

# Command Line Build Your Own C/C++ Files

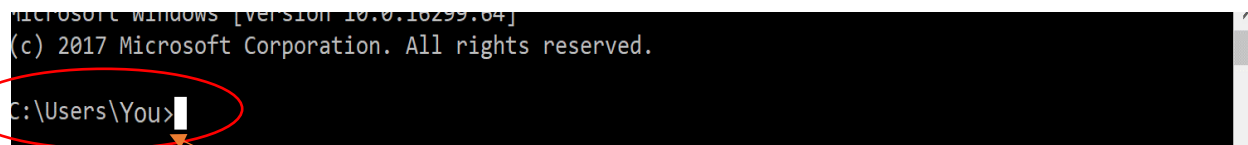
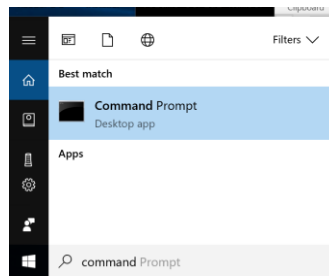
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## LEARN RUDIMENTARY STUFF ABOUT COMMAND PROMPT

### START THE COMMAND PROMPT



Pay attention to the text here. “You” shows your user id.

### BASIC COMMANDS YOU MUST KNOW: (NOT CASE SENSITIVE)

- `cd` = change folder
- `dir` = list the folder content
- `comp` = Compares the contents of two files or sets of files.
- `fc` = Compares two files or sets of files and displays the differences between them
- `copy` = Copies one or more files to another location.
- `del` = Deletes one or more files.
- `Find` = Searches for a text string in a file or files.
- `mkdir` = Creates a directory.
- `path` = Displays or sets a search path for executable files.
- `start` = Starts a separate window to run a specified program or command.
- `tree` = Graphically displays the directory structure of a drive or path.
- `Type` = Displays the contents of a text file.
- `xcopy` = Copies files and directory trees.
- `Echo` = echo string
- `>>` = redirect content into another file

Best way to learn this is to try them. After typing each command, observe what it does.

```
cd ..
dir
dir /?
```

```
cd ..
dir
cd c:\users\You (again, you should change to your own folder . "You" is just a sample)
dir /od
dir /os
echo hello world > x.txt
type x.txt
copy x.txt y.txt
comp x.txt y.txt
echo helloAgain >> x.txt
type x.txt
comp x.txt y.txt
comp x.txt y.txt /M
del x.txt y.txt OR del *.txt (if you do not have any other *.txt file in your folder)
mkdir test
dir
rmdir test
start
cd \windows
dir
dir /os
dir /od
tree
cd \users\You
mkdir usaco
cd usaco
mkdir f1\f2
dir /s
dir f1 /s
rmdir f1 /s
dir /s
```

Bare fundamentals about the Windows file system:

- C:\windows
- C:\program files
- C:\program files (x86)
- C:\users\...
- There is no such folder called "Quick Access" ; unless you manually create it, of course.
- C:\users\you\documents
- C:\users\you\downloads
- C:\users\you\desktop

## FIND LOCATION OF YOUR MICROSOFT VISUAL STUDIO C/C++ INSTALLATION

Various version of visual studio can use different folder names.

I have 2 samples here. One is for 2015, another one is for 2017 community version

One for 2015 Version: "C:\Program Files (x86)\Microsoft Visual Studio 14.0\"

One for 2017 Community Version :

"C:\Program Files (x86)\Microsoft Visual Studio\2017\Community\VC\Auxiliary\Build"

If you are not sure where it is installed. Go thru the File Explorer. It should be installed under either:

- C:\Program Files (x86) or
- C:\Program Files

## CHANGE TO THE LOCATION

e.g. : (depending on which version, of course)

```
cd "C:\Program Files (x86)\Microsoft Visual Studio\2017\Community\VC\Auxiliary\Build
```

or

```
cd "C:\Program Files (x86)\Microsoft Visual Studio 14.0\VC\bin
```

## SET UP THE BUILD ENVIRONMENT.

At C:\Program Files (x86)\Microsoft Visual Studio\2017\Community\VC\Auxiliary\Build>

At the folder, run this:

```
vcvars64.bat
```

You should see a list \*.bat batch command files. These are command script files.

To verify, type at the command line:

```
cl
```

Your should see:

```
Microsoft (R) C/C++ Optimizing Compiler Version 19.12.25835 for x64  
Copyright (C) Microsoft Corporation. All rights reserved.
```

```
usage: cl [ option... ] filename... [ /link linkoption... ]
```

NOTE: This vcvars64.bat batch commands (windows script file) set up environment in order for you to compile and link code.

Reference: If you are interested, here is a link to all [Compiler Options](#).

## COMPILE & LINK YOUR OWN PROJECT

e.g. location of your project is at: \users\You\Project1

```
> cd c:\Users\You \Project1
```

To build it : `cl [ option... ] filename... [ /link linkoption... ]`

- e.g. your file is doFactorial.cpp
- the following will produce executable name "doFactorial.exe".

```
cl doFactorial.cpp
```

- the following will produce executable name "mystuff.exe".

```
cl doFactorial.cpp -o mystuff.exe
```

## TO AUTOMATICALLY SETUP THE ENVIRONMENT

- 1) create a batch file to do setup

create a file with ".bat" extension.

➤ Notepad setEnv.bat

```
set thisFolder=%cd%
    echo %thisFolder%
    cd "C:\Program Files (x86)\Microsoft Visual
    Studio\2017\Community\VC\Auxiliary\Build"
    call vcvars64.bat

    cd %thisFolder%
```

do you put space in-between the "="

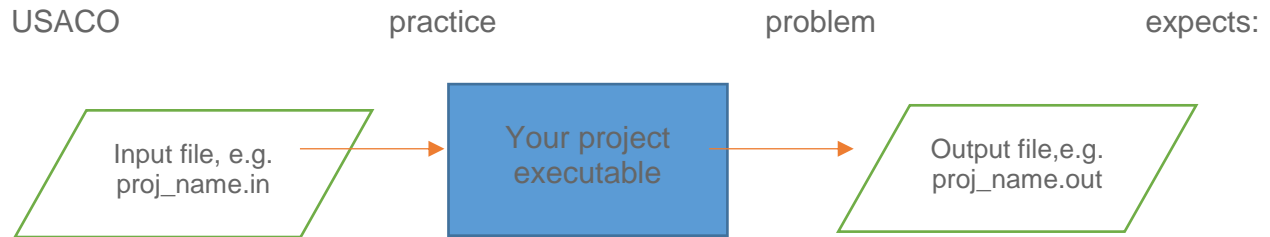
OR

- 2) setup using the control panel.
  - will skip this for now as the goal of this exercise is to help you understand using batch file for each different environment.

## ANOTHER SAMPLE TO COMPILE AND LINK MULTIPLE FILES

Check out the sample in the [Appendix A](#).

## TO AUTOMATE YOUR USACO PROJECT TESTS WITH BATCH FILE



Eg. : The usaco’s project name : **sensor**. Thus, your program assumes the input file name is “**sensor.in**”, and store your output to “**sensor.out**”.

Steps:

- 1) copy 1.in to sensor.in (Usually there are 10+ test data files, e.g. 1.in, 2.in, .... 15.in)
- 2) run your code
- 3) file compare 1.out with sensor.out.

Important reminder:

- 1) Should compile your code in Release mode.
- 2) When you submit it as a test, you should always pick C++. Your file should have extension .cpp

*Sample batch file to automate your test with a typical USACO problem set:*

```

@for /l %%a in (1 1 15) do ( call :runIt sensor %%a )
@goto :EOF

:runIt
@set fname=%%a
@set ct=%%2
@copy %ct%.in %fname%.in
@%fname%.exe
@fc %fname%.out %ct%.out

:EOF
  
```

## TO CREATE SHARED LIBRARY (WINDOWS)

A library is basically just an archive of object files.

This will show you how to create libraries files which contain only functions. This is good for program modularity, and code re-use. Write Once, Use Many.

You can turn these source files into libraries that can be used statically or dynamically by other programs.

### STEPS:

1. Setup your environment; as shown above.
2. Create proper header and library files. Note that you will need:
3. Proper header file for user applications.
4. If you are building dynamic link library instead of static shared library, you will need to create a special header for your library C/C++ source file
  - a. Do note this is not the same header file as the one used by the user applications.

### IN THE CASE OF BUILDING STATIC SHARED LIBRARY

#### Create Header files

Create proper headers and function files.

Sample:

fact.h in source folder c:\sr\cpp\h
<pre> #ifndef __MYLIBH__ #define __MYLIBH__  int factorial(int);  #endif                 </pre>
fact.cpp in source folder c:\sr\cpp
<pre> #include &lt;fact.h&gt;  int factorial(int n) {     if (n==2)         return 2;     return n * factorial(n-1); }                 </pre>



*To build Static linked library:*

Generate the obj file :

```
cl /c /EHsc fact.cpp //.
```

Build the shared library \*.lib :

```
lib fact.obj
```

After this, a library file called fact.lib is generated.

*To test with an application:*

```
cl testApp.cpp fact.lib
```

Do note that testApp.exe can be run in a different folder from fact.lib.

**IN THE CASE OF BUILDING DYNAMIC LINK LIBRARY:***Create Header files*

Create proper headers and function files.

Sample:

factdll.h in source folder c:\sr\cpp\h
<pre>#ifndef __MYDLL__ #define __MYDLL__  #ifdef MYDLL_EXPORTS #define MYDLL_API __declspec(dllexport) #else #define MYDLL_API __declspec(dllimport) #endif  MYDLL_API int factorial(int);  #endif</pre>
factdll.cpp in source folder c:\sr\cpp
<pre>#include &lt;factdll.h&gt;  MYDLL_API int factorial(int n) {     if (n==2)         return 2;     return n * factorial(n-1); }</pre>

**Build the dynamic link library:**

```
➤ cl /c /EHsc factdll.cpp /I./h /DMYDLL_EXPORTS
//note: /I is an upper case "i" to indicate path for header files
```

This will create two files : factdll.lib and factdll.dll .

**To test with an application:**

```
➤ cl /EHsc testApp.cpp /link fact.lib
```

Run your app.

**A COUPLE OF COMMON WHAT IF SITUATIONS:**

- 1) Your DLL file is in another location other than your current folder. Then, the path to the dll files must be included in the system path.

Eg. Your location of your newly built dll is at : C:\myfolders\mydlls\

Your testApp.exe is elsewhere. You need to do:

```
➤ set path=%path%;c:\myfolders\mydlls
```

- 2) location of the header files is not in the same folder where the testApp.cpp is.

Note: you must specify "-I./" to tell the compiler where to find the header files. The alternative is to set your system include path environment variable:

In Windows: e.g. your header files are in c:\sr\cpp\h

```
➤ cl /W4 /EHsc /IC:\sr\cpp\h testApp.cpp fact.lib
```

or

```
➤ set include=%include%;c:\sr\cpp\h
➤ cl /W4 /EHsc testApp.cpp fact.lib
```

- 3) Want to name the executable name different from the "main" source file.
    - add /out: to generate executable file name not myApp.cpp. Eg.
- ```
➤ cl myApp.cpp fact.lib /out:hello.exe
```

## NEED TO MAKE SMALLER RUNTIME FOOTPRINT

Produces an output file to run on the Windows Runtime. Footprint is far smaller:

- `dir myApp.exe` ←---- this is just to check the original size.
- `cl myApp.cpp factorial.lib /ZW /EHsc`
- `dir hello.exe` ←---- check the new size.

This will generate even smaller footprint as it removes default window metadata:

- `cl myApp.cpp factorial.lib -D_CRT_SECURE_NO_WARNINGS /ZW:nostdlib /EHsc`

## TO CREATE SHARED LIBRARY (LINUX)

### SETUP UP ENVIRONMENT

A few system environment variables you should know:

```
LD_LIBRARY_PATH  
C_INCLUDE_PATH
```

e.g.

```
export LD_LIBRARY_PATH=/home/pi/wk/libfolder1:/home/pi/wk/libfolder2  
export C_INCLUDE_PATH=/home/pi/wk/inc
```

### IN THE CASE OF BUILDING STATIC SHARED LIBRARY

You should create at least :

- One library \*.c or \*.cpp file
- One header file containing the applicable global, macros, function prototypes, etc.

More sample:

```
ar r libSimple.a Simple.o // this will produce library file *.a. You can name <whatever>.a  
ranlib mySimple.a // create indexing inside the library file
```

Test your client app test.cpp:

```
gcc -o testExe testApp.c libSimple.a
```

or

```
gcc -o testExe testApp.c -L/path/to/library-directory -lSimple
```

### IN THE CASE OF BUILDING DYNAMIC LINK LIBRARY

- 1) Compile your library file and make it become a dynamically lined “shared object” library.

e.g. your library files are : fact.cpp and fib.cpp

```
gcc -c -Wall -Werror -fpic fact.cpp fib.cpp  
gcc -shared -o libSimple.so fact.o fib.o
```

note that : libSimple.so is the shared library. The extension must be \*.so .

It MUST be prefixed with **lib**xxxx.so.

*Test your client app test.cpp:*

```
gcc -Wall -o test test.cpp -ISimple -L$LD_LIBRARY_PATH
```

note that it is **-ISimple** NOT, **-llibSimple** .

If your header files are in /myNewPath

```
➤ gcc -o clientApp -c clientApp.cpp -I /myNewPath -L. -lmyLib clientApp.o  
or  
➤ export C_INCLUDE_PATH=$C_INCLUDE_PATH;/myNewPath  
➤ gcc -o clientApp -c clientApp.cpp -L. -lmyLib clientApp.o
```

IMPORTANT:

- Make sure you are “appending”, instead of overwrite the system environment variable.)
- -I, -L, etc., take precedence over environment variables
- C\_INCLUDE\_PATH may be different based on the version of compiler you use. Look up the proper system variable path.

---

Ref:

[Setting the Path and Environment Variables for Command-Line Builds](#)

[Walkthrough: Compiling a C Program on the Command Line](#)

## APPENDIX A

### EXAMPLE TO SHOW HOW TO COMPILE AND LINK SEVERAL FILES INTO AN EXECUTABLE

To build it : `cl [ option... ] filename... [ /link linkoption... ]`

- e.g. your files are: filesSample.cpp, lib.cpp, sub1.cpp, sub2.cpp
- the following will produce executable name "filesSample.exe". This is not because filesSamples.cpp is the first one in the list. It is because the function "main()" is in the filesSample.cpp.

```
cl filesSample.cpp lib.cpp sub1.cpp sub2.cpp
```

- the following will produce executable name "clientApp.exe".

```
cl filesSample.cpp lib.cpp sub1.cpp sub2.cpp -o clientApp.exe
```

### Sample files

```

// filesSample.cpp
#include <stdio.h>
#include <fstream>
#include <iomanip>
#include <iostream>
using namespace std;

#include "lib.h"
#include "memory.h"

int main()
{
    int arr[10];

    memset(arr, 0, sizeof(arr));
    memcpy(Test.a, "abcd", 4);
    Test.x = 10;
    Test.y = 20;

    for (int i = 0; i < sizeof(arr) / sizeof(arr[0]); i++)
        arr[i] = i * 2;

    for (int i = 0; i < Max1; i++)
        cout << i << ": This is a Demo! \n" ;

    cout << "Test Module returns: " << testModule() << endl;
    cout << "Sort dummy returns: " << getList(arr, 4) << endl;
    cout << "Old MyStructType value: a= \\" << Test.a <<
        "\\ x= " << Test.x <<
        " y= " << Test.y << endl;

    func2(&Test);
    cout << "Old MyStructType value: a= \\" << Test.a <<
        "\\ x= " << Test.x <<
        " y= " << Test.y << endl;

    return 0;
}
    
```

```
// lib.cpp

#include "stdio.h"
#include <fstream>
#include <iomanip>
#include <iostream>

#include "lib.h"

int Max1 = 4;
int Max2 = 4;
MyStructType Test;

MyStructType * func(MyStructType *a)
{
    return &a[0];
}

int finditem(int *a)
{
    return *(a + 5);
}

int getList(int *a, int ct)
{
    return *(a+ct);
}
```

```
// sub1.cpp
#include "stdio.h"
#include <fstream>
#include <iomanip>
#include <iostream>

#include "lib.h"

int testModule()
{
    return Max1 + 1;
}
```



```

// sub2.cpp
#include "stdio.h"
#include <fstream>
#include <iomanip>
#include <iostream>

#include "lib.h"

void func1()
{
    return;
}

void func2( MyStructType *t)
{
    t->x = Max2+ t->x;
    t->y = Max2 + t->y;
    memcpy(t->a, "new one", 8);
    return ;
}
    
```

```

//lib.h
#pragma once

typedef struct {
    int x;
    int y;
    char a[4];
} MyStructType;

extern int Max1;
extern int Max2;
extern MyStructType Test;

extern void func1();
extern void func2(MyStructType *);

extern MyStructType * func(MyStructType[]);
extern int getList(int *, int);
extern int testModule();
    
```