

What goes inside the compilation process?

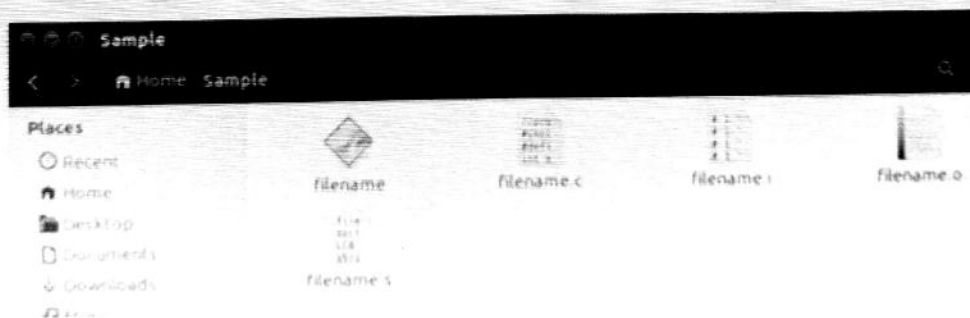
Compiler converts a C program into an executable. There are four phases for a C program to become an executable:

1. Pre-processing
2. Compilation
3. Assembly
4. Linking

By executing below command, We get the all intermediate files in the current directory along with the executable.

```
$gcc -Wall -save-temps filename.c -o filename
```

The following screenshot shows all generated intermediate files.



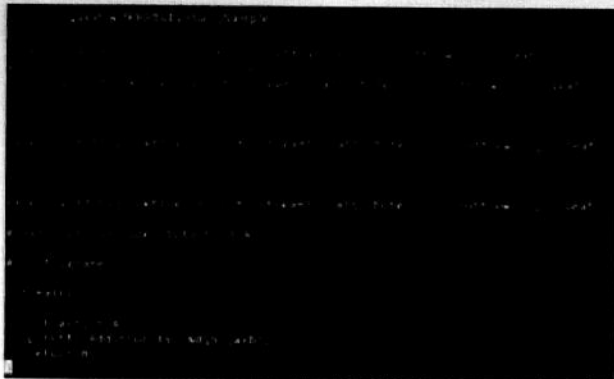
Let us one by one see what these intermediate files contain.

Pre-processing

This is the first phase through which source code is passed. This phase include:

- Removal of Comments
- Expansion of Macros
- Expansion of the included files.
- Conditional compilation

The preprocessed output is stored in the **filename.i**. Let's see what's inside filename.i: using \$vi filename.i



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```

Compiling

The next step is to compile filename.i and produce an; intermediate compiled output file **filename.s**. This file is in assembly level instructions. Let's see through this file using **\$vi filename.s**

```

gdb> w k f t b i n / x86_64-linux-gnu/libc.so.6
(gdb) disassemble $PC
0x7f9d1e100000: pushq   %rbp
0x7f9d1e100005: cfi_def_cfa_offset,16
0x7f9d1e10000a: cfi_offset,6,-16
0x7f9d1e10000d: movq    %rsp,%rbp
0x7f9d1e100010: cfi_def_cfa_register,0
0x7f9d1e100013: subq    $16,%rsp
0x7f9d1e100016: movl    $5,%i(%rbp)
0x7f9d1e100019: movl    $4,%i+4(%rbp)
0x7f9d1e10001c: movl    4(%rbp),%eax
0x7f9d1e10001f: movl    8(%rbp),%edx
0x7f9d1e100022: addl    %edx,%eax
0x7f9d1e100025: movl    %eax,%esi
0x7f9d1e100028: movl    $1,%edi

```

The snapshot shows that it is in assembly language, which assembler can understand.

Assembly

In this phase the filename.s is taken as input and turned into **filename.o** by assembler. This file contain machine level instructions. At this phase, only existing code is converted into machine language, the function calls like printf() are not resolved. Let's view this file using **\$vi filename.o**



Linking

Linking of function calls with the object files is implemented. Linker does not require any special environment like passing the file names as **name.o** and **\$size filename** to convert an object file to an executable program.

```

ubuntu ~/Sample
$ cd Sample
~/Sample$ size filename.o
text      data      bss       dec       hex filename.o
  16      128      16      160      100 filename.o
~/Sample$ size filename
text      data      bss       dec       hex filename
  16      128      16      160      100 filename
~/Sample$

```

linking, so printf() is dy