Lab Report for Object-oriented Programming course
Lab 2: C/C++ Preprocessor

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Contents

Chapter 1

Background Knowledge & Concepts Required for This Lab

1.1 C/C++ Compiling Process

1.1.1 Overall process of compiling

Compiling a source code file in C++ is a four-step process.[1] For example, if you have a C++ source code file named *prog1.cpp* and you execute the compile command

```
g++ -Wall -std=c++11 -o prog1 prog1.cpp
```

the compilation process looks like this:

1. The C++ preprocessor copies the contents of the included header files into the source code file, generates macro code, and replaces symbolic constants defined using *#define* with their values.

2. The expanded source code file produced by the C++ preprocessor is compiled into the assembly language for the platform.

3. The assembler code generated by the compiler is assembled into the object code for the platform.

4. The object code file generated by the assembler is linked together with the object code files for any library functions used to produce an executable file.

By using appropriate compiler options, we can stop this process at any stage.

1. To stop the process after the preprocessor step, you can use the *-E* option:

   ```
   g++ -Wall -std=c++11 -E prog1.cpp
   ```

[1] `http://faculty.cs.niu.edu/mcmahon/CS241/Notes/compile.html`

The expanded source code file will be printed on standard output (the screen by default); you can redirect the output to a file if you wish. Note that the expanded source code file is often incredibly large - a 20 line source code file can easily produce an expanded file of 20,000 lines or more, depending on which header files were included.

2. To stop the process after the compile step, you can use the *-S* option:

   ```
   g++ -Wall -std=c++11 -S prog1.cpp
   ```

   By default, the assembler code for a source file named *filename.cpp* will be placed in a file named *filename.s*.

3. To stop the process after the assembly step, you can use the *-c* option:

   ```
   g++ -Wall -std=c++11 -c prog1.cpp
   ```

   By default, the assembler code for a source file named *filename.cpp* will be placed in a file named *filename.o*. The entire process for compiling is shown in the figure 1.1

1.1.2 Preprocessing

1.1.3 Parsing

1.1.4 Global optimization

1.1.5 Code generation

1.1.6 Peehole optimization

1.1.7 Linking

1.2 C/C++ Preprocessing

1.2.1 The need of preprocessing

1.2.2 Different preprocessing algorithms

1.2.3 Preprocessing algorithm utilized by the current g++

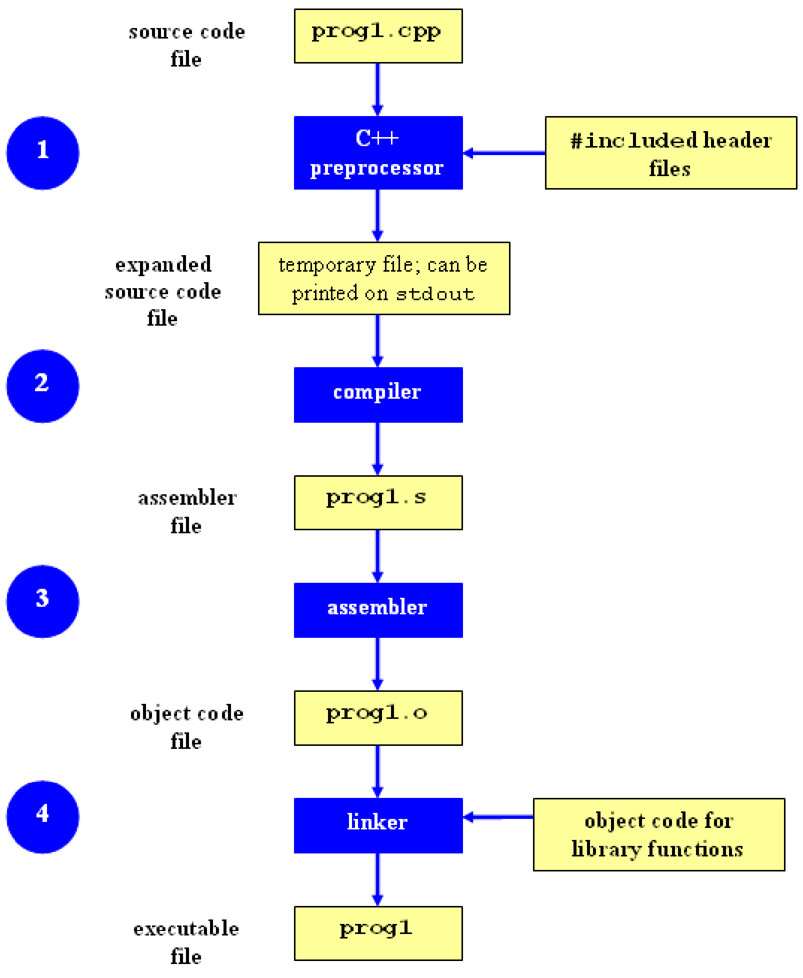


Figure 1.1: Overall compiling process

Chapter 2

Specifications of This Lab

2.1 Regulations in the preprocessing process

2.2 Test cases designed in the lab

2.3 Other specifications of the programming

Chapter 3

Structure and the OO Ideas Adopted

3.1 Objected-oriented ideas adopted in the implementation

3.1.1 Encapsulation

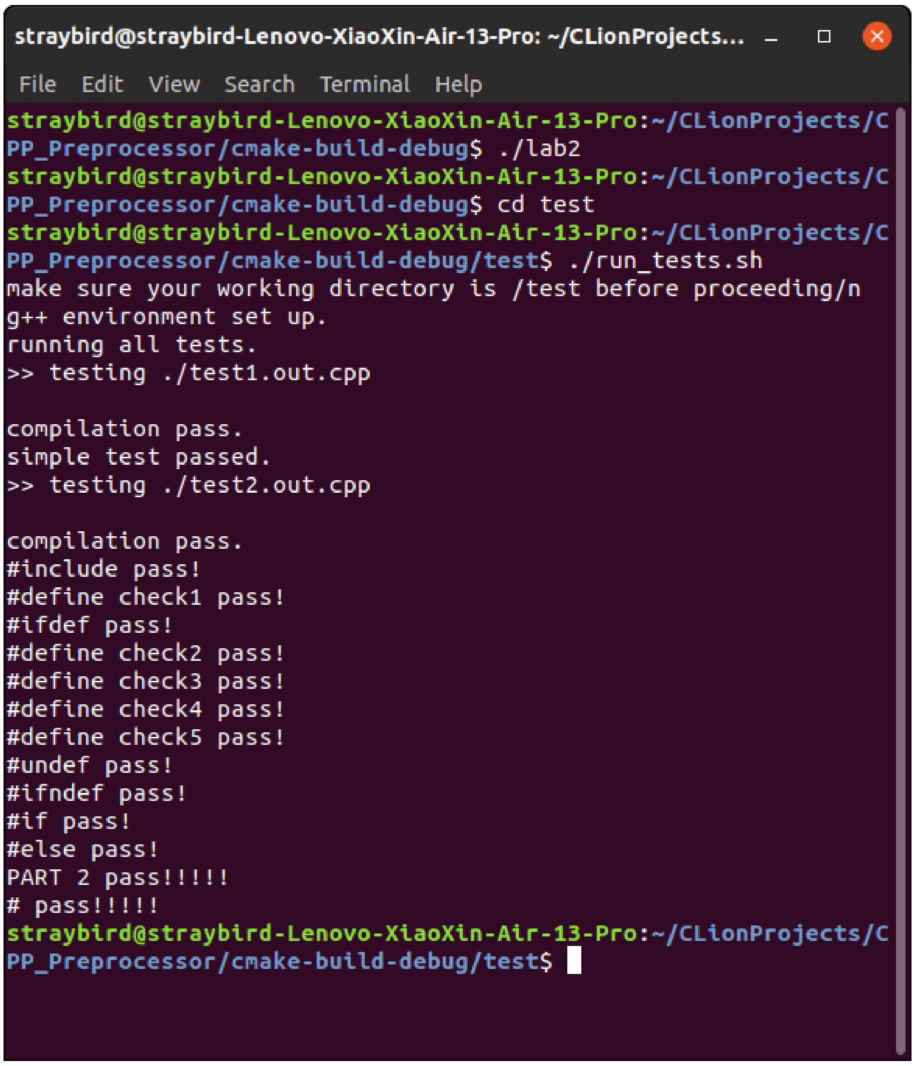
Chapter 4

Running Result of My Implementation

The following screenshots are the tests that are identical to the steps in the requirement documentation and proves that my version of implementation functions identical to the standard version.

4.1 Test result of the testcases

The results are shown as Figure 4.2.

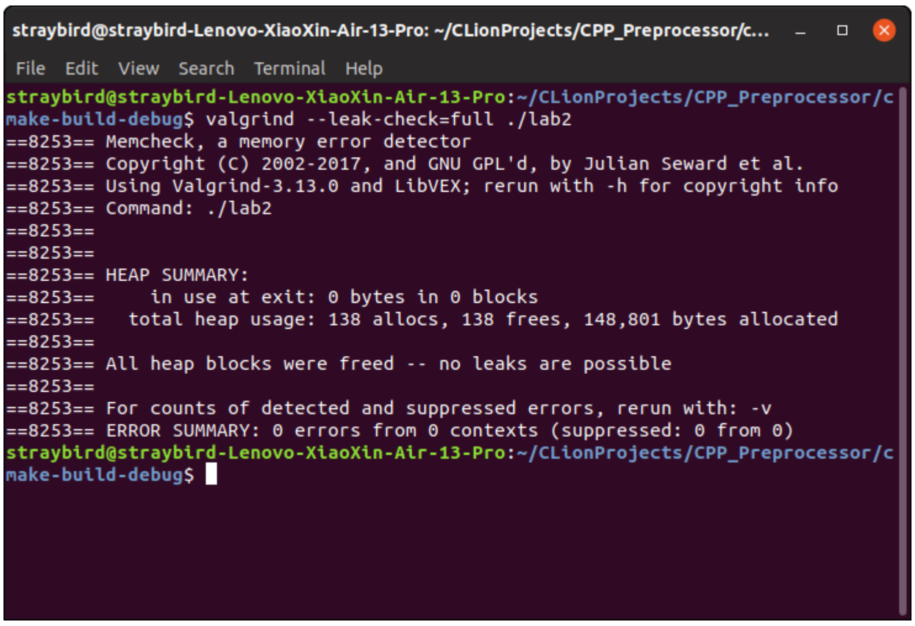

straybird@straybird-Lenovo-XiaoXin-Air-13-Pro: ~/CLionProjects...
File Edit View Search Terminal Help

```
straybird@straybird-Lenovo-XiaoXin-Air-13-Pro:~/CLionProjects/C
PP_Preprocessor/cmake-build-debug$ ./lab2
straybird@straybird-Lenovo-XiaoXin-Air-13-Pro:~/CLionProjects/C
PP_Preprocessor/cmake-build-debug$ cd test
straybird@straybird-Lenovo-XiaoXin-Air-13-Pro:~/CLionProjects/C
PP_Preprocessor/cmake-build-debug/test$ ./run_tests.sh
make sure your working directory is /test before proceeding/n
g++ environment set up.
running all tests.
>> testing ./test1.out.cpp

compilation pass.
simple test passed.
>> testing ./test2.out.cpp

compilation pass.
#include pass!
#define check1 pass!
#ifdef pass!
#define check2 pass!
#define check3 pass!
#define check4 pass!
#define check5 pass!
#undef pass!
#ifndef pass!
#if pass!
#else pass!
PART 2 pass!!!!!
# pass!!!!!
straybird@straybird-Lenovo-XiaoXin-Air-13-Pro:~/CLionProjects/C
PP_Preprocessor/cmake-build-debug/test$
```

Figure 4.1: Testcase Result


straybird@straybird-Lenovo-XiaoXin-Air-13-Pro: ~/CLionProjects/CPP_Preprocessor/c...
File Edit View Search Terminal Help

```
straybird@straybird-Lenovo-XiaoXin-Air-13-Pro:~/CLionProjects/CPP_Preprocessor/c
make-build-debug$ valgrind --leak-check=full ./lab2
==8253== Memcheck, a memory error detector
==8253== Copyright (C) 2002-2017, and GNU GPL'd, by Julian Seward et al.
==8253== Using Valgrind-3.13.0 and LibVEX; rerun with -h for copyright info
==8253== Command: ./lab2
==8253==
==8253==
==8253== HEAP SUMMARY:
==8253==     in use at exit: 0 bytes in 0 blocks
==8253==   total heap usage: 138 allocs, 138 frees, 148,801 bytes allocated
==8253==
==8253== All heap blocks were freed -- no leaks are possible
==8253==
==8253== For counts of detected and suppressed errors, rerun with: -v
==8253== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
straybird@straybird-Lenovo-XiaoXin-Air-13-Pro:~/CLionProjects/CPP_Preprocessor/c
make-build-debug$ 
```

Figure 4.2: Memory Leak Check

Chapter 5

Memory Leak

5.1 Potential Memory Leak

5.2 Prove of Free from Memory Leak in my Implementation

Bibliography

[1] Wikipedia contributors. (2019, February 3). Encapsulation (computer programming). In *Wikipedia, The Free Encyclopedia.* Retrieved 10:19, March 23, 2019, from `https://en.wikipedia.org/w/index.php?title=Encapsulation_(computer_programming)&oldid=881507936`

[2] Wikipedia contributors. (2019, March 17). Reversi. In *Wikipedia, The Free Encyclopedia.* Retrieved 10:20, March 23, 2019, from `https://en.wikipedia.org/w/index.php?title=Reversi&oldid=888167585`

[3] Wikipedia contributors. (2019, March 15). Polymorphism (computer science). In *Wikipedia, The Free Encyclopedia.* Retrieved 10:21, March 23, 2019, from `https://en.wikipedia.org/w/index.php?title=Polymorphism_(computer_science)&oldid=887878749`

[4] Wikipedia contributors. (2019, February 27). Object-oriented programming. In *Wikipedia, The Free Encyclopedia.* Retrieved 10:22, March 23, 2019, from `https://en.wikipedia.org/w/index.php?title=Object-oriented_programming&oldid=885274966`

[5] Wikipedia contributors. (2019, February 21). Inheritance (object-oriented programming). In *Wikipedia, The Free Encyclopedia.* Retrieved 10:22, March 23, 2019, from `https://en.wikipedia.org/w/index.php?title=Inheritance_(object-oriented_programming)&oldid=884436146`