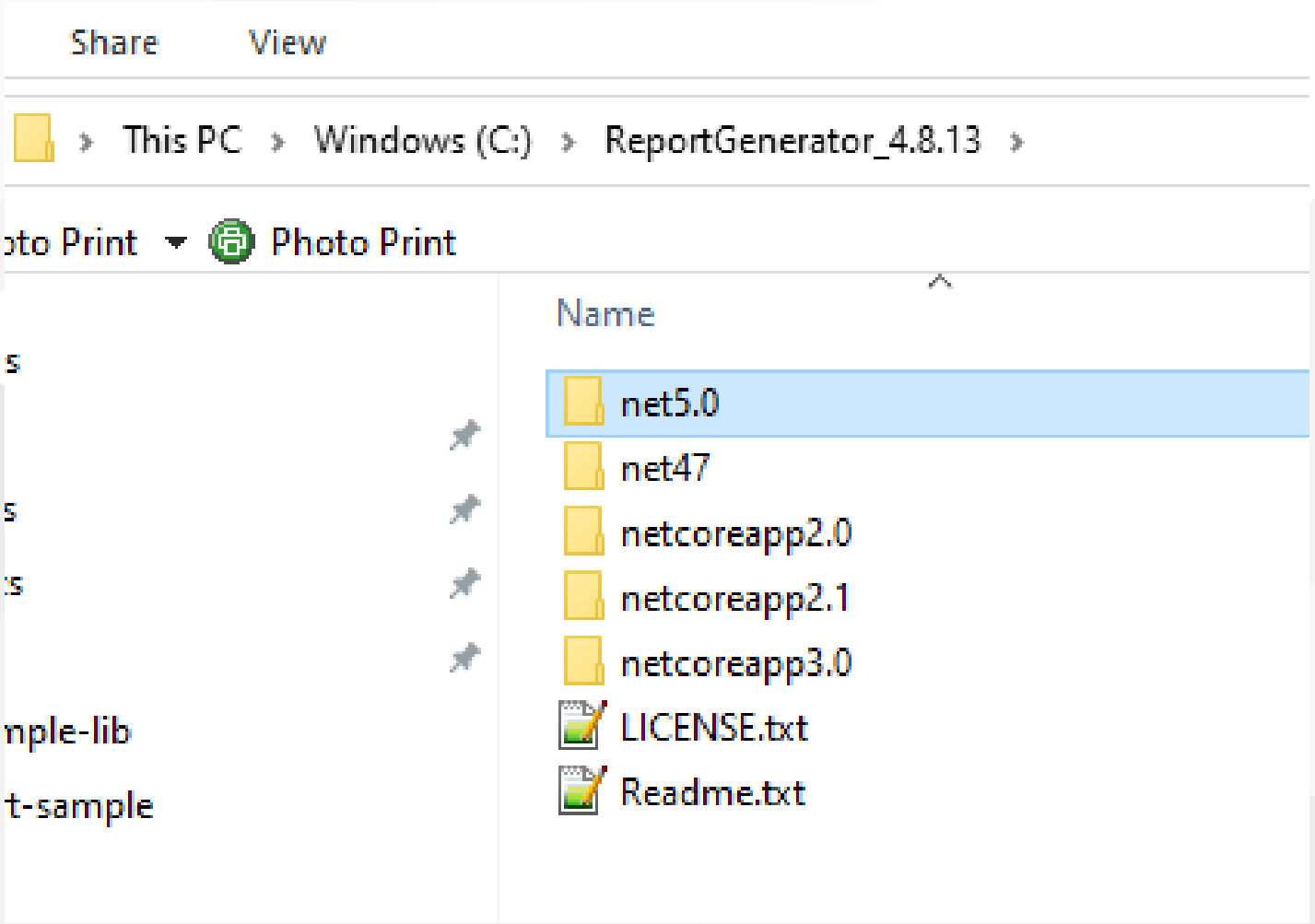

C:\Program Files\LLVM\bin
C:\Program Files\Git\cmd
%OPCH%
OK
Cancel


Microsoft Windows [Version 10.0.19043.1288]
(c) Microsoft Corporation. All rights reserved.
C:\Users\ugur.coruh>OpenCover.Console
Launching OpenCover 4.7.1221.0
Incorrect Arguments: The target argument is required
Usage:
["]-target:<target application>["]
[["]-targetdir:<target directory>["]]
[["]-searchdirs:<additional PDB directory>[;<additional PDB
[["]-targetargs:<arguments for the target process>["]]

ReportGenerator

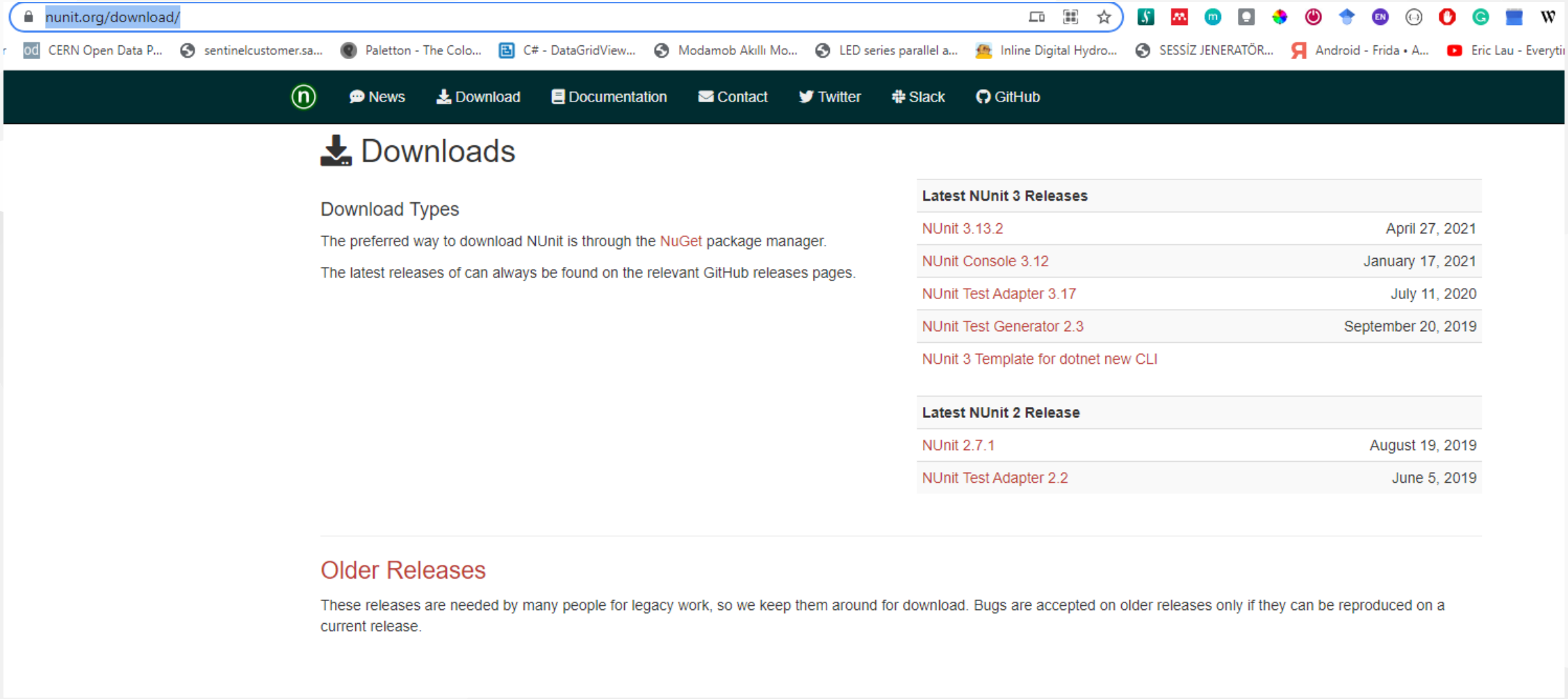
Release ReportGenerator_4.8.13 · danielpalme/ReportGenerator · GitHub



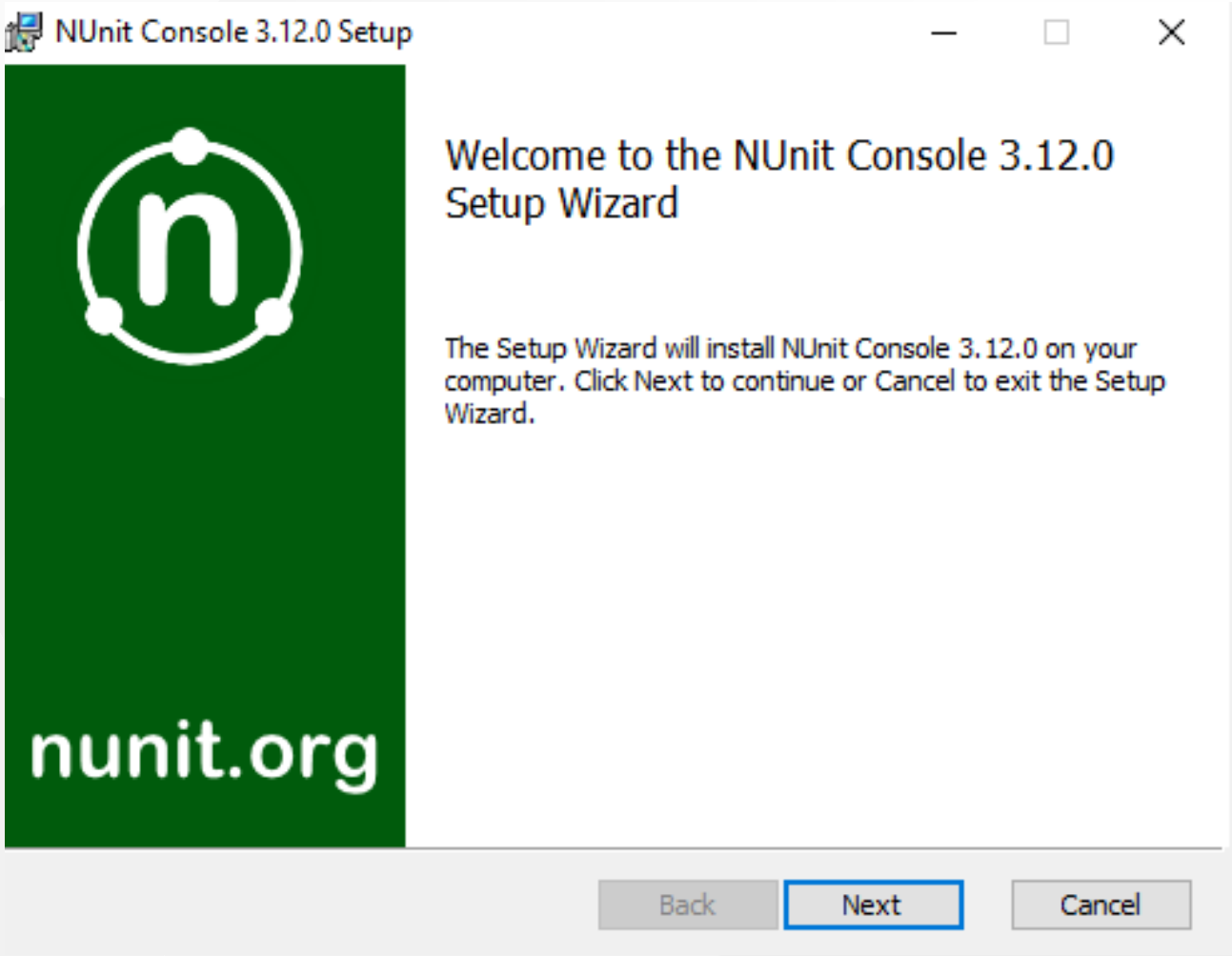

Share
View
This PC
Windows (C:)
ReportGenerator_4.8.13
oto Print
Photo Print
Name
net5.0
net47
netcoreapp2.0
netcoreapp2.1
netcoreapp3.0
LICENSE.txt
Readme.txt
nple-lib
t-sample

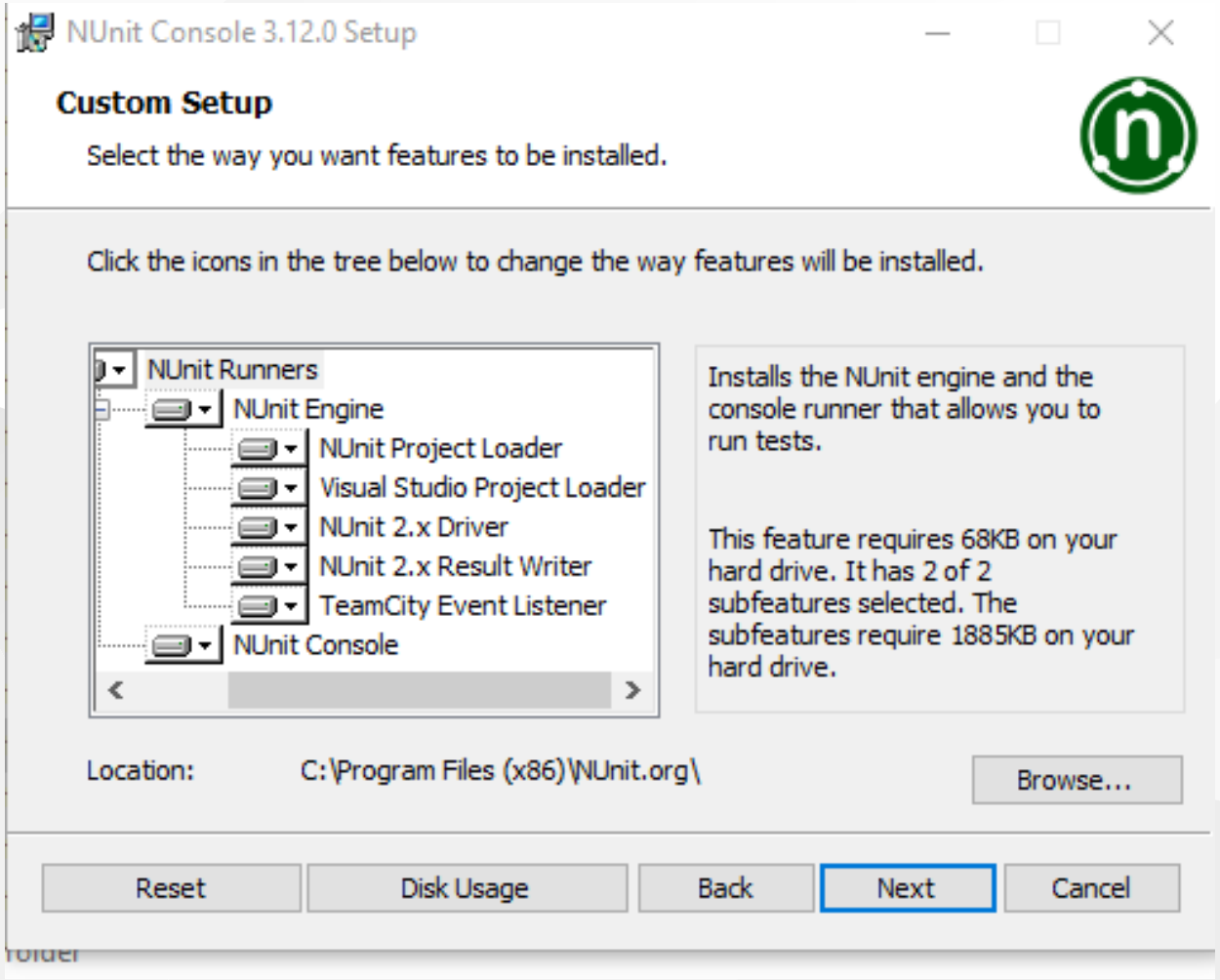
NUnit Console

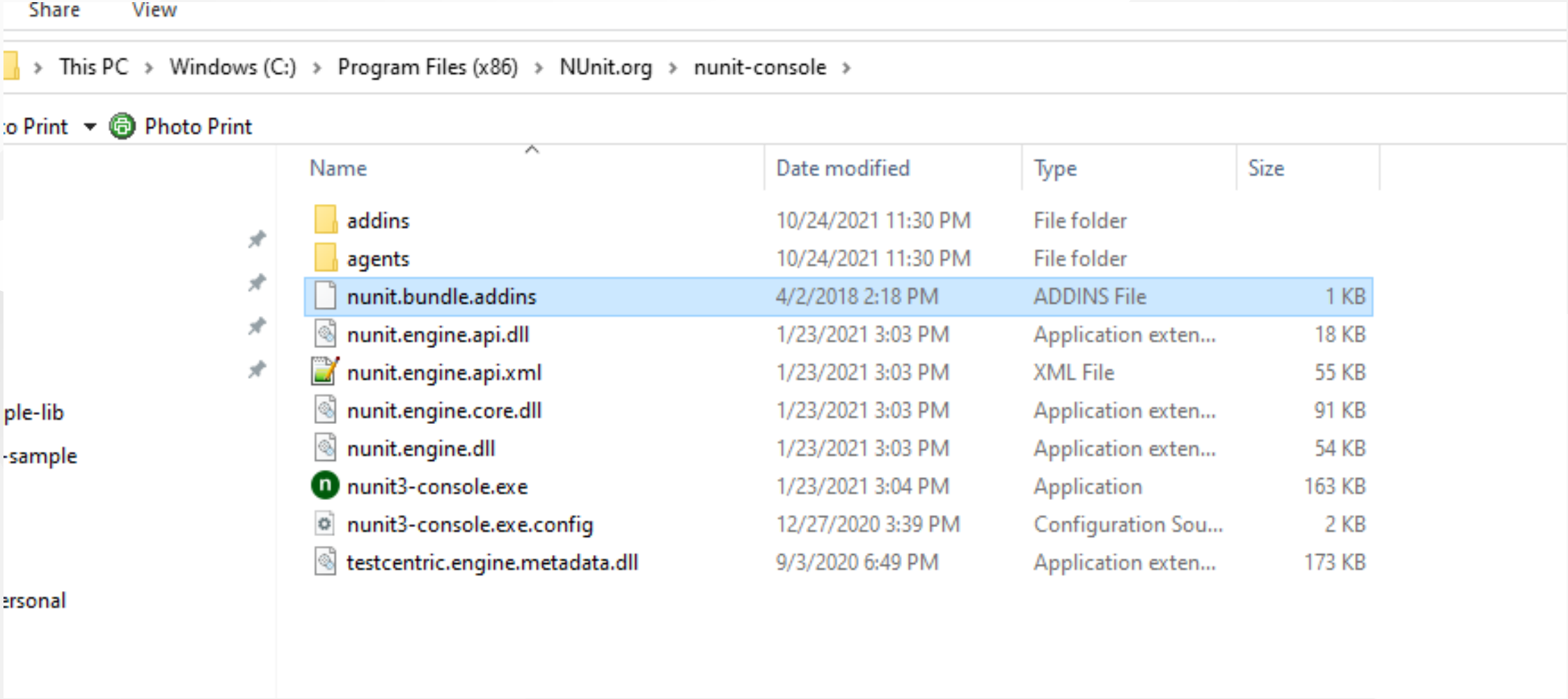
Downloads




Assets 10
nunit-console-runner.3.12.0.nupkg 733 KB
NUnit.Console-3.12.0.msi 1.04 MB
NUnit.Console-3.12.0.zip 14.4 MB
NUnit.Console.3.12.0.nupkg 19.2 KB
NUnit.ConsoleRunner.3.12.0.nupkg 746 KB
NUnit.Engine.3.12.0.nupkg 1 MB
NUnit.Engine.Api.3.12.0.nupkg 42.8 KB
NUnit.Runners.3.12.0.nupkg 19.3 KB
Source code (zip)
Source code (tar.gz)


NUnit Console 3.12.0 Setup
Welcome to the NUnit Console 3.12.0 Setup Wizard
The Setup Wizard will install NUnit Console 3.12.0 on your computer. Click Next to continue or Cancel to exit the Setup Wizard.
nunit.org
Back
Next
Cancel


NUnit Console 3.12.0 Setup
Custom Setup
Select the way you want features to be installed.
Click the icons in the tree below to change the way features will be installed.
NUnit Runners
NUnit Engine
NUnit Project Loader
Visual Studio Project Loader
NUnit 2.x Driver
NUnit 2.x Result Writer
TeamCity Event Listener
NUnit Console
Installs the NUnit engine and the console runner that allows you to run tests.
This feature requires 68KB on your hard drive. It has 2 of 2 subfeatures selected. The subfeatures require 1885KB on your hard drive.
Location:
C:\Program Files (x86)\NUnit.org\
Browse...
Reset
Disk Usage
Back
Next
Cancel


Share
View
This PC
Windows (C:)
Program Files (x86)
NUnit.org
nunit-console
o Print
Photo Print
Name
Date modified
Type
Size
addins
10/24/2021 11:30 PM
File folder
agents
10/24/2021 11:30 PM
File folder
nunit.bundle.addins
4/2/2018 2:18 PM
ADDINS File
1 KB
nunit.engine.api.dll
1/23/2021 3:03 PM
Application exten...
18 KB
nunit.engine.api.xml
1/23/2021 3:03 PM
XML File
55 KB
nunit.engine.core.dll
1/23/2021 3:03 PM
Application exten...
91 KB
nunit.engine.dll
1/23/2021 3:03 PM
Application exten...
54 KB
nunit3-console.exe
1/23/2021 3:04 PM
Application
163 KB
nunit3-console.exe.config
12/27/2020 3:39 PM
Configuration Sou...
2 KB
testcentric.engine.metadata.dll
9/3/2020 6:49 PM
Application exten...
173 KB
ple-lib
-sample
ersonal

NUnit + MSTest Batch Report Generation (Not Tested)

OpenCover and ReportGenerator Unit Test Coverage in Visual Studio 2013 and 2015 – CodeHelper.Net

OpenCover and ReportGenerator Unit Test Coverage in Visual Studio 2013 and 2015 - CodeProject

Java Unit Tests

Eclipse IDE (JUnit4 , JUnit5)

In this sample we will create two example for similar library

Please check the following links

JUnit 5 tutorial - Learn how to write unit tests

JUnit 5

JUnit 5 User Guide

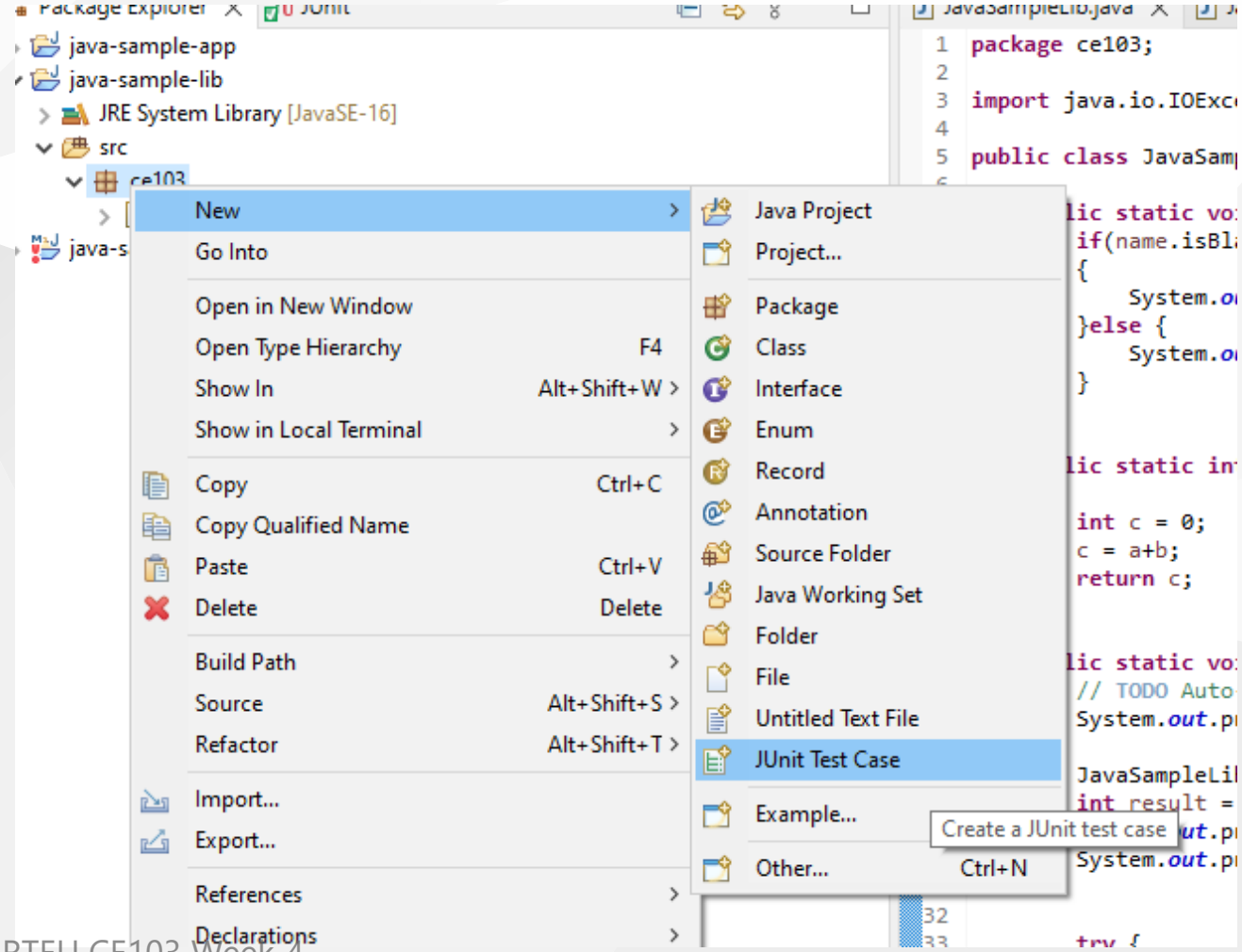
https://www.eclemma.org/

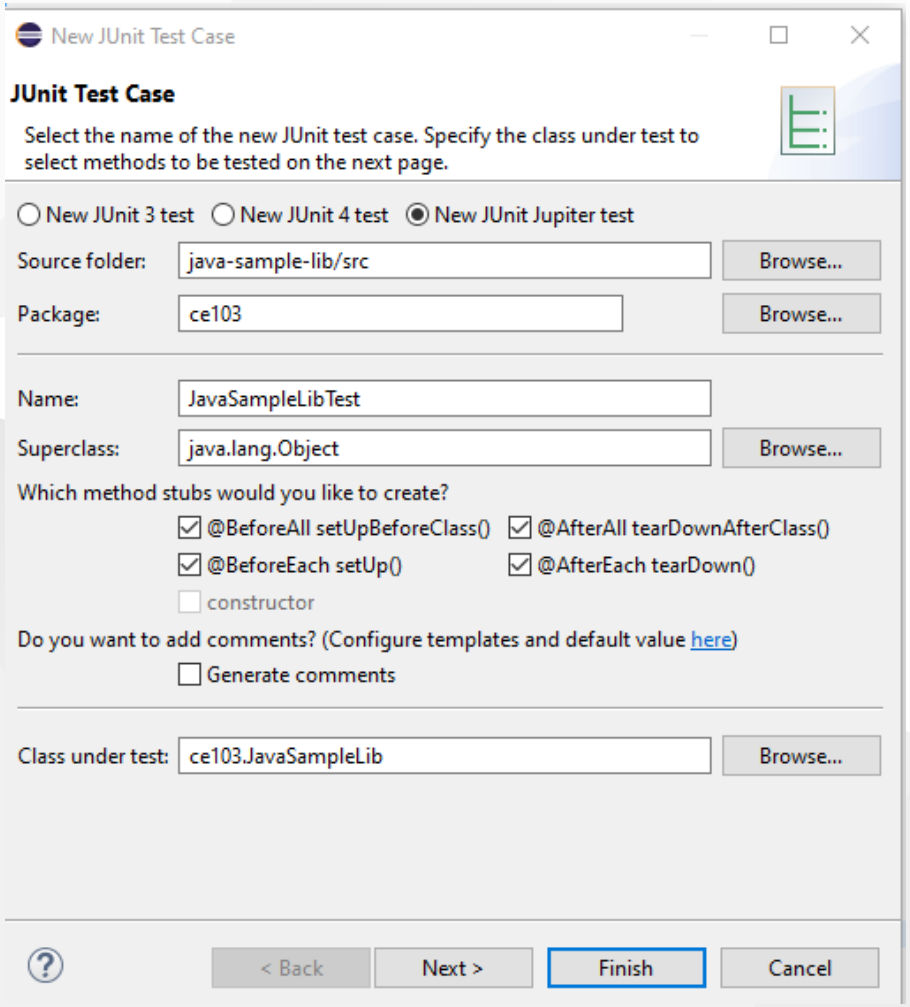
JUnit Hello World Example - Examples Java Code Geeks - 2021

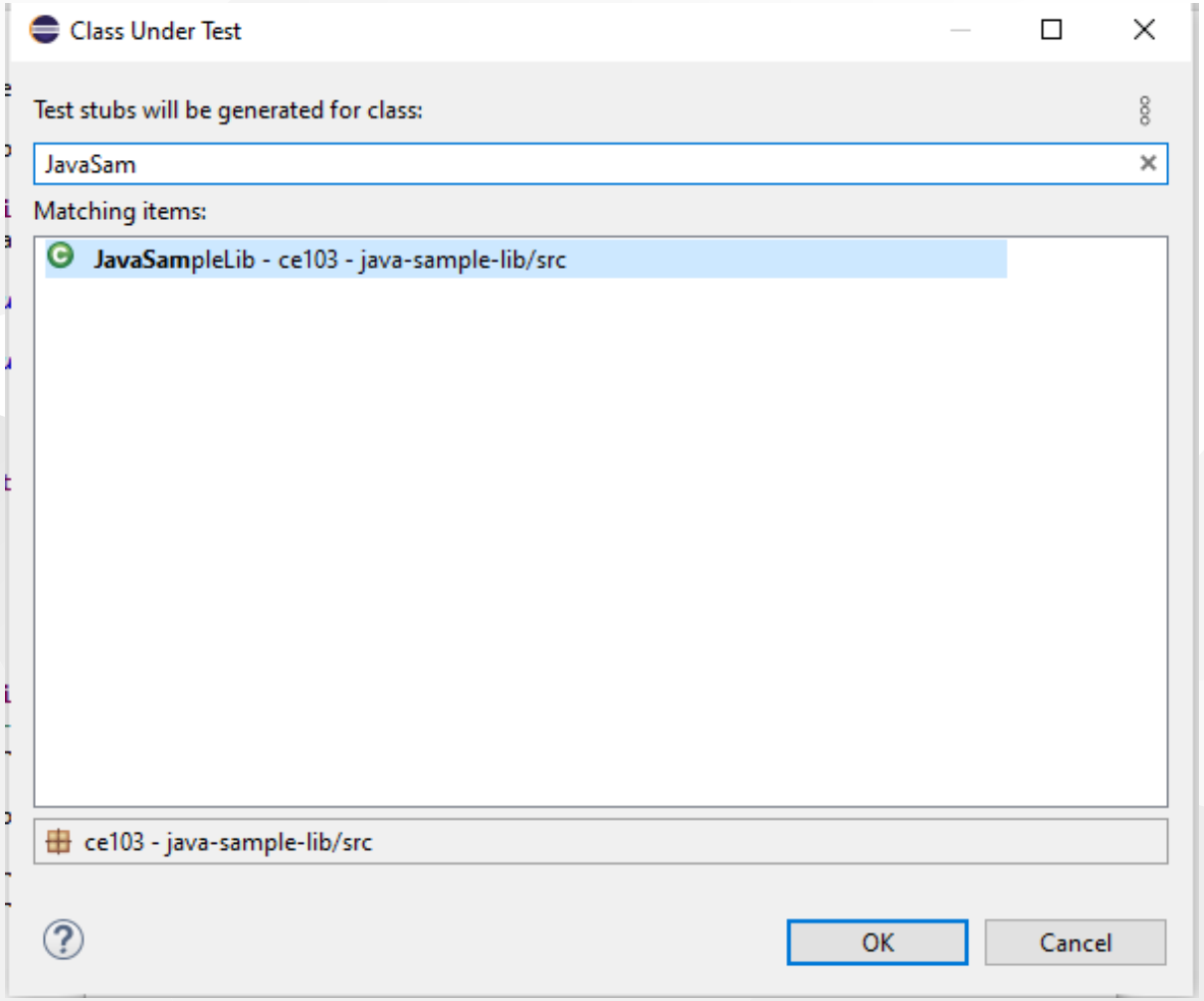
https://yasinmemic.medium.com/java-ile-unit-test-yazmak-birim-test-ca15cf0d024b

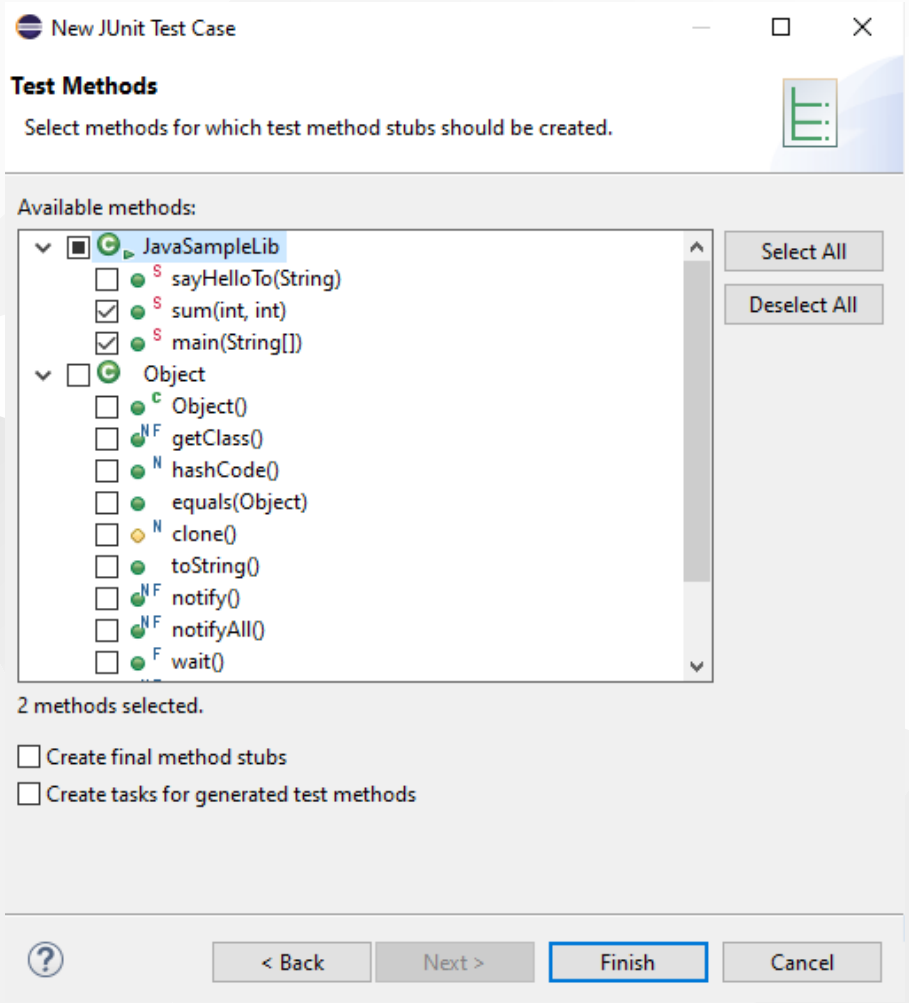
Java Application + JUnit

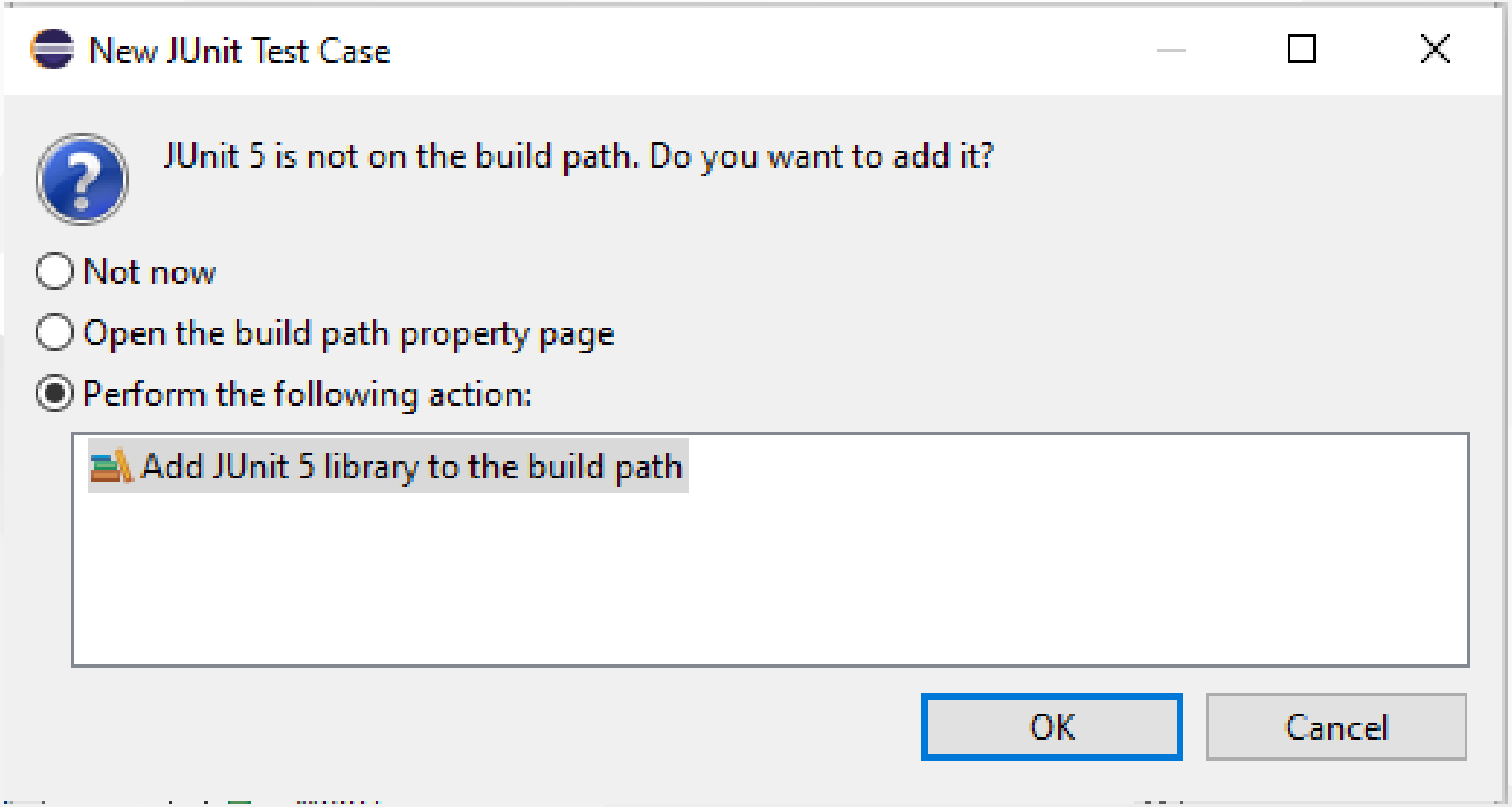
In normal java application we can right click the project java-sample-lib and add Junit case



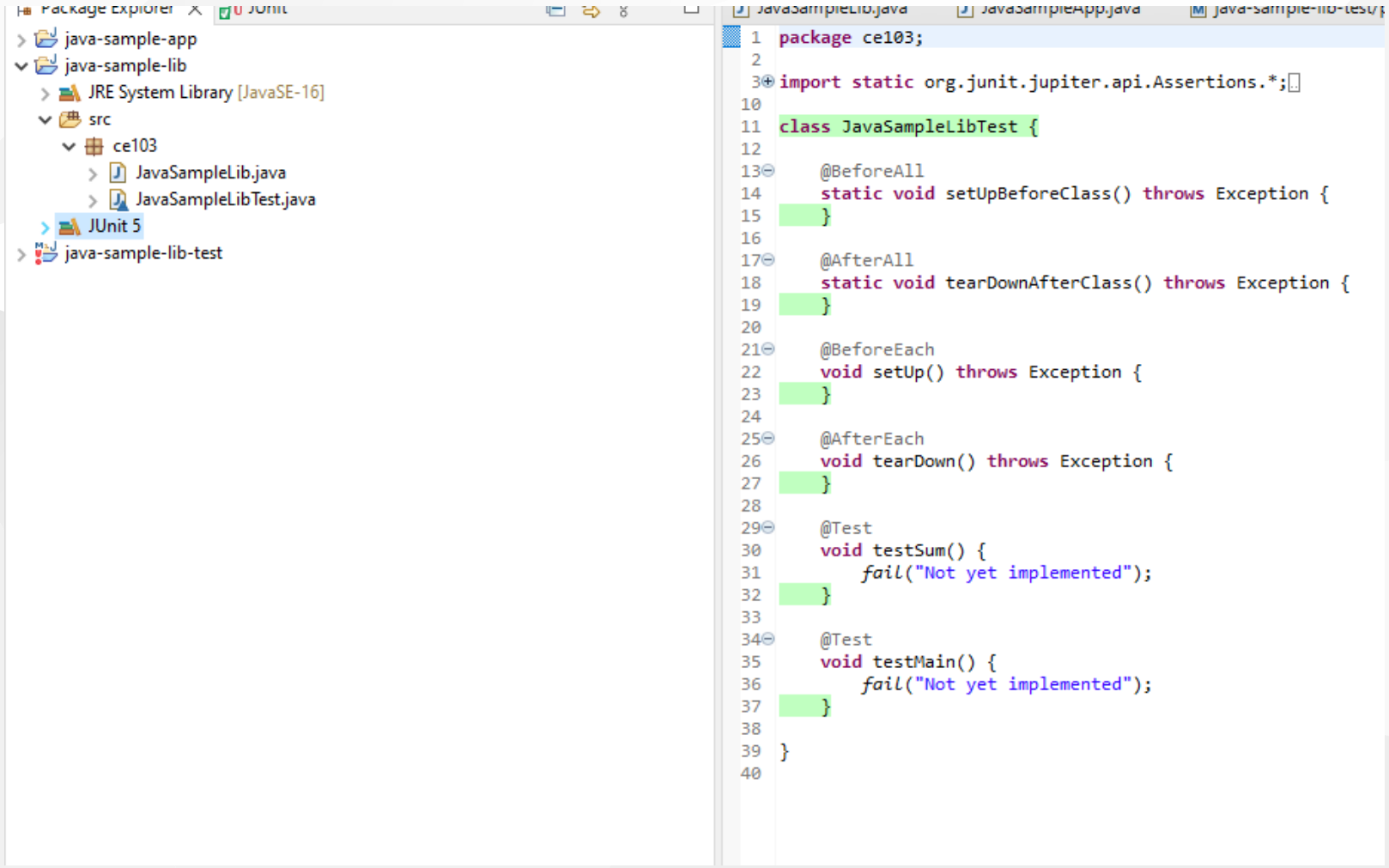

New JUnit Test Case
JUnit Test Case
Select the name of the new JUnit test case. Specify the class under test to select methods to be tested on the next page.
New JUnit 3 test
New JUnit 4 test
New JUnit Jupiter test
Source folder:
java-sample-lib/src
Browse...
Package:
ce103
Browse...
Name:
JavaSampleLibTest
Superclass:
java.lang.Object
Browse...
Which method stubs would you like to create?
@BeforeAll setUpBeforeClass()
@AfterAll tearDownAfterClass()
@BeforeEach setUp()
@AfterEach tearDown()
constructor
Do you want to add comments? (Configure templates and default value here)
Generate comments
Class under test:
ce103.JavaSampleLib
Browse...
< Back
Next >
Finish
Cancel


Class Under Test
Test stubs will be generated for class:
JavaSam
Matching items:
JavaSampleLib - ce103 - java-sample-lib/src
ce103 - java-sample-lib/src
OK
Cancel


New JUnit Test Case
Test Methods
Select methods for which test method stubs should be created.
Available methods:
JavaSampleLib
sayHelloTo(String)
sum(int, int)
main(String[])
Object
Object()
getClass()
hashCode()
equals(Object)
clone()
toString()
notify()
notifyAll()
wait()
Select All
Deselect All
2 methods selected.
Create final method stubs
Create tasks for generated test methods
< Back
Next >
Finish
Cancel


New JUnit Test Case
JUnit 5 is not on the build path. Do you want to add it?
Not now
Open the build path property page
Perform the following action:
Add JUnit 5 library to the build path
OK
Cancel

and you will have the following test class



We need to cover all code branches that we coded

I have updated JavaSampleLib.java as follow to check outputs

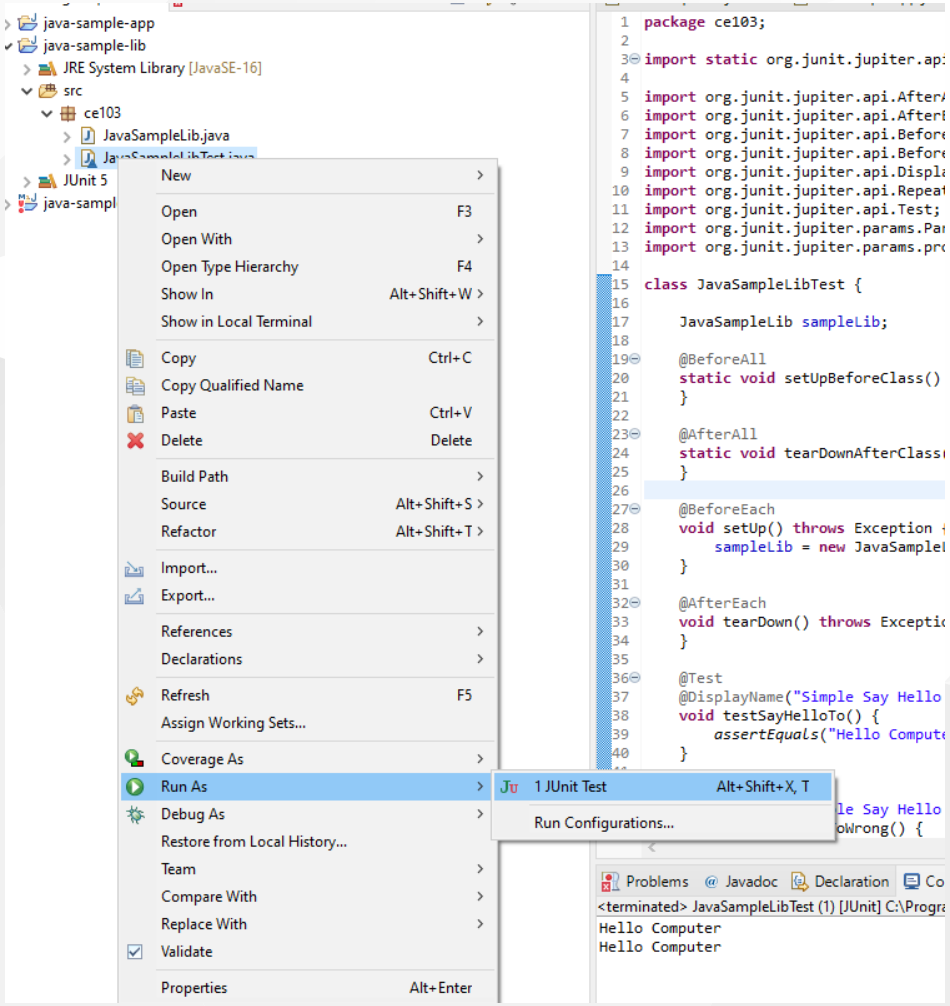
JavaSampleLib.java

```
package ce103;

public class JavaSampleLib {

    public static String sayHelloTo(String name) {

        String output = "";

        if(!name.isBlank() && !name.isEmpty()){
            output = "Hello "+name;
        }else {
            output = "Hello There";
        }

        System.out.println(output);

        return output;
    }

    public static int sum(int a,int b)
    {
        int c = 0;
        c = a+b;
        return c;
    }

    public int multiply(int a, int b) {
        return a * b;
    }

//    public static void main(String[] args) {
//        // TODO Auto-generated method stub
//        System.out.println("Hello World!");
//
//        JavaSampleLib.sayHelloTo("Computer");
//        int result = JavaSampleLib.sum(5, 4);
//        System.out.println("Results is" + result);
//        System.out.printf("Results is %d \n", result);
//
//
//        try {
//            System.in.read();
//        } catch (IOException e) {
//            // TODO Auto-generated catch block
//            e.printStackTrace();
//        }
//
//    }
```

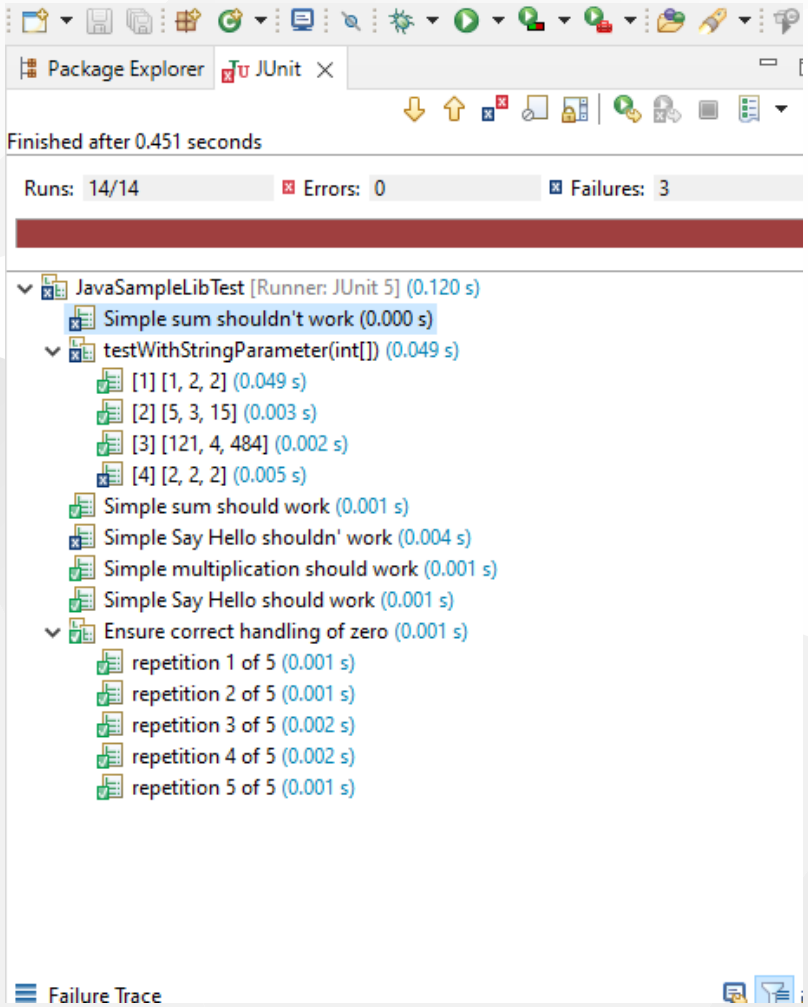
and JavaSampleLibTest.java

```java
package ce103;

import static org.junit.jupiter.api.Assertions.*;

import org.junit.jupiter.api.AfterAll;
import org.junit.jupiter.api.AfterEach;
import org.junit.jupiter.api.BeforeAll;
import org.junit.jupiter.api.BeforeEach;
import org.junit.jupiter.api.DisplayName;
import org.junit.jupiter.api.RepeatedTest;
import org.junit.jupiter.api.Test;
import org.junit.jupiter.params.ParameterizedTest;
import org.junit.jupiter.params.provider.MethodSource;

class JavaSampleLibTest {

    JavaSampleLib sampleLib;

    @BeforeAll
    static void setUpBeforeClass() throws Exception {
    }

    @AfterAll
    static void tearDownAfterClass() throws Exception {
    }

    @BeforeEach
    void setUp() throws Exception {
        sampleLib = new JavaSampleLib();
    }

    @AfterEach
    void tearDown() throws Exception {
    }

    @Test
    @DisplayName("Simple Say Hello should work")
    void testSayHelloTo() {
        assertEquals("Hello Computer", JavaSampleLib.sayHelloTo("Computer"), "Regular say hello should work");
    }

    @Test
    @DisplayName("Simple Say Hello shouldn' work")
    void testSayHelloToWrong() {
        assertEquals("Hello All", JavaSampleLib.sayHelloTo("Computer"), "Regular say hello won't work");
    }


    @Test
    @DisplayName("Simple sum should work")
    void testSumCorrect() {
        assertEquals(9, JavaSampleLib.sum(4, 5), "Regular sum should work");
    }

    @Test
    @DisplayName("Simple sum shouldn't work")
    void testSumWrong() {
        assertEquals(10, JavaSampleLib.sum(4, 5), "Regular sum shouldn't work");
    }

    @Test
    @DisplayName("Simple multiplication should work")
    void testMultiply() {
        assertEquals(20, sampleLib.multiply(4, 5), "Regular multiplication should work");
    }

    @RepeatedTest(5)
    @DisplayName("Ensure correct handling of zero")
    void testMultiplyWithZero() {
        assertEquals(0, sampleLib.multiply(0, 5), "Multiple with zero should be zero");
        assertEquals(0, sampleLib.multiply(5, 0), "Multiple with zero should be zero");
    }

    public static int[][] data() {
        return new int[][] { { 1, 2, 2 }, { 5, 3, 15 }, { 121, 4, 484 },{ 2, 2, 2 } };
    }

    @ParameterizedTest
    @MethodSource(value = "data")
    void testWithStringParameter(int[] data) {
        JavaSampleLib tester = new JavaSampleLib();
        int m1 = data[0];
        int m2 = data[1];
        int expected = data[2];
        assertEquals(expected, tester.multiply(m1, m2));
    }

}
```

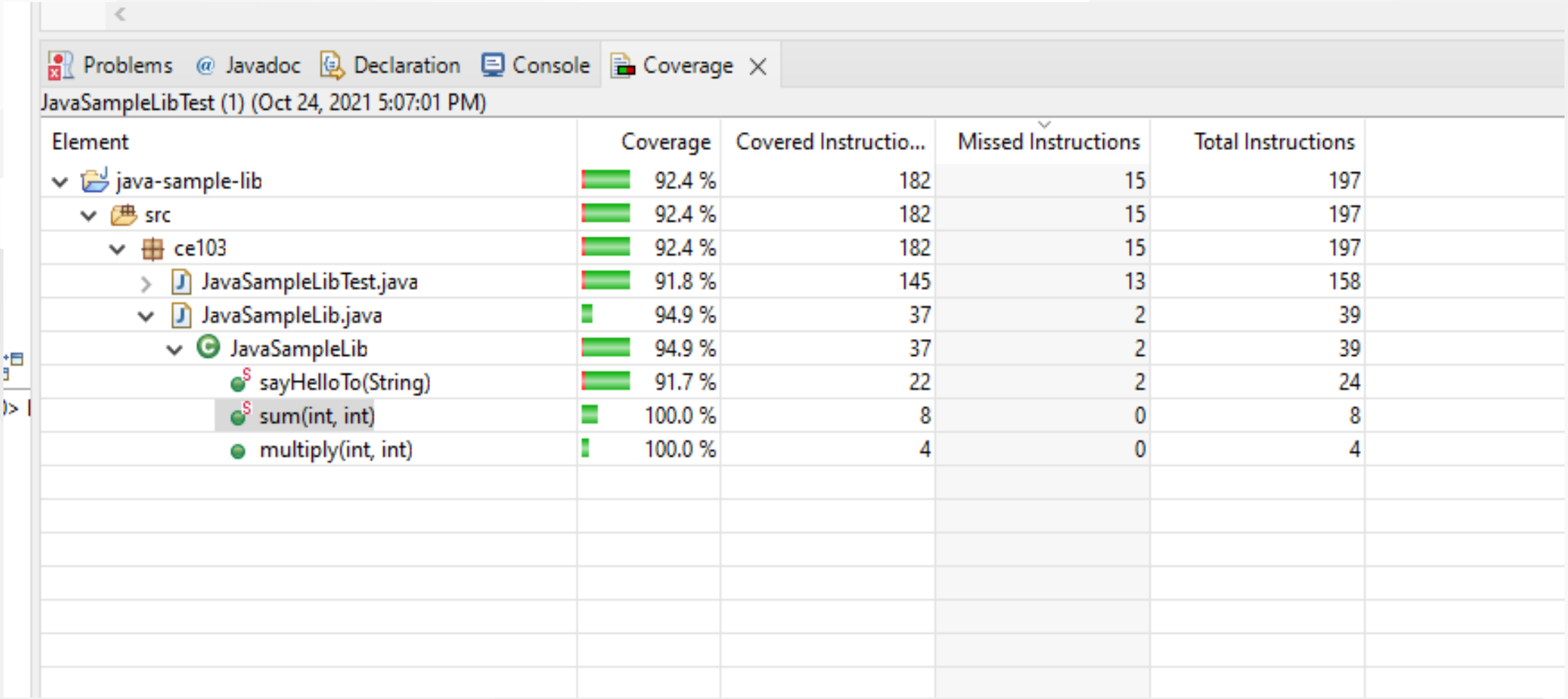
if we run tests



we will see all results there



also we can see the code coverage of tests



Element	Coverage	Covered Instructio...	Missed Instructions	Total Instructions
java-sample-lib	92.4 %	182	15	197
src	92.4 %	182	15	197
ce103	92.4 %	182	15	197
JavaSampleLibTest.java	91.8 %	145	13	158
JavaSampleLib.java	94.9 %	37	2	39
JavaSampleLib	94.9 %	37	2	39
sayHelloTo(String)	91.7 %	22	2	24
sum(int, int)	100.0 %	8	0	8
multiply(int, int)	100.0 %	4	0	4

when we open our source code (just close and open again another case highlighting will not work) you will see tested part of your codes

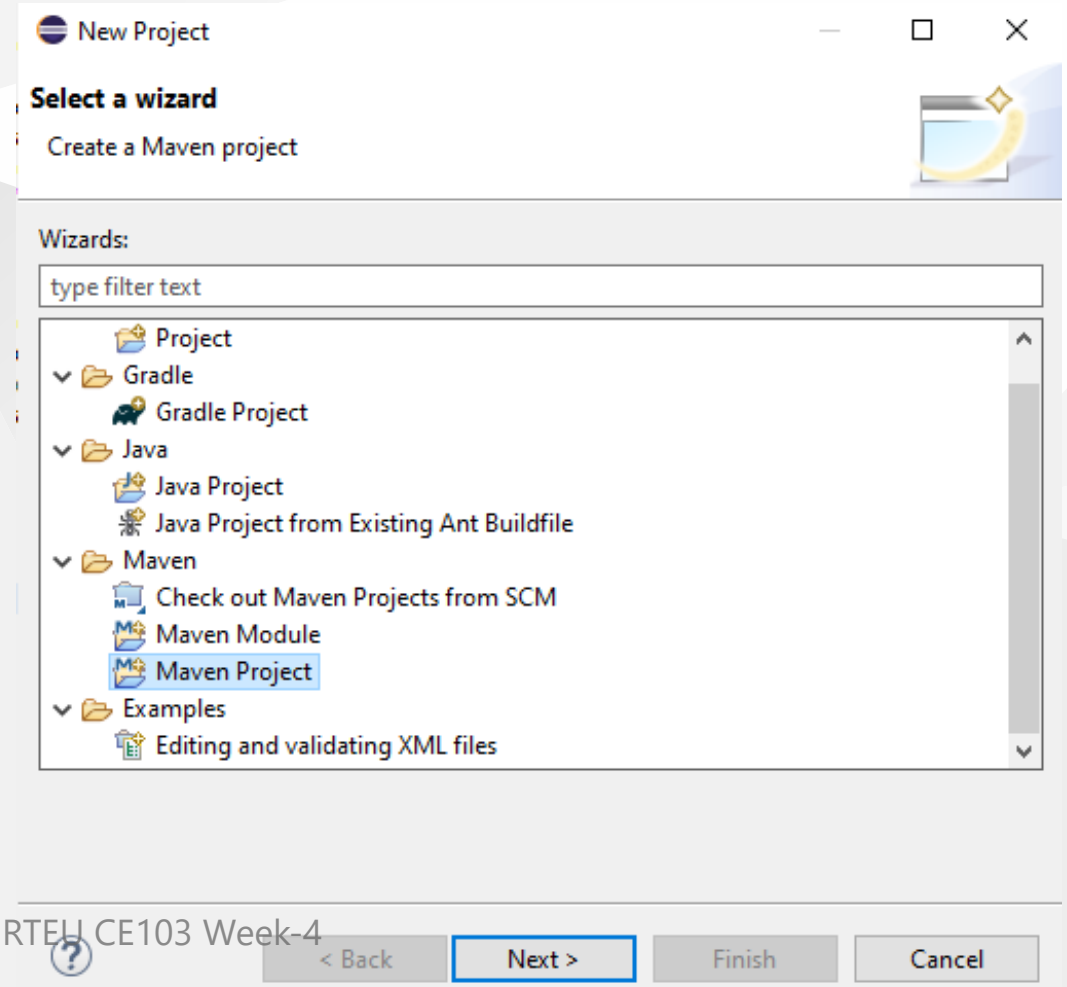
```
1  package ce103;
2
3  public class JavaSampleLib {
4
5      public static String sayHelloTo(String name) {
6
7          String output = "";
8
9          if(!name.isBlank() && !name.isEmpty()){
10             output = "Hello "+name;
11         }else {
12             output = "Hello There";
13         }
14
15         System.out.println(output);
16
17         return output;
18     }
19
20     public static int sum(int a,int b)
21     {
22         int c = 0;
23         c = a+b;
24         return c;
25     }
26
27     public int multiply(int a, int b) {
28         return a * b;
29     }
30
```

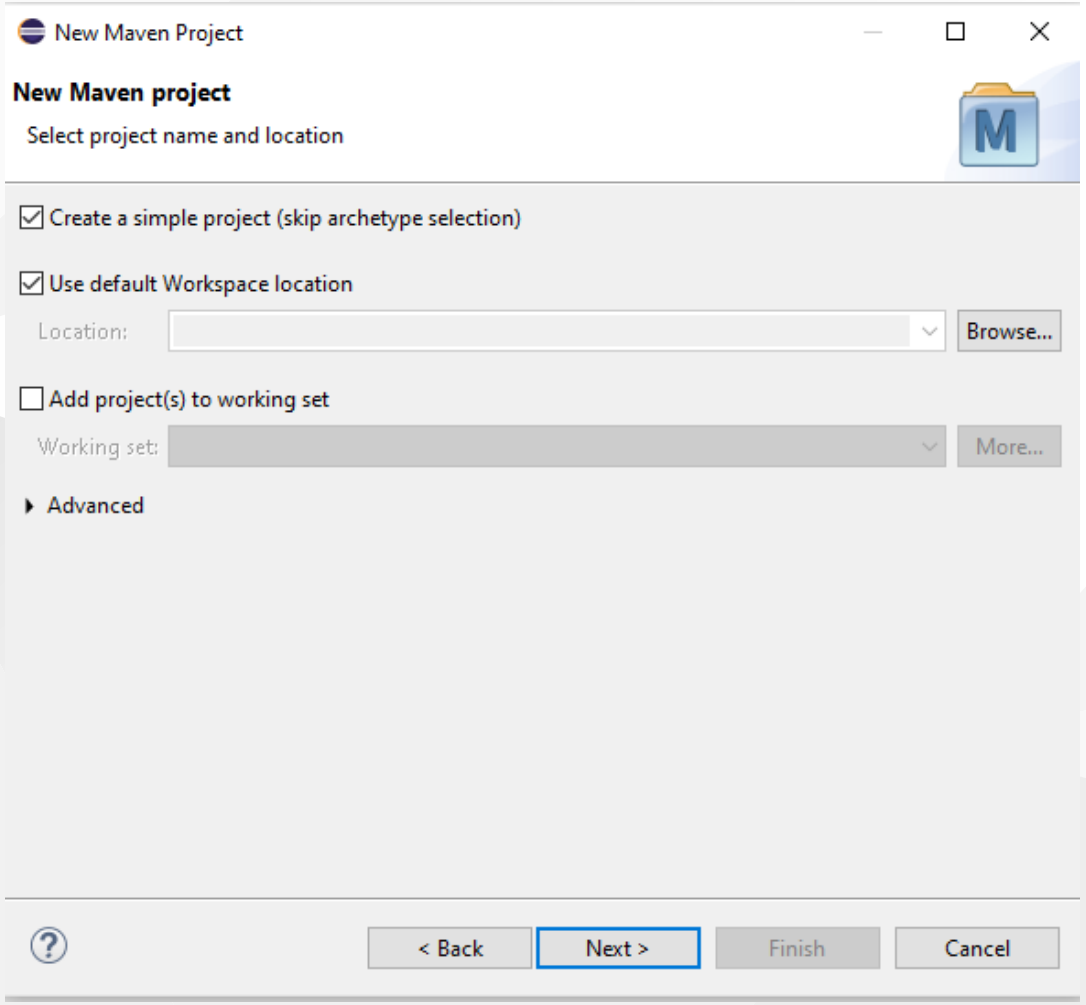
Maven Java Application + JUnit

Lets create Maven project with tests

Create a maven project

File -> New -> Maven Project




New Maven Project
New Maven project
Select project name and location
Create a simple project (skip archetype selection)
Use default Workspace location
Location:
Browse...
Add project(s) to working set
Working set:
More...
Advanced
< Back
Next >
Finish
Cancel

Lets convert our sample java-sample-lib directories to standard folder structure for test and app division

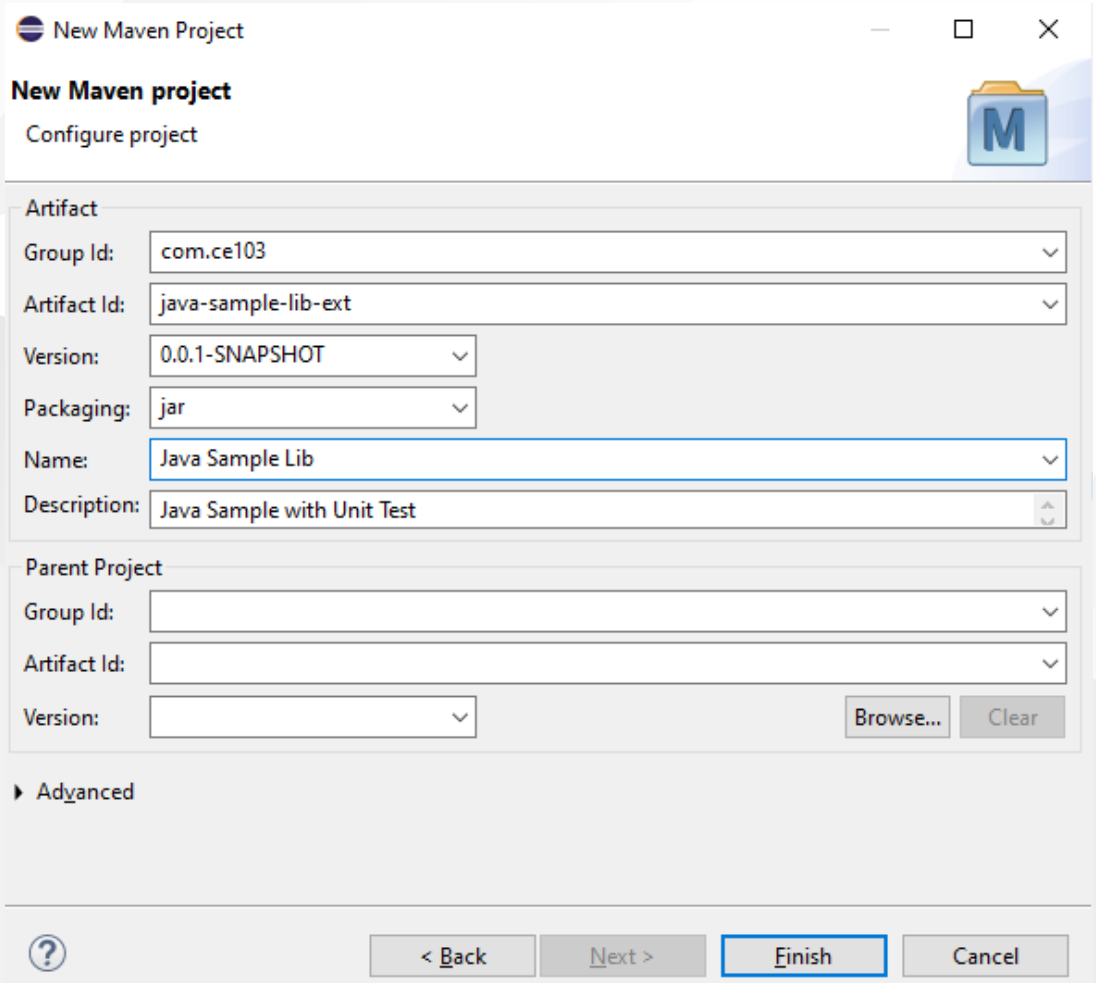
Maven – Introduction to the Standard Directory Layout

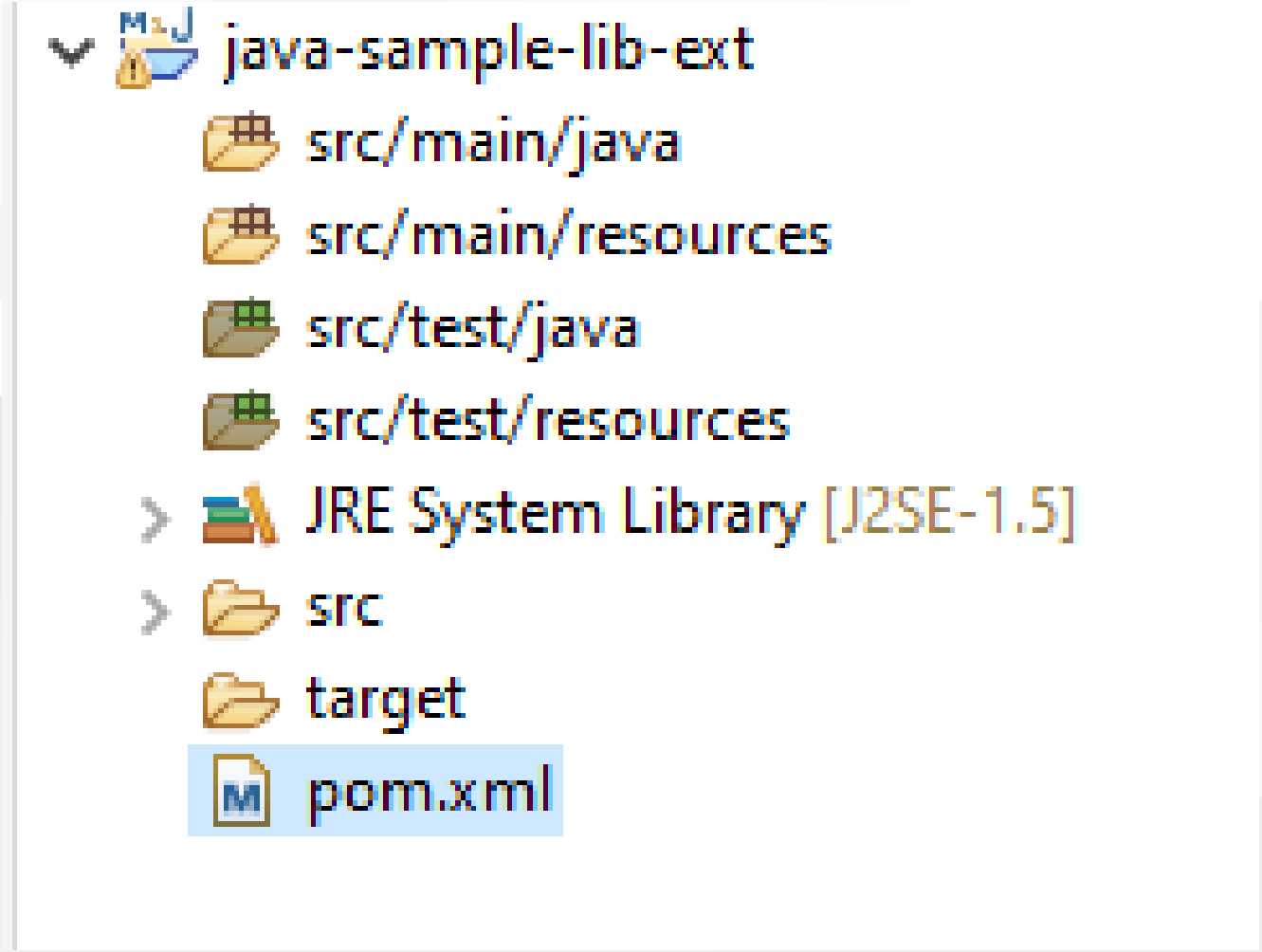
Also for intro you can use this

JUnit Hello World Example - Examples Java Code Geeks - 2021

Eclipse
Maven
Java
JUnit 4.12 (pulled by Maven automatically)

Lets give new sample java-sample-lib-mvnbut in this time we will create a maven project




java-sample-lib-ext
src/main/java
src/main/resources
src/test/java
src/test/resources
JRE System Library [J2SE-1.5]
src
target
pom.xml

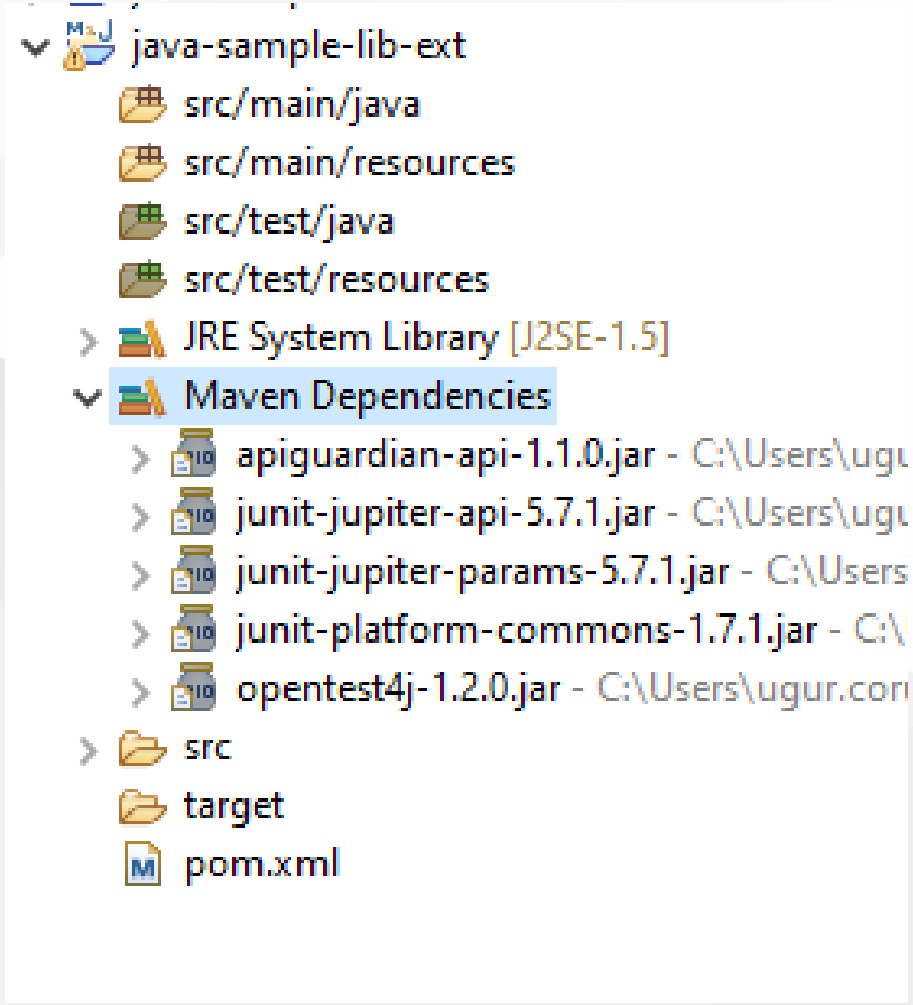
pom.xml file

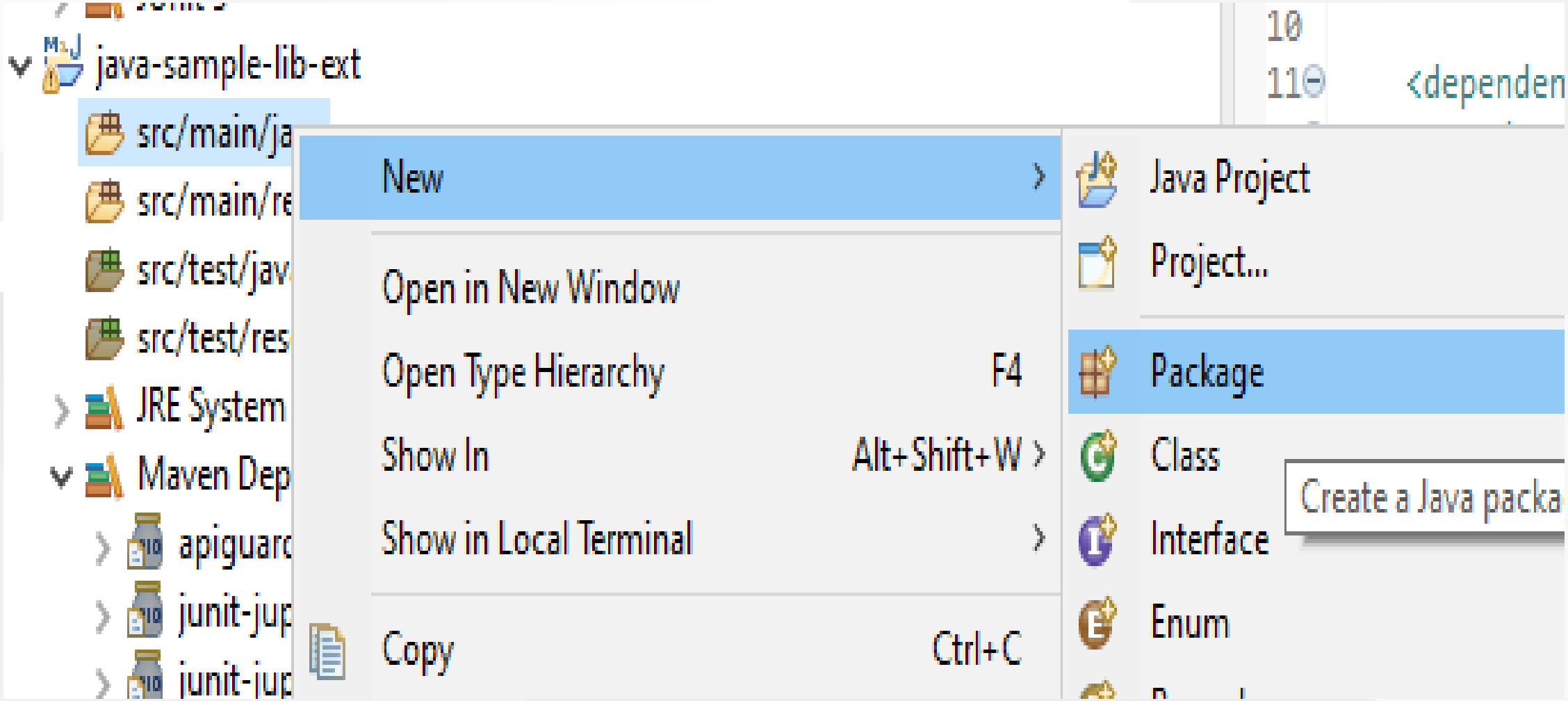
```xml
<project xmlns="http://maven.apache.org/POM/4.0.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 https://maven.apache.org/xsd/maven-4.0.0.xsd">
  <modelVersion>4.0.0</modelVersion>
  <groupId>com.ce103</groupId>
  <artifactId>java-sample-lib-ext</artifactId>
  <version>0.0.1-SNAPSHOT</version>
  <name>Java Sample Lib</name>
  <description>Java Sample with Unit Test</description>
</project>
```

we will add JUnit 5 for our project

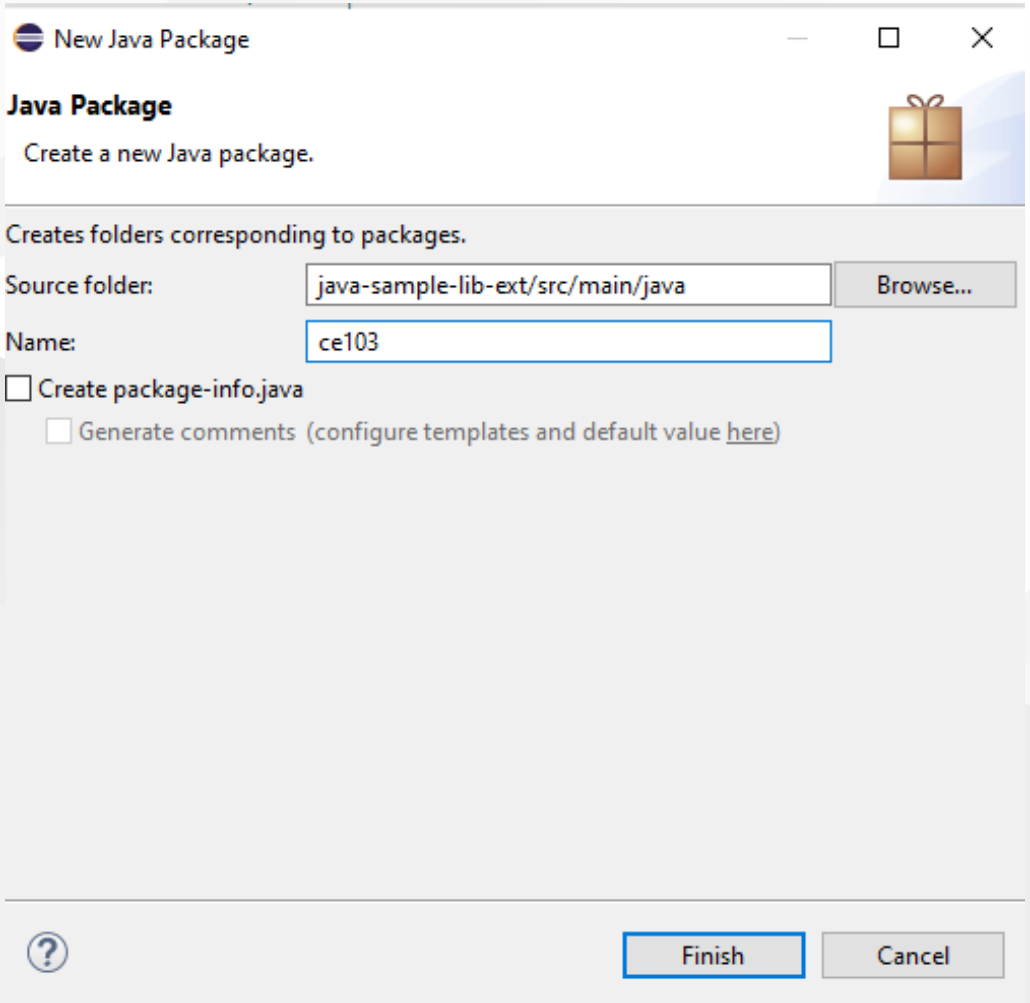
```
<project xmlns="http://maven.apache.org/POM/4.0.0"
    xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
    xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 https://maven.apache.org/xsd/maven-4.0.0.xsd">
    <modelVersion>4.0.0</modelVersion>
    <groupId>com.ce103</groupId>
    <artifactId>java-sample-lib-ext</artifactId>
    <version>0.0.1-SNAPSHOT</version>
    <name>Java Sample Lib</name>
    <description>Java Sample with Unit Test</description>

    <dependencies>
        <dependency>
            <groupId>org.junit.jupiter</groupId>
            <artifactId>junit-jupiter-params</artifactId>
            <version>5.7.1</version>
            <scope>test</scope>
        </dependency>
    </dependencies>

</project>
```

it will automatically download libraries

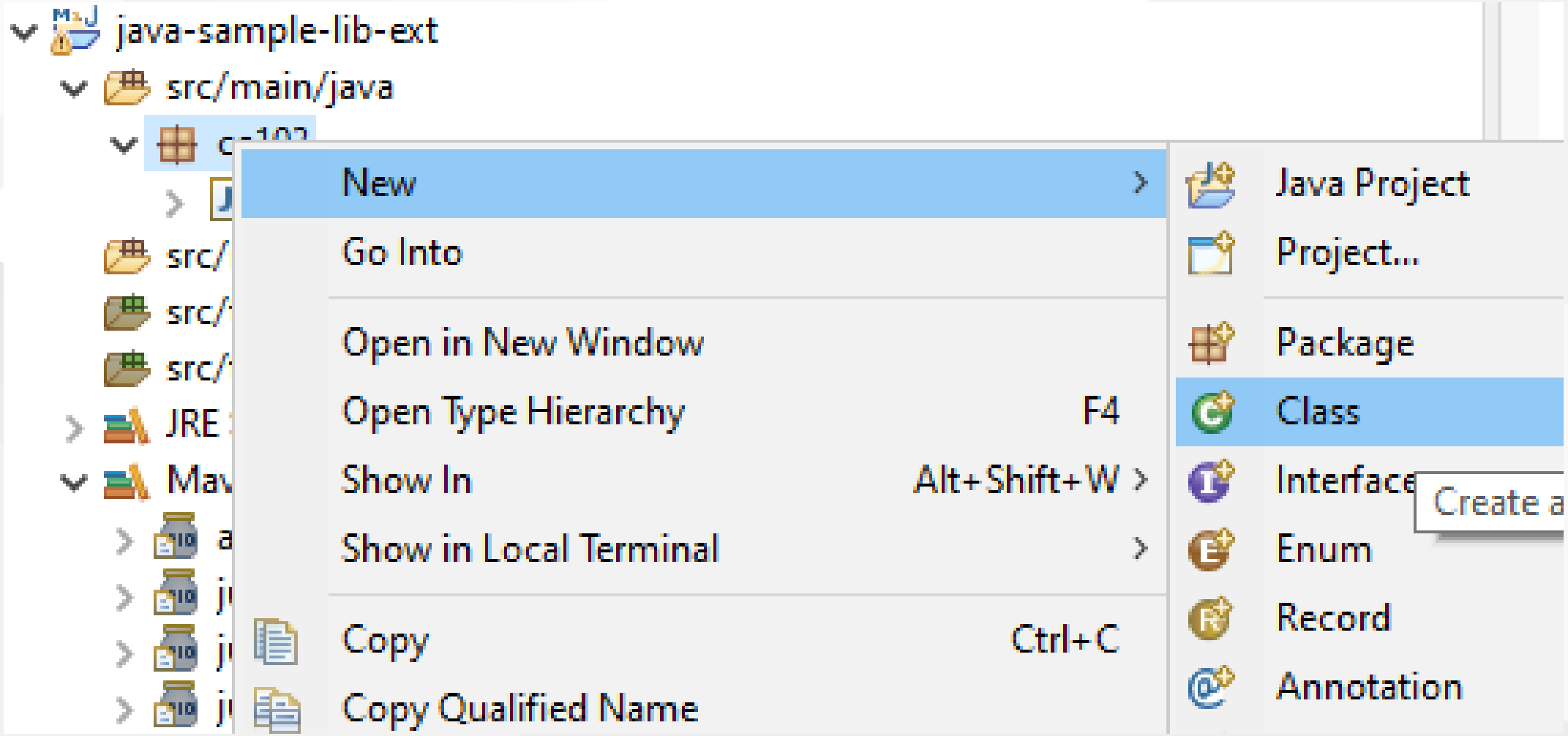


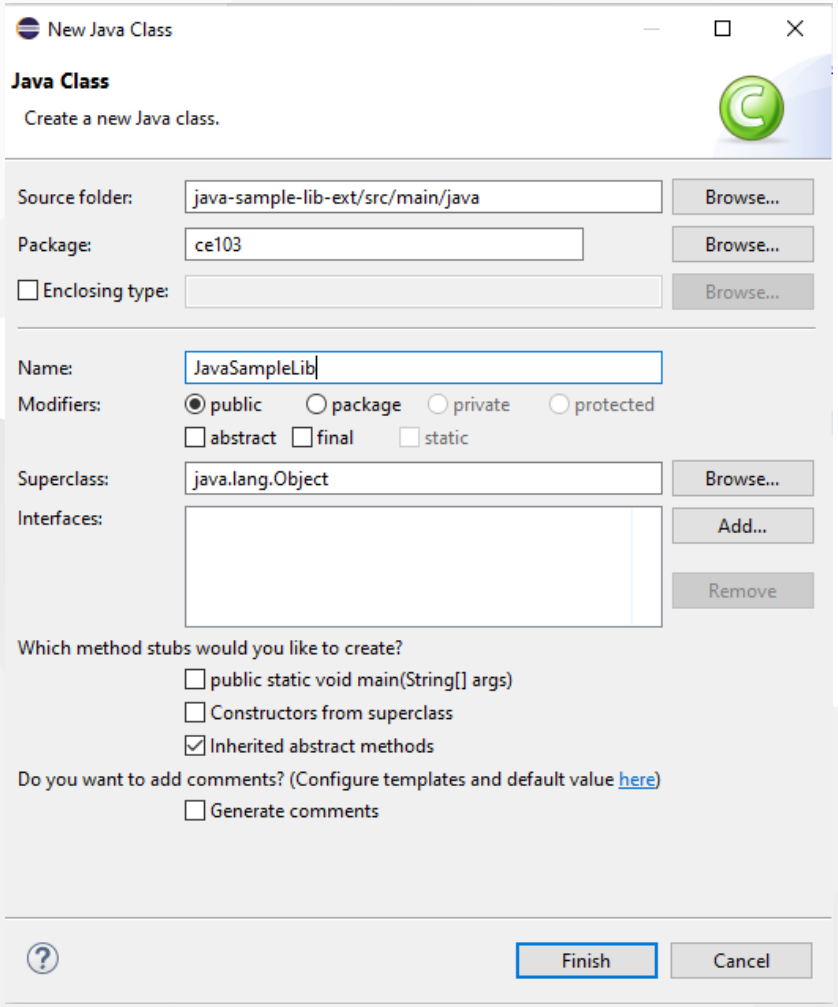

java-sample-lib-ext
src/main/ja
src/main/re
src/test/jav
src/test/res
JRE System
Maven Dep
apiguard
junit-jup
junit-jup
10
11
<dependen
New
Open in New Window
Open Type Hierarchy F4
Show In Alt+Shift+W
Show in Local Terminal
Copy Ctrl+C
Java Project
Project...
Package
Class
Interface
Enum
Create a Java packa

Create java sample library in ce103 package, first create java package



In this package create library class

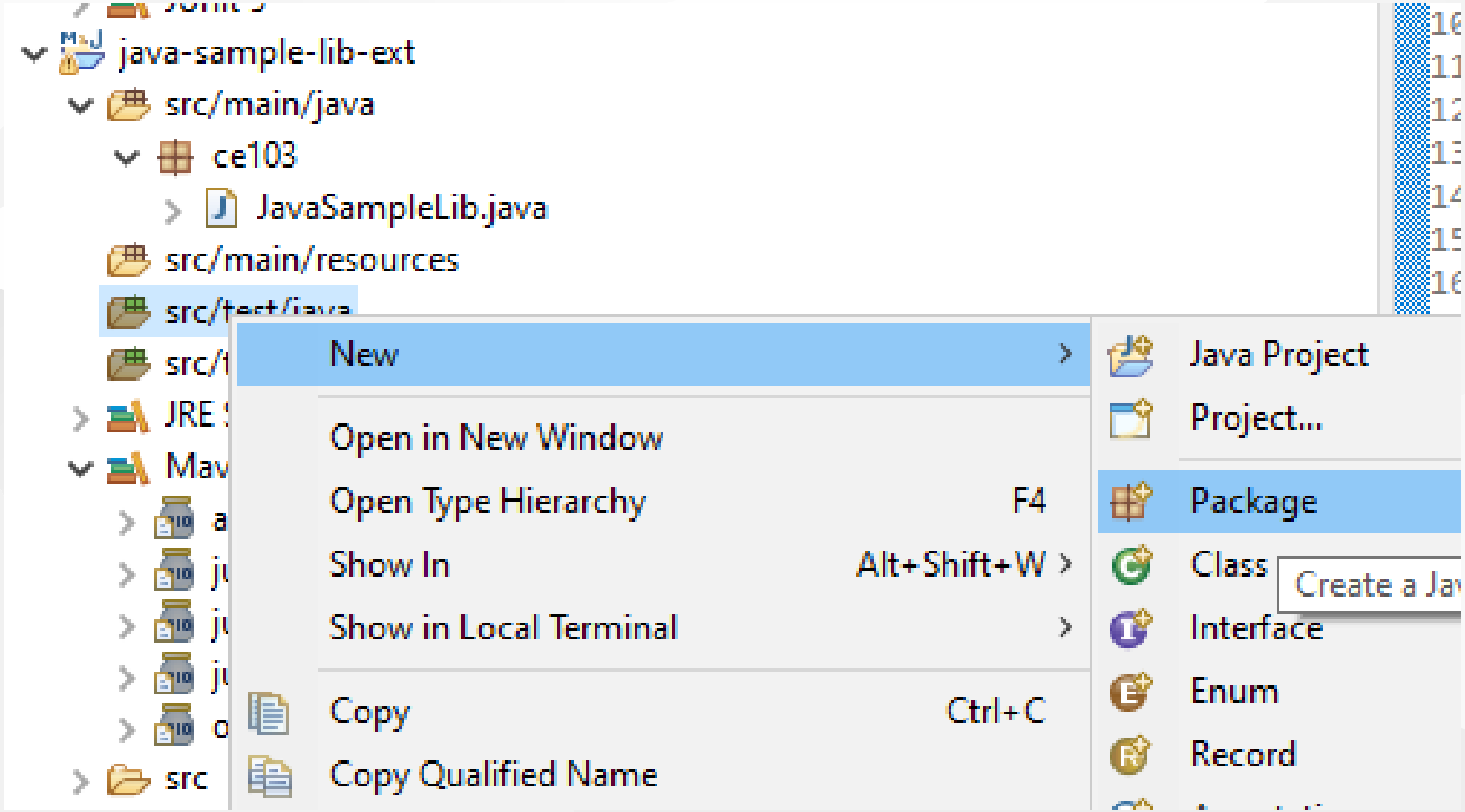


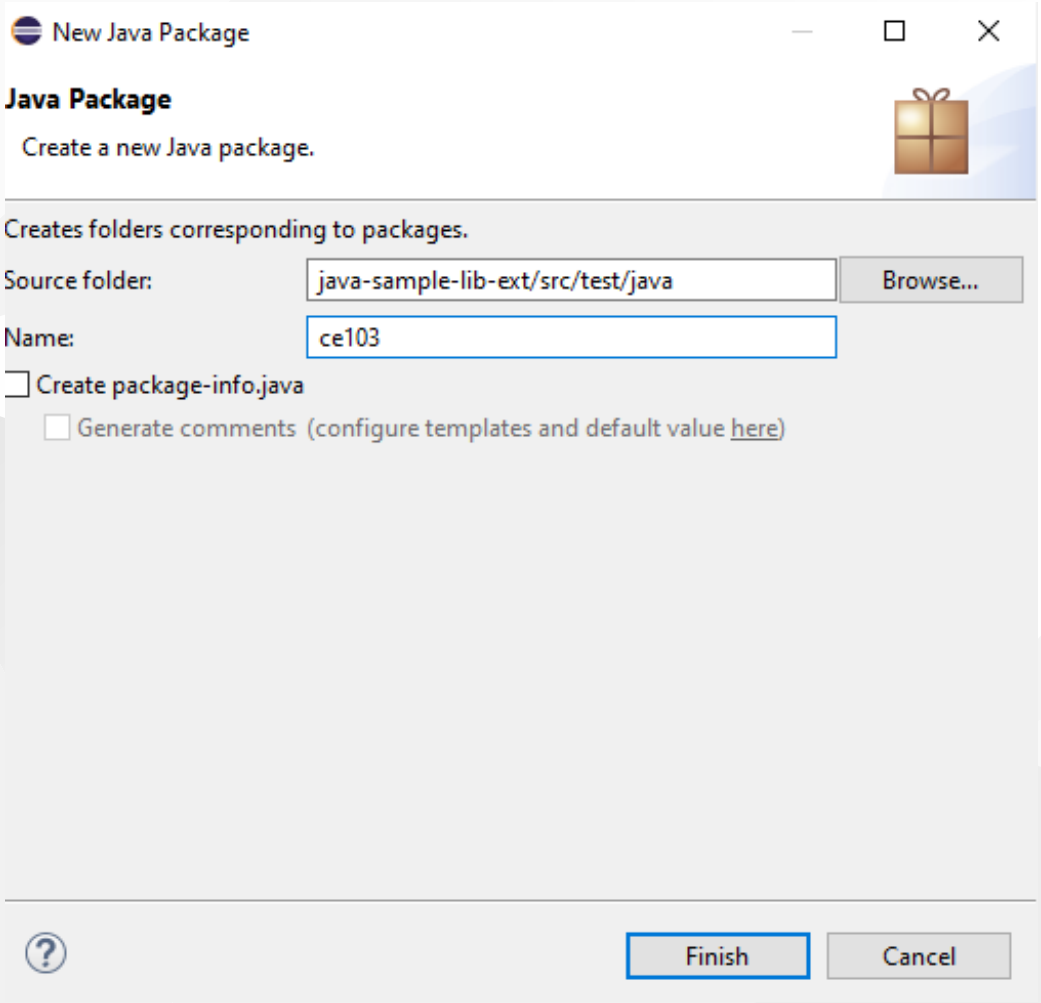

New Java Class
Java Class
Create a new Java class.
Source folder:
java-sample-lib-ext/src/main/java
Browse...
Package:
ce103
Browse...
Enclosing type:
Browse...
Name:
JavaSampleLib
Modifiers:
public
package
private
protected
abstract
final
static
Superclass:
java.lang.Object
Browse...
Interfaces:
Add...
Remove
Which method stubs would you like to create?
public static void main(String[] args)
Constructors from superclass
Inherited abstract methods
Do you want to add comments? (Configure templates and default value here)
Generate comments
Finish
Cancel

copy content from other library

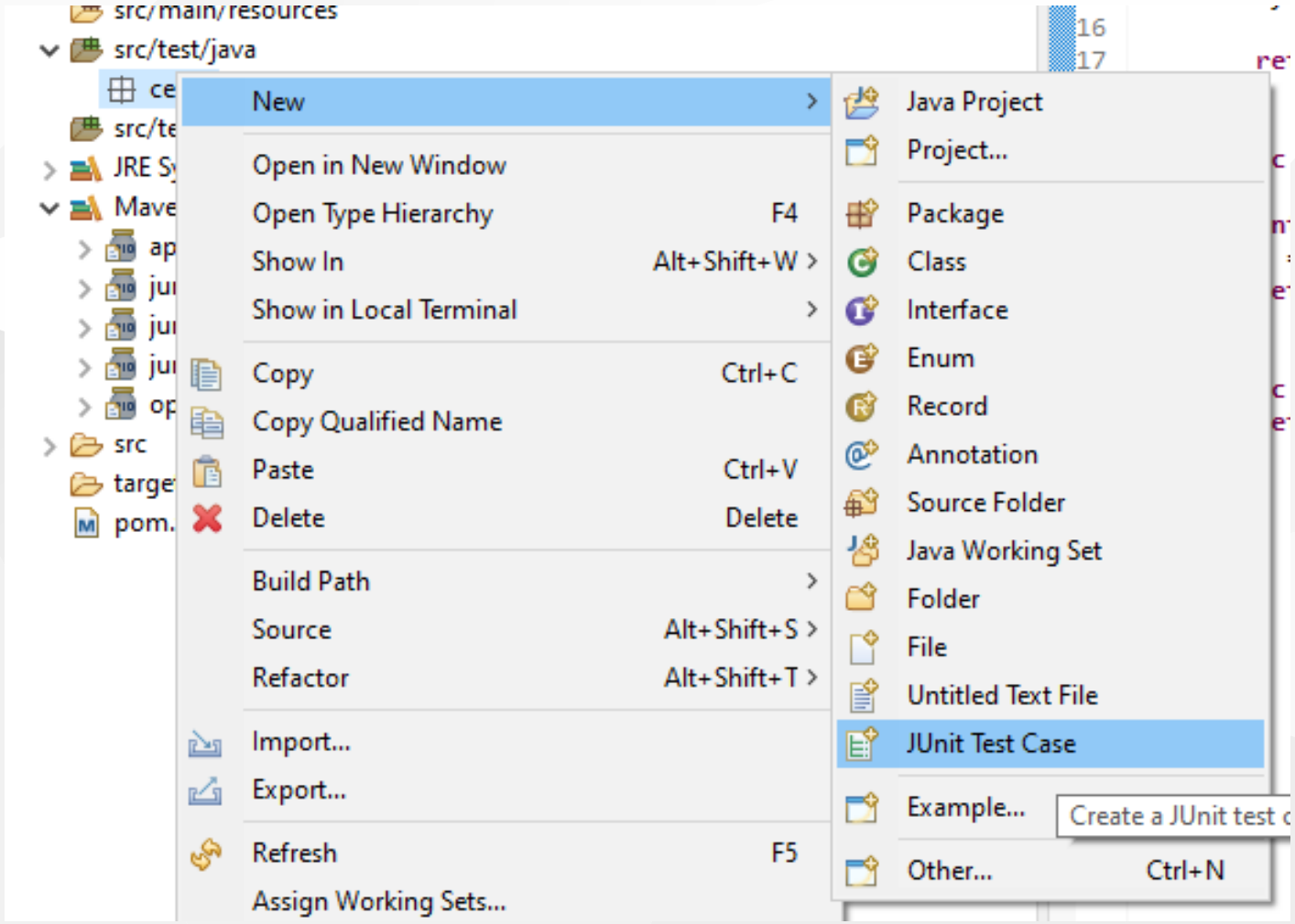
```
package ce103;

public class JavaSampleLib {

public static String sayHelloTo(String name) {

        String output = "";

        if(!name.isBlank() && !name.isEmpty()){
            output = "Hello "+name;
        }else {
            output = "Hello There";
        }

        System.out.println(output);

        return output;
    }

    public static int sum(int a,int b)
    {
        int c = 0;
        c = a+b;
        return c;
    }

    public int multiply(int a, int b) {
        return a * b;
    }


}
```

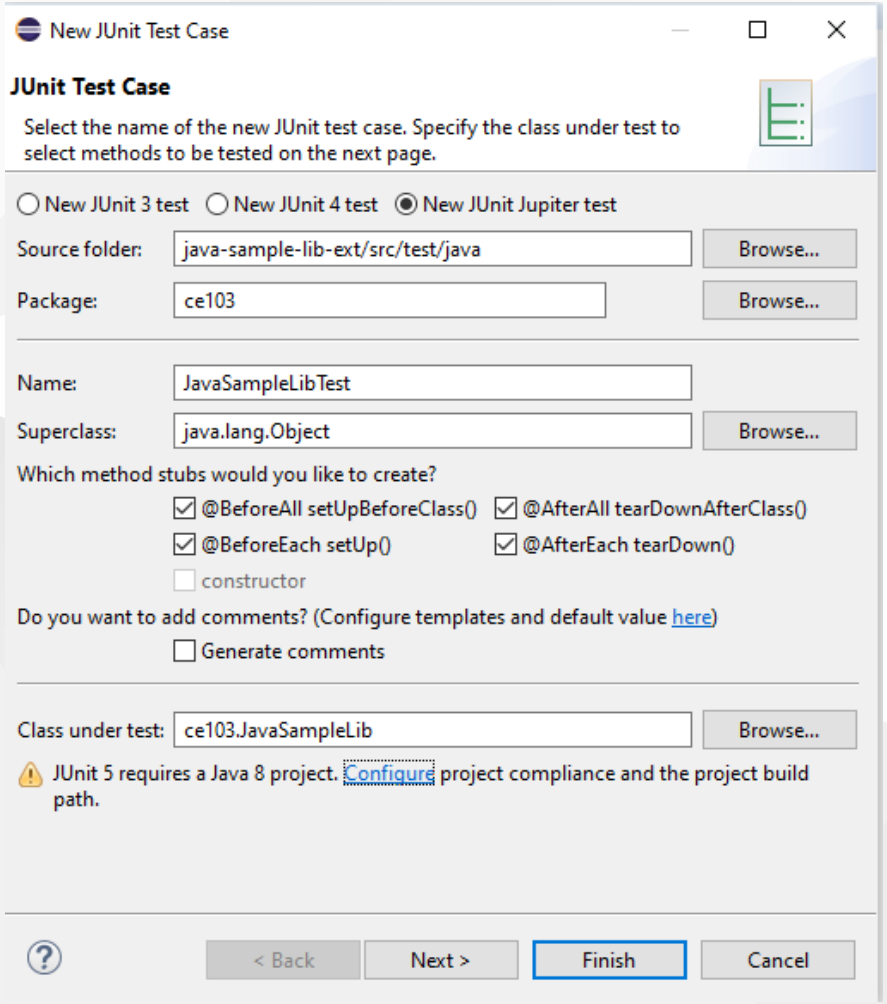
Now lets create tests inf src/test/java

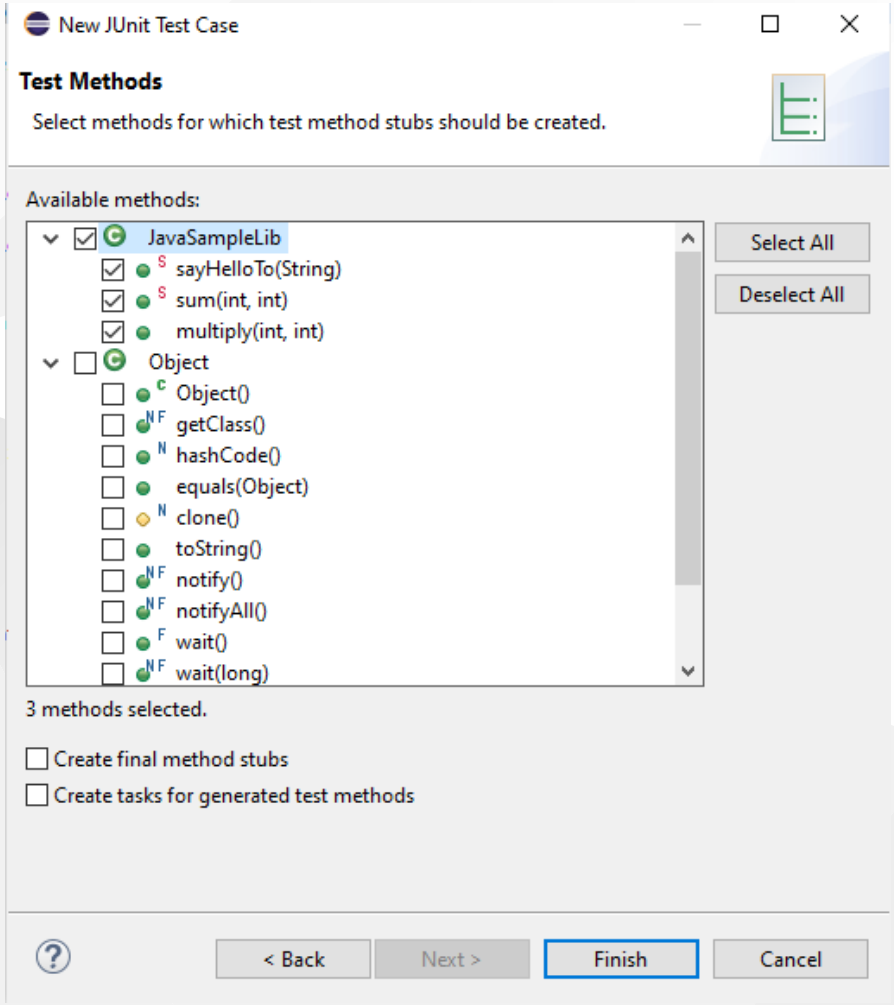


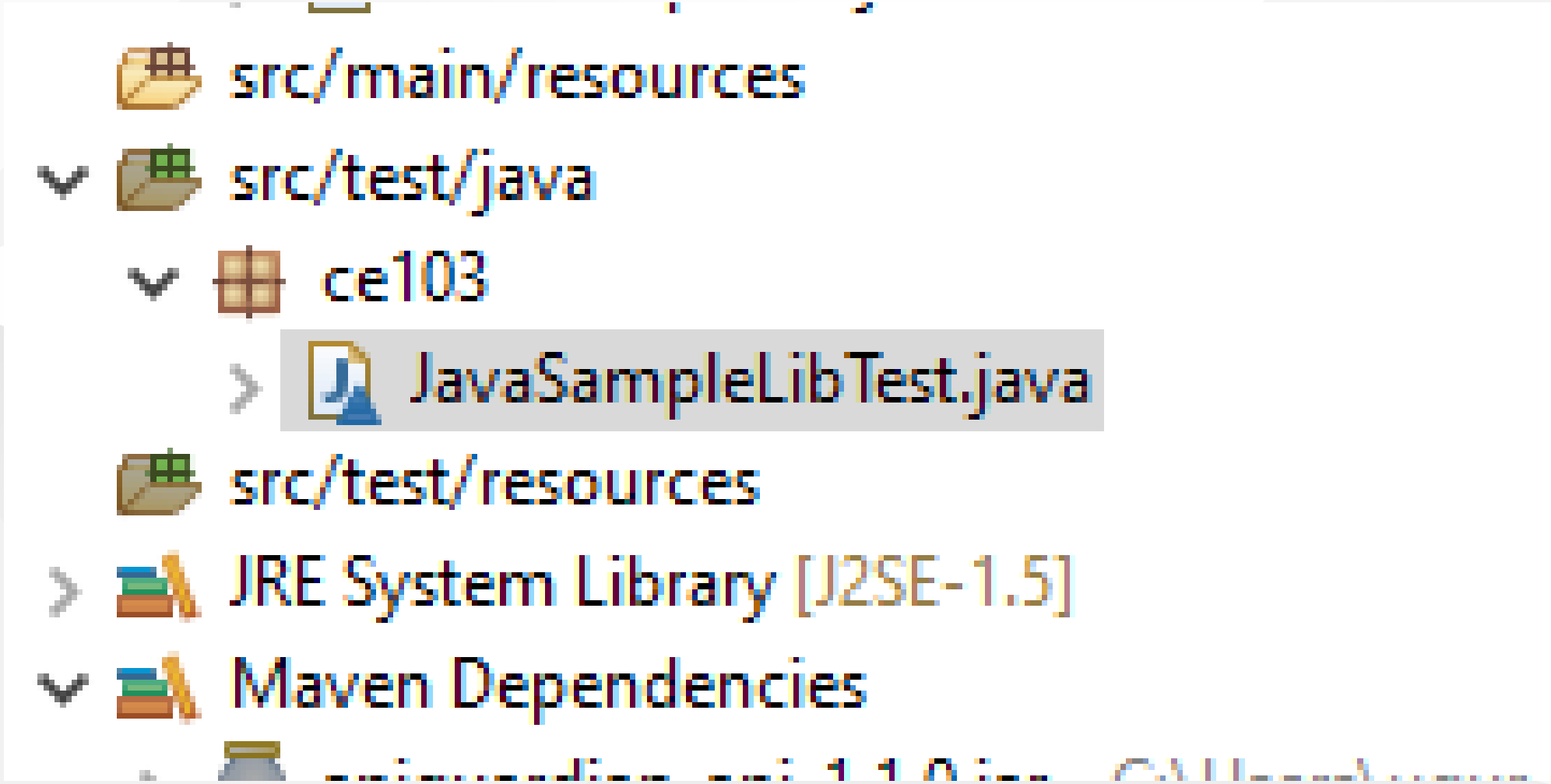

New Java Package
Java Package
Create a new Java package.
Creates folders corresponding to packages.
Source folder:
java-sample-lib-ext/src/test/java
Browse...
Name:
ce103
Create package-info.java
Generate comments (configure templates and default value here)
Finish
Cancel

create a JUnit Case




New JUnit Test Case
JUnit Test Case
Select the name of the new JUnit test case. Specify the class under test to select methods to be tested on the next page.
New JUnit 3 test
New JUnit 4 test
New JUnit Jupiter test
Source folder:
java-sample-lib-ext/src/test/java
Browse...
Package:
ce103
Browse...
Name:
JavaSampleLibTest
Superclass:
java.lang.Object
Browse...
Which method stubs would you like to create?
@BeforeAll setUpBeforeClass()
@AfterAll tearDownAfterClass()
@BeforeEach setUp()
@AfterEach tearDown()
constructor
Do you want to add comments? (Configure templates and default value here)
Generate comments
Class under test:
ce103.JavaSampleLib
Browse...
JUnit 5 requires a Java 8 project. Configure project compliance and the project build path.
< Back
Next >
Finish
Cancel

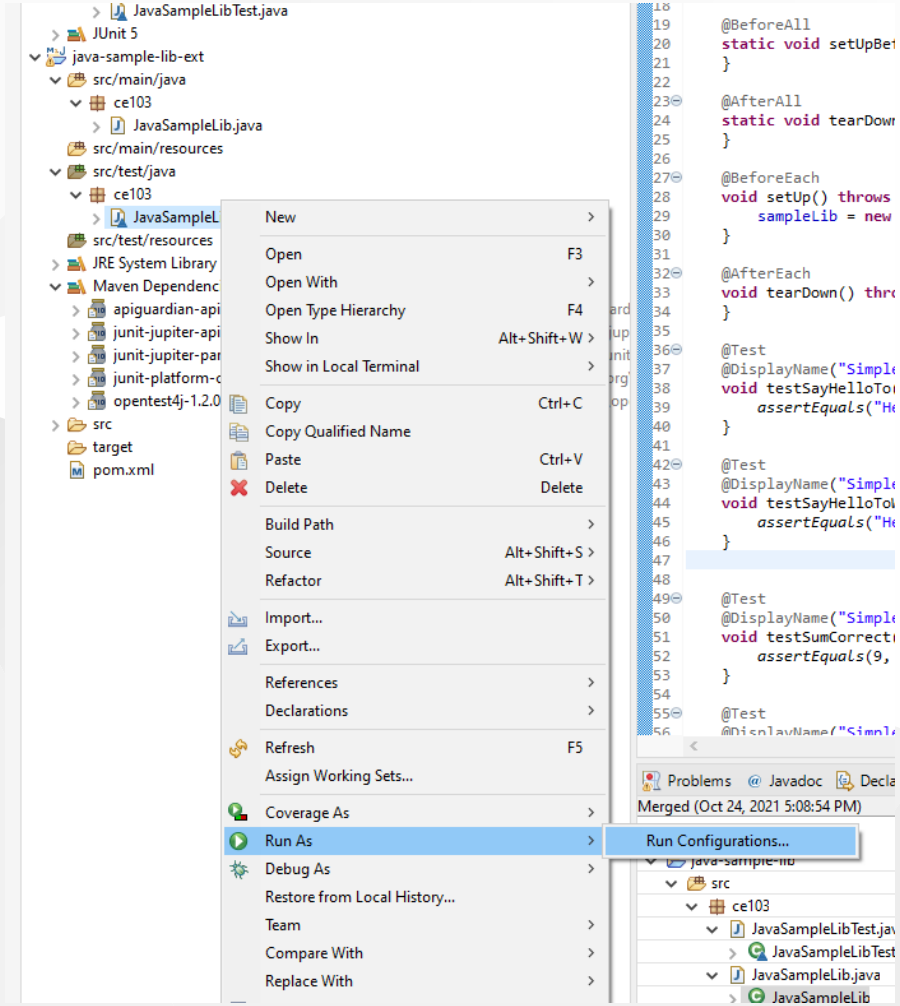

New JUnit Test Case
Test Methods
Select methods for which test method stubs should be created.
Available methods:
JavaSampleLib
sayHelloTo(String)
sum(int, int)
multiply(int, int)
Object
Object()
getClass()
hashCode()
equals(Object)
clone()
toString()
notify()
notifyAll()
wait()
wait(long)
Select All
Deselect All
3 methods selected.
Create final method stubs
Create tasks for generated test methods
< Back
Next >
Finish
Cancel

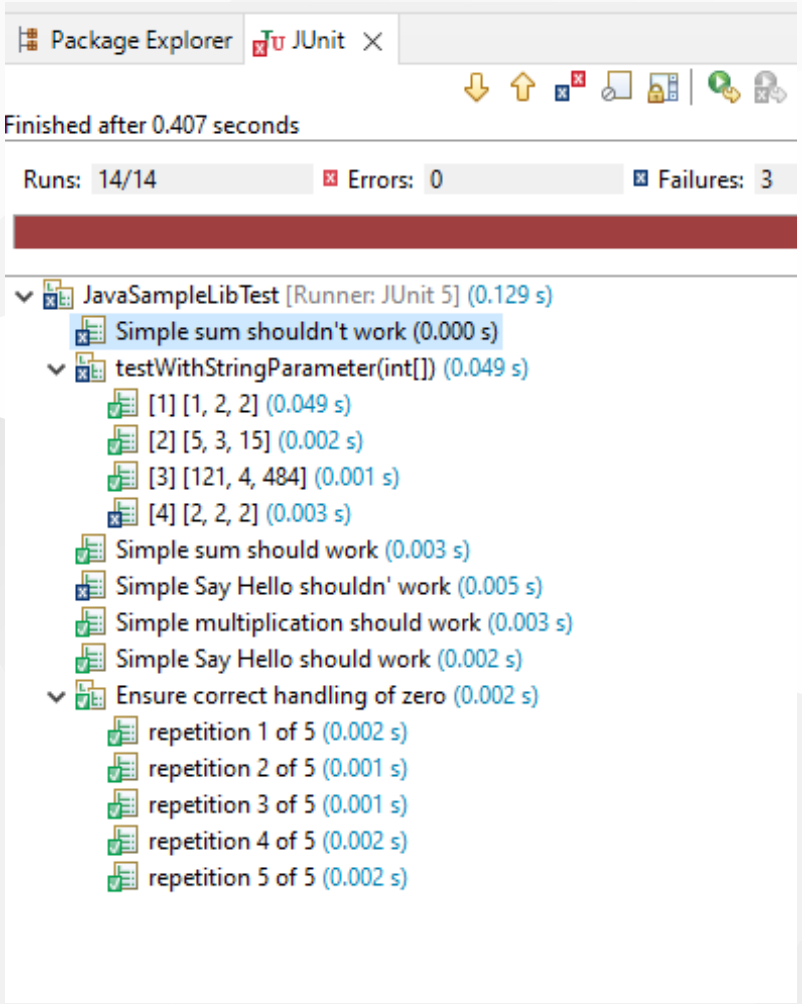

src/main/resources
src/test/java
ce103
JavaSampleLibTest.java
src/test/resources
JRE System Library [J2SE-1.5]
Maven Dependencies

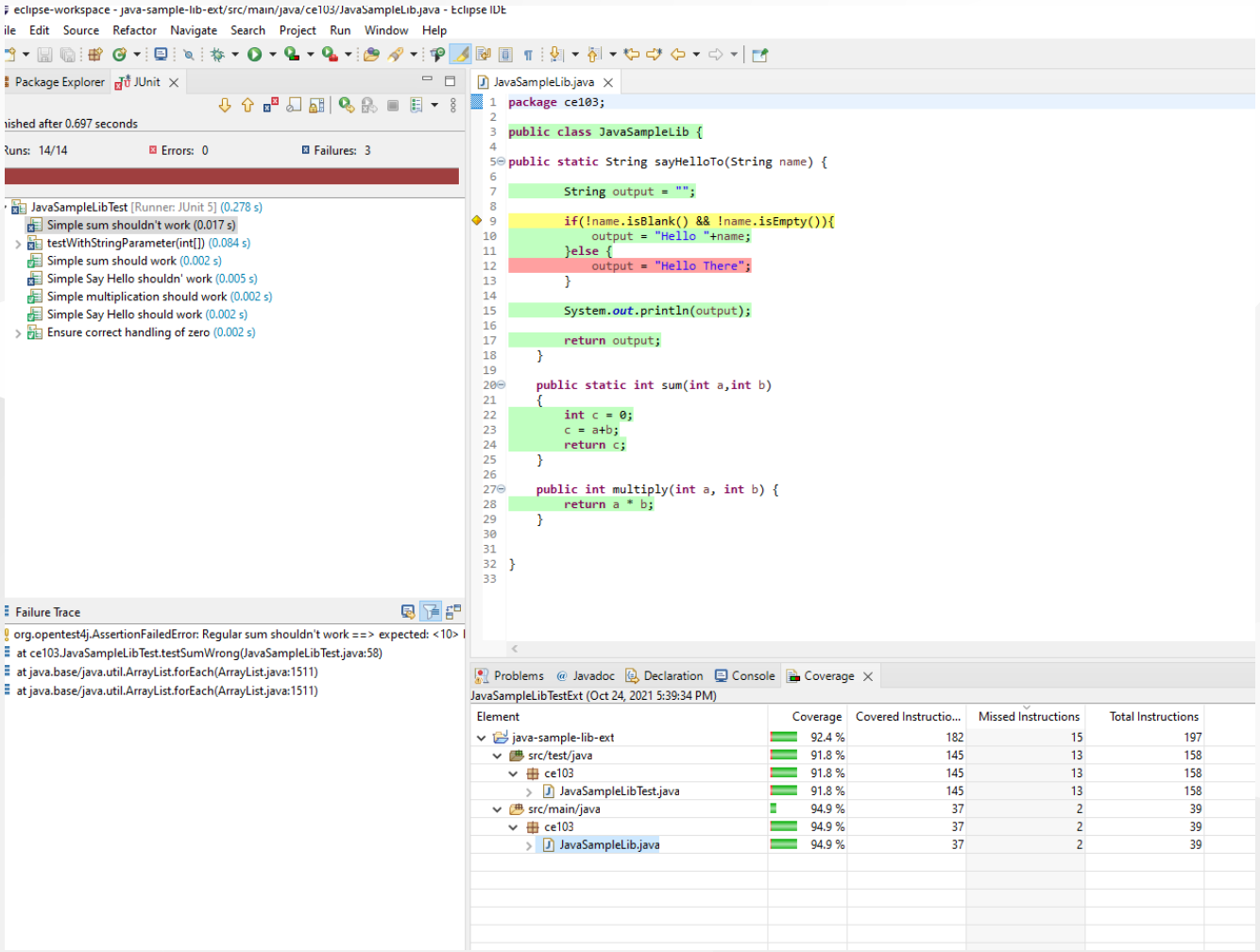
you will simple template

```
package ce103;

import static org.junit.jupiter.api.Assertions.*;

import org.junit.jupiter.api.AfterAll;
import org.junit.jupiter.api.AfterEach;
import org.junit.jupiter.api.BeforeAll;
import org.junit.jupiter.api.BeforeEach;
import org.junit.jupiter.api.Test;

class JavaSampleLibTest {

    @BeforeAll
    static void setUpBeforeClass() throws Exception {
    }

    @AfterAll
    static void tearDownAfterClass() throws Exception {
    }

    @BeforeEach
    void setUp() throws Exception {
    }

    @AfterEach
    void tearDown() throws Exception {
    }

    @Test
    void testSayHelloTo() {
        fail("Not yet implemented");
    }

    @Test
    void testSum() {
        fail("Not yet implemented");
    }

    @Test
    void testMultiply() {
        fail("Not yet implemented");
    }

}
```

now lets copy tests from other projects


JavaSampleLibTest.java
JUnit 5
java-sample-lib-ext
src/main/java
ce103
JavaSampleLib.java
src/main/resources
src/test/java
ce103
JavaSampleL
src/test/resources
JRE System Library
Maven Dependenc
apiguardian-api
junit-jupiter-api
junit-jupiter-par
junit-platform-c
opentest4j-1.2.0
src
target
pom.xml
New
Open F3
Open With
Open Type Hierarchy F4
Show In Alt+Shift+W
Show in Local Terminal
Copy Ctrl+C
Copy Qualified Name
Paste Ctrl+V
Delete Delete
Build Path
Source Alt+Shift+S
Refactor Alt+Shift+T
Import...
Export...
References
Declarations
Refresh F5
Assign Working Sets...
Coverage As
Run As
Debug As
Restore from Local History...
Team
Compare With
Replace With
Run Configurations...
@BeforeAll
static void setUpBe
}
@AfterAll
static void tearDow
}
@BeforeEach
void setUp() throws
sampleLib = new
}
@AfterEach
void tearDown() thr
}
@Test
@DisplayName("Simpl
void testSayHelloTo
assertEquals("H
}
@Test
@DisplayName("Simpl
void testSayHelloTo
assertEquals("H
}
@Test
@DisplayName("Simpl
void testSumCorrect
assertEquals(9,
}
@Test
Problems
Javadoc
Merged (Oct 24, 2021 5:08:54 PM)
src
ce103
JavaSampleLib.java
JavaSampleLib


Package Explorer
JUnit
Finished after 0.407 seconds
Runs: 14/14
Errors: 0
Failures: 3
JavaSampleLibTest [Runner: JUnit 5] (0.129 s)
Simple sum shouldn't work (0.000 s)
testWithStringParameter(int[]) (0.049 s)
[1] [1, 2, 2] (0.049 s)
[2] [5, 3, 15] (0.002 s)
[3] [121, 4, 484] (0.001 s)
[4] [2, 2, 2] (0.003 s)
Simple sum should work (0.003 s)
Simple Say Hello shouldn' work (0.005 s)
Simple multiplication should work (0.003 s)
Simple Say Hello should work (0.002 s)
Ensure correct handling of zero (0.002 s)
repetition 1 of 5 (0.002 s)
repetition 2 of 5 (0.001 s)
repetition 3 of 5 (0.001 s)
repetition 4 of 5 (0.002 s)
repetition 5 of 5 (0.002 s)


eclipse-workspace - java-sample-lib-ext/src/main/java/ce103/JavaSampleLib.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Run Window Help
Package Explorer
JUnit
Finished after 0.697 seconds
Runs: 14/14
Errors: 0
Failures: 3
JavaSampleLibTest [Runner: JUnit 5] (0.278 s)
Simple sum shouldn't work (0.017 s)
testWithStringParameter(int[]) (0.084 s)
Simple sum should work (0.002 s)
Simple Say Hello shouldn' work (0.005 s)
Simple multiplication should work (0.002 s)
Simple Say Hello should work (0.002 s)
Ensure correct handling of zero (0.002 s)
Failure Trace
org.opentest4j.AssertionFailedError: Regular sum shouldn't work ==> expected: <10>
at ce103.JavaSampleLibTest.testSumWrong(JavaSampleLibTest.java:58)
at java.base/java.util.ArrayList.forEach(ArrayList.java:1511)
at java.base/java.util.ArrayList.forEach(ArrayList.java:1511)
JavaSampleLib.java
1 package ce103;
3 public class JavaSampleLib {
5 public static String sayHelloTo(String name) {
7 String output = "";
9 if(!name.isBlank() && !name.isEmpty()){
10 output = "Hello "+name;
11 }else {
12 output = "Hello There";
13 }
15 System.out.println(output);
17 return output;
18 }
20 public static int sum(int a,int b)
21 {
22 int c = 0;
23 c = a+b;
24 return c;
25 }
27 public int multiply(int a, int b) {
28 return a * b;
29 }
32 }
Problems Javadoc Declaration Console Coverage
JavaSampleLibTestExt (Oct 24, 2021 5:39:34 PM)
Element | Coverage | Covered Instructio... | Missed Instructions | Total Instructions
java-sample-lib-ext | 92.4 % | 182 | 15 | 197
src/test/java | 91.8 % | 145 | 13 | 158
ce103 | 91.8 % | 145 | 13 | 158
JavaSampleLibTest.java | 91.8 % | 145 | 13 | 158
src/main/java | 94.9 % | 37 | 2 | 39
ce103 | 94.9 % | 37 | 2 | 39
JavaSampleLib.java | 94.9 % | 37 | 2 | 39

Thats a part of java unit testing...

TDD (Test Driven Development)

Test and Deployment Automation Management

Travis-CI + C

Travis-CI + Cpp

Travis-CI + C#

Travis-CI + Java

References

GitHub - MicrosoftDocs/cpp-docs: C++ Documentation