C++ For C Coders

Data Structures
C++ for C Coders

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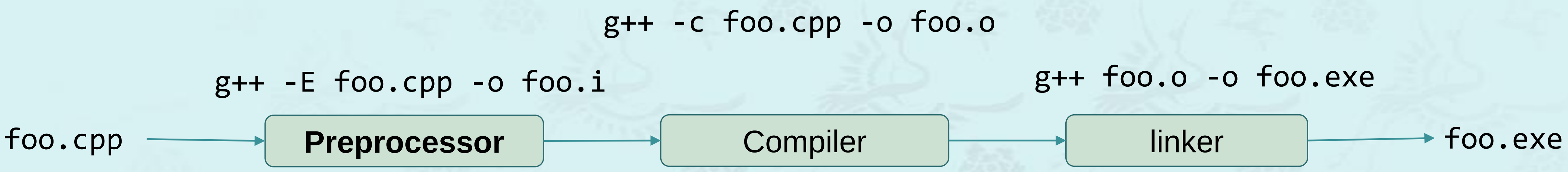
Introduction to the GNU C preprocessor
Header Files
Macros
Conditionals

NMN, DRY, KISS, NSE

Introduction to the GNU C preprocessor



```
g++ -c foo.cpp -o foo.o
```

```
g++ -E foo.cpp -o foo.i
```

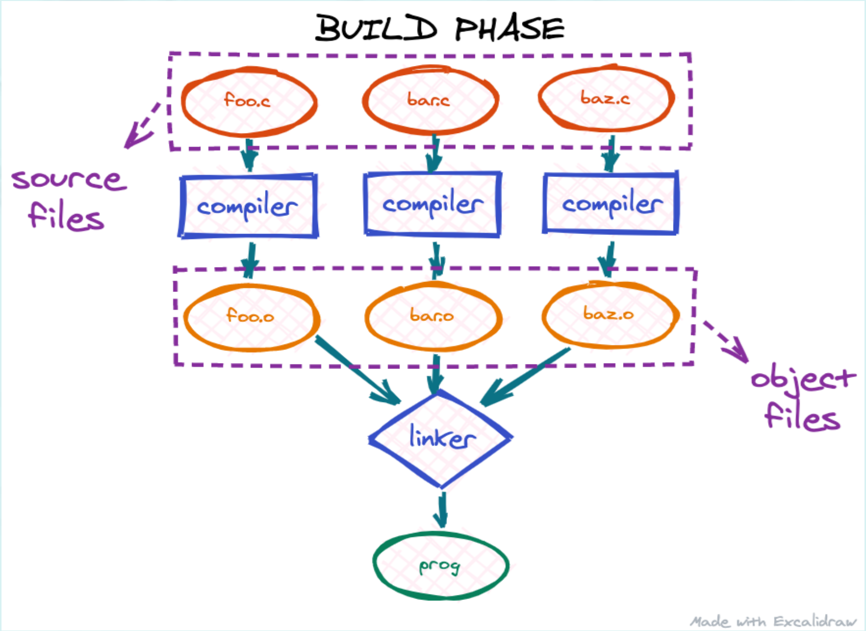
```
g++ foo.o -o foo.exe
```

foo.cpp → **Preprocessor** → Compiler → linker → foo.exe

```
foo.i
- Header files are included.
- Macros are replaced.
- Comments are removed.
```

```
foo.o
- object file
```

```
#define
#include
#ifdef               #endif
#if defined          #endif
#ifndef              #endif
#if                  #endif
#if      #else       #endif
```



Four main macro directives

1. Macros
2. File Inclusion
3. Conditional Compilation
4. Other directives
5. Predefined macros
6. Ref: https://gcc.gnu.org/onlinedocs/cpp/

1. Macros #define

Macros are pieces of code in a program that is given some name.

- #define - substitutes a preprocessor macro.

```
#include <iostream>

// macro definition
#define PI 3.141592
int main()
{
    double radius = 5;
    double area = PI * radius * radius;
    std::cout << "area = " << area << "\n";

    return 0;
}
```

2. Macros with Arguments

Macros are pieces of code in a program that is given some name.

- #define - substitutes a preprocessor macro.

```
#include <iostream>

// macro with parameter
#define SQUARE(a) ((a) * (a))
int main()
{
    int squared;
    int x = 100;
    squared = SQUARE(x);
    std::cout << "squared = " << squared;
    return 0;
}
```

```
#include <iostream>

// macro with parameter
#define MAX(x, y) ((x) > (y) ? (x) : (y))
int main()
{
    std::cout << "Max = " << MAX(10, 20);
    return 0;
}
```

3. File Inclusion #include

Macros are pieces of code in a program that is given some name.

- #include - inserts a particular header from another file.
- There are two types of files that can be included by the user in the program: Standard files and User-defined files.

```
#include <file_name>        // standard files
#include "file_name”
```

```
#include <stdio.h>
#include "myheader.h"
```

- The *filepath* is given to specify the directory.
- The contents of the header file is directly copy-pasted to the *sourcefile*.

```
g++ sourcefile -I filepath
```

4. Conditional Compilation

Controls the execution of the surrounded code.

- The 3 reasons it is used:
  - For different Operating Systems(Linux, MacOS, etc.)
  - To compile into different versions, using the same source file.
  - To refer as a comment.

Conditional Compilation directives:

- #undef – undefines a preprocessor macro.
- #ifdef – returns true if this macro is defined.
- #ifndef – returns true if this macro is not defined.
- #if – tests if a compile time condition is true.
- #else – the alternative for #if.
- #elif – #else and #if in one statement.
- #endif - ends preprocessor conditional.
- #error – prints error message on stderr.
- #pragma – issues special command to the compiler. compiler specific

5. Conditional Compilation Examples

```
#undef  FILE_SIZE
#define FILE_SIZE 10
```

```
#ifndef MESSAGE
   #define MESSAGE "Hello!"
#endif
```

```
#ifdef DEBUG
   // Your debugging statements here
#endif
```

This is useful if you pass the **-DDEBUG** flag to the gcc compiler at the time of compilation. This will define **DEBUG**, so you can turn debugging on and off on the fly during compilation.

Now, can you interpret what this macro does?

```
#ifdef DEBUG
  #define DPRINT(func) func;
#else
  #define DPRINT(func) ;
#endif
```

6. Predefined Macros

Macro	Value
__DATE__	A string containing the current date.
__FILE__	A string containing the file name.
__LINE__	An integer representing the current line number.
__STDC__	If follows ANSI standard C, then the value is a nonzero integer.
__TIME__	A string containing the current time.

```
#include <stdio.h>

int main() {
   printf("File :%s\n", __FILE__ );
   printf("Date :%s\n", __DATE__ );
   printf("Time :%s\n", __TIME__ );
   printf("Line :%d\n", __LINE__ );
   printf("ANSI :%d\n", __STDC__ );
}
```

```
File :test.cpp
Date :Mar 5 2023
Time :22:46:24
Line :7
ANSI :1
```

7. Header Guards

Example(rand.h):

```
#ifndef RAND_H
#define RAND_H

unsigned long rand_extended();

void randomize(int list[], int size);
int *randomize_insideout(int* list, int size);
void randomize_naive(int list[], int size);

#endif
```

Avoiding Macros in C++

- In C++, you should generally **avoid macros** when possible.
- **Inline functions** should also get rid of the need for macros for efficiency reasons.
- **Use const** to declare typed constants rather than #define to create untyped (and therefore less safe) constants.

In-house Coding Principles

- NMN – No Magic Number
- DRY – Do not Repeat Yourself
- NSE – No Side Effect
- KISS – Keep It Simple, Stupid!

NMN - No Magic Number

Example

```
#include <iostream>
using namespace std;

int main(int argc, char **argv} {
        …
}
```

Homework!

NSE – No Side Effect!

Example

```
#include <iostream>
using namespace std;

int add(int num1, int num2);

int main(int argc, char **argv} {
        int num1 = 5;
        int num2 = 5;

        int sum = add(num1, num2);
        printf("sum is: %d\n", &sum);
}

int add(int num1, int num2) {
        int sum = num1 + num2;

        printf("sum is: %d\n", sum);

        return sum;
}
```

```
Result:
$ sum is: 10
$ sum is: 10
```