

CE103 Algorithms and Programming I

Introduction to Code Reusability and Automate Testing

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0.1 CE103 Algorithms and Programming I

0.1.1 Week-4

0.1.1.1 Introduction to Code Reusability and Automated Testing Download [DOC¹](#), [SLIDE²](#), [PPTX³](#)

0.1.1.2 Outline

- Introduction to Code Reusability and Automated Testing
 - Shared Library Development
 - C
 - C++
 - C#
 - Java
 - Unit Testing
 - C
 - C++
 - C#
 - Java
 - Continues Integration Platforms
-

0.2 Introduction to Code Reusability and Automated Testing

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

0.3 Selected Development Environment

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

0.4 Example Content

- 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 the result to the sum variable.
 - We will locate them in the library and use them from a console application, also we will create unit tests for testing their functionalities and return variables
-

¹[ce103-week-4-test.en.md_doc.pdf](#)

²[ce103-week-4-test.en.md_slide.pdf](#)

³[ce103-week-4-test.en.md_slide.pptx](#)

0.5 Shared Library Development

0.5.1 C Programming (Static Library)

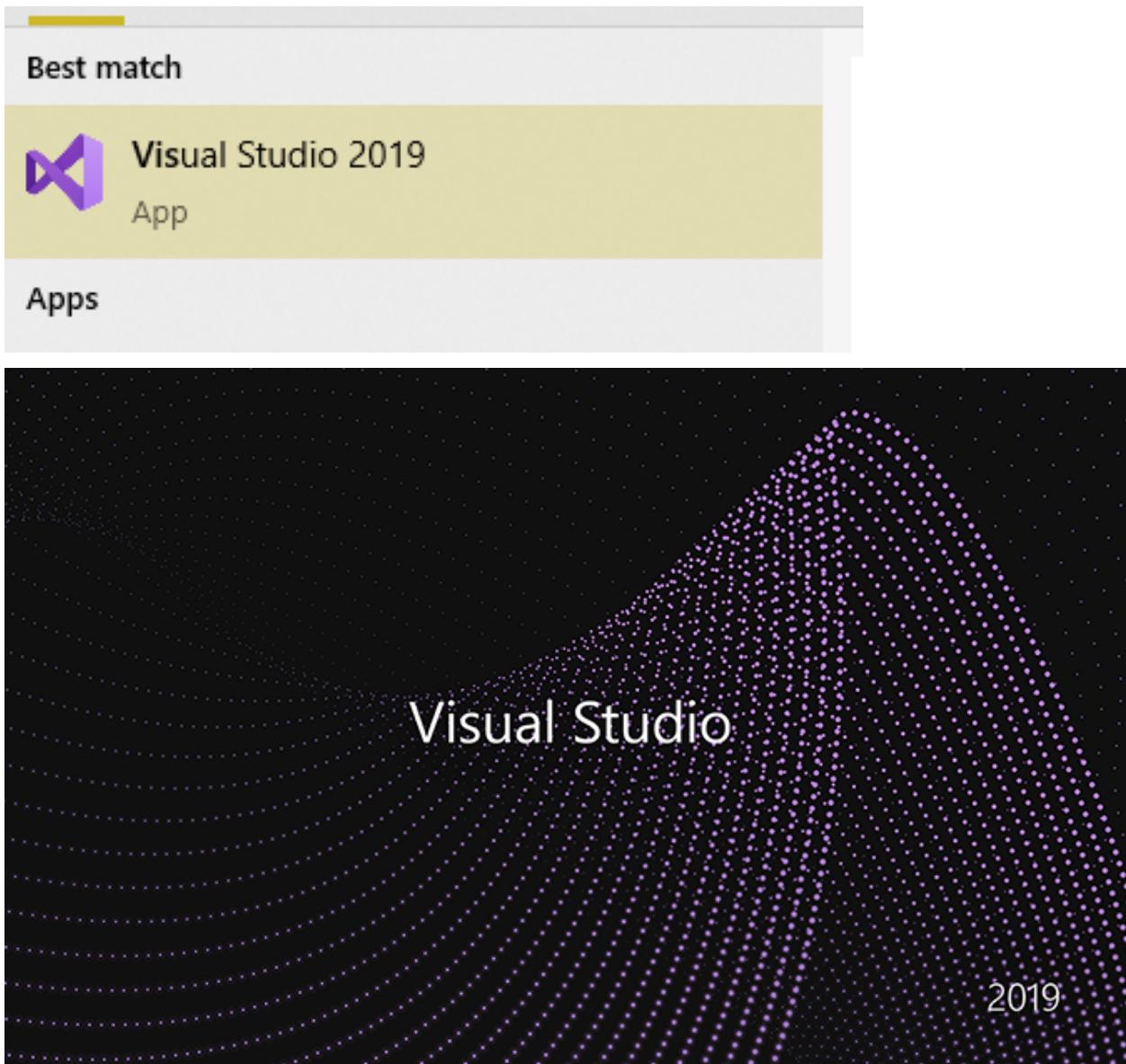
0.5.1.1 Visual Studio Community Edition

0.6 Shared Library Development - (VS C Static Library)-1

- In this sample, we will create a **c-lib-sample** project that contains a library, executable, unit tests and unit test runners.
 - First of all, you install Visual Studio Community Edition from the website
 - Visual Studio 2019 Community Edition - Son Ücretsiz Sürümü İndir⁴
-

0.7 Shared Library Development - (VS C Static Library)-2

- Open visual studio community edition and select create a new project



⁴<https://visualstudio.microsoft.com/tr/vs/community/>

0.8 Shared Library Development - (VS C Static Library)-3

- Select create a new project

Get started

 **Clone a repository**
Get code from an online repository like GitHub or Azure DevOps

 **Open a project or solution**
Open a local Visual Studio project or .sln file

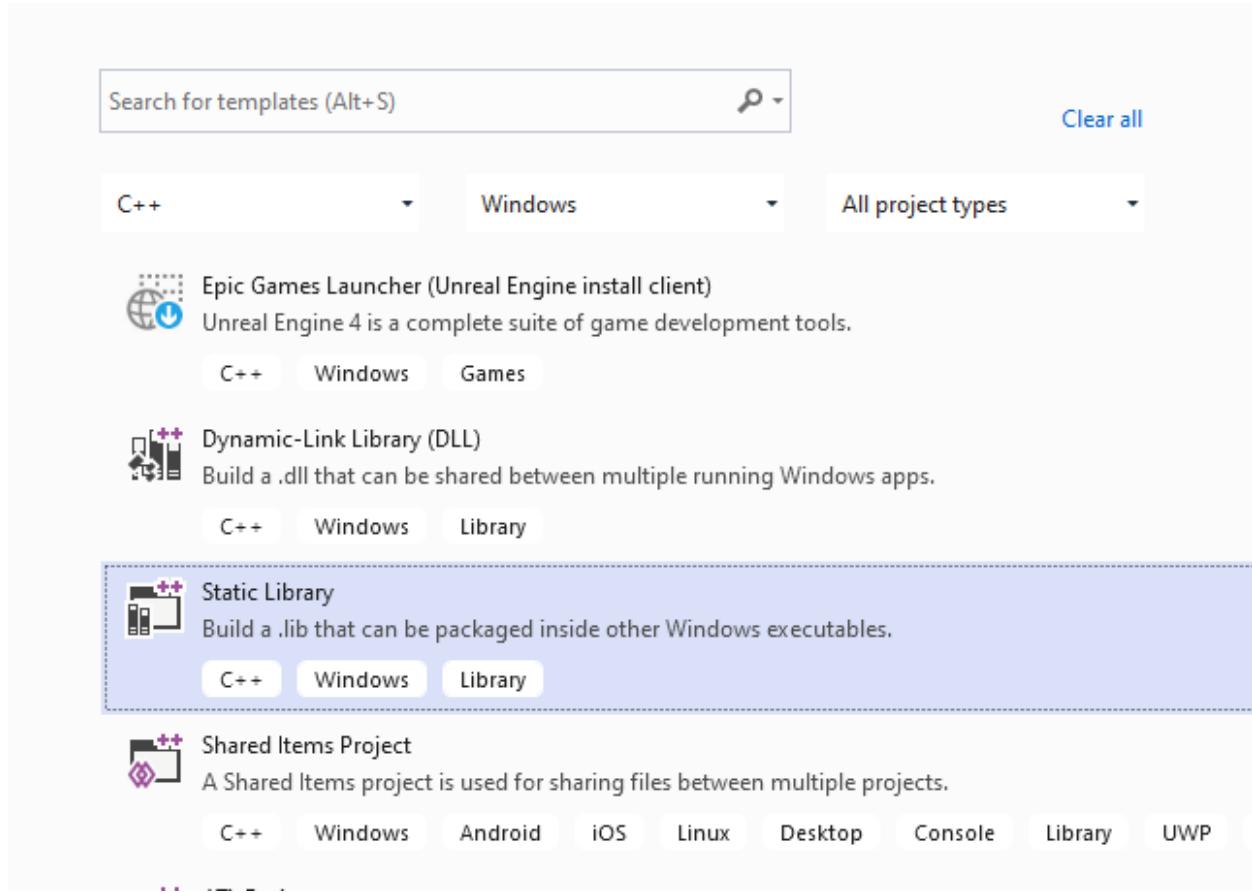
 **Open a local folder**
Navigate and edit code within any folder

 **Create a new project**
Choose a project template with code scaffolding to get started

[Continue without code →](#)

0.9 Shared Library Development - (VS C Static Library)-4

- Select C++ static library from the project list



0.10 Shared Library Development - (VS C Static Library)-5

- Give static library project name

Configure your new project

Static Library C++ Windows Library

Project name

c-sample-lib

Location

E:\UgurCoruh\RTEU\Lectures\2021-2022 Güz CE103 - Algorithms and Programming I\Lectures\ce1l

...

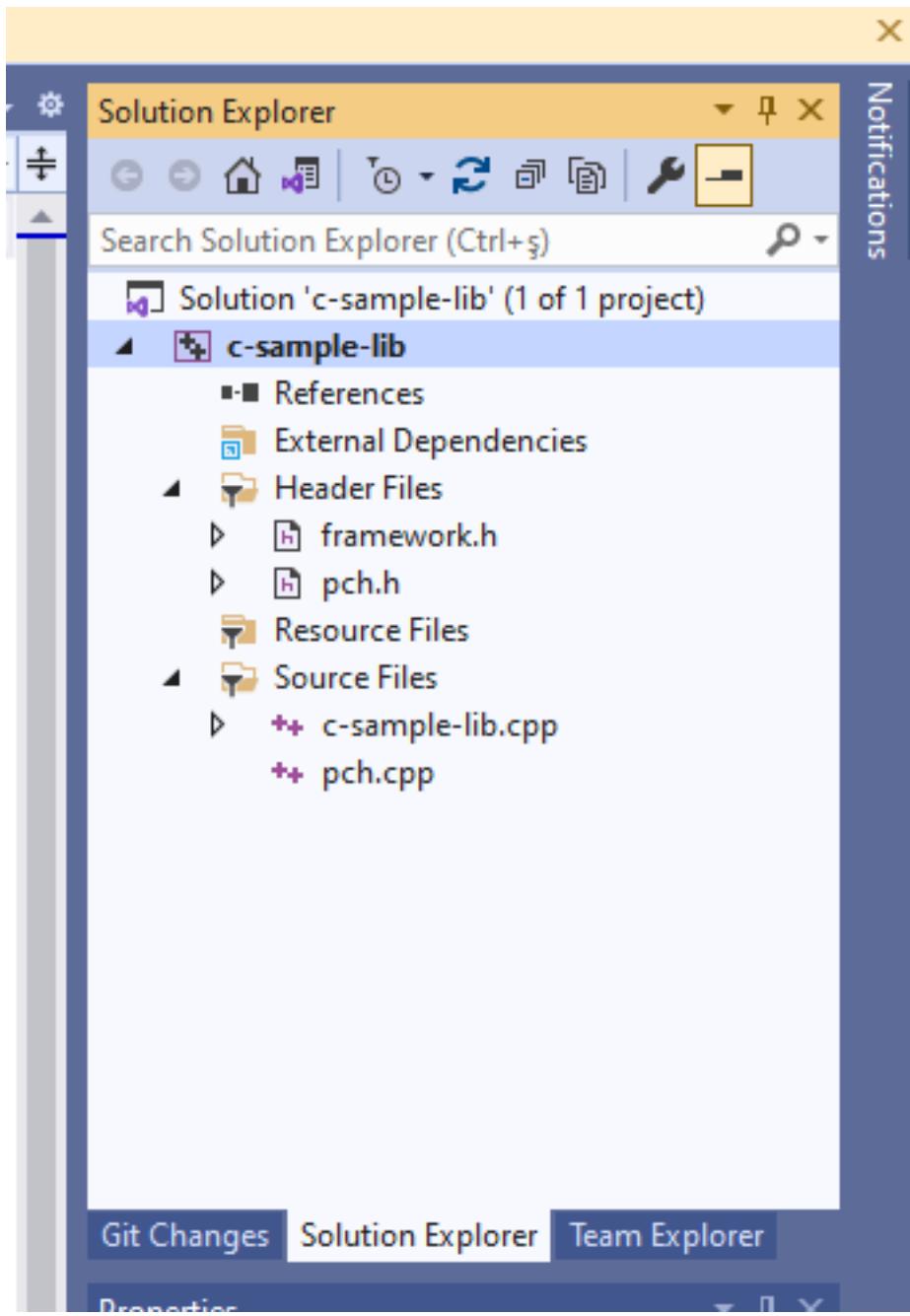
Solution name i

c-sample-lib

Place solution and project in the same directory

0.11 Shared Library Development - (VS C Static Library)-6

- Default configuration come with C++ project types and setting



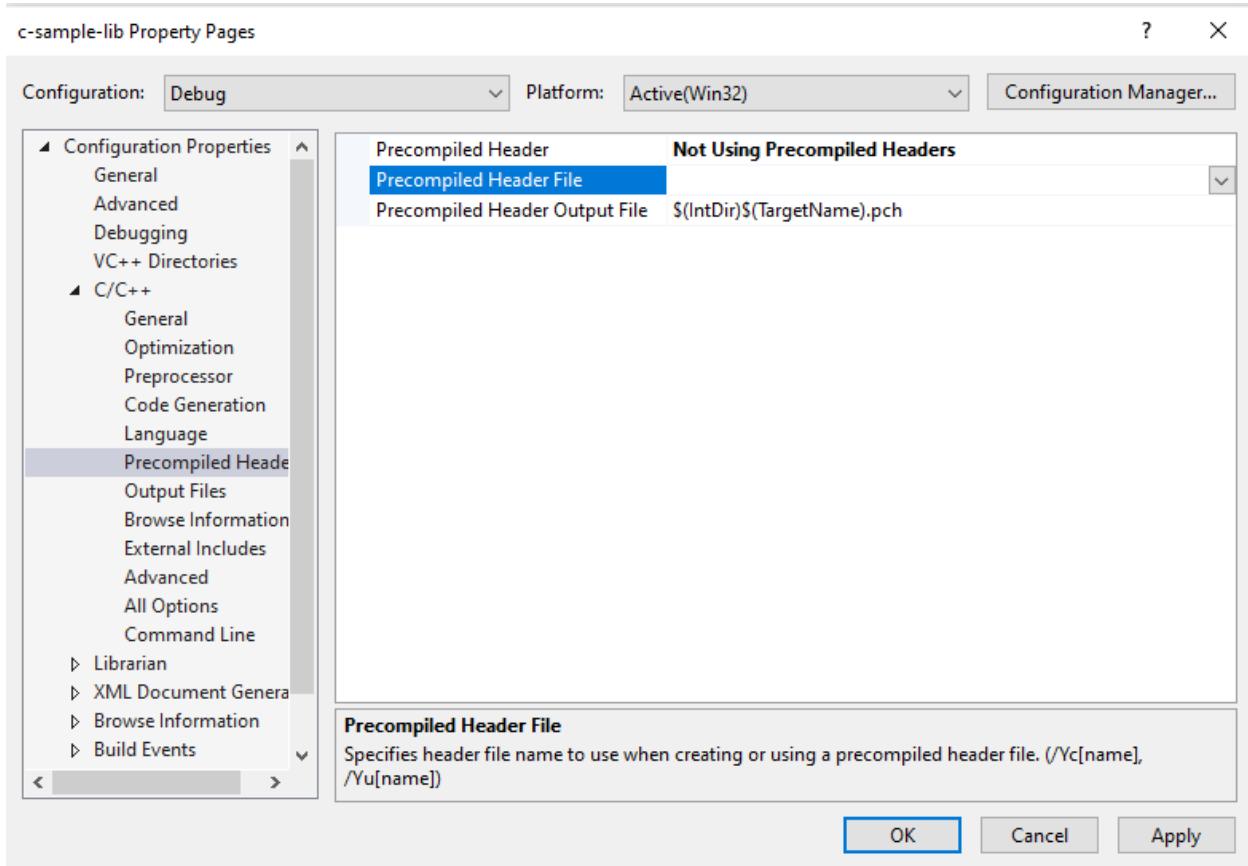
0.12 Shared Library Development - (VS C Static Library)-7

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

```
void fnCSampleLib(){  
}
```

0.13 Shared Library Development - (VS C Static Library)-8

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



0.14 Shared Library Development - (VS C Static Library)-9

- 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;
}

```

0.15 Shared Library Development - (VS C Static Library)-10

- Also, update `samplelib.h` as follows.

```

#pragma once

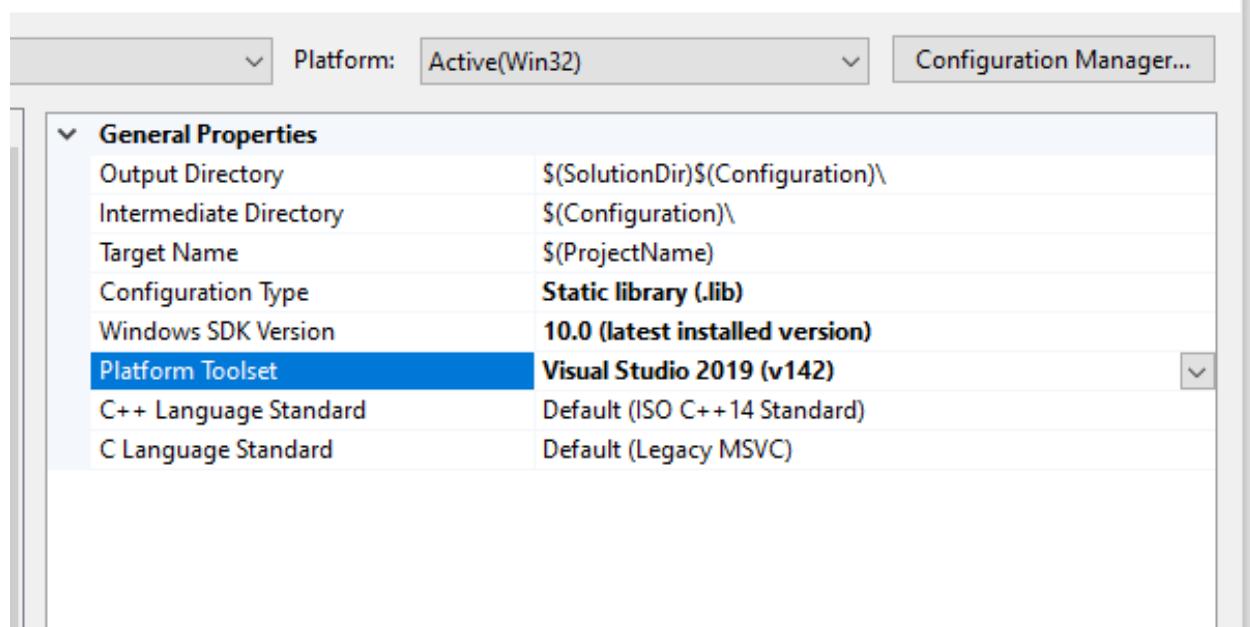
#define WIN32_LEAN_AND_MEAN           // Exclude rarely-used stuff from Windows headers

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

```

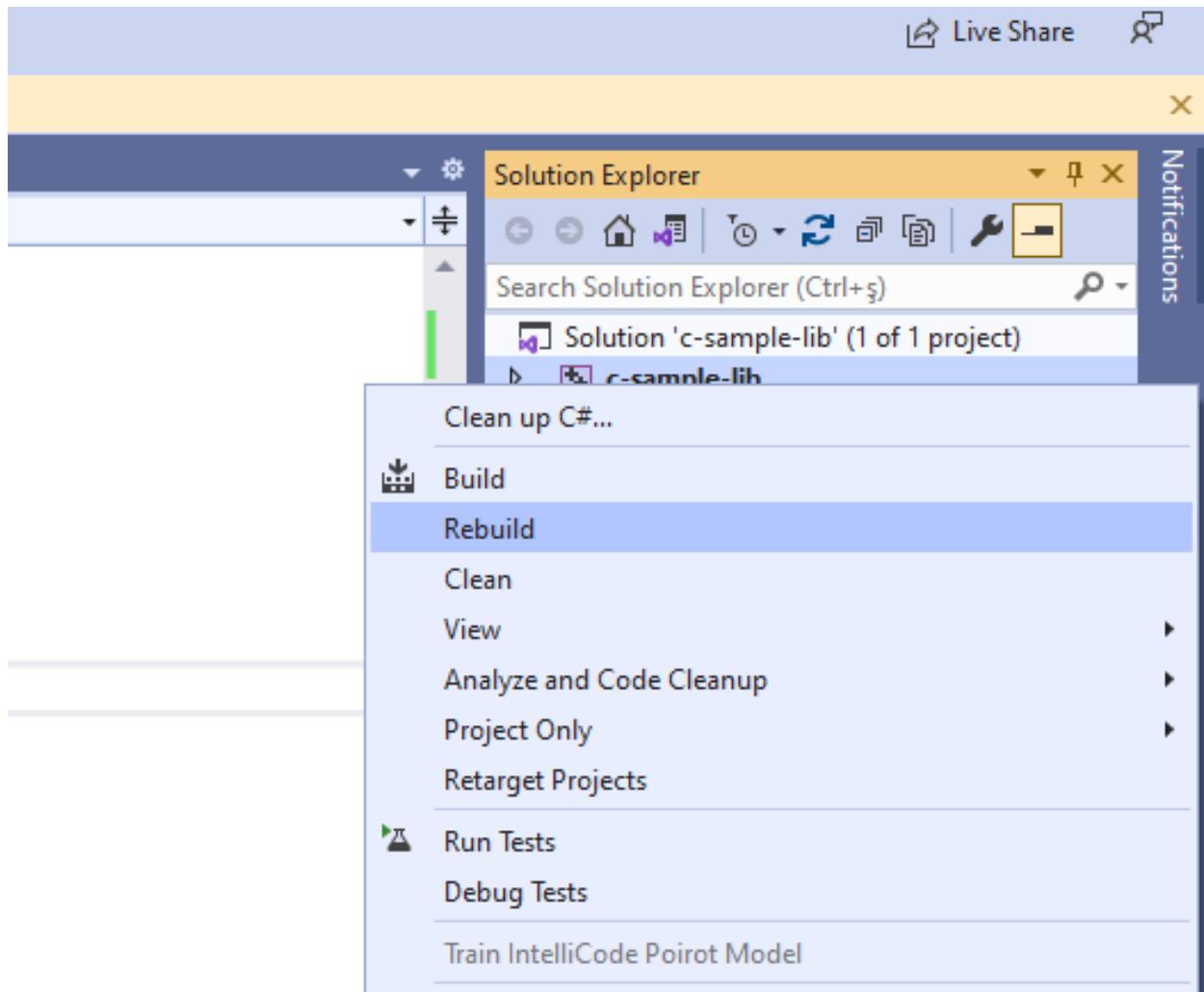
0.16 Shared Library Development - (VS C Static Library)-11

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



0.17 Shared Library Development - (VS C Static Library)-12

- Now we can compile our library



0.18 Shared Library Development - (VS C Static Library)-13

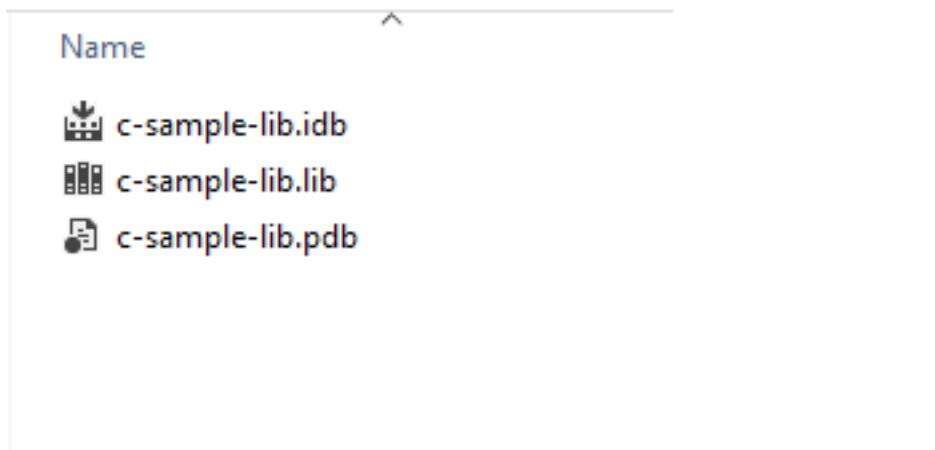
- You can follow operation from the output window

The screenshot shows the Visual Studio Output window. At the top, it says "144 % No issues found". Below that, the title bar says "Output" and the dropdown says "Show output from: Build". The main area of the window displays the following text:

```
Rebuild started...
1>----- Rebuild All started: Project: c-sample-lib, Configuration: Debug
1>c-sample-lib.c
1>c-sample-lib.vcxproj -> E:\UgurCoruh\RTEU\Lectures\2021-2
===== Rebuild All: 1 succeeded, 0 failed, 0 skipped ==
```

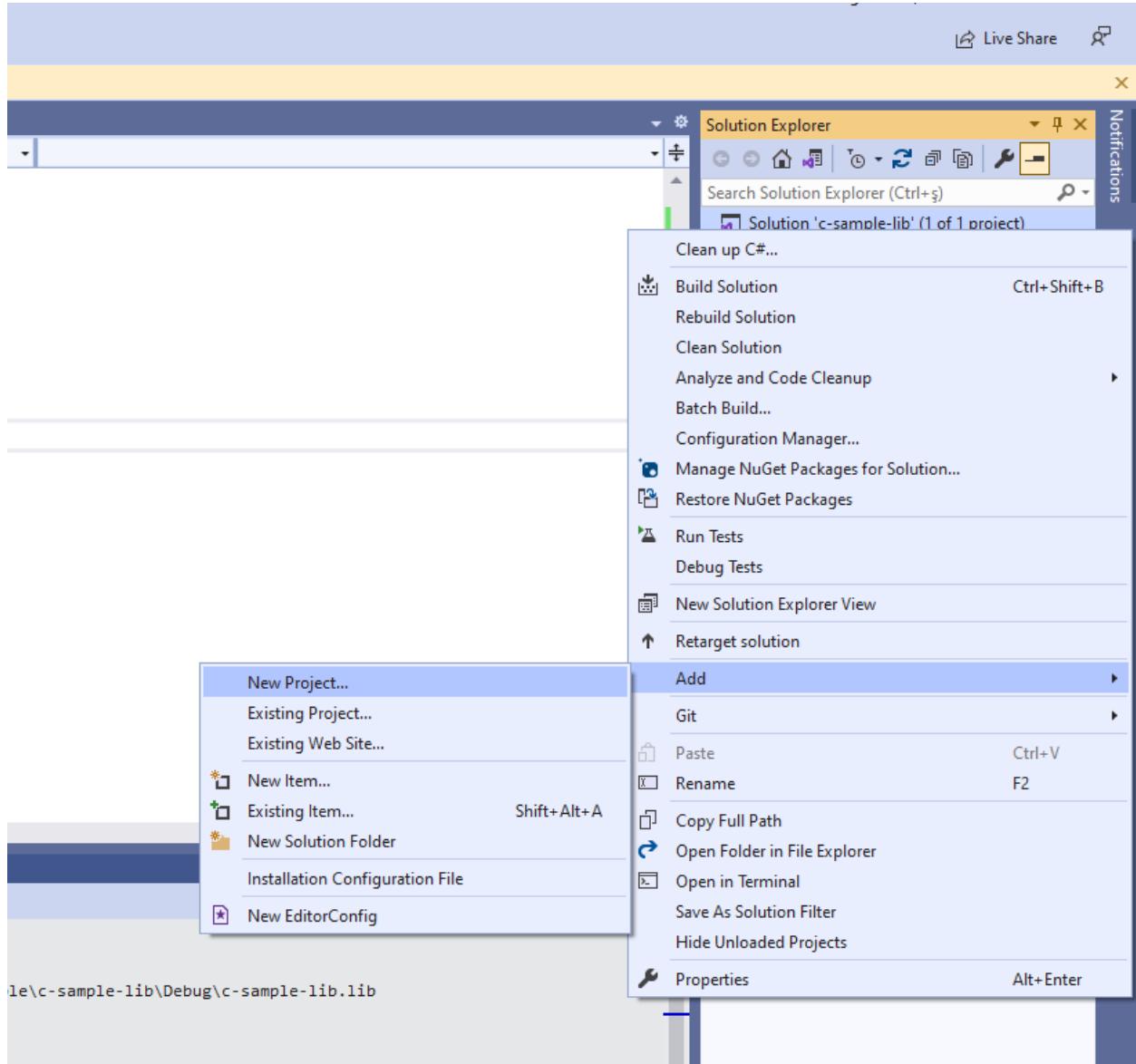
0.19 Shared Library Development - (VS C Static Library)-14

- In the debug folder, we will see our output



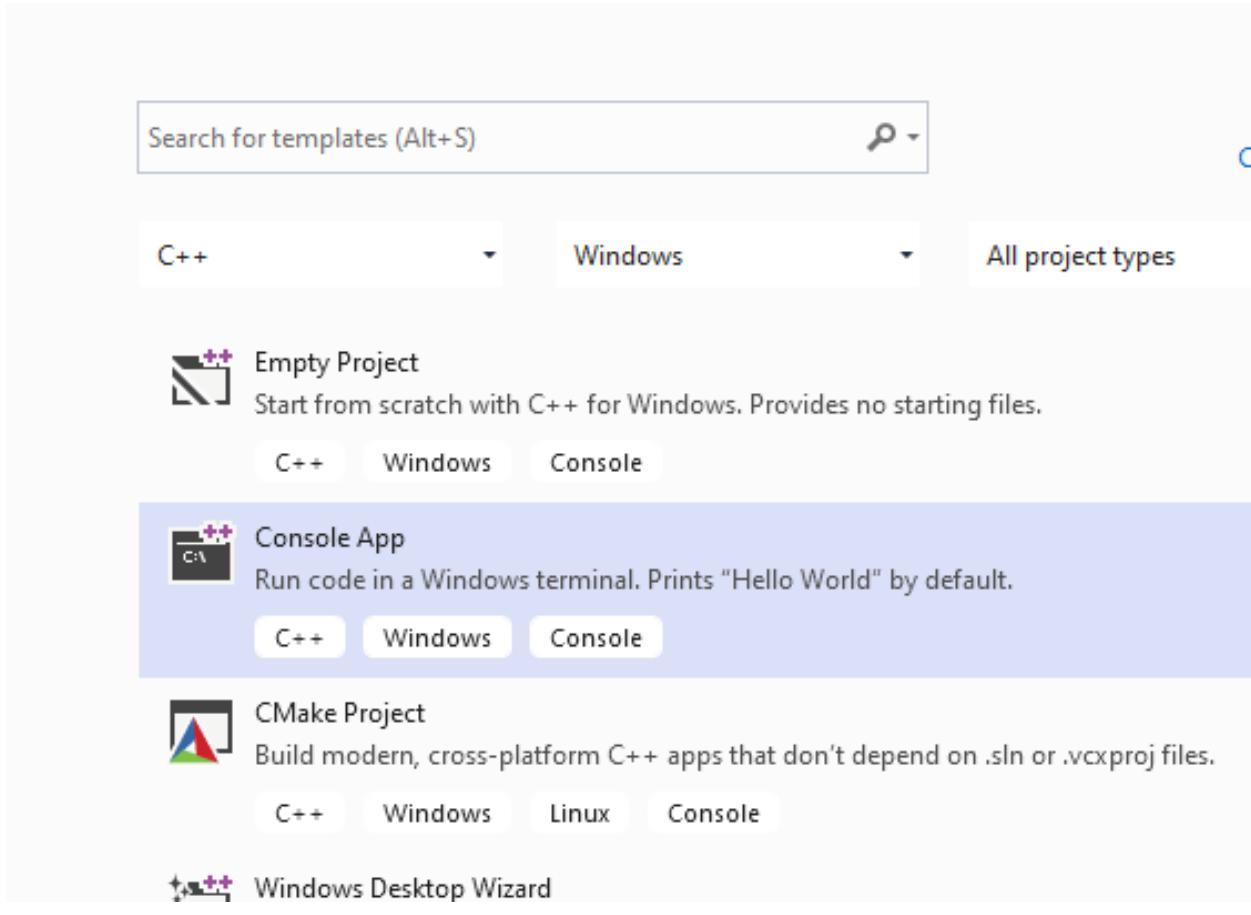
0.20 Shared Library Development - (VS C Static Library)-15

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



0.21 Shared Library Development - (VS C Static Library)-16

select C++ Windows Console Application from list



0.22 Shared Library Development - (VS C Static Library)-17

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

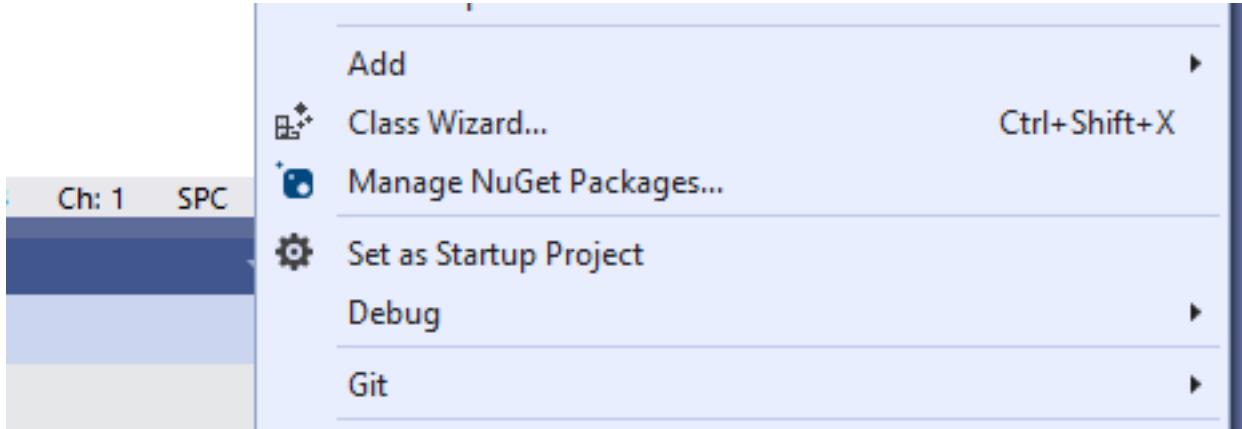
we will convert `c-sample-app.c` to following code

```
#include <stdio.h>

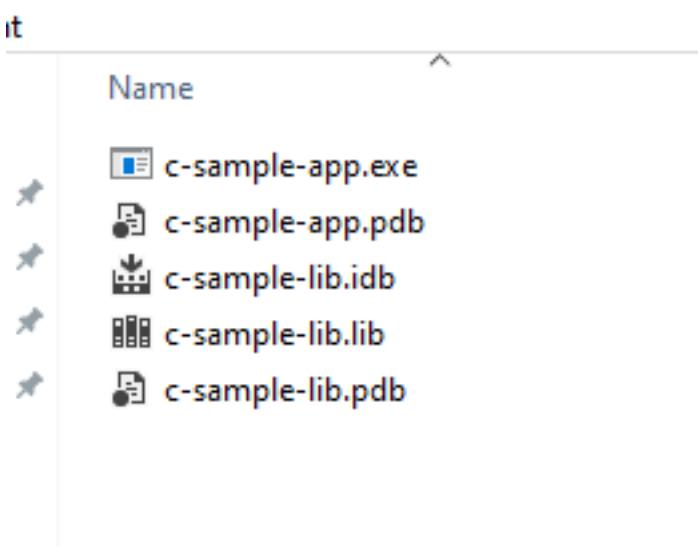
/// <summary>
///
/// </summary>
/// <returns></returns>
int main()
{
    printf("Hello World!\n");
}
```

0.23 Shared Library Development - (VS C Static Library)-18

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 the application we will see only "Hello World"

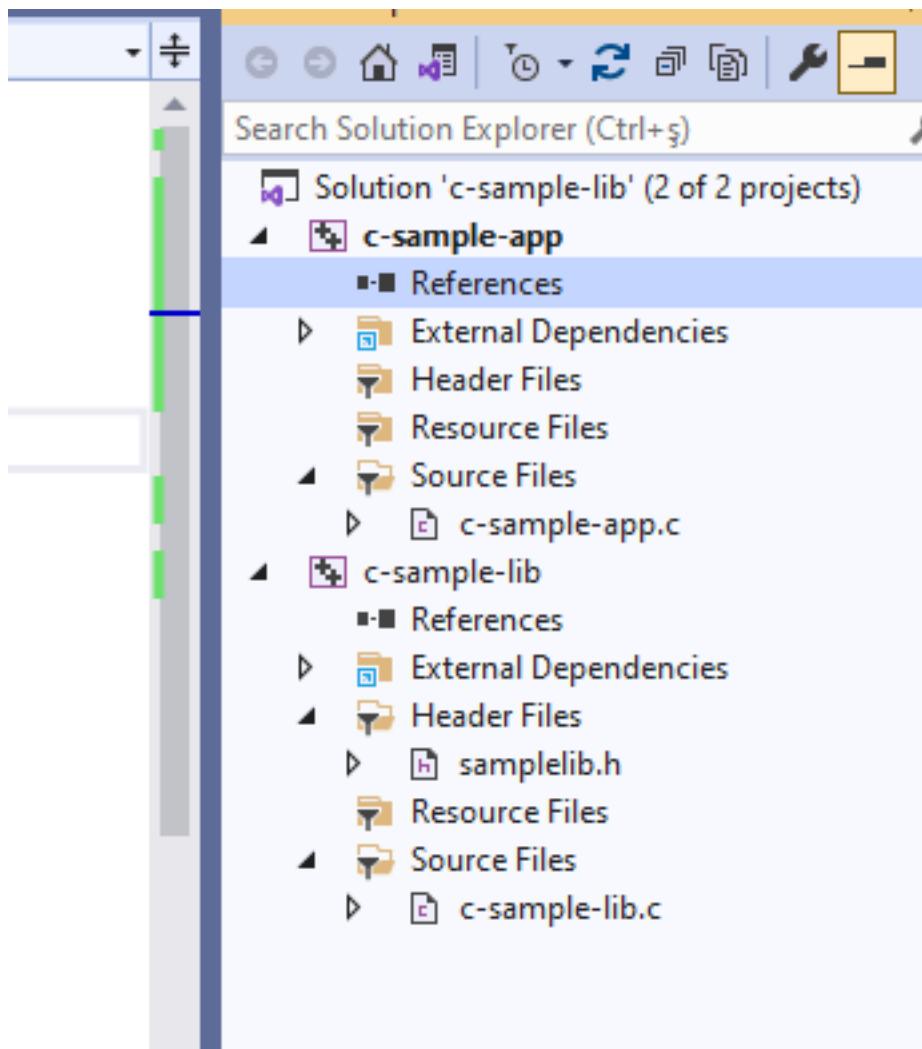
0.24 Shared Library Development - (VS C Static Library)-19

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

0.25 Shared Library Development - (VS C Static Library)-20

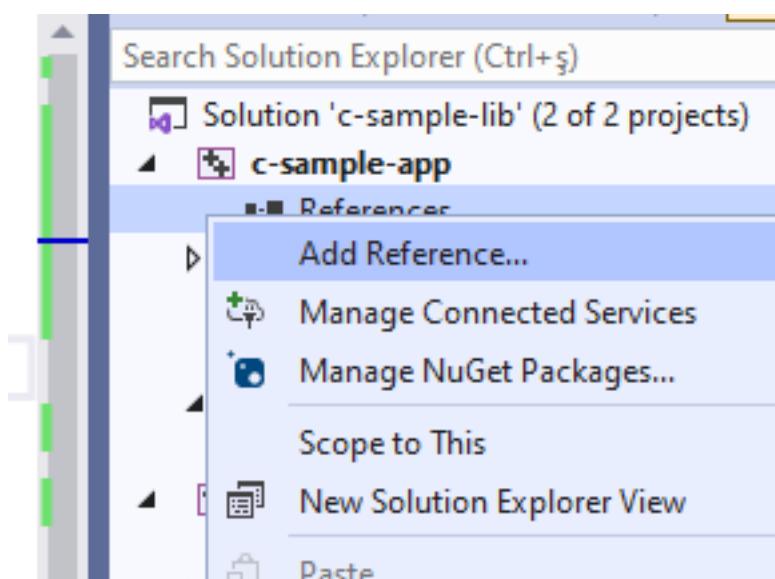
First option

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



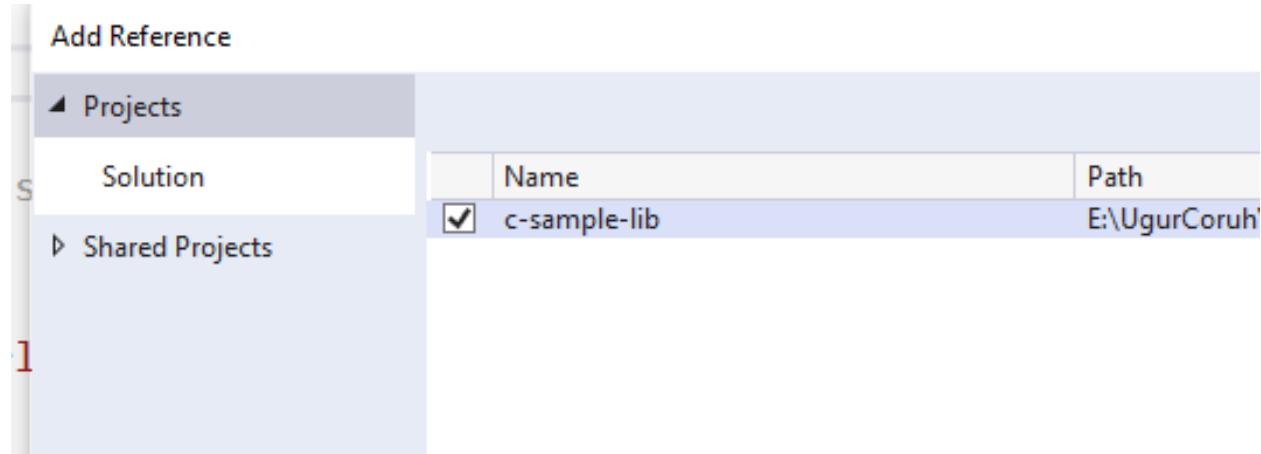
0.26 Shared Library Development - (VS C Static Library)-21

- Select Add Reference



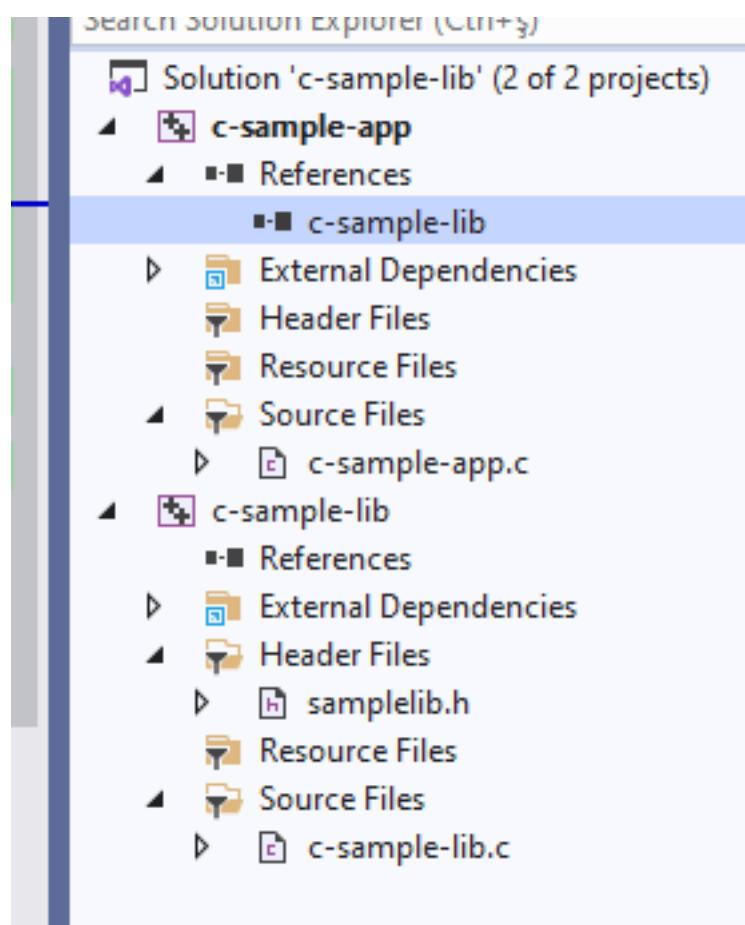
0.27 Shared Library Development - (VS C Static Library)-22

- Browse for solution and select c-sample-lib



0.28 Shared Library Development - (VS C Static Library)-23

You can check added reference from references section



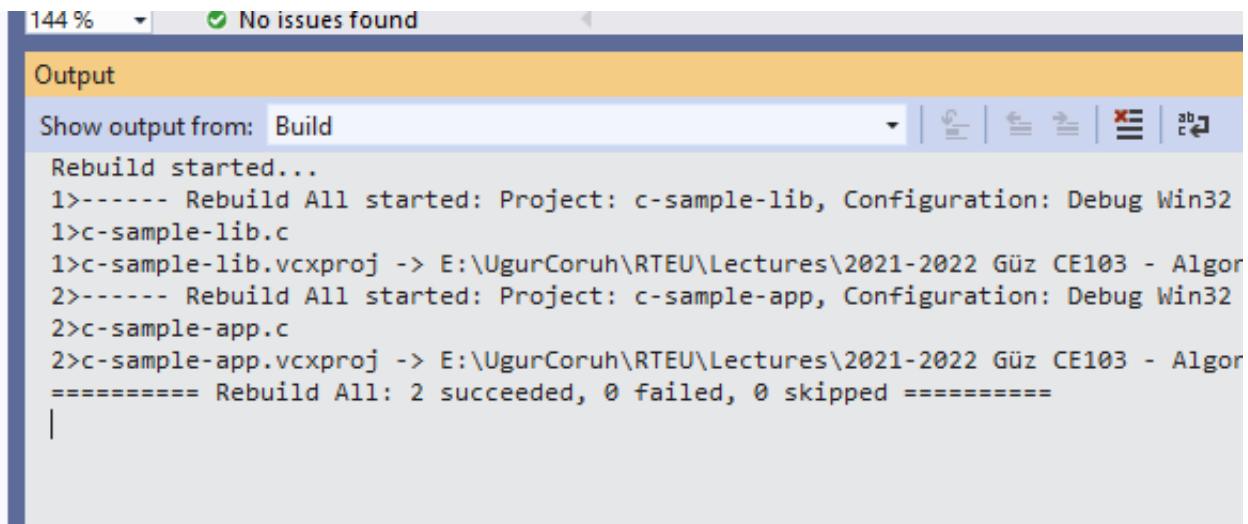
0.29 Shared Library Development - (VS C Static Library)-24

- 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");
}
```

0.30 Shared Library Development - (VS C Static Library)-25

- we can build our c-sample-app



The screenshot shows the Visual Studio Output window with the following log:

```
144 %  No issues found
Output
Show output from: Build
Rebuild started...
1>----- Rebuild All started: Project: c-sample-lib, Configuration: Debug Win32
1>c-sample-lib.c
1>c-sample-lib.vcxproj -> E:\UgurCoruh\RTEU\Lectures\2021-2022 Güz CE103 - Algor
2>----- Rebuild All started: Project: c-sample-app, Configuration: Debug Win32
2>c-sample-app.c
2>c-sample-app.vcxproj -> E:\UgurCoruh\RTEU\Lectures\2021-2022 Güz CE103 - Algor
===== Rebuild All: 2 succeeded, 0 failed, 0 skipped =====
```

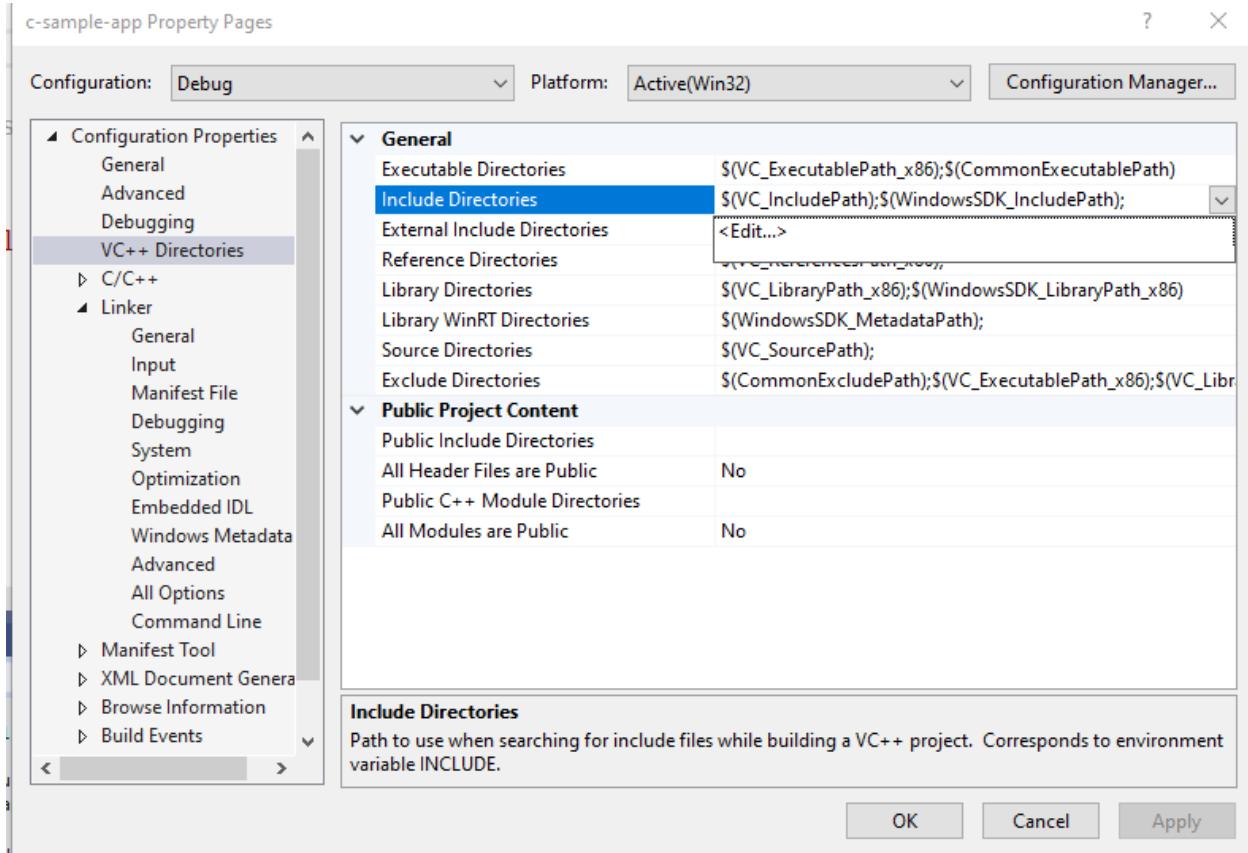
0.31 Shared Library Development - (VS C Static Library)-26

- Also we can only write header name

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

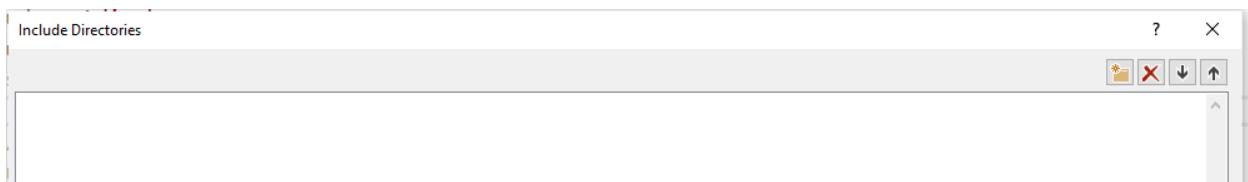
0.32 Shared Library Development - (VS C Static Library)-27

- For this option, we need to configure include directories

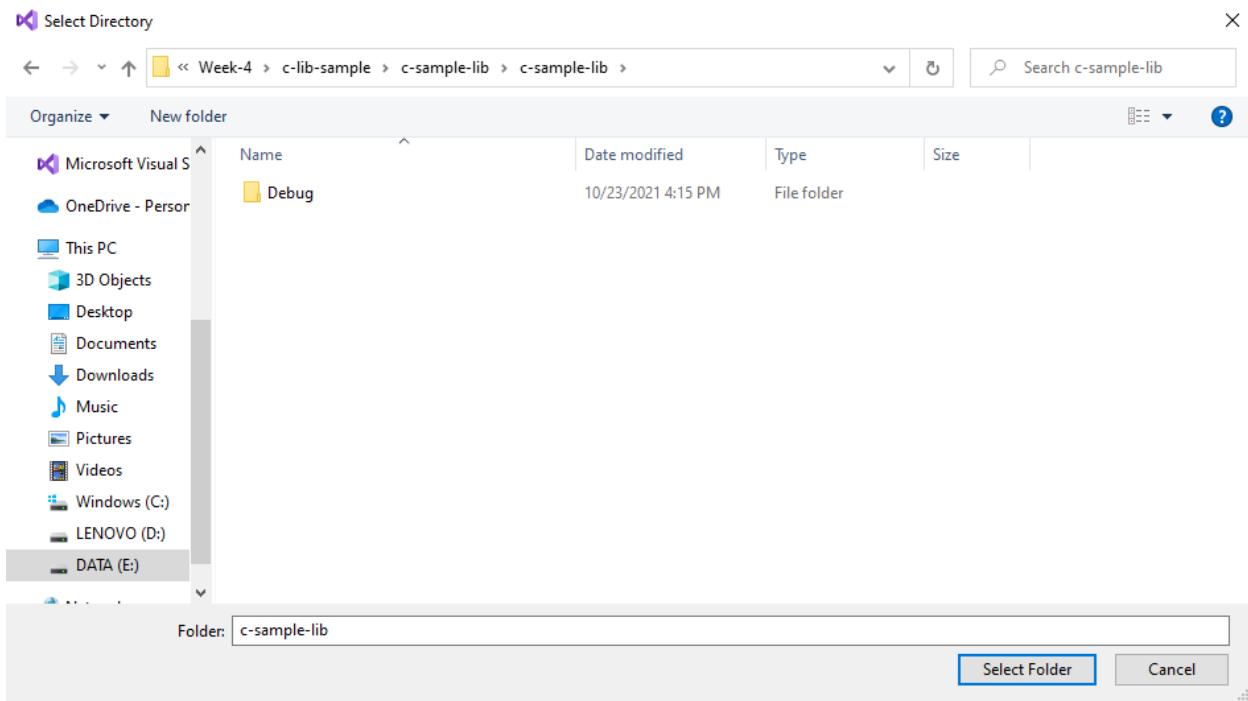


0.33 Shared Library Development - (VS C Static Library)-28

select c-sample-lib header file location

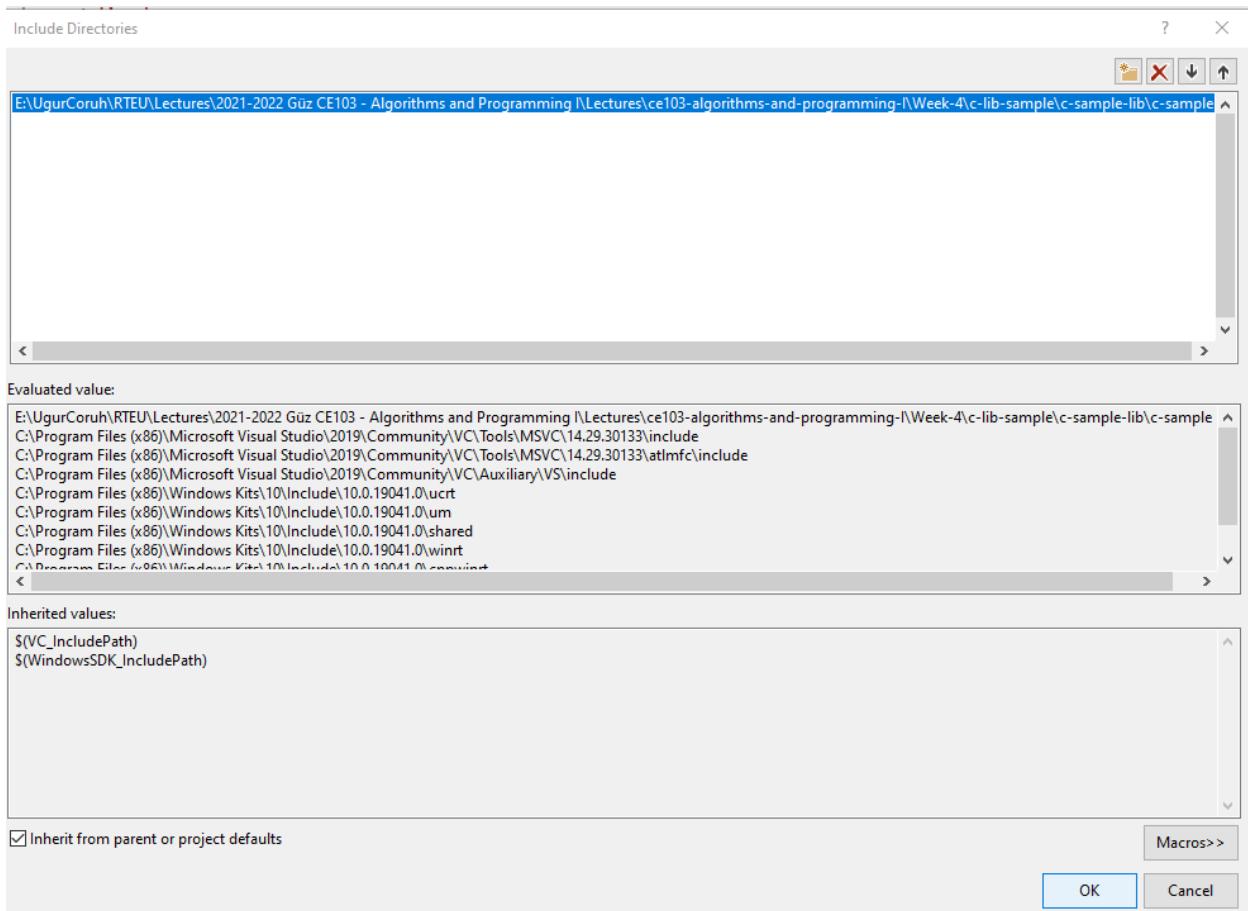


browse for folder



0.34 Shared Library Development - (VS C Static Library)-29

your full path will be added to your configuration



0.35 Shared Library Development - (VS C Static Library)-30

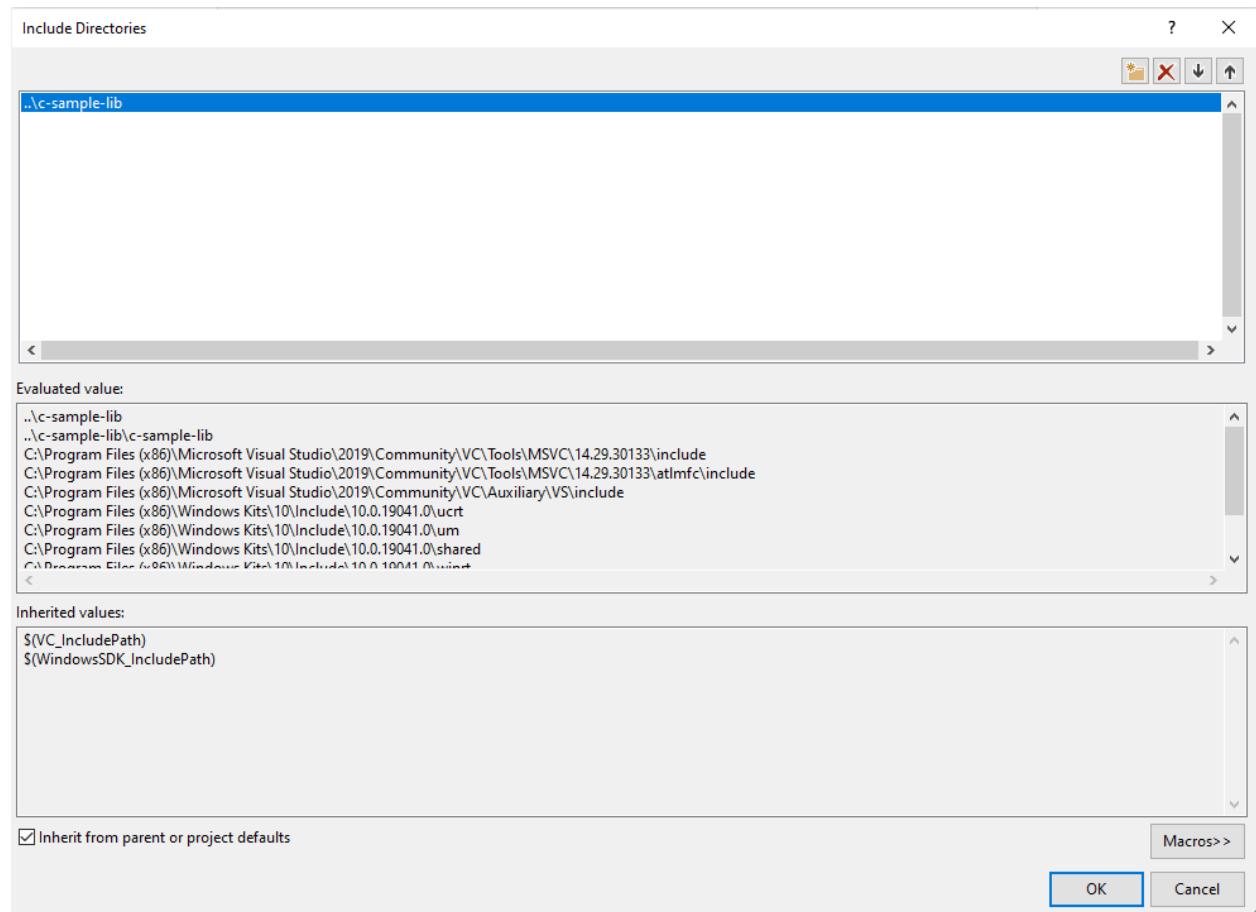
if you add header file paths to your configuration you can use header files by name in your source code

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

0.36 Shared Library Development - (VS C Static Library)-31

- 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



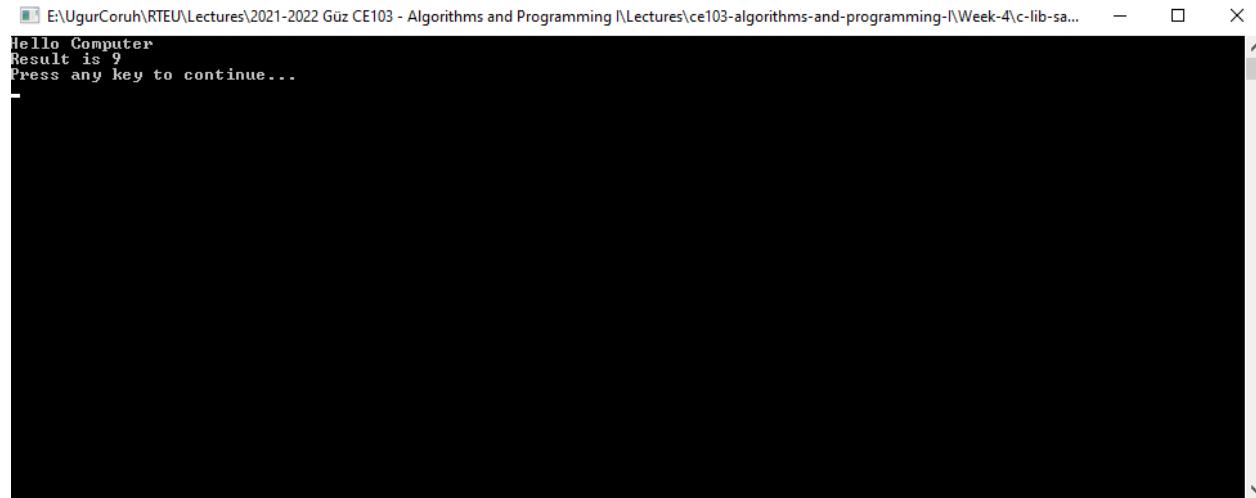
0.37 Shared Library Development - (VS C Static Library)-32

- 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;
}
```

0.38 Shared Library Development - (VS C Static Library)-33

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



0.39 Shared Library Development - (VS C Static Library)-34

- A 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. In another case you can use a precompiled static library with you or this library can be part of any installation then if there is an installed app and static libraries are placed on the system folder or any different location then you can use configuration files to set library path and included header paths
-

0.40 Shared Library Development - (VS C Static Library)-35

- Now we can remove the 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

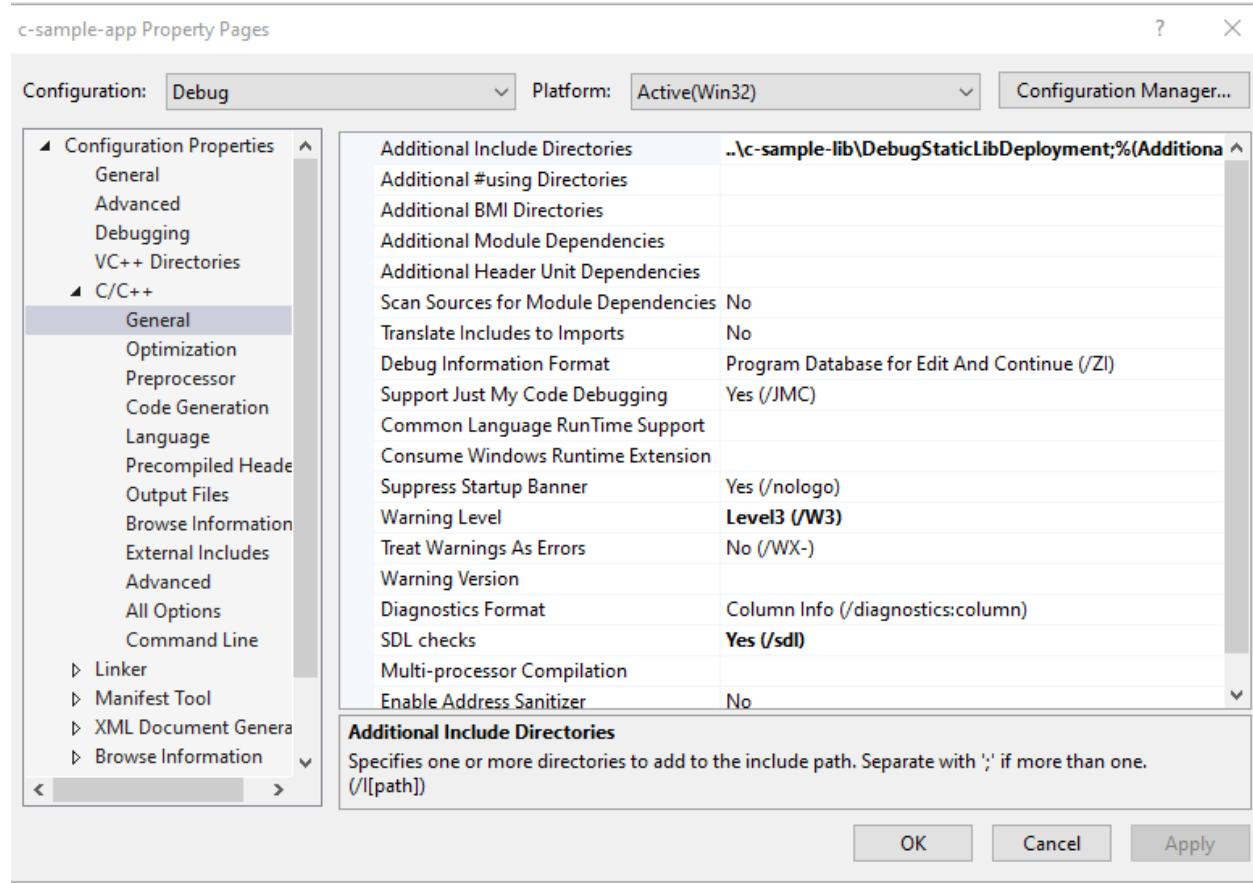
- Set C/C++ -> General -> Additional Include Directories

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

0.41 Shared Library Development - (VS C Static Library)-36

Not Working Solution

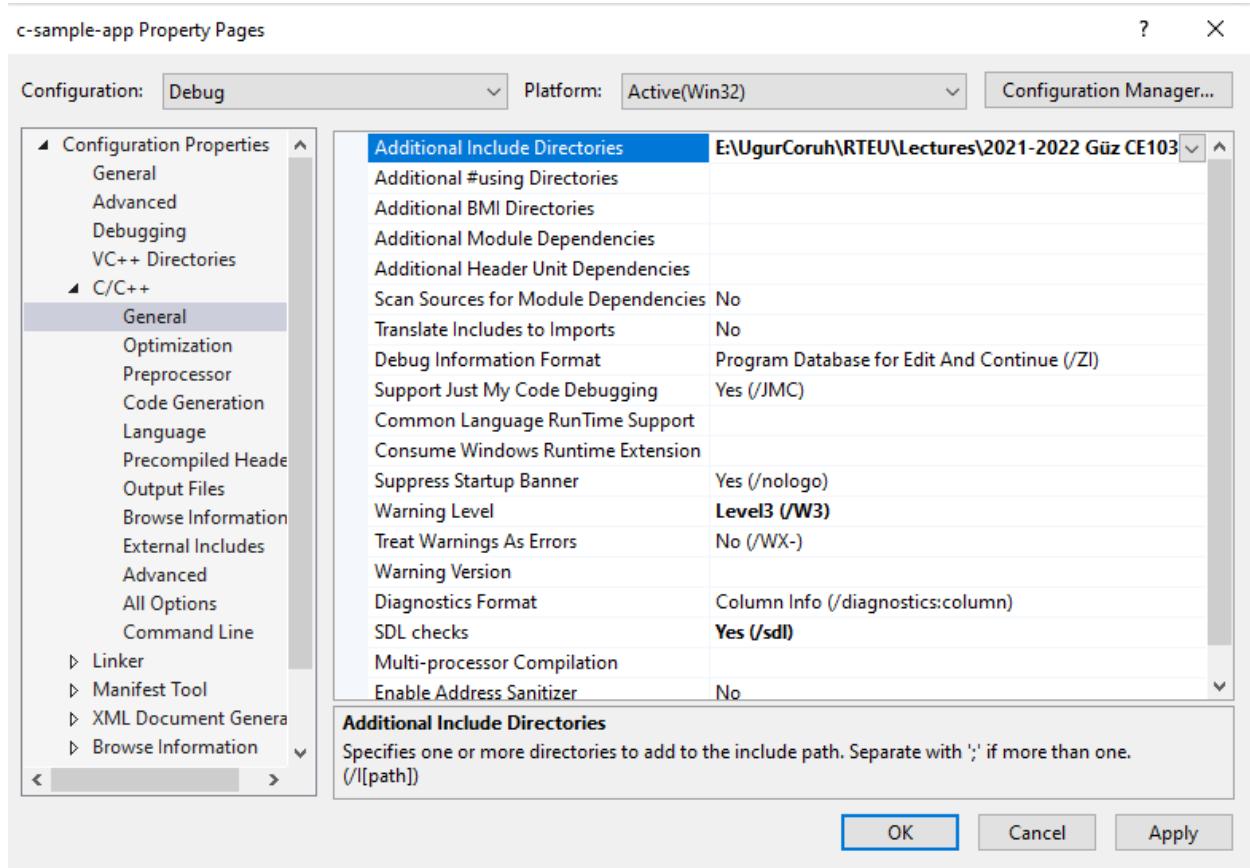
..\\c-sample-lib\\DebugStaticLibDeployment



0.42 Shared Library Development - (VS C Static Library)-37

Working Solution

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



0.43 Shared Library Development - (VS C Static Library)-38

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

0.44 Shared Library Development - (VS C Static Library)-39

Working Solution

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

Configuration: Debug Platform: Active(Win32) Configuration Manager...

▲ Configuration Properties ▼

- General
- Advanced
- Debugging
- VC++ Directories
- ▶ C/C++
 - General
 - Optimization
 - Preprocessor
 - Code Generation
 - Language
 - Precompiled Headers
 - Output Files
 - Browse Information
 - External Includes
 - Advanced
 - All Options
 - Command Line
- ▷ Linker
- ▷ Manifest Tool
- ▷ XML Document Generation
- ▷ Browse Information

▼ General

| | |
|------------------------------|--|
| Executable Directories | <code>\$(VC_ExecutePath_x86);\$(CommonExecutablePath)</code> |
| Include Directories | <code>\$(IncludePath)</code> |
| External Include Directories | <code>\$(ExternalAllIncludePath)</code> |
| Reference Directories | <code>\$(VC_ReferencesPath_x86);</code> |
| Library Directories | <code>E:\UgurCoruh\RTEU\Lectures\2021-2022 Güz CE103 - A\</code> |
| Library WinRT Directories | <code>\$(WindowsSDK_MetadataPath);</code> |
| Source Directories | <code>\$(VC_SourcePath);</code> |
| Exclude Directories | <code>\$(CommonExcludePath);\$(VC_ExecutePath_x86);\$(VC_Libr</code> |

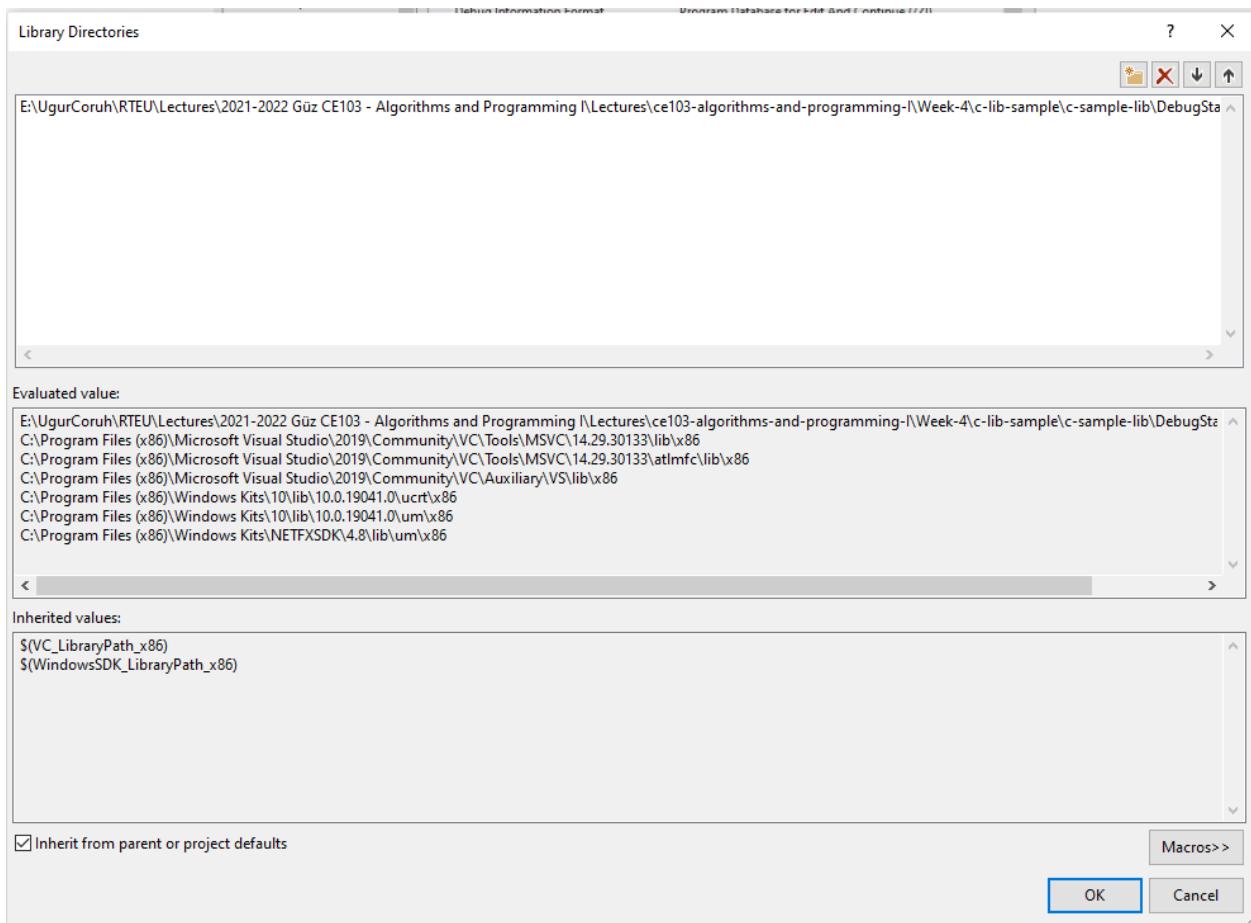
▼ Public Project Content

| | |
|-------------------------------|----|
| Public Include Directories | No |
| All Header Files are Public | No |
| Public C++ Module Directories | |
| All Modules are Public | |

Library Directories
Path to use when searching for library files while building a VC++ project. Corresponds to environment variable LIB.

OK Cancel Apply

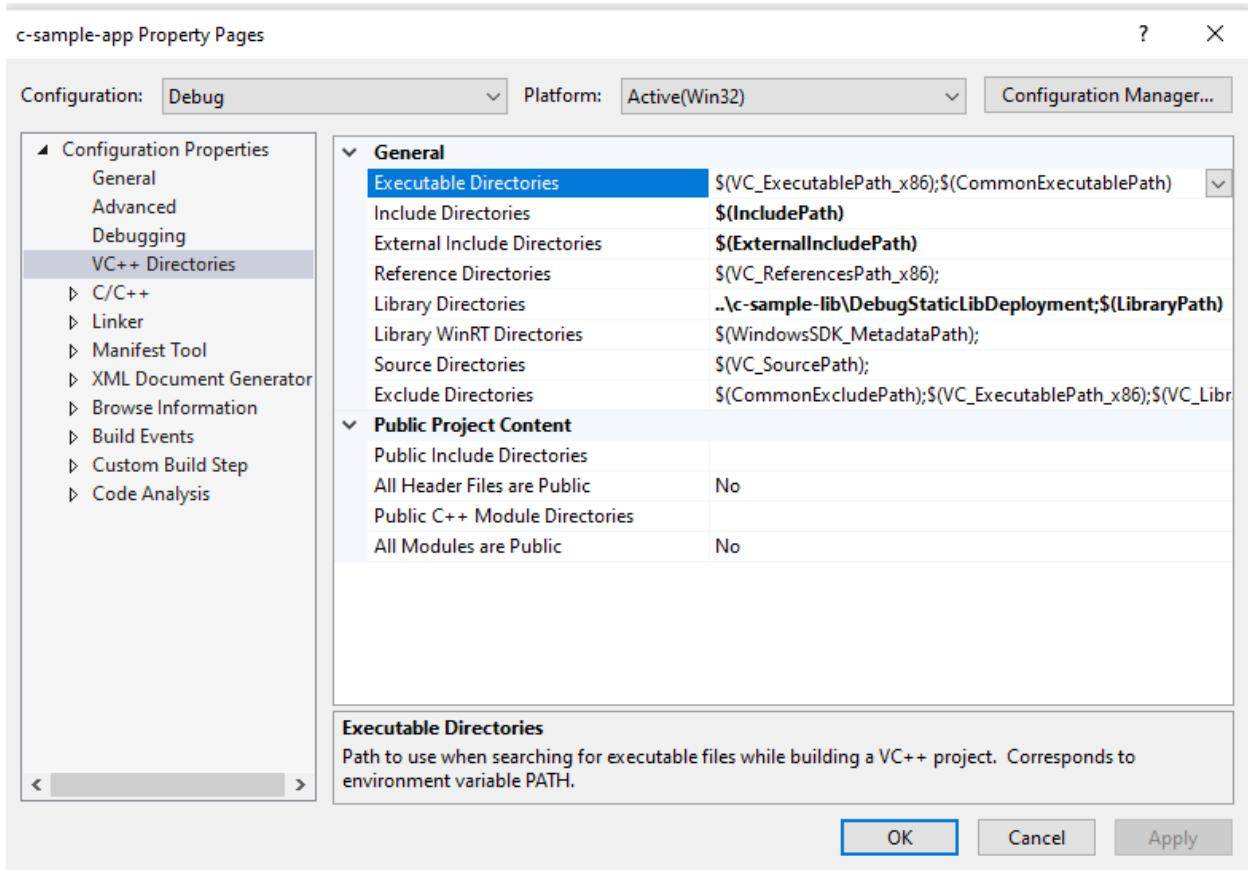
0.45 Shared Library Development - (VS C Static Library)-40



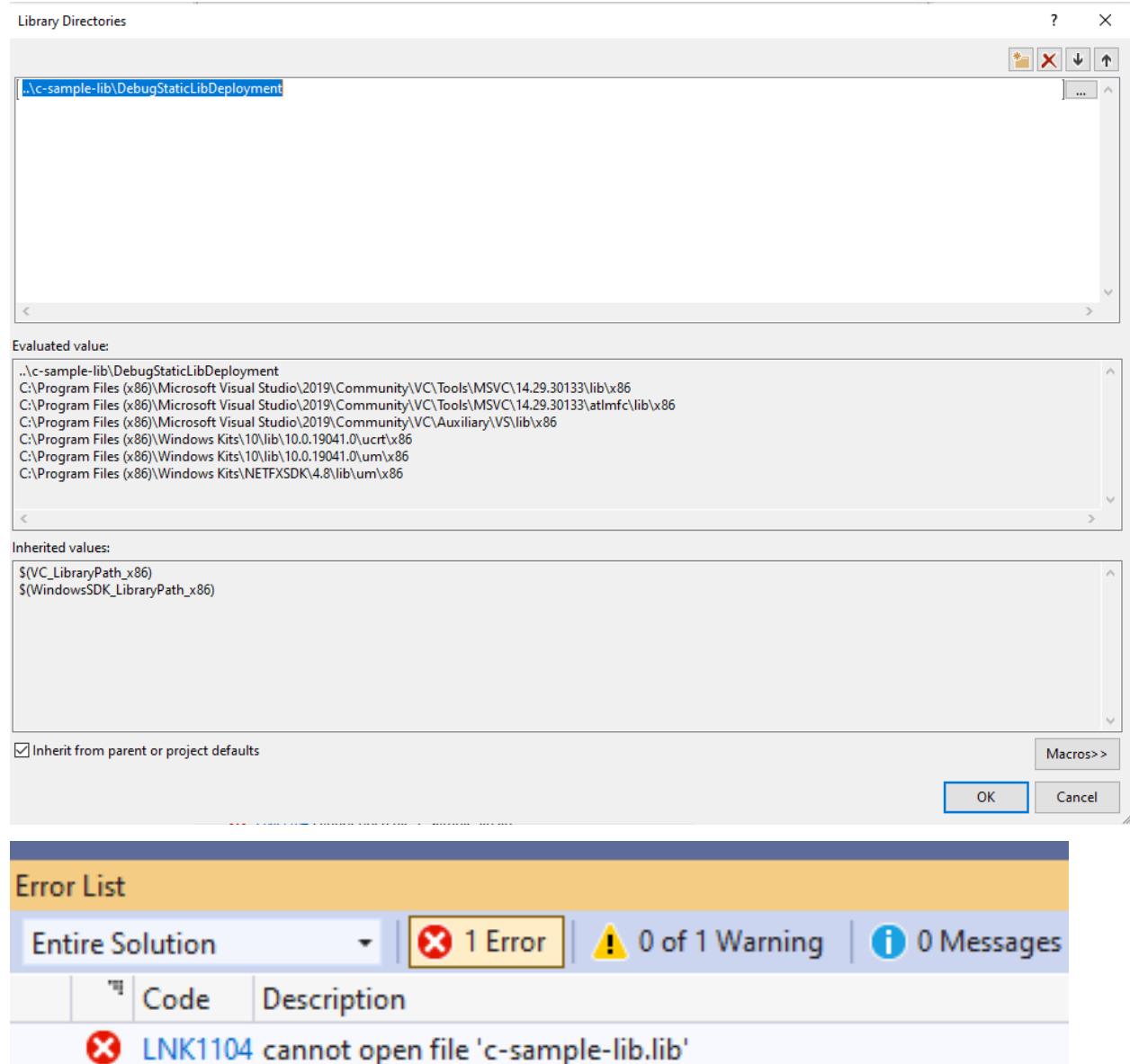
0.46 Shared Library Development - (VS C Static Library)-41

Not Working

.. \c-sample-lib\DebugStaticLibDeployment



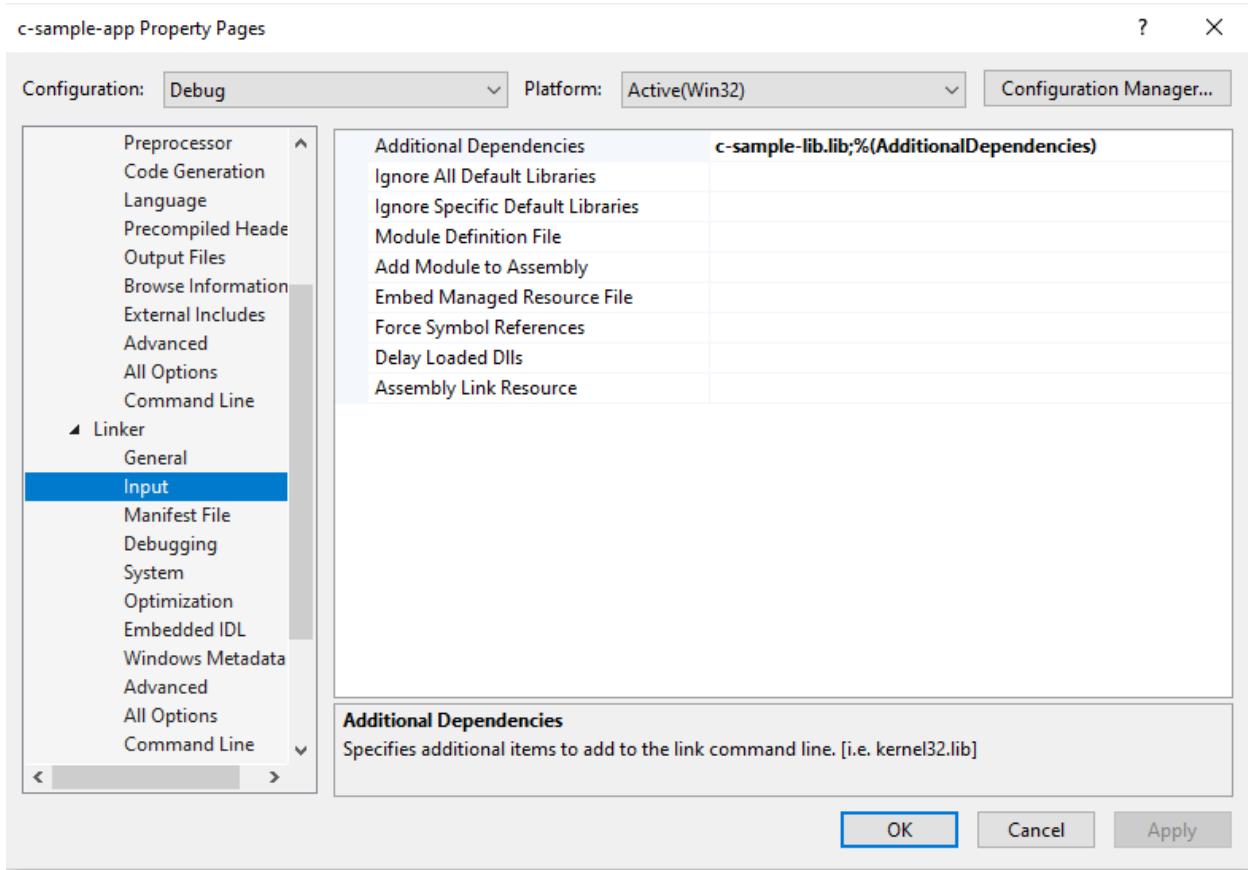
0.47 Shared Library Development - (VS C Static Library)-42



0.48 Shared Library Development - (VS C Static Library)-43

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 a different location and they are ready to use.

0.49 Shared Library Development - (VS C Static Library)-44

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;
}
```

0.50 Shared Library Development - (VS C Static Library)-45

- and output will be as follow

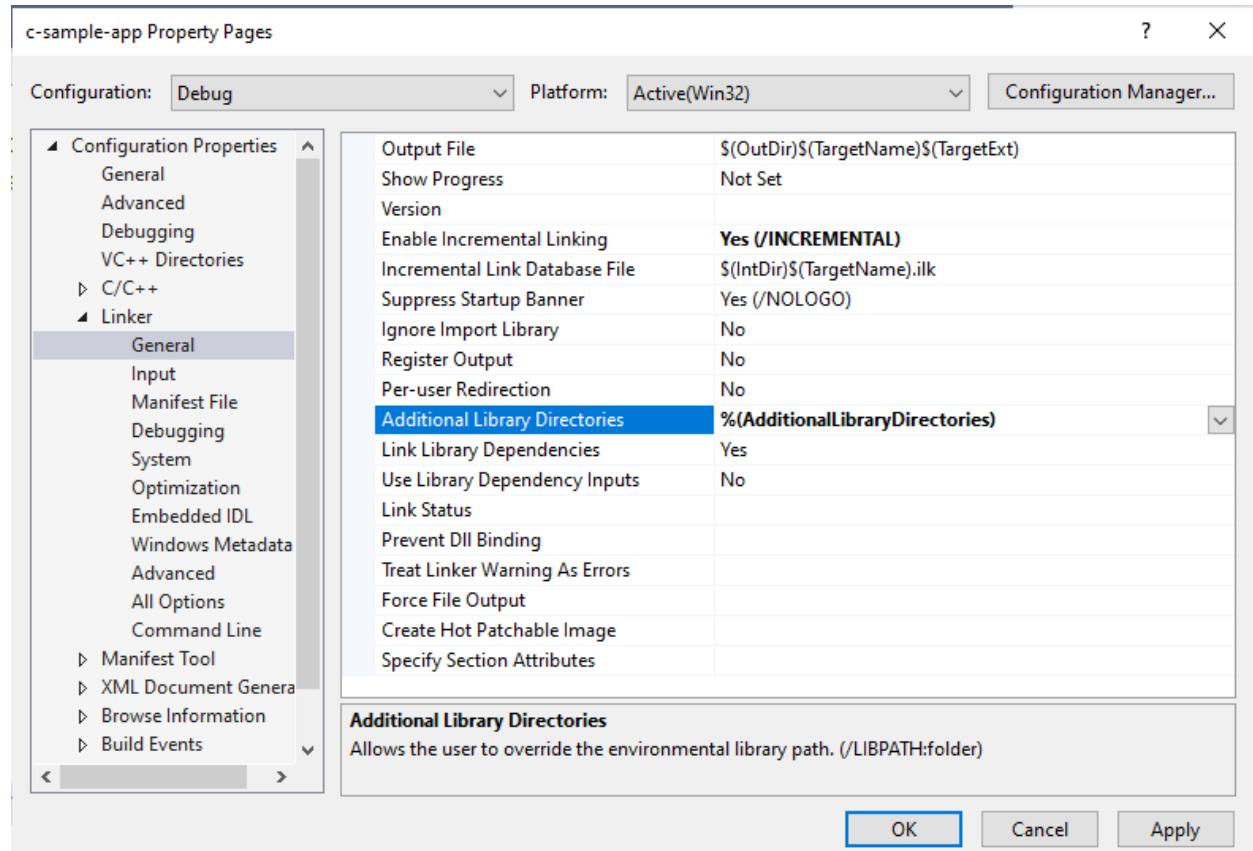
```
Hello Computer
Result is 9
Press any key to continue...
```

0.51 Shared Library Development - (VS C Static Library)-46

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

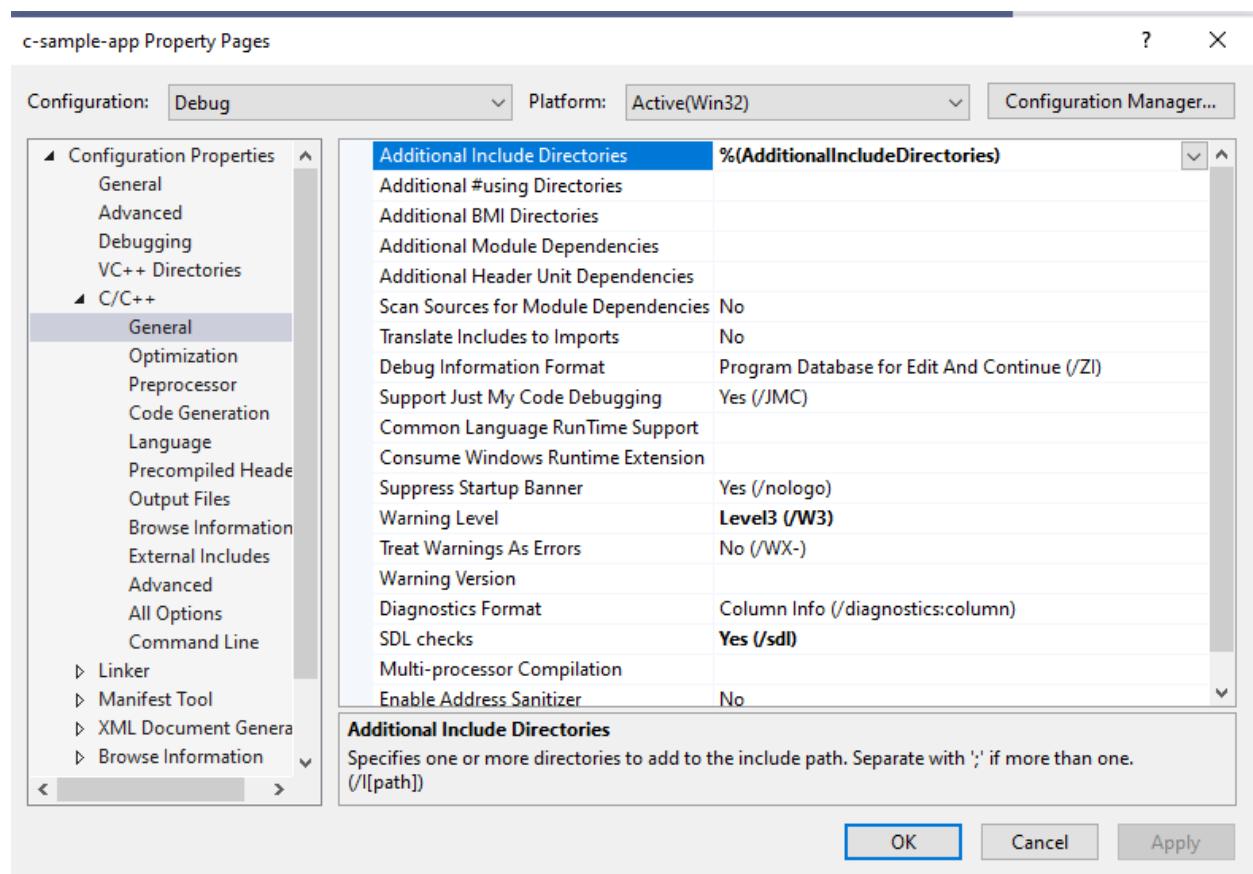
We will remove all library related settings from configurations and we will write them in source code

Clear linker->general->additional library directories



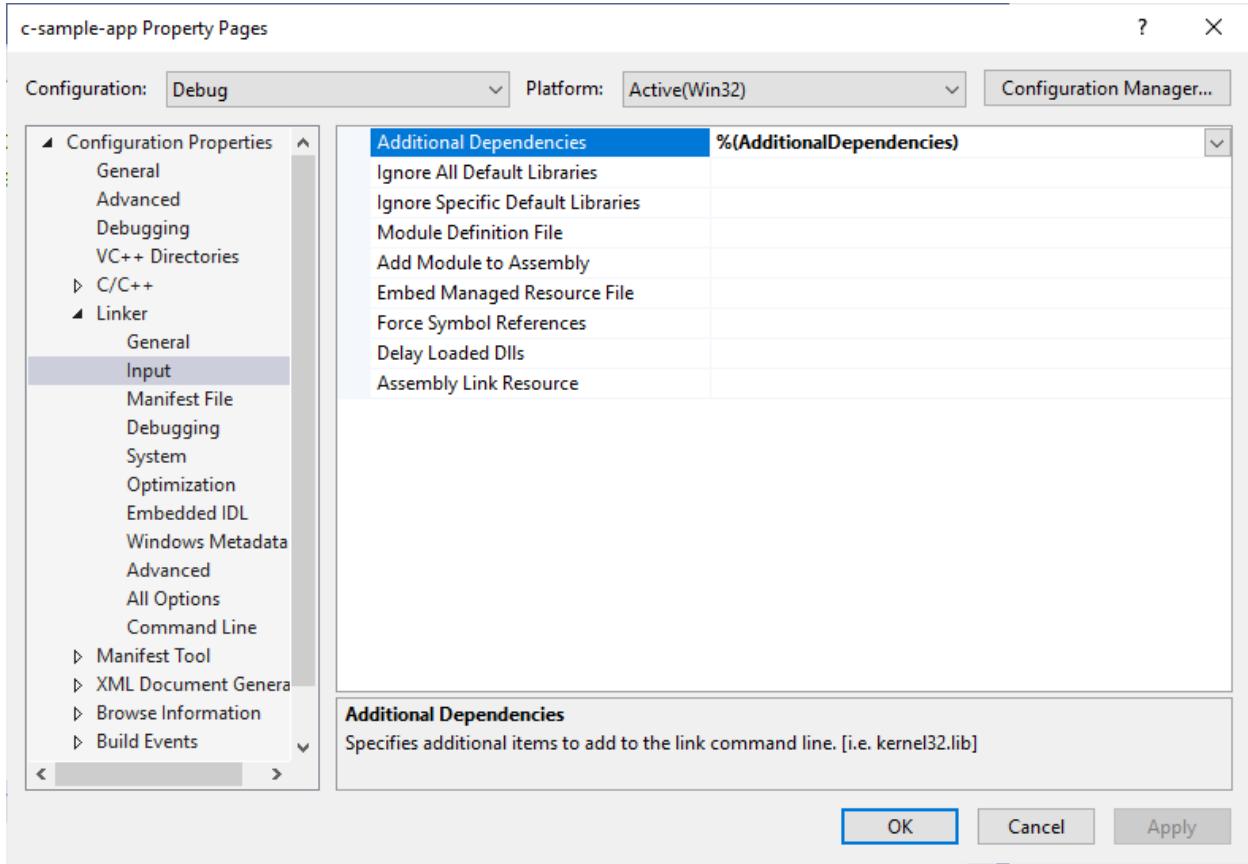
0.52 Shared Library Development - (VS C Static Library)-47

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



0.53 Shared Library Development - (VS C Static Library)-48

Clear Linker->Input->Additional Dependencies



0.54 Shared Library Development - (VS C Static Library)-49

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.

0.55 Shared Library Development

0.55.1 C++ Programming (Static Library)

0.55.1.1 Visual Studio Community Edition

0.56 Shared Library Development - (VS Cpp Static Library)-1

- 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.
-

0.57 Shared Library Development - (VS Cpp Static Library)-2

- 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;  
}
```

0.58 Shared Library Development

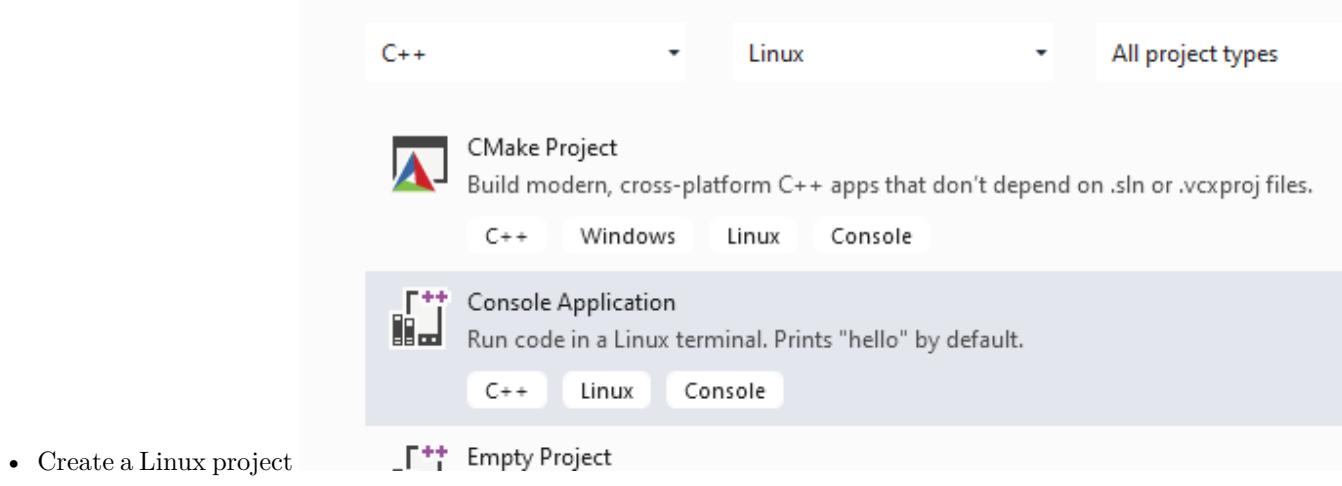
0.58.1 C++ Programming (Static Library)

0.58.1.1 Visual Studio Community Edition WSL Option

0.59 Shared Library Development - (VS Cpp WSL Static Library)-1

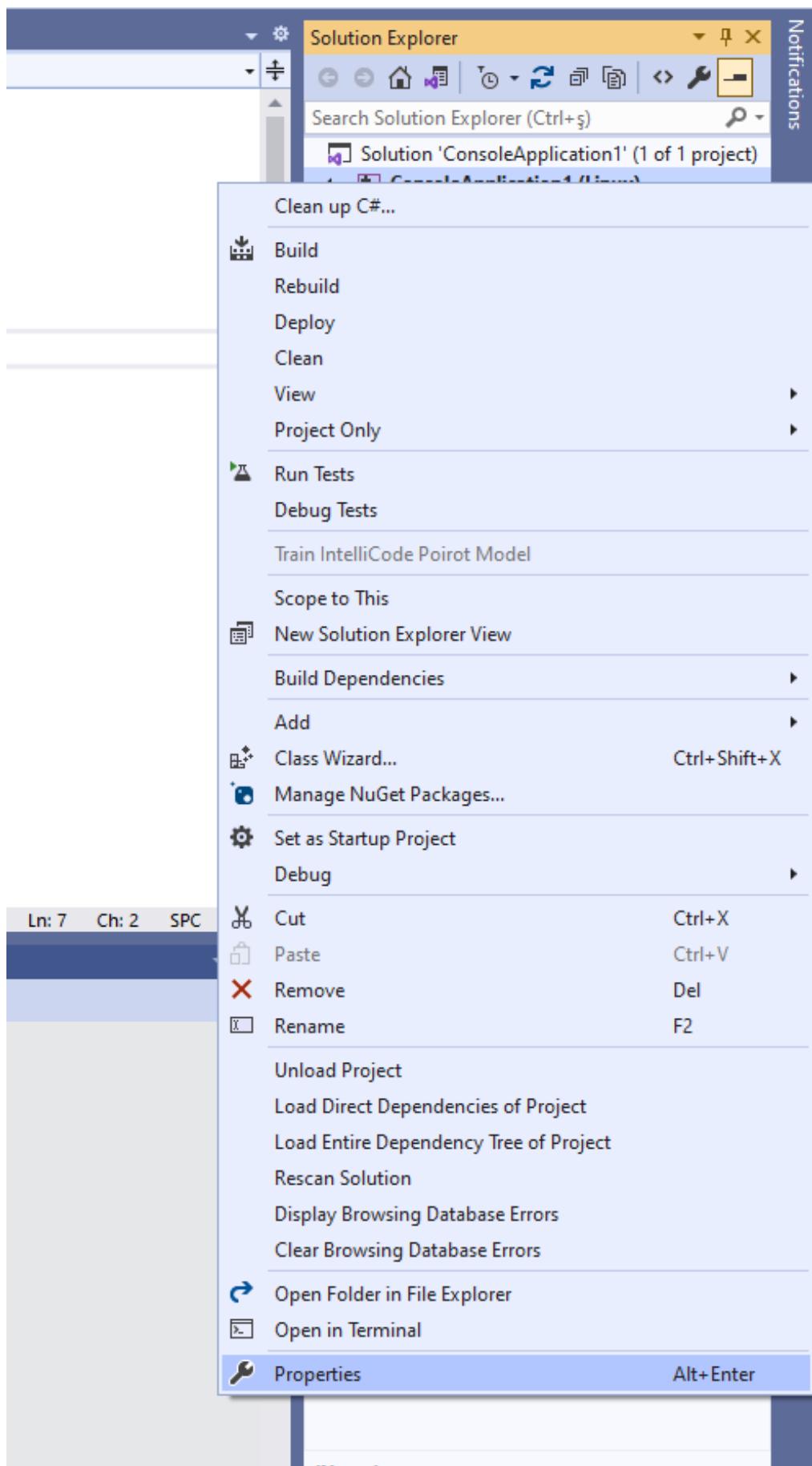
- Install WSL2
 - GitHub - ucoruh/ns3-wsl-win10-setup: ns3 windows 10 WSL2 setup and usage⁵

⁵<https://github.com/ucoruh/ns3-wsl-win10-setup>



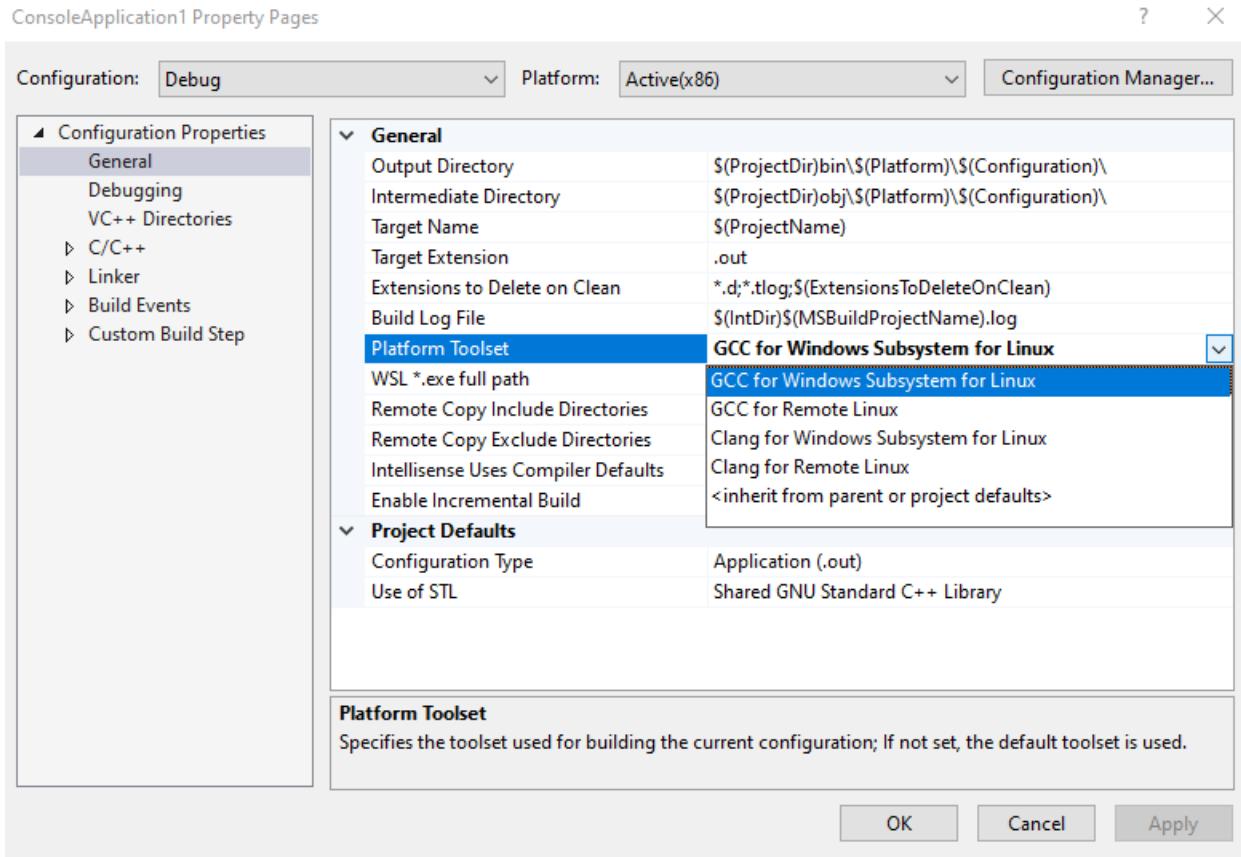
0.60 Shared Library Development - (VS Cpp WSL Static Library)-2

- Configure Platform Toolset to WSL



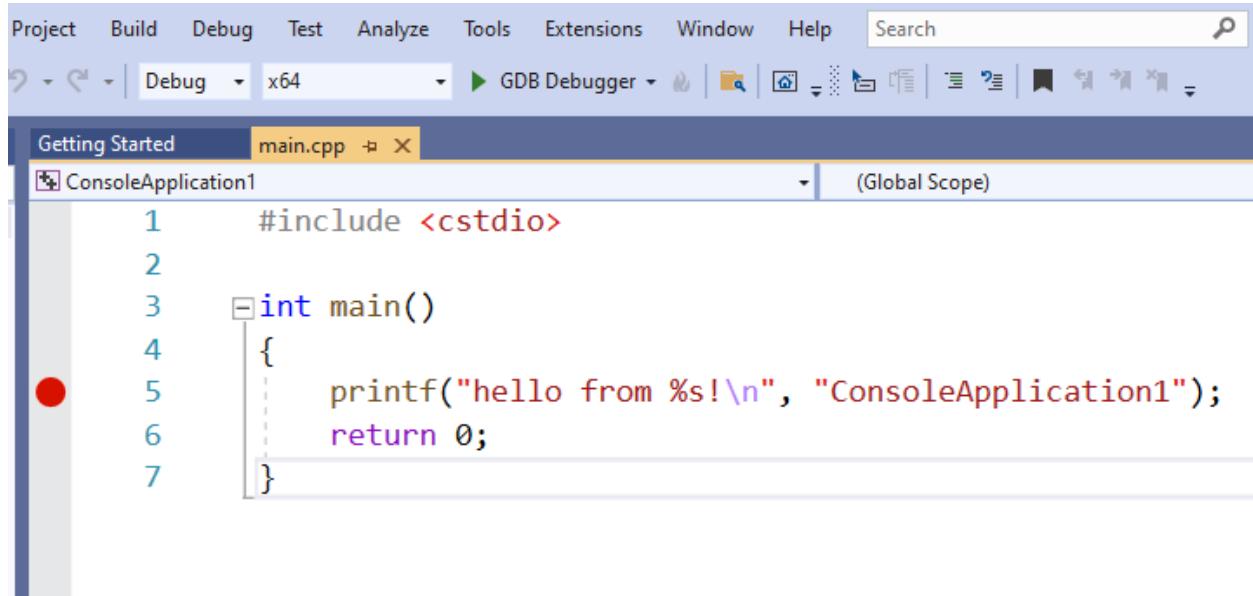
0.61 Shared Library Development - (VS Cpp WSL Static Library)-3

- Select GCC for Windows Subsystem for Linux



0.62 Shared Library Development - (VS Cpp WSL Static Library)-4

Put a breakpoint and run debugger

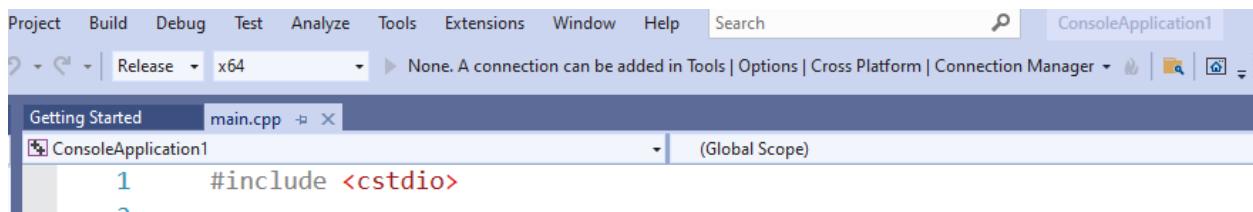


The screenshot shows the Visual Studio IDE interface. The menu bar includes Project, Build, Debug, Test, Analyze, Tools, Extensions, Window, Help, and Search. The toolbar has icons for file operations like Open, Save, and Print. The status bar at the bottom shows 'Debug x64 GDB Debugger'. The main window displays the code for 'main.cpp' under the 'Getting Started' tab. The code is:

```
1 #include <cstdio>
2
3 int main()
4 {
5     printf("hello from %s!\n", "ConsoleApplication1");
6     return 0;
7 }
```

0.63 Shared Library Development - (VS Cpp WSL Static Library)-5

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.

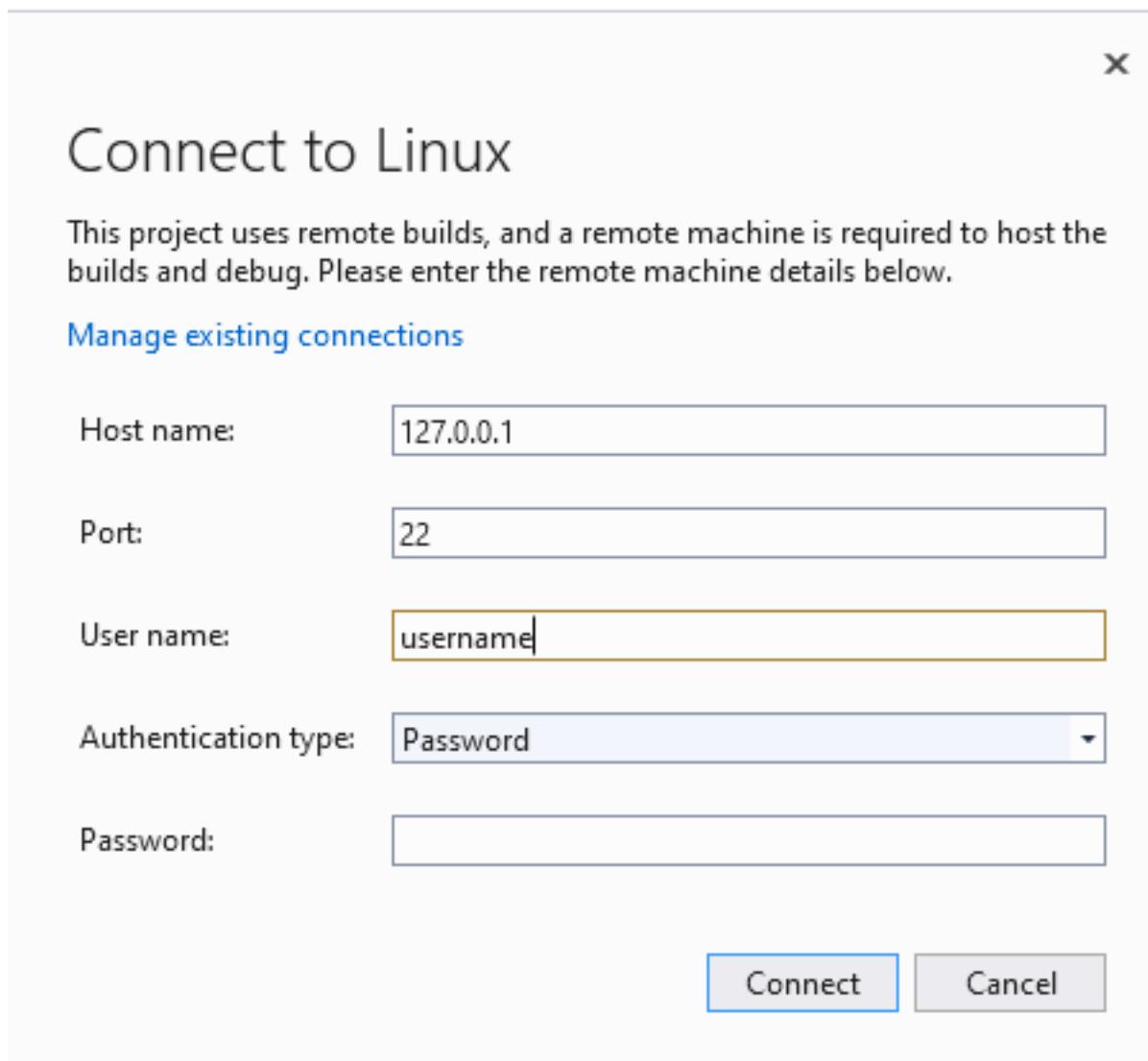


The screenshot shows the Visual Studio IDE interface. The menu bar includes Project, Build, Debug, Test, Analyze, Tools, Extensions, Window, Help, and Search. The toolbar has icons for file operations like Open, Save, and Print. The status bar at the bottom shows 'Release x64 None. A connection can be added in Tools | Options | Cross Platform | Connection Manager'. The main window displays the code for 'main.cpp' under the 'Getting Started' tab. The code is:

```
1 #include <cstdio>
```

0.64 Shared Library Development - (VS Cpp WSL Static Library)-6

- Configure SSH parameters



0.65 Shared Library Development - (VS Cpp WSL Static Library)-7

- 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 Studios⁶
 - Connect to Remote WSL Environment
 - * Baglan hedef Linux sisteminizde Visual Studio | Microsoft Docs⁷

0.66 Shared Library Development

0.66.1 C# Programming (Dinamik Library)

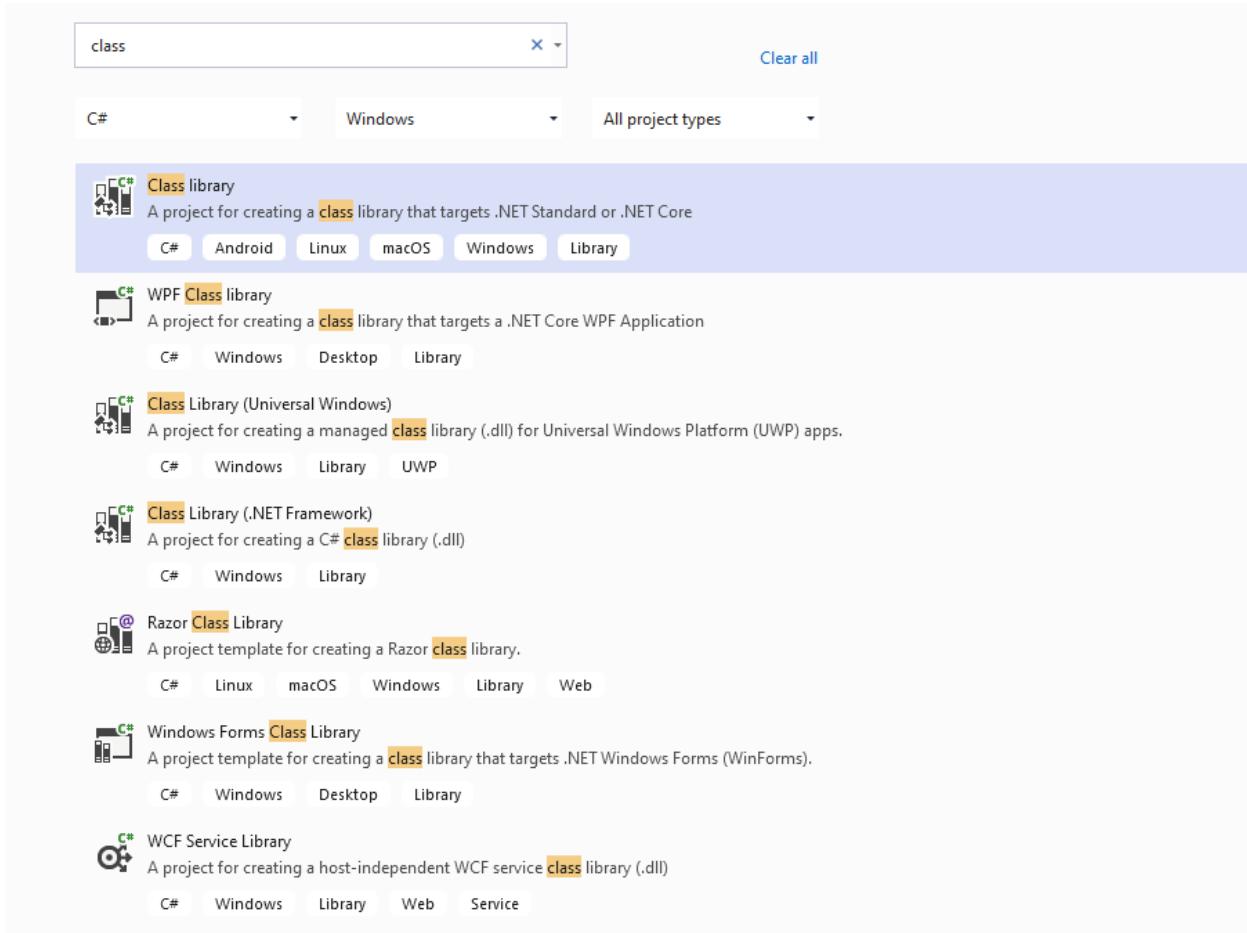
0.66.1.1 Visual Studio Community Edition

⁶<https://www.illuminastudios.com/dev-diaries/ssh-on-windows-subsystem-for-linux/>

⁷<https://docs.microsoft.com/tr-tr/cpp/linux/connect-to-your-remote-linux-computer?view=msvc-160>

0.67 Shared Library Development - (VS Csharp Dynamic Library)-1

- 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



0.68 Shared Library Development - (VS Csharp Dynamic Library)-2

- There is no static library option

Configure your new project

Class library C# Android Linux macOS Windows Library

Project name

csharp-sample-lib

Location

E:\UgurCoruh\RTEU\Lectures\2021-2022 Güz CE103 - Algorithms and Programming \Lectures\ce11

...

Solution name i

csharp-sample-lib

Place solution and project in the same directory

0.69 Shared Library Development - (VS Csharp Dynamic Library)-3

- We will select .Net Core 3.1

Additional information

Class library C# Android Linux macOS Windows Library

Target Framework i

.NET Core 3.1 (Long-term support)

.NET Standard 2.0

.NET Standard 2.1

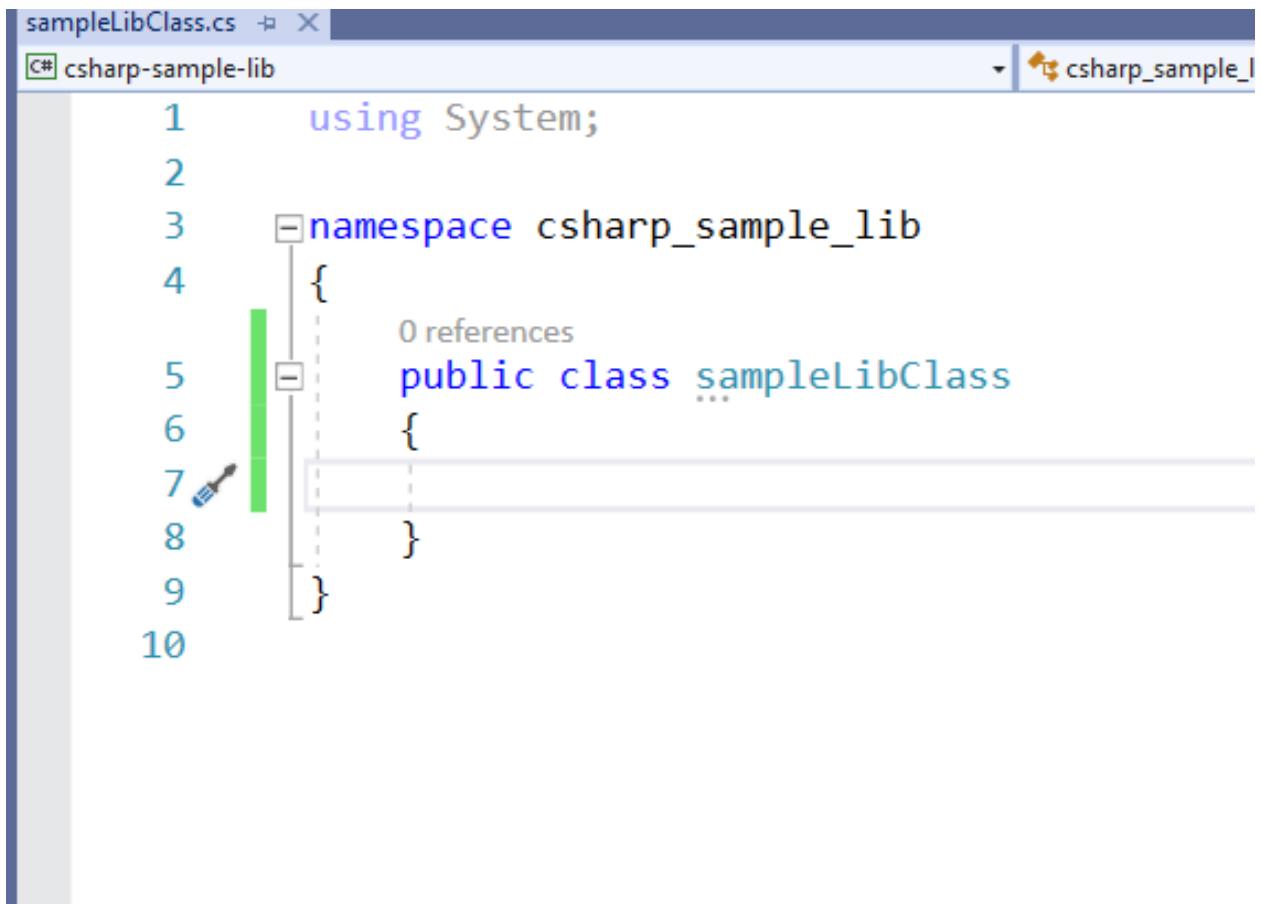
.NET Core 2.1 (Long-term support)

.NET Core 3.1 (Long-term support)

.NET 5.0 (Current)

0.70 Shared Library Development - (VS Csharp Dynamic Library)-4

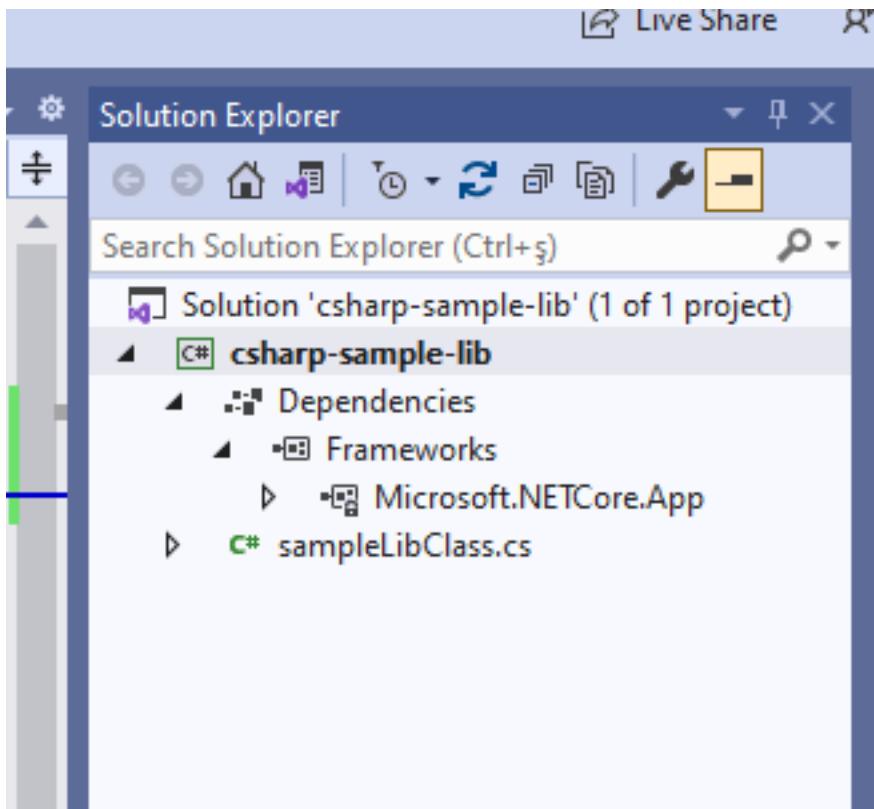
- You will have default empty class library file



```
sampleLibClass.cs  X  csharp-sample-lib  csharp_sample_l
1     using System;
2
3     namespace csharp_sample_lib
4     {
5         public class sampleLibClass
6         {
7             public sampleLibClass()
8             {
9             }
10        }
11    }
```

0.71 Shared Library Development - (VS Csharp Dynamic Library)-5

- In the project you can see .NETcore reference



0.72 Shared Library Development - (VS Csharp Dynamic Library)-6

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

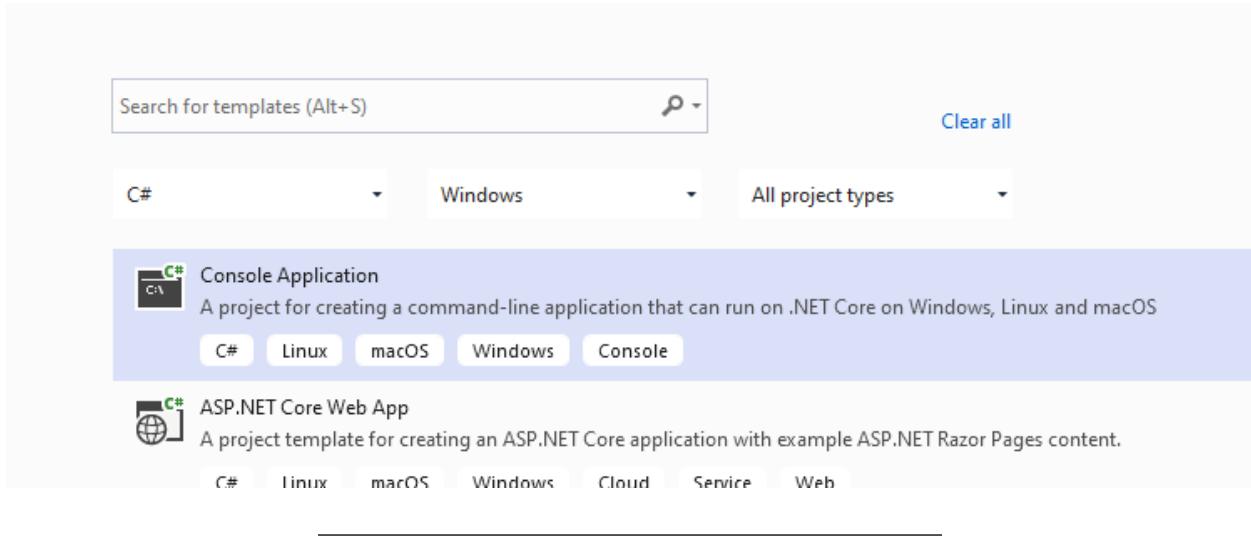
```
.\e-lib\csharp-sample-lib\csharp-sample-lib.csproj (in 3 ms).
.\e\csharp-sample-lib\csharp-sample-lib\bin\Debug\netcoreapp3.1\csharp-sample-lib.dll
```

0.73 Shared Library Development - (VS Csharp Dynamic Library)-7

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

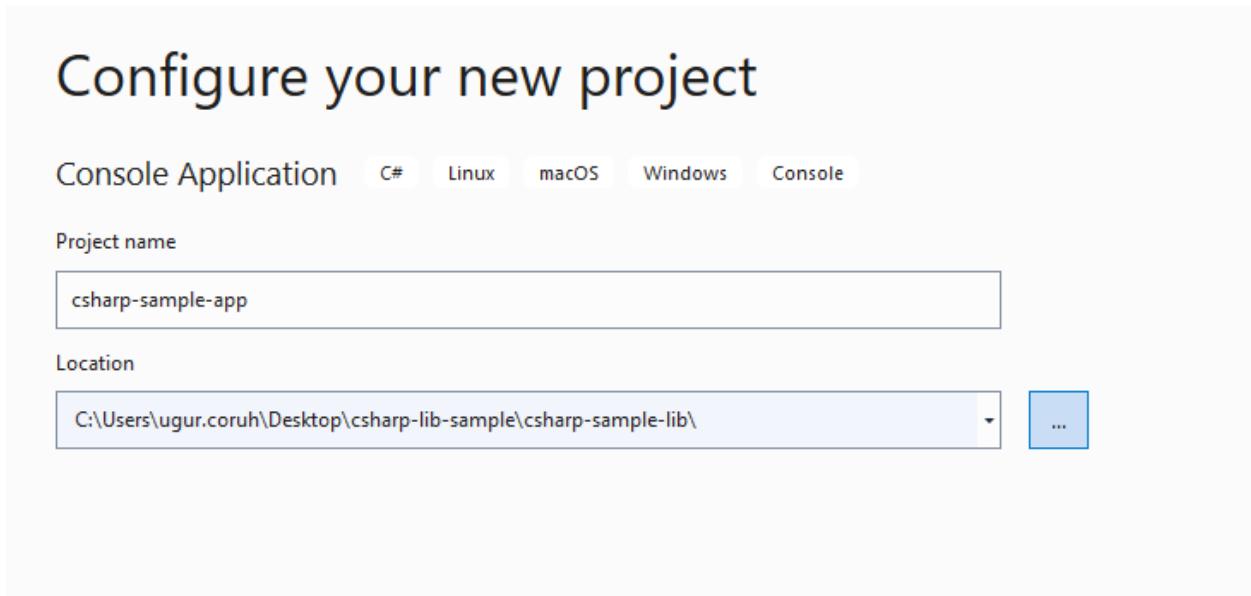
0.74 Shared Library Development - (VS Csharp Dynamic Library)-8

- Select New Project



0.75 Shared Library Development - (VS Csharp Dynamic Library)-9

- Set project name



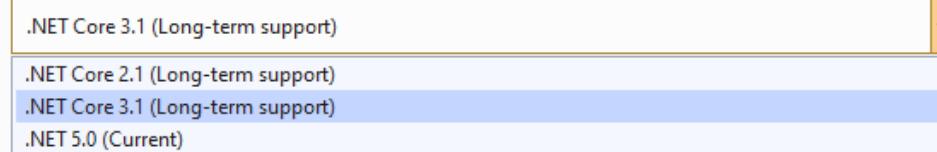
0.76 Shared Library Development - (VS Csharp Dynamic Library)-10

- Select .NETCore framework

Additional information

Console Application C# Linux macOS Windows Console

Target Framework 



0.77 Shared Library Development - (VS Csharp Dynamic Library)-11

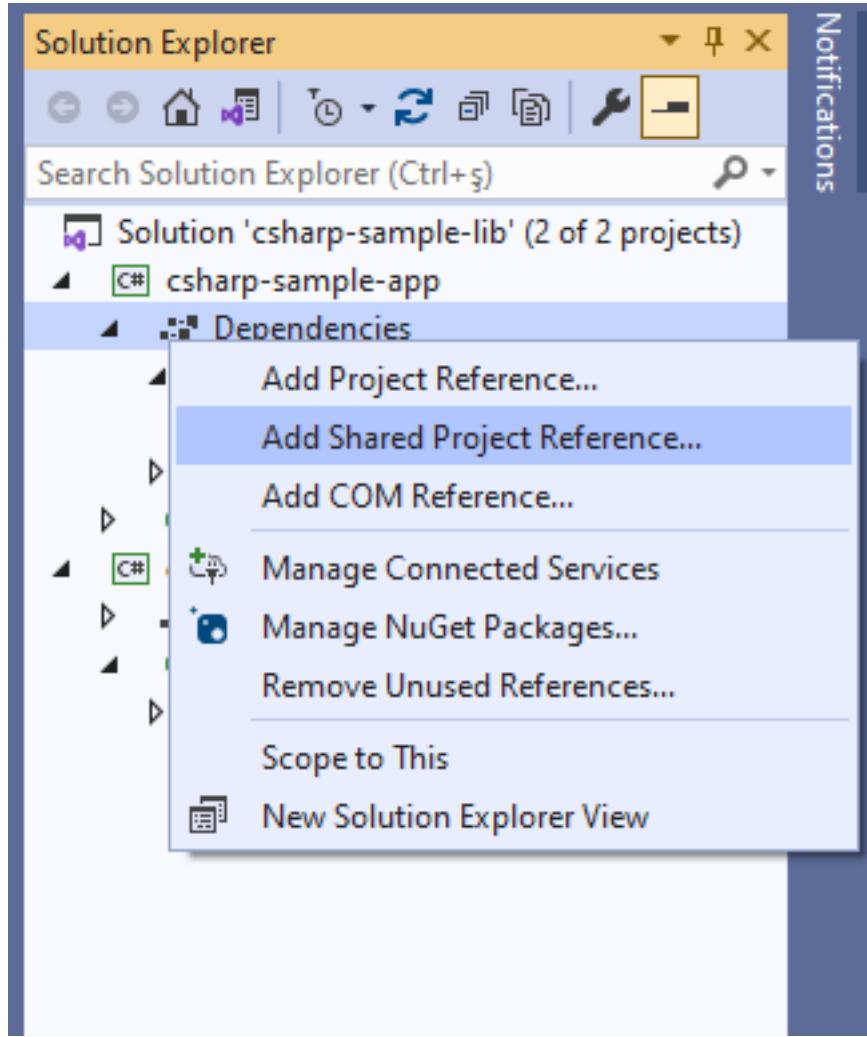
- You will have the following sample main.cs file

```
using System;

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

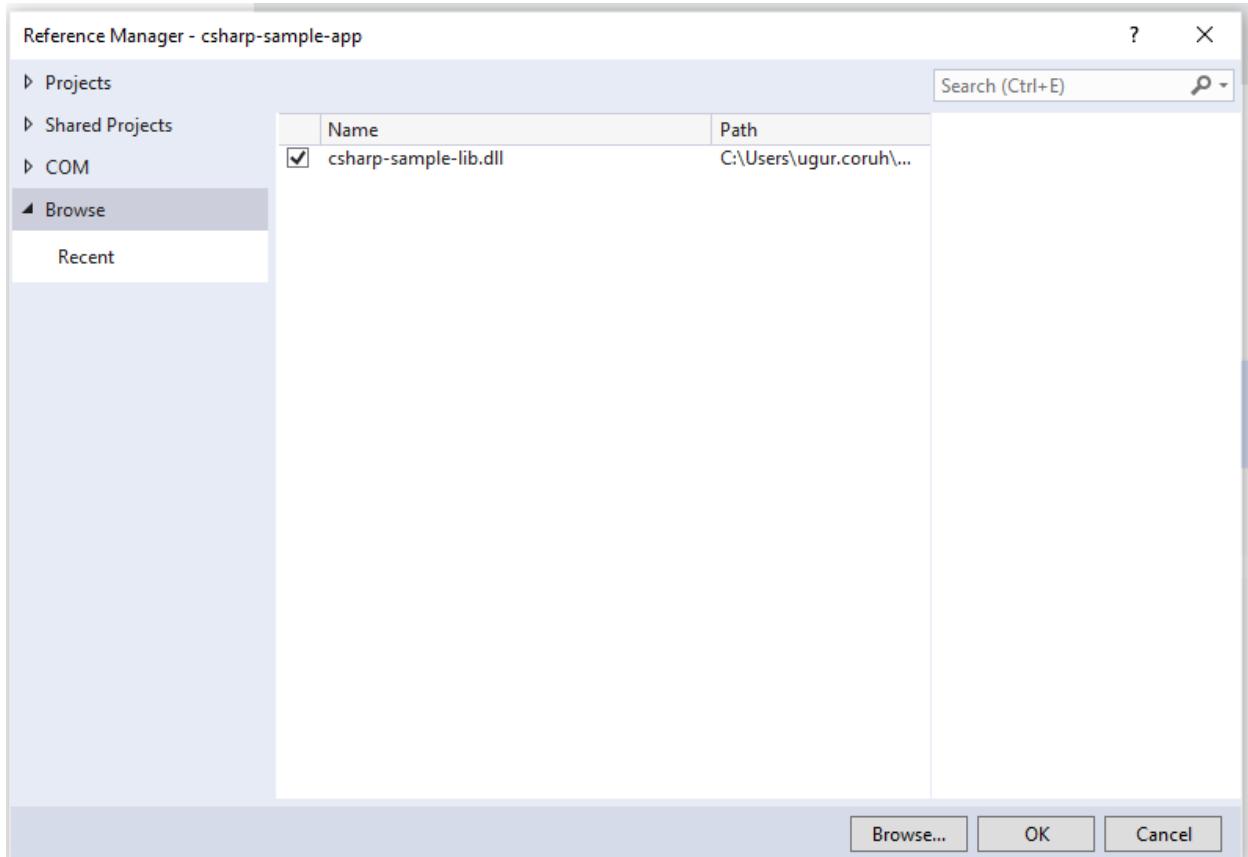
0.78 Shared Library Development - (VS Csharp Dynamic Library)-12

- Now we can link projects with adding references open reference section



0.79 Shared Library Development - (VS Csharp Dynamic Library)-13

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



0.80 Shared Library Development - (VS Csharp Dynamic Library)-14

- now we can update our library code and use it in console application
 - copy following sample to sampleLibClass file in the library
-

0.81 Shared Library Development - (VS Csharp Dynamic Library)-15

```
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;
}
}

```

0.82 Shared Library Development - (VS Csharp Dynamic Library)-16

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

```

using csharp_sample_lib;
using System;

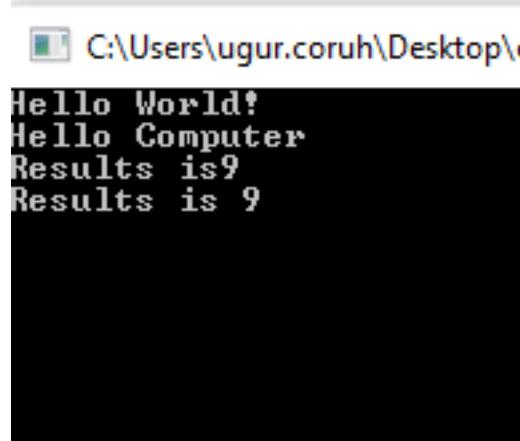
namespace csharp_sample_app
{
    class Program
    {
        static void Main(string[] args)
        {
            Console.WriteLine("Hello World!");

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

```

0.83 Shared Library Development - (VS Csharp Dynamic Library)-17

- You will see following output that mean we called DLL functions



```

C:\Users\ugur.coruh\Desktop\csharp_sample_app>Hello World!
Hello Computer
Results is 9
Results is 9

```

0.84 Shared Library Development - (VS Csharp Dynamic Library)-18

- Also we can publish this console application with dll for linux environment or others
 - for linux environment we should install .NETCore
-

0.85 Shared Library Development - (VS Csharp Dynamic Library)-19

- follow the link below or commands that I shared with you as below for deployment
- How to Install Dotnet Core on Ubuntu 20.04 – TecAdmin⁸

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
```

0.86 Shared Library Development - (VS Csharp Dynamic Library)-20

Step 2 – Installing Dotnet Core SDK

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

0.87 Shared Library Development - (VS Csharp Dynamic Library)-21

Step 3 – Install Dotnet Core Runtime Only

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

```
sudo apt update
```

0.88 Shared Library Development - (VS Csharp Dynamic Library)-22

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.

0.89 Shared Library Development - (VS Csharp Dynamic Library)-23

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:

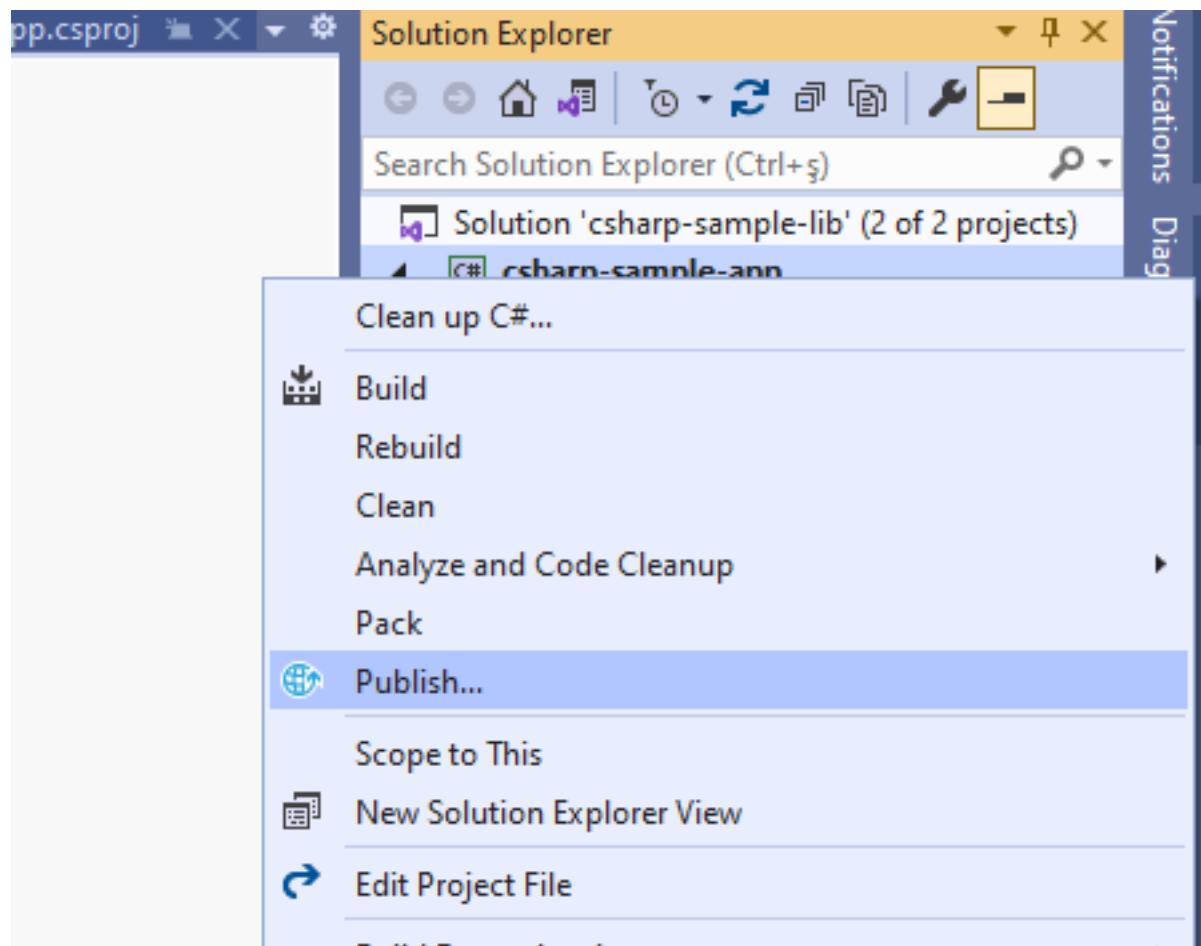
```
dotnet --version
```

⁸<https://tecatmin.net/how-to-install-net-core-on-ubuntu-20-04/>

```
ucoruh@LAPTOP-RQNN  
3.1.414  
ucoruh@LAPTOP-RQNN
```

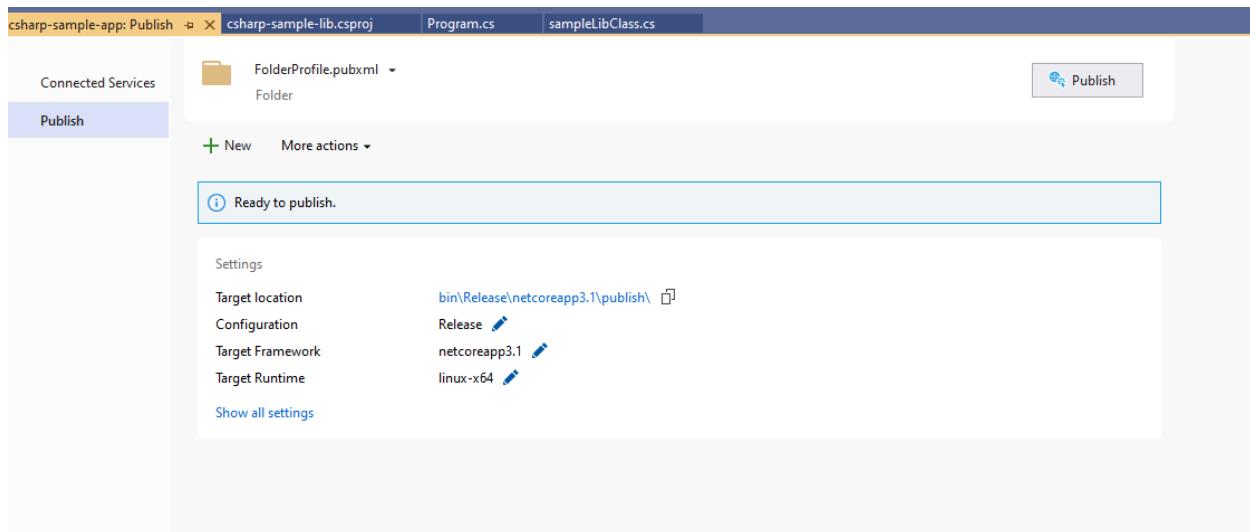
0.90 Shared Library Development - (VS Csharp Dynamic Library)-24

- Now we will publish our application as single executable
- Open publish menu



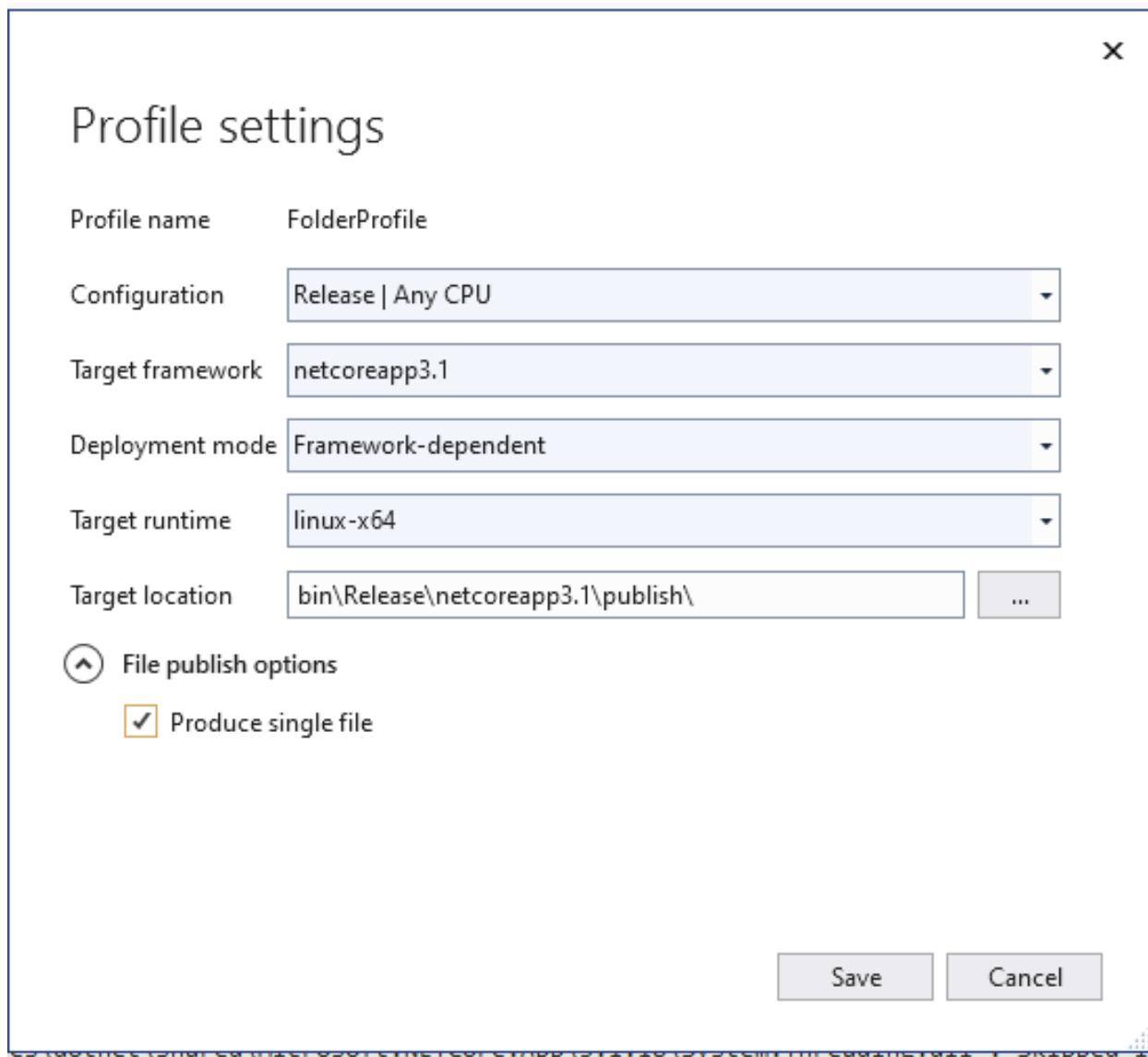
0.91 Shared Library Development - (VS Csharp Dynamic Library)-25

- Select netcoreapp3.1 and Release for linux-x64



0.92 Shared Library Development - (VS Csharp Dynamic Library)-26

- Select produce single file



0.93 Shared Library Development - (VS Csharp Dynamic Library)-27

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

esktop > csharp-lib-sample > csharp-sample-lib > csharp-sample-app > bin > Release > netcoreapp3.1 > publish

| Name | Date modified | Type | Size |
|-----------------------------|--------------------|--------------------|-------|
| csharp-sample-app | 10/24/2021 1:36 AM | File | 97 KB |
| csharp-sample-app.pdb | 10/24/2021 1:36 AM | Program Debug D... | 10 KB |
| csharp-sample-lib.pdb | 10/24/2021 1:30 AM | Program Debug D... | 10 KB |
| packages-microsoft-prod.deb | 4/23/2020 10:02 PM | DEB File | 4 KB |

0.94 Shared Library Development - (VS Csharp Dynamic Library)-28

- 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-RQNN9IG: /mnt/c/Users/ugun.coruh/Desktop/csharp-lib-sample/csharp-sample-lib/csharp-sample-app/bin/Release/netcoreapp3.1/publish$ dotnet --version
3.1.414
ucoruh@LAPTOP-RQNN9IG: /mnt/c/Users/ugun.coruh/Desktop/csharp-lib-sample/csharp-sample-lib/csharp-sample-app/bin/Release/netcoreapp3.1/publish$ ./csharp-sample-app
csharp-sample-app      csharp-sample-app.pdb      csharp-sample-lib.pdb      packages-microsoft-prod.deb
ucoruh@LAPTOP-RQNN9IG: /mnt/c/Users/ugun.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
```

0.95 Shared Library Development - (VS Csharp Dynamic Library)-29

check dotnet –version and then run application

```
publish$ dotnet --version
publish$ ./
publish$ ./csharp-sample-app
```

- you will see similar output

```
ucoruh@LAPTOP-RQNN9IG: /mnt/c/
csharp-sample-app
ucoruh@LAPTOP-RQNN9IG: /mnt/c/
Hello World!
Hello Computer
Results is9
Results is 9
```

0.96 Shared Library Development - (VS Csharp Dynamic Library)-30

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

| Name | Date modified | Type | Size |
|--------------------------------------|--------------------|----------------------|-------|
| csharp-sample-app | 10/24/2021 1:36 AM | File | 88 KB |
| csharp-sample-app.deps.json | 10/24/2021 1:36 AM | JSON File | 1 KB |
| csharp-sample-app.dll | 10/24/2021 1:36 AM | Application exten... | 4 KB |
| csharp-sample-app.pdb | 10/24/2021 1:36 AM | Program Debug D... | 10 KB |
| csharp-sample-app.runtimeconfig.json | 10/24/2021 1:36 AM | JSON File | 1 KB |
| csharp-sample-lib.dll | 10/24/2021 1:30 AM | Application exten... | 4 KB |
| csharp-sample-lib.pdb | 10/24/2021 1:30 AM | Program Debug D... | 10 KB |

0.97 Shared Library Development - (VS Csharp Dynamic Library)-31

- If you run csharp-sample-app
- you will have the same output

```
ucoruh@LAPTOP-RQNN5:~/Desktop$ cd /Users/ucoruh/Desktop/csharp-lib-sample/csharp-sample-lib/bin/Release/netcoreapp3.1/publish
ucoruh@LAPTOP-RQNN5:/Users/ucoruh/Desktop/csharp-lib-sample/csharp-sample-lib/bin/Release/netcoreapp3.1/publish$ ./csharp-sample-app
Hello World!
Hello Computer
Results is 9
Results is 9
```

0.98 Shared Library Development

0.98.1 Java Programming

0.98.1.1 Eclipse IDE

0.99 Shared Library Development - (Eclipse Java Jar Library)-1

- You should download and install eclipse installer and then you should select Eclipse IDE for Java Developers
 - Eclipse Installer 2021-09 R | Eclipse Packages⁹

⁹<https://www.eclipse.org/downloads/packages/installer>



eclipse**installer**
by Oomph

0.100 Shared Library Development - (Eclipse Java Jar Library)-2

The screenshot shows the Eclipse Installer interface. At the top, there's a header with the "eclipseinstaller" logo and "by Oomph". Below the header is a search bar with the placeholder "type filter text" and a magnifying glass icon. The main content area displays five different Eclipse IDE packages:

- Eclipse IDE for Java Developers**: Includes Java IDE, Git client, XML Editor, Maven and Gradle integration. It features a circular icon with a purple "T" and a green "G".
- Eclipse IDE for Enterprise Java and Web Developers**: Tools for Java and Web applications, including JavaScript, TypeScript, JavaServer Pages, and Faces. It features a circular icon with a gear labeled "Java EE IDE".
- Eclipse IDE for C/C++ Developers**: An IDE for C/C++ developers. It features a circular icon with a blue "C++" symbol.
- Eclipse IDE for Embedded C/C++ Developers**: An IDE for Embedded C/C++ developers, including managed cross build plug-ins (Arm and RISC-V) and debug plug-ins (SEGGER J-Link, OpenOCD, pyocd, and QEMU). It features a circular icon with a blue "C" symbol.
- 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. It features a circular icon with a blue "php" symbol.

0.101 Shared Library Development - (Eclipse Java Jar Library)-3

The screenshot shows the **eclipseinstaller** website interface for installing the **Eclipse IDE for Java Developers**. The page includes a **DONATE** button, a menu icon, and a circular profile picture.

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

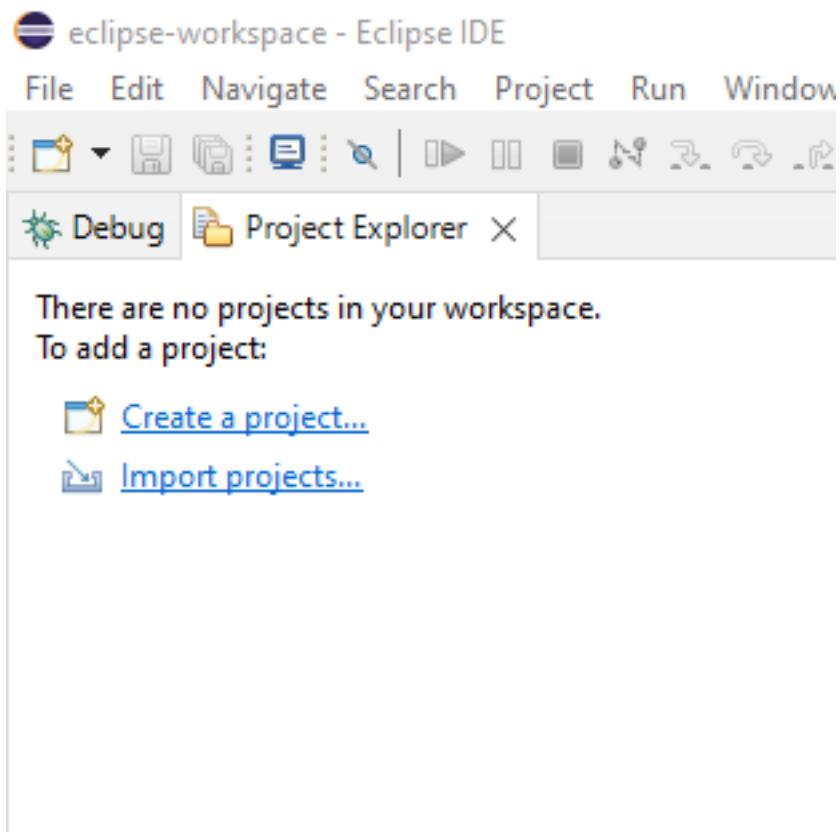
BACK

0.102 Shared Library Development - (Eclipse Java Jar Library)-4



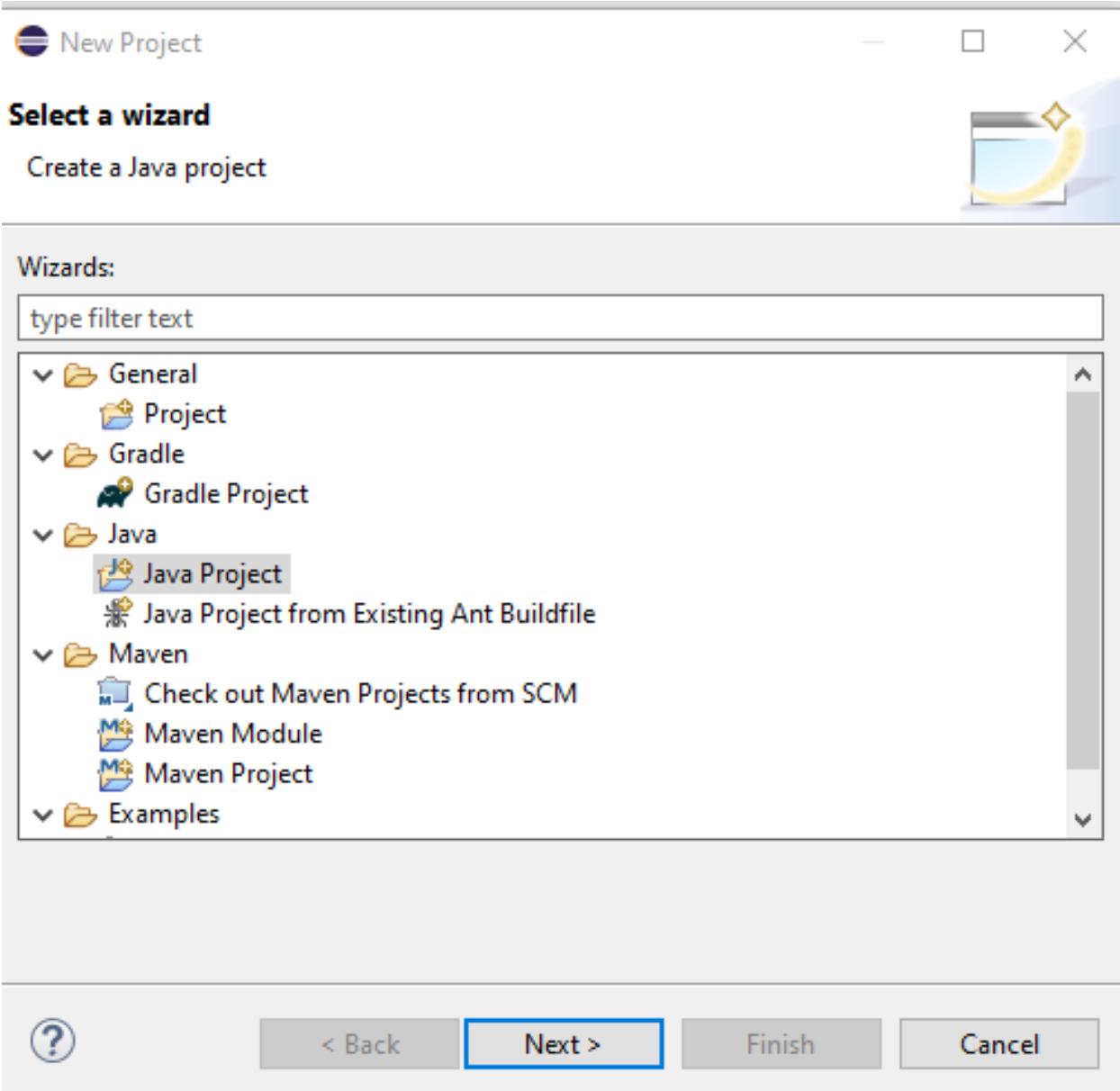
0.103 Shared Library Development - (Eclipse Java Jar Library)-5

- select create a project



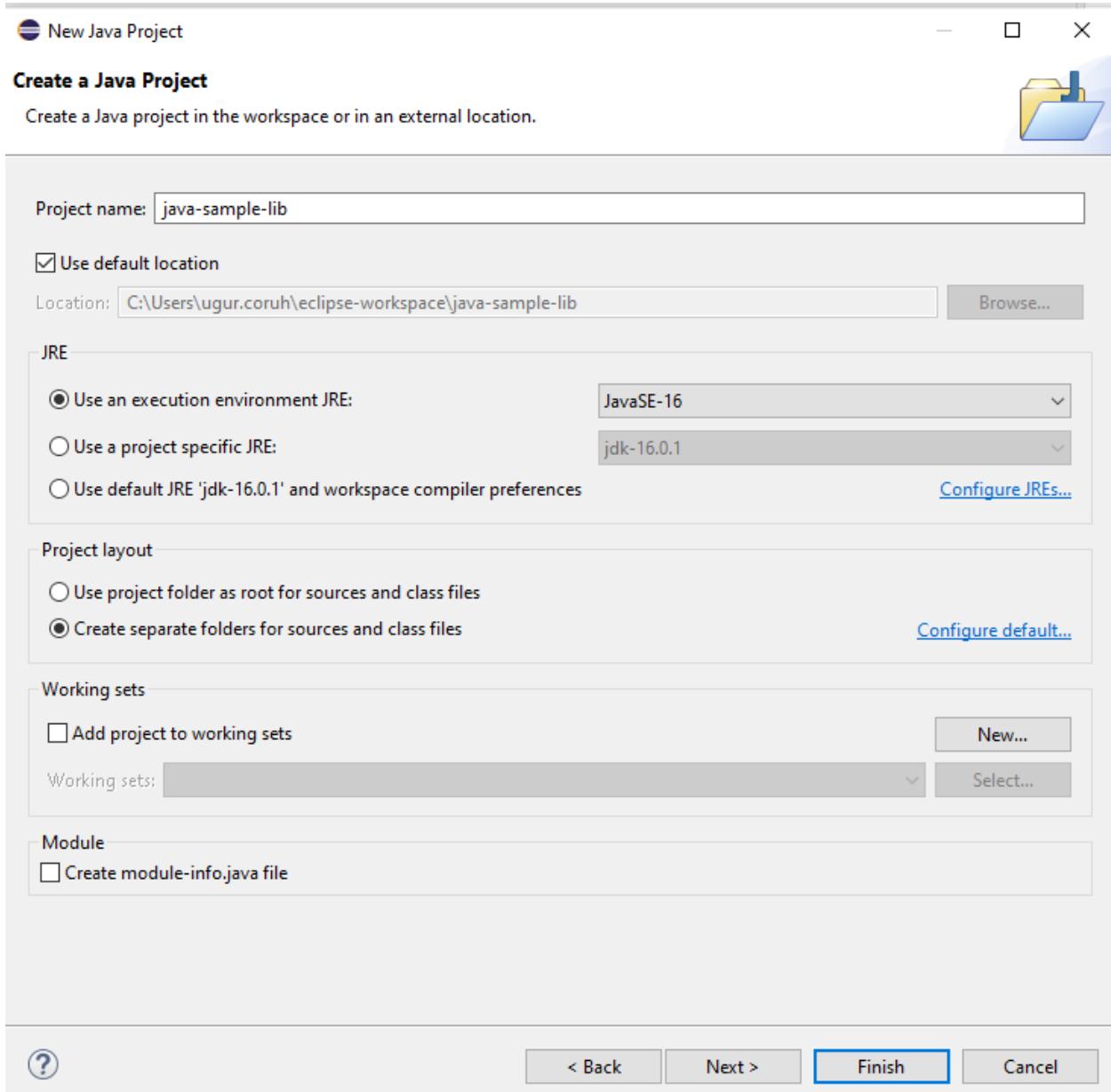
0.104 Shared Library Development - (Eclipse Java Jar Library)-6

select java project



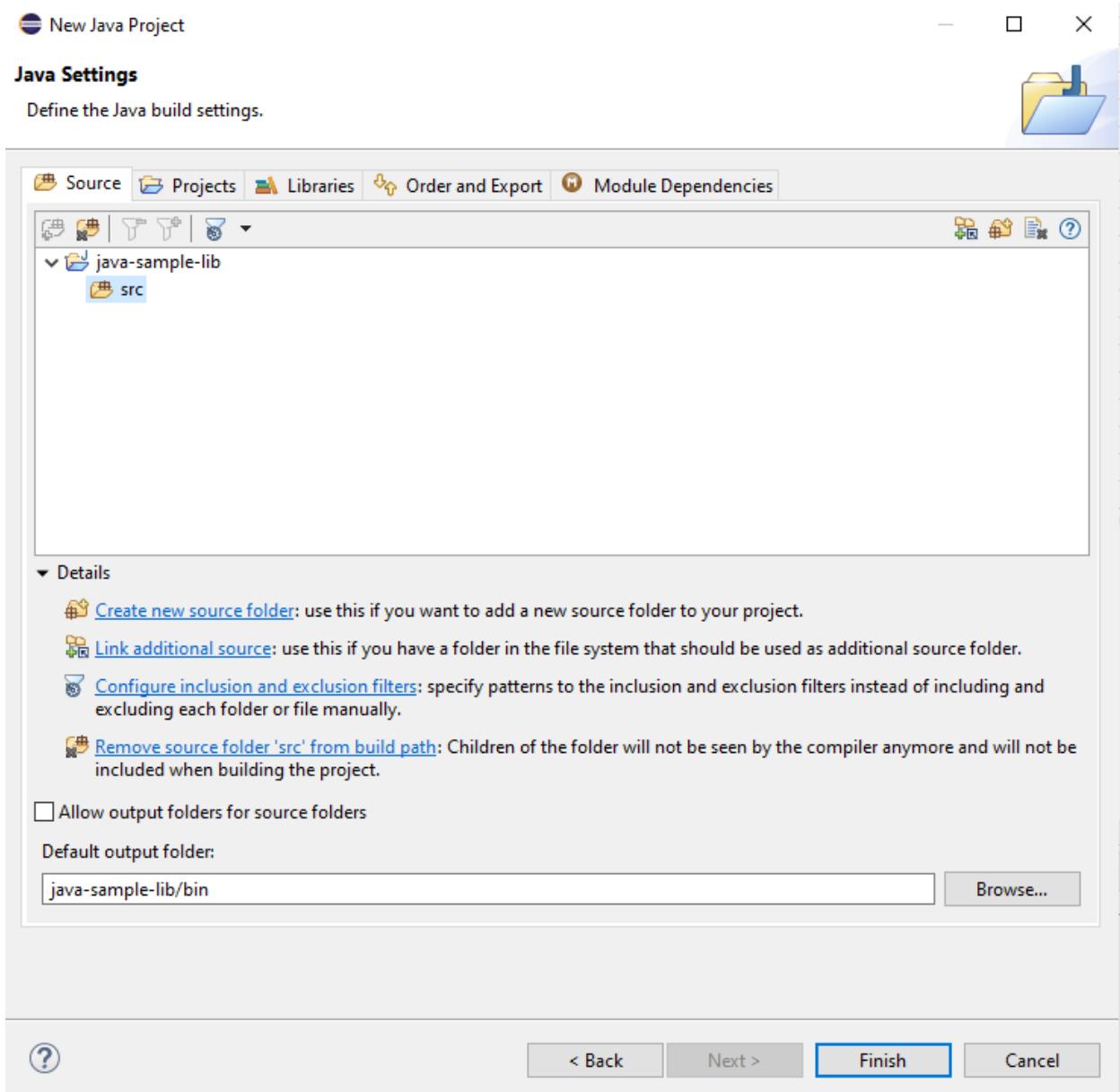
0.105 Shared Library Development - (Eclipse Java Jar Library)-7

- give project name



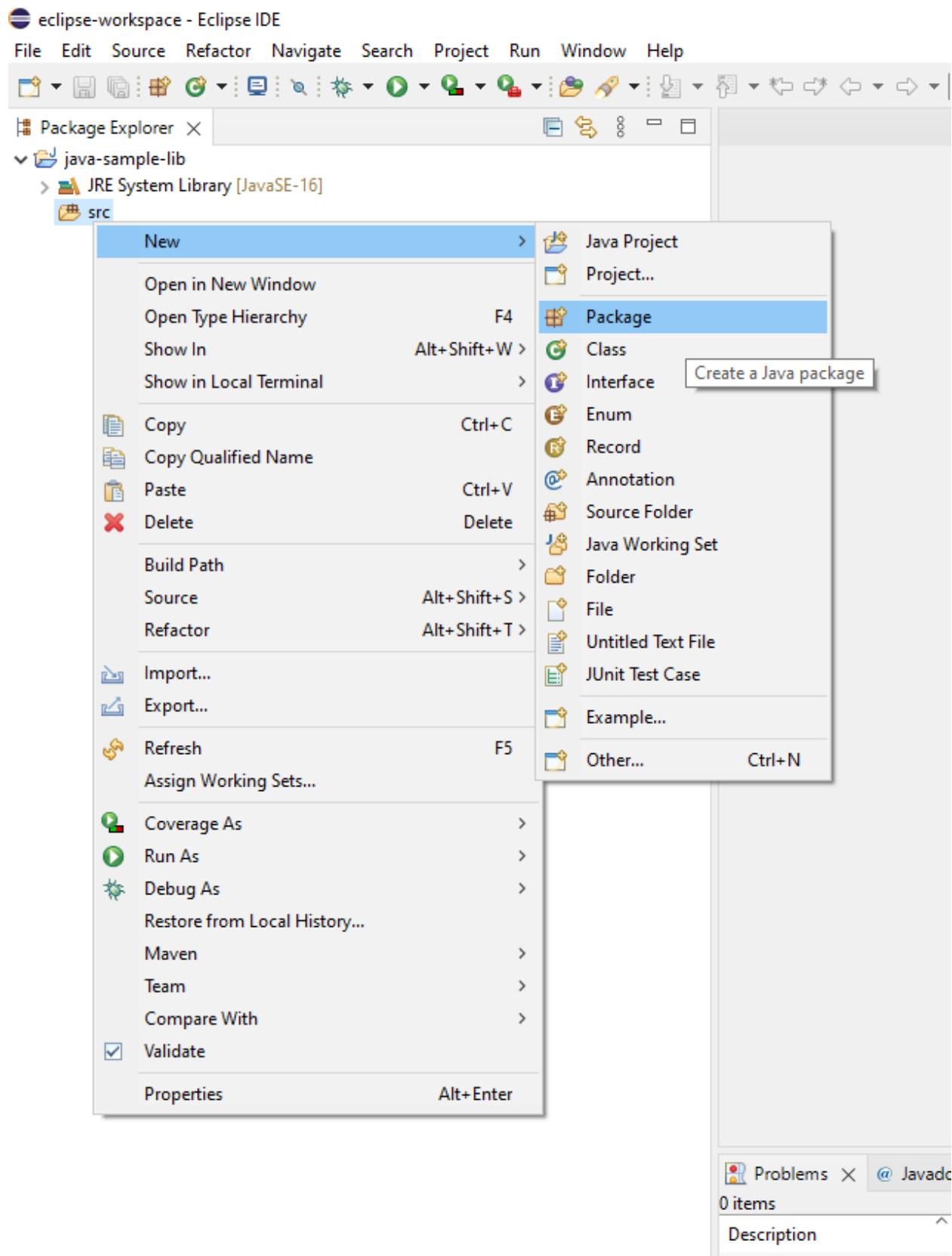
0.106 Shared Library Development - (Eclipse Java Jar Library)-8

- select finish



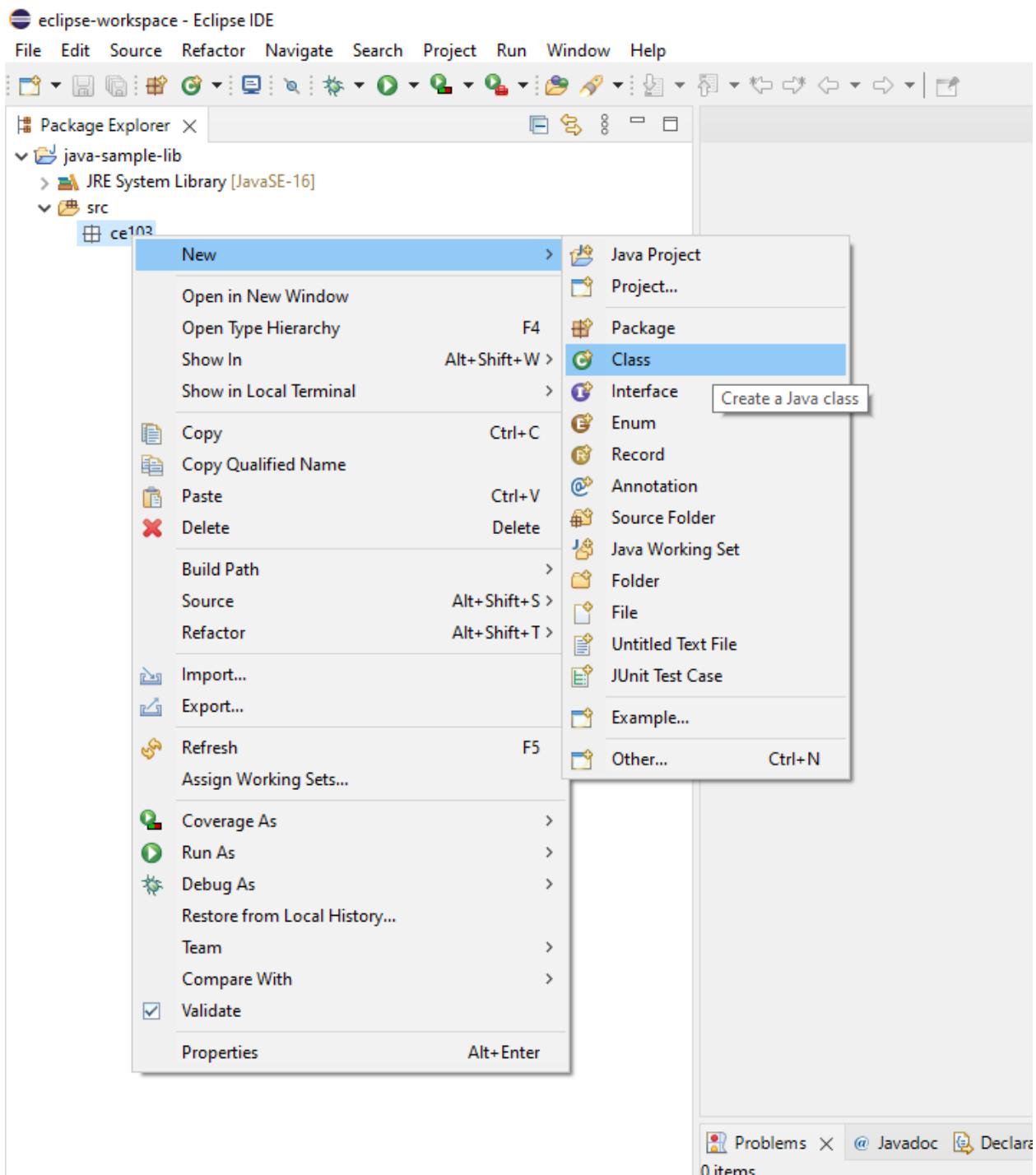
0.107 Shared Library Development - (Eclipse Java Jar Library)-9

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



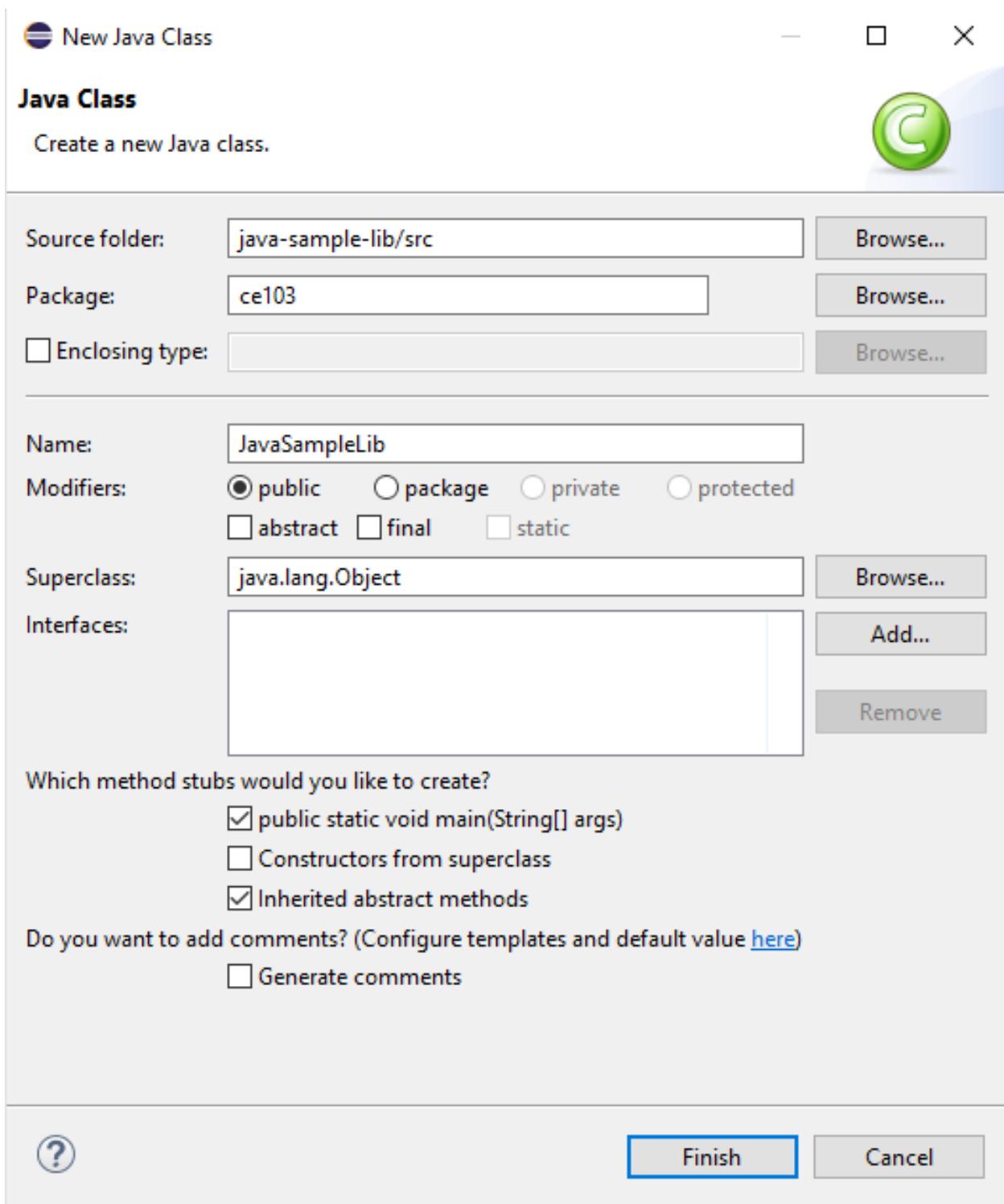
0.108 Shared Library Development - (Eclipse Java Jar Library)-10

- then we can create our class that includes our functions



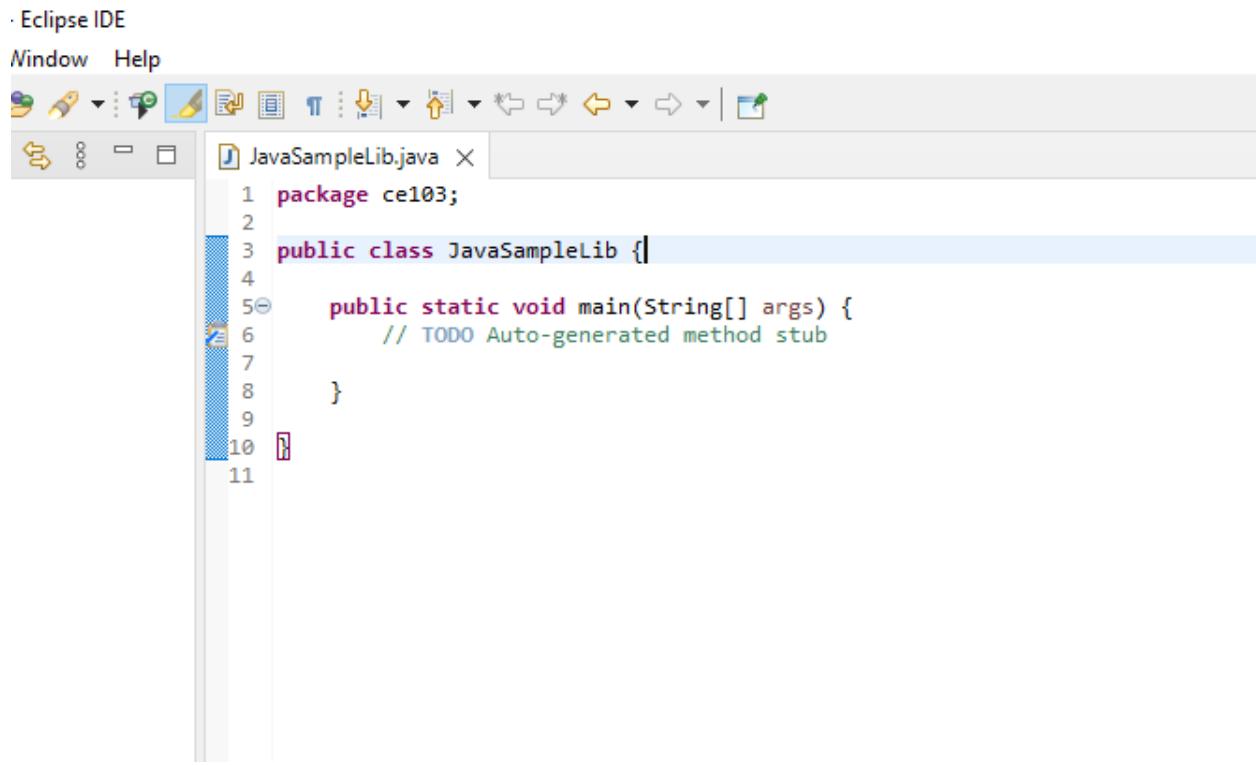
0.109 Shared Library Development - (Eclipse Java Jar Library)-11

- give class a name



0.110 Shared Library Development - (Eclipse Java Jar Library)-12

- you will have following class with main



0.111 Shared Library Development - (Eclipse Java Jar Library)-13

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

```
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();
}

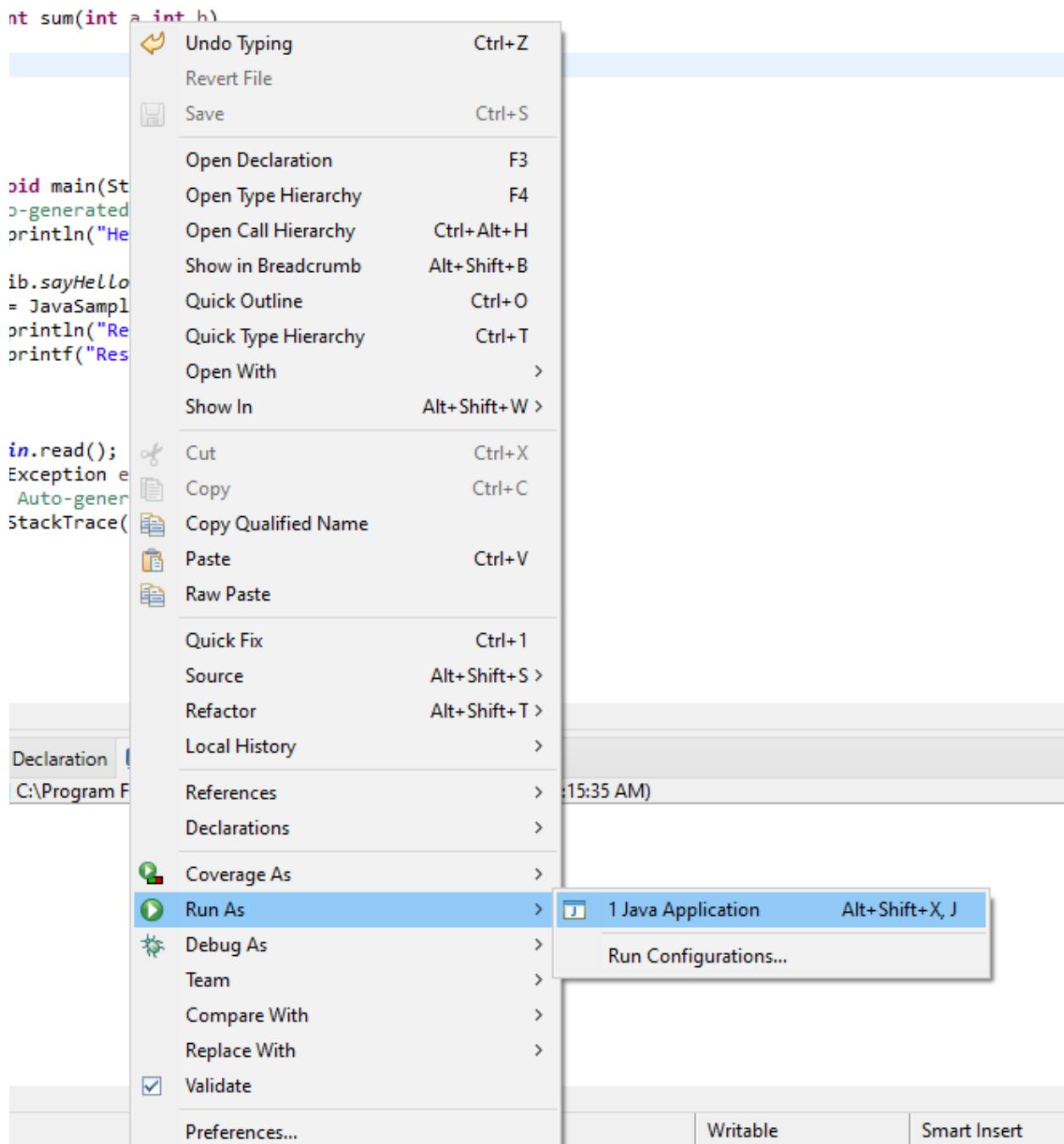
}

}

```

0.112 Shared Library Development - (Eclipse Java Jar Library)-14

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



0.113 Shared Library Development - (Eclipse Java Jar Library)-15

- we can see output from console as below

The screenshot shows the Eclipse IDE interface with the following details:

- Project Explorer:** Shows a project named "java-sample-lib" containing a "src" folder and a "ce103" package, which contains a "JavaSampleLib.java" file.
- Java Sample Code:** The code in `JavaSampleLib.java` is as follows:

```
1 package ce103;
2
3 import java.io.IOException;
4
5 public class JavaSampleLib {
6
7     public static void sayHelloTo(String name) {
8         if(name.isBlank() || name.isEmpty())
9         {
10             System.out.println("Hello "+name);
11         }else{
12             System.out.println("Hello There");
13         }
14     }
15
16     public static int sum(int a,int b)
17     {
18         int c = 0;
19         c = a+b;
20         return c;
21     }
22
23     public static void main(String[] args) {
24         // TODO Auto-generated method stub
25         System.out.println("Hello World!");
26
27         JavaSampleLib.sayHelloTo("Computer");
28         int result = JavaSampleLib.sum(5, 4);
29         System.out.println("Results is" + result);
30         System.out.printf("Results is %d \n", result);
31
32
33         try {
34             System.in.read();
35         } catch (IOException e) {
36             // TODO Auto-generated catch block
37             e.printStackTrace();
38         }
39     }
40 }
41
42 }
```

- Console Output:** The "Console" tab shows the following output:
Hello World!
Hello There
Results is9
Results is 9

0.114 Shared Library Development - (Eclipse Java Jar Library)-16

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

File Edit Source Refactor Navigate Search Project Run

New Alt+Shift+N >

Open File...

Open Projects from File System...

Recent Files >

Close Editor Ctrl+W

Close All Editors Ctrl+Shift+W

Save Ctrl+S

Save As...

Save All Ctrl+Shift+S

Revert

Move...

Rename... F2

Refresh F5

Convert Line Delimiters To >

Print... Ctrl+P

Import... Export

Export... Properties Alt+Enter

Switch Workspace >

Restart

Exit

0.115 Shared Library Development - (Eclipse Java Jar Library)-17

- Select Java->Runnable JAR File

 Export

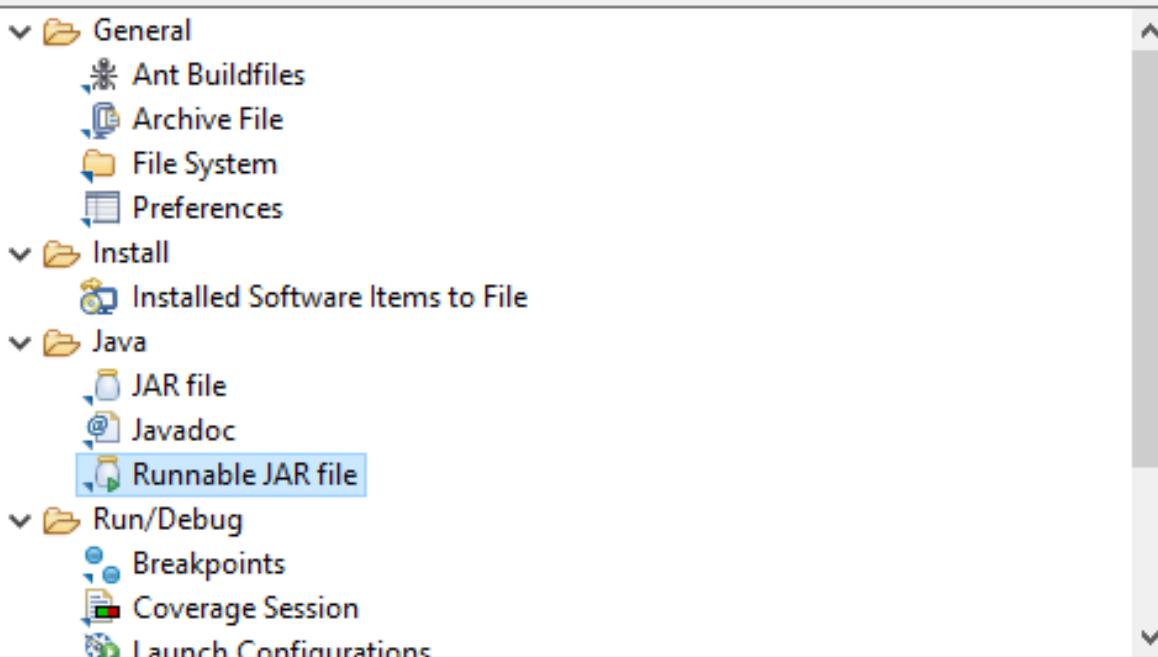
Select

Export all resources required to run an application into a JAR file on the local file system.



Select an export wizard:

type filter text



The screenshot shows the 'Select' export wizard dialog in Eclipse. The 'Java' category is expanded, revealing three options: 'JAR file', 'Javadoc', and 'Runnable JAR file'. The 'Runnable JAR file' option is highlighted with a blue selection bar. Other categories like 'General', 'Install', and 'Run/Debug' are also visible but not expanded.



< Back

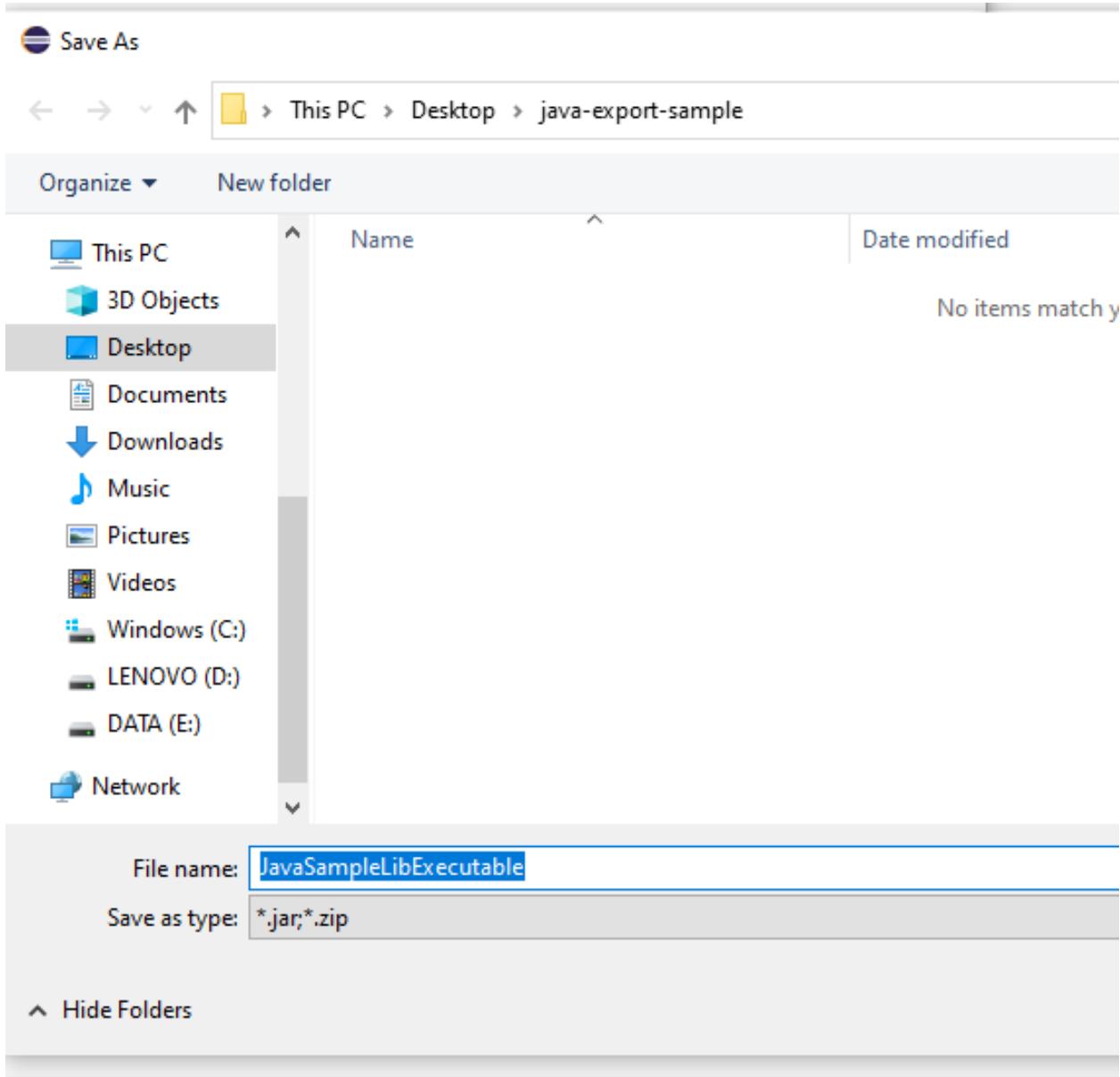
Next >

Finish

Cancel

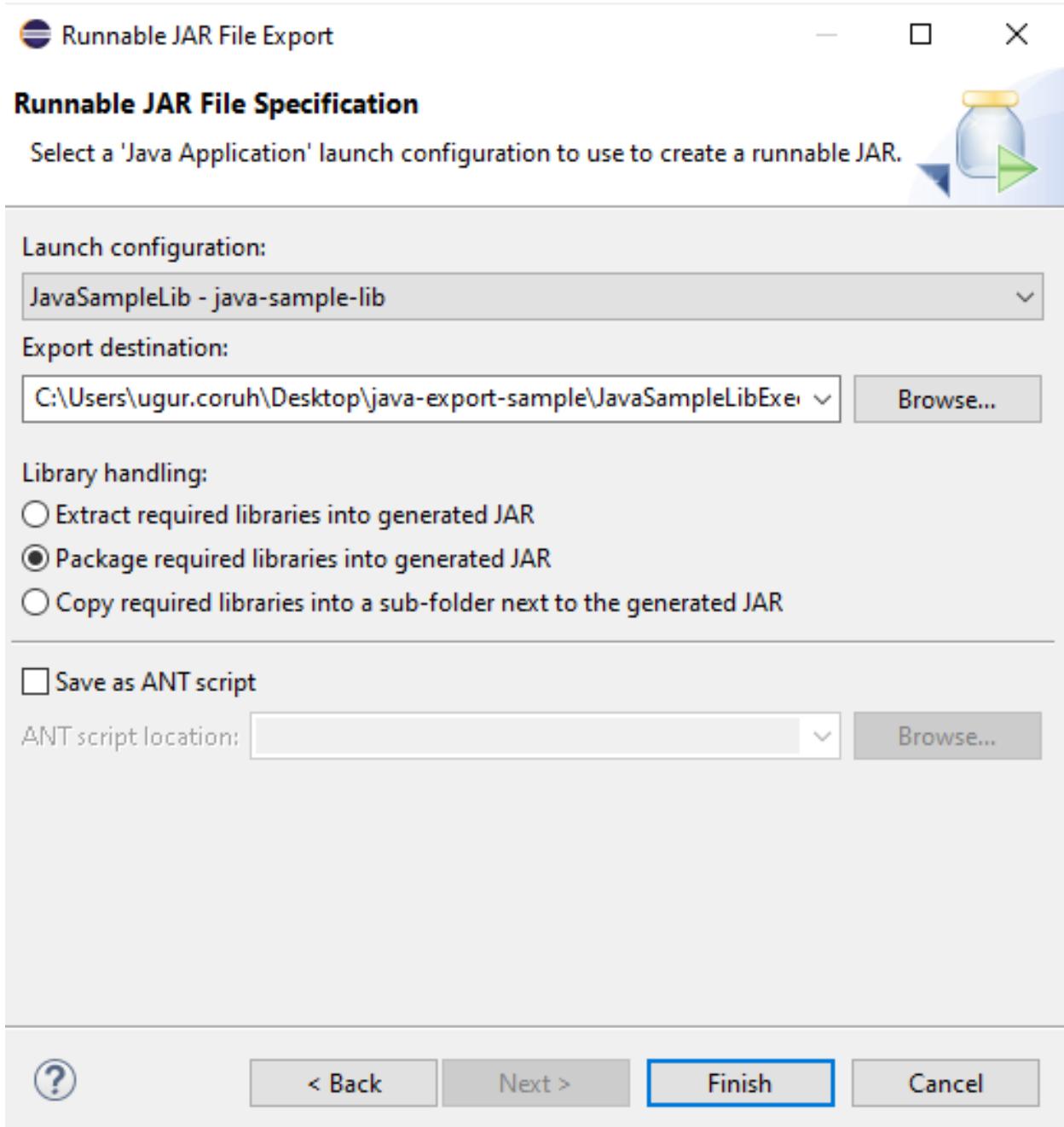
0.116 Shared Library Development - (Eclipse Java Jar Library)-18

click next and set output path for jar file



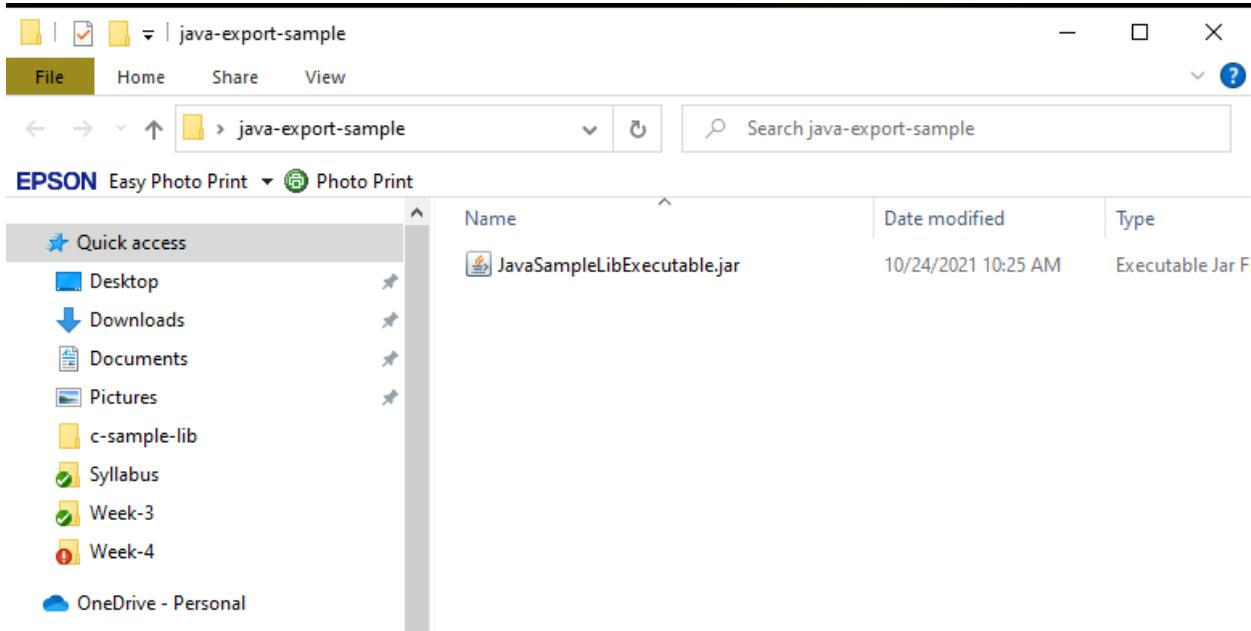
0.117 Shared Library Development - (Eclipse Java Jar Library)-19

- If our project has several external dependency 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



0.118 Shared Library Development - (Eclipse Java Jar Library)-20

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



0.119 Shared Library Development - (Eclipse Java Jar Library)-21

- 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
```

```
C:\Users\ugur.coruh\Desktop\java-export-sample>java -jar JavaSampleLibExecutable.jar
Exception in thread "main" java.lang.UnsupportedClassVersionError: ce103/JavaSampleLib has been compiled by a more recent
version of the Java Runtime (class file version 60.0), this version of the Java Runtime only recognizes class file ver
sions up to 52.0
        at java.lang.ClassLoader.defineClass1(Native Method)
        at java.lang.ClassLoader.defineClass(Unknown Source)
        at java.security.SecureClassLoader.defineClass(Unknown Source)
        at java.net.URLClassLoader.defineClass(Unknown Source)
        at java.net.URLClassLoader.access$100(Unknown Source)
        at java.net.URLClassLoader$1.run(Unknown Source)
        at java.net.URLClassLoader$1.run(Unknown Source)
        at java.security.AccessController.doPrivileged(Native Method)
        at java.net.URLClassLoader.findClass(Unknown Source)
        at java.lang.ClassLoader.loadClass(Unknown Source)
        at java.lang.ClassLoader.loadClass(Unknown Source)
        at java.lang.Class.forName0(Native Method)
        at java.lang.Class.forName(Unknown Source)
        at org.eclipse.jdt.internal.jarinjarloader.JarRsrcLoader.main(JarRsrcLoader.java:59)
C:\Users\ugur.coruh\Desktop\java-export-sample>
```

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

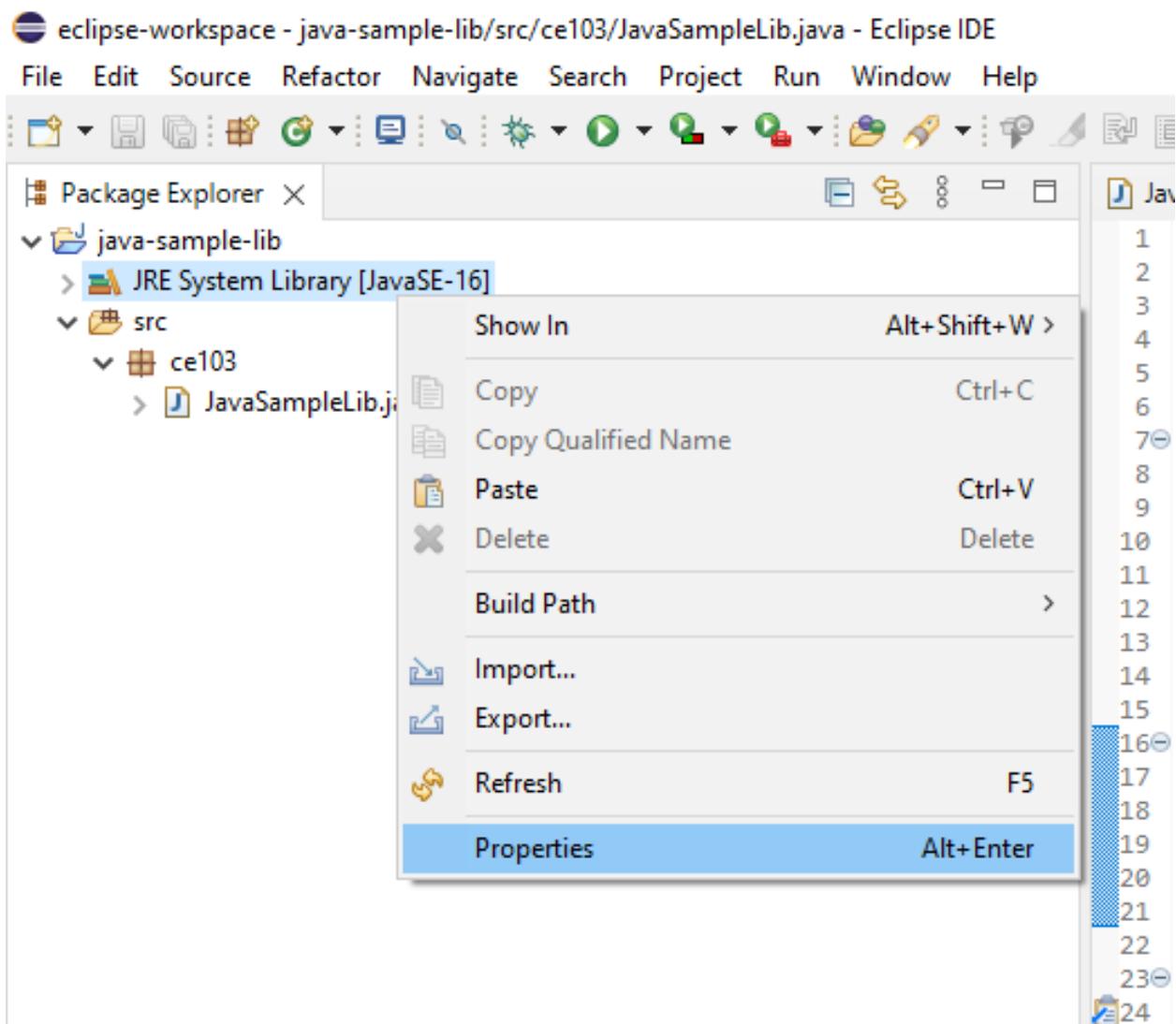
If we check version we can see problem Java version 1.8.0_231

```
C:\Users\ugur.coruh\Desktop\java-export-sample>java -showversion
java version "1.8.0_231"
Java(TM) SE Runtime Environment (build 1.8.0_231-b11)
Java HotSpot(TM) 64-Bit Server VM (build 25.231-b11, mixed mode)

Usage: java [-options] class [args...]
```

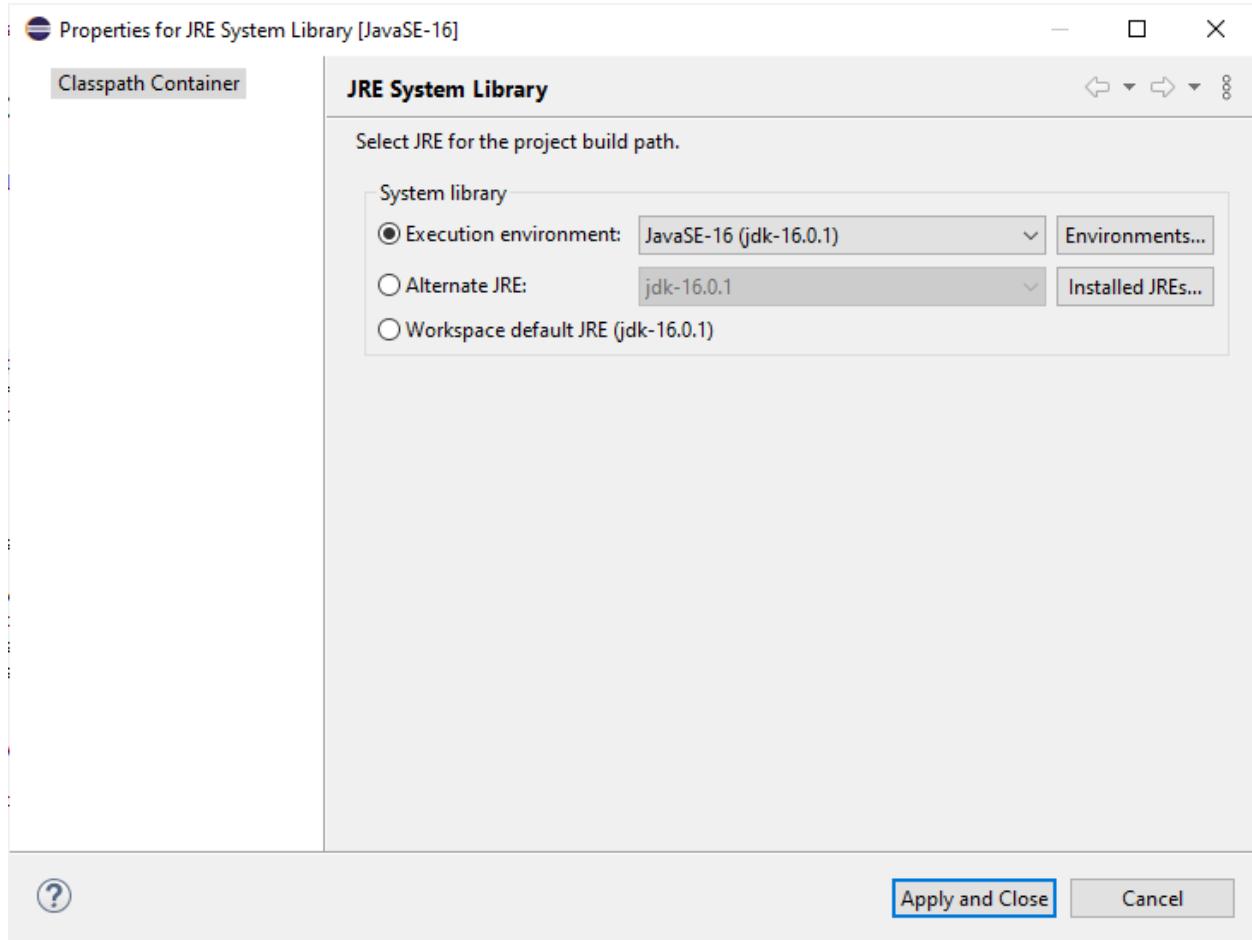
0.120 Shared Library Development - (Eclipse Java Jar Library)-22

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



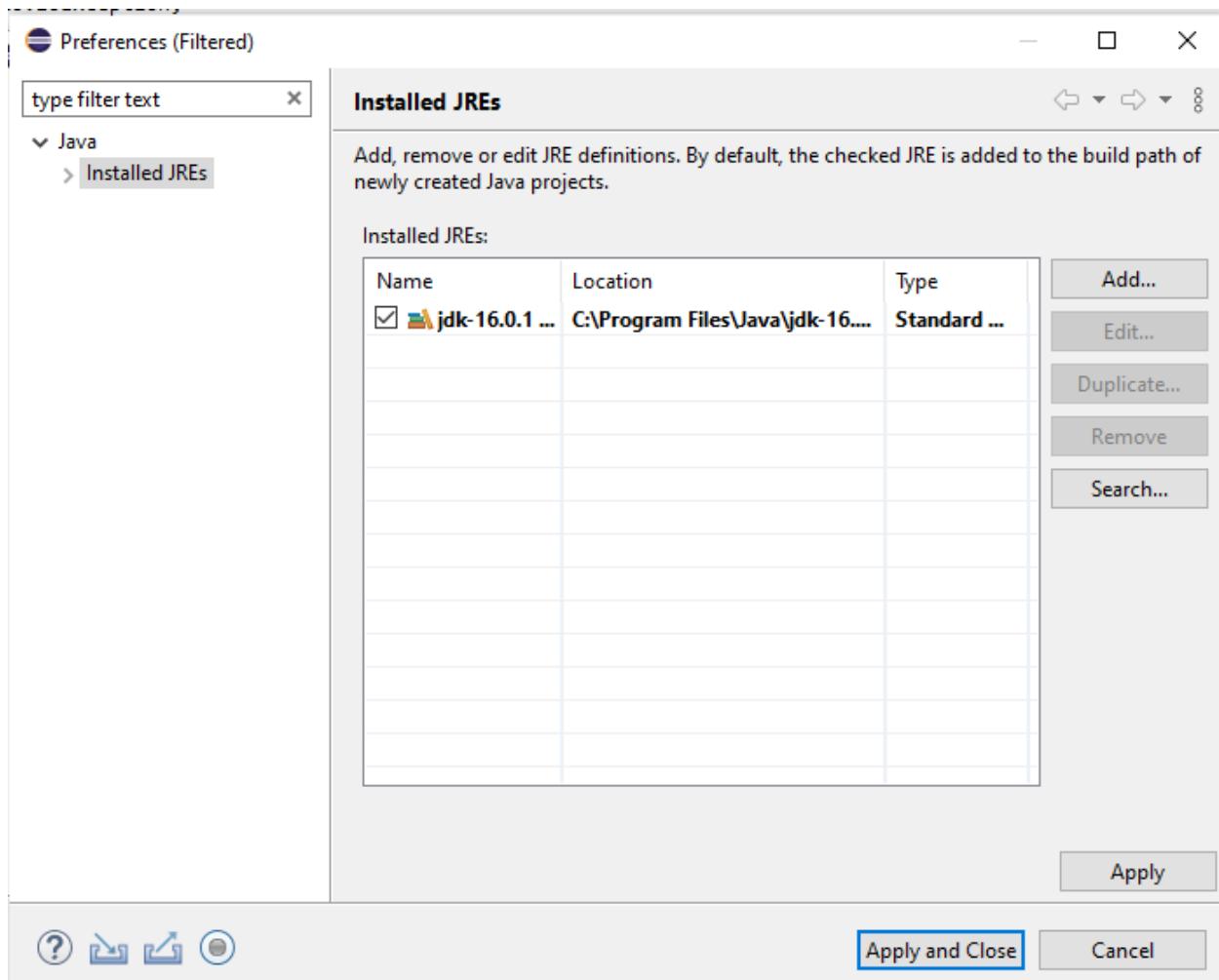
0.121 Shared Library Development - (Eclipse Java Jar Library)-23

- select environments



0.122 Shared Library Development - (Eclipse Java Jar Library)-24

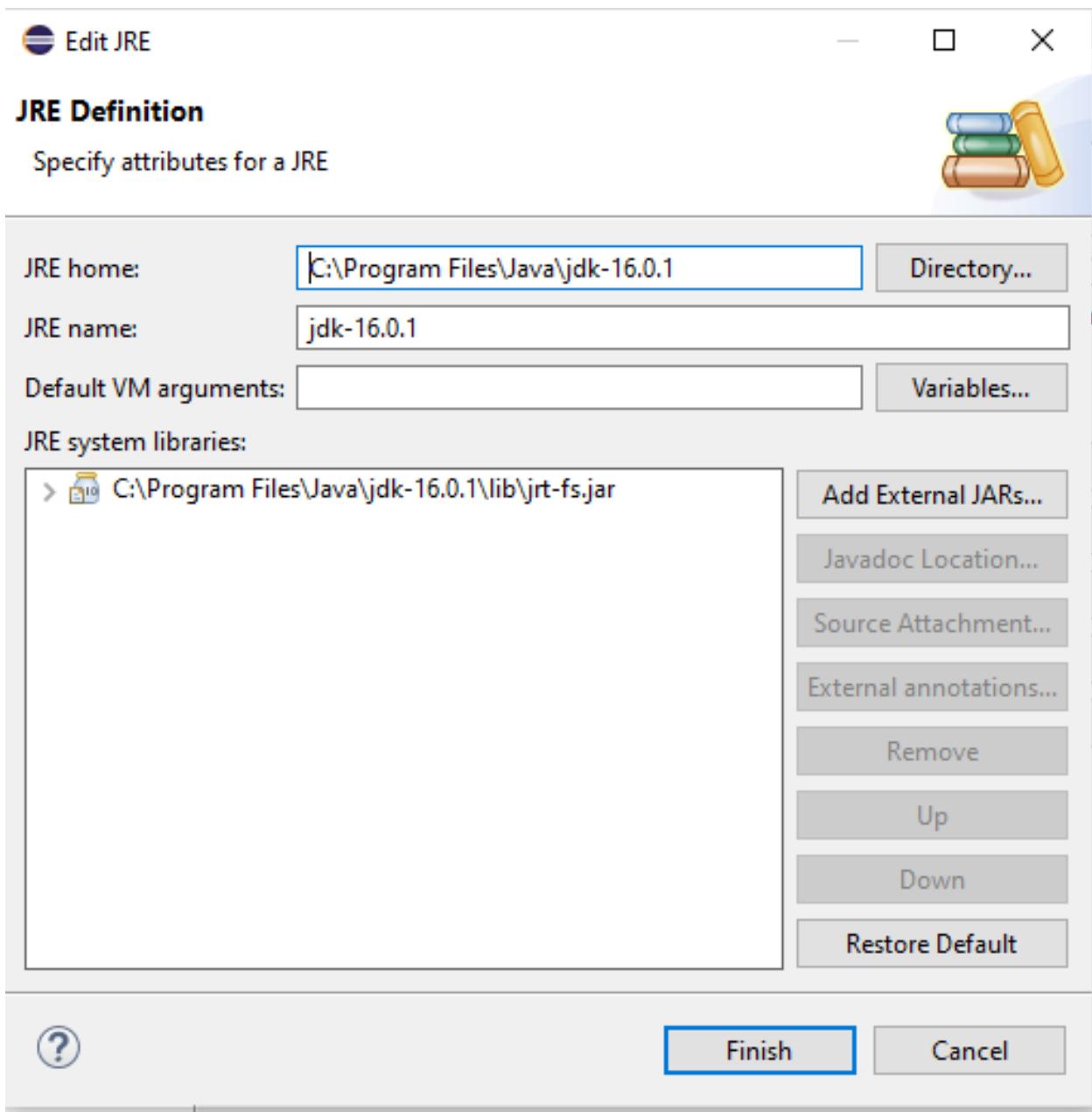
- select installed JRE or JDK



0.123 Shared Library Development - (Eclipse Java Jar Library)-25

- you can see installed JRE or JDK home

C:\Program Files\Java\jdk-16.0.1



0.124 Shared Library Development - (Eclipse Java Jar Library)-26

- Open system environment to fix this problem

All Apps Documents Web More ▾

Best match



System Configuration

App



Settings



Edit the system environment
variables



System



Reset this PC



Recovery



Recovery options



About your PC



Taskbar notification area



See if you have a 32-bit or 64-bit
version of Windows



Search the web

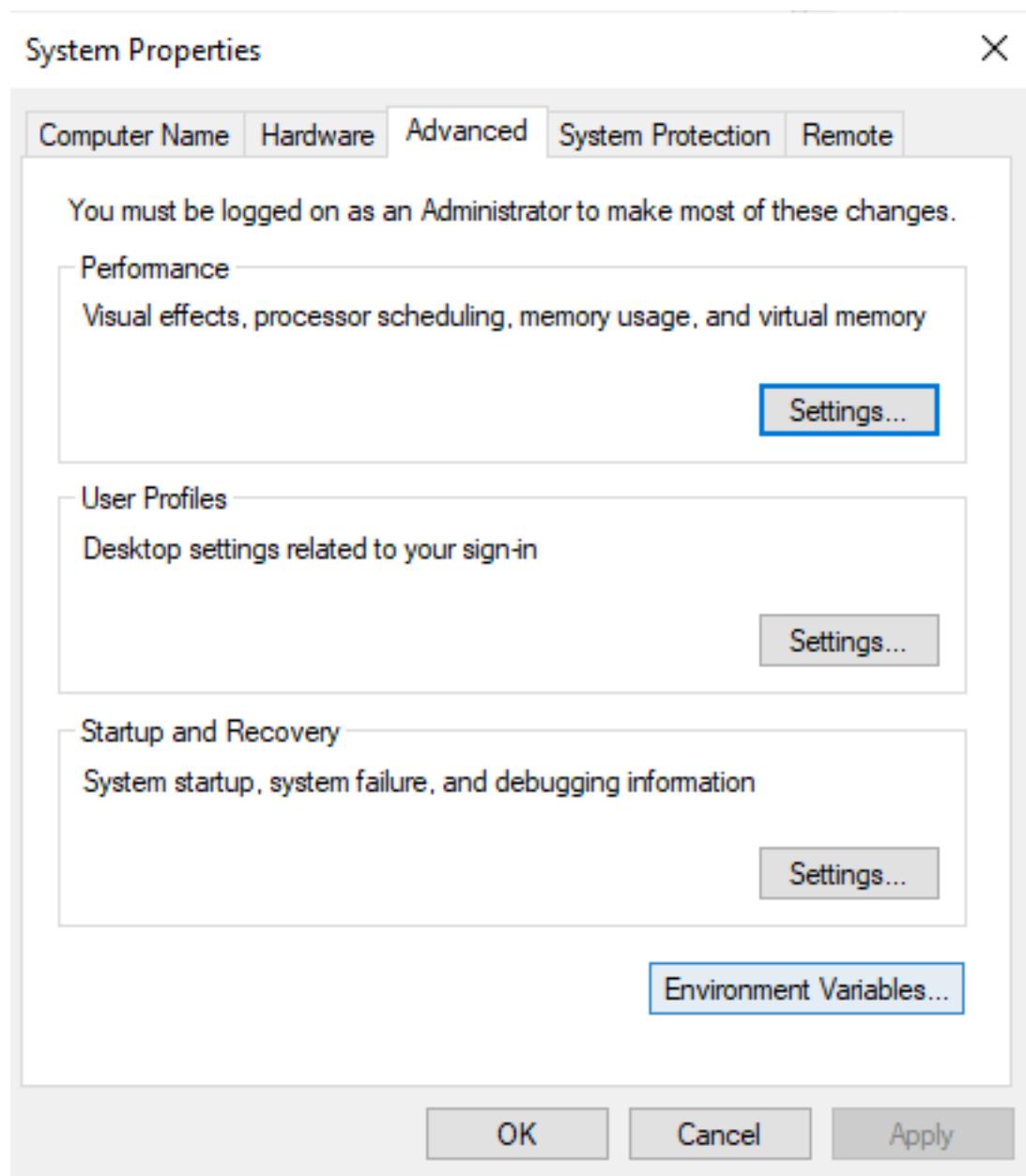


syste - See web results



Apps (7+)

0.125 Shared Library Development - (Eclipse Java Jar Library)-27



0.126 Shared Library Development - (Eclipse Java Jar Library)-28

- Check user settings first

Environment Variables

X

User variables for ugur.coruh

| Variable | Value |
|---------------------------------|--|
| ChocolateyLastPathUpdate | 132416153103954791 |
| GOPATH | C:\Users\ugur.coruh\go |
| IntelliJ IDEA Community Edit... | C:\Program Files\JetBrains\IntelliJ IDEA Community Edition 2021.1.1... |
| OneDrive | C:\Users\ugur.coruh\OneDrive |
| OneDriveConsumer | C:\Users\ugur.coruh\OneDrive |
| Path | C:\Program Files\Java\jdk-16.0.1\bin;C:\Python27;C:\Users\ugur.co... |
| TEMP | C:\Users\ugur.coruh\AppData\Local\Temp |

New...

Edit...

Delete

System variables

| Variable | Value |
|----------------------|--|
| asl.log | Destination=file |
| ChocolateyInstall | C:\ProgramData\chocolatey |
| CHOKIDAR_USESPOLLING | true |
| ComSpec | C:\WINDOWS\system32\cmd.exe |
| configsetroot | C:\WINDOWS\ConfigSetRoot |
| DriverData | C:\Windows\System32\Drivers\DriverData |
| JAVA HOME | C:\Program Files\Java\jdk-16.0.1\ |

New...

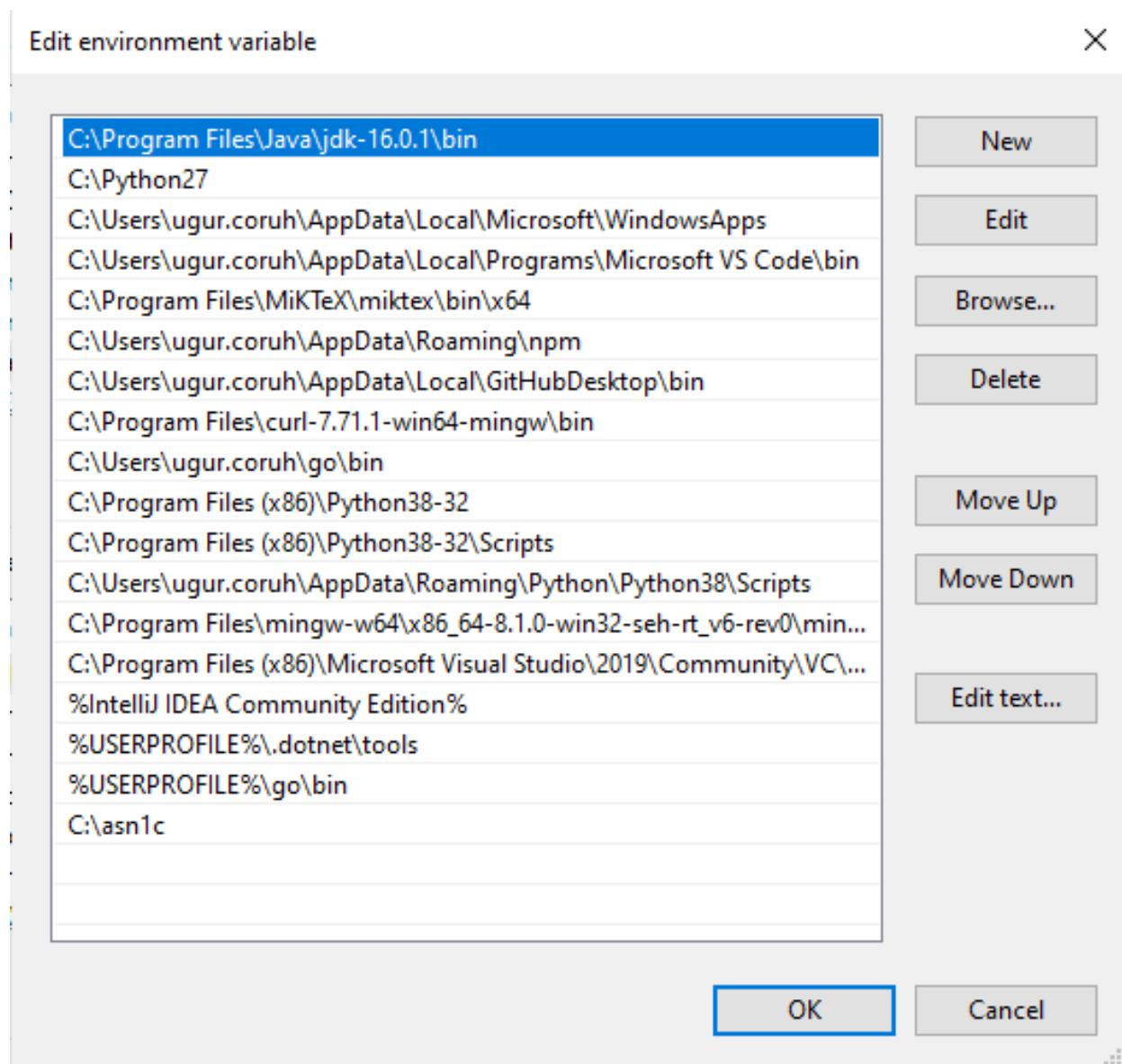
Edit...

Delete

OK

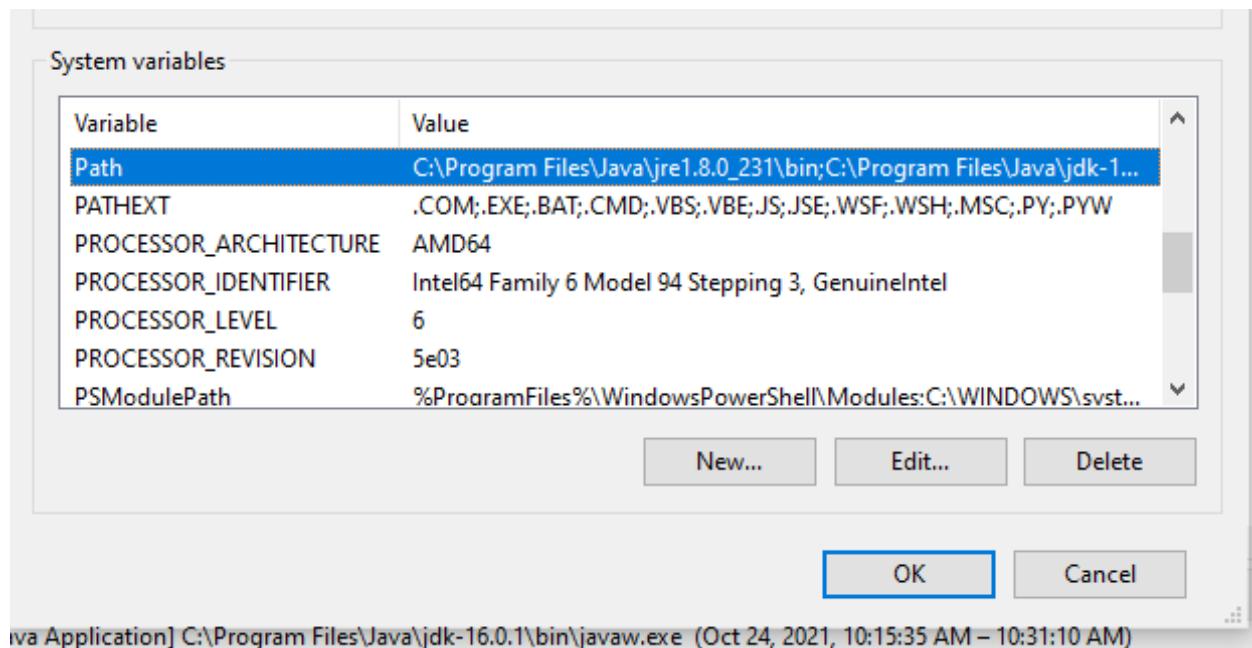
Cancel

0.127 Shared Library Development - (Eclipse Java Jar Library)-29



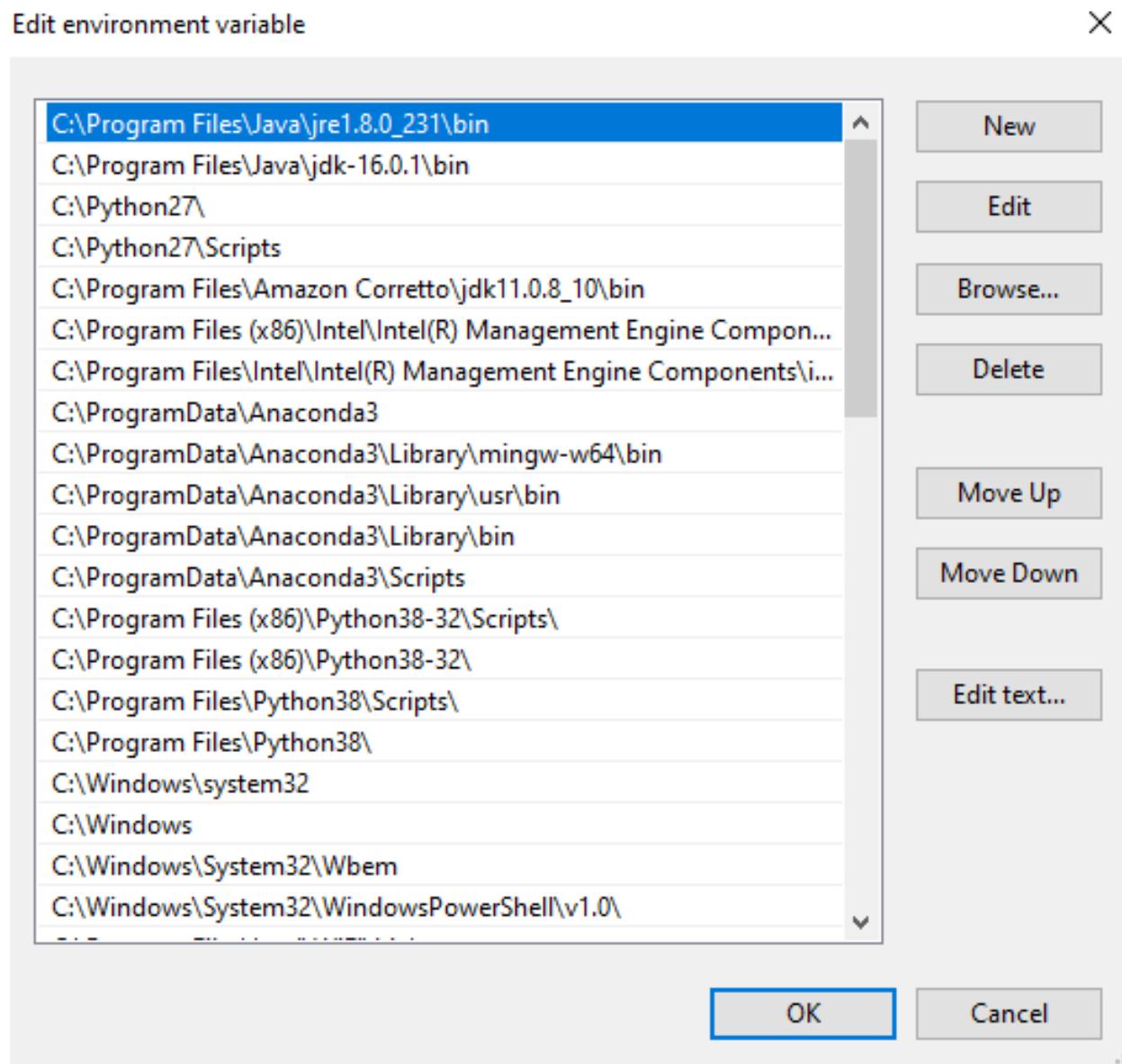
0.128 Shared Library Development - (Eclipse Java Jar Library)-30

- Check system settings



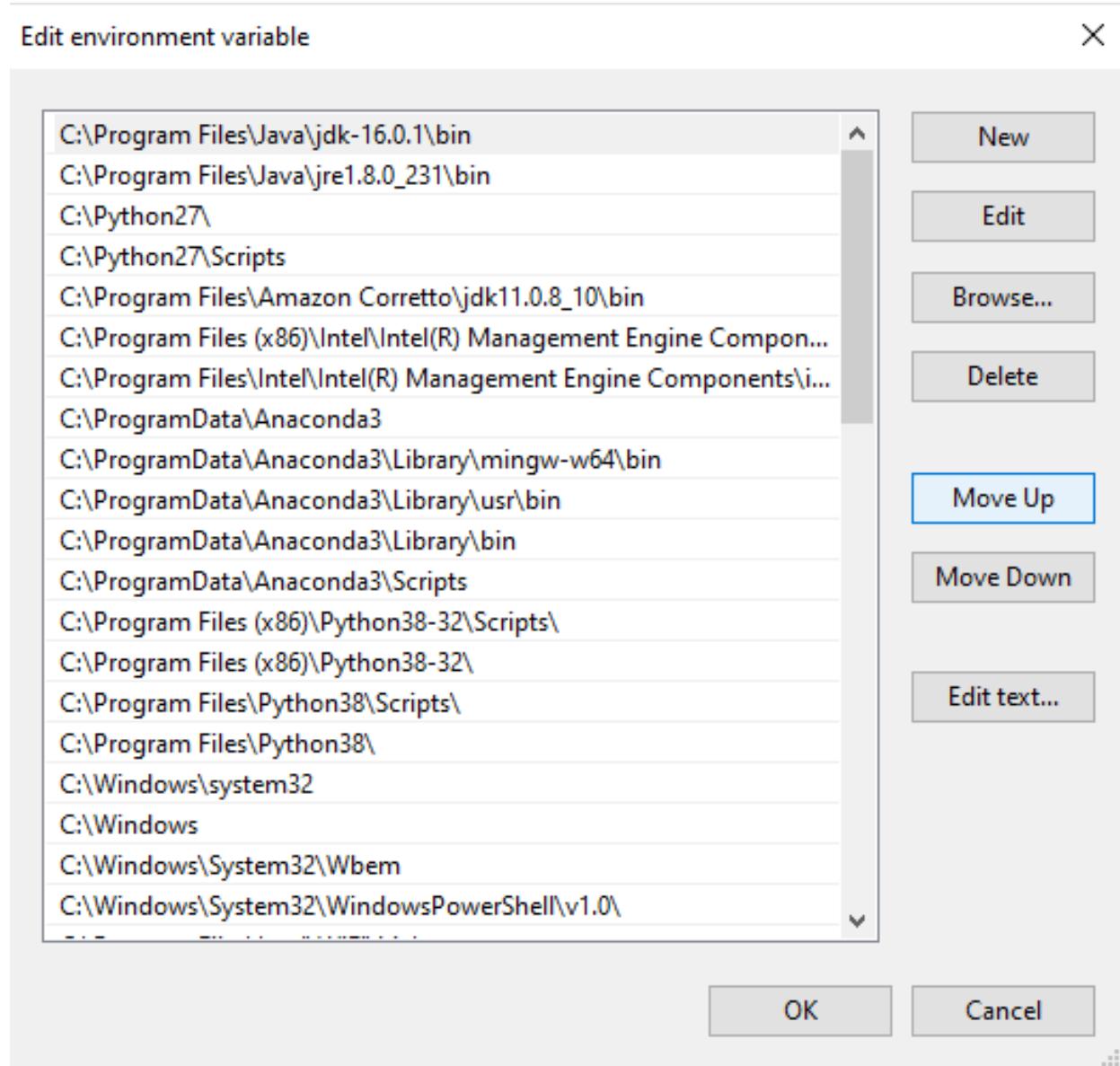
[Java Application] C:\Program Files\Java\jdk-16.0.1\bin\javaw.exe (Oct 24, 2021, 10:15:35 AM – 10:31:10 AM)

0.129 Shared Library Development - (Eclipse Java Jar Library)-31



0.130 Shared Library Development - (Eclipse Java Jar Library)-32

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



0.131 Shared Library Development - (Eclipse Java Jar Library)-33

- Also in system setting check JAVA_HOME

| System variables | |
|----------------------|-----------------------------------|
| Variable | Value |
| JAVA_HOME | C:\Program Files\Java\jdk-16.0.1\ |
| MOSQUITTO_DIR | C:\Program Files\mosquitto |
| NUMBER_OF_PROCESSORS | 8 |
| OS | Windows NT |

0.132 Shared Library Development - (Eclipse Java Jar Library)-34

- 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
```

```
C:\> C:\WINDOWS\system32\cmd.exe
Microsoft Windows [Version 10.0.19043.1288]
(c) Microsoft Corporation. All rights reserved.

C:\Users\ugur.coruh>java --version
java 16.0.1 2021-04-20
Java(TM) SE Runtime Environment (build 16.0.1+9-24)
Java HotSpot(TM) 64-Bit Server VM (build 16.0.1+9-24, mixed mode, sharing)

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

0.133 Shared Library Development - (Eclipse Java Jar Library)-35

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
```

0.134 Shared Library Development - (Eclipse Java Jar Library)-36

- 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 wrapper¹⁰

¹⁰<http://launch4j.sourceforge.net/index.html>



app-setup.exe
Installer created by an external installer program.



jar library

dll library

jar library

dll library

jar library

dll library

Embedded JRE

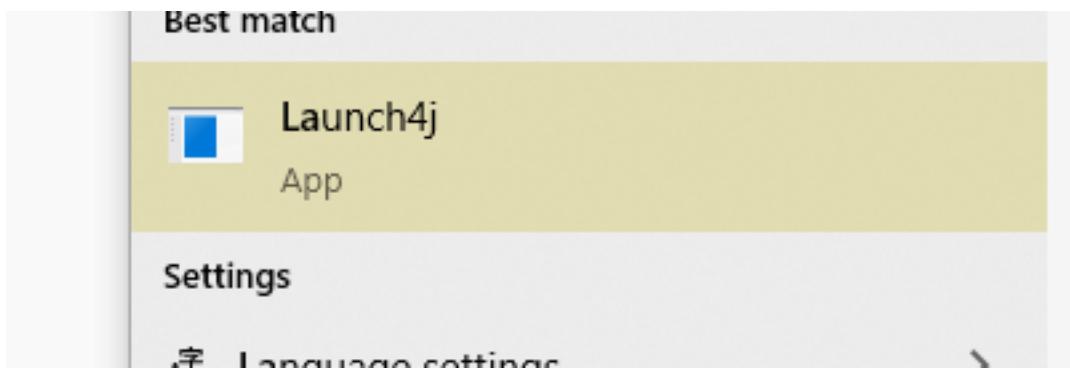
0.135 Shared Library Development - (Eclipse Java Jar Library)-37

- you can watch this tutorial also
 - How to convert jar to exe using Launch4J Full explanation - YouTube¹¹

0.136 Shared Library Development - (Eclipse Java Jar Library)-38

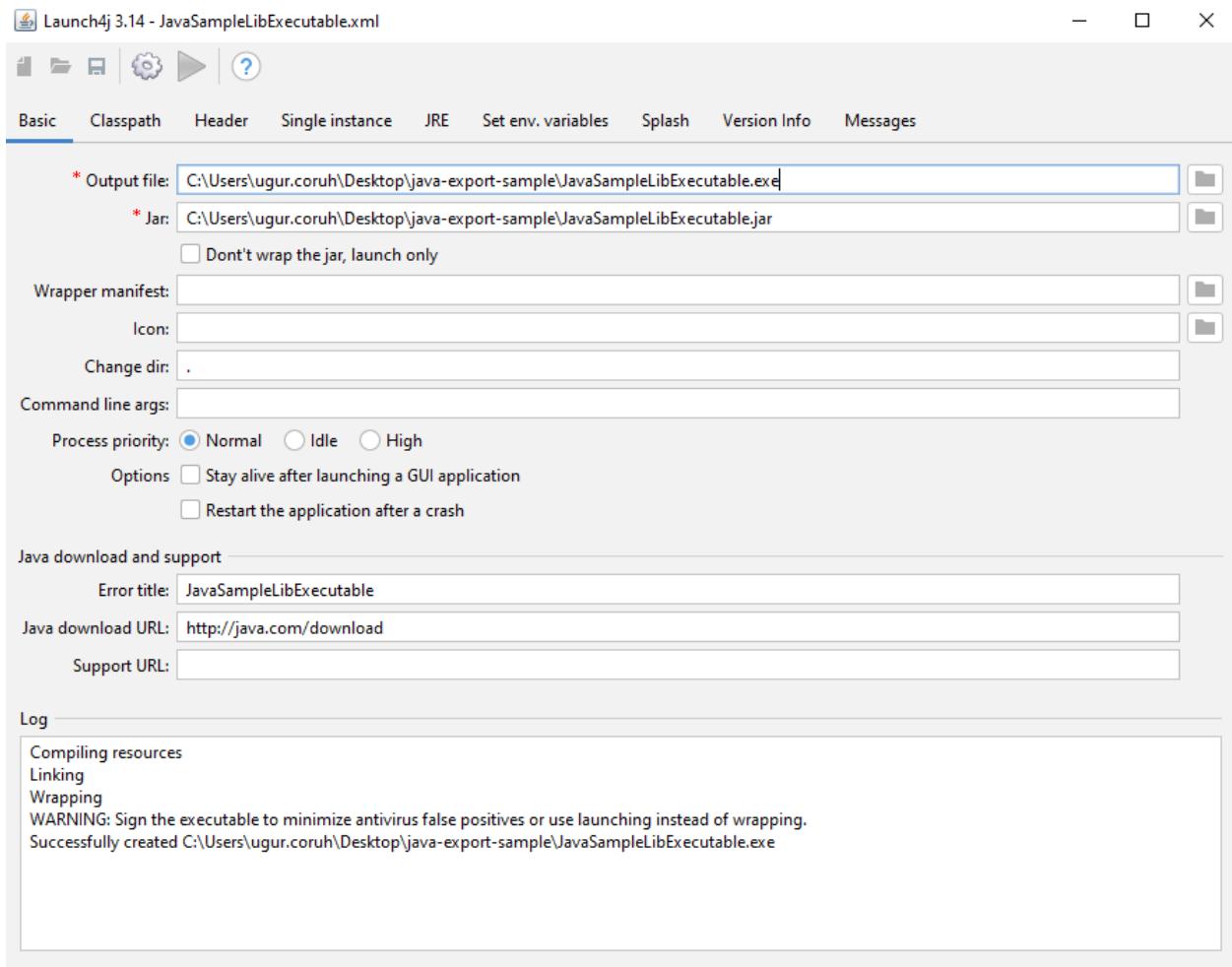
- Download and install launch4j and open application

¹¹https://www.youtube.com/watch?v=MyMPPuYGN-U&ab_channel=GoXR3PlusStudio



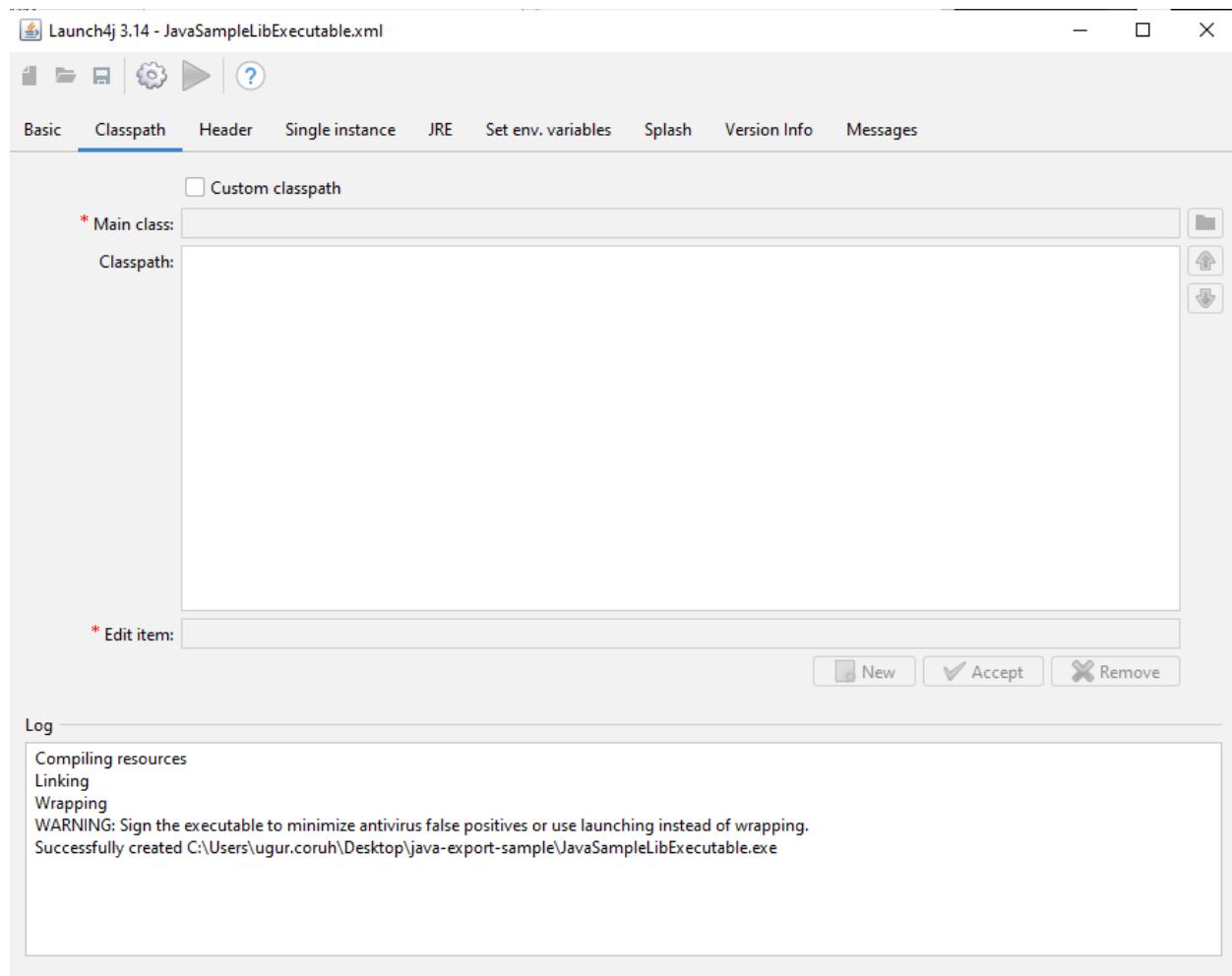
0.137 Shared Library Development - (Eclipse Java Jar Library)-39

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



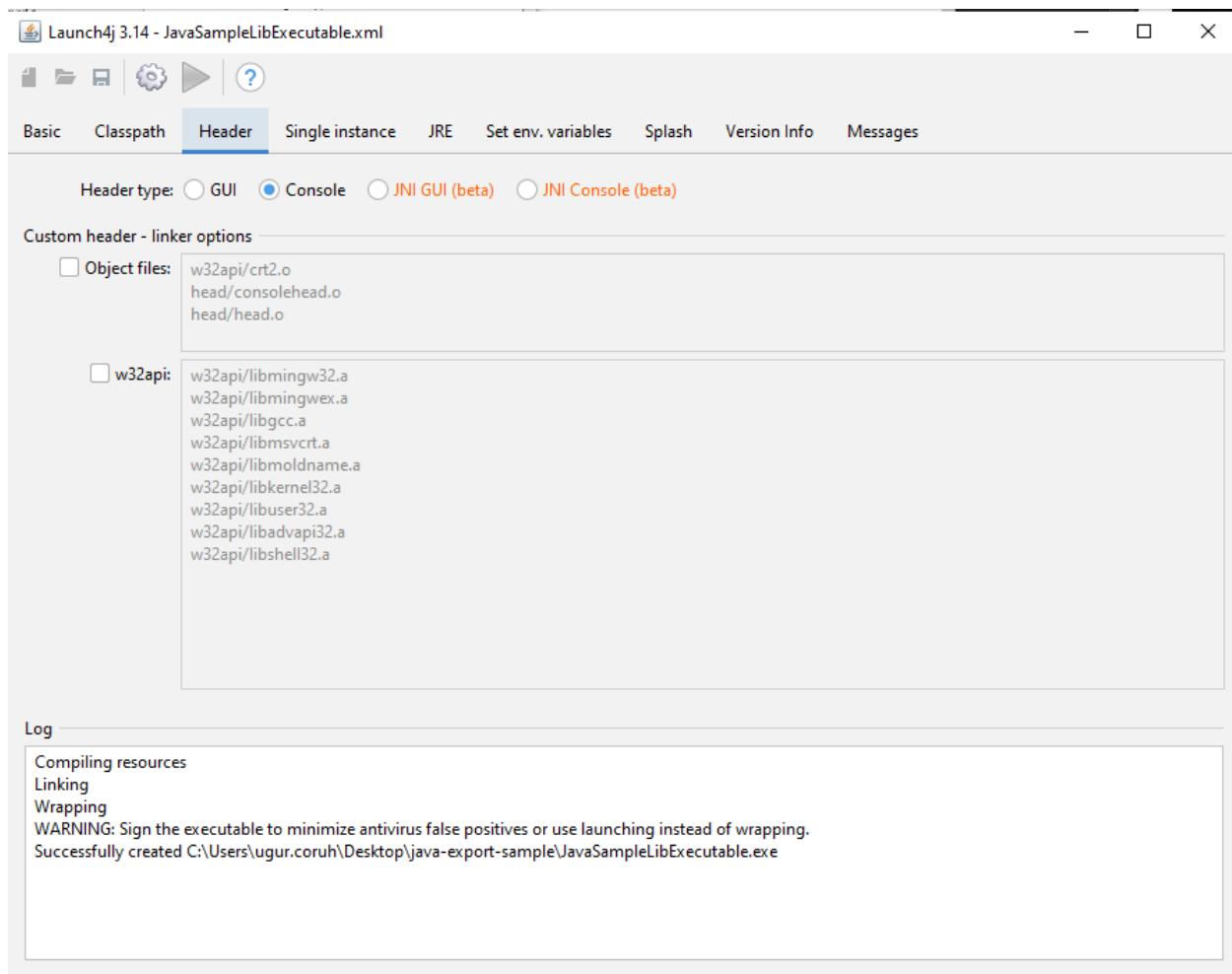
0.138 Shared Library Development - (Eclipse Java Jar Library)-40

- We can customize main class if have multiple main class



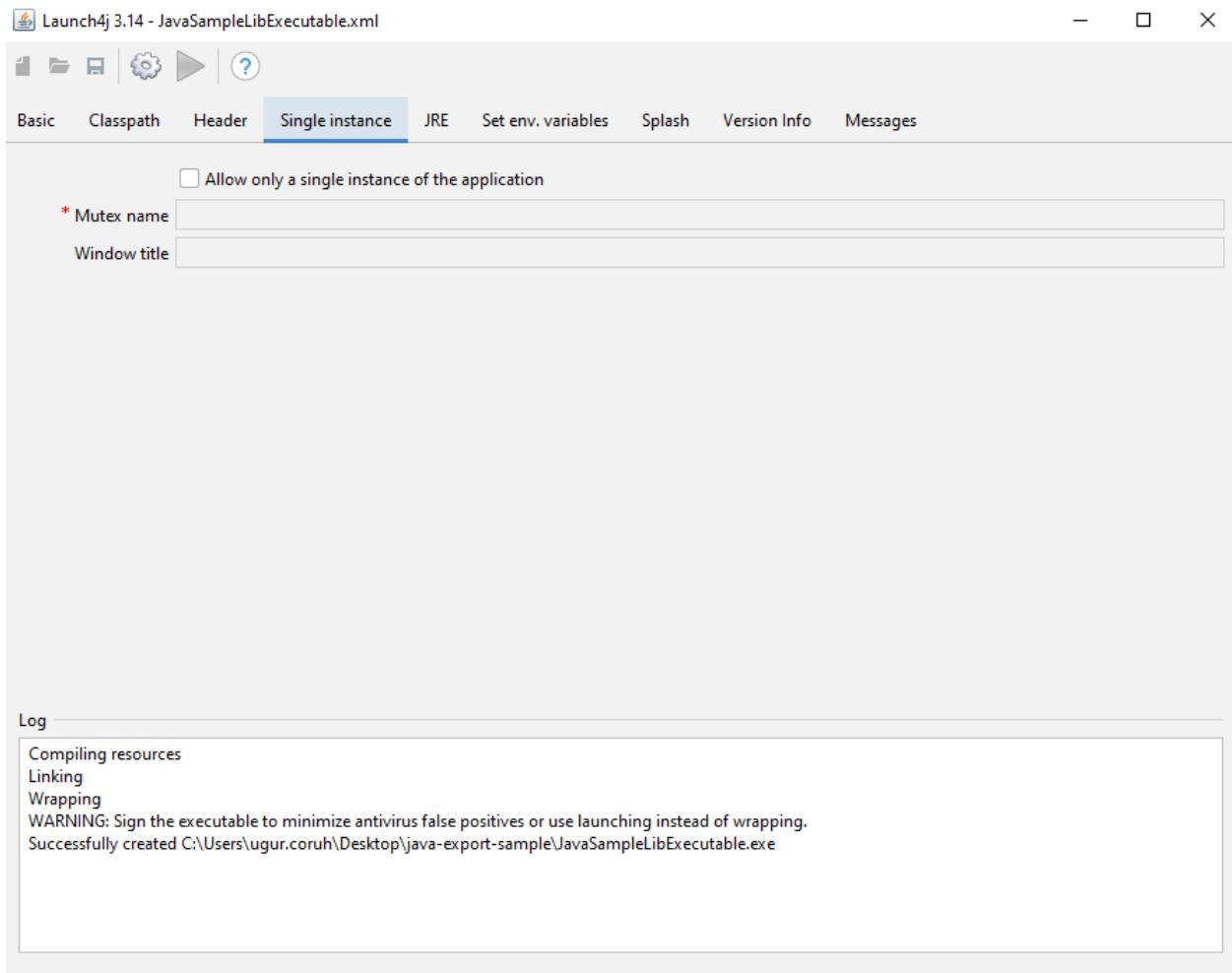
0.139 Shared Library Development - (Eclipse Java Jar Library)-41

select console from setting for this application



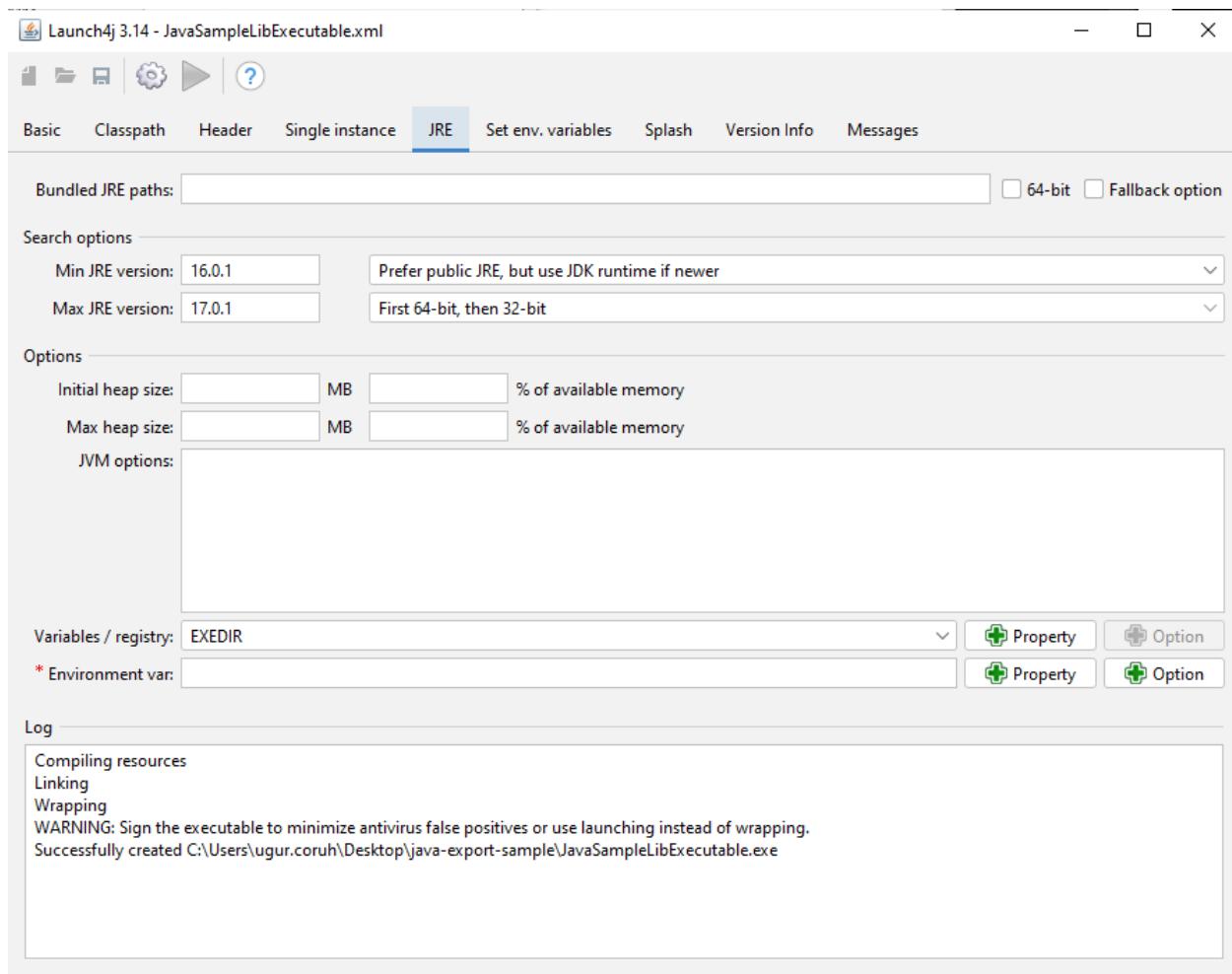
0.140 Shared Library Development - (Eclipse Java Jar Library)-42

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



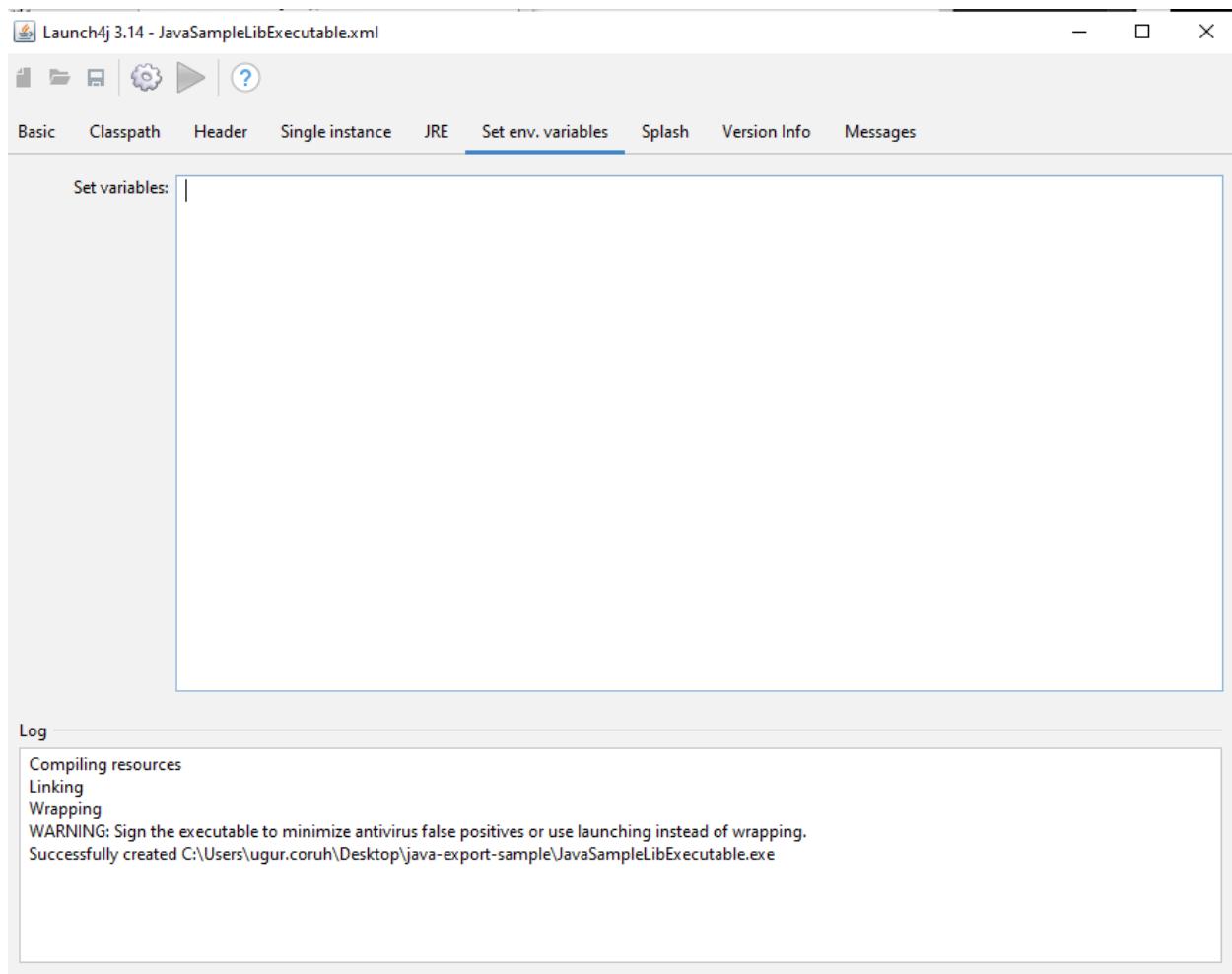
0.141 Shared Library Development - (Eclipse Java Jar Library)-43

- we need to set runtime environment versions



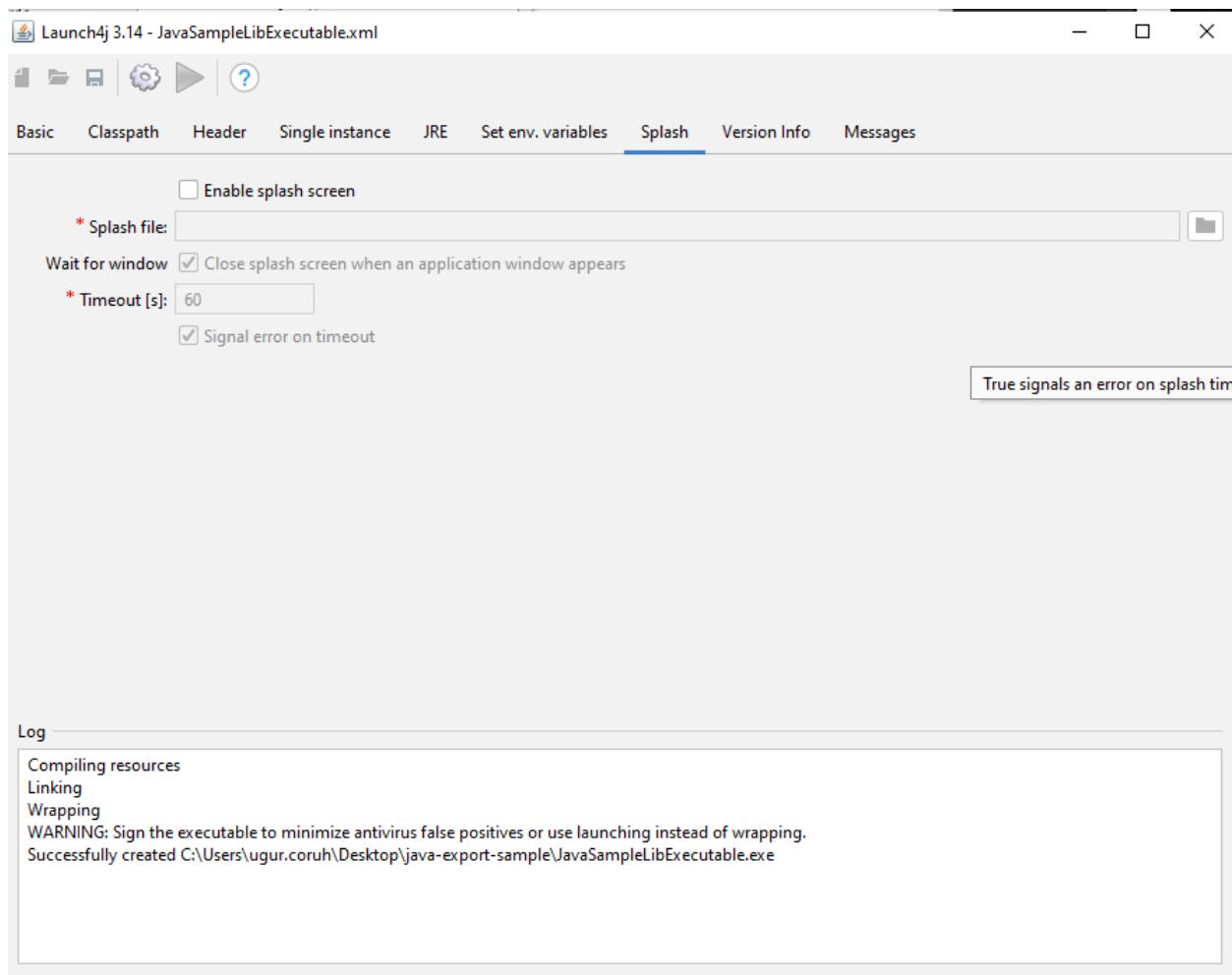
0.142 Shared Library Development - (Eclipse Java Jar Library)-44

you can set system parameters before running application



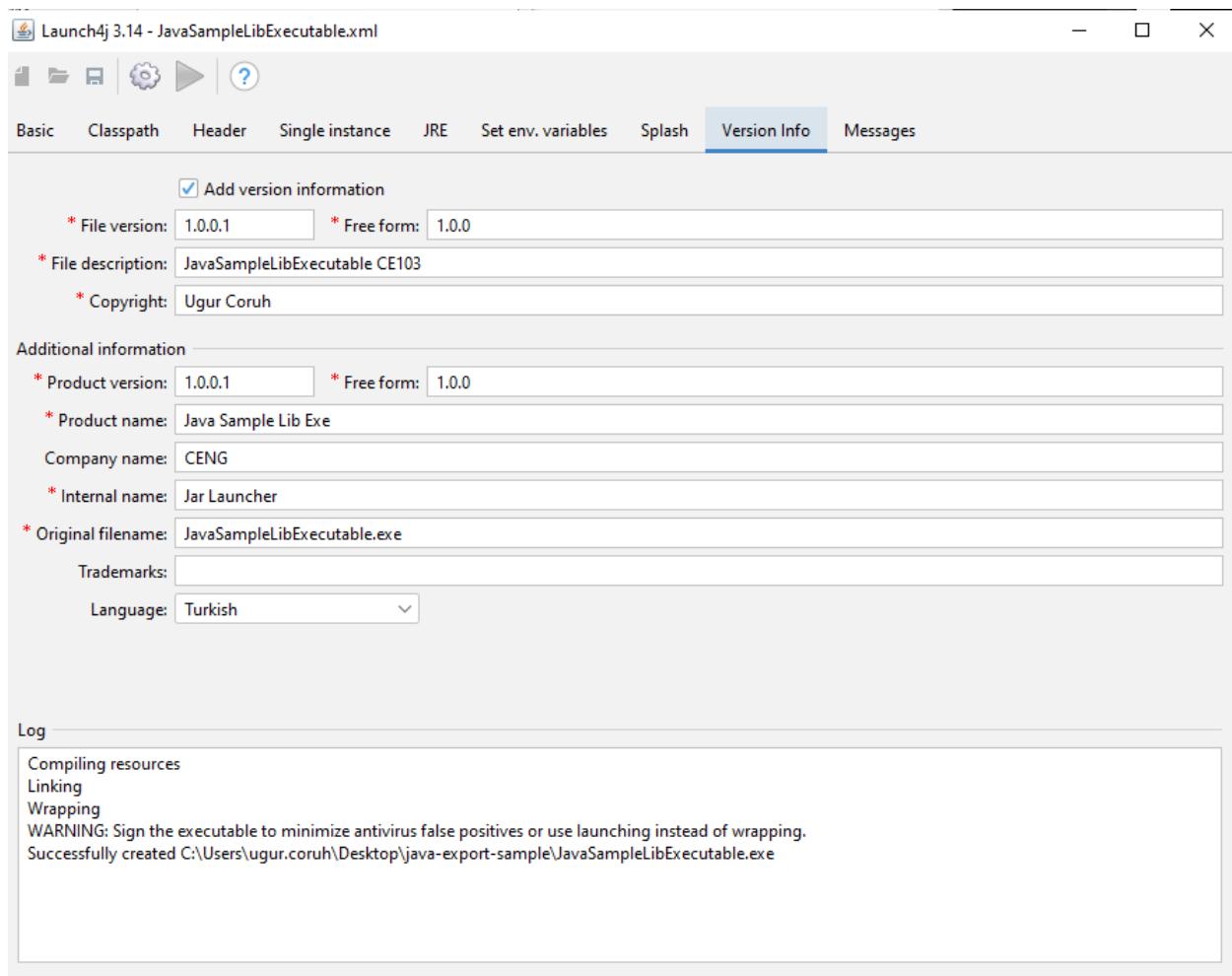
0.143 Shared Library Development - (Eclipse Java Jar Library)-45

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



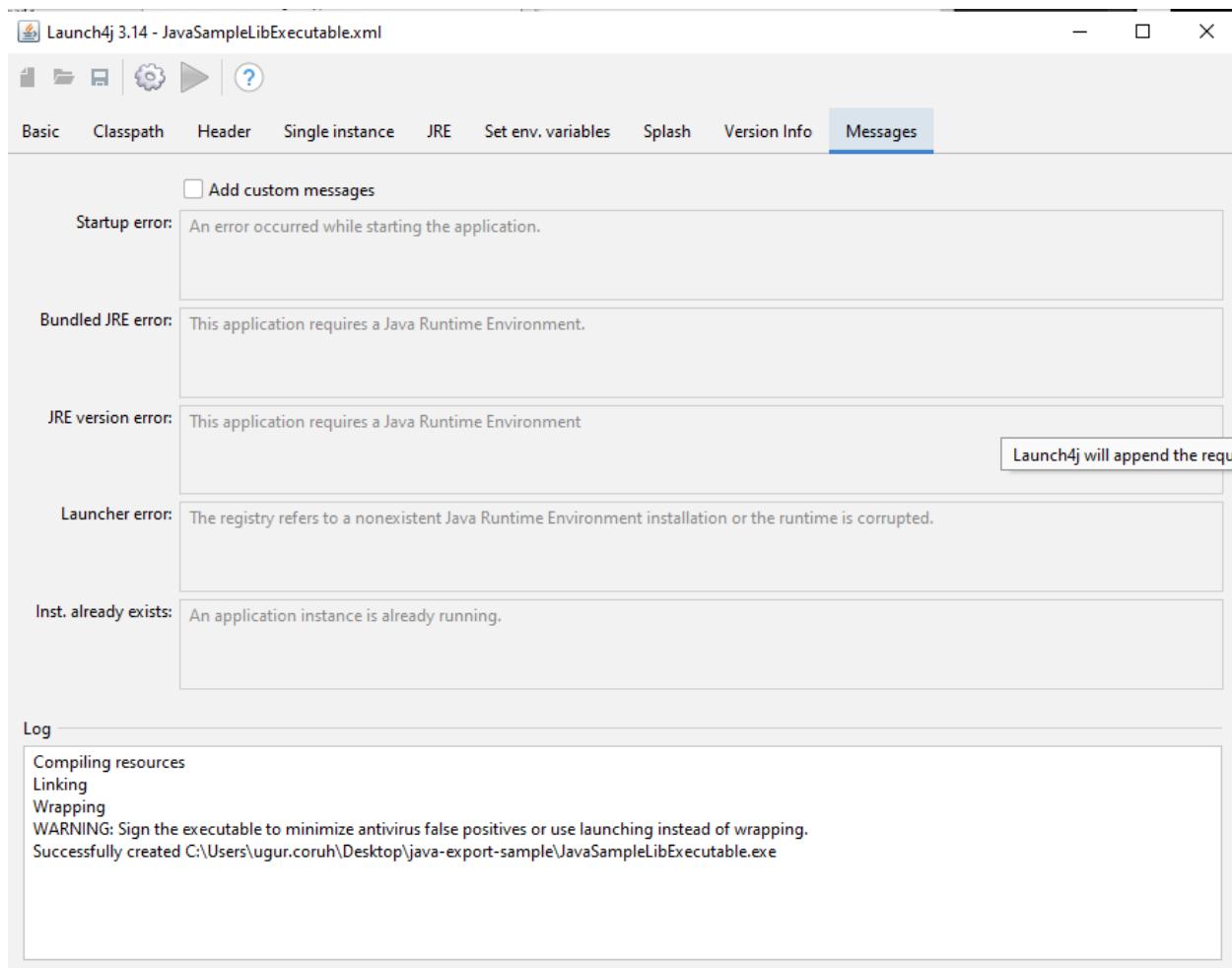
0.144 Shared Library Development - (Eclipse Java Jar Library)-46

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



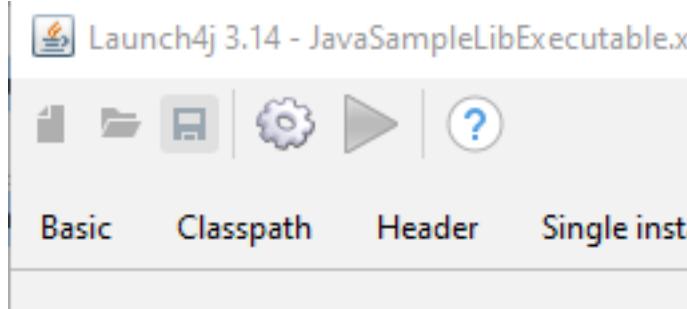
0.145 Shared Library Development - (Eclipse Java Jar Library)-47

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



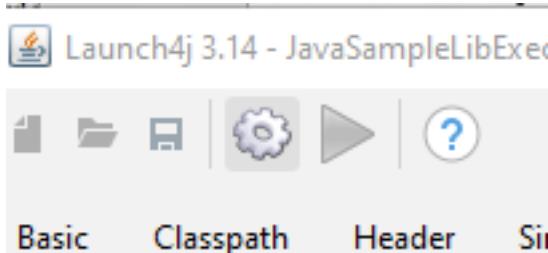
0.146 Shared Library Development - (Eclipse Java Jar Library)-48

- with this options save configuration file xml



0.147 Shared Library Development - (Eclipse Java Jar Library)-49

- and compile settings



0.148 Shared Library Development - (Eclipse Java Jar Library)-50

- You will see generated output file in log screen

Compiling resources

Linking

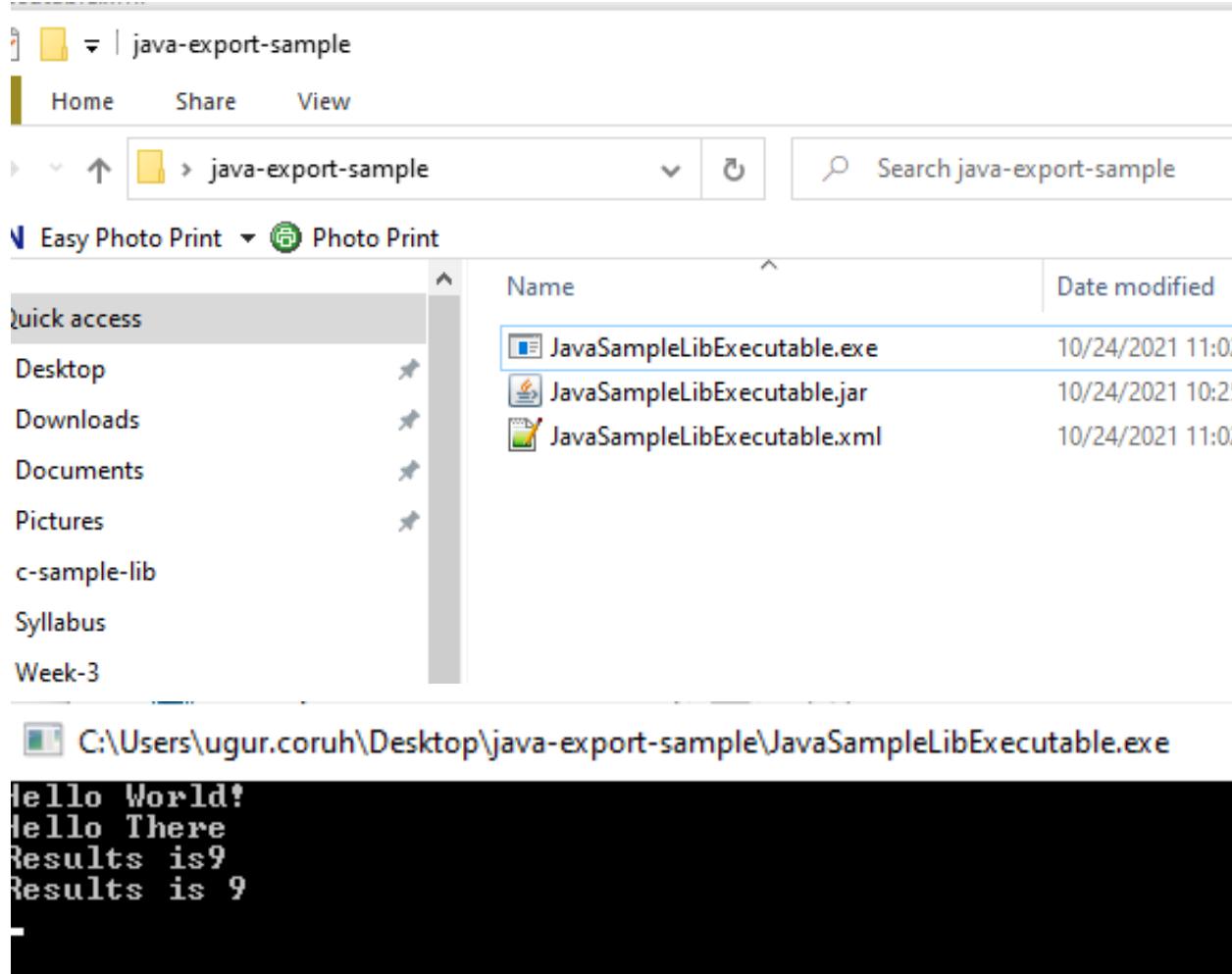
Wrapping

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

0.149 Shared Library Development - (Eclipse Java Jar Library)-51

- now we can run exe by click



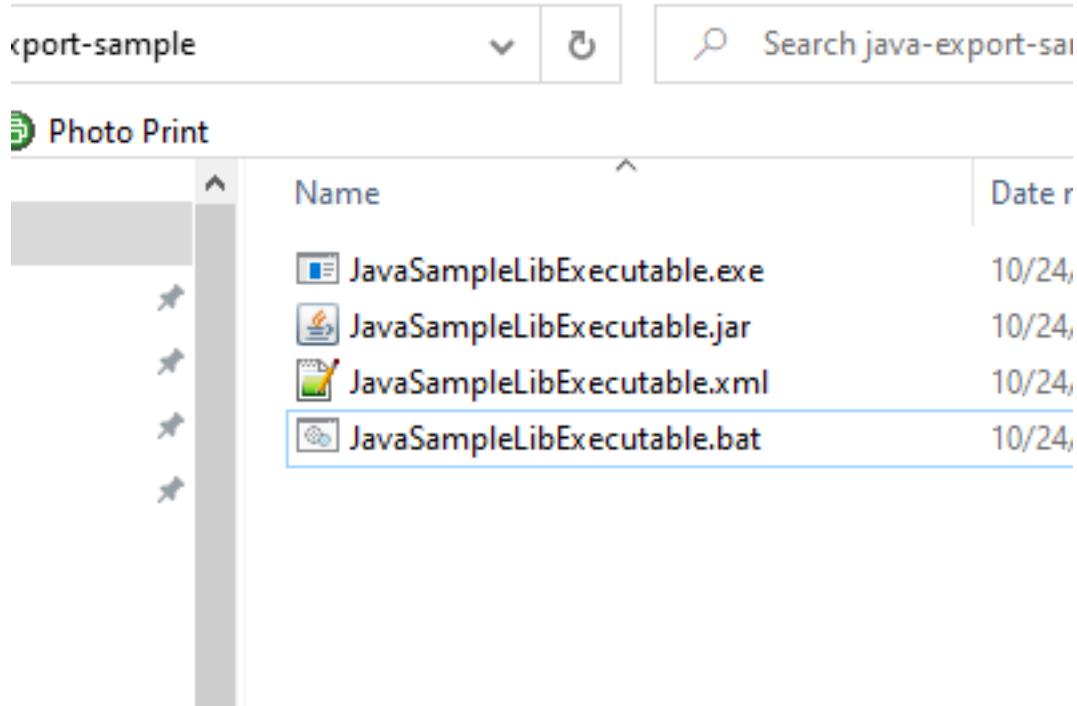
0.150 Shared Library Development - (Eclipse Java Jar Library)-52

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

0.151 Shared Library Development - (Eclipse Java Jar Library)-53

JavaSampleLibExecutable.bat

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



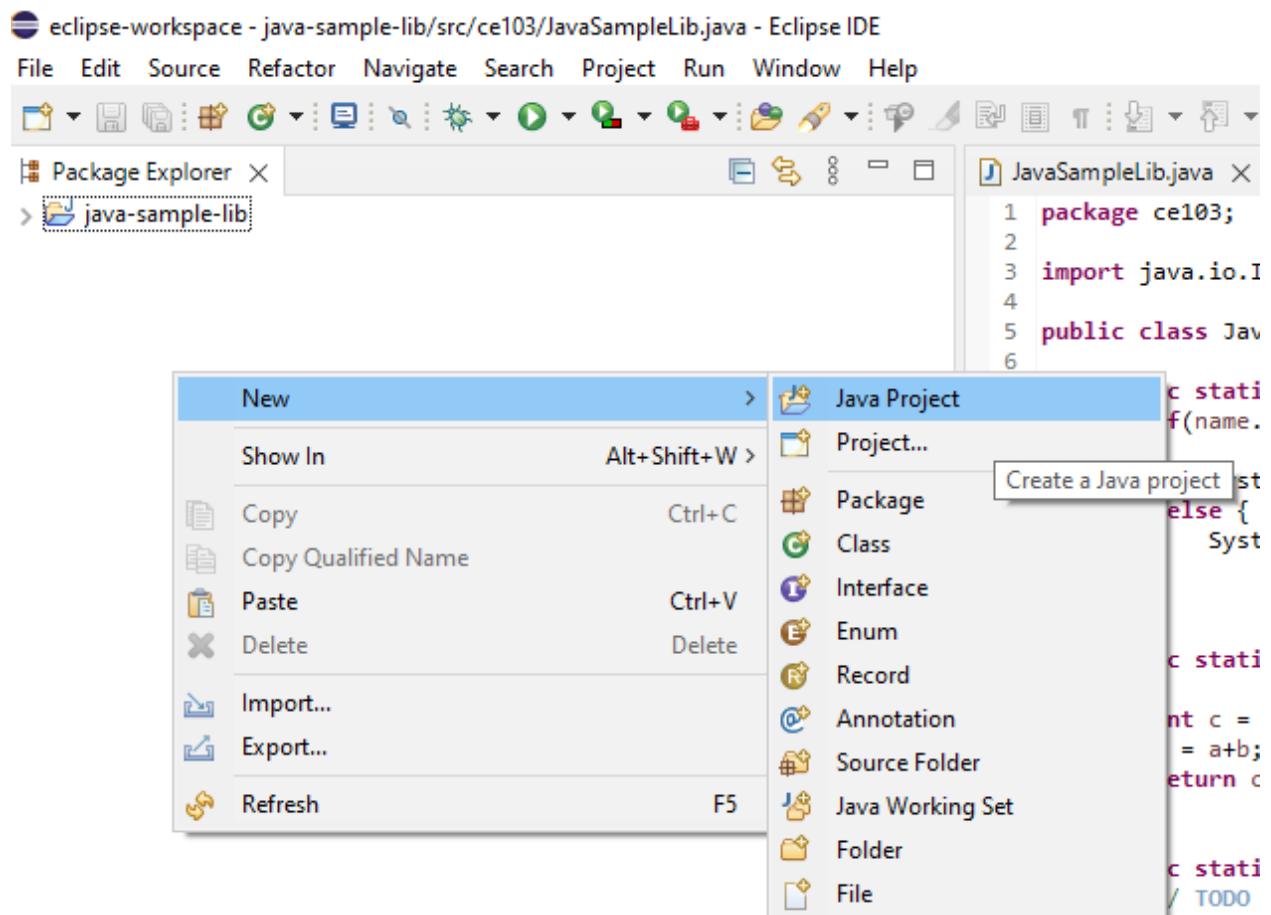
- if we click bat file then we will automate command line task for current jar file

A screenshot of a Windows Command Prompt window. The title bar says 'cmd C:\WINDOWS\system32\cmd.exe'. The command line shows 'C:\Users\ugur.coruh\Desktop\java-export-sample>java -jar JavaSampleLibExecutable.jar'. The output of the command is:

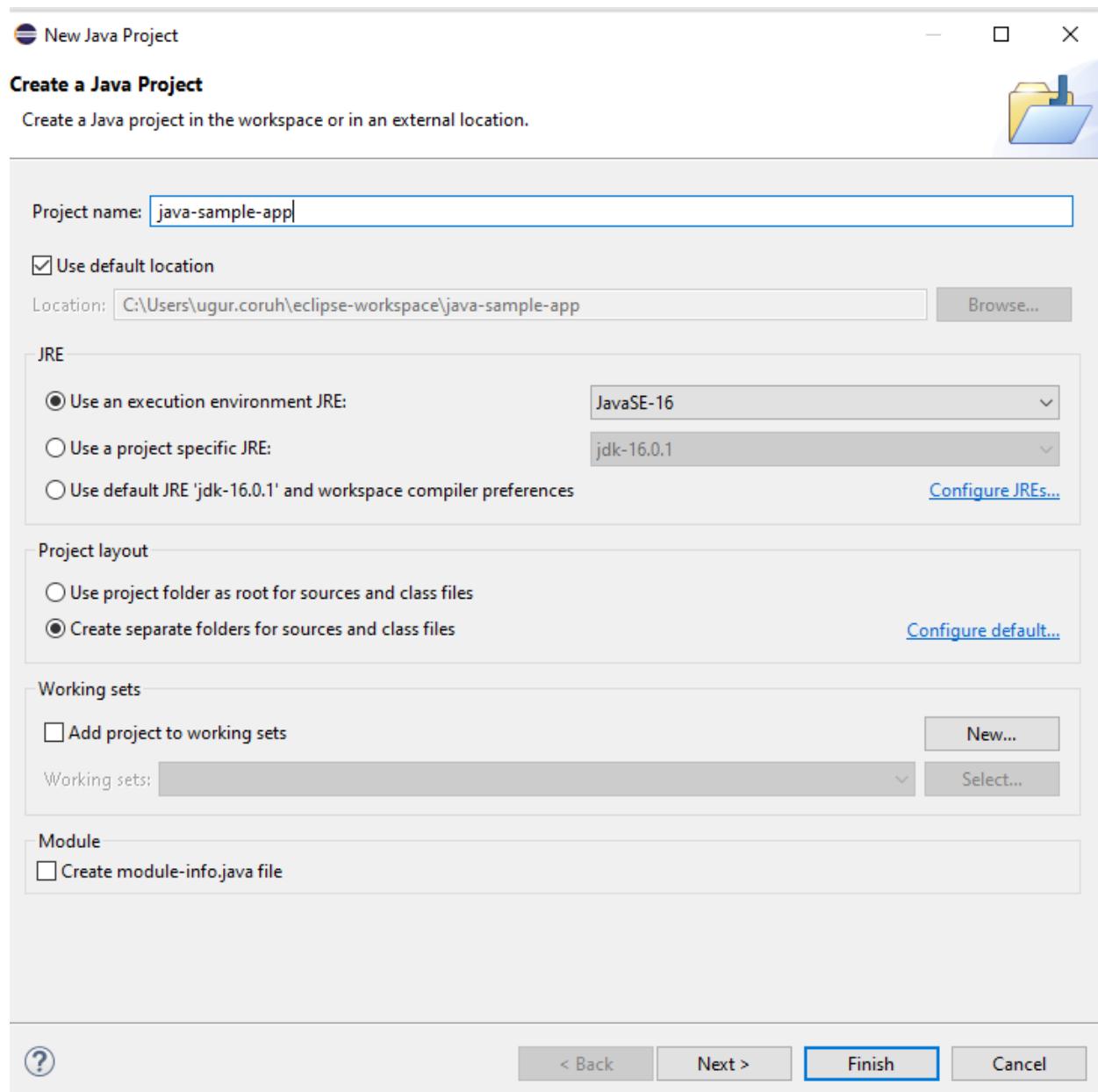
```
Hello World!
Hello There
Results is 9
Results is 9
```

0.152 Shared Library Development - (Eclipse Java Jar Library)-54

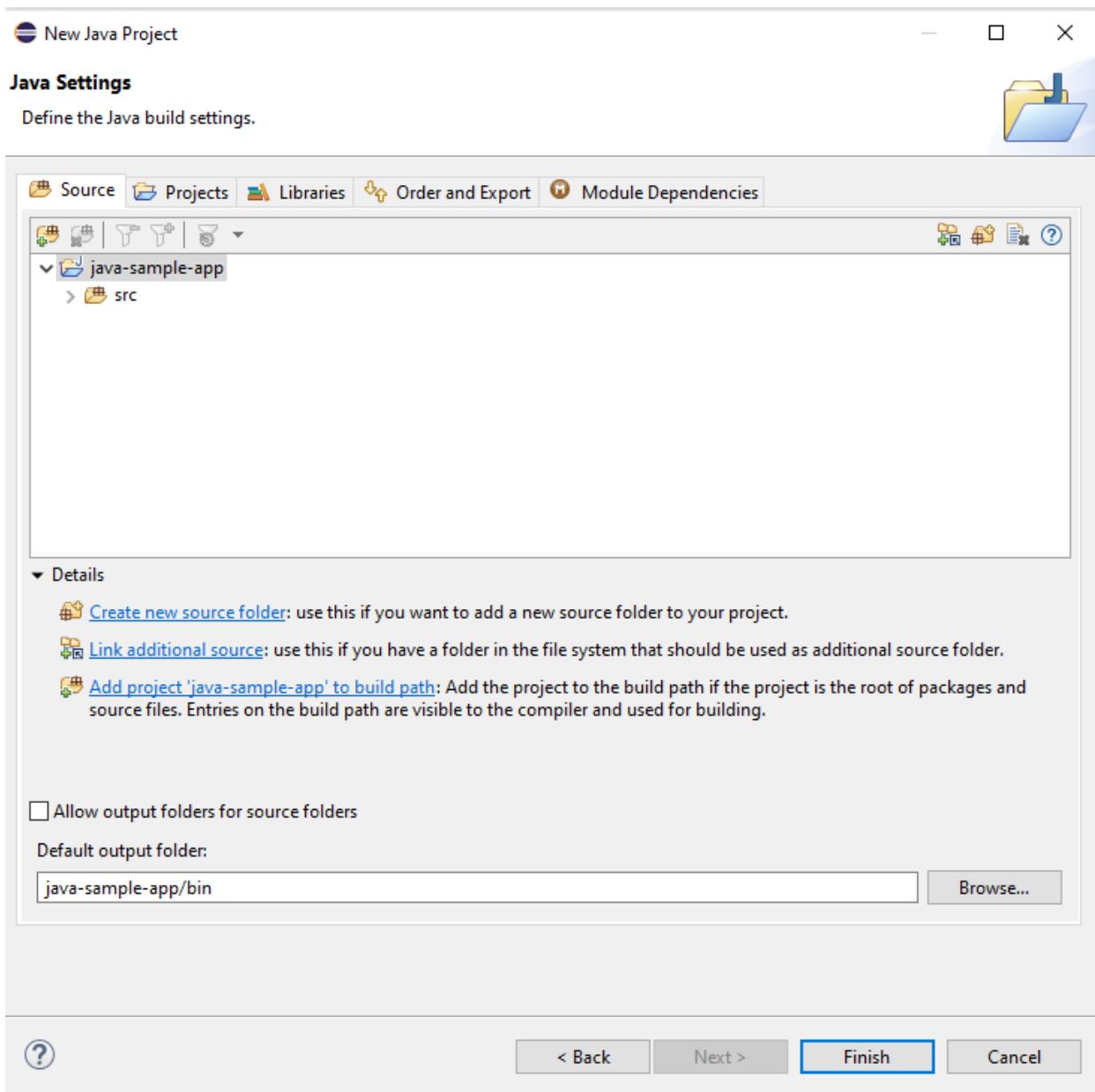
Now return back to our java library and create another console application that use library functions



0.153 Shared Library Development - (Eclipse Java Jar Library)-55

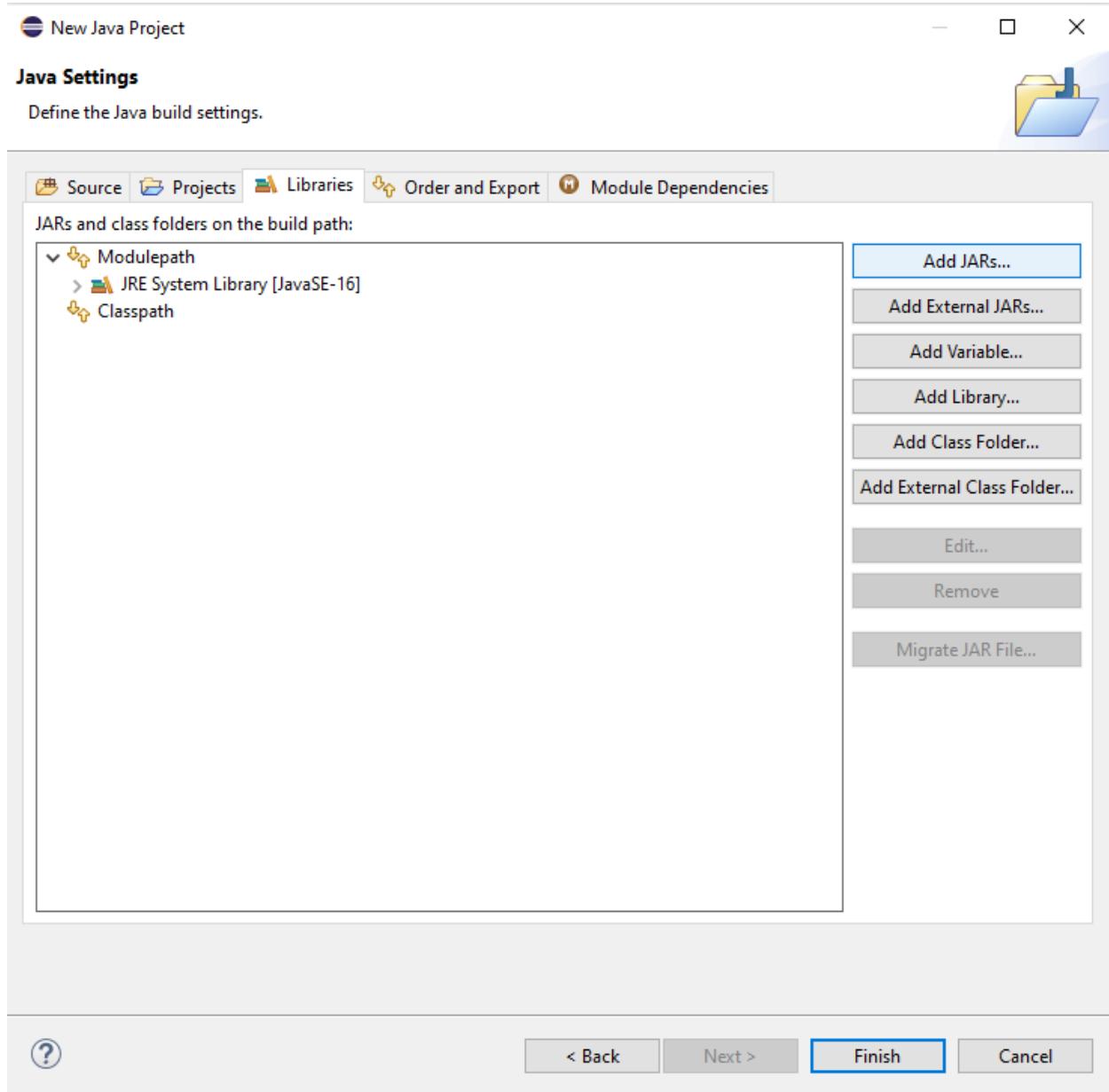


0.154 Shared Library Development - (Eclipse Java Jar Library)-56



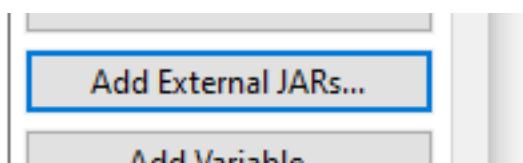
0.155 Shared Library Development - (Eclipse Java Jar Library)-57

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



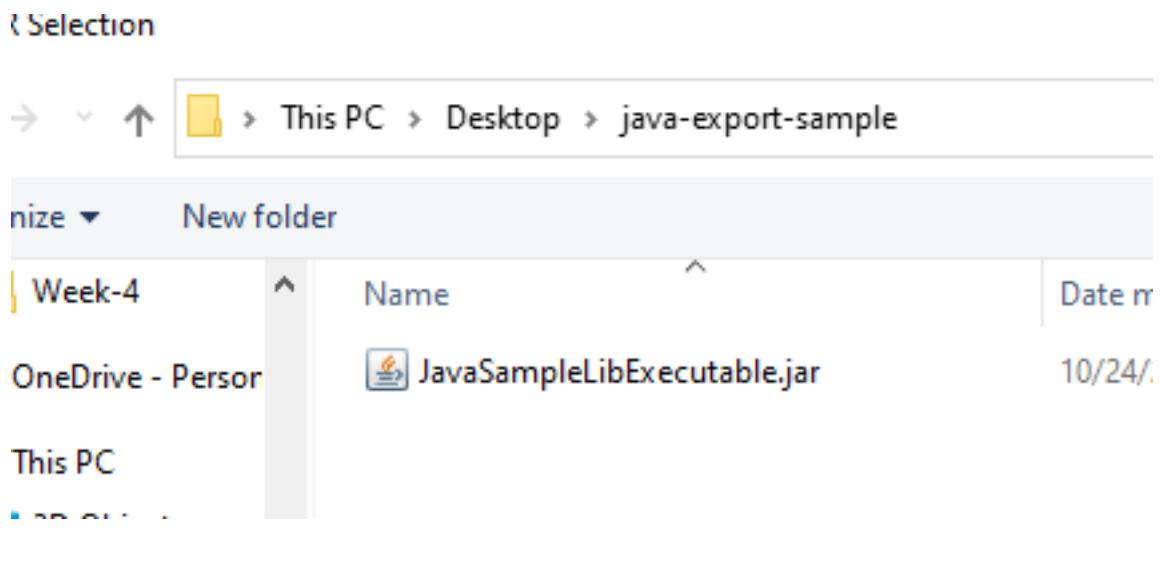
0.156 Shared Library Development - (Eclipse Java Jar Library)-58

- Select Add External JARs...



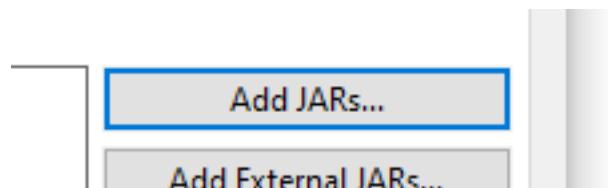
0.157 Shared Library Development - (Eclipse Java Jar Library)-59

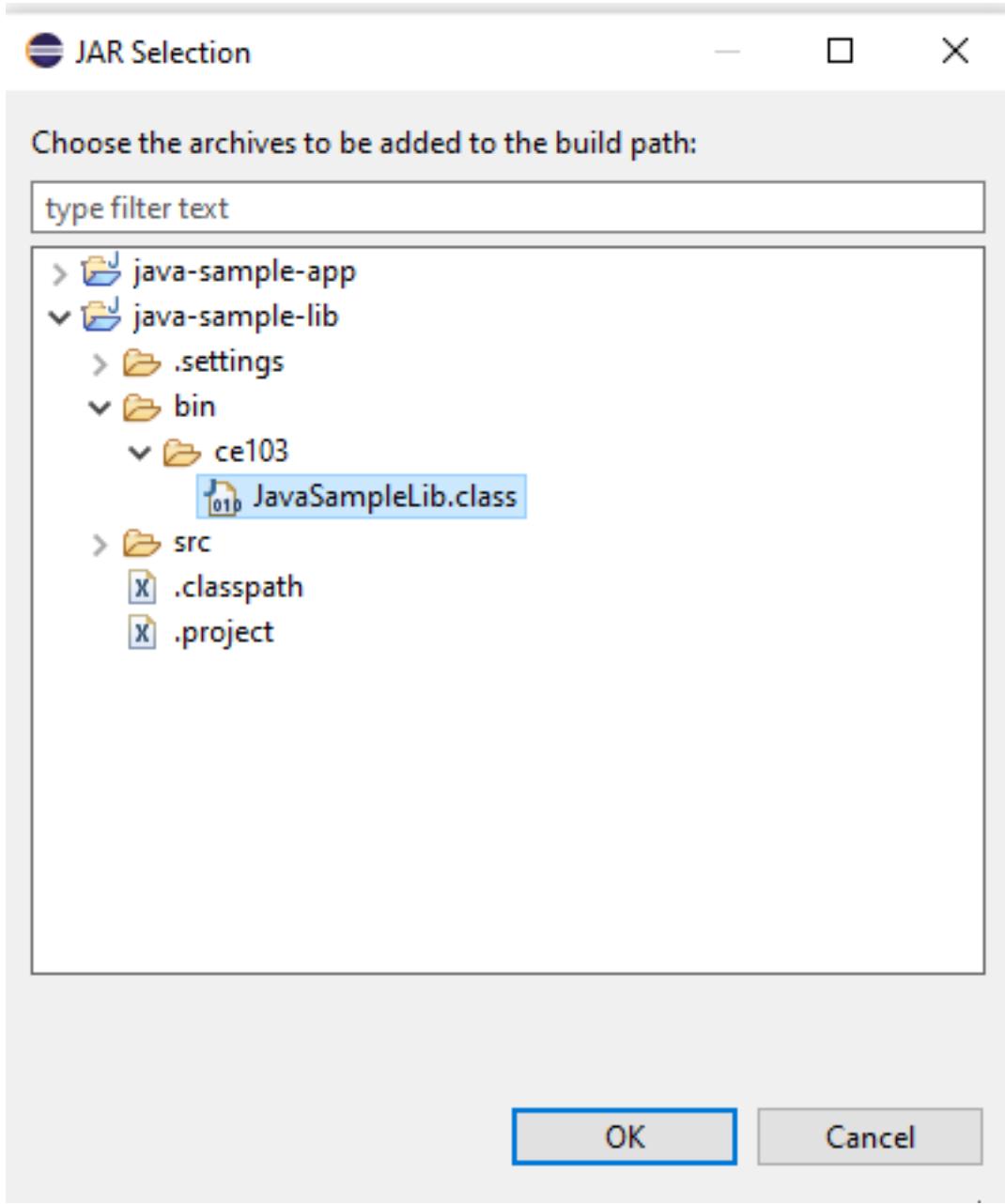
- Open Exported jar folder and select



0.158 Shared Library Development - (Eclipse Java Jar Library)-60

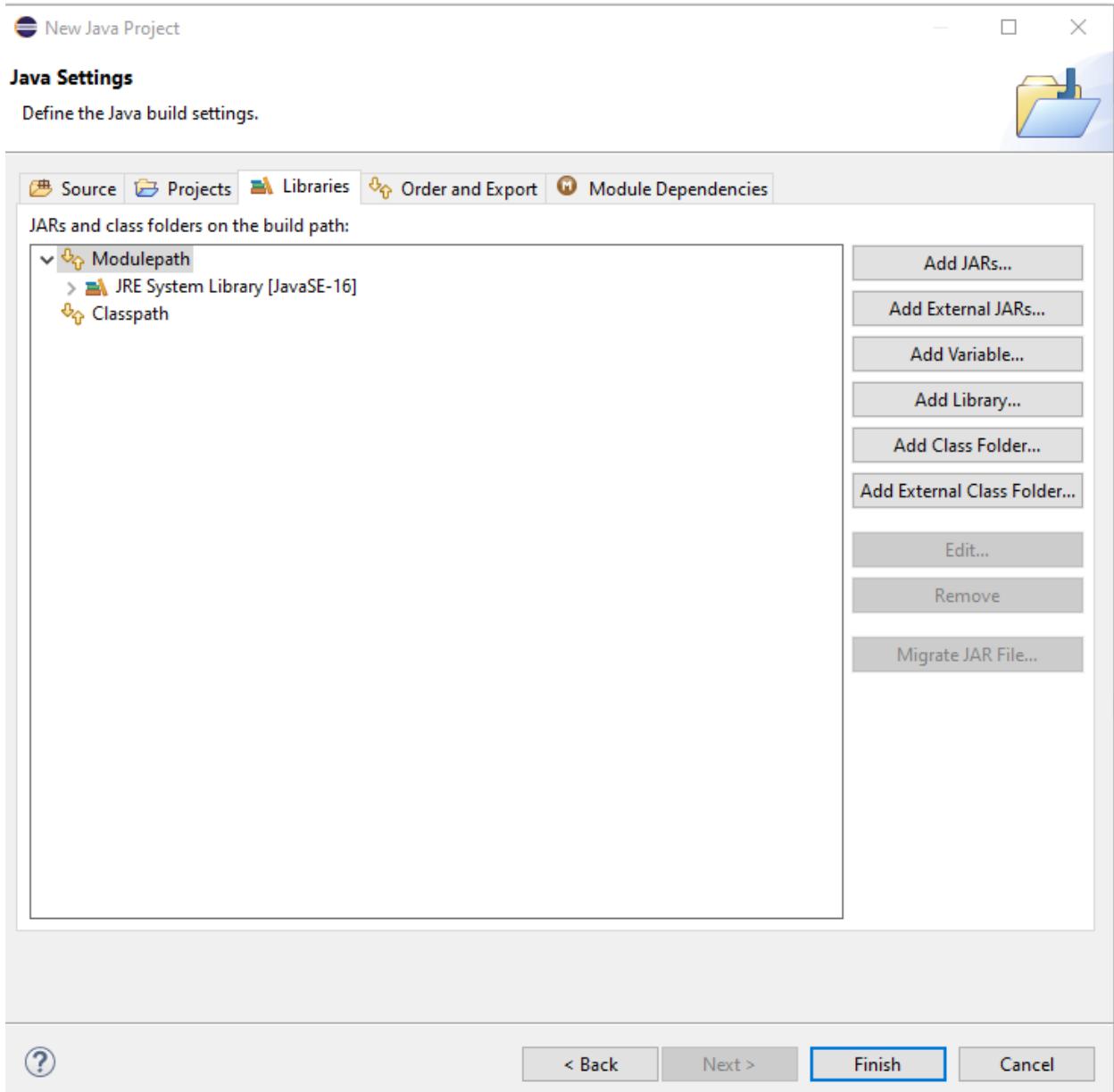
- Or we can select by Add jar from current workspace





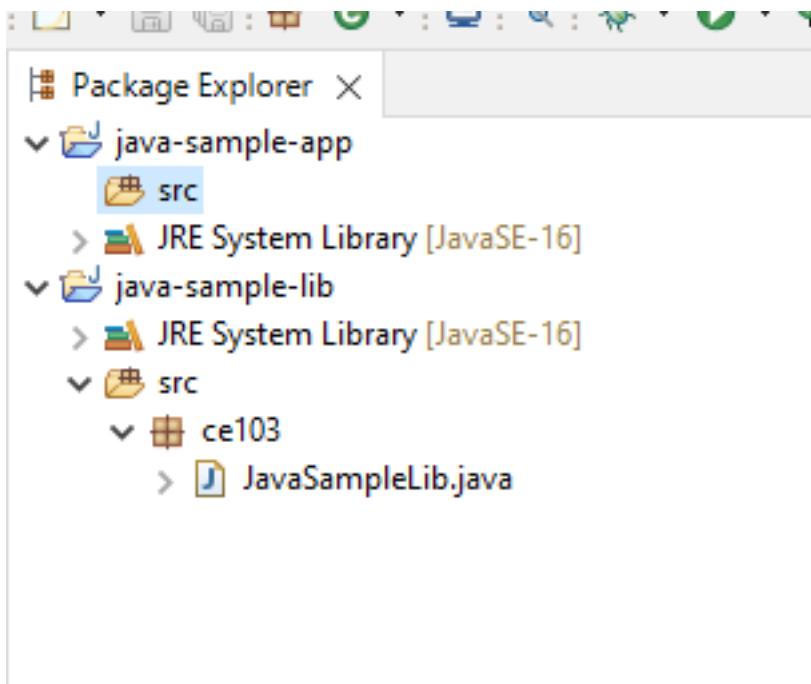
0.159 Shared Library Development - (Eclipse Java Jar Library)-61

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



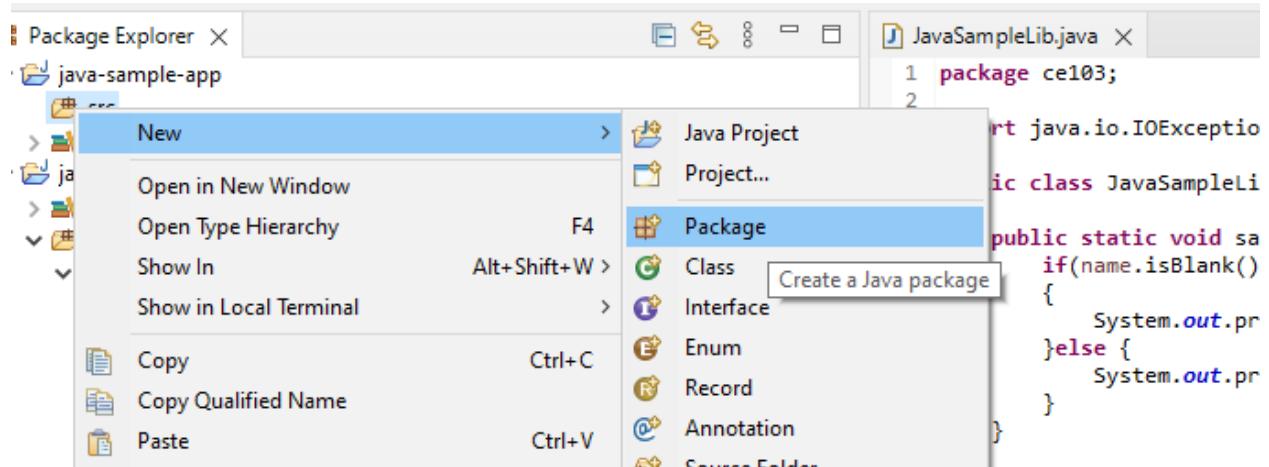
0.160 Shared Library Development - (Eclipse Java Jar Library)-62

- we will have the following project

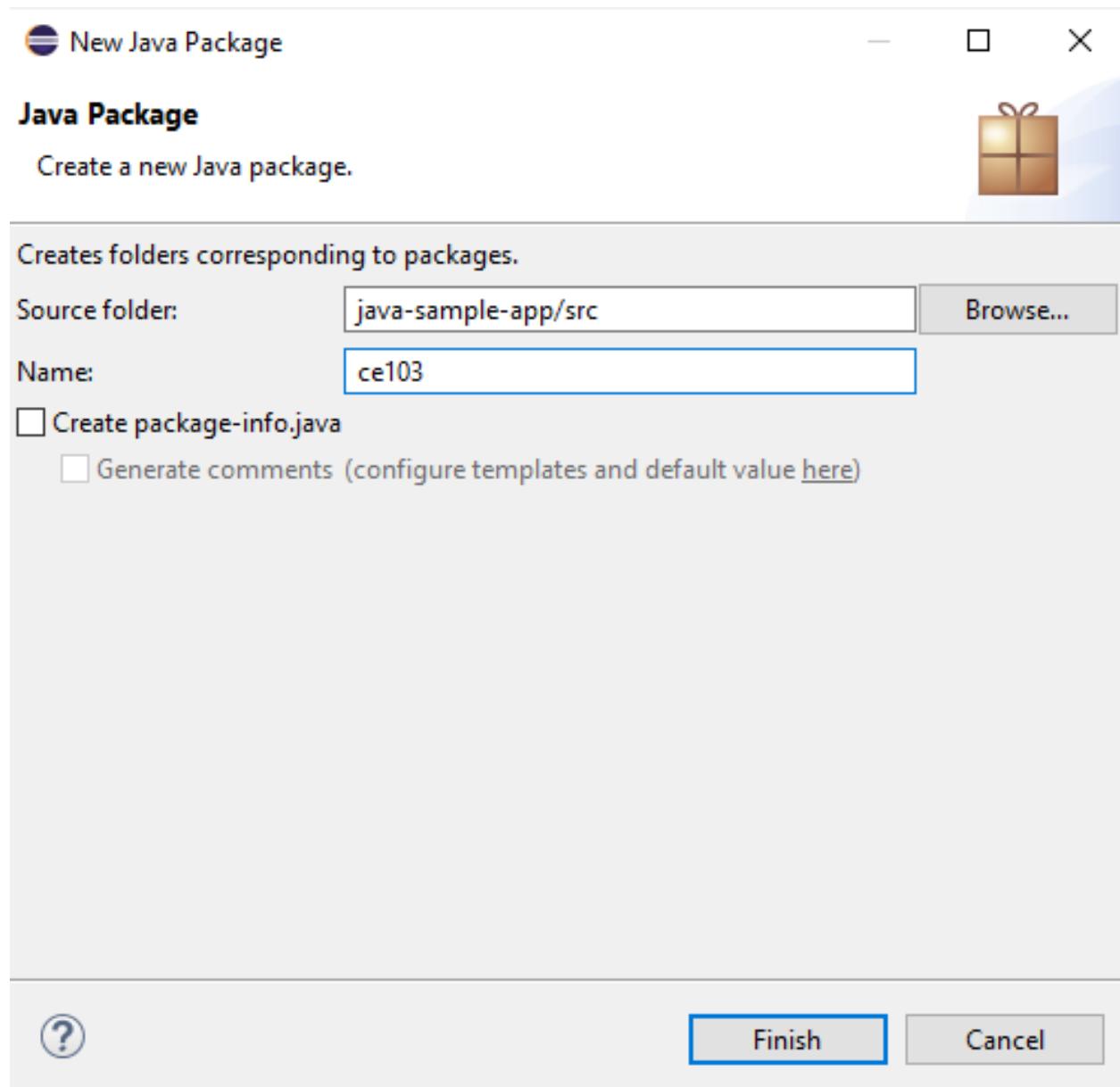


0.161 Shared Library Development - (Eclipse Java Jar Library)-63

- lets create a package

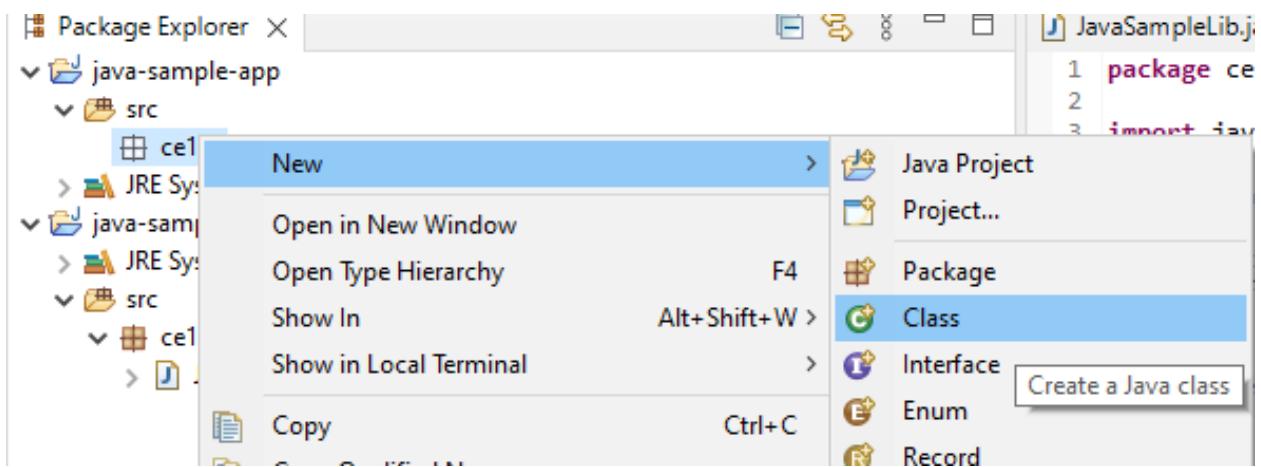


0.162 Shared Library Development - (Eclipse Java Jar Library)-64



0.163 Shared Library Development - (Eclipse Java Jar Library)-65

- and lets create a main class for our application



0.164 Shared Library Development - (Eclipse Java Jar Library)-66

- check create main function

Java Class

Create a new Java class.

Source folder:

Package:

Enclosing type:

Name:

Modifiers: public package private protected
 abstract final static

Superclass:

Interfaces:

Which method stubs would you like to create?

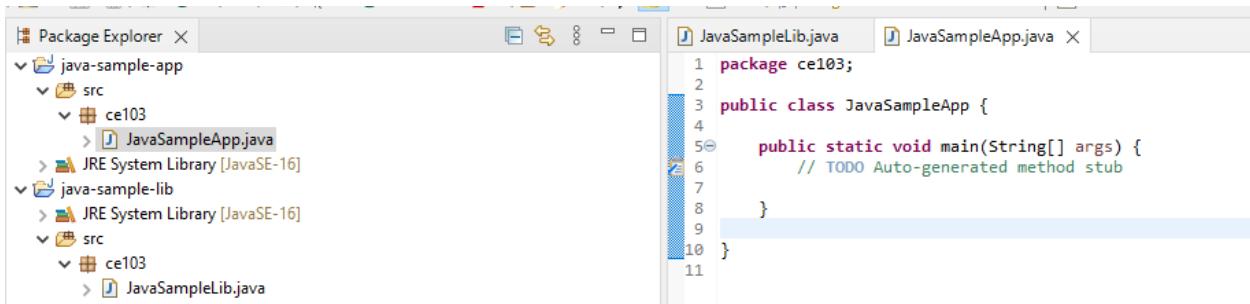
- public static void main(String[] args)
- Constructors from superclass
- Inherited abstract methods

Do you want to add comments? (Configure templates and default value [here](#))

- Generate comments

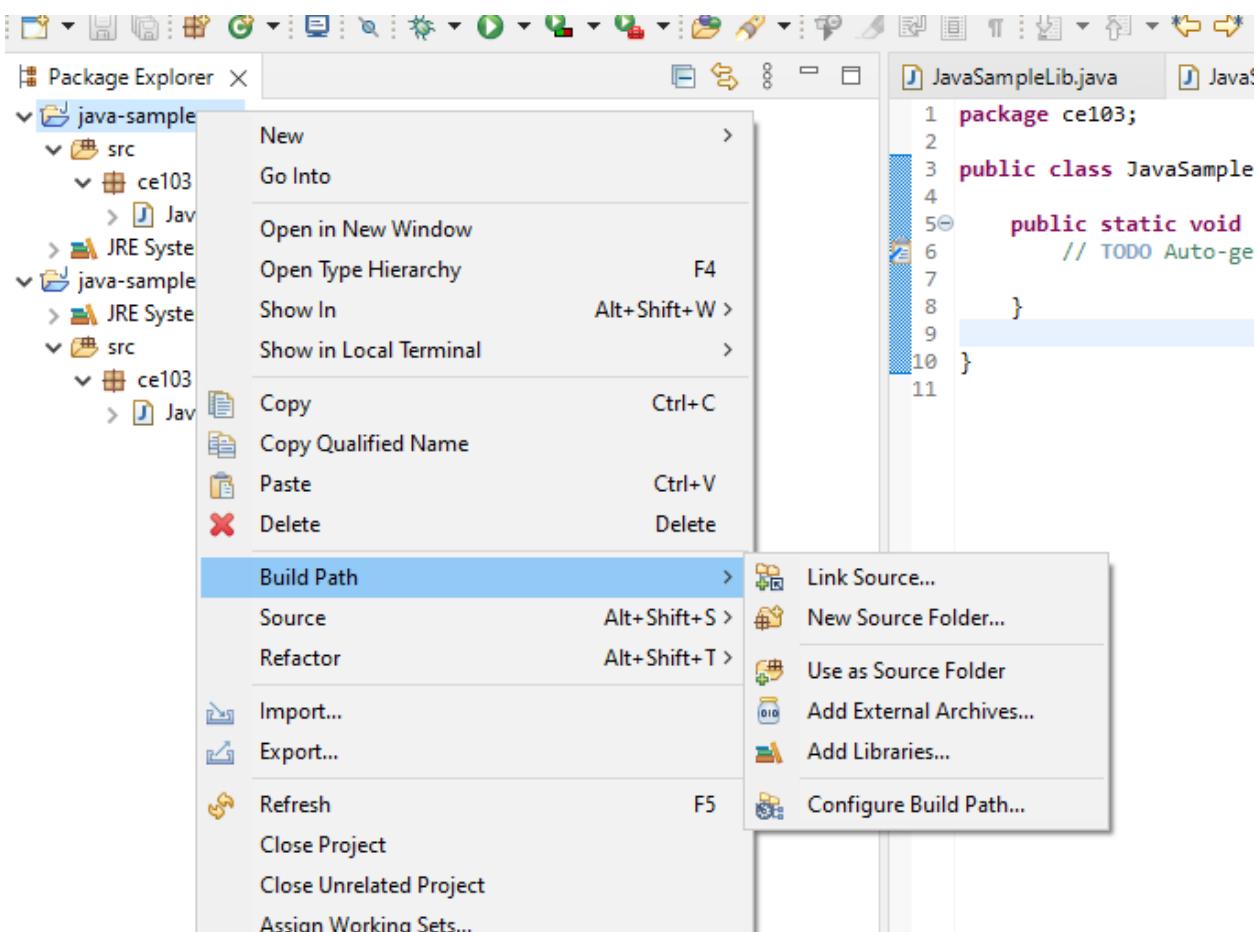


0.165 Shared Library Development - (Eclipse Java Jar Library)-67



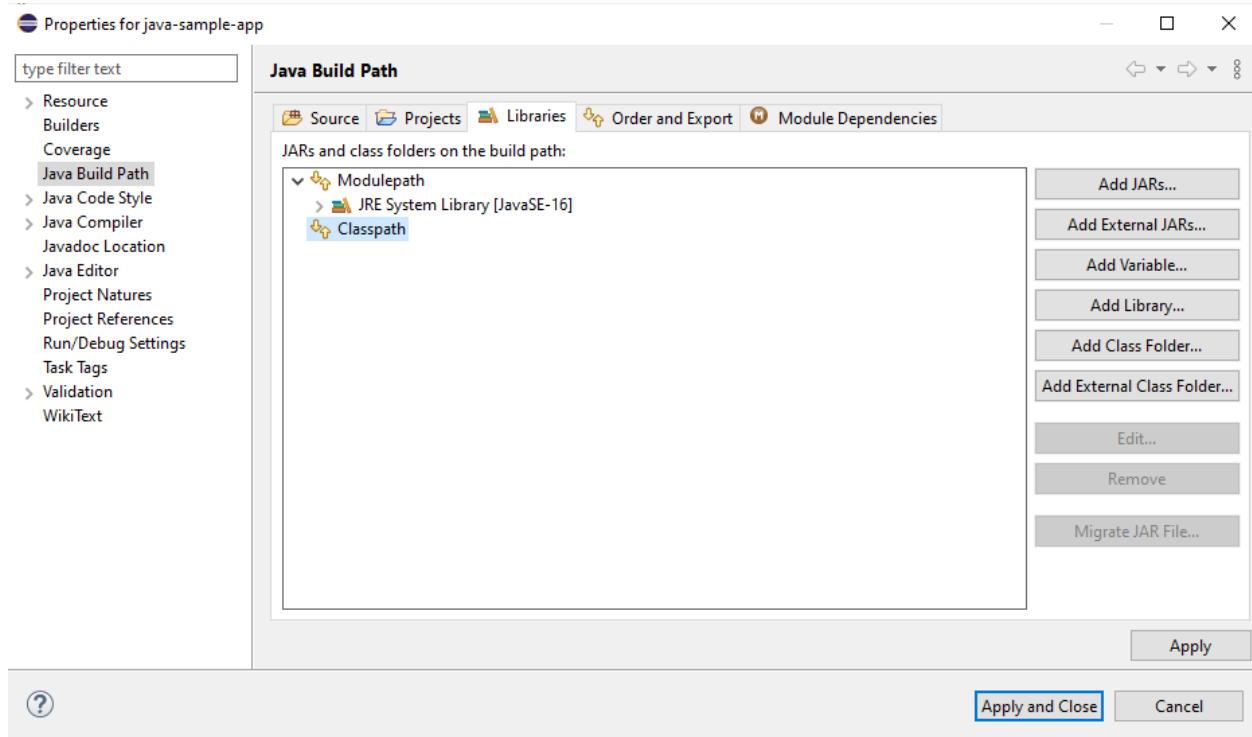
0.166 Shared Library Development - (Eclipse Java Jar Library)-68

- right click to project and add reference



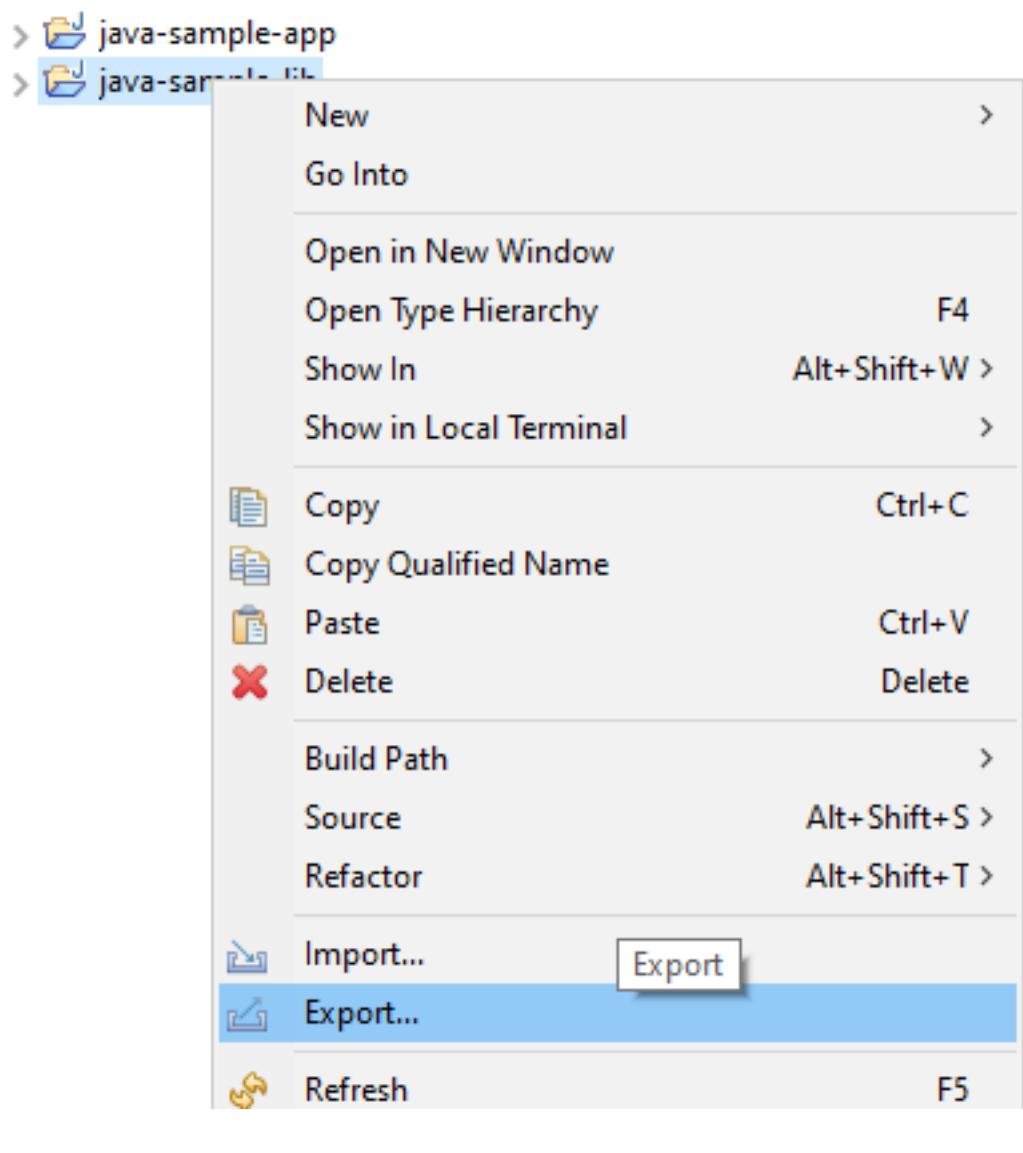
0.167 Shared Library Development - (Eclipse Java Jar Library)-69

- you can enter same configurations from project properties



0.168 Shared Library Development - (Eclipse Java Jar Library)-70

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



0.169 Shared Library Development - (Eclipse Java Jar Library)-71

Select JAR file

Export resources into a JAR file on the local file system

Select an export wizard:

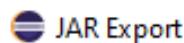
type filter text

- ▼ Install
 - Installed Software Items to File
- ▼ Java
 - JAR file
 - Javadoc
 - Runnable JAR file
- ▼ Run/Debug
 - Breakpoints
 - Coverage Session
 - Launch Configurations
- ▼ Team

0.170 Shared Library Development - (Eclipse Java Jar Library)-72

we configured output as

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



JAR File Specification

Define which resources should be exported into the JAR.



Select the resources to export:

- > java-sample-app
- > java-sample-lib

- .classpath
- .project

- Export generated class files and resources
- Export all output folders for checked projects
- Export Java source files and resources
- Export refactorings for checked projects. [Select refactorings...](#)

Select the export destination:

JAR file:

Options:

- Compress the contents of the JAR file
- Add directory entries
- Overwrite existing files without warning



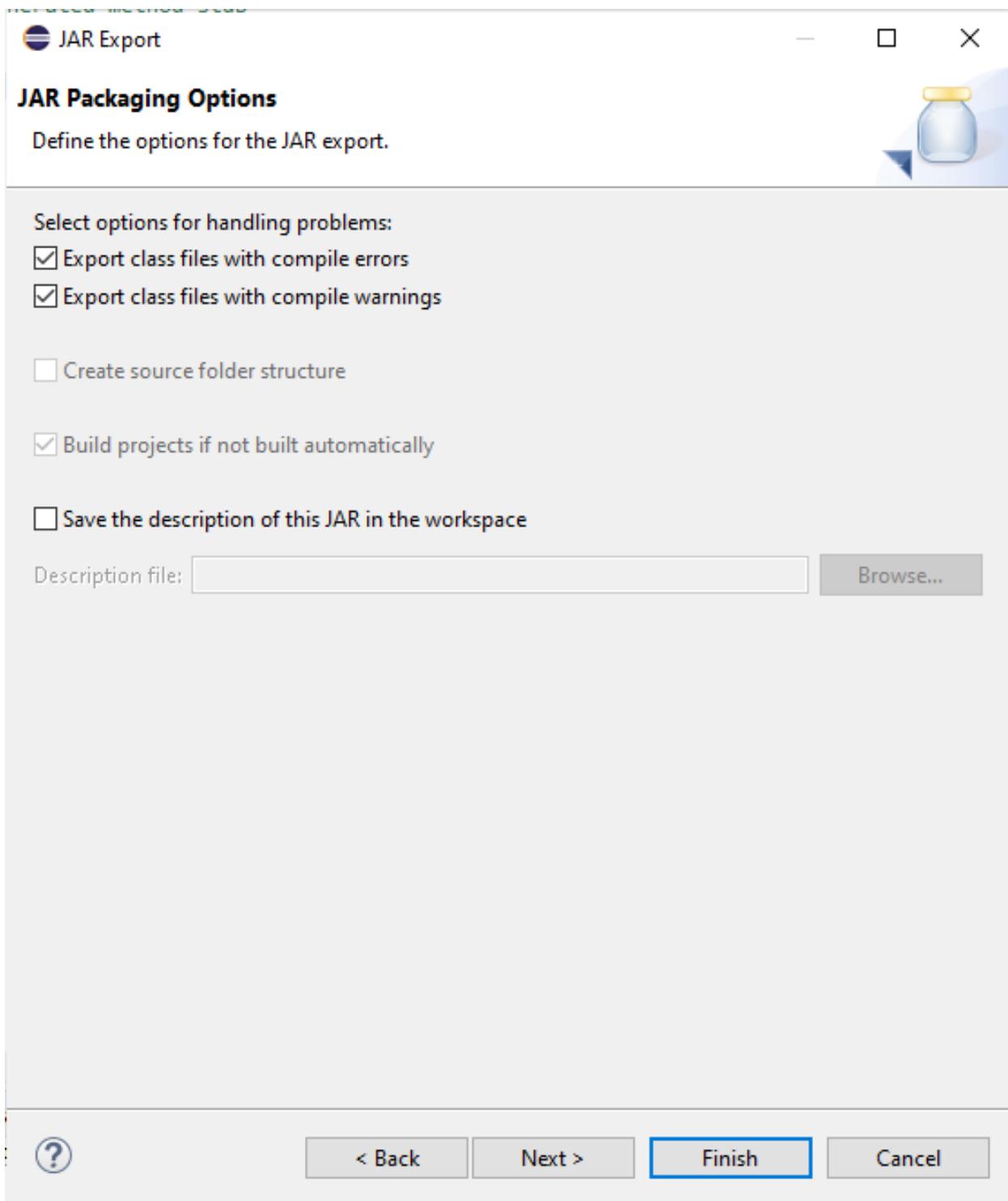
< Back

Next >

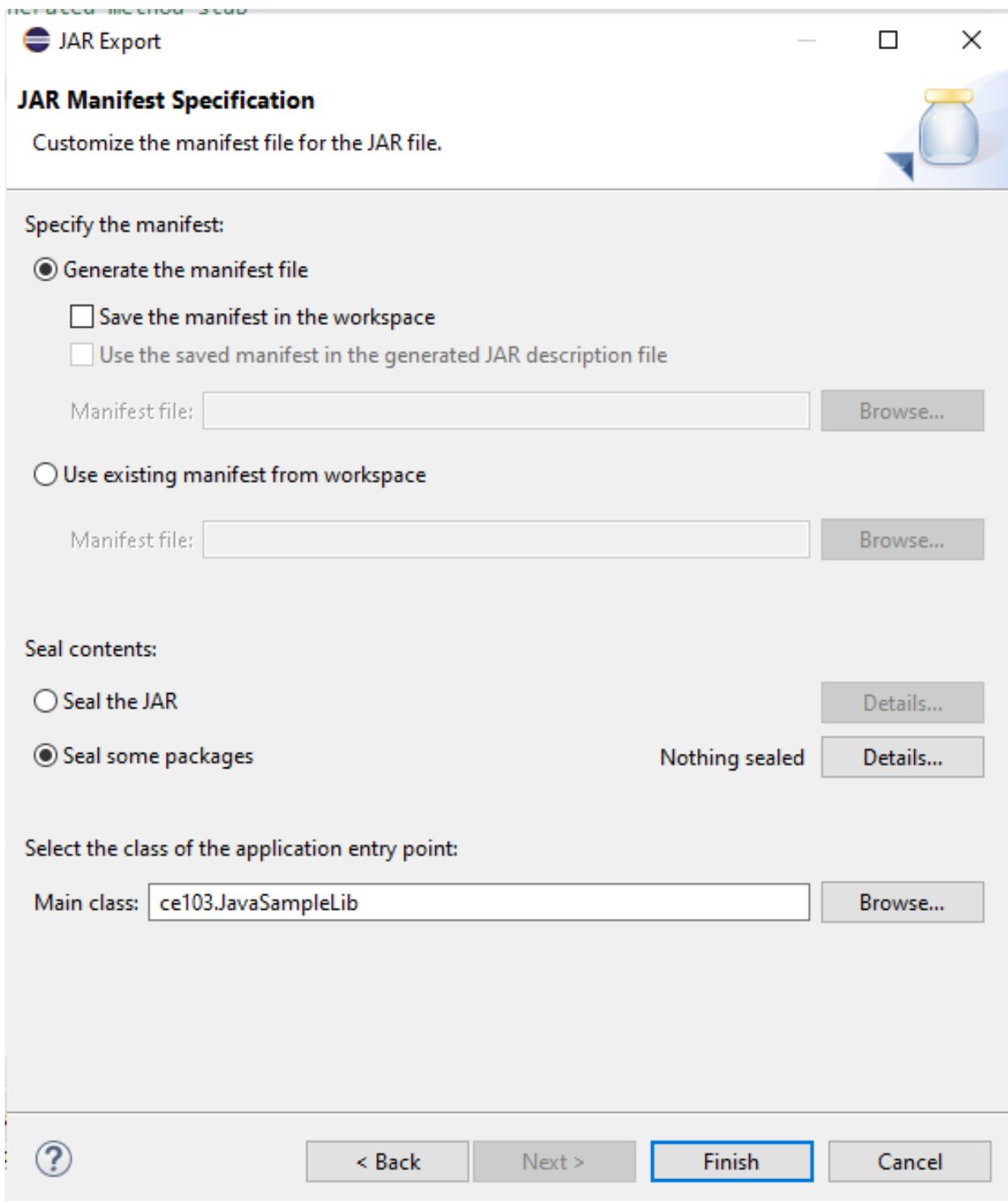
Finish

Cancel

0.171 Shared Library Development - (Eclipse Java Jar Library)-73

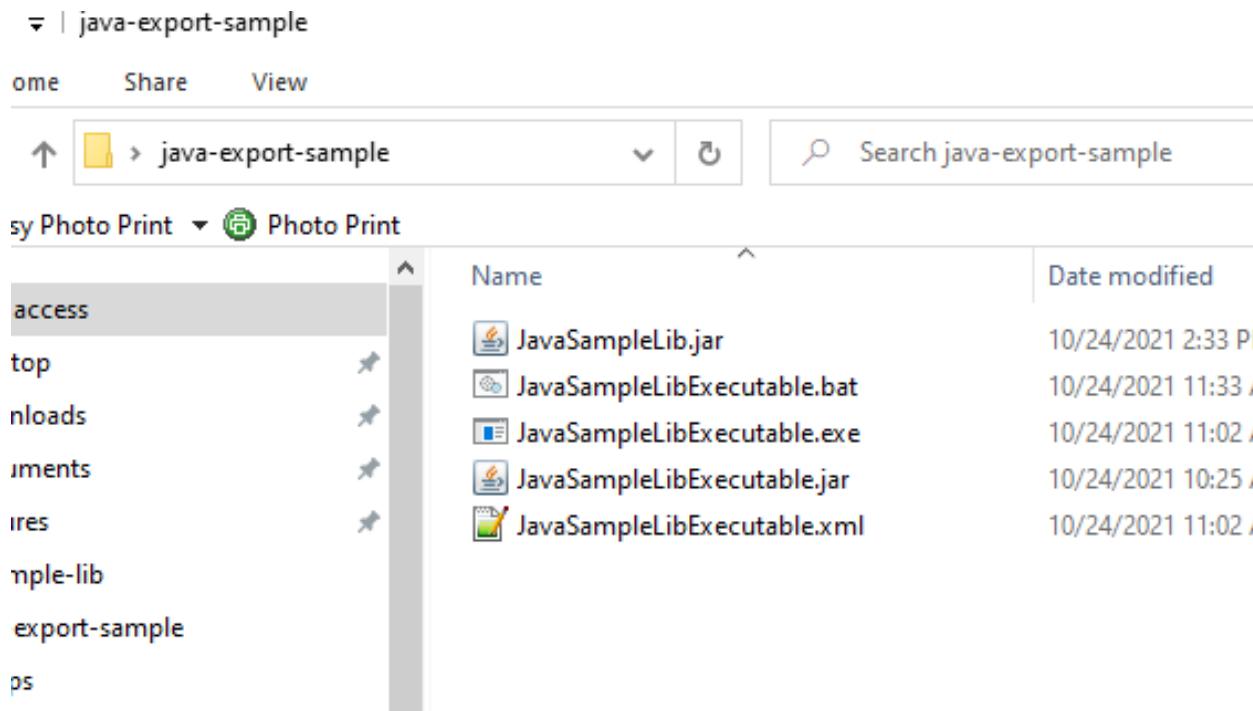


0.172 Shared Library Development - (Eclipse Java Jar Library)-74



0.173 Shared Library Development - (Eclipse Java Jar Library)-75

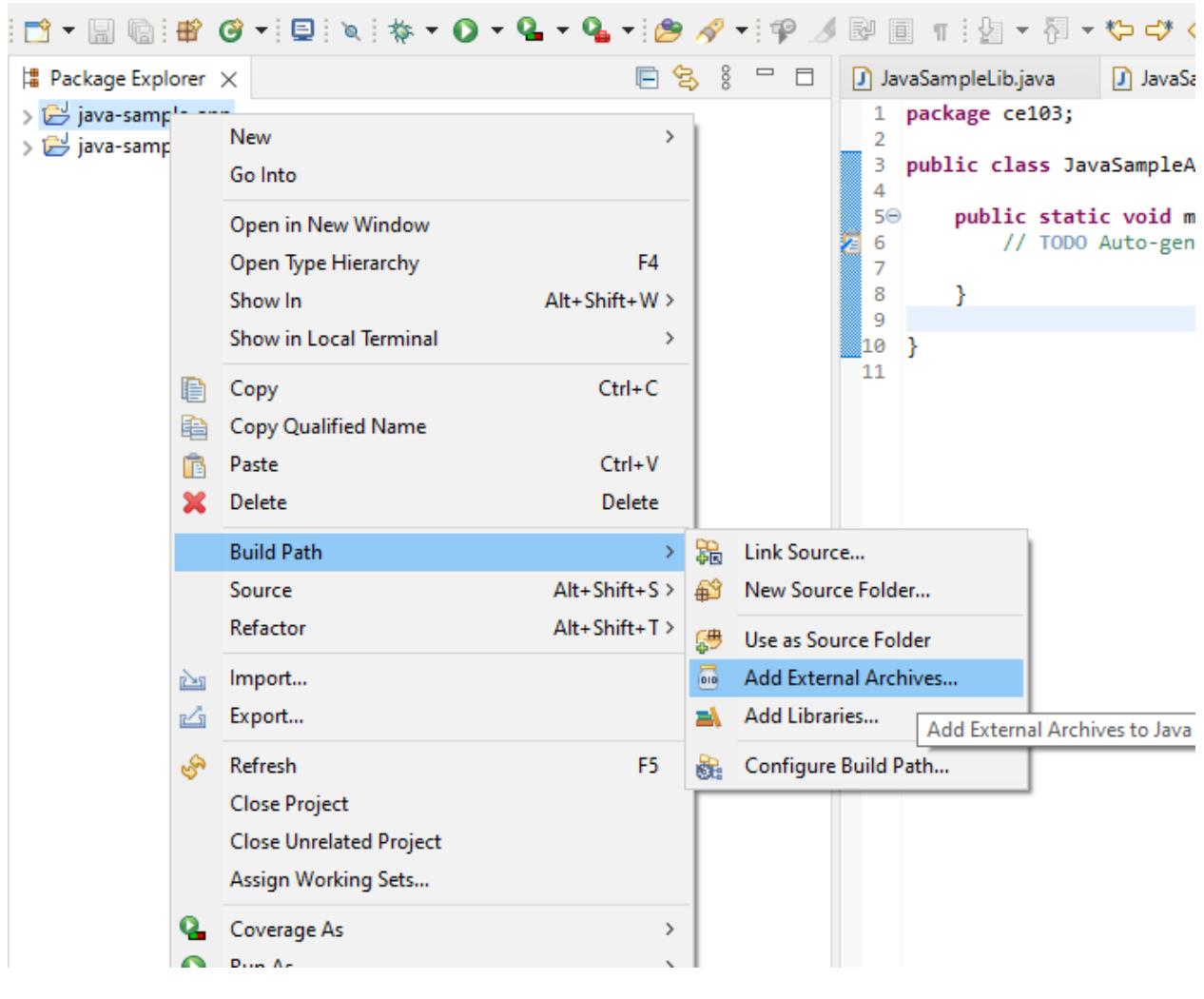
In the same export folder now we have JavaSampleLib.jar



0.174 Shared Library Development - (Eclipse Java Jar Library)-76

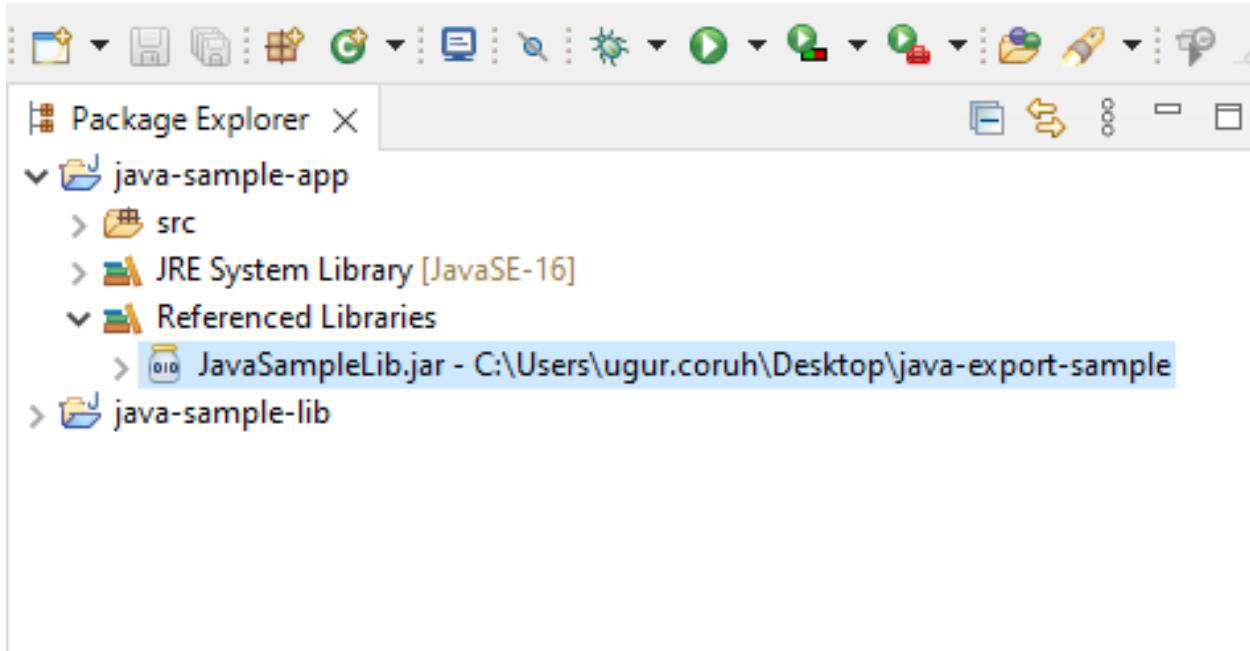
return back to java-sample-app and then add this jar file to our project

Build Path->Add External Archives



0.175 Shared Library Development - (Eclipse Java Jar Library)-77

you will see its added to reference libraries



0.176 Shared Library Development - (Eclipse Java Jar Library)-78

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

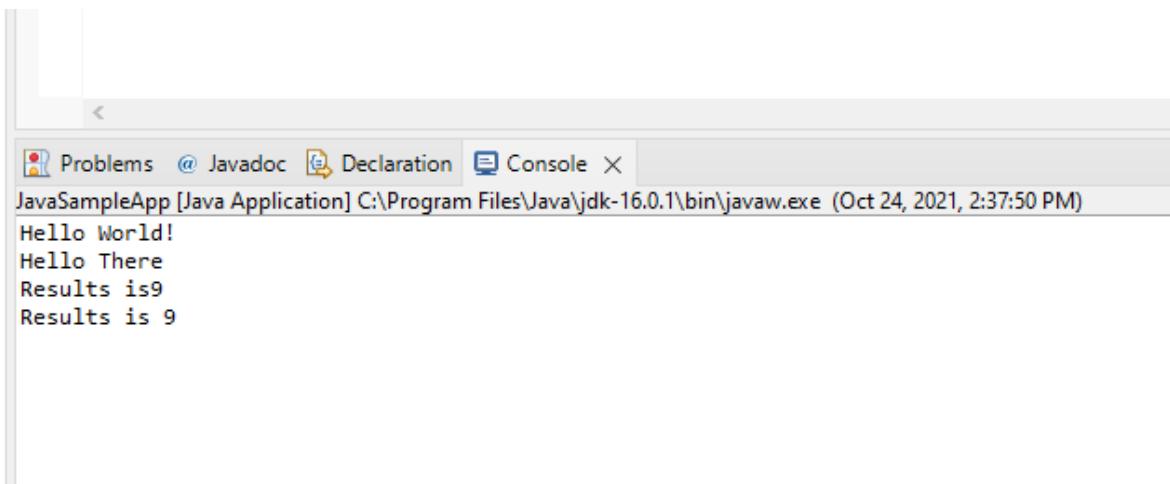
        System.out.println("Hello World!");

        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();
        }
    }
}
```

0.177 Shared Library Development - (Eclipse Java Jar Library)-79

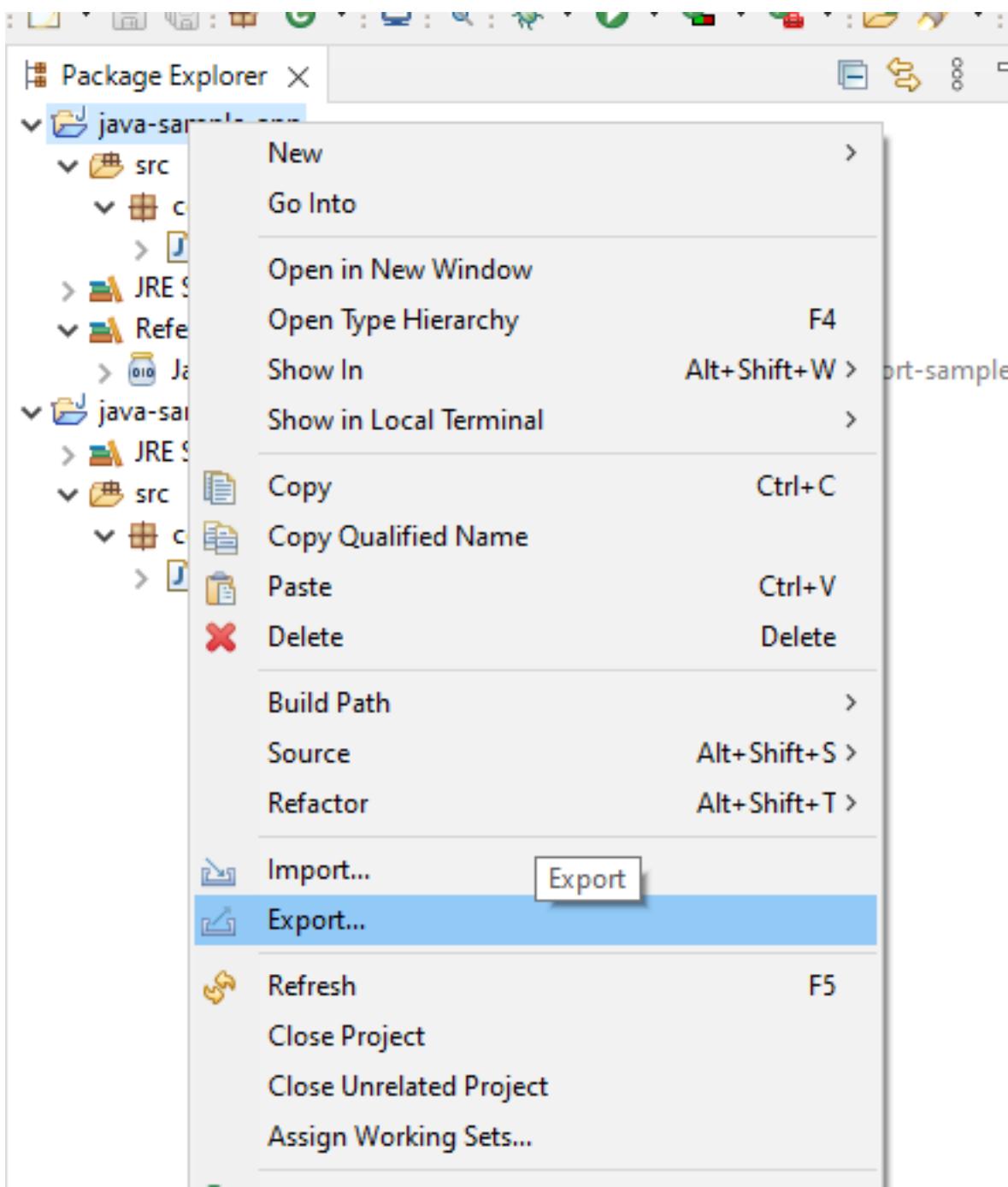
When we run application we will see similar output



A screenshot of the Eclipse IDE interface, specifically the Java Application perspective. The title bar shows "JavaSampleApp [Java Application] C:\Program Files\Java\jdk-16.0.1\bin\javaw.exe (Oct 24, 2021, 2:37:50 PM)". The top menu bar includes "Problems", "Javadoc", "Declaration", and "Console". The "Console" tab is selected, displaying the following text:
Hello World!
Hello There
Results is9
Results is 9

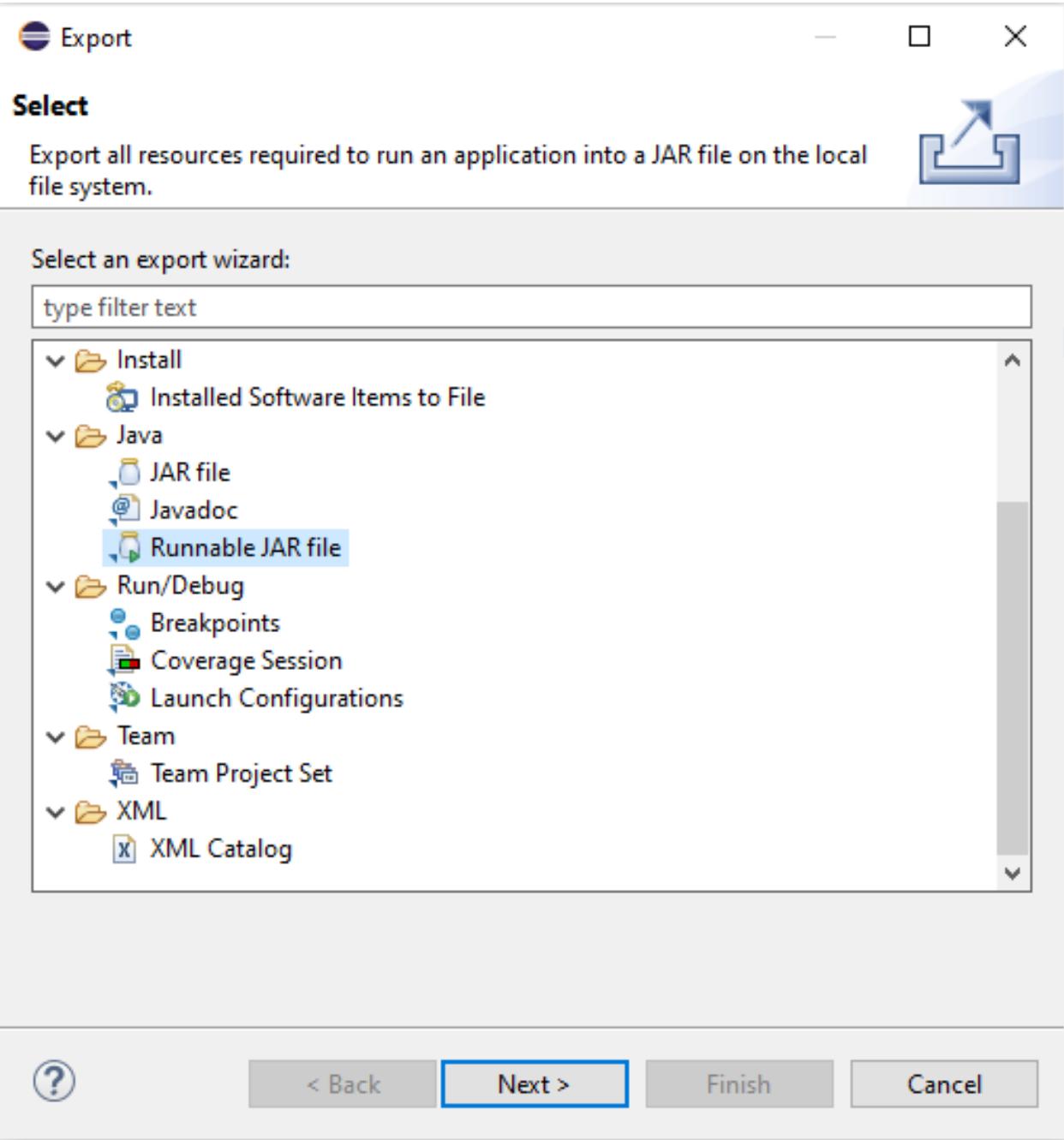
0.178 Shared Library Development - (Eclipse Java Jar Library)-80

Lets export this application with its dependent library



0.179 Shared Library Development - (Eclipse Java Jar Library)-81

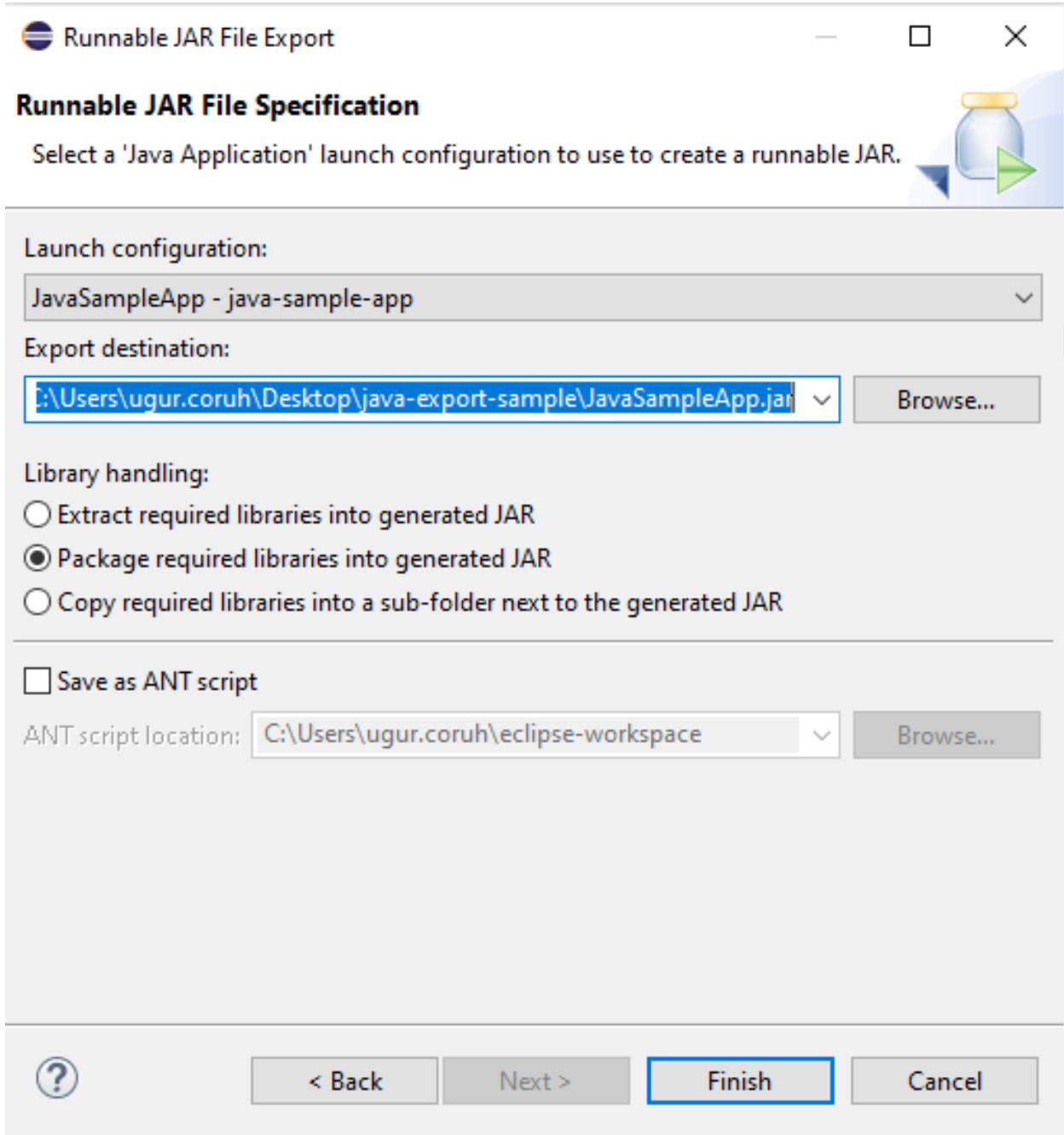
Select runnable jar



0.180 Shared Library Development - (Eclipse Java Jar Library)-82

Set Launch configuration and Export destination

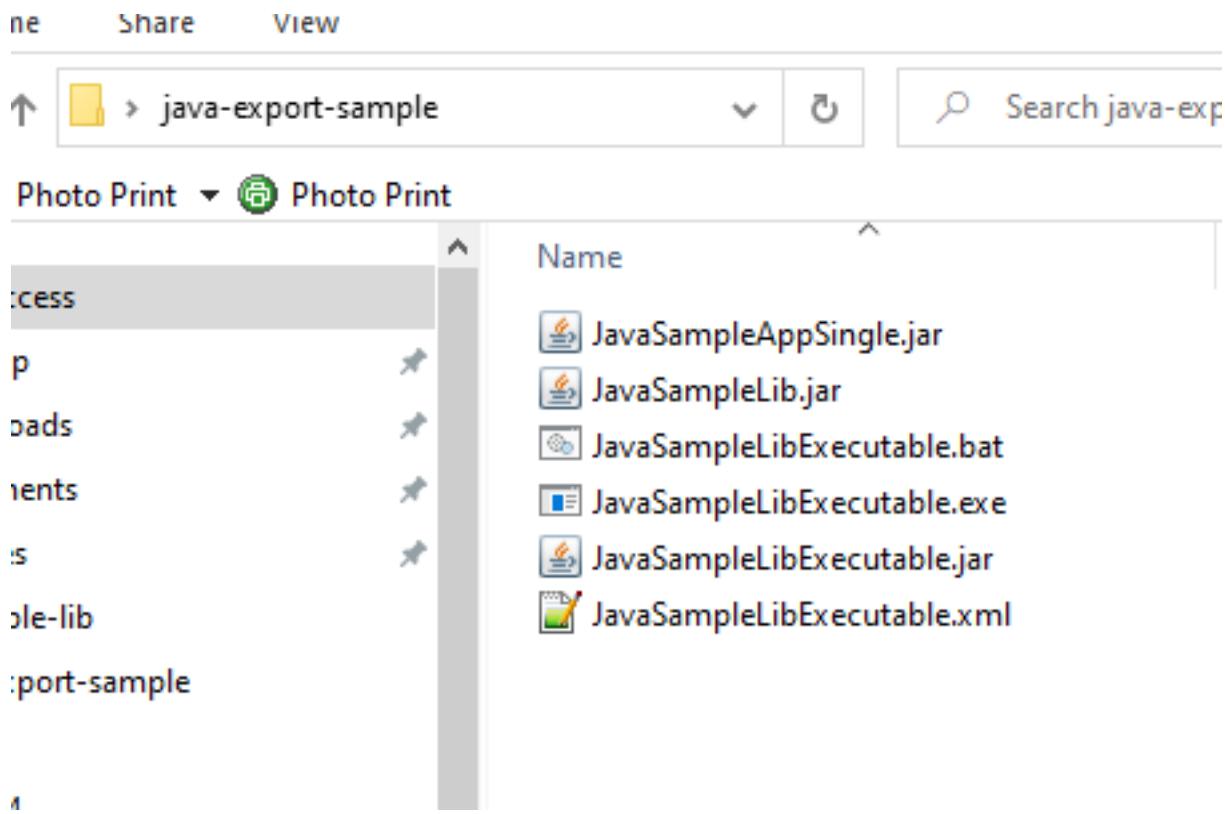
C:\Users\ugur.coruh\Desktop\java-export-sample\JavaSampleAppSingle.jar



0.181 Shared Library Development - (Eclipse Java Jar Library)-83

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

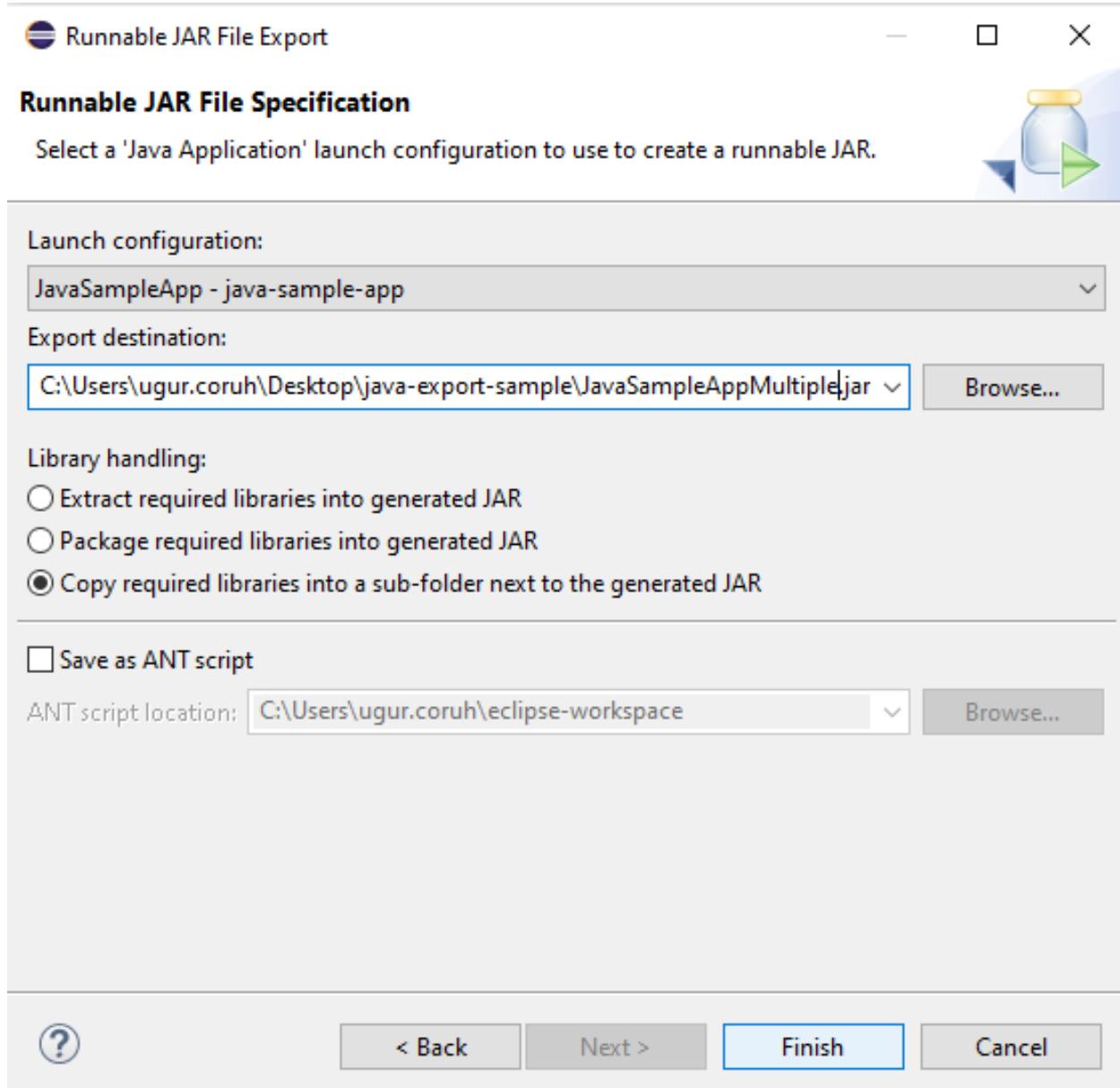
```
C:\Users\ugur.coruh\Desktop\java-export-sample>java -jar JavaSampleAppSingle.jar
Hello World!
Hello There
Results is9
Results is 9
```

```
24
25
26
27 }
28 }
```

0.182 Shared Library Development - (Eclipse Java Jar Library)-84

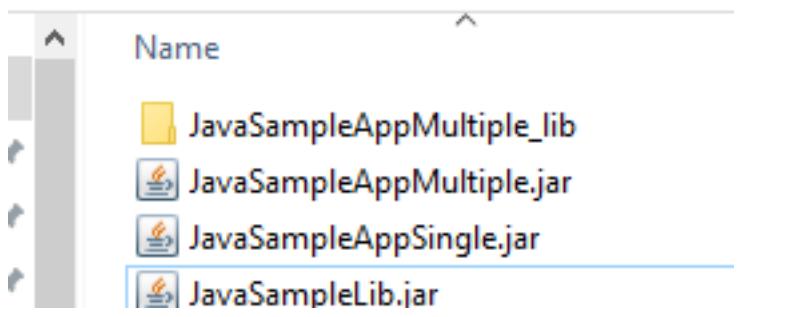
only change copy required libraries setting and then give a new name for new jar file and export

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



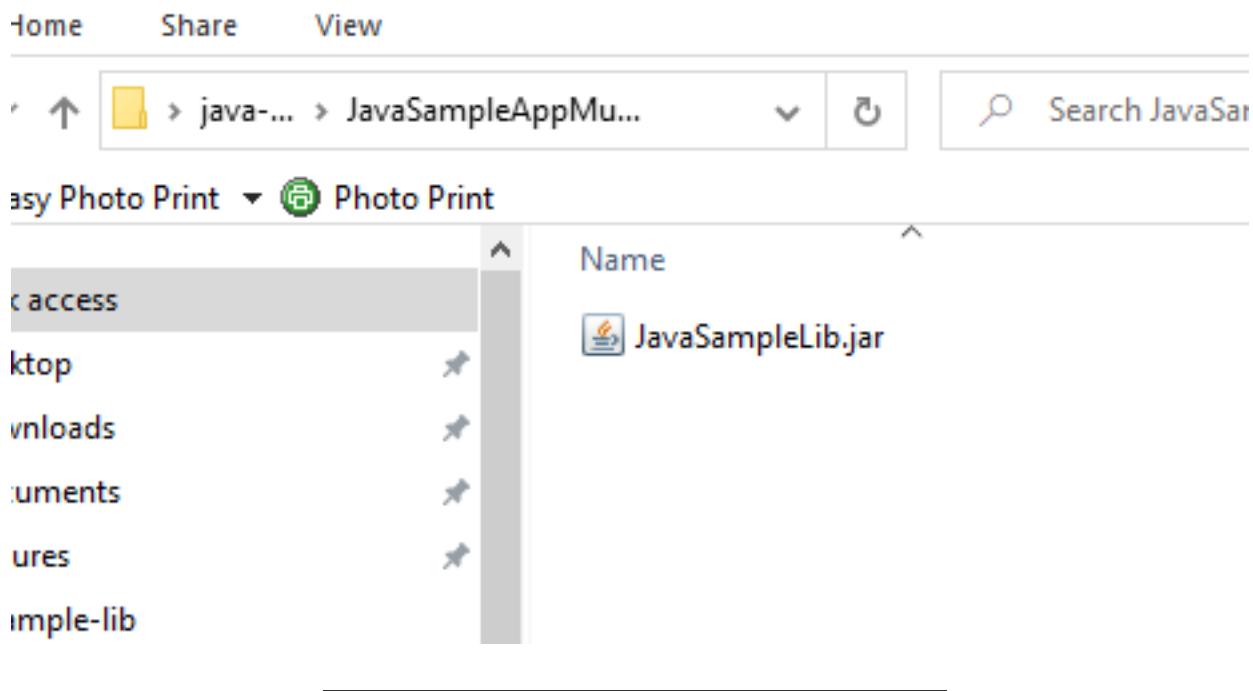
0.183 Shared Library Development - (Eclipse Java Jar Library)-85

now we have a folder that contains our libraries referenced



0.184 Shared Library Development - (Eclipse Java Jar Library)-86

in this file we can find our library



0.185 Shared Library Development - (Eclipse Java Jar Library)-87

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 is 9
Results is 9
```

A screenshot of a terminal window on a Windows system. The command 'java -jar JavaSampleAppMultiple.jar' is run, and the output is displayed. The output consists of four lines: 'Hello World!', 'Hello There', 'Results is 9', and 'Results is 9'. The terminal window has a dark background and white text. The title bar of the window is visible at the top.

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>
```

A screenshot of a terminal window showing a Java exception. The error message is 'Exception in thread "main" java.lang.NoClassDefFoundError: ce103/JavaSampleLib'. Below this, the stack trace shows the cause of the error: 'Caused by: java.lang.ClassNotFoundException: ce103.JavaSampleLib'. The terminal window has a dark background and white text. The title bar of the window is visible at the top.

0.186 Application Testing

- C
- C++
- C#
- Java

0.187 Unit Test Development

Wikipedia Unit Test Library List for Each Language

https://en.wikipedia.org/wiki/List_of_unit_testing_frameworks

0.187.0.1 Visual Studio Community Edition

0.187.0.1.1 C Unit Tests

0.187.0.2 Visual Studio Community Edition - C Unit Tests

- There is no direct C source testing but with additional frameworks. Visual Studio can test C sources.
 - You can check the following entry
 - <https://stackoverflow.com/questions/65820/unit-testing-c-code>
 - Recommended framework is Check
 - <https://libcheck.github.io/check/web/install.html>
 - <https://github.com/libcheck/check/releases>
-

0.187.0.3 Visual Studio Community Edition

0.187.0.3.1 C++ Unit Tests

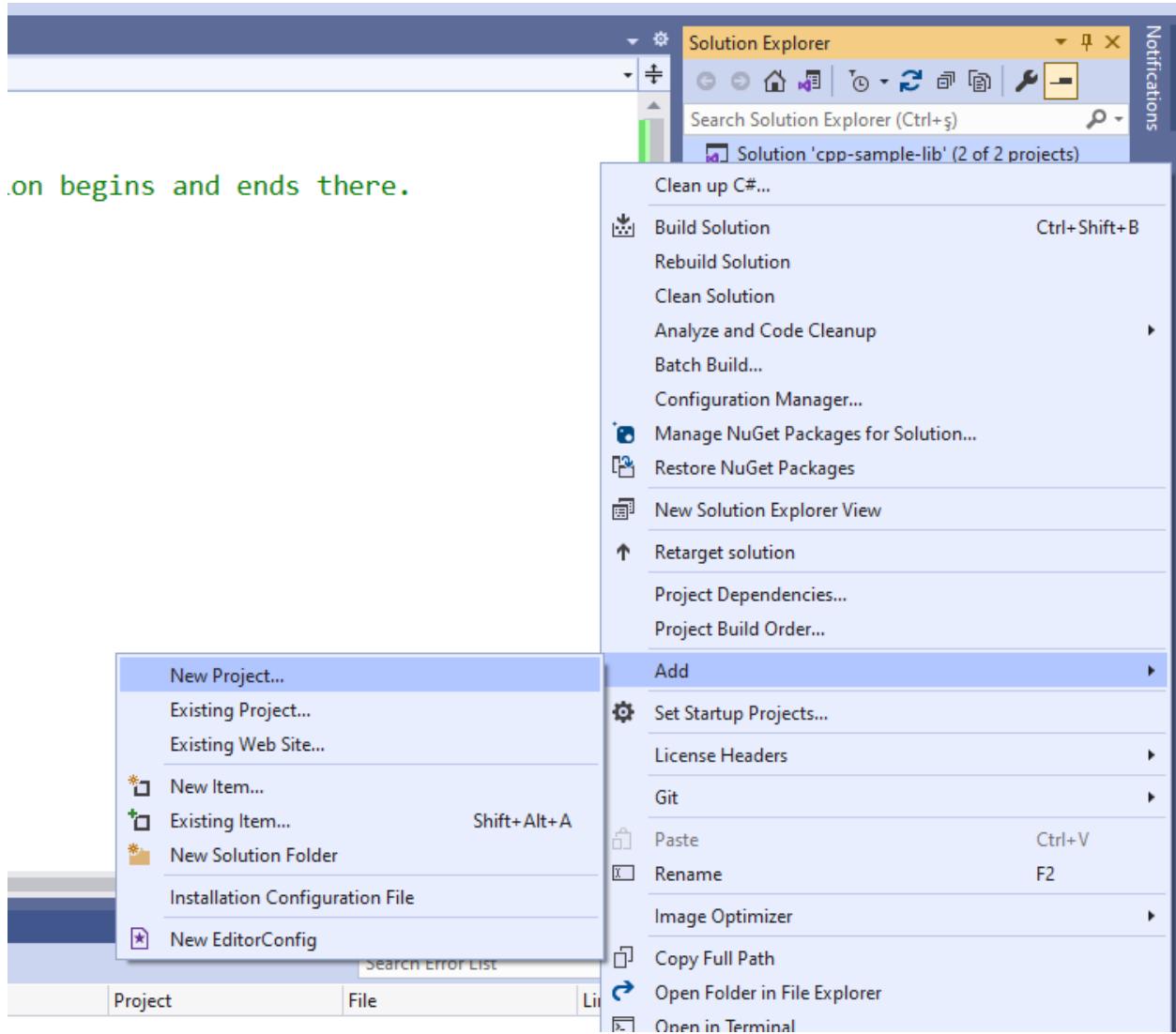
0.187.0.4 Visual Studio Community Edition - C++ Unit Tests-1

- C/C++ için birim testleri yazma - Visual Studio (Windows) | Microsoft Docs¹²
-

0.187.0.5 Visual Studio Community Edition - C++ Unit Tests-2

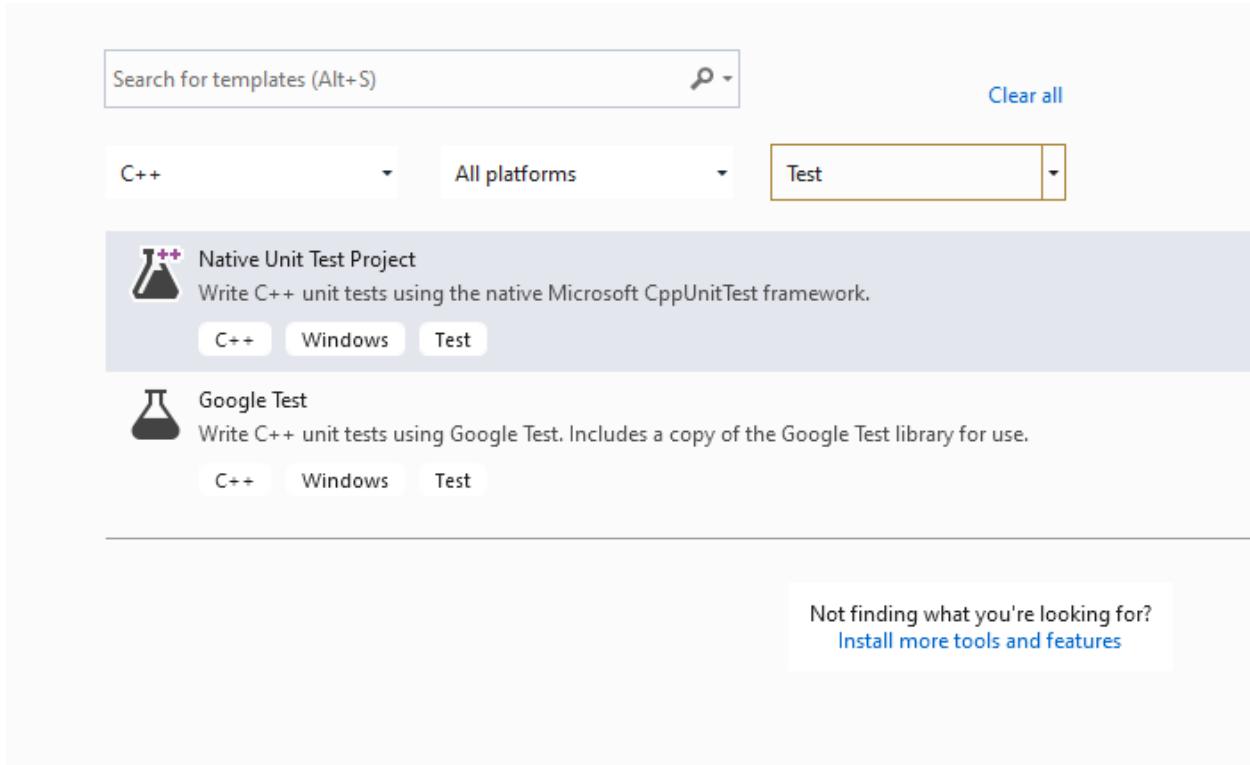
- Use cpp-sample-lib project and add

¹²<https://docs.microsoft.com/tr-tr/visualstudio/test/writing-unit-tests-for-c-cpp?view=vs-2019>



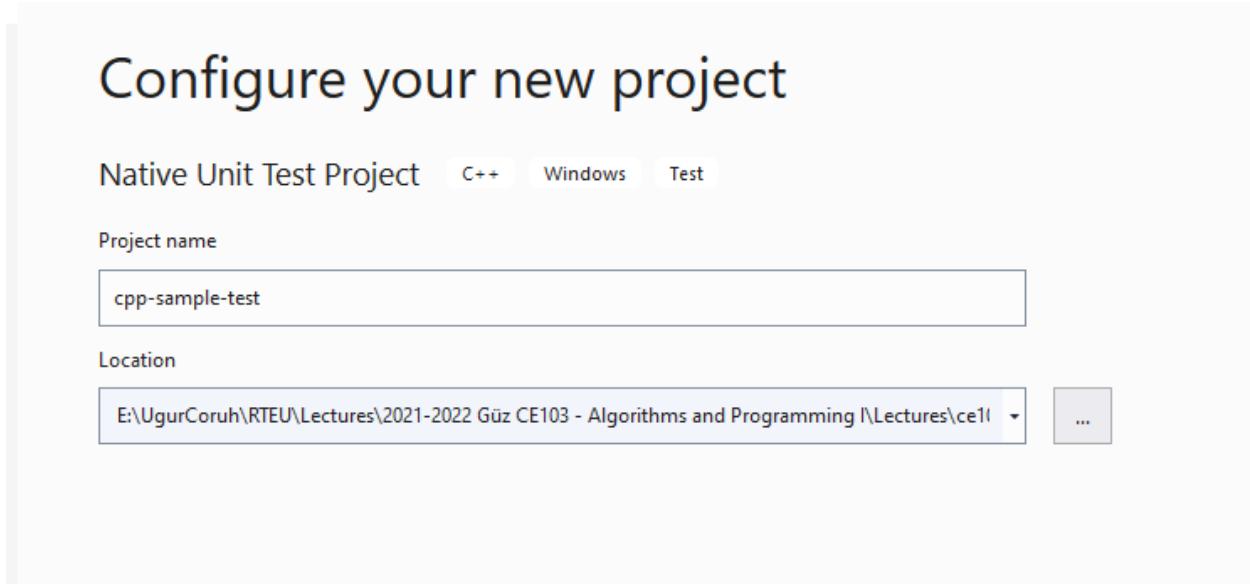
0.187.0.6 Visual Studio Community Edition - C++ Unit Tests-3

- Select Native Unit Test



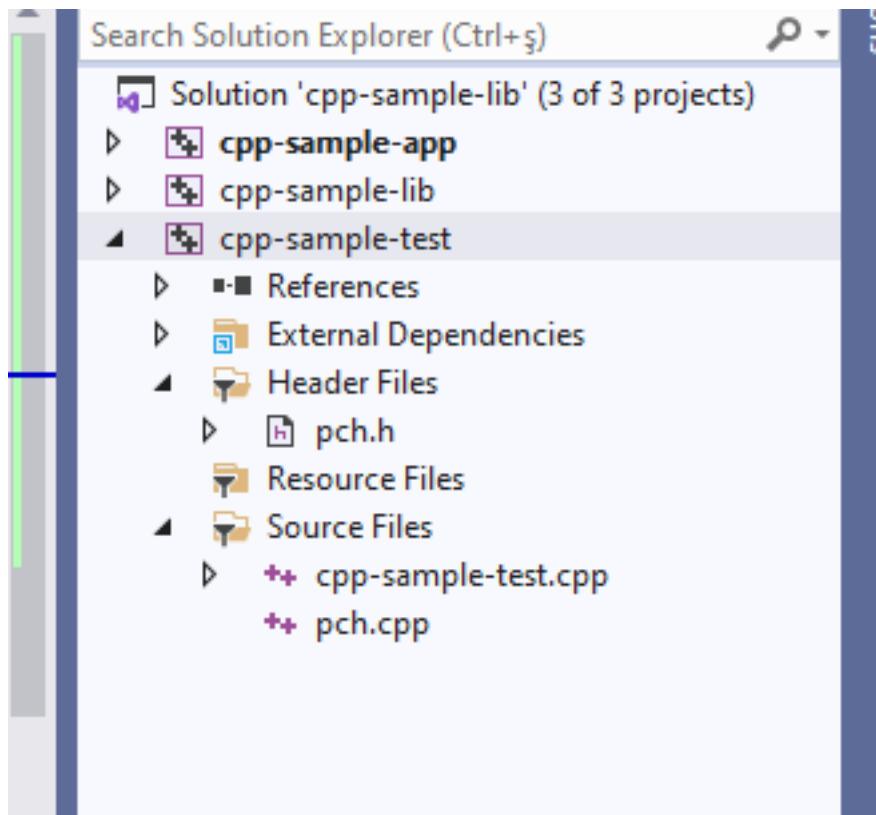
0.187.0.7 Visual Studio Community Edition - C++ Unit Tests-4

- Set project path and name



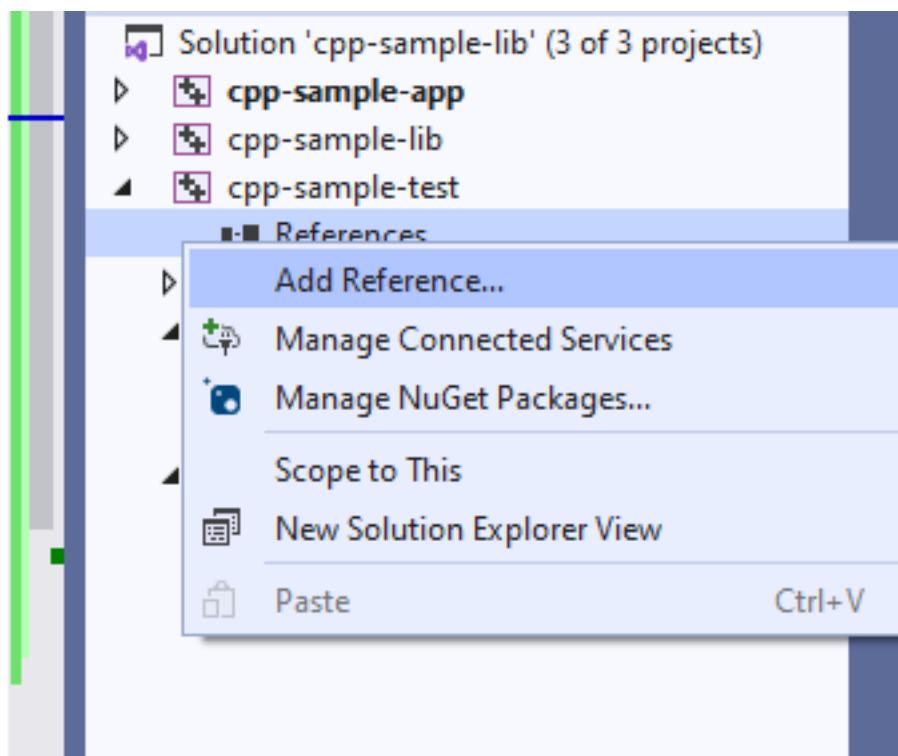
0.187.0.8 Visual Studio Community Edition - C++ Unit Tests-5

- You will have `cpp-sample-test` project



0.187.0.9 Visual Studio Community Edition - C++ Unit Tests-6

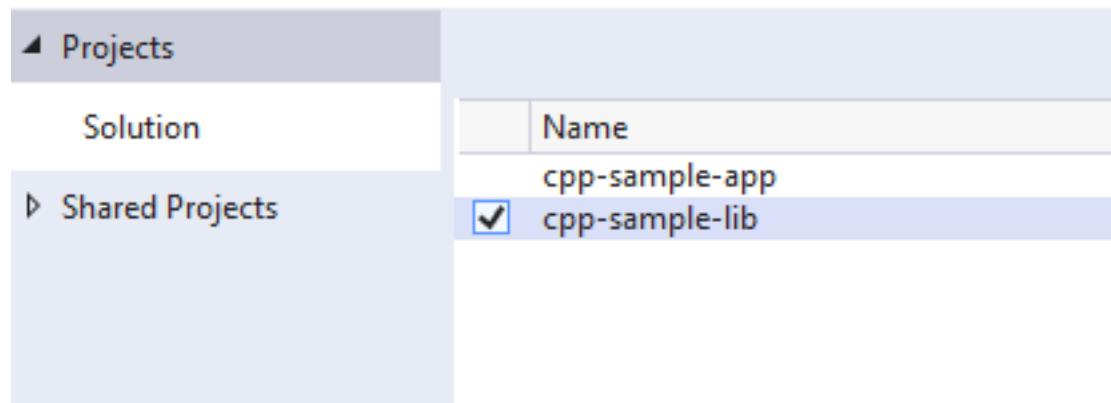
- Add library project from references



0.187.0.10 Visual Studio Community Edition - C++ Unit Tests-7

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

Add Reference



0.187.0.11 Visual Studio Community Edition - C++ Unit Tests-8 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));
            }
    };
}
```

The screenshot shows the Visual Studio Community Edition interface. At the top, there are tabs for 'cpp-sample-test.cpp' and 'cpp-sample-app.cpp'. Below the tabs, the code editor displays a C++ file named 'cpp-sample-test'. The code contains several test cases using Google Test framework:

```
8 namespace cppsampletest
9 {
10     TEST_CLASS(cppsampletest)
11     {
12         public:
13             TEST_METHOD(TestSumCorrect)
14             {
15                 Assert::
16             }
17             TEST_METHOD(TestSumInCorrect)
18             {
19                 Assert::
20             }
21     };
22 }
23
24 }
```

On the right side of the code editor, there is a vertical color bar indicating code coverage: a green bar covers lines 8 through 23, while line 24 is white. The status bar at the bottom left shows '144 %'.

Below the code editor is the 'Test Explorer' window. It shows the following test results:

| Test | Duration | Results |
|---------------------|----------|--------------------|
| cpp-sample-test (2) | 253 ms | 2 Failed |
| cppsampletest (2) | 253 ms | 2 Failed |
| cppsampletest (2) | 253 ms | 1 Passed, 1 Failed |
| TestSumCorrect | < 1 ms | Passed |
| TestSumInCorrect | 253 ms | Failed |

The status bar at the bottom right of the 'Test Explorer' window indicates 'No issues found'.

0.187.0.12 Visual Studio Community Edition - C++ Unit Tests-9

0.187.0.13 Visual Studio Community Edition

0.187.0.13.1 C# Unit Tests

- MSTest + .Net
 - Fine Code Coverage
 - NUnit + .NetCore
-

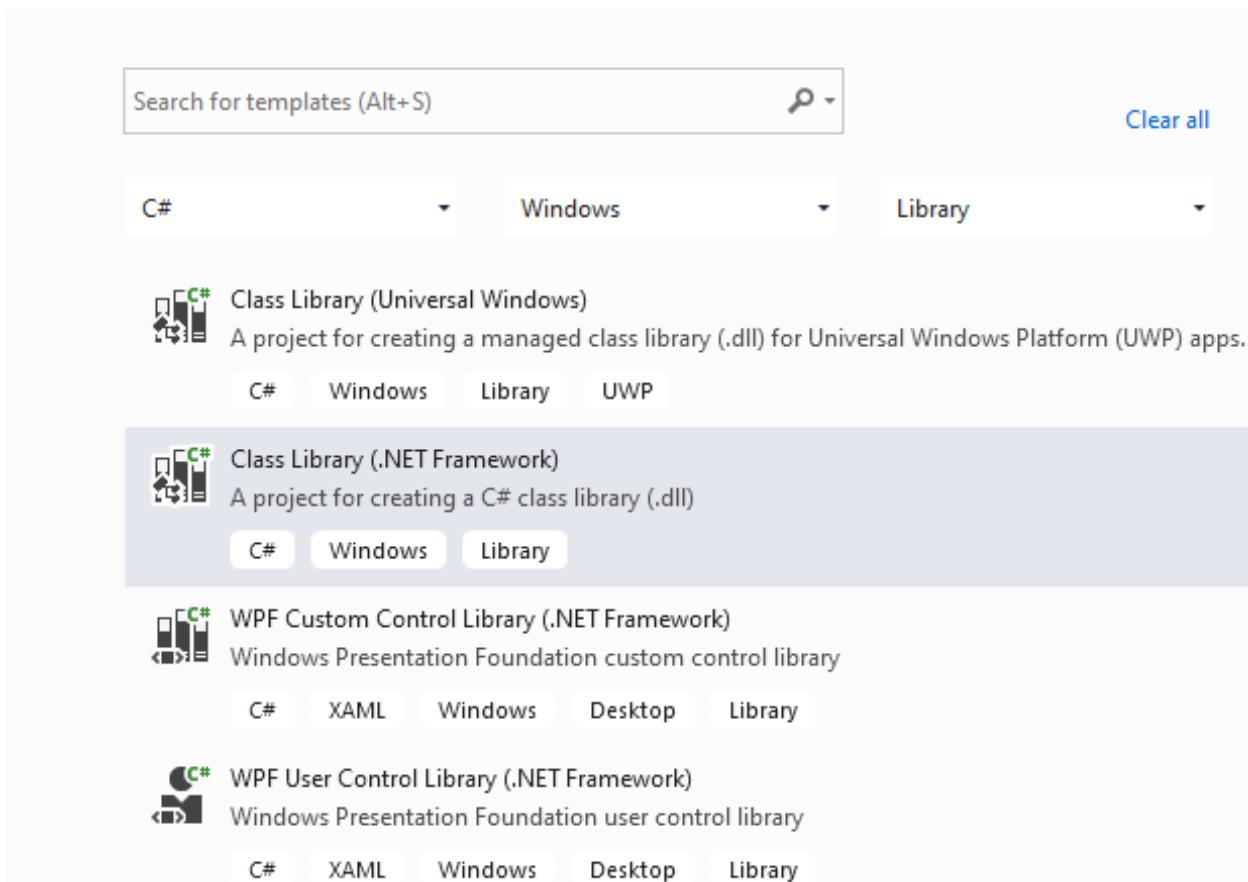
0.187.1 Visual Studio Community Edition (C# Unit Test + MSTestV2+.Net)-1

- Install extension fine code coverage

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

0.187.2 Visual Studio Community Edition (C# Unit Test + MSTestV2+.Net)-2

- Create a .Net Framework Library



0.187.3 Visual Studio Community Edition (C# Unit Test + MSTestV2+.Net)-3

- Set project framework and path

Configure your new project

Class Library (.NET Framework) C# Windows Library

Project name

cs-lib-sample

Location

C:\Users\ugur.coruh\Desktop\cs-lib-sample\



Solution name i

cs-lib-sample

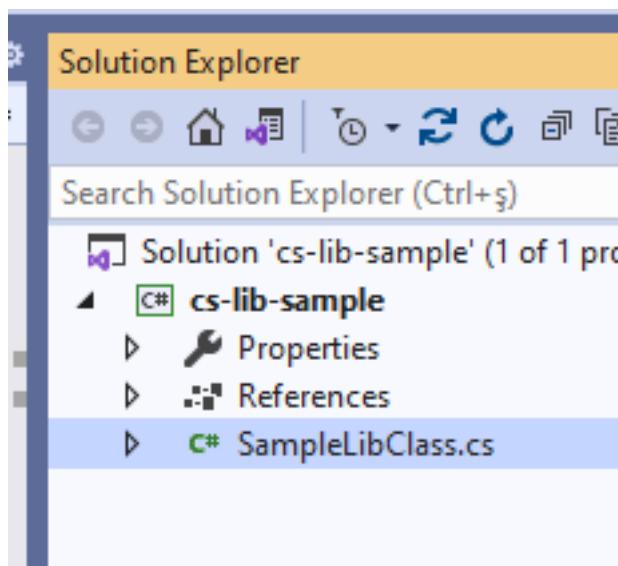
Place solution and project in the same directory

Framework

.NET Framework 3.0

0.187.4 Visual Studio Community Edition (C# Unit Test + MSTestV2+.Net)-4

- Create library functions



0.187.5 Visual Studio Community Edition (C# Unit Test + MSTestV2+.Net)-5

```
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);

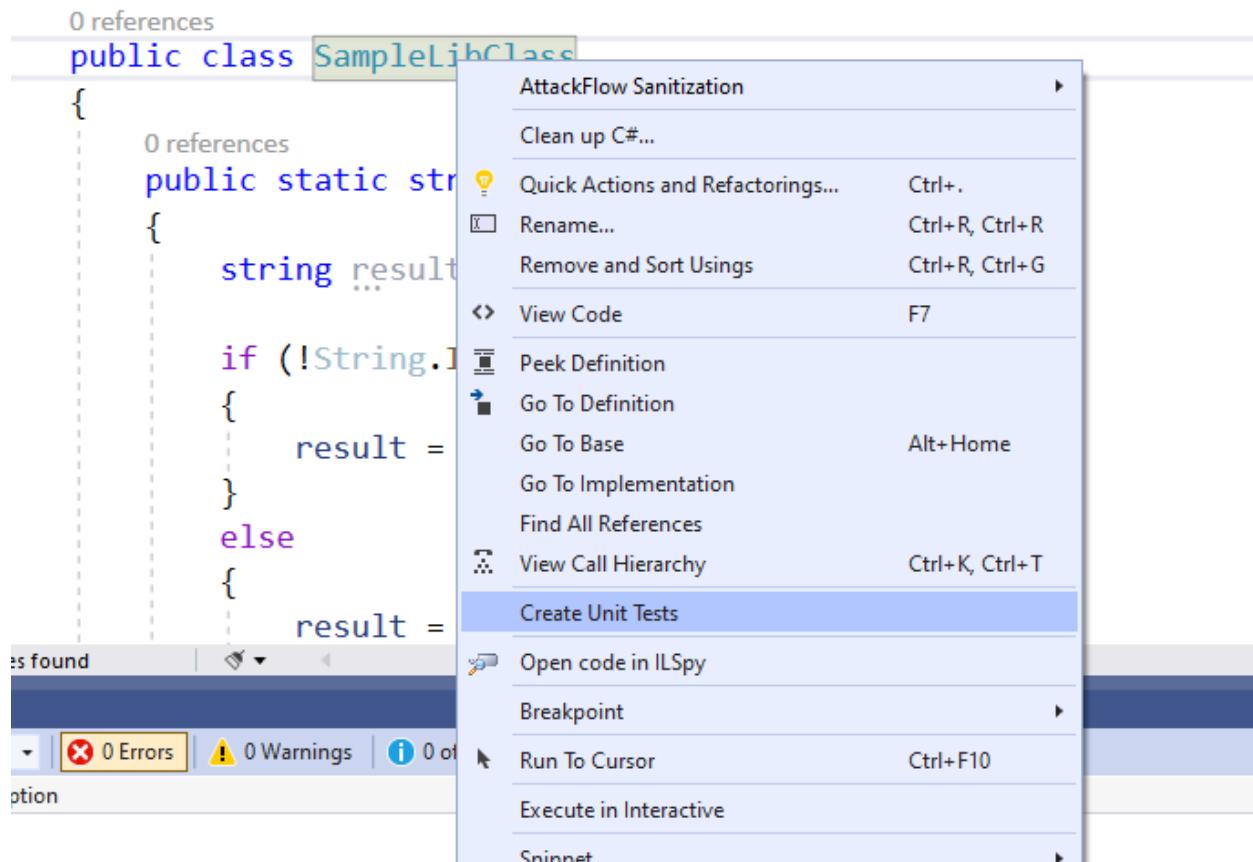
            return result;
        }

        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;
        }
    }
}
```

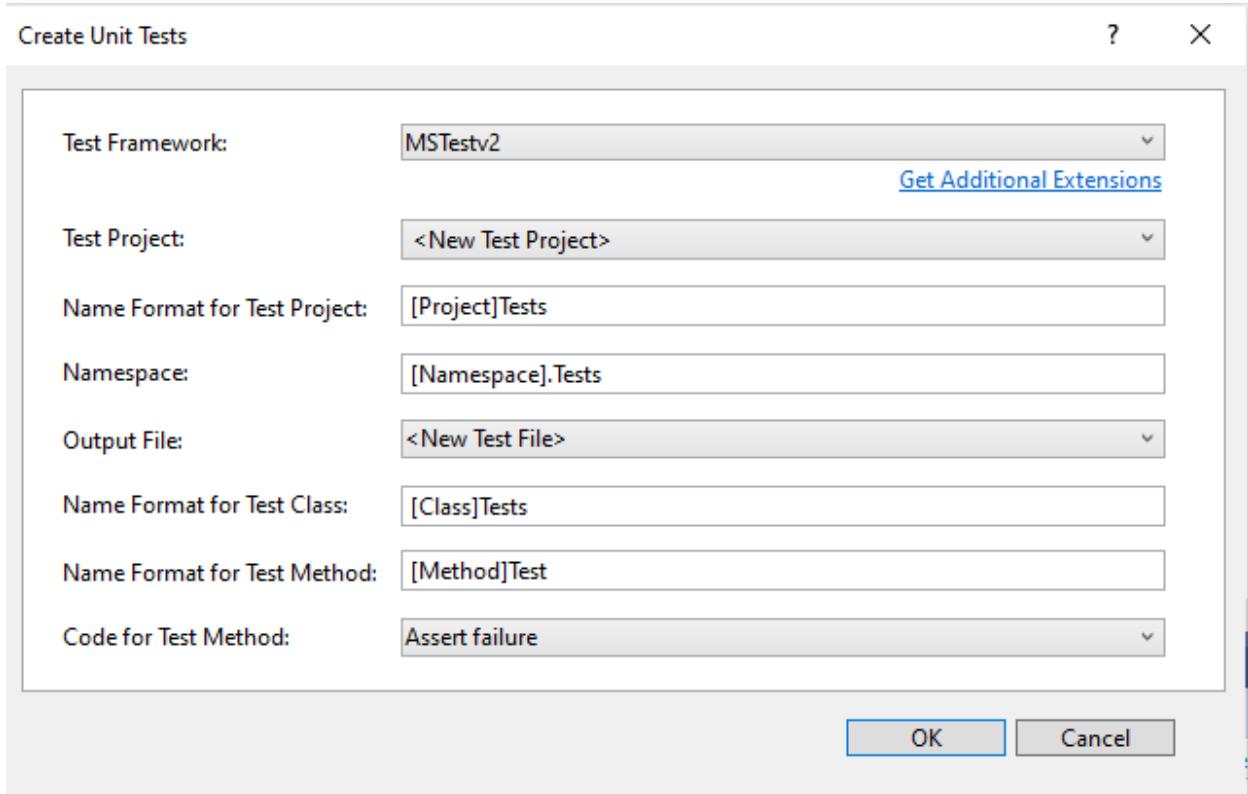
0.187.6 Visual Studio Community Edition (C# Unit Test + MSTestV2+.Net)-6

- Right click and then create unit test project



0.187.7 Visual Studio Community Edition (C# Unit Test + MSTestV2+.Net)-7

- Press OK



0.187.8 Visual Studio Community Edition (C# Unit Test + MSTestV2+.Net)-8

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

```

[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();

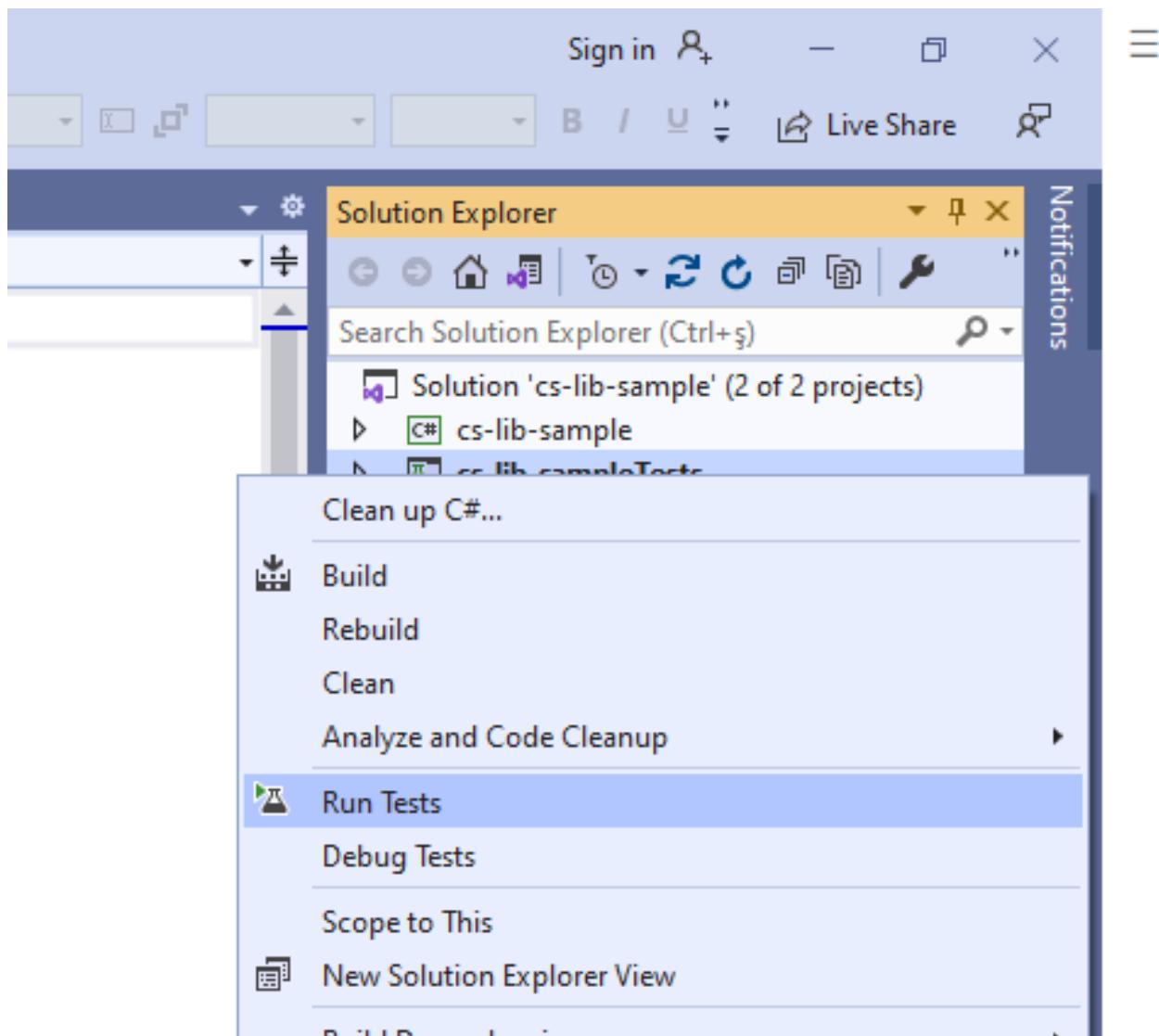
    Assert.AreEqual(20, sampleLib.multiply(4, 5), "Regular multiplication should work");
}

}

```

0.187.9 Visual Studio Community Edition (C# Unit Test + MSTestV2+.Net)-9

- Run tests



0.187.10 Visual Studio Community Edition (C# Unit Test + MSTestV2+.Net)-10

you will code coverage and entered or passed branches

```

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

```

No issues found

2 references | 1/2 passing

| 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% |

0.187.10.1 Visual Studio Community Edition

0.187.10.1.1 C# Unit Test + NUnit + .NETCore

0.187.10.2 Visual Studio Community Edition (C# Unit Test+NUnit+.NETCore)-1

- Use csharp-sample-lib for this example
- Create and add a unit test project to solution

Search for templates (Alt+S)  Clear all

C# Windows Test

 MSTest Test Project
A project that contains MSTest unit tests that can run on .NET Core on Windows, Linux and MacOS.
C# Linux macOS Windows Test

 NUnit Test Project
A project that contains NUnit tests that can run on .NET Core on Windows, Linux and MacOS.
C# Linux macOS Windows Desktop Test Web

 Unit Test Project (.NET Framework)
A project that contains MSTest unit tests.
C# Windows Test

 xUnit Test Project
A project that contains xUnit.net tests that can run on .NET Core on Windows, Linux and MacOS.
C# Linux macOS Windows Test

 Web Driver Test for Edge (.NET Core)
A project that contains unit tests that can automate UI testing of web sites within Edge browser (using Microsoft's WebDriver API).
C# Windows Web Test

 Web Driver Test for Edge (.NET Framework)
A project that contains unit tests that can automate UI testing of web sites within Edge browser (using Microsoft's WebDriver API).
C# Windows Web Test

 Unit Test App (Universal Windows)
A project to create a unit test app for Universal Windows Platform (UWP) apps using MSTest.
C# Windows UWP Test

0.187.10.3 Visual Studio Community Edition (C# Unit Test+NUnit+.NETCore)-2

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\ce11

...

0.187.10.4 Visual Studio Community Edition (C# Unit Test+NUnit+.NETCore)-3

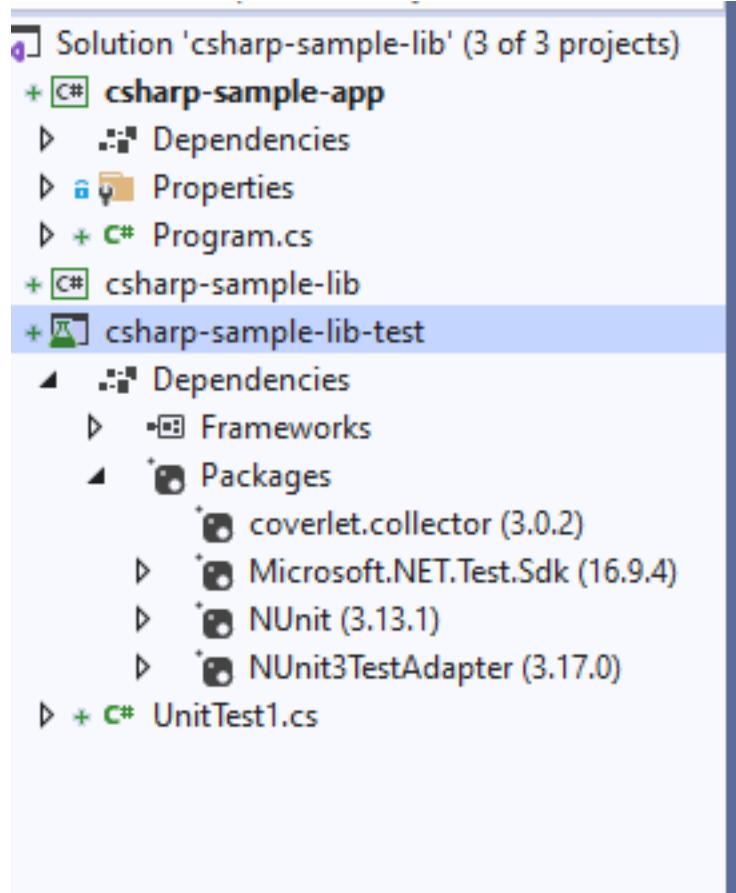
Additional information

NUnit Test Project C# Linux macOS Windows Desktop Test Web

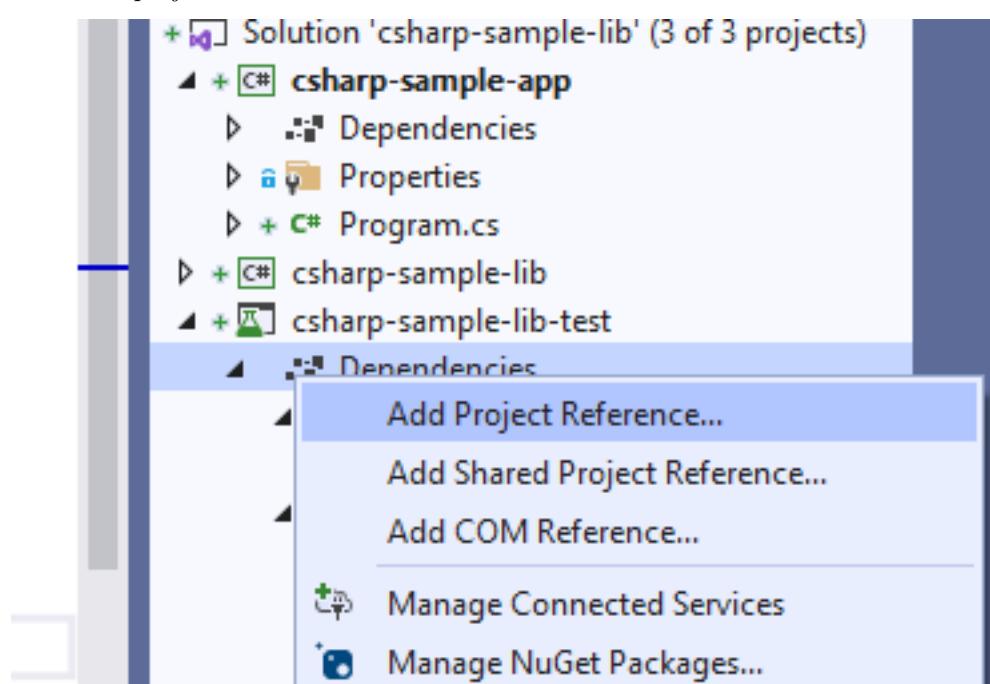
Target Framework ⓘ

.NET Core 3.1 (Long-term support)

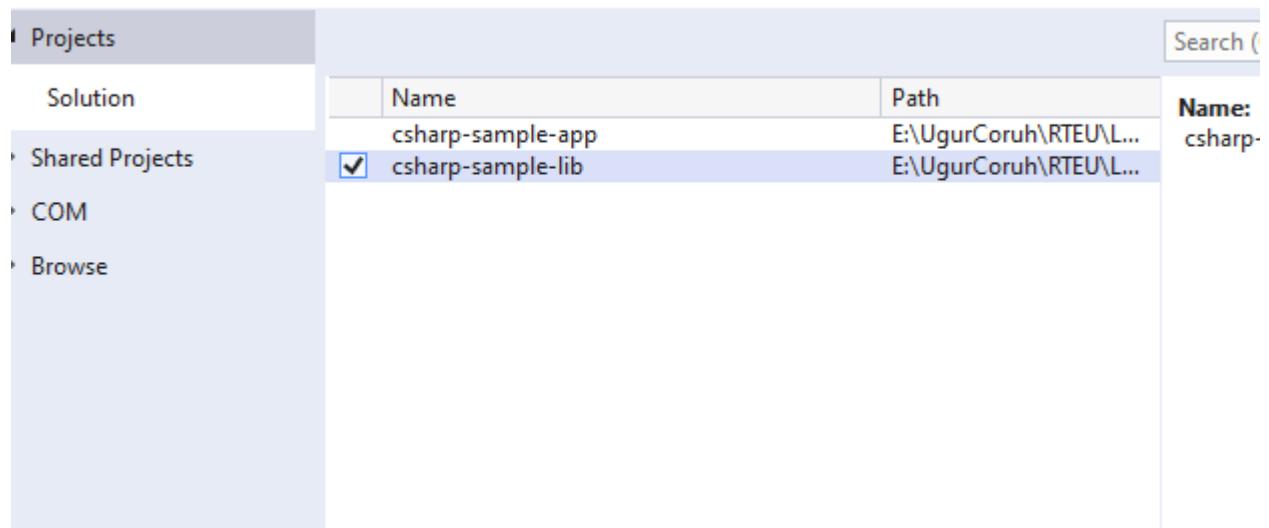
- .NET Framework 4.0
- .NET Framework 4.5
- .NET Framework 4.5.1
- .NET Framework 4.5.2
- .NET Framework 4.6
- .NET Framework 4.6.1
- .NET Framework 4.6.2
- .NET Framework 4.7
- .NET Framework 4.7.1
- .NET Framework 4.7.2
- .NET Framework 4.8
- .NET Core 1.0 (Out of support)
- .NET Core 1.1 (Out of support)
- .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)



- Add project reference



0.187.10.7 Visual Studio Community Edition (C# Unit Test+NUnit+.NETCore)-6
Reference Manager - csharp-sample-lib-test



0.187.10.8 Visual Studio Community Edition (C# Unit Test+NUnit+.NETCore)-7 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");
        }

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

        [Test]
        public void testSumCorrect()
        {
            Assert.AreEqual(5, sum(2, 3));
        }
}
```

```

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

```

0.187.10.9 Visual Studio Community Edition (C# Unit Test+NUnit+.NETCore)-8

- 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;
        }

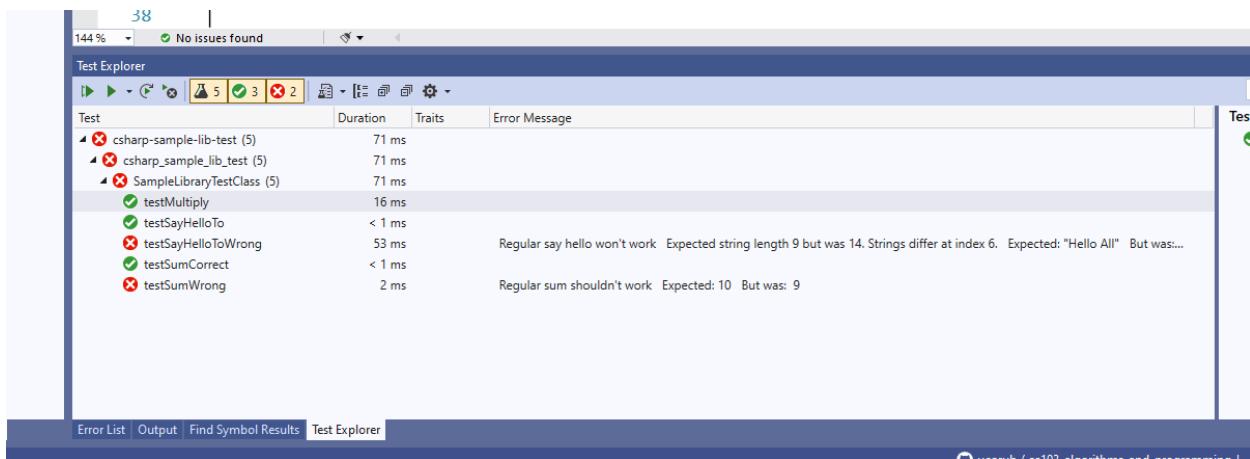
        public int multiply(int a, int b)
        {
            return a * b;
        }
    }
}

```

```
        }  
    }  
}
```

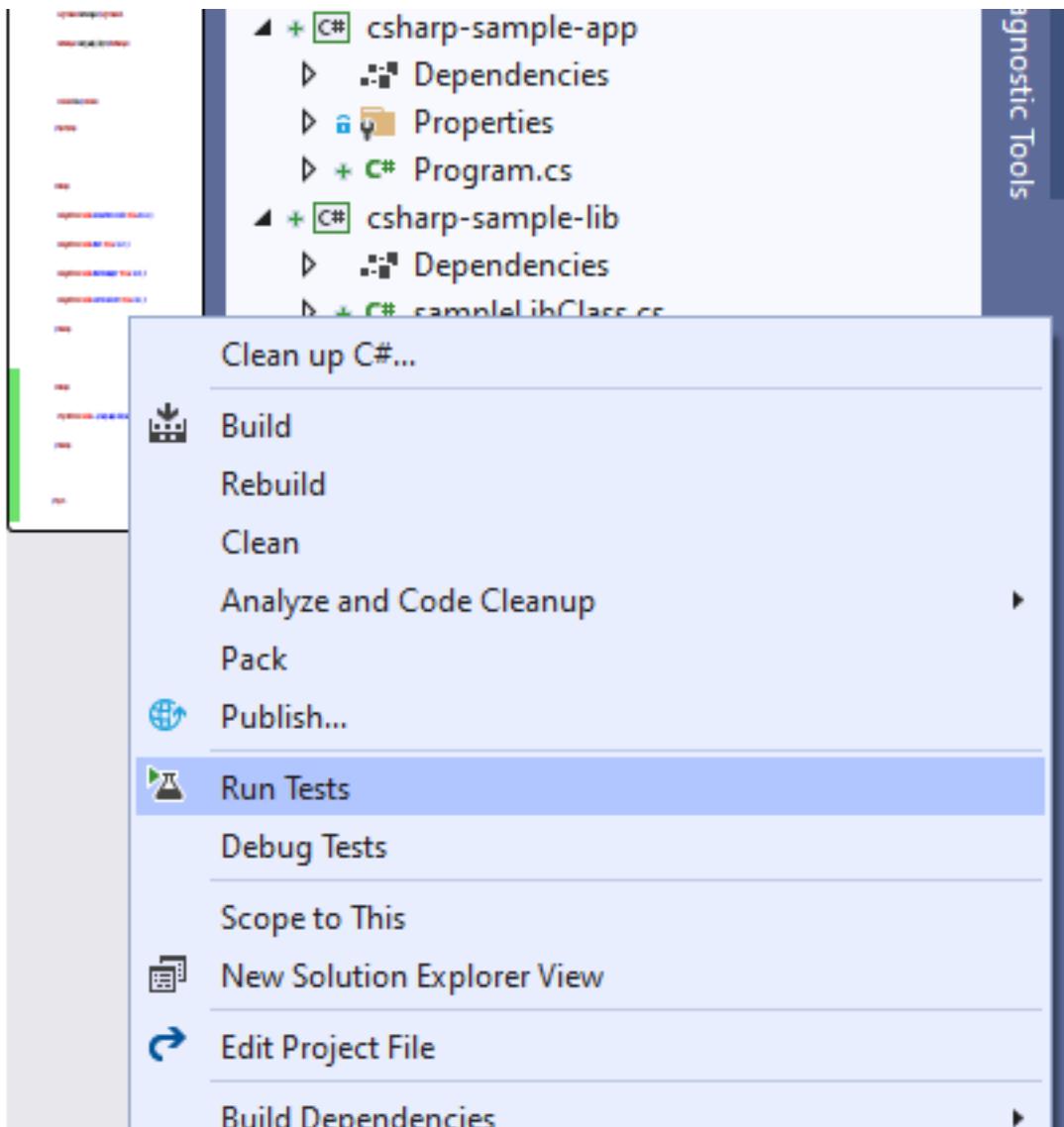
0.187.10.10 Visual Studio Community Edition (C# Unit Test+NUnit+.NETCore)-9

- Open test explorer and run tests



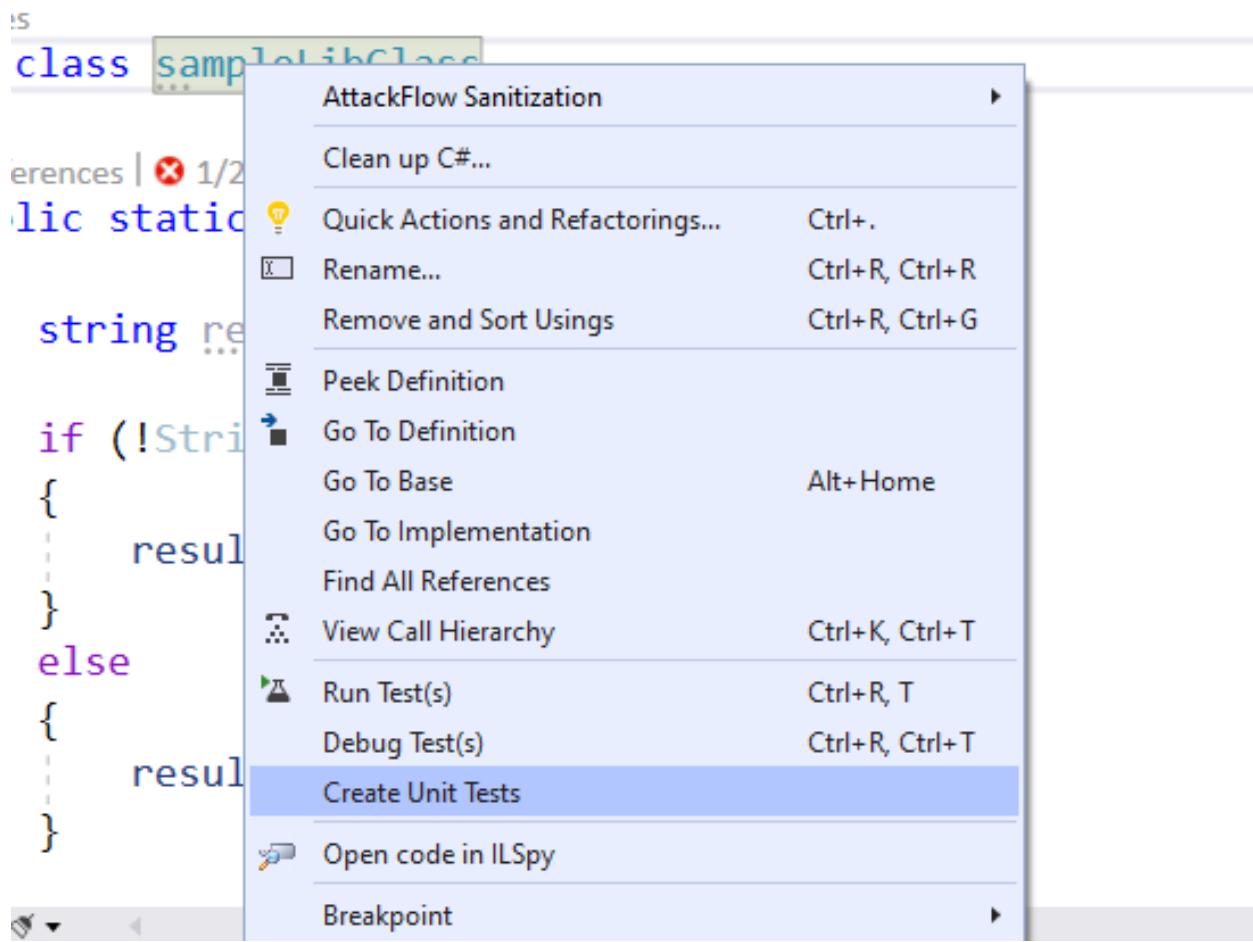
0.187.10.11 Visual Studio Community Edition (C# Unit Test+NUnit+.NETCore)-10

- or you can run from project

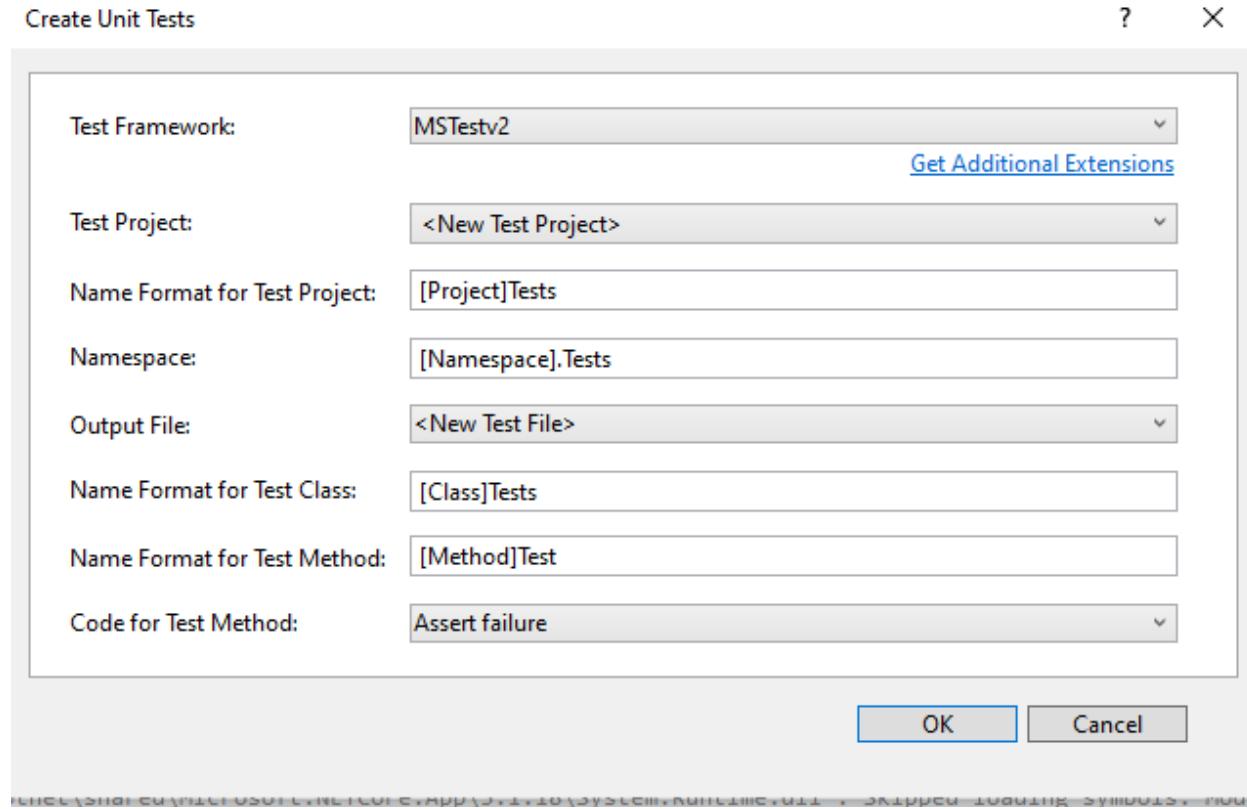


0.187.10.12 Visual Studio Community Edition (C# Unit Test+NUnit+.NETCore)-11

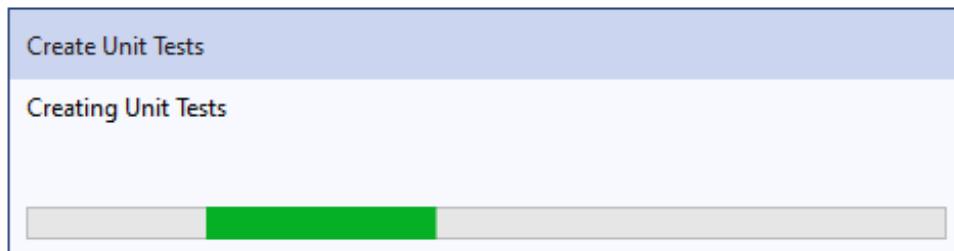
- Also we can create unit test from library class,
- Right click the sampleLibClass and select create unit tests but this option do not provide nunit tests.



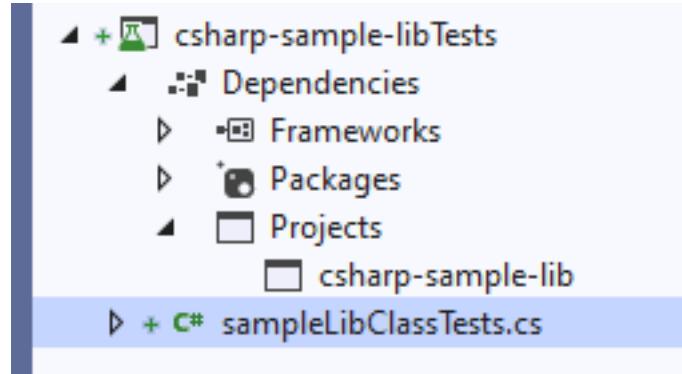
0.187.10.13 Visual Studio Community Edition (C# Unit Test+NUnit+.NETCore)-12



0.187.10.14 Visual Studio Community Edition (C# Unit Test+NUnit+.NETCore)-13



0.187.10.15 Visual Studio Community Edition (C# Unit Test+NUnit+.NETCore)-14



0.187.10.16 Visual Studio Community Edition (C# Unit Test+NUnit+.NETCore)-15

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

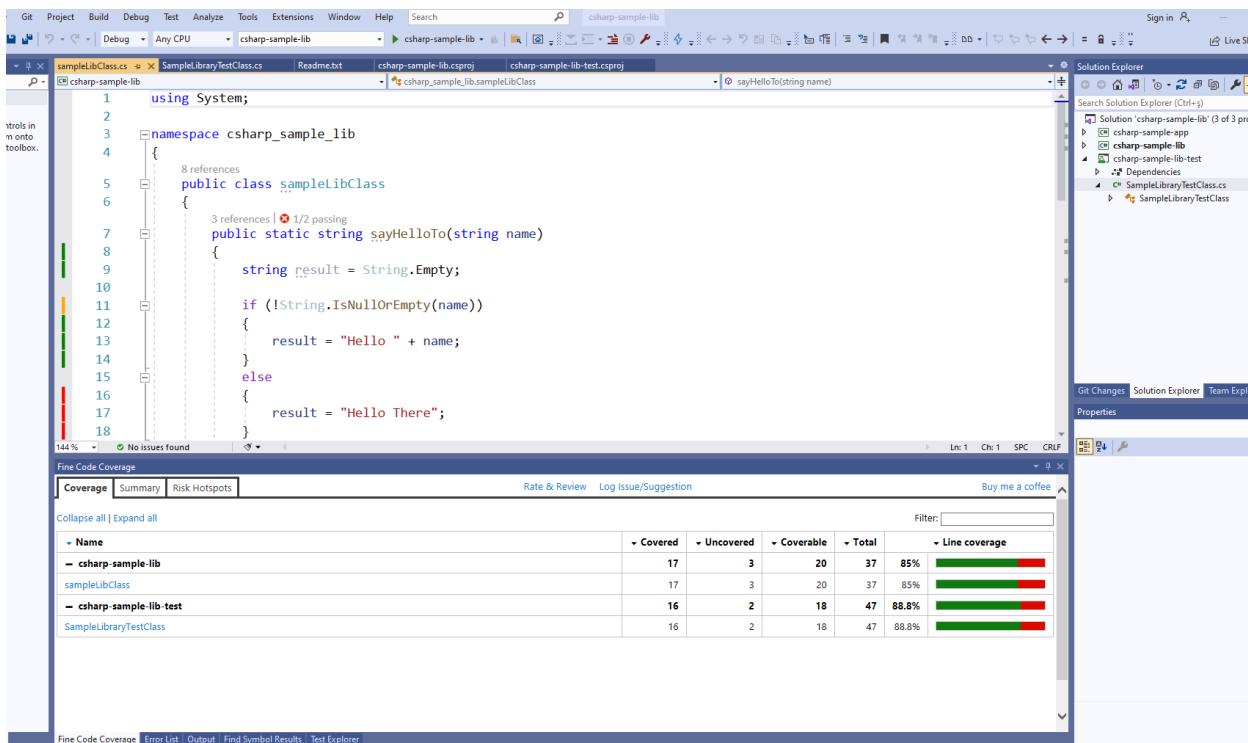
namespace csharp_sample_lib.Tests
{
    [TestClass()]
    public class sampleLibClassTests
    {
        [TestMethod()]
        public void sayHelloToTest()
        {
            Assert.Fail();
        }

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

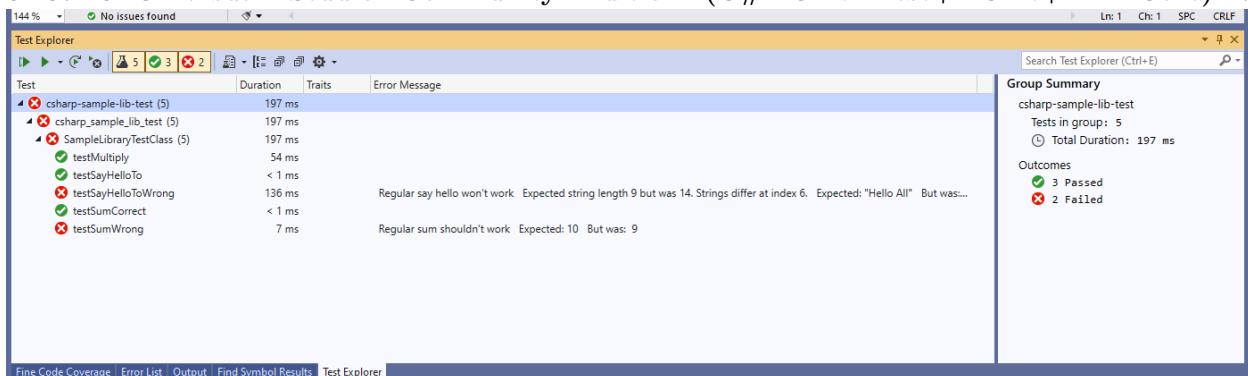
        [TestMethod()]
        public void multiplyTest()
        {
            Assert.Fail();
        }
    }
}
```

0.187.10.17 Visual Studio Community Edition (C# Unit Test+NUnit+.NETCore)-16

- 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



0.187.10.18 Visual Studio Community Edition (C# Unit Test+NUnit+.NETCore)-17



- Inline code highlight is part of enterprise visual studio edition
 - Analyzing code coverage in Visual Studio - DEV Community¹³

0.187.10.19 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner + Report)

0.187.10.20 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner + Report)-1

0.187.10.20.1 TL;DR

¹³<https://dev.to/rruizdev/analizando-cobertura-del-codigo-en-visual-studio-1p27>

- 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 Overflow¹⁴

- Follow the instructions on the link
 - CMD OpenCover · sukhoi1/Useful-Notes Wiki · GitHub¹⁵
 - Install OpenCover, ReportGenerator, Nunit,Runners packages then use the package installation folder to get tools that you need
-

0.187.10.21 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner + Report)-2

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

¹⁴<https://stackoverflow.com/questions/64611083/the-nunit-3-driver-encountered-an-error-while-executing-reflected-code-nunit-en>

¹⁵<https://github.com/sukhoi1/Useful-Notes/wiki/CMD-OpenCover>

The screenshot shows the Visual Studio Solution Explorer window. The 'Packages' node is expanded, listing several NuGet packages: coverlet.collector (3.1.0), Microsoft.NET.Test.Sdk (16.11.0), NUnit (3.13.2), NUnit.Runners (3.12.0), NUnit3TestAdapter (4.0.0), OpenCover (4.7.1221) which is selected, and ReportGenerator (4.8.13). Below the packages are sections for 'Projects' containing nunit-console-run.bat, open-cover.bat, and open-cover-runner.bat, and a C# file named UnitTest1.cs.

Git Changes Solution Explorer Team Explorer

Properties

OpenCover Package Reference Properties

| General | |
|------------------------|---|
| Aliases | |
| Excluded Assets | |
| Generate Path Property | |
| Included Assets | |
| Name | OpenCover |
| Path | C:\Users\ugur.coruh\.nuget\packages\opencover\4.7.1221\lib\net45\ |
| Private Assets | |
| Suppress Warnings | |
| Version | 4.7.1221 |

0.187.10.22 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner + Report)-3

- 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" -ta
pause
```

0.187.10.23 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner + Report)-4

- but nunit3-console.exe gives error

```
C:\Users\ugur.coruh\Desktop\csharp-sample-lib>"C:\Users\ugur.coruh\.nuget\packages\opencover\4.7.1221\tools\OpenCover.Console.exe" -targetargs:"C:\Users\ugur.coruh\Desktop\csharp-sample-lib-test\bin\Debug\netcoreapp3.1\csharp-sample-lib-test.dll" -filter:"+[csharp-sample-lib]* -[*test]*" -target:"C:\Users\ugur.coruh\.nuget\packages\nunit.consolerunner\3.12.0\tools\nunit3-console.exe" -output:"C:\Users\ugur.coruh\Desktop\csharp-sample-lib-test\bin\Debug\netcoreapp3.1\coverage" -skipautoprops -register:user && "C:\Users\ugur.coruh\Desktop\csharp-sample-lib-test\bin\Debug\netcoreapp3.1\ReportGenerator.exe" -reports:"C:\Users\ugur.coruh\Desktop\csharp-sample-lib-test\bin\Debug\netcoreapp3.1\coverage" -ta
Launching OpenCover 4.7.1221.0
Copyright (c) 2021 Charlie Poole, Rob Prouse
Build 4.7.1221.0 (2021-06-06 00:00:00)
Unit Console Runner 3.12.0 (.NET 2.0)
Copyright (c) 2021 Charlie Poole, Rob Prouse
Build 3.12.0 (2021-06-06 00:00:00)
RunTime Environment
OS Version: Microsoft Windows NT 6.2.9200.0
Runtime: .NET Framework CLR v4.0.30319.42000
Test File: C:\Users\ugur.coruh\Desktop\csharp-sample-lib\csharp-sample-lib-test\bin\Debug\netcoreapp3.1\csharp-sample-lib-test.dll
Errors, Failures and Warnings
D:\Error
NUnit.Engine.NUnitEngineException : The NUnit 3 driver encountered an error while executing reflected code.
  at NUnit.Engine.NUnitEngineException..ctor (System.InvalidCastException) : Unable to cast transparent proxy to type 'System.Web.UI.ICallbackEventHandler'.
The NUnit 3 driver encountered an error while executing reflected code.
Server stack trace:
at NUnit.Engine.Drivers.NUnit3FrameworkDriver.CreateObject (String typeName, Object[] args)
at NUnit.Engine.Drivers.NUnit3FrameworkDriver.CreateObject (String typeName, Object[] args, Object settings)
at NUnit.Engine.Runners.DirectTestRunner.LoadDriver (IFrameworkDriver driver, String testFile, TestPackage subPackage)
at NUnit.Engine.Runners.DirectTestRunner.LoadPackage ()
at NUnit.Engine.Runners.DirectTestRunner.LoadPackage (IEventListener listener)
at NUnit.Engine.Drivers.NUnit3FrameworkDriver.CreateObject (String typeName, Object[] args)
at NUnit.Engine.Drivers.NUnit3FrameworkDriver.CreateObject (String typeName, Object[] args, Object settings)
at NUnit.Engine.Drivers.NUnit3FrameworkDriver.CreateObject (String typeName, Object[] args, Object settings, Object[] outArgs)
at System.Runtime.Remoting.Messaging.StackBuilderSink.PrivateProcessMessage (Int32 methodID, Object[] args, Object[] outArgs)
at System.Runtime.Remoting.Messaging.StackBuilderSink.PrivateProcessMessage (Int32 methodHandle, Object[] args, Object server, Object[] outArgs)
at System.Runtime.Remoting.Messaging.StackBuilderSink.PrivateProcessMessage (Object message)
Exception rethrown at [0]
at System.Runtime.Remoting.Proxies.RealProxy.HandleReturnMessage ( IMessage reqMsg, IMessage retMsg )
at System.Runtime.Remoting.Proxies.RealProxy.PrivateInvoke ( Object o, Int32 type, Int32 flags, IMethodCallMessage msg )
at NUnit.Engine.ITestEngineRunner.Run ( ITestEventListener listener, TestFilter filter )
at NUnit.Engine.Runners.ProcessRunner.RunTests ( ITestEventListener listener, TestFilter filter )
at NUnit.Engine.Runners.ProcessRunner.RunTests ( ITestEventListener listener, TestFilter filter )
InvalidOperationException
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 23:01:11Z
End time: 2021-10-24 23:01:11Z
Duration: 2.015 seconds
Results (unit3) saved as TestResult.xml
For results, this could be for a number of reasons. The most common reasons are:
1) you have multiple assembly references in your project, but only one of them has an output file and refer to the Usage guide (Usage.vst) about filters. Ensure
2) you have registered the correct assembly correctly, please refer to the Usage
guide and the --register switch.
3) your assemblies under test were not loaded, refer to the output XML
manifest file for more information.
4) you are targeting .NET Core and your assemblies under test were not
loaded, refer to the Usage guide.
5) you are targeting .NET Core and your assemblies under test were
loaded, but the assembly name was incorrect, refer to the Usage guide.
2021-10-25T02:01:12Z: Arguments
2021-10-25T02:01:12Z: -targetdir:C:\Users\ugur.coruh\Desktop\csharp-sample-lib\csharp-sample-lib-test\bin\Debug\netcoreapp3.1\coverage
2021-10-25T02:01:12Z: -targetdir:C:\Users\ugur.coruh\Desktop\csharp-sample-lib\csharp-sample-lib-test\bin\Debug\netcoreapp3.1\coverage
2021-10-25T02:01:12Z: Writing report file C:\Users\ugur.coruh\Desktop\csharp-sample-lib\csharp-sample-lib-test\bin\Debug\netcoreapp3.1\coverage\index.html
2021-10-25T02:01:12Z: Coverage analysis took 0.3 seconds
C:\Users\ugur.coruh\Desktop\csharp-sample-lib>pause
Press any key to continue . . .
```

0.187.10.24 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner + Report)-5

- 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 Rhapsody¹⁶
 - Code coverage of .NET Core unit tests with OpenCover – Automation Rhapsody¹⁷
 - Sample OpenCover report
 - Summary - Coverage Report¹⁸
-

0.187.10.25 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner + Report)-6

0.187.10.26 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,
-

0.187.10.27 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner + Report)-7

0.187.10.28 OpenCover

- Releases · OpenCover/opencover · GitHub¹⁹



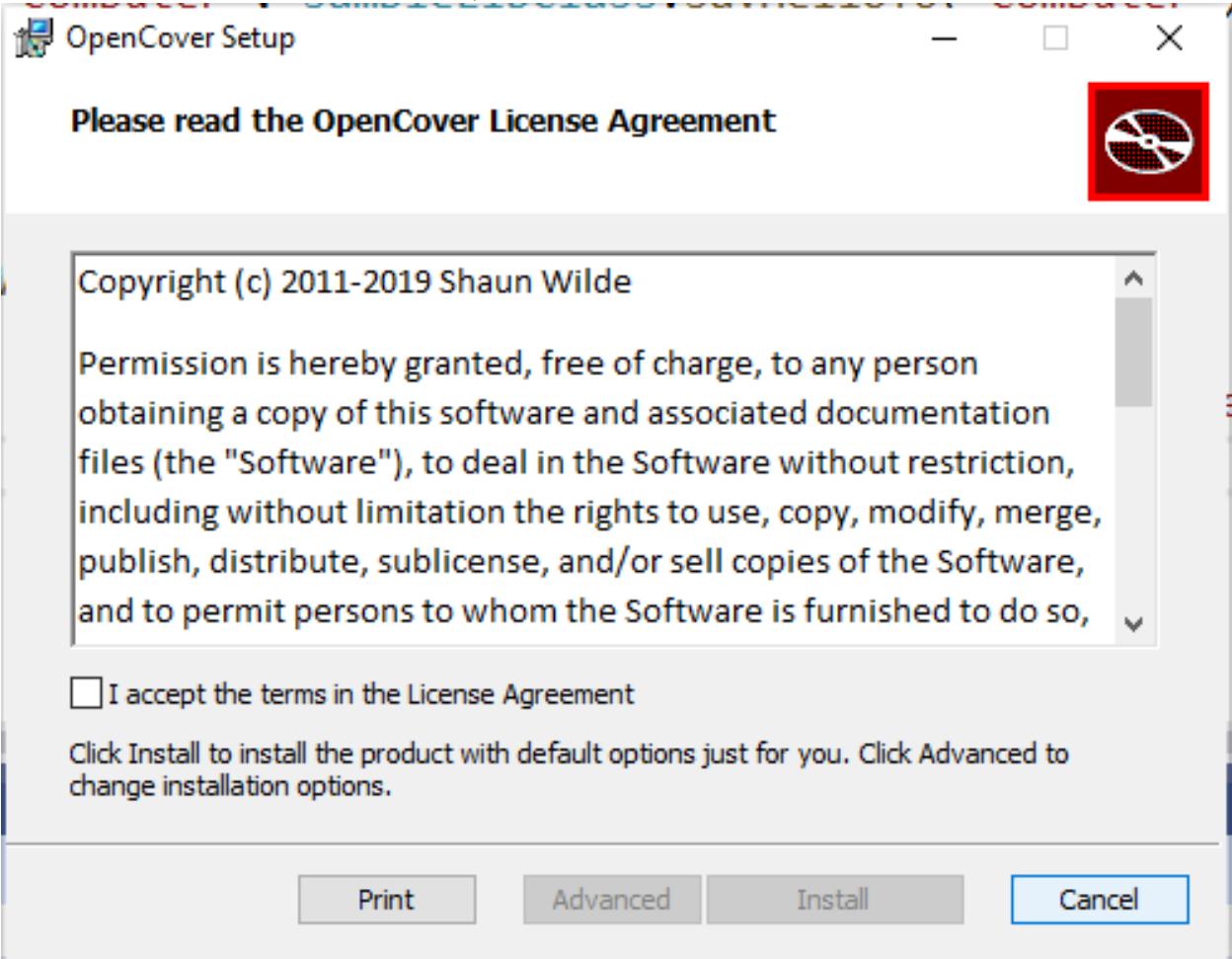
¹⁶<https://automationrhapsody.com/code-coverage-manual-automated-tests-opencover-net-applications/>

¹⁷<https://automationrhapsody.com/code-coverage-net-core-unit-tests-opencover/>

¹⁸<https://automationrhapsody.com/examples/OpenCover-report/>

¹⁹<https://github.com/OpenCover/opencover/releases>

0.187.10.29 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner +



Report)-8

0.187.10.30 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner + Report)-9 Select advanced and then install for all users



Installation Scope

Choose the installation scope and folder



Install just for you (ugur.coruh)

OpenCover will be installed in a per-user folder and be available just for your user account. You do not need local Administrator privileges.

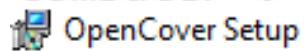
Install for all users of this machine

OpenCover will be installed in a per-machine folder by default and be available for all users. You can change the default installation folder. You must have local Administrator privileges.

Back

Next

Cancel



Destination Folder

Click Next to install to the default folder or click Change to choose another.



Install OpenCover to:

C:\Program Files (x86)\OpenCover\

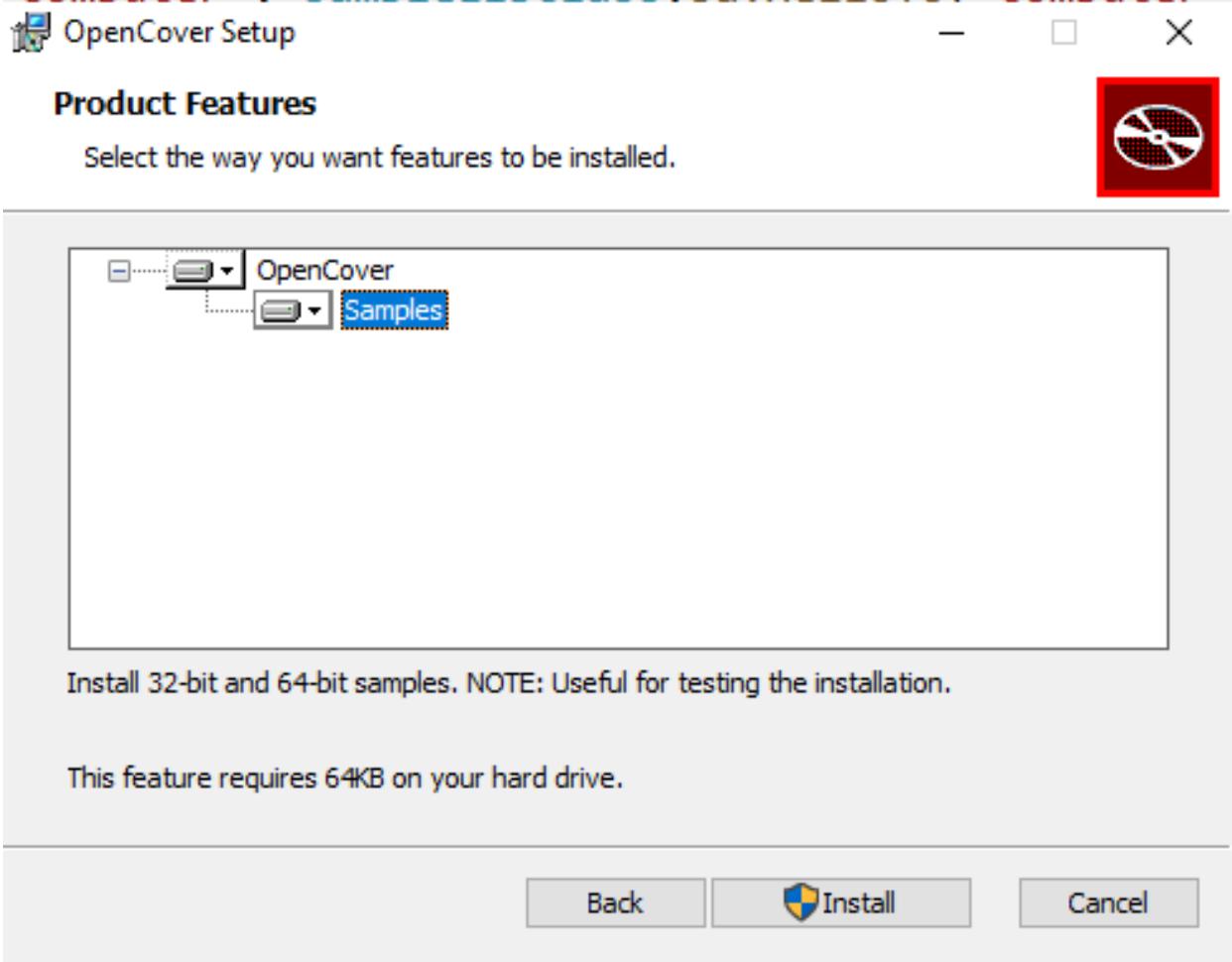
Change...

Back

Next

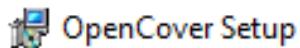
Cancel

Report)-10



Report)-11

0.187.10.33 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner +

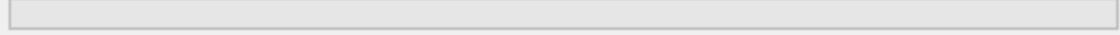


Installing OpenCover



Please wait while the Setup Wizard installs OpenCover.

Status:



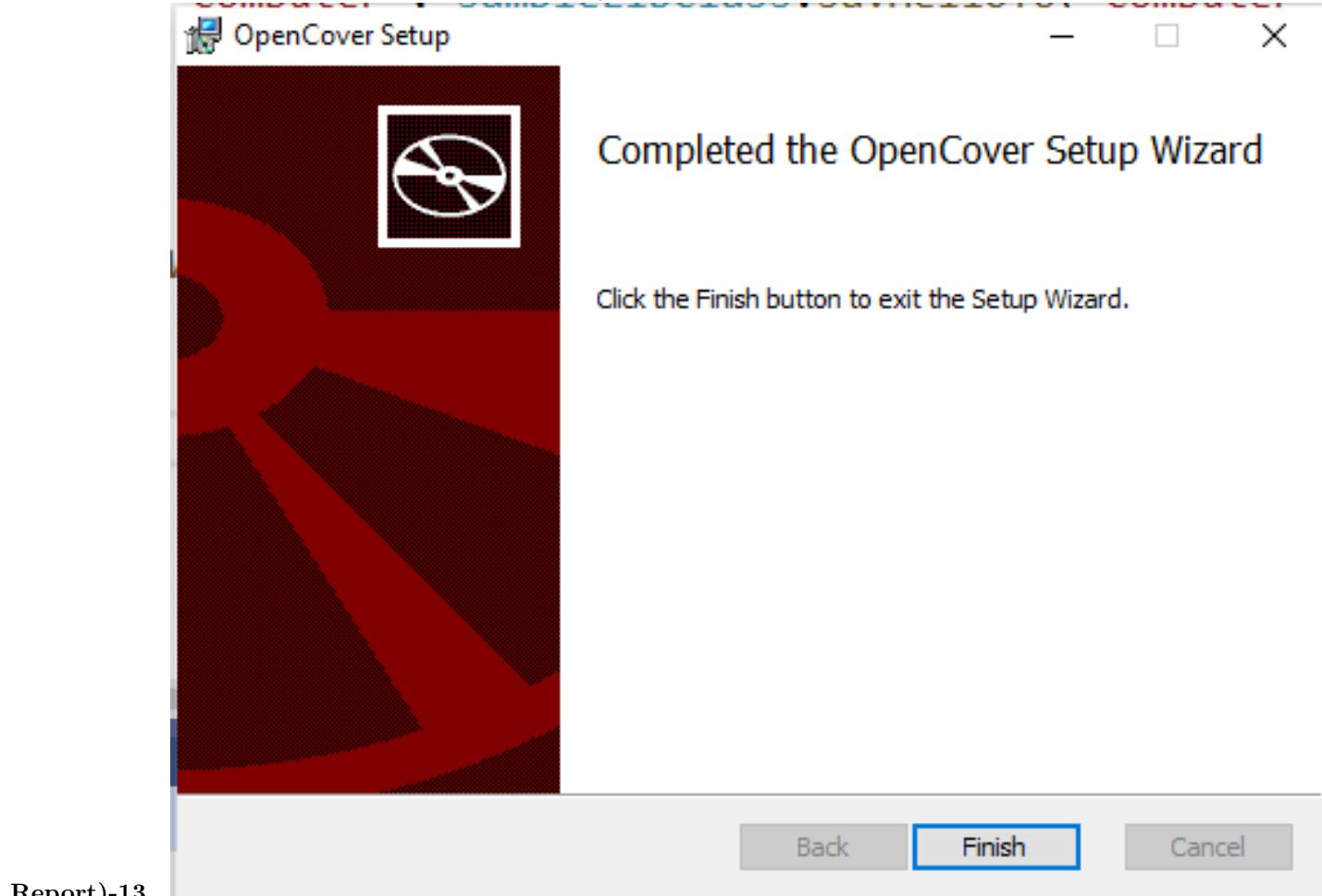
Back

Next

Cancel

Report)-12

0.187.10.34 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner +



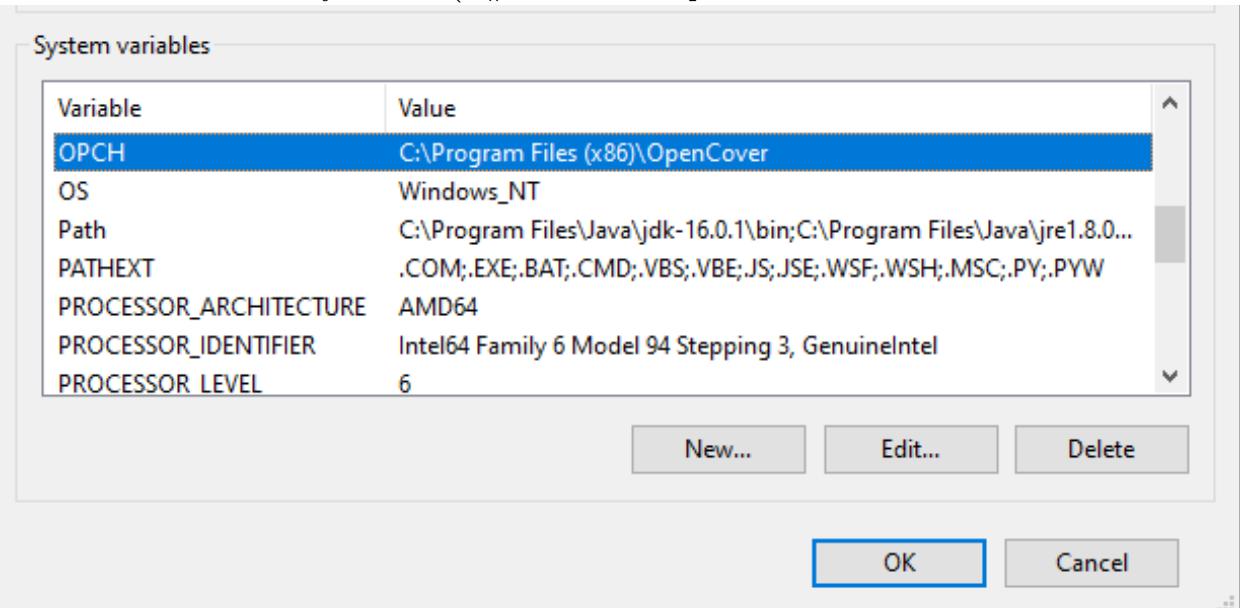
Report)-13

0.187.10.35 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner

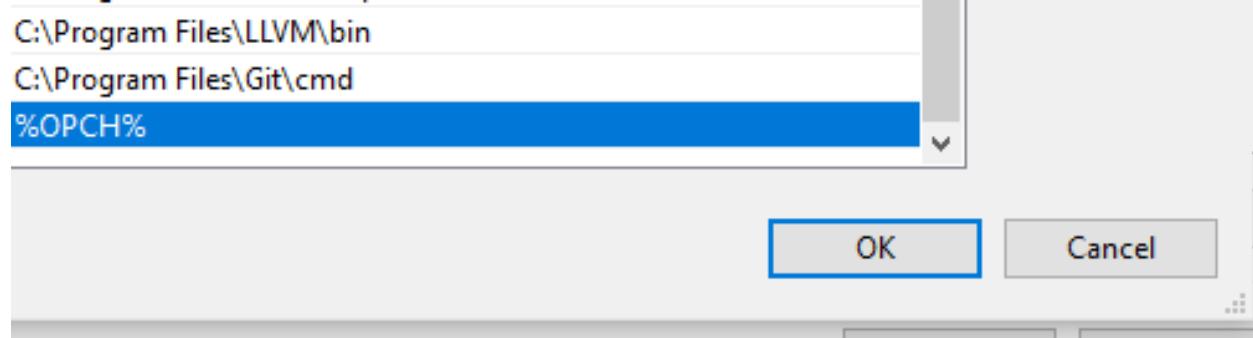
| | | |
|--|------------------------------|----------|
| | Mono.Cecil.Mdb.dll | 9/15/202 |
| | Mono.Cecil.Pdb.dll | 9/15/202 |
| | Mono.Cecil.Rocks.dll | 9/15/202 |
| | Newtonsoft.Json.dll | 11/9/201 |
| | OpenCover.Console.exe | 6/19/202 |
| | OpenCover.Console.exe.config | 6/19/202 |
| | OpenCover.Console.pdb | 6/19/202 |
| | OpenCover.Extensions.dll | 6/19/202 |
| | OpenCover.Extensions.pdb | 6/10/202 |

+ Report)-14

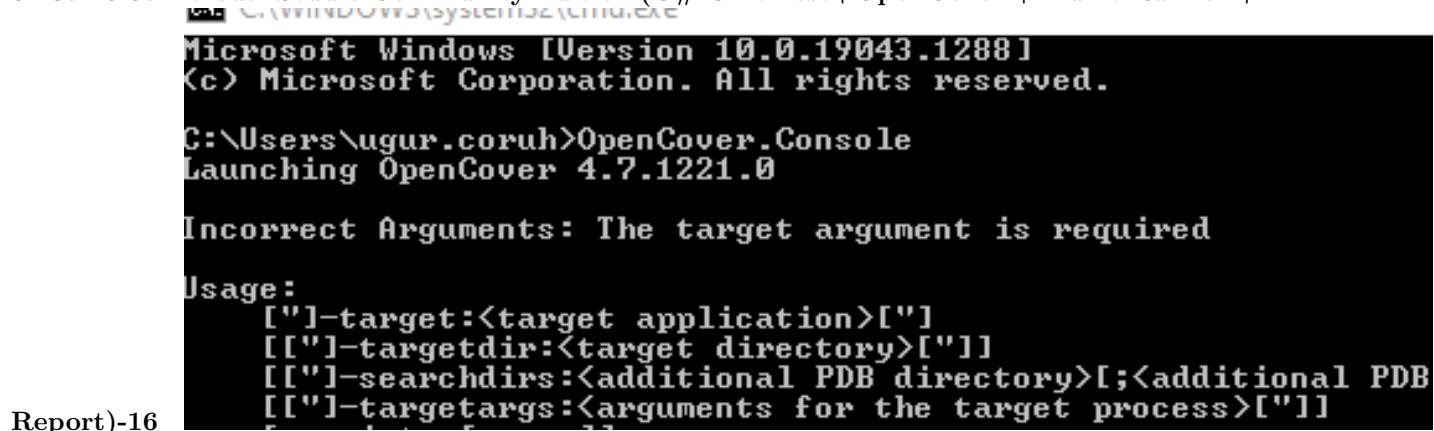
0.187.10.36 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner +



Report)-15



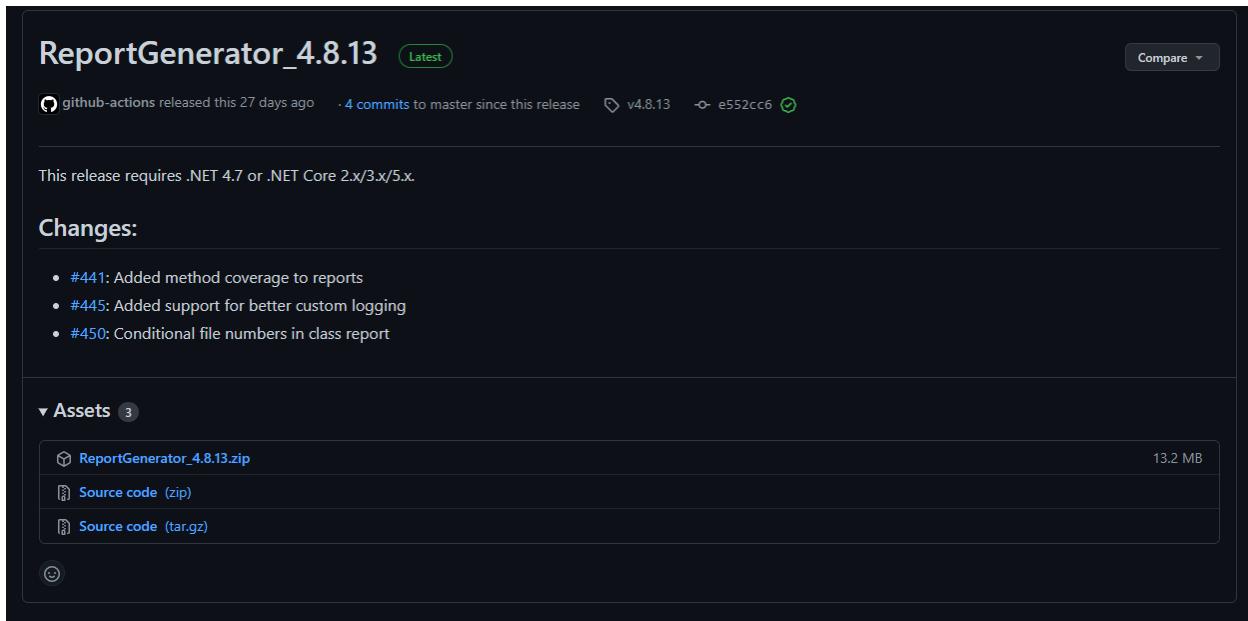
0.187.10.37 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner +



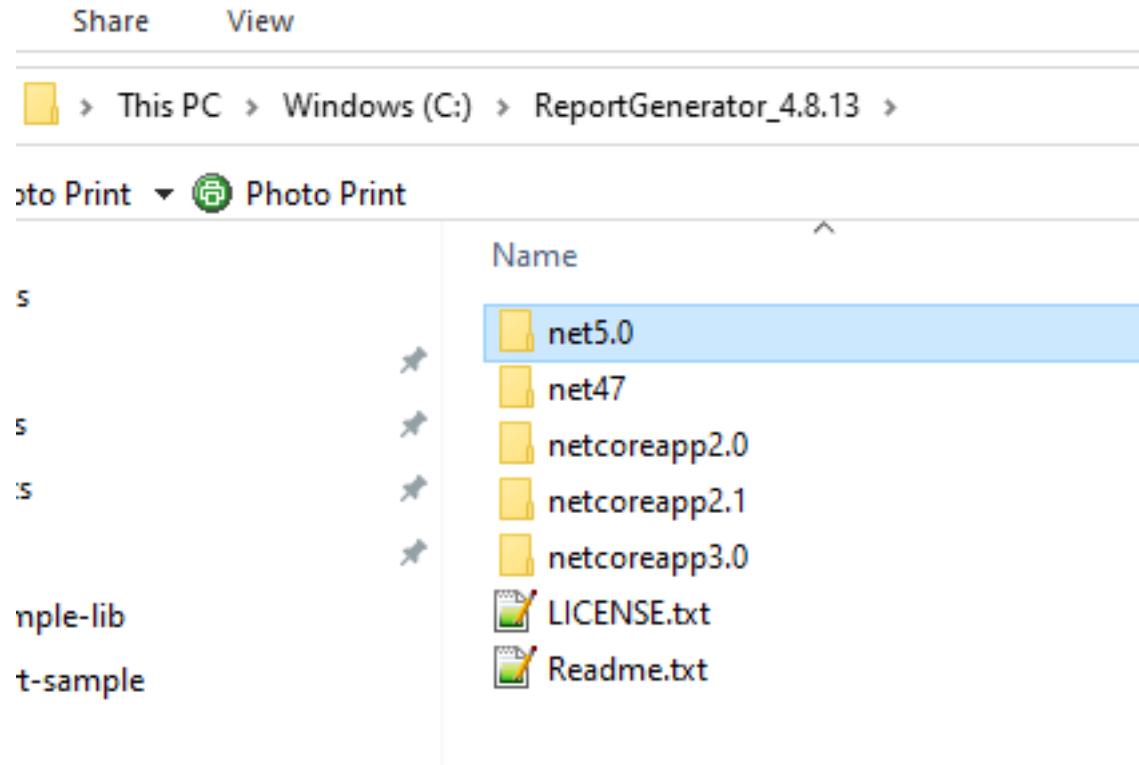
0.187.10.38 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner + Report)-17

0.187.10.38.1 ReportGenerator

- Release ReportGenerator_4.8.13 · danielpalme/ReportGenerator · GitHub²⁰



0.187.10.39 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner +



Report)-18

0.187.10.40 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner + Report)-19

²⁰<https://github.com/danielpalme/ReportGenerator/releases/tag/v4.8.13>

0.187.10.40.1 NUnit Console

- Downloads²¹

The screenshot shows the NUnit download page. At the top, there's a navigation bar with links for News, Download, Documentation, Contact, Twitter, Slack, and GitHub. Below the navigation bar, there's a section titled "Downloads" with a sub-section "Download Types". It says "The preferred way to download NUnit is through the NuGet package manager." and "The latest releases can always be found on the relevant GitHub releases pages." To the right, there are two tables: "Latest NUnit 3 Releases" and "Latest NUnit 2 Release".

| Latest NUnit 3 Releases | |
|-------------------------------------|--------------------|
| NUnit 3.13.2 | April 27, 2021 |
| NUnit Console 3.12 | January 17, 2021 |
| NUnit Test Adapter 3.17 | July 11, 2020 |
| NUnit Test Generator 2.3 | September 20, 2019 |
| NUnit 3 Template for dotnet new CLI | |

| Latest NUnit 2 Release | |
|------------------------|-----------------|
| NUnit 2.7.1 | August 19, 2019 |
| NUnit Test Adapter 2.2 | June 5, 2019 |

Older Releases

These releases are needed by many people for legacy work, so we keep them around for download. Bugs are accepted on older releases only if they can be reproduced on a current release.

0.187.10.41 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner +

The screenshot shows the Visual Studio Marketplace search results for "nunit". On the left, there's a sidebar with a "Assets" section containing 10 items. The items listed are: nunit-console-runner.3.12.0.nupkg, NUnit.Console-3.12.0.msi, NUnit.Console-3.12.0.zip, NUnit.Console.3.12.0.nupkg, NUnit.ConsoleRunner.3.12.0.nupkg, NUnit.Engine.3.12.0.nupkg, NUnit.Engine.Api.3.12.0.nupkg, NUnit.Runners.3.12.0.nupkg, Source code (zip), and Source code (tar.gz). The file sizes for these assets range from 733 KB to 42.8 KB.

Report)-20

²¹<https://nunit.org/download/>

0.187.10.42 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner +

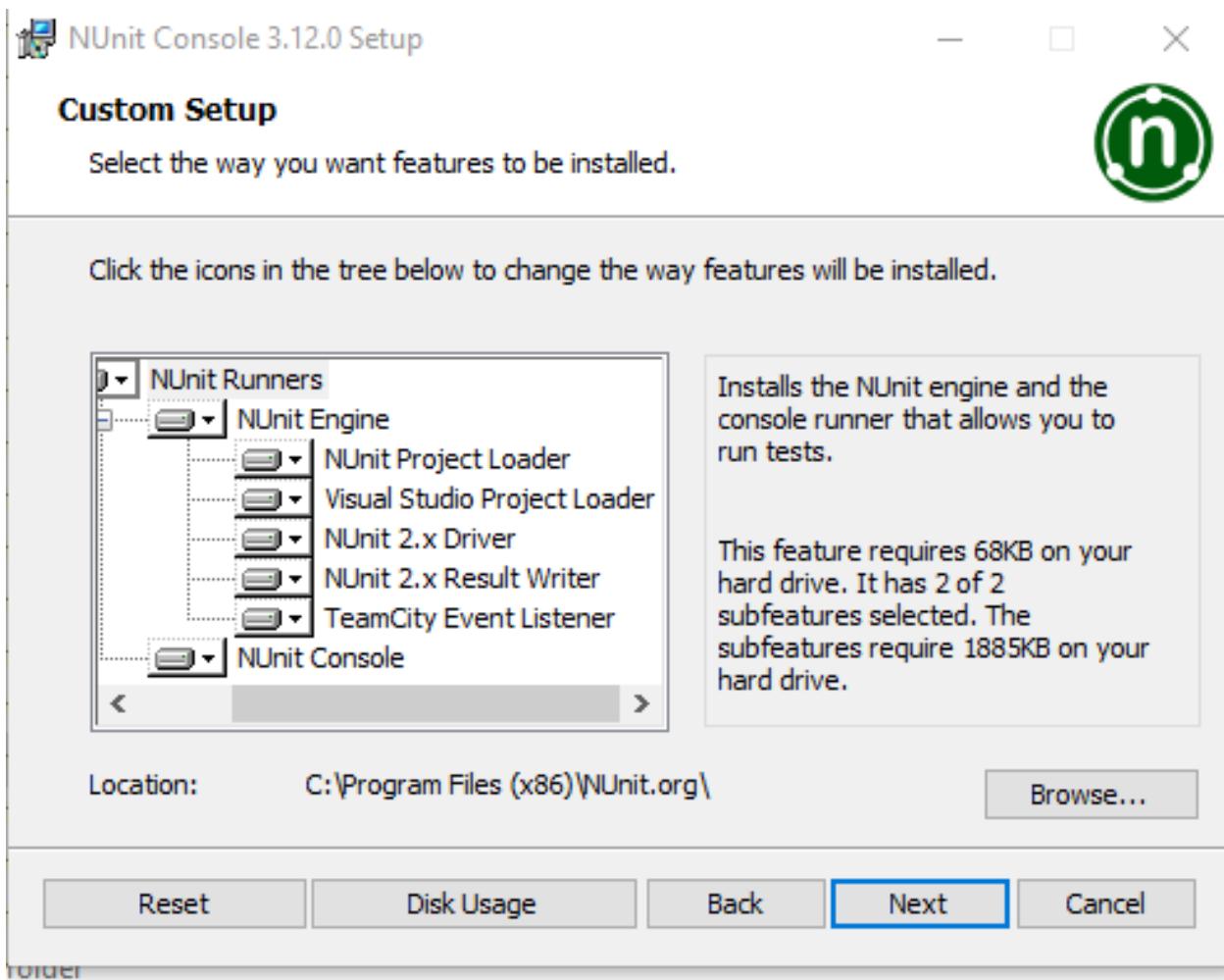
NUnit Console 3.12.0 Setup



Report)-21

0.187.10.43 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner + Report)-22

- Download setup



0.187.10.44 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner + Report)-23

- Install setup

Share View

This PC > Windows (C:) > Program Files (x86) > NUnit.org > nunit-console >

Print Photo Print

| | Name | Date modified | Type | Size |
|--|---------------------------------|---------------------|----------------------|--------|
| | addin | 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 |

0.187.10.45 Visual Studio Community Edition (C# Unit Test+OpenCover + Nunit Runner + Report)-24

0.187.11 NUnit + MSTest Batch Report Generation (Not Tested)

- OpenCover and ReportGenerator Unit Test Coverage in Visual Studio 2013 and 2015 – CodeHelper.Net²²
 - OpenCover and ReportGenerator Unit Test Coverage in Visual Studio 2013 and 2015 - CodeProject²³
-

0.187.12 Java Unit Tests

0.187.12.1 Eclipse IDE (JUnit4 , JUnit5)

0.187.12.2 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test In this sample we will create two example for similar library

Please check the following links

JUnit 5 tutorial - Learn how to write unit tests²⁴

JUnit 5²⁵

JUnit 5 User Guide²⁶

<https://www.eclemma.org/>

JUnit Hello World Example - Examples Java Code Geeks - 2021²⁷

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

0.187.12.3 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test In normal java application we can right click the project java-sample-lib and add Junit case

²²<http://codehelper.net/unit-testing/opencover-and-reportgenerator-unit-test-coverage-in-visual-studio-2013-and-2015/>

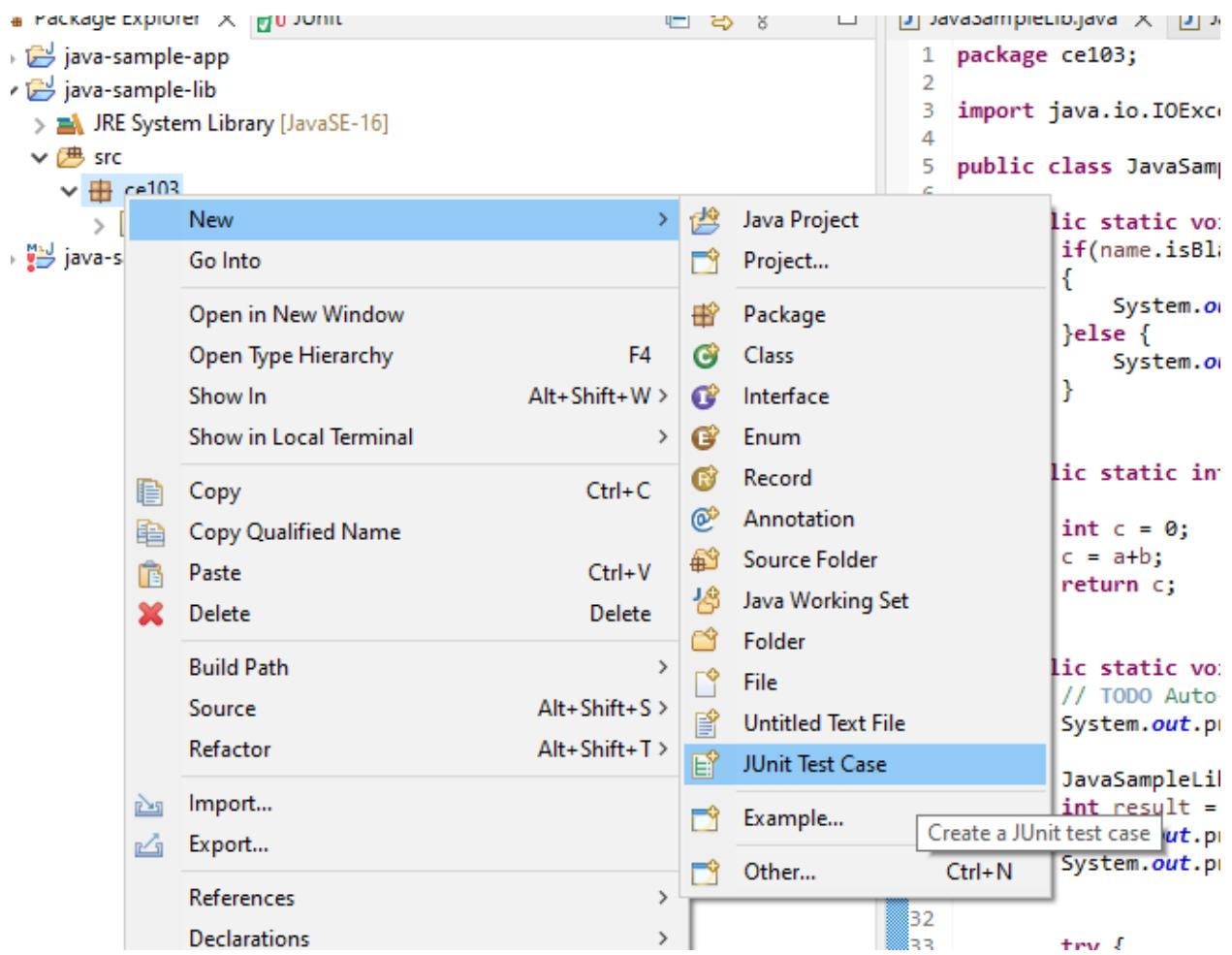
²³<https://www.codeproject.com/Articles/1276980/OpenCover-and-ReportGenerator-Unit-Test-Coverage-i>

²⁴<https://www.vogella.com/tutorials/JUnit/article.html>

²⁵<https://junit.org/junit5/>

²⁶<https://junit.org/junit5/docs/current/user-guide/>

²⁷<https://examples.javacodegeeks.com/core-java/junit/junit-hello-world-example/>



New JUnit Test Case

JUnit Test Case

Select the name of the new JUnit test case. Spec
select methods to be tested on the next page.

New JUnit 3 test New JUnit 4 test New JUnit 5 test

Source folder: `java-sample-lib/src`

Package: `ce103`

Name: `JavaSampleLibTest`

Superclass: `java.lang.Object`

Which method stubs would you like to create?

`@BeforeAll setUpBeforeClass()`

`@BeforeEach setUp()`

constructor

Do you want to add comments? (Configure tem

Generate comments

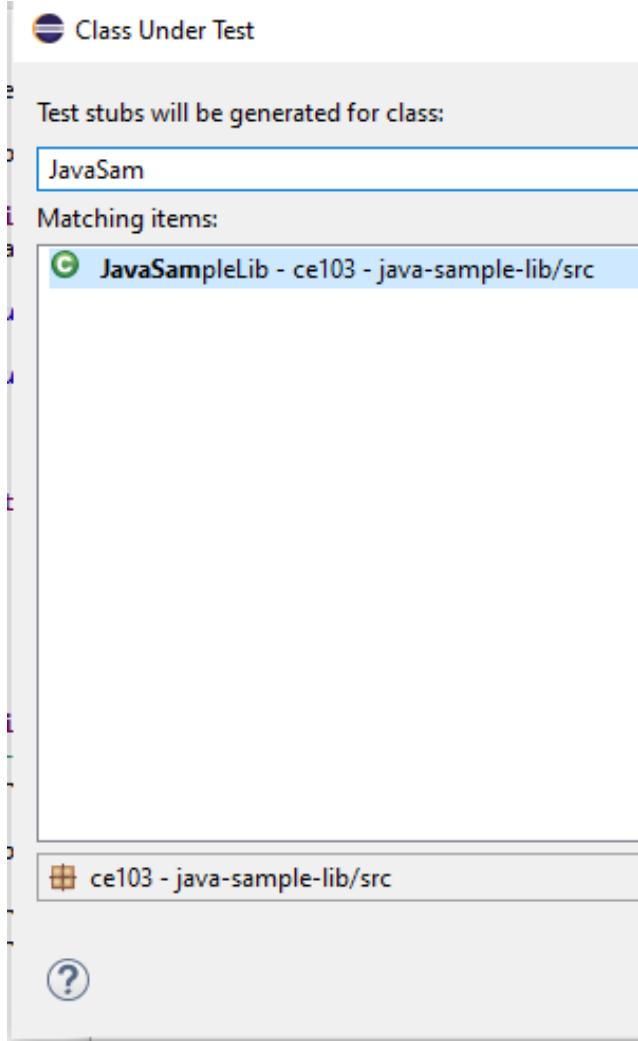
Class under test: `ce103.JavaSampleLib`



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0.187.12.4 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test



0.187.12.5 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test

New JUnit Test Case

Test Methods

Select methods for which test method stubs sh

Available methods:

- ▼  JavaSampleLib
 -  S sayHelloTo(String)
 -  S sum(int, int)
 -  S main(String[])
- ▼  Object
 -  c Object()
 -  NF getClass()
 -  N hashCode()
 -  equals(Object)
 -  N clone()
 -  toString()
 -  NF notify()
 -  NF notifyAll()
 -  F wait()

2 methods selected.

Create final method stubs

Create tasks for generated test methods



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0.187.12.6 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test

New JUnit Test Case



JUnit 5 is not on the build path. Do you

Not now

Open the build path property page

Perform the following action:

Add JUnit 5 library to the build path

0.187.12.7 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test

0.187.12.8 Eclipse IDE (JUnit4, JUnit5) + Java Unit Test

and you will have the following test class

The screenshot shows the Eclipse IDE interface. On the left, the Package Explorer view displays a project structure with 'java-sample-app' and 'java-sample-lib'. 'java-sample-lib' contains a 'src' folder with 'ce103' package, which includes 'JavaSampleLib.java' and 'JavaSampleLibTest.java'. A 'JUnit 5' entry is also visible under 'java-sample-lib'. On the right, the Java code editor shows the content of 'JavaSampleLibTest.java':

```
1 package ce103;
2
3 import static org.junit.jupiter.api.Assertions.*;
4
5 class JavaSampleLibTest {
6
7     @BeforeAll
8     static void setUpBeforeClass() throws Exception {
9         ...
10    }
11
12    @AfterAll
13    static void tearDownAfterClass() throws Exception {
14        ...
15    }
16
17    @BeforeEach
18    void setUp() throws Exception {
19        ...
20    }
21
22    @AfterEach
23    void tearDown() throws Exception {
24        ...
25    }
26
27    @Test
28    void testSum() {
29        assertEquals(5, sum(2, 3));
30        fail("Not yet implemented");
31    }
32
33    @Test
34    void testMain() {
35        assertEquals("Hello World", main());
36        fail("Not yet implemented");
37    }
38
39 }
```

0.187.12.9 Eclipse IDE (JUnit4, JUnit5) + Java Unit Test

Now we will create tests that check our function flowchart and return values

We need to cover all code branches that we coded

I have updated JavaSampleLib.java as follows 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();
    //      }
    //  }

}
```

0.187.12.10 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test and JavaSampleLibTest.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't 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");
    }

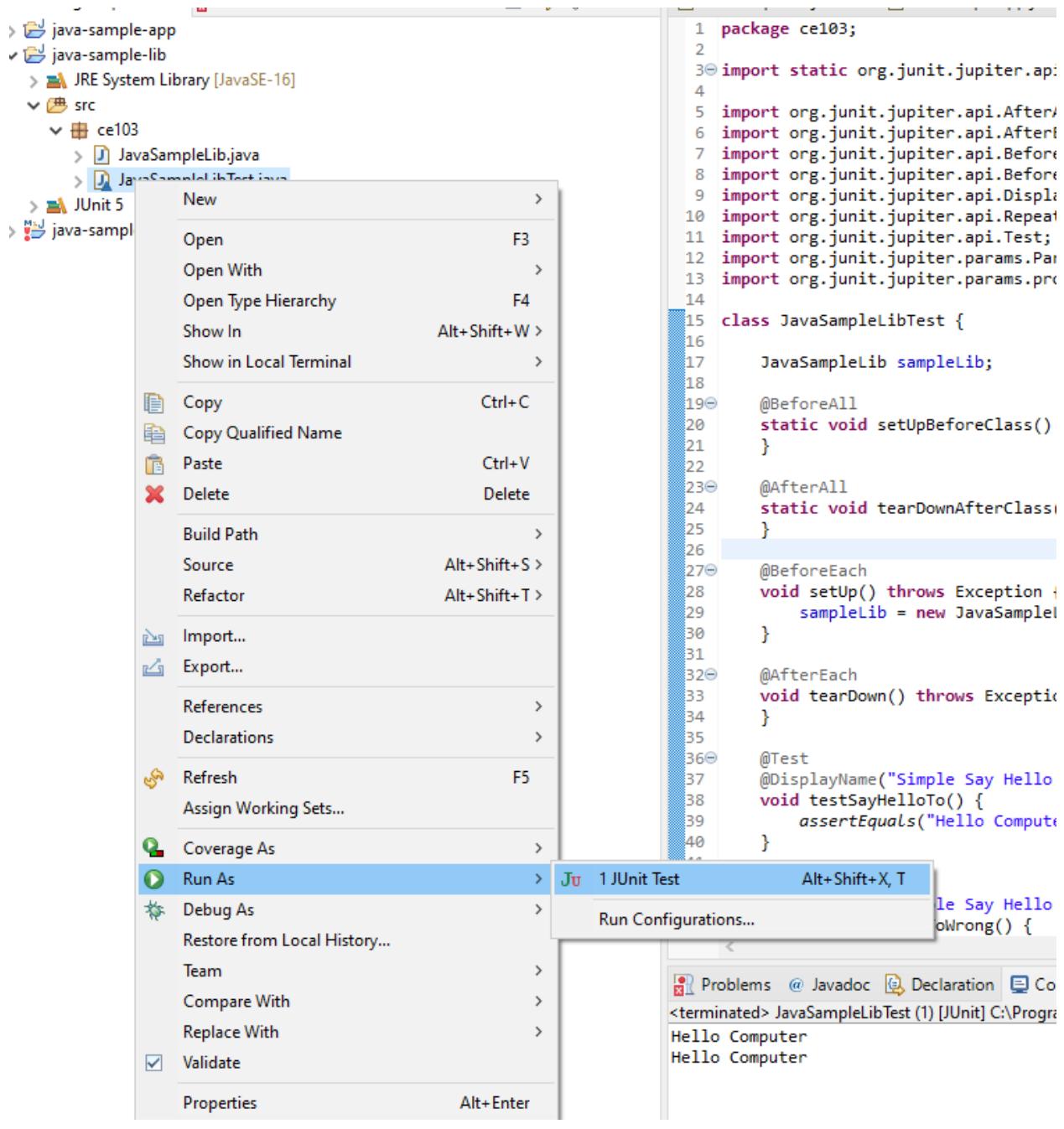
    @RepeatedTest(5)
    @DisplayName("Ensure correct handling of zero")
    void testMultiplyWithZero() {
        assertEquals(0, sampleLib.multiply(0, 5), "Multiple with zero should be zero");
        assertEquals(0, sampleLib.multiply(5, 0), "Multiple with zero should be zero");
    }

    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));
    }
}

```

0.187.12.11 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test if we run tests



0.187.12.12 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test we will see all results there

The screenshot shows the Eclipse IDE interface with the JUnit perspective selected. The top bar includes standard icons for file operations, search, and navigation. Below the toolbar, the 'Package Explorer' and 'JUnit' tabs are visible, with 'JUnit' currently active.

The main area displays the test results:

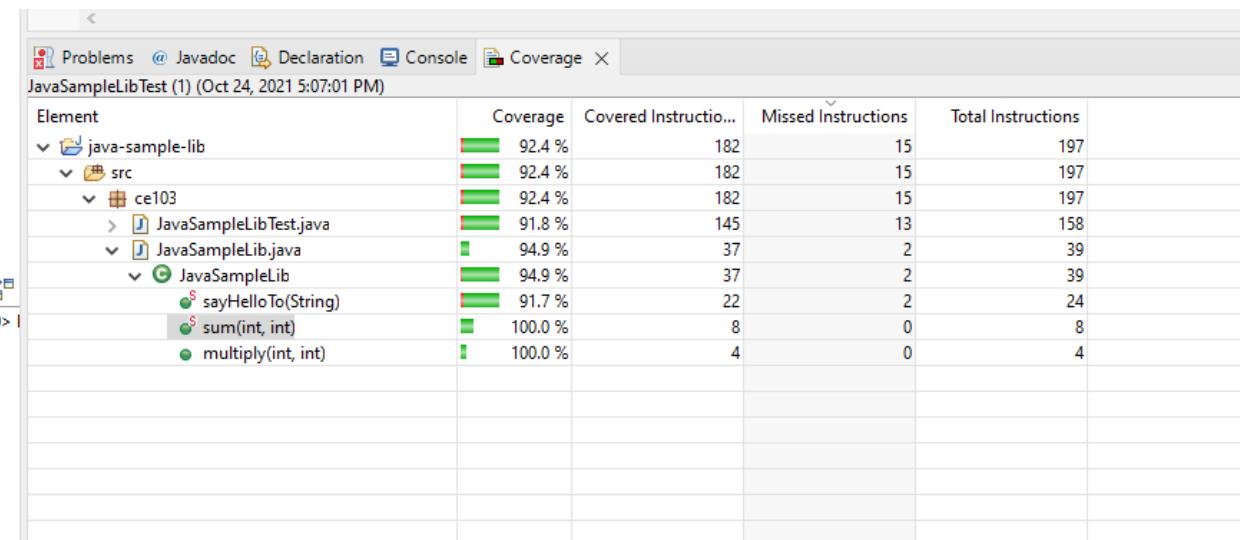
- Finished after 0.451 seconds
- Runs: 14/14
- Errors: 0
- Failures: 3

The test tree shows the following structure:

- JavaSampleLibTest [Runner: JUnit 5] (0.120 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] (0.003 s)
 - [3] [121, 4, 484] (0.002 s)
 - [4] [2, 2, 2] (0.005 s)
 - Simple sum should work (0.001 s)
 - Simple Say Hello shouldn't work (0.004 s)
 - Simple multiplication should work (0.001 s)
 - Simple Say Hello should work (0.001 s)- Ensure correct handling of zero (0.001 s)
 - repetition 1 of 5 (0.001 s)
 - repetition 2 of 5 (0.001 s)
 - repetition 3 of 5 (0.002 s)
 - repetition 4 of 5 (0.002 s)
 - repetition 5 of 5 (0.001 s)

At the bottom left, there is a 'Failure Trace' button, and on the right side, there are three small icons: a magnifying glass, a blue square, and a blue triangle.

0.187.12.13 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test also we can see the code coverage of tests



0.187.12.14 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test 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 }
```

0.187.12.15 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test

0.187.12.16 Maven Java Application + JUnit Lets create Maven project with tests

Create a maven project

File -> New -> Maven Project



Select a wizard

Create a Maven project



Wizards:

type filter text

- Project
- Gradle
- Gradle Project
- Java
 - Java Project
 - Java Project from Existing Ant Buildfile
- Maven
 - Check out Maven Projects from SCM
 - Maven Module
 - Maven Project
- Examples
 - Editing and validating XML files



< Back

Next >

Finish

Cancel



New Maven project

Select project name and location

Create a simple project (skip archetype selection)

Use default Workspace location

Location:

Add project(s) to working set

Working set:

► Advanced



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0.187.12.17 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test

0.187.12.18 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test Lets convert our sample java-sample-lib directories to standard folder structure for test and app division

Maven – Introduction to the Standard Directory Layout²⁸

Also for intro you can use this

JUnit Hello World Example - Examples Java Code Geeks - 2021²⁹

Eclipse

Maven

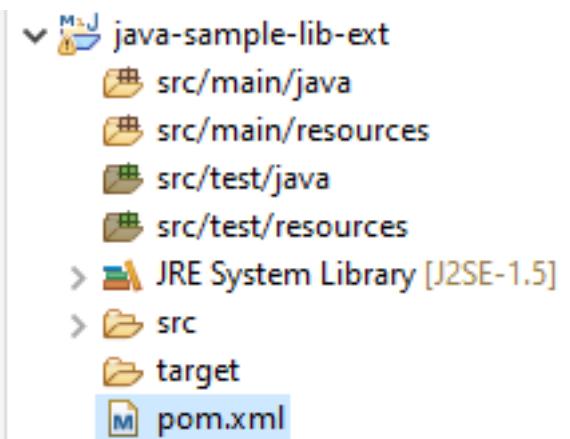
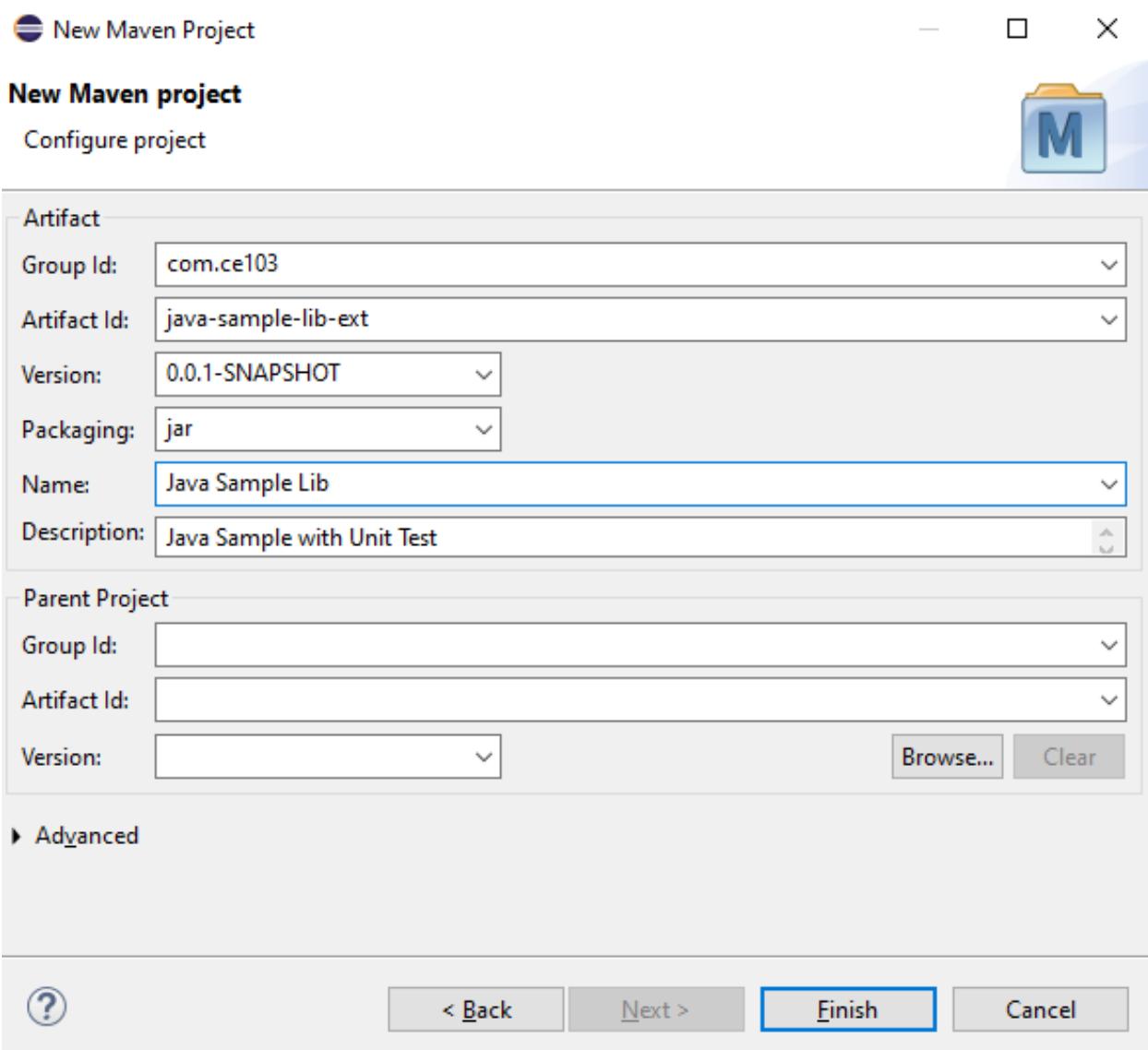
Java

JUnit 4.12 (pulled by Maven automatically)

0.187.12.19 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test Lets give new sample java-sample-lib-mvnbut in this time we will create a maven project

²⁸<http://maven.apache.org/guides/introduction/introduction-to-the-standard-directory-layout.html>

²⁹<https://examples.javacodegeeks.com/core-java/junit/junit-hello-world-example/>



0.187.12.20 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test

0.187.12.21 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test pom.xml file

```
<project xmlns="http://maven.apache.org/POM/4.0.0" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  <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>
```

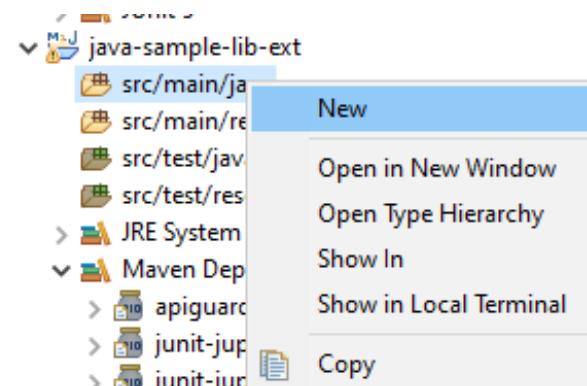
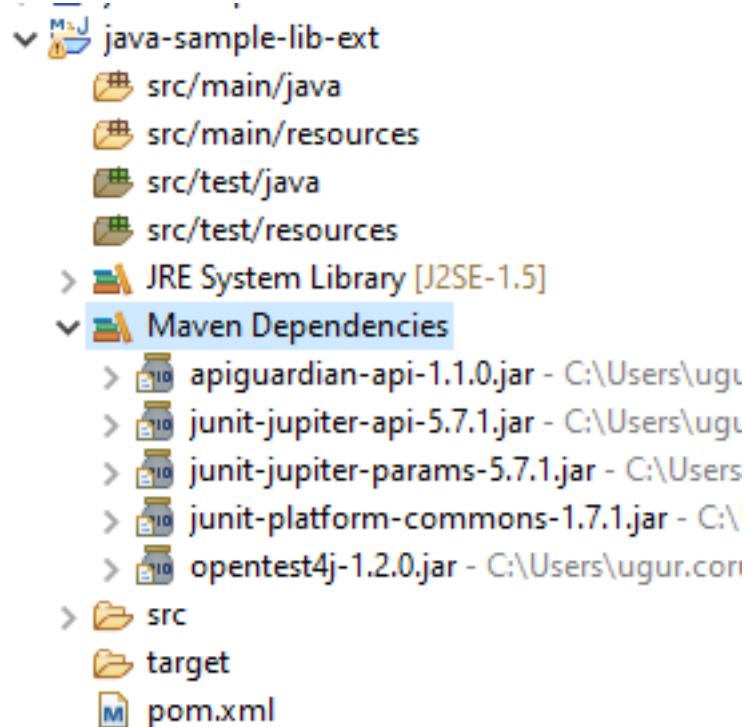
0.187.12.22 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test we will add JUnit 5 for our project

```
<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>

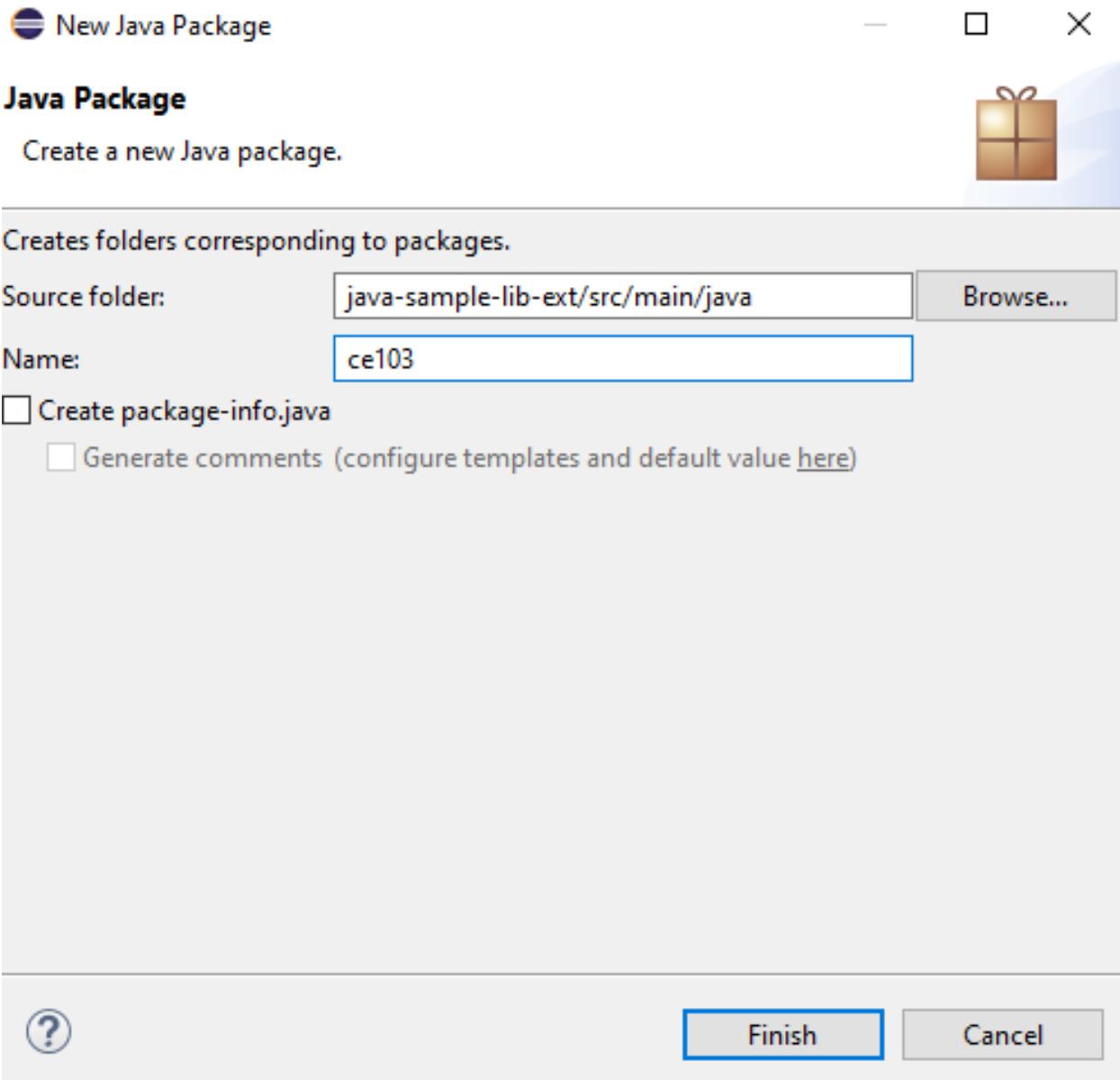
</project>
```

0.187.12.23 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test it will automatically download libraries

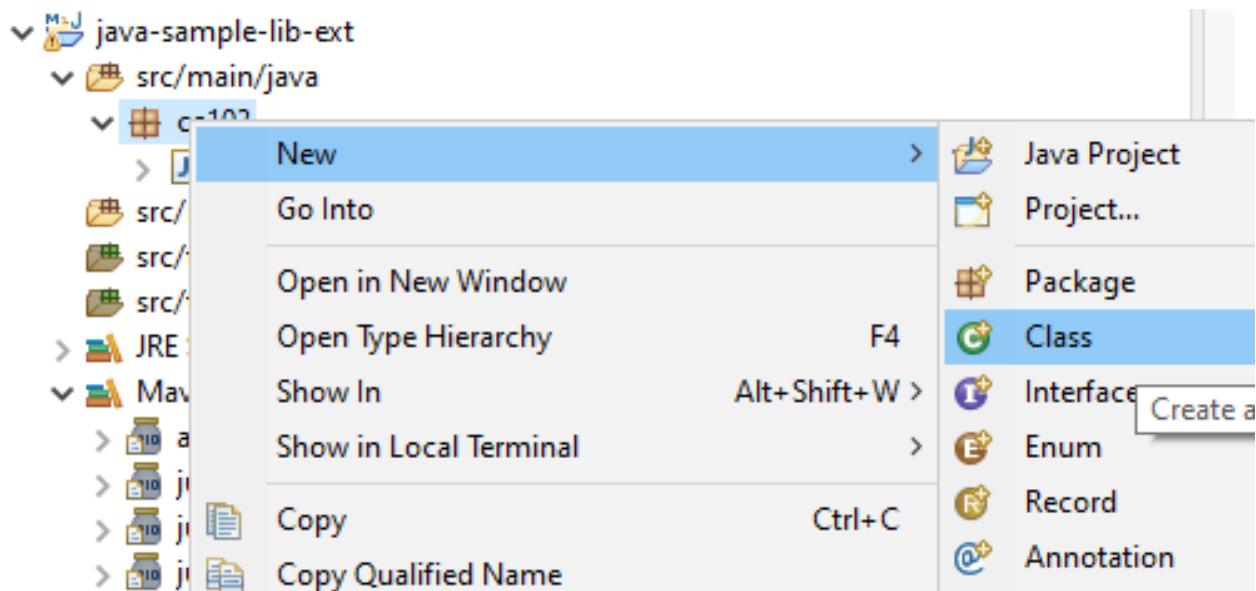


0.187.12.24 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test

0.187.12.25 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test Create java sample library in ce103 package, first create java package



0.187.12.26 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test In this package create library class





Java Class

Create a new Java class.

Source folder:

java-sample-lib-ext/src/main/java

Package:

ce103

Enclosing type:

Name:

JavaSampleLib

Modifiers:

public package

abstract final

Superclass:

java.lang.Object

Interfaces:

Which method stubs would you like to create?

public static void main(S

Constructors from super

Inherited abstract metho

Do you want to add comments? (Configure tem

Generate comments



0.187.12.27 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test

0.187.12.28 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test 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);

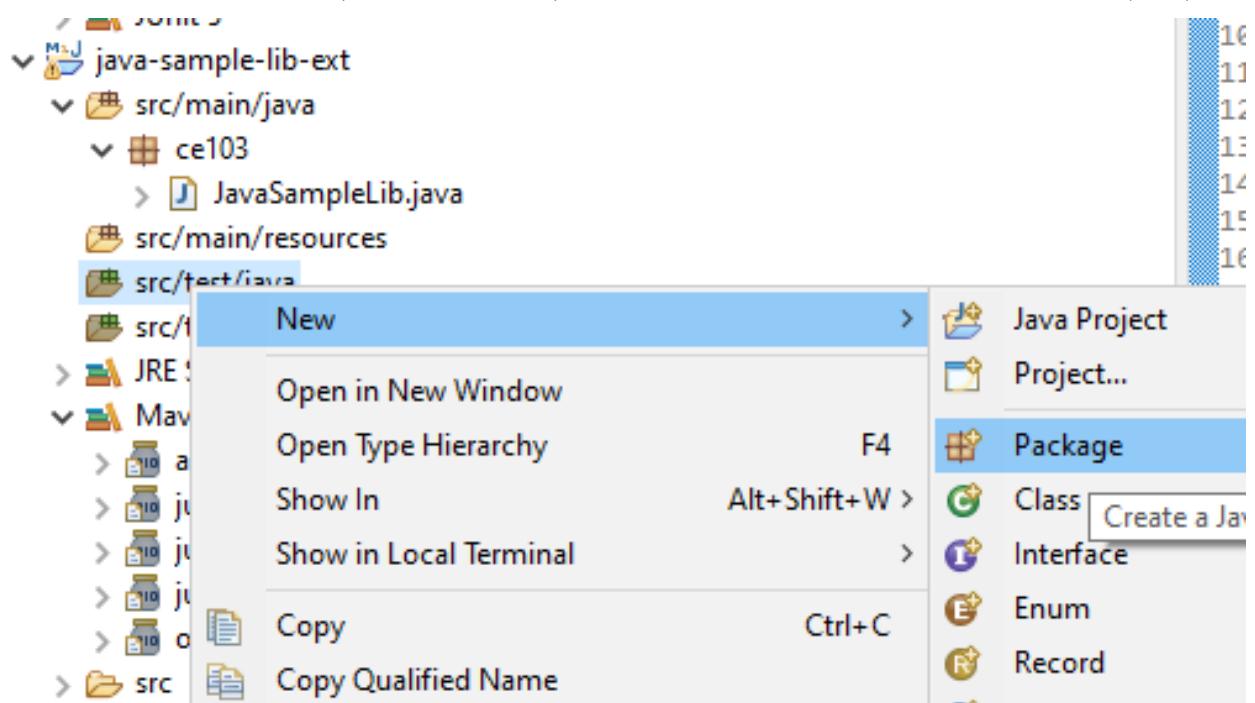
        return output;
    }

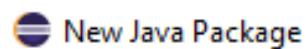
    public static int sum(int a,int b)
    {
        int c = 0;
        c = a+b;
        return c;
    }

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

```

0.187.12.29 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test 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-ex

Name:

ce103

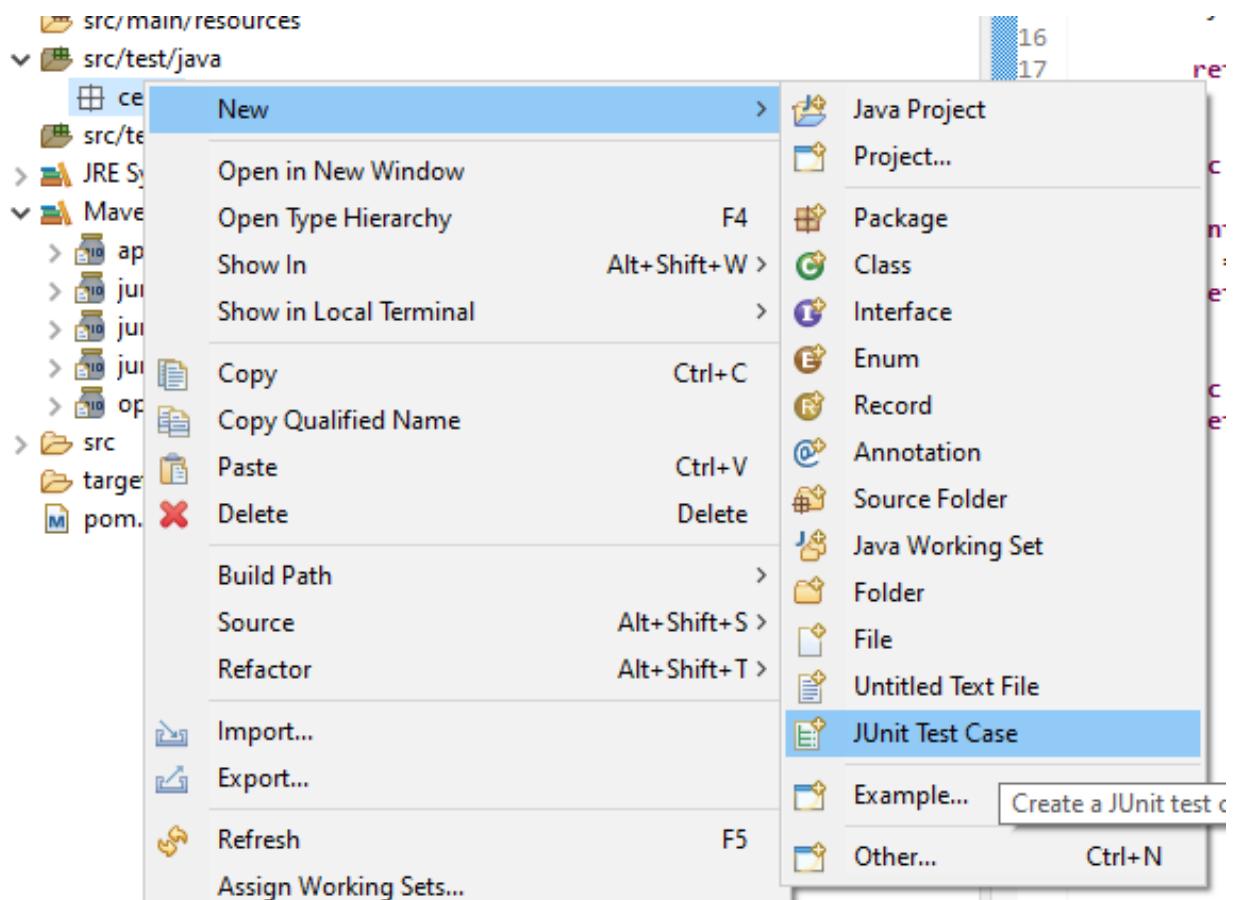
Create package-info.java

Generate comments (configure template)



0.187.12.30 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test

0.187.12.31 Eclipse IDE (JUnit4 , JUnit5) + Java Unit Test create a JUnit Case



New JUnit Test Case

JUnit Test Case

Select the name of the new JUnit test case. Spec
select methods to be tested on the next page.

New JUnit 3 test New JUnit 4 test Ne

Source folder:

Package:

Name:

Superclass:

Which method stubs would you like to create?

@BeforeAll setUpBeforeClas

@BeforeEach setUp()

constructor

Do you want to add comments? (Configure tem

Generate comments

Class under test:

 JUnit 5 requires a Java 8 project. [Configure path](#).



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Nex

0.187.12.32 Eclipse IDE (JUnit4, JUnit5) + Java Unit Test

New JUnit Test Case

Test Methods

Select methods for which test method stubs s

Available methods:

- ▼ **C JavaSampleLib**
 - S sayHelloTo(String)**
 - S sum(int, int)**
 - M multiply(int, int)**
- ▼ **C Object**
 - C Object()**
 - NF getClass()**
 - N hashCode()**
 - M equals(Object)**
 - N clone()**
 - M toString()**
 - NF notify()**
 - NF notifyAll()**
 - F wait()**
 - NF wait(long)**

3 methods selected.

Create final method stubs

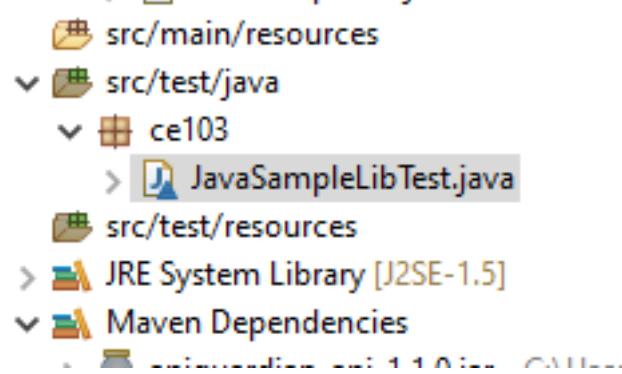
Create tasks for generated test methods



< Back

Next >

0.187.12.33 Eclipse IDE (JUnit4, JUnit5) + Java Unit Test



0.187.12.34 Eclipse IDE (JUnit4, JUnit5) + Java Unit Test

0.187.12.35 Eclipse IDE (JUnit4, JUnit5) + Java Unit Test 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");
    }

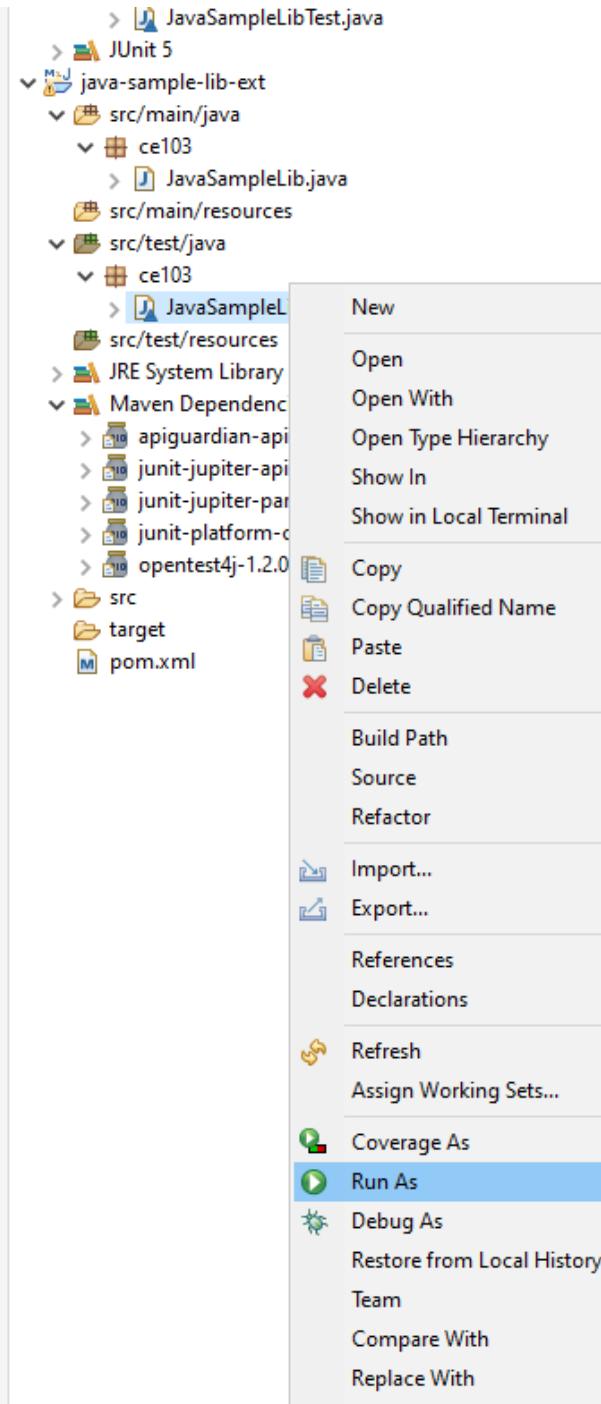
    @Test
    void testSum() {
        fail("Not yet implemented");
    }

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

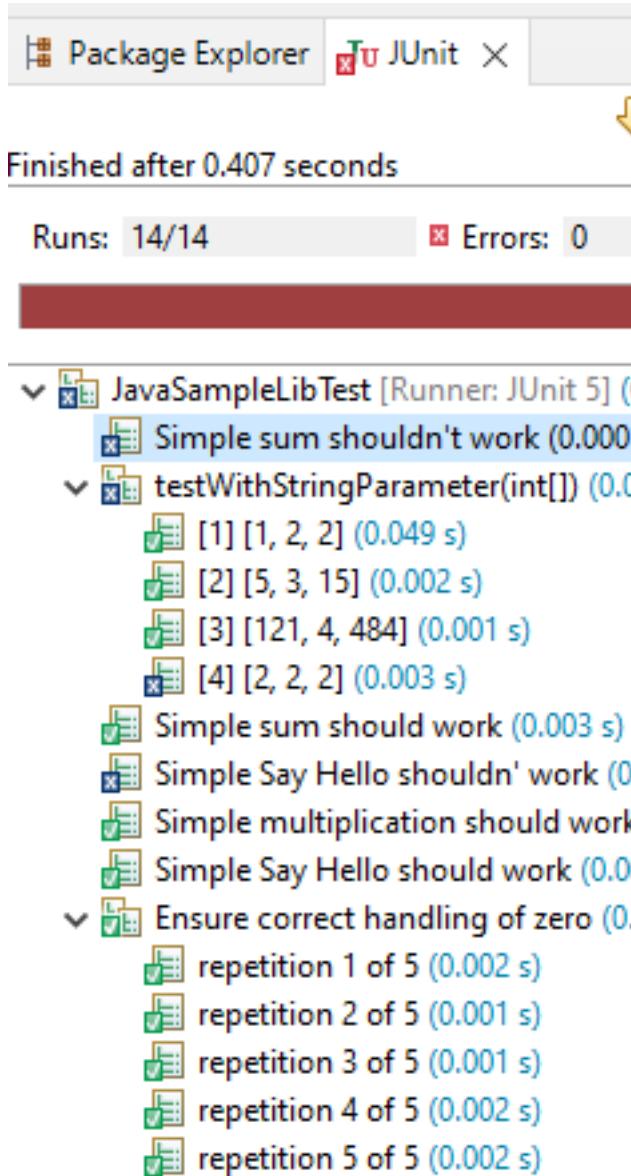
```
 }  
 }
```

0.187.12.36 Eclipse IDE (JUnit4, JUnit5) + Java Unit Test now lets copy tests from other projects

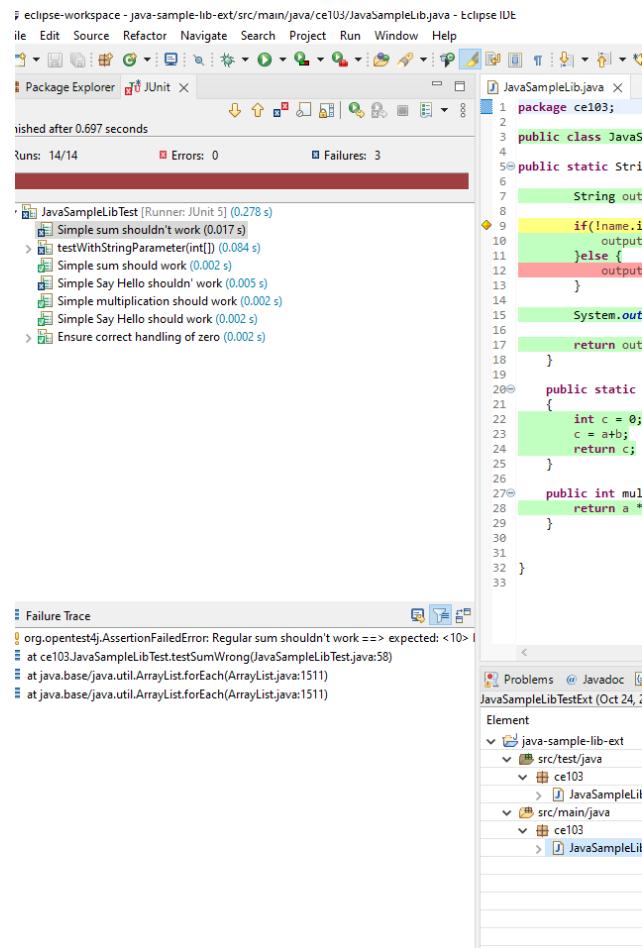
Convert source codes to java codes...



0.187.12.37 Eclipse IDE (JUnit4, JUnit5) + Java Unit Test



0.187.12.38 Eclipse IDE (JUnit4, JUnit5) + Java Unit Test



0.187.12.39 Eclipse IDE (JUnit4, JUnit5) + Java Unit Test

0.187.12.40 Eclipse IDE (JUnit4, JUnit5) + Java Unit Test That's a part of java unit testing...

0.188 TDD (Test Driven Development)

- Test Driven Development (TDD)
 - https://en.wikipedia.org/wiki/Test-driven_development
 - Acceptance Test Driven Development (ATDD)
 - https://en.wikipedia.org/wiki/Acceptance_test-driven_development
 - Also check out
 - https://en.wikipedia.org/wiki/Kent_Beck
 - Extreme Programming
 - https://en.wikipedia.org/wiki/Extreme_programming
 - Software Design Patterns
 - https://en.wikipedia.org/wiki/Software_design_pattern
-

0.189 Test and Deployment Automation Management

There are several Continues-Integration services online as follow; - Travis-CI - Appveyor - Jenkins - CircleCI - GitLab - Pantheon - GitHub - Bitrise - Flosum - Buddy - Semaphore

0.190 Test and Deployment Automation Management

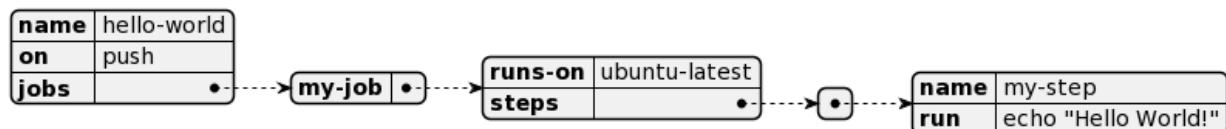
- Github provides Github Actions for Releases and Tests
- Jenkins has on promise solutions private development

0.191 Test and Deployment Automation Management

- GitHub Actions provide several actions and marketspace
 - <https://github.com/marketplace/actions/build-c-project>
- Also, we Can Provide Our Custom Actions

```
name: hello-world
on: push
jobs:
  my-job:
    runs-on: ubuntu-latest
    steps:
      - name: my-step
        run: echo "Hello World!"
```

0.192 Test and Deployment Automation Management

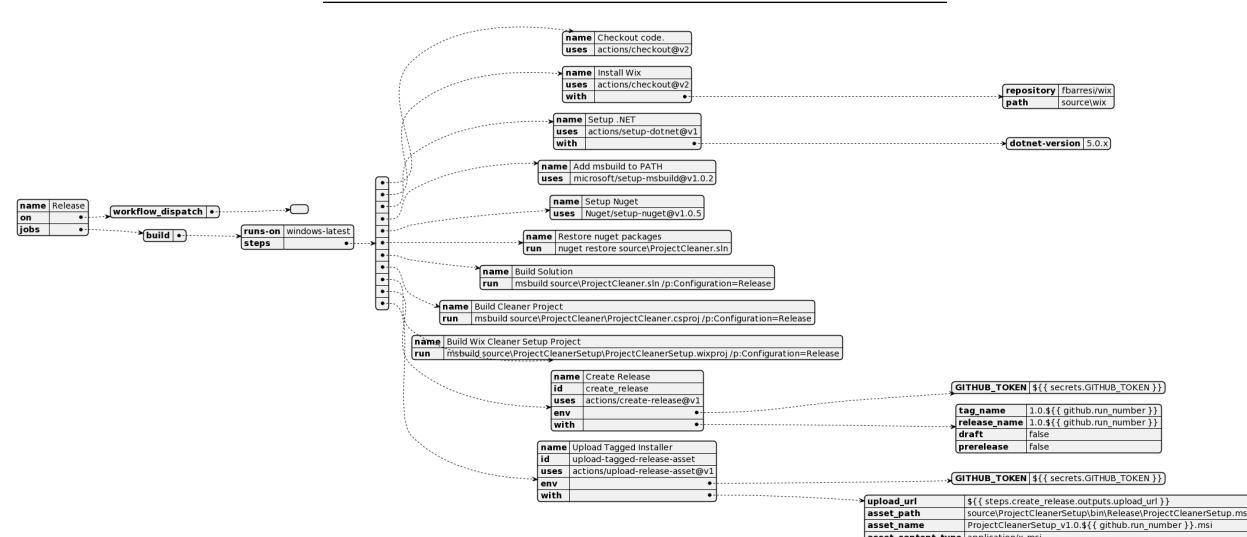


0.193 Test and Deployment Automation Management

- <https://github.com/ucoruh/project-cleaner/blob/main/.github/workflows/dotnet-desktop.yml>

This action build c# application and generates setup manually.

- Also there is a nice web example
 - <https://dev.to/geromegrignon/github-actions-full-ci-cd-javascript-workflow-39om>



1 References

GitHub - MicrosoftDocs/cpp-docs: C++ Documentation³⁰

End – Of – Week – 4

³⁰<https://github.com/MicrosoftDocs/cpp-docs>