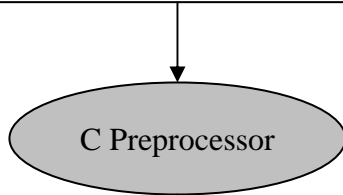# Princeton University
COS 217: Introduction to Programming Systems
Building C Programs

```
#include <stdio.h>
int main(void)
/* Print "hello, world\n" to stdout. */
{
   printf("hello, world\n");
   return 0;
}
```

hello.c
Source code
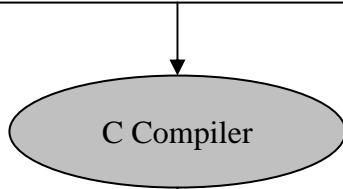C language
Contains preprocessor directives

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 <u>declaration</u> of printf() function
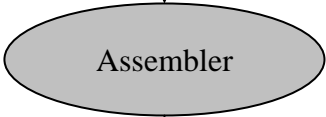Missing <u>definition</u> of printf() function

C Compiler

Compile
```
gcc217 –S hello.i
```

```
    .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
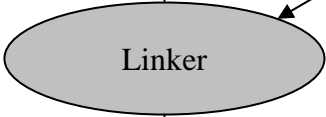Assembly language
Missing definition of printf() function

Assemble

`gcc217 −c hello.s`

```
100101000110100100100…
```

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

```
111100100000101001001100…
```

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

Assembler

Linker

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 −ansi −pedantic −m32 −march=i386
```