

# Princeton University

## COS 217: Introduction to Programming Systems

### Building C Programs

```
#include <stdio.h>
/* Write "hello, world\n" to the standard
   output stream. Return 0. */
int main(void)
{
    printf("hello, world\n");
    return 0;
}
```

**hello.c**  
Source code  
C language  
Contains preprocessor  
directives

C Preprocessor

### Preprocess

gcc217 -E hello.c > hello.i

```
...
int printf(char *format, ...);
...
int main(void)
{
    printf("hello, world\n");
    return 0;
}
```

**hello.i**  
Source code  
C language  
Contains declaration of printf() function  
Missing definition of printf() function

C Compiler

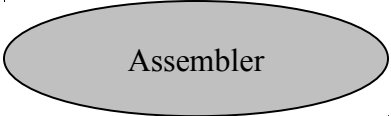
### Compile

gcc217 -S hello.i

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```
.section .rodata
cGreeting:
.asciz "hello, world\n"
.section .text
.globl main
.type main,@function
main:
pushl %ebp
movl %esp, %ebp
pushl $cGreeting
call printf
addl $4, %esp
movl $0, %eax
movl %ebp, %esp
popl %ebp
ret
```

**hello.s**  
Source code  
Assembly language  
Missing definition of printf() function



**Assemble**  
gcc217 -c hello.s

```
100101000110100100100...
```

**hello.o**  
Object code  
Machine language  
Missing definition of printf() function

```
11110010000010100100110...
```

**libc.a**  
Library containing  
machine language definition  
of printf() function (and many  
others)



**Link**  
gcc217 hello.o -lc -o hello

```
001010000101000000111110...
```

**hello**  
Executable code  
Machine language

```
Shortcut:
gcc217 hello.c -o hello
```

```
gcc217
is an abbreviation for
gcc -Wall -Wextra -ansi -pedantic -m32 -march=i386
```