Multiple Files Compilation

If We Want to Write a Program with our Linked List

```
int main()
{
    List l;

    l.insertHead(123);
    l.insertHead(11);
    l.insertHead(9);
    l.insertHead(1);
    l.insertHead(20);

    for (int i = 0; i < 5; i++) {
        cout << "The current list is: ";
        l.print();
    }

    return 0;

}
```

Where should we put this?

One Big .cpp File?

CPP

Code for Linked List

```
class ListNode {
private:
   int item;
   ListNode *next;
…
}
….
```

Code for the main function

```
int main() {


}
```

If We Lump Every Code into ONE SINGLE File

- Microsoft Windows operating system has roughly **50 million lines** of code.
- The file is too large to
  - load/save
  - be understood
  - search for errors
- One single file cannot be shared/distributed if you have more than one programmer

Project Sizes in University

- Course assignment

- Course project/FYP

Project Size at Work

Breaking Into Multiple Files

- Logically, we can break our code into various files based on their functionality

LinkedList.cpp

Code for Linked List

```
class ListNode {
private:
  int item;
  ListNode *next;
…
}
….
```

main.cpp

Code for the main function

```
int main() {


}
```

However

- Then the main.cpp will be

```
int main()
{
    List l;

    l.insertHead(123);
    l.insertHead(11);
    l.insertHead(9);
    l.insertHead(1);
    l.insertHead(20);

    for (int i = 0; i < 5; i++) {
        cout << "The current list is: ";
        l.print();
    }

    return 0;

}
```

main.cpp

Compilation ERROR!!!

Because “List” is not declared

- We can put the declaration of “List” into main.cpp without the body or implementation of “List”
- But then we have to copy the declaration to every file if “List” is used?

```
class ListNode
{
private:
    int _item;
    ListNode *_next;

public:
    ListNode(int);
    int content() { return _item; };
    friend class List;
};

int main()
{
    List l;

    l.insertHead(123);
    l.insertHead(11);
    l.insertHead(9);
    l.insertHead(1);
    l.insertHead(20);

    for (int i = 0; i < 5; i++) {
        cout << "The current list is: ";
        l.print();
    }

    return 0;

}
```

main.cpp

Header File

- We separate the code for Linked List into two files
  - ".h file", the declaration of all classes and functions
  - ".cpp file", function bodies and implementations

LinkedList.h

```
class ListNode
{
private:
    int _item;
    ListNode *_next;
public:
    ListNode(int);
  // etc. et.c
};

class List
{
private:
    int _size;
    ListNode *_head;

public:
    List()
     ~List();
    void insertHead(int);
  // etc. etc.
};
```

LinkedList.cpp

```
ListNode::ListNode(int n)
{
    _item = n;
    _next = NULL;
}

void List::insertHead(int n)
{
    ListNode *aNewNode
       = new ListNode(n);
    aNewNode->_next = _head;
    _head = aNewNode;
    _size++;
};

// etc. etc….
```

#include

- But then
  - Compilation error because no declaration of List/ListNode
- Use #include to “paste” the whole file of “LinkedList.h” into the .cpp file

LinkedList.cpp

```
#include “LinkedList.h”

ListNode::ListNode(int n)
{
    _item = n;
    _next = NULL;
}

void List::insertHead(int n)
{
    ListNode *aNewNode
       = new ListNode(n);
    aNewNode->_next = _head;
    _head = aNewNode;
    _size++;
};

// etc. etc….
```

However, What if?

file1.h

```
class Whatever {
.
.
}
```

file2.h

```
#include “file1.h”
```

file3.h

```
#include “file1.h”
#include “file2.h”
```

file1.cpp

```
#include “file1.h”
```

file2.cpp

```
#include “file2.h”
```

file3.cpp

```
#include “file3.h”
```

Included “file1.h” more than one time?!
Cause ERROR because class Whatever is declared twice here

#pragma once

file1.h

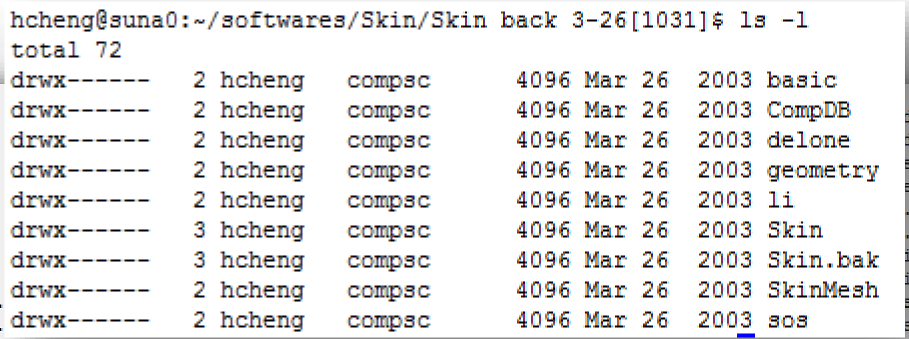
```
#pragma once

class Whatever {
.
}
```

file1.cpp

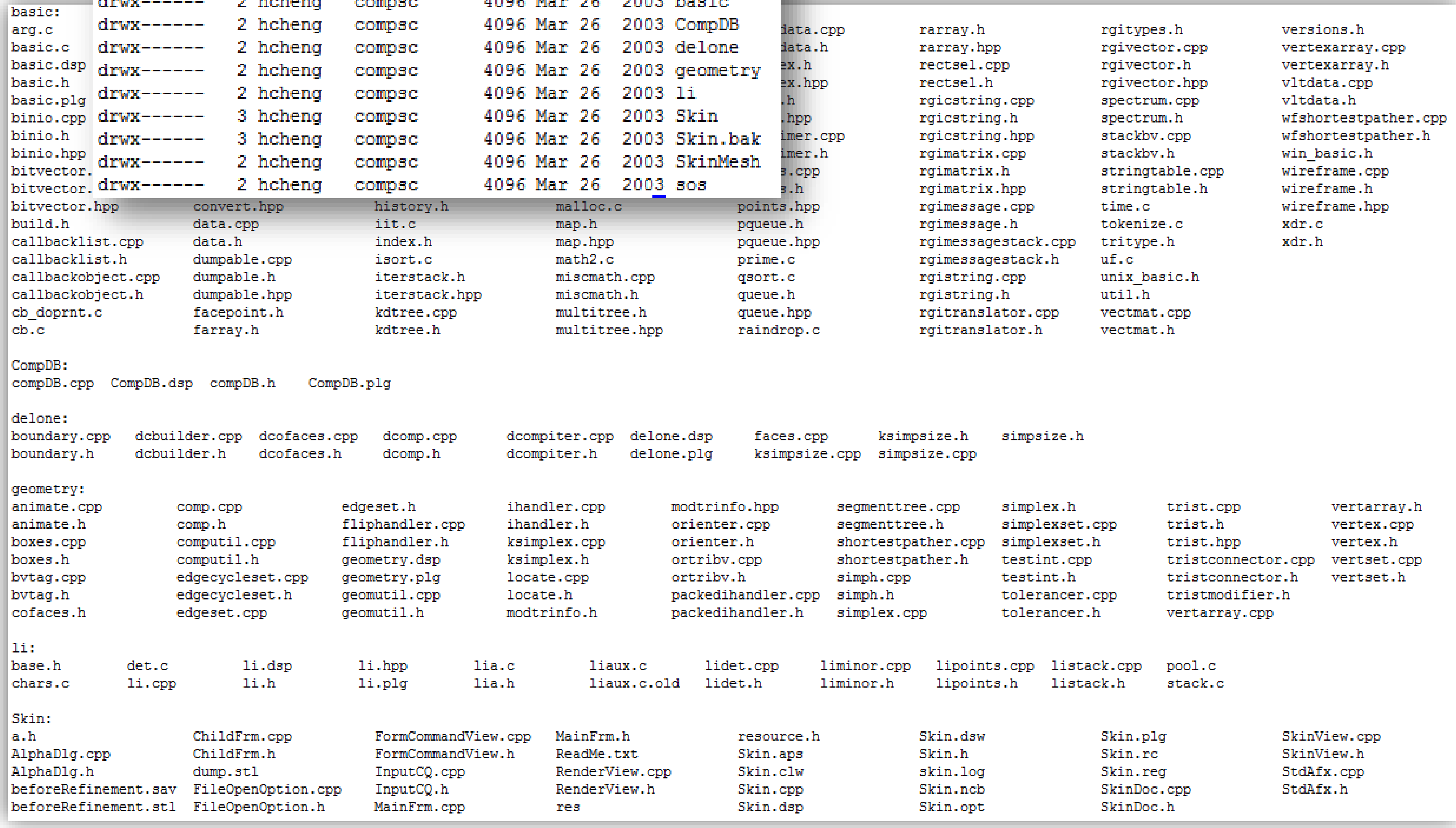
```
 #include “file1.h”
```

- use “#pragma once” to make sure the file will appear only once even it is included a few times

Alan’s Ph.D Code



```
hcheng@suna0:~/softwares/Skin/Skin back 3-26[1031]$ ls -l
total 72
drwx------   2 hcheng   compsc      4096 Mar 26  2003 basic
drwx------   2 hcheng   compsc      4096 Mar 26  2003 CompDB
drwx------   2 hcheng   compsc      4096 Mar 26  2003 delone
drwx------   2 hcheng   compsc      4096 Mar 26  2003 geometry
drwx------   2 hcheng   compsc      4096 Mar 26  2003 li
drwx------   3 hcheng   compsc      4096 Mar 26  2003 Skin
drwx------   3 hcheng   compsc      4096 Mar 26  2003 Skin.bak
drwx------   2 hcheng   compsc      4096 Mar 26  2003 SkinMesh
drwx------   2 hcheng   compsc      4096 Mar 26  2003 sos
```



```
basic:
arg.c                                                                                        data.cpp         rarray.h              rgitypes.h            versions.h
basic.c                                                                                      data.h           rarray.hpp            rgivector.cpp         vertexarray.cpp
basic.dsp                                                                                    ex.h             rectsel.cpp           rgivector.h           vertexarray.h
basic.h                                                                                      ex.hpp           rectsel.h             rgivector.hpp         vltdata.cpp
basic.plg                                                                                    .h               rgicstring.cpp        spectrum.cpp          vltdata.h
binio.cpp                                                                                    .hpp             rgicstring.h          spectrum.h            wfshortestpather.cpp
binio.h                                                                                      imer.cpp         rgicstring.hpp        stackbv.cpp           wfshortestpather.h
binio.hpp                                                                                    imer.h           rgimatrix.cpp         stackbv.h             win_basic.h
bitvector.                                                                                   s.cpp            rgimatrix.h           stringtable.cpp       wireframe.cpp
bitvector.                                                                                   s.h              rgimatrix.hpp         stringtable.h         wireframe.h
bitvector.hpp         convert.hpp           history.h             malloc.c              points.hpp            rgimessage.cpp        time.c                wireframe.hpp
build.h               data.cpp              iit.c                 map.h                 pqueue.h              rgimessage.h          tokenize.c            xdr.c
callbacklist.cpp      data.h                index.h               map.hpp               pqueue.hpp            rgimessagestack.cpp   tritype.h             xdr.h
callbacklist.h        dumpable.cpp          isort.c               math2.c               prime.c               rgimessagestack.h     uf.c
callbackobject.cpp    dumpable.h            iterstack.h           miscmath.cpp          qsort.c               rgistring.cpp         unix_basic.h
callbackobject.h      dumpable.hpp          iterstack.hpp         miscmath.h            queue.h               rgistring.h           util.h
cb_doprnt.c           facepoint.h           kdtree.cpp            multitree.h           queue.hpp             rgitranslator.cpp     vectmat.cpp
cb.c                  farray.h              kdtree.h              multitree.hpp         raindrop.c            rgitranslator.h       vectmat.h

CompDB:
compDB.cpp  CompDB.dsp  compDB.h    CompDB.plg

delone:
boundary.cpp   dcbuilder.cpp  dcofaces.cpp   dcomp.cpp      dcompiter.cpp  delone.dsp     faces.cpp      ksimpsize.h    simpsize.h
boundary.h     dcbuilder.h    dcofaces.h     dcomp.h        dcompiter.h    delone.plg     ksimpsize.cpp  simpsize.cpp

geometry:
animate.cpp         comp.cpp            edgeset.h           ihandler.cpp        modtrinfo.hpp       segmenttree.cpp     simplex.h           trist.cpp           vertarray.h
animate.h           comp.h              fliphandler.cpp     ihandler.h          orienter.cpp        segmenttree.h       simplexset.cpp      trist.h             vertex.cpp
boxes.cpp           computil.cpp        fliphandler.h       ksimplex.cpp        orienter.h          shortestpather.cpp  simplexset.h        trist.hpp           vertex.h
boxes.h             computil.h          geometry.dsp        ksimplex.h          ortribv.cpp         shortestpather.h    testint.cpp         tristconnector.cpp  vertset.cpp
bvtag.cpp           edgecycleset.cpp    geometry.plg        locate.cpp          ortribv.h           simph.cpp           testint.h           tristconnector.h    vertset.h
bvtag.h             edgecycleset.h      geomutil.cpp        locate.h            packedihandler.cpp  simph.h             tolerancer.cpp      tristmodifier.h
cofaces.h           edgeset.cpp         geomutil.h          modtrinfo.h         packedihandler.h    simplex.cpp         tolerancer.h        vertarray.cpp

li:
base.h        det.c         li.dsp        li.hpp        lia.c         liaux.c       lidet.cpp     liminor.cpp   lipoints.cpp  listack.cpp   pool.c
chars.c       li.cpp        li.h          li.plg        lia.h         liaux.c.old   lidet.h       liminor.h     lipoints.h    listack.h     stack.c

Skin:
a.h                   ChildFrm.cpp          FormCommandView.cpp   MainFrm.h             resource.h            Skin.dsw              Skin.plg              SkinView.cpp
AlphaDlg.cpp          ChildFrm.h            FormCommandView.h     ReadMe.txt            Skin.aps              Skin.h                Skin.rc               SkinView.h
AlphaDlg.h            dump.stl              InputCQ.cpp           RenderView.cpp        Skin.clw              skin.log              Skin.reg              StdAfx.cpp
beforeRefinement.sav  FileOpenOption.cpp    InputCQ.h             RenderView.h          Skin.cpp              Skin.ncb              SkinDoc.cpp           StdAfx.h
beforeRefinement.stl  FileOpenOption.h      MainFrm.cpp           res                   Skin.dsp              Skin.opt              SkinDoc.h
```

How to Compile Multiple Files?

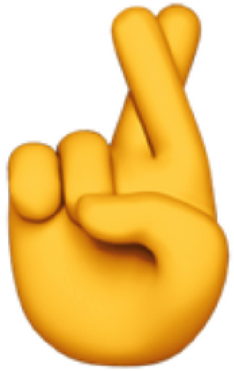
- E.g. we have
  - LinkedList.h
  - LinkedList.cpp
  - main.cpp
- in **VSCode**, you can simply change to the directory contains the files in the terminal and type:

```
g++ LinkedList.cpp main.cpp
```

- Noted that you don't need to add in ".h"

Exectuables

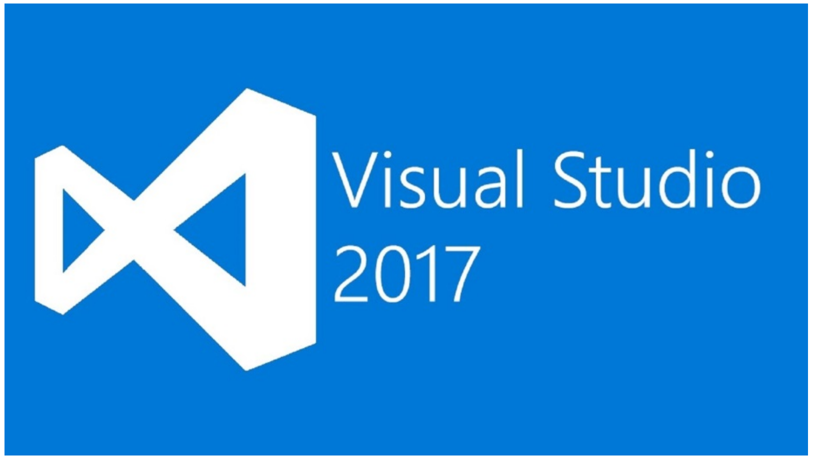
- If there is not error, the executable will be “a.exe” in the same directory. Just type “a.exe” to run the program
- You can rename “a.exe” to another name or simply give it a name, e.g. “myProg.exe” when it compiles by option “-o”



```
g++ LinkedList.cpp main.cpp -o myProg.exe
```

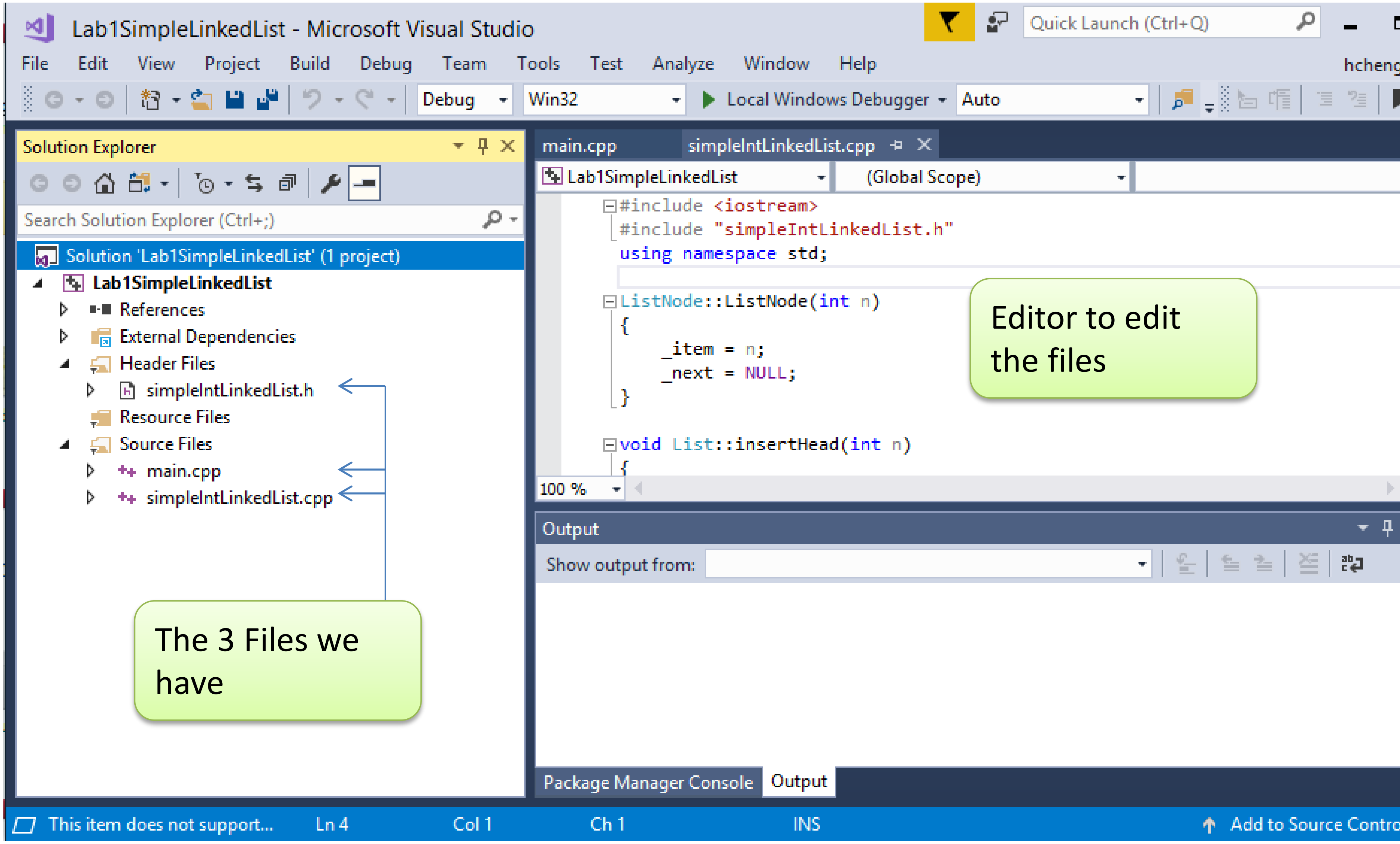
Using MS Studio

- In MSVS C++ Studio, you can create a "**solution**"(project) to compile multiple files
- But for our assignments, we will created the .sln file for you



Try Our Assignment One

- Download assignment from coursemology and unzip it
- Find the .sln file inside and double click it

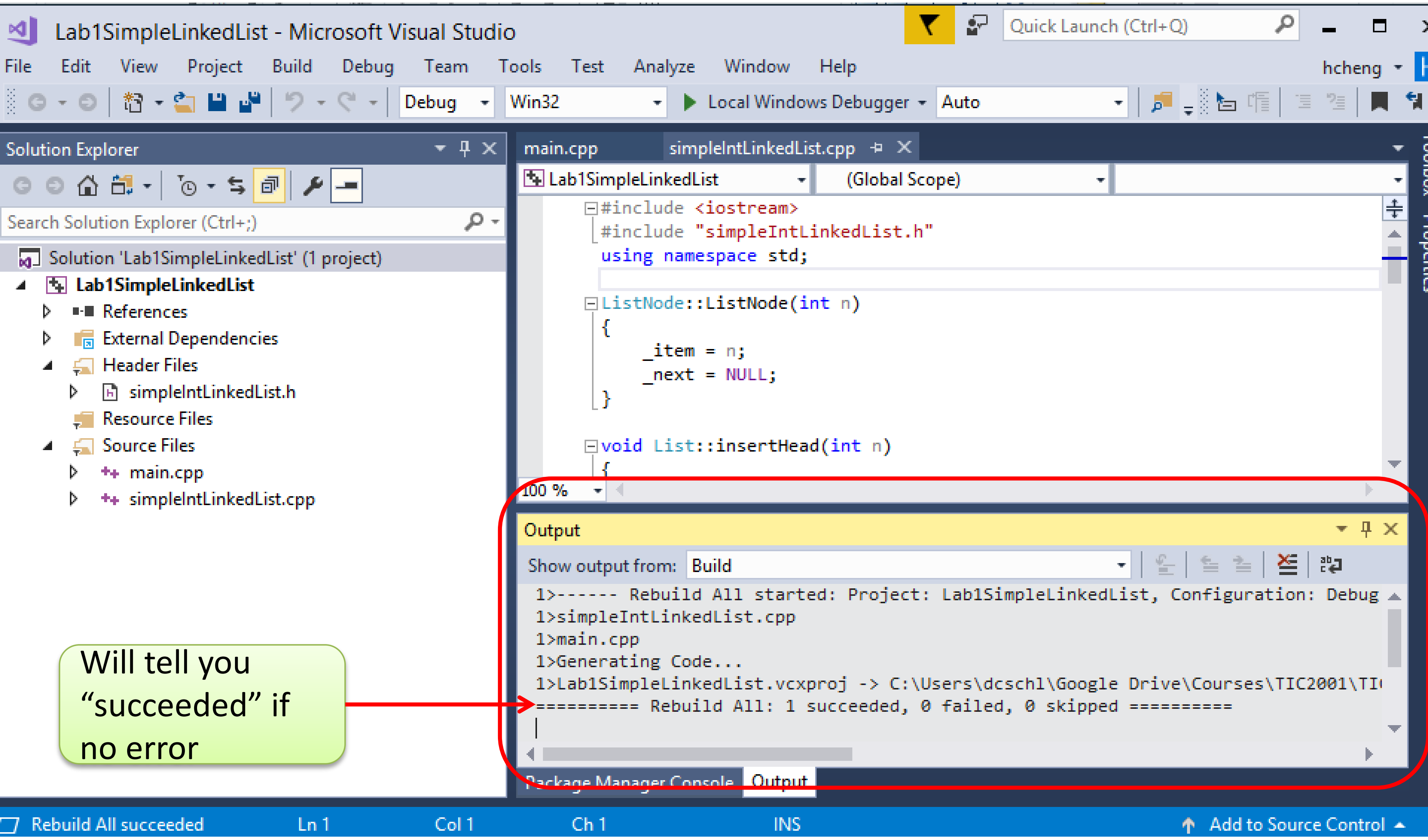


```
#include <iostream>
#include "simpleIntLinkedList.h"
using namespace std;

ListNode::ListNode(int n)
{
        _item = n;
        _next = NULL;
}

void List::insertHead(int n)
{
```

Editor to edit the files

The 3 Files we have

If You Compile (Build) by “F7”



```cpp
#include <iostream>
#include "simpleIntLinkedList.h"
using namespace std;

ListNode::ListNode(int n)
{
    _item = n;
    _next = NULL;
}

void List::insertHead(int n)
{
```

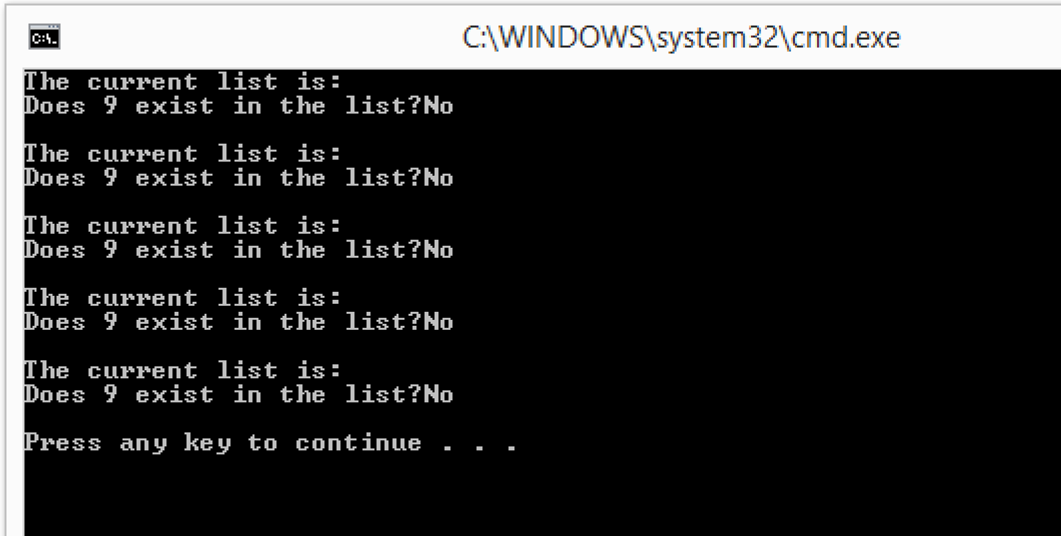
Show output from: Build

```
1>------ Rebuild All started: Project: Lab1SimpleLinkedList, Configuration: Debug
1>simpleIntLinkedList.cpp
1>main.cpp
1>Generating Code...
1>Lab1SimpleLinkedList.vcxproj -> C:\Users\dcschl\Google Drive\Courses\TIC2001\TI
========== Rebuild All: 1 succeeded, 0 failed, 0 skipped ==========
```

Will tell you “succeeded” if no error

Compile and Run

- To Compile your code
  - Build > Build Solution
- To run your code
  - Debug > Start Without Debugging
  - Or simply press "ctrl-F5"
- Example Output:



```
The current list is:
Does 9 exist in the list?No

The current list is:
Does 9 exist in the list?No

The current list is:
Does 9 exist in the list?No

The current list is:
Does 9 exist in the list?No

The current list is:
Does 9 exist in the list?No

Press any key to continue . . .
```

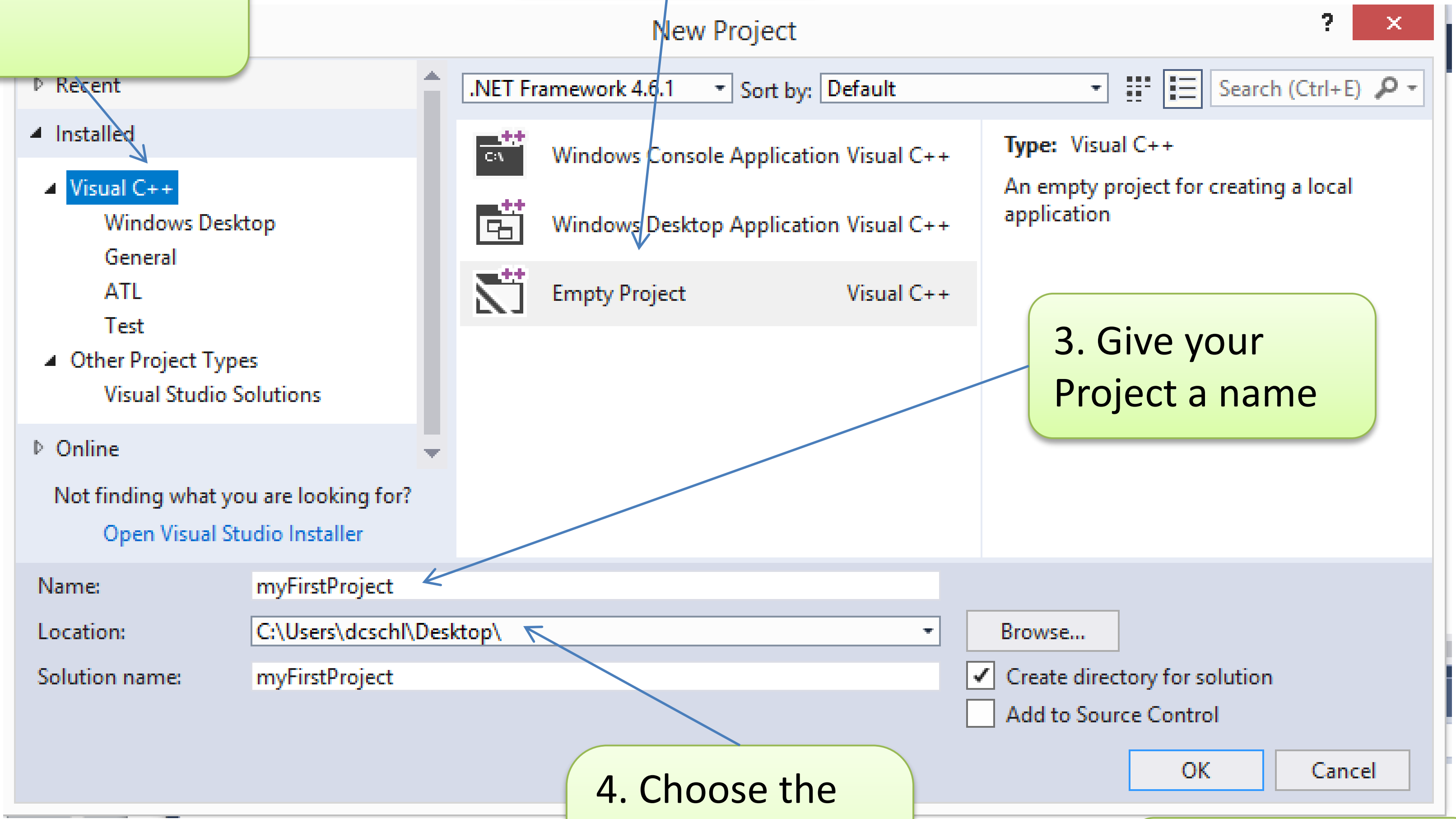
Creating a "Solution" in MSVS

- But if you want to create your own project
  - In which you shouldn't need to do it for our assignments
- You can create a solution by
  - File > New > Project
  - Or simply "Ctrl-shift-N"

To Crea mple WS

1. Click Visual C++

2. Select “Empty Project”



New Project

- Recent
- Installed
  - Visual C++
    - Windows Desktop
    - General
    - ATL
    - Test
  - Other Project Types
    - Visual Studio Solutions
- Online

Not finding what you are looking for?
Open Visual Studio Installer

.NET Framework 4.6.1 | Sort by: Default | Search (Ctrl+E)

Windows Console Application	Visual C++
Windows Desktop Application	Visual C++
Empty Project	Visual C++

Type: Visual C++
An empty project for creating a local application

Name: myFirstProject
Location: C:\Users\dcschl\Desktop\
Solution name: myFirstProject

Browse...
[✓] Create directory for solution
[ ] Add to Source Control

OK | Cancel

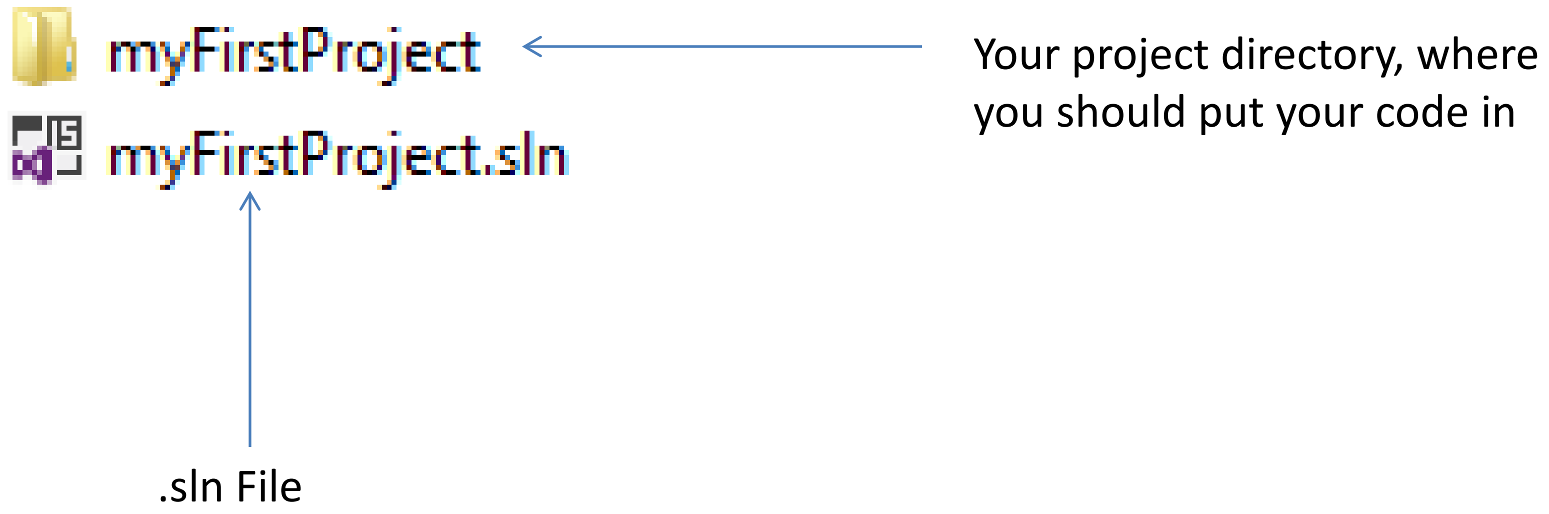
3. Give your Project a name

4. Choose the directory you want to place the folder

5. Click “OK”

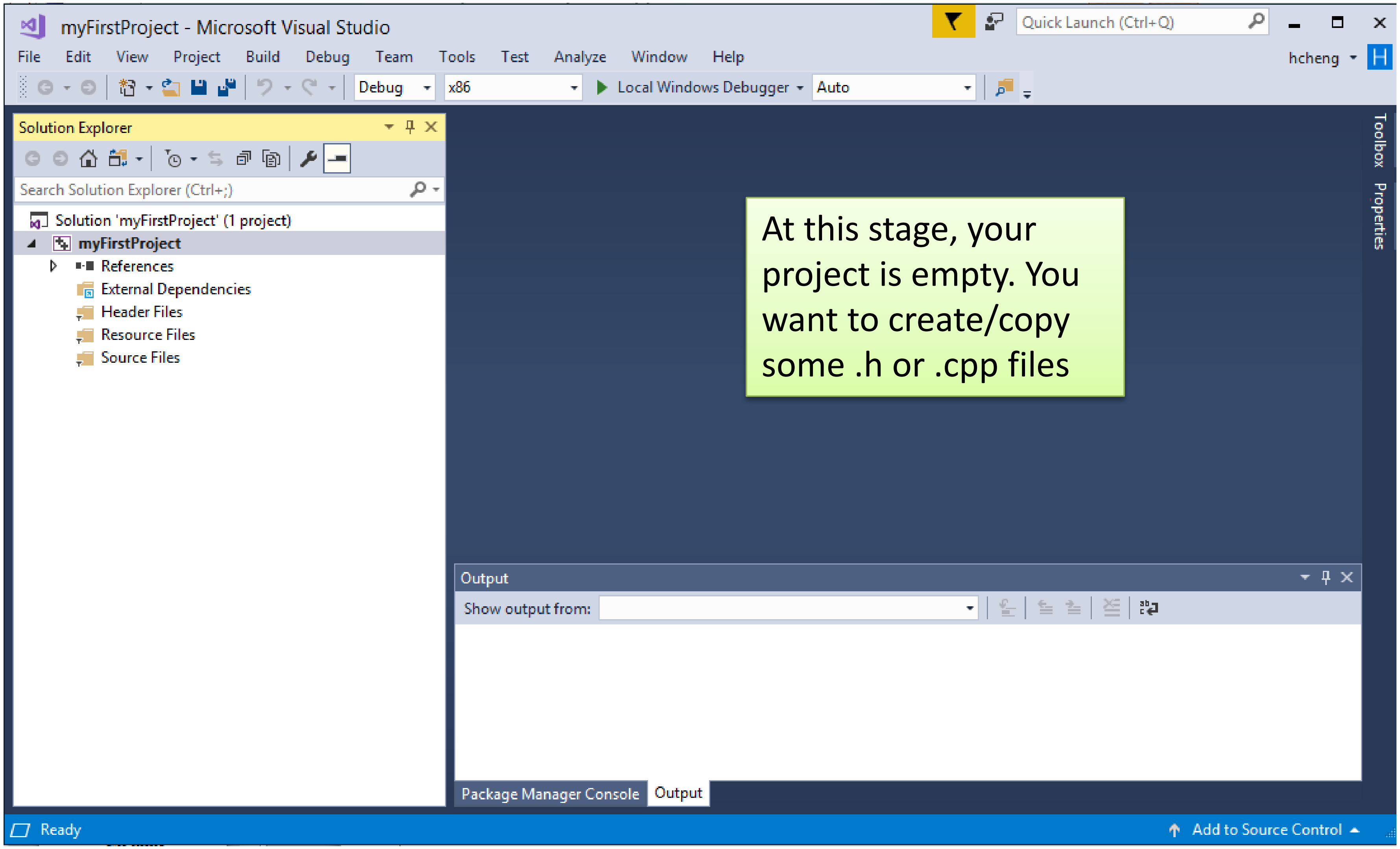
Files created

- In the folder you created, you will find:


myFirstProject
myFirstProject.sln

- Whenever you want to re-open your project, just click the .sln file

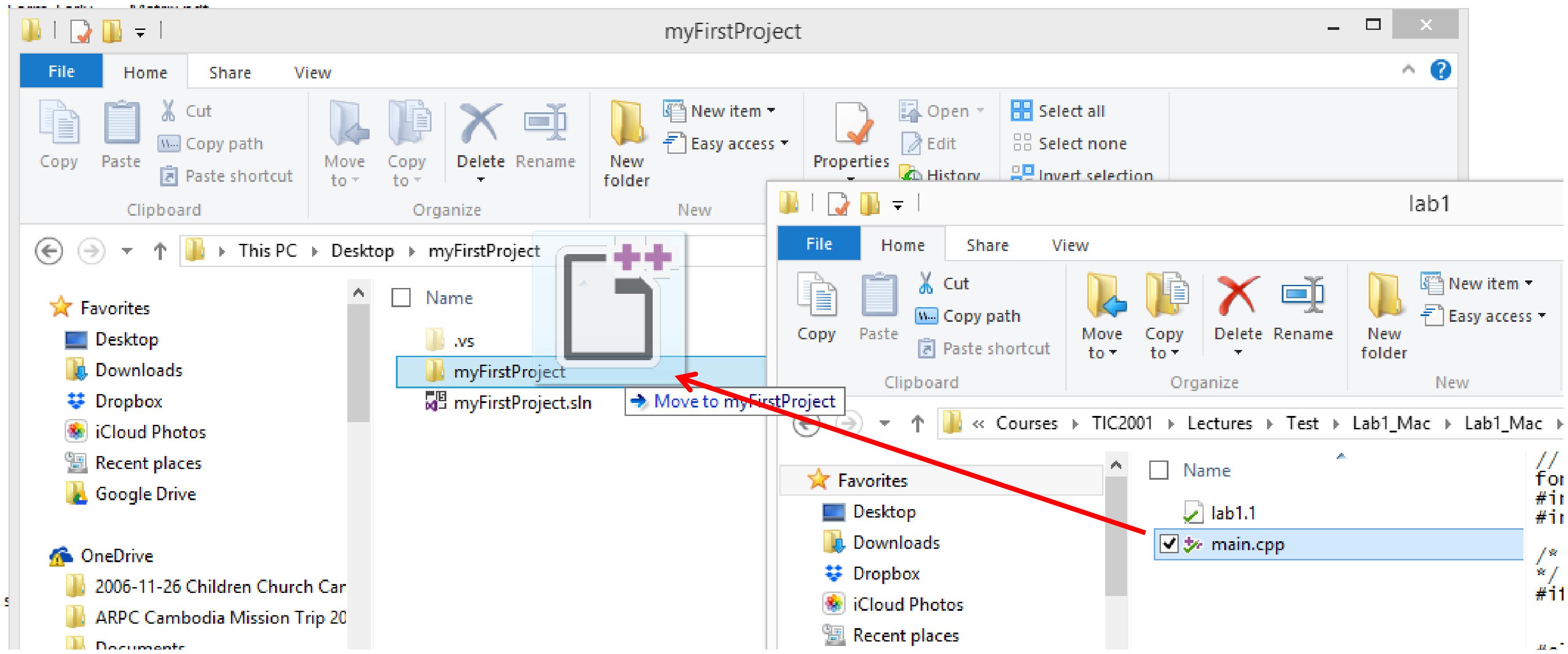
Empty Project



At this stage, your project is empty. You want to create/copy some .h or .cpp files

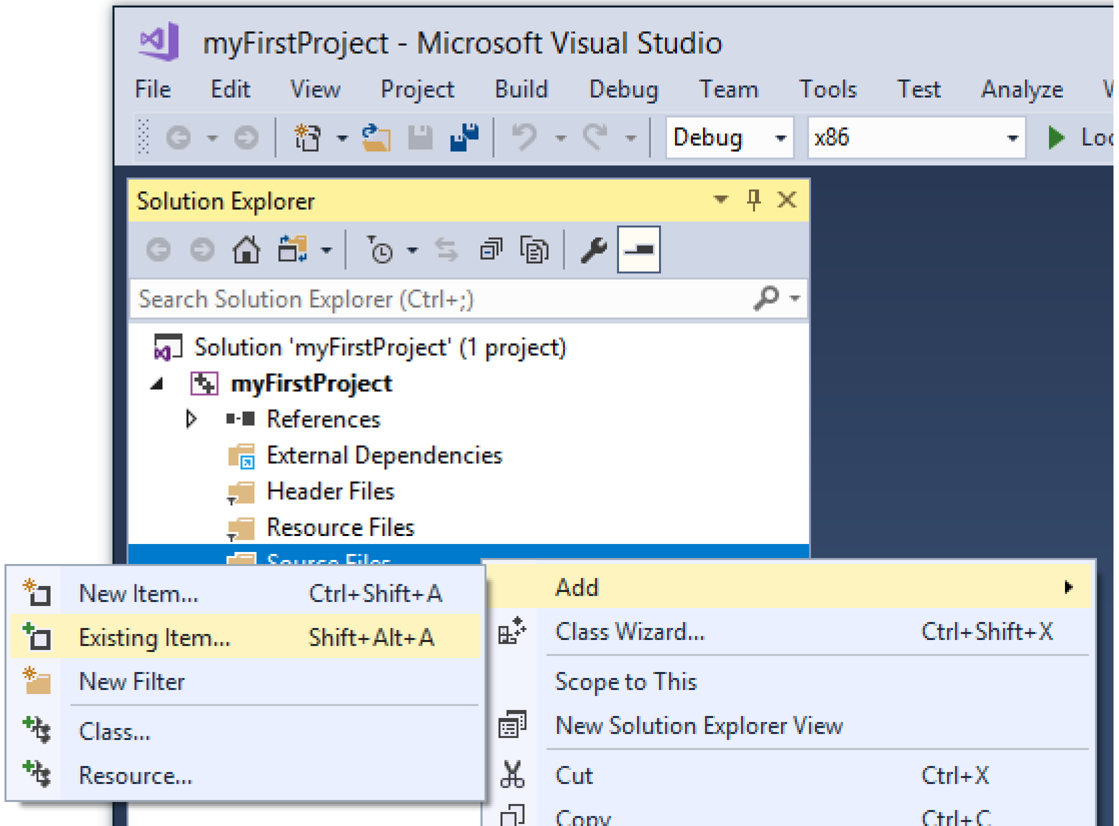
Copy Old .cpp File

- If you already have some .cpp file (e.g. from your prev. course) you want to compile
  - Copy the .cpp into your project directory



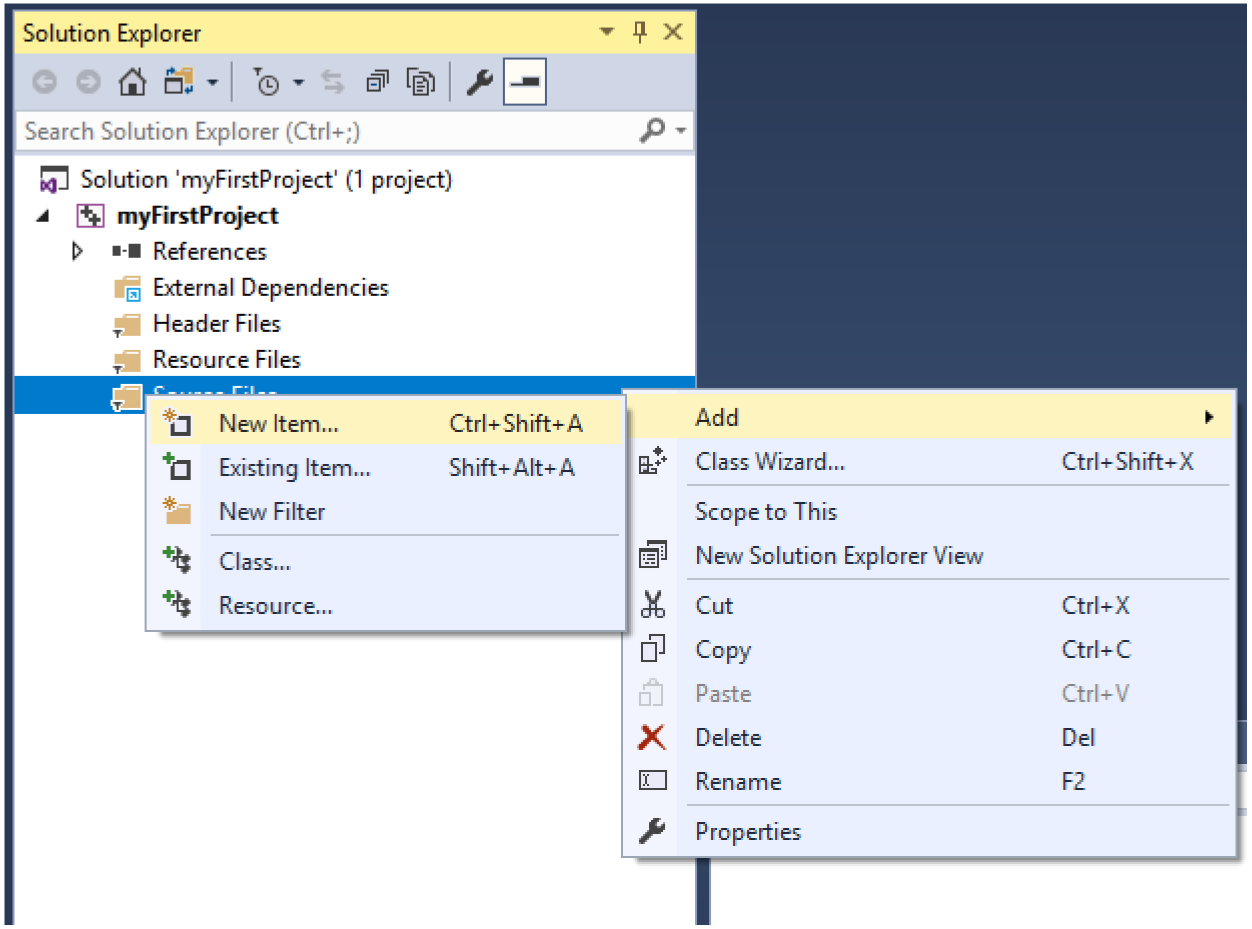
Then in Your Project

- Right Click "Source Files" > Add > Existing Item
- Then find the file you just copied

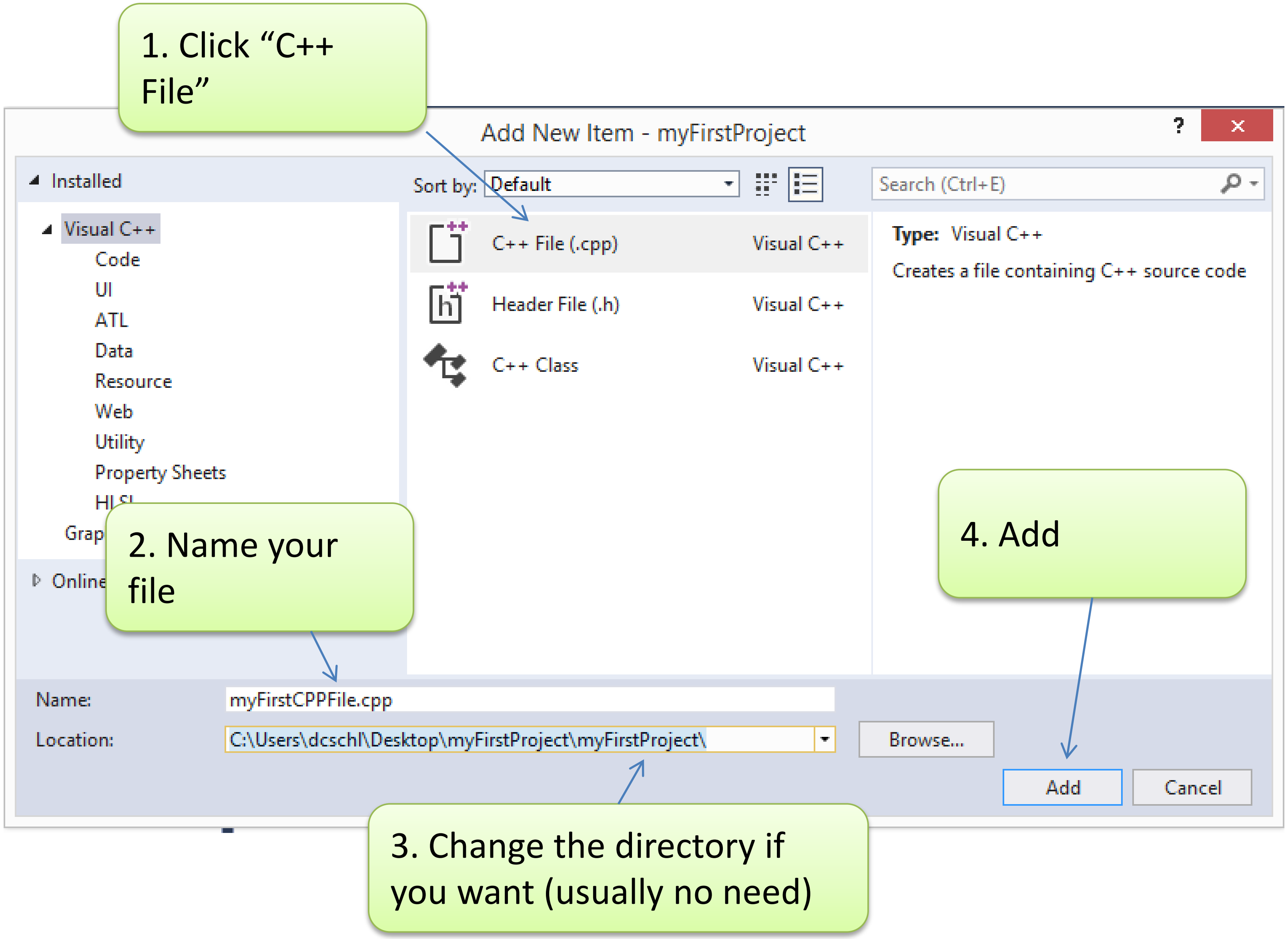


Or, To Create a .cpp File from Scratch

- Right click “Source Files” > Add > New Item



Or, To Create a .cpp File from Scratch



1. Click "C++ File"

Add New Item - myFirstProject

Installed

Visual C++
- Code
- UI
- ATL
- Data
- Resource
- Web
- Utility
- Property Sheets
- HLSL

Graphics

Online

Sort by: Default

Search (Ctrl+E)

C++ File (.cpp)	Visual C++
Header File (.h)	Visual C++
C++ Class	Visual C++

Type: Visual C++

Creates a file containing C++ source code

2. Name your file

Name: myFirstCPPFile.cpp

Location: C:\Users\dcschl\Desktop\myFirstProject\myFirstProject\

3. Change the directory if you want (usually no need)

4. Add

Compile and Run (Same same)

- To Compile your code
  - Build > Build Solution
- To run your code
  - Debug > Start Debugging
  - Or simply press “F5”

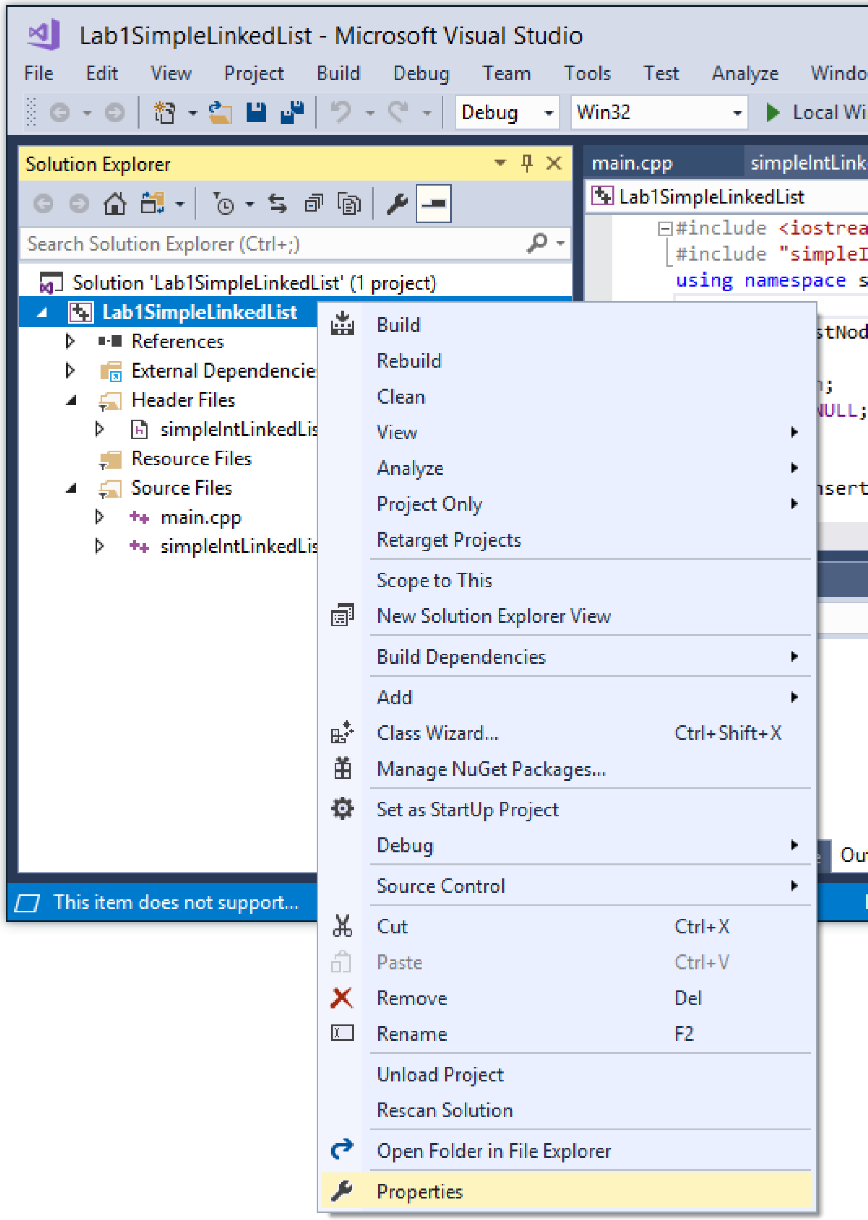
If You Run the Program

- Something will “flash” in front of your eyes
  - In fact, that is the output (printout) of your code

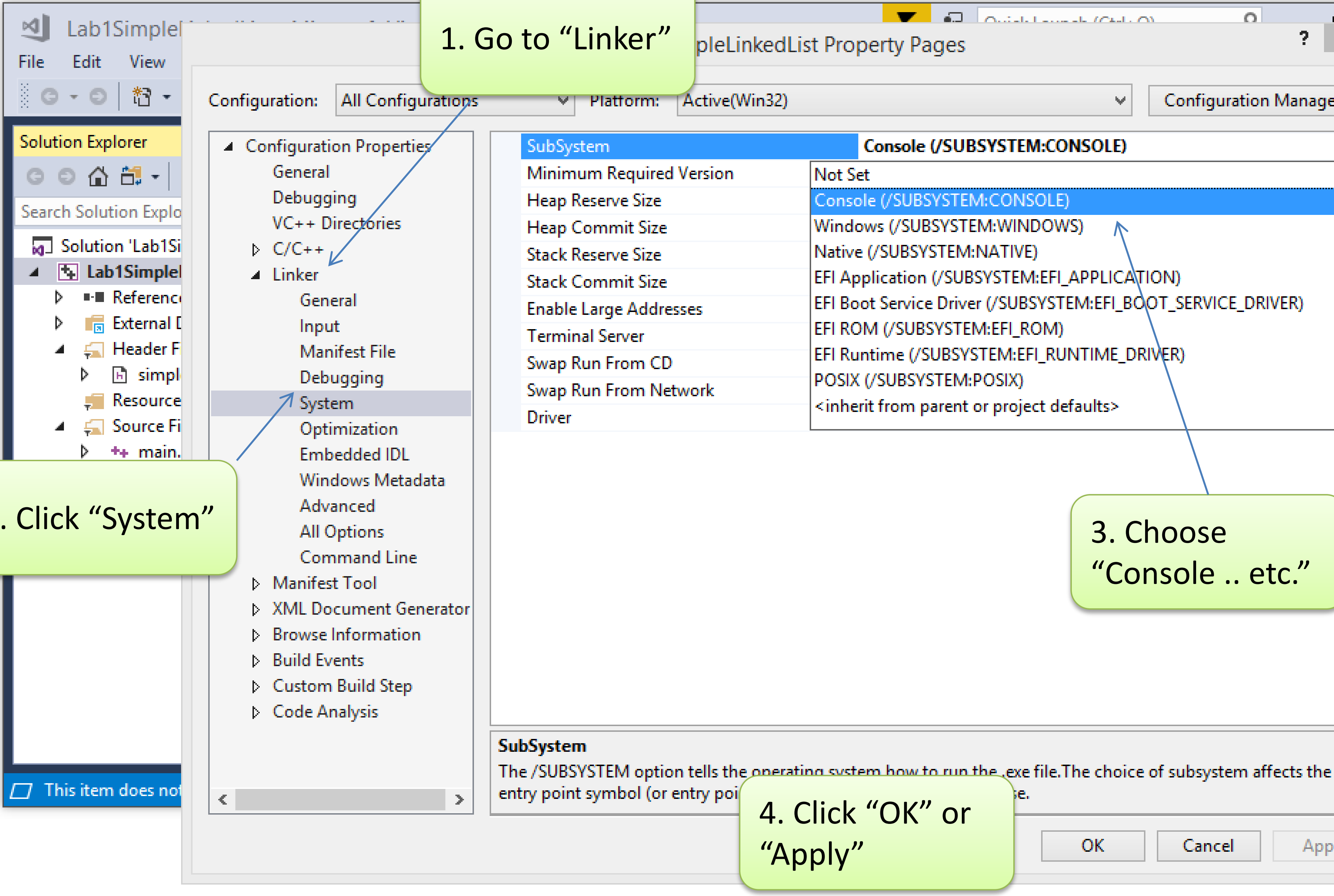
- Because your program runs, then finished, the console with the output will be closed also
  - (Such a stupid thing)

In Order to View Program Output

- (You only have to do it once)
- Right Click your project
  - Not the first line but the second
- Select Properties



1. Go to "Linker"



Lab1Simple

File Edit View

Solution Explorer

Search Solution Explo

Solution 'Lab1Si

Lab1Simple

Referenc

External D

Header F

simpl

Resource

Source Fi

main.

This item does not

pleLinkedList Property Pages

Configuration: All Configurations Platform: Active(Win32) Configuration Manage

- Configuration Properties
  - General
  - Debugging
  - VC++ Directories
  - C/C++
  - Linker
    - General
    - Input
    - Manifest File
    - Debugging
    - System
    - Optimization
    - Embedded IDL
    - Windows Metadata
    - Advanced
    - All Options
    - Command Line
  - Manifest Tool
  - XML Document Generator
  - Browse Information
  - Build Events
  - Custom Build Step
  - Code Analysis

SubSystem	**Console (/SUBSYSTEM:CONSOLE)**
Minimum Required Version	
Heap Reserve Size	
Heap Commit Size	
Stack Reserve Size	
Stack Commit Size	
Enable Large Addresses	
Terminal Server	
Swap Run From CD	
Swap Run From Network	
Driver	

Not Set
Console (/SUBSYSTEM:CONSOLE)
Windows (/SUBSYSTEM:WINDOWS)
Native (/SUBSYSTEM:NATIVE)
EFI Application (/SUBSYSTEM:EFI_APPLICATION)
EFI Boot Service Driver (/SUBSYSTEM:EFI_BOOT_SERVICE_DRIVER)
EFI ROM (/SUBSYSTEM:EFI_ROM)
EFI Runtime (/SUBSYSTEM:EFI_RUNTIME_DRIVER)
POSIX (/SUBSYSTEM:POSIX)
<inherit from parent or project defaults>

SubSystem
The /SUBSYSTEM option tells the operating system how to run the .exe file.The choice of subsystem affects the entry point symbol (or entry poi e.

OK Cancel App

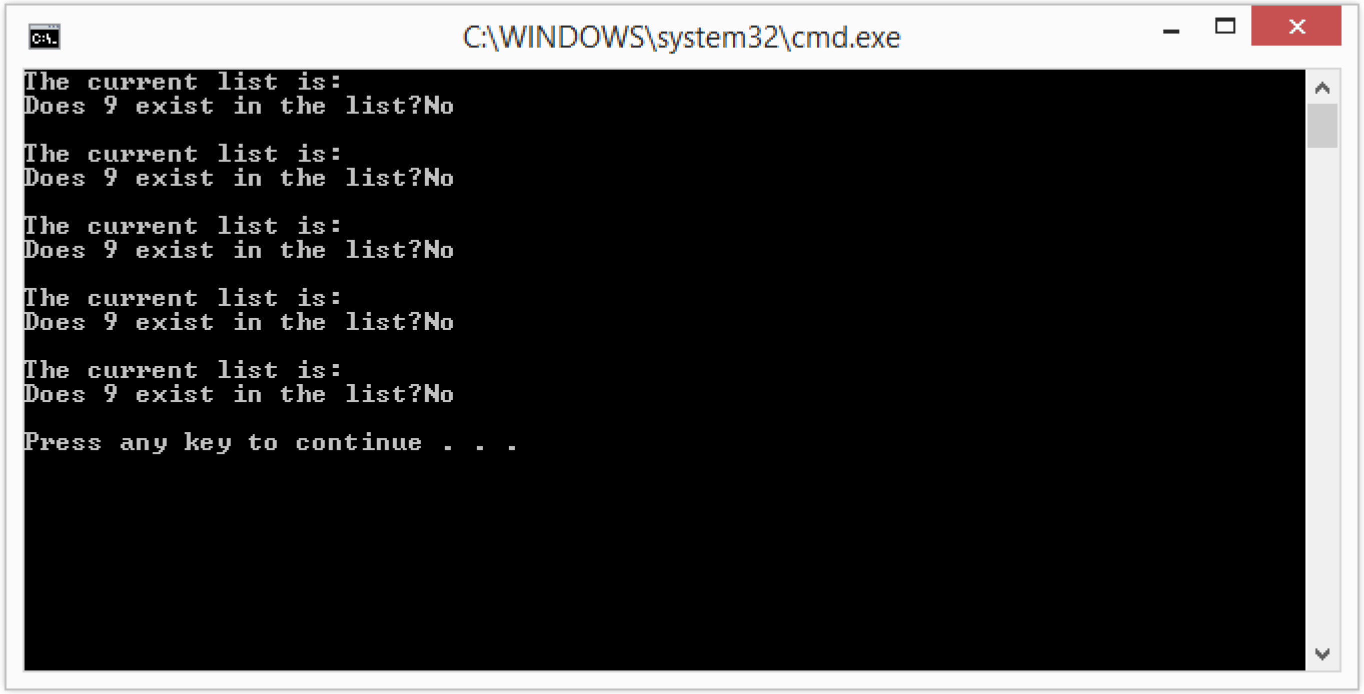
2. Click "System"

3. Choose "Console .. etc."

4. Click "OK" or "Apply"

Pause Before Closing Window

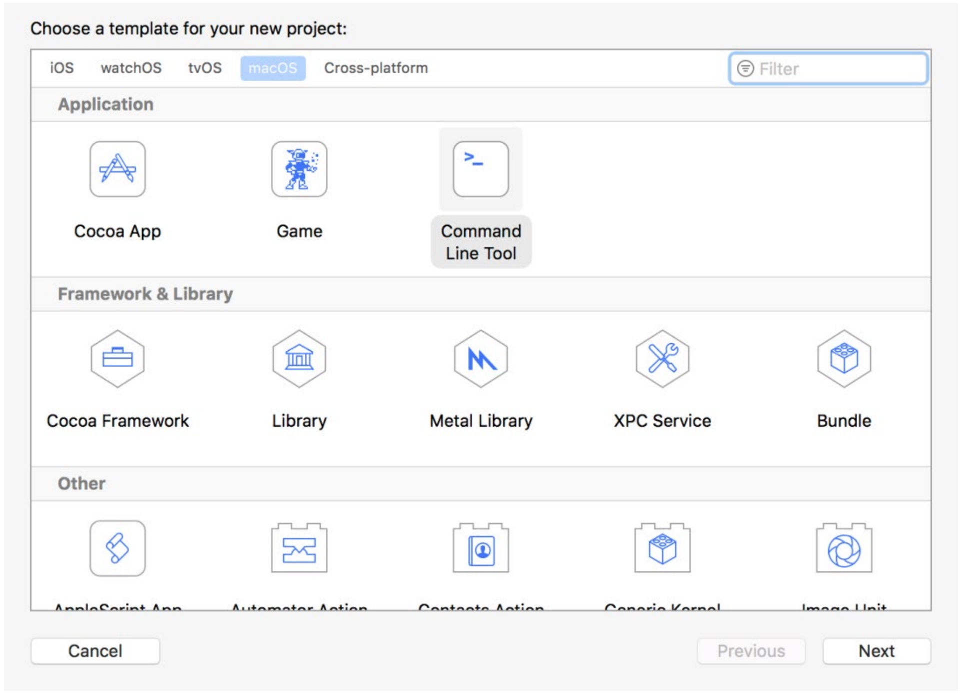
- Then there is a line to wait for you to read your output before closing the window



```
The current list is:
Does 9 exist in the list?No

The current list is:
Does 9 exist in the list?No

The current list is:
Does 9 exist in the list?No

The current list is:
Does 9 exist in the list?No

The current list is:
Does 9 exist in the list?No

Press any key to continue . . .
```

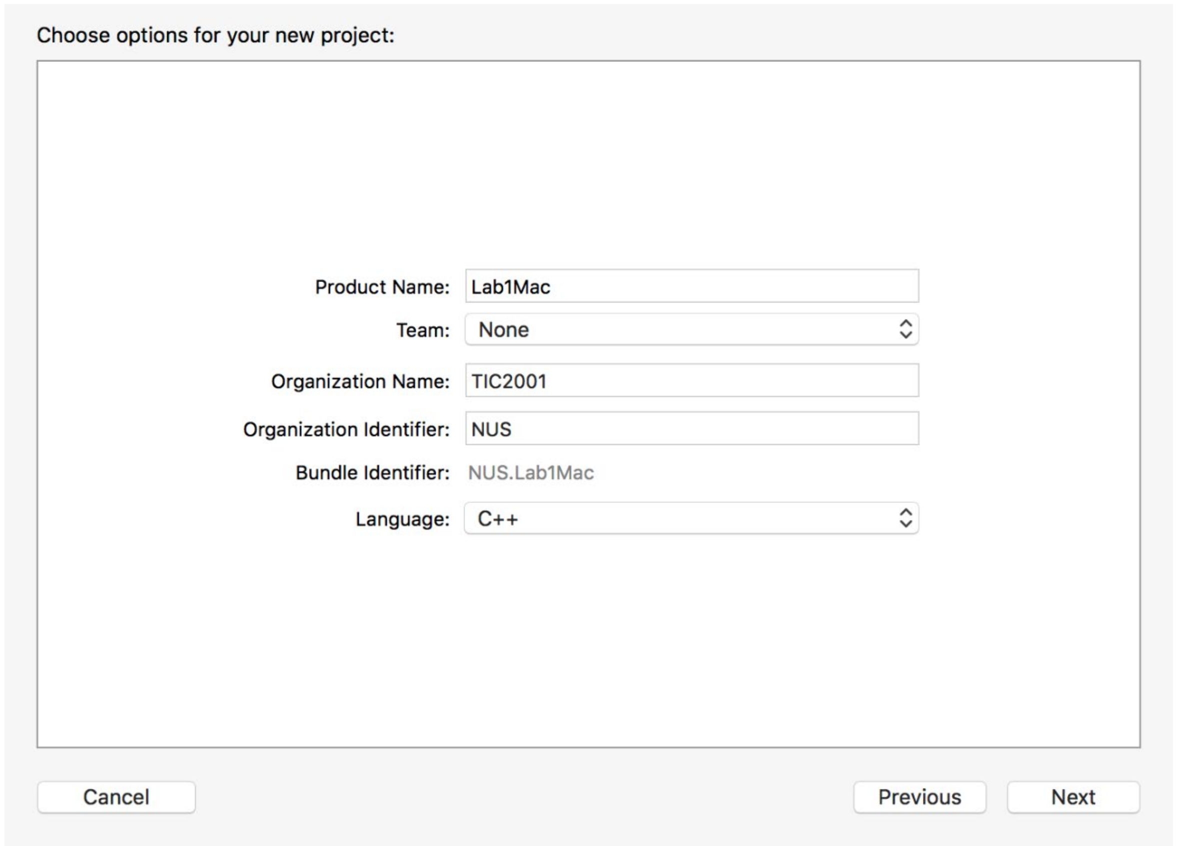
Appendix: Create an Xcode Project

- Start Xcode
- "Create a new Xcode project"
- "Command Line Tool" then "Next"



Appendix: Create an Xcode Project

- Name your project name in "Product Name"
- And change other options according to your preference

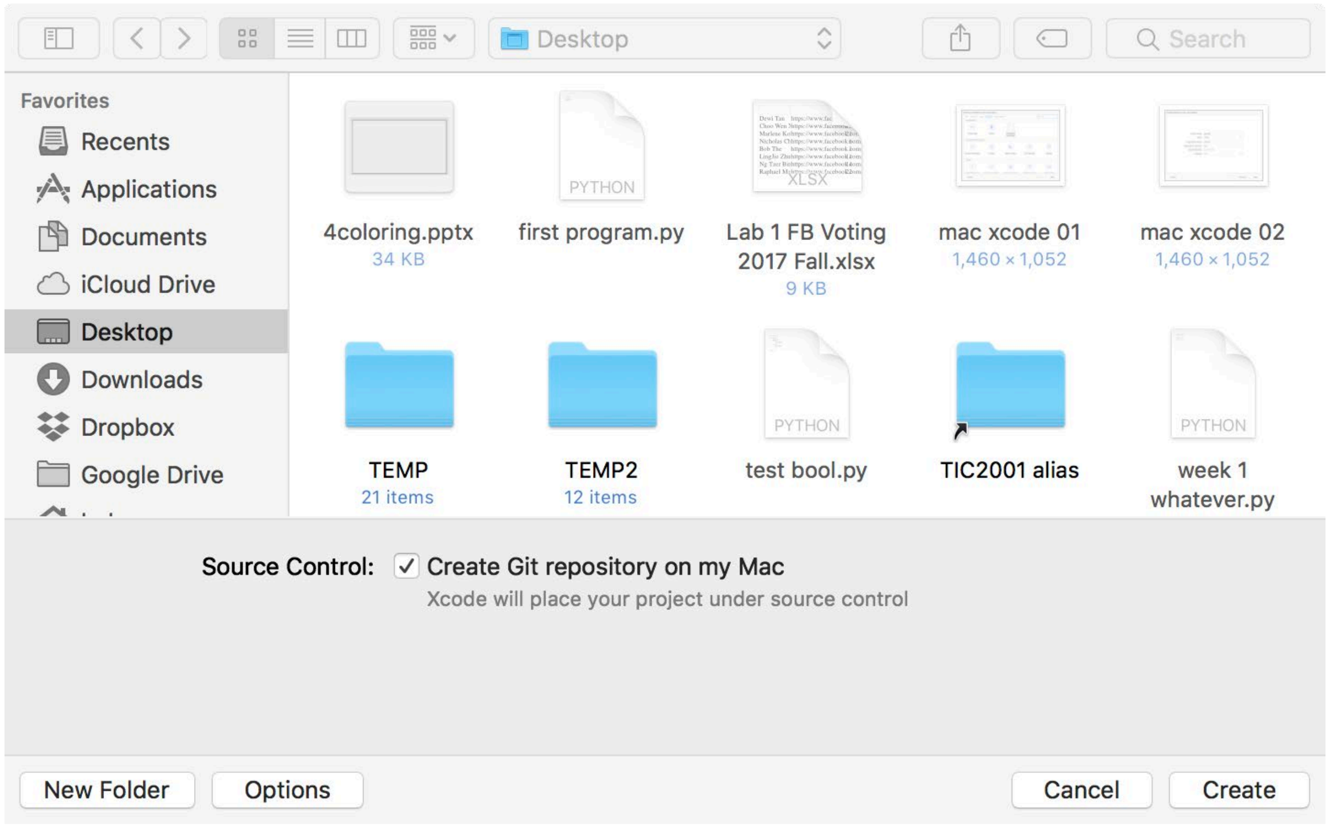


Choose options for your new project:

Product Name:	Lab1Mac
Team:	None
Organization Name:	TIC2001
Organization Identifier:	NUS
Bundle Identifier:	NUS.Lab1Mac
Language:	C++

Appendix: Create an Xcode Project

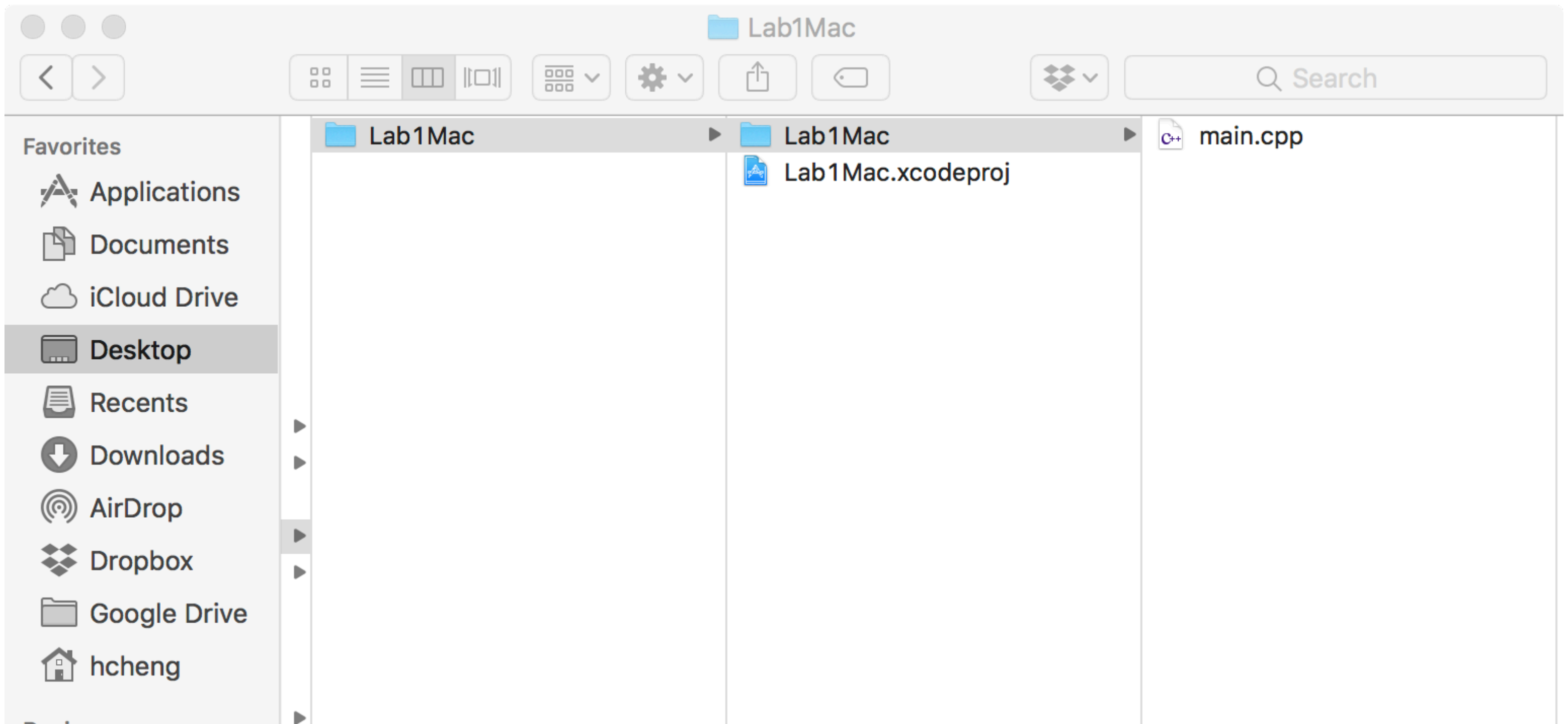
- Then choose a directory/folder to create your project



Source Control: ✓ Create Git repository on my Mac
Xcode will place your project under source control

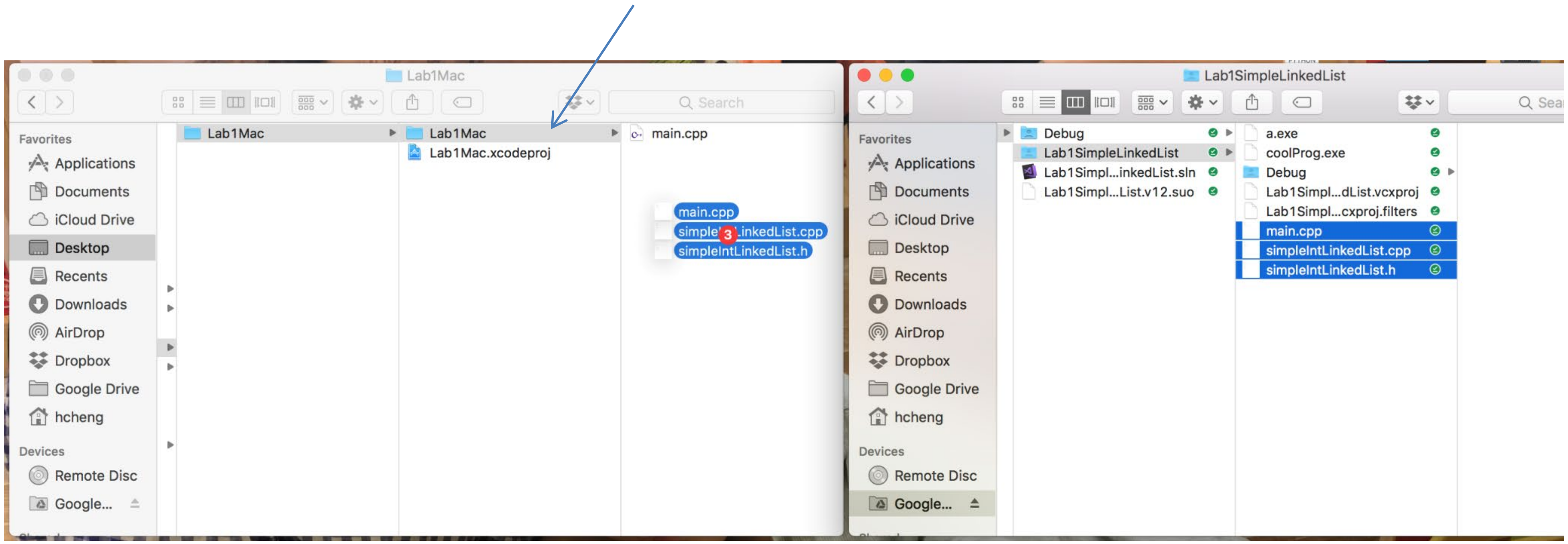
Appendix: Create an Xcode Project

- After doing so, you should have a subfolder with the same name
- And a default main.cpp for you



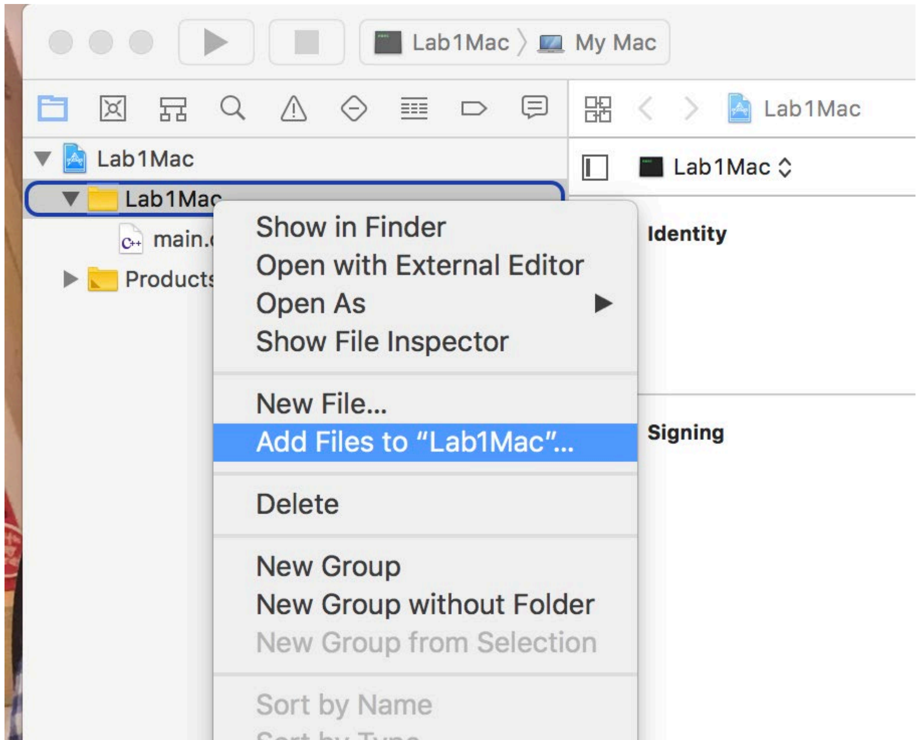
Appendix: Create an Xcode Project

- If you have some existing .h and .cpp files, you can copy them into your project folder
- Usually they should be placed inside the folder besides your .xcodeproj file



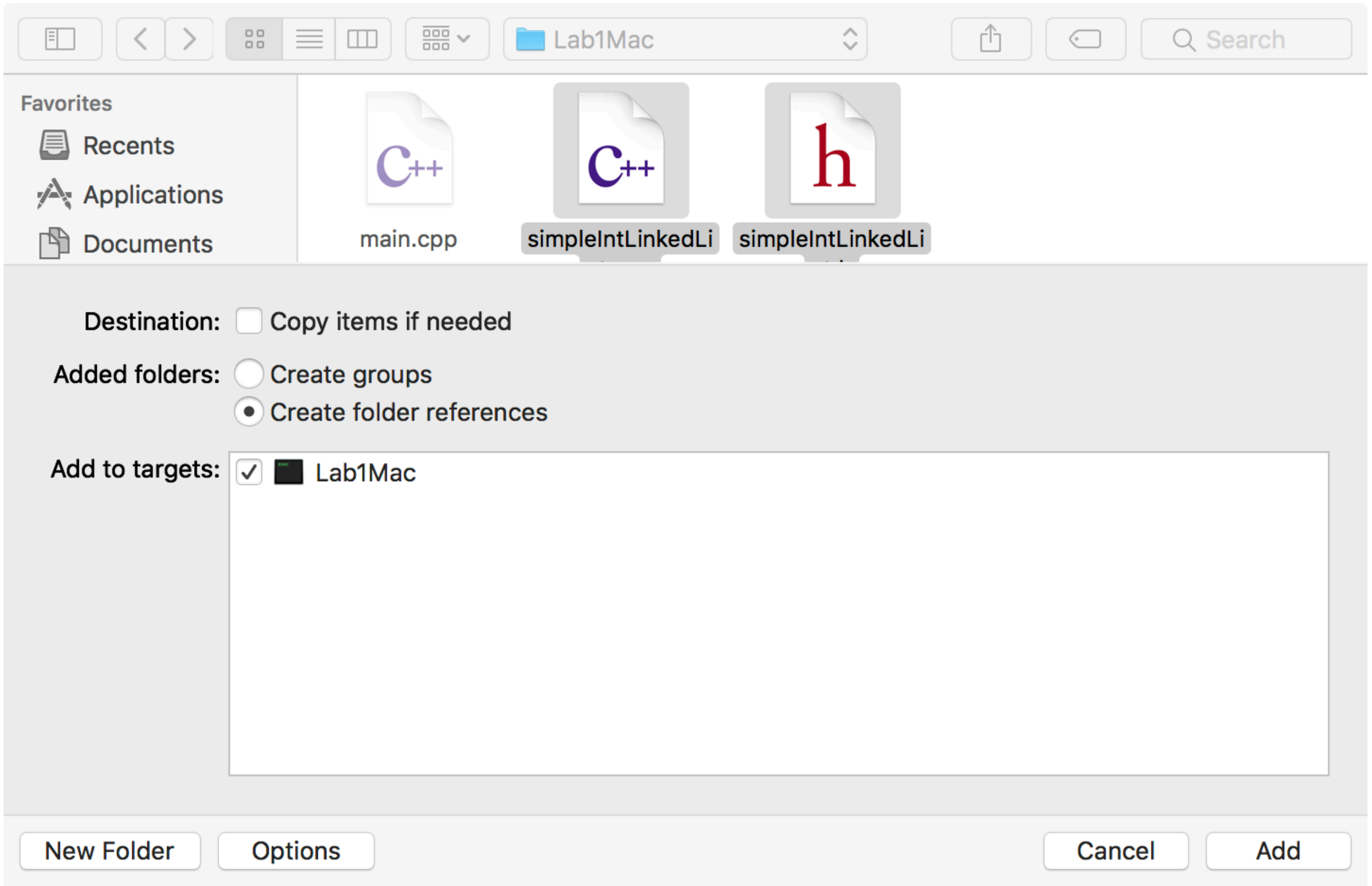
Appendix: Create an Xcode Project

- After opening your .xcodeproj file
- You can add your existing files by clicking the project folder inside Xcode and “Add Files to …”



Appendix: Create an Xcode Project

- Then you can choose what files you want to add into your project



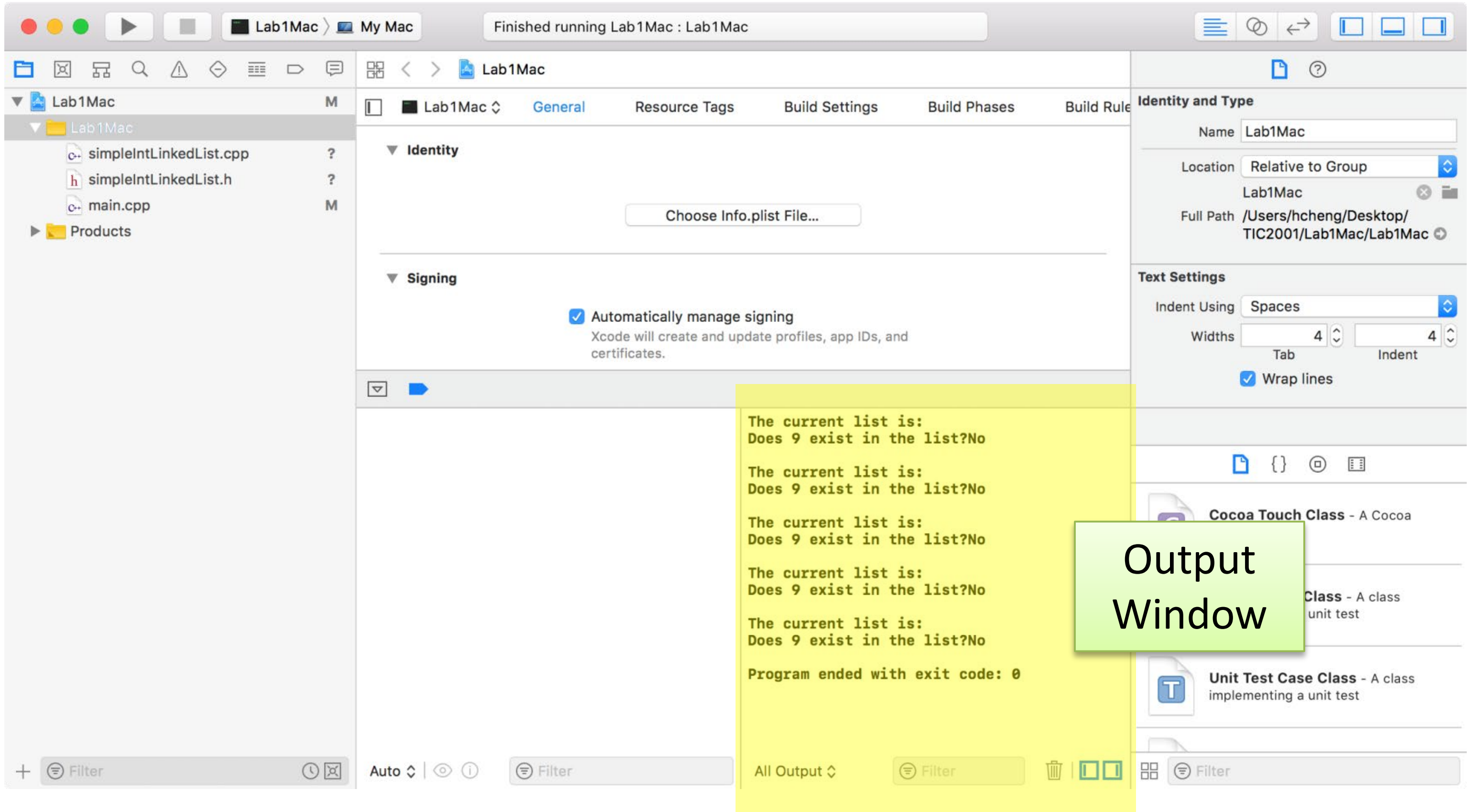
Destination: [ ] Copy items if needed

Added folders: ○ Create groups [● Create folder references]

Add to targets: [✓] Lab1Mac

Appendix: Create an Xcode Project

- Finally, you can "Run" your project and the output will be in your output window



```
The current list is:
Does 9 exist in the list?No

The current list is:
Does 9 exist in the list?No

The current list is:
Does 9 exist in the list?No

The current list is:
Does 9 exist in the list?No

The current list is:
Does 9 exist in the list?No

Program ended with exit code: 0
```

Finished running Lab1Mac : Lab1Mac

Identity and Type
Name: Lab1Mac
Location: Relative to Group
Lab1Mac
Full Path: /Users/hcheng/Desktop/TIC2001/Lab1Mac/Lab1Mac

Text Settings
Indent Using: Spaces
Widths: Tab 4, Indent 4
✓ Wrap lines

Identity
Choose Info.plist File...

Signing
✓ Automatically manage signing
Xcode will create and update profiles, app IDs, and certificates.