

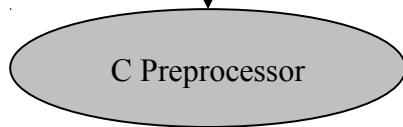
Princeton University
COS 217: Introduction to Programming Systems
Building C Programs

```
#include <stdio.h>

/* Write "hello, world\n" to stdout.
   Return 0. */

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

hello.c
Source code
C language
Contains preprocessor directives

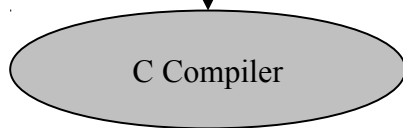


Preprocess

`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 *declarations* of `printf()` and many other functions
Missing *definition* of `printf()`



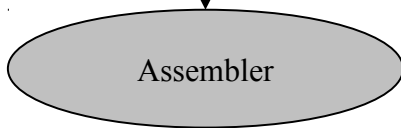
Compile

`gcc217 -S hello.i`

Continued on next page

```
.section ".rodata"
cGreeting:
.string "hello, world\n"
.section ".text"
.globl main
.type main,@function
main:
movq $cGreeting, %rdi
movl $0, %eax
call printf
movl $0, %eax
ret
```

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



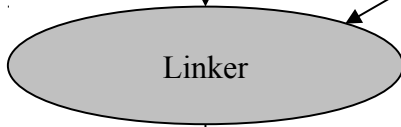
Assemble
`gcc217 -c hello.s`

```
100101000110100100100...
```

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

```
11110010000010100100110...
```

libc.a
Library containing
machine language definitions
of `printf()` and many
other functions



Link
`gcc217 hello.o -o hello`

```
001010000101000000111110...
```

hello
Executable code
Machine language
Contains definition of `printf()`

Shortcut:
`gcc217 hello.c -o hello`

```
gcc217
is an abbreviation for
gcc -Wall -Wextra -Wno-unused-parameter
-ansi -pedantic
```