

```

M11212913@telnet:~$ cd SystemSoftware/
M11212913@telnet:~/SystemSoftware$ ls -l
total 20
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 C-Lang_Macro
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 dynlnk-demo
-rw-r--r-- 1 M11212913 telnet 136 2024-11-09 18:10 hello.c
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 kkk
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 stcInk-demo
M11212913@telnet:~/SystemSoftware$ gcc hello.c
M11212913@telnet:~/SystemSoftware$ ls -l
total 28
-rwxr-xr-x 1 M11212913 telnet 7087 2024-11-09 18:10 a.out
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 C-Lang_Macro
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 dynlnk-demo
-rw-r--r-- 1 M11212913 telnet 136 2024-11-09 18:10 hello.c
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 kkk
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 stcInk-demo
M11212913@telnet:~/SystemSoftware$ |

```

對 hello.c 用 gcc 產生一個大小 7k 左右的 a.out 執行檔。

```

M11212913@telnet:~/SystemSoftware$ cpp ./hello.c > main.c
M11212913@telnet:~/SystemSoftware$ ls -l
total 48
-rwxr-xr-x 1 M11212913 telnet 7087 2024-11-09 18:10 a.out
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 C-Lang_Macro
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 dynlnk-demo
-rw-r--r-- 1 M11212913 telnet 136 2024-11-09 18:10 hello.c
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 kkk
-rw-r--r-- 1 M11212913 telnet 17441 2024-11-09 18:11 main.c
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 stcInk-demo
M11212913@telnet:~/SystemSoftware$

```

`cpp ./hello.c > main.c`

對 hello.c 做前處理，這步驟展開所有巨集的部分，例如把 main.c 中 `#include <stdio.h>` 的部分取代為頭檔內的所有程式碼。

```

M11212913@telnet:~/SystemSoftware$ /usr/lib/i386-linux-gnu/gcc/i686-linux-gnu/4.5/cc1 main.c
main
Analyzing compilation unit
Performing interprocedural optimizations
<*free_lang_data> <visibility> <early_local_cleanups> <whole-program> <inline>Assembling functions:
main
Execution times (seconds)
lexical analysis      : 0.00 ( 0%) usr 0.00 ( 0%) sys 0.01 (100%) wall 0 kB ( 0%) gcc
TOTAL                : 0.00                      0.01                      747 kB
M11212913@telnet:~/SystemSoftware$ ls -l
total 52
-rwxr-xr-x 1 M11212913 telnet 7087 2024-11-10 03:28 a.out
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-10 03:26 C-Lang_Macro
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-10 03:26 dynlnk-demo
-rw-r--r-- 1 M11212913 telnet 136 2024-11-10 03:26 hello.c
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-10 03:26 kkk
-rw-r--r-- 1 M11212913 telnet 17441 2024-11-10 03:28 main.c
-rw-r--r-- 1 M11212913 telnet 468 2024-11-10 03:28 main.s
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-10 03:26 stcInk-demo
-rw-r--r-- 1 M11212913 telnet 0 2024-11-10 03:27 typescript

```

[/usr/lib/i386-linux-gnu/gcc/i686-linux-gnu/4.5/cc1 main.c](#)

對 main.c compiler 產生名為 main.s 的 x86 組合語言檔。

```
M11212913@telnet:~/SystemSoftware$ as -o main.o main.s
M11212913@telnet:~/SystemSoftware$ ls -l
total 56
-rwxr-xr-x 1 M11212913 telnet 7087 2024-11-09 18:10 a.out
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 C-Lang_Macro
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 dynlnk-demo
-rw-r--r-- 1 M11212913 telnet 136 2024-11-09 18:10 hello.c
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 kkk
-rw-r--r-- 1 M11212913 telnet 17441 2024-11-09 18:11 main.c
-rw-r--r-- 1 M11212913 telnet 884 2024-11-09 18:12 main.o
-rw-r--r-- 1 M11212913 telnet 468 2024-11-09 18:11 main.s
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 stcInk-demo
M11212913@telnet:~/SystemSoftware$ |
```

[as -o main.o main.s](#)

對 main.s 組譯，產生名為 main.o 的 object 檔。

```
M11212913@telnet:~/SystemSoftware$ ld -o main.out /usr/lib/crt1.o /usr/lib/crti.o /usr/lib/i386-linux-gnu/gcc/i686-linux-gnu/4.5/crtbegin.o ./main.o -lc -lgcc -lgcc_s /usr/lib/i386-linux-gnu/gcc/i686-linux-gnu/4.5/crtend.o /usr/lib/crtn.o -L /usr/lib/i386-linux-gnu/gcc/i686-linux-gnu/4.5 -L /usr/i686-pc-linux-gnu/lib -L /usr/lib/ -dynamic-linker /lib/ld-linux.so.2
M11212913@telnet:~/SystemSoftware$ ls -l
total 64
-rwxr-xr-x 1 M11212913 telnet 7087 2024-11-09 18:10 a.out
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 C-Lang_Macro
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 dynlnk-demo
-rw-r--r-- 1 M11212913 telnet 136 2024-11-09 18:10 hello.c
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 kkk
-rw-r--r-- 1 M11212913 telnet 17441 2024-11-09 18:11 main.c
-rw-r--r-- 1 M11212913 telnet 884 2024-11-09 18:12 main.o
-rwxr-xr-x 1 M11212913 telnet 4378 2024-11-09 18:12 main.out
-rw-r--r-- 1 M11212913 telnet 468 2024-11-09 18:11 main.s
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 stcInk-demo
M11212913@telnet:~/SystemSoftware$ |
```

[ld -o main.out /usr/lib/crt1.o /usr/lib/crti.o /usr/lib/i386-linux-gnu/gcc/i686-linux-gnu/4.5/crtbegin.o ./main.o -lc -lgcc -lgcc_s /usr/lib/i386-linux-gnu/gcc/i686-linux-gnu/4.5/crtend.o /usr/lib/crtn.o -L /usr/lib/i386-linux-gnu/gcc/i686-linux-gnu/4.5 -L /usr/i686-pc-linux-gnu/lib -L /usr/lib/ -dynamic-linker /lib/ld-linux.so.2](#)

連結上述 library，產生一個大小 4k 多，名為 main.out 的執行檔。

```

-rwxr-xr-x 1 M11212913 telnet 7087 2024-11-09 18:10 a.out
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 C-Lang_Macro
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 dynlnk-demo
-rw-r--r-- 1 M11212913 telnet 136 2024-11-09 18:10 hello.c
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 kkk
-rw-r--r-- 1 M11212913 telnet 17441 2024-11-09 18:11 main.c
-rw-r--r-- 1 M11212913 telnet 884 2024-11-09 18:12 main.o
-rwxr-xr-x 1 M11212913 telnet 4378 2024-11-09 18:12 main.out
-rw-r--r-- 1 M11212913 telnet 468 2024-11-09 18:11 main.s
drwxr-xr-x 2 M11212913 telnet 4096 2024-11-09 18:10 stclnk-demo
M11212913@telnet:~/SystemSoftware$

```

與 gcc 產生的執行檔相比，四個步驟產生的執行檔大小比較小。

```

M11212913@telnet:~/SystemSoftware$ ldd main.out
linux-gate.so.1 => (0xb788a000)
libc.so.6 => /lib/i386-linux-gnu/libc.so.6 (0xb7719000)
libgcc_s.so.1 => /lib/i386-linux-gnu/libgcc_s.so.1 (0xb76fd000)
/lib/ld-linux.so.2 (0xb788b000)
M11212913@telnet:~/SystemSoftware$ ldd a.out
linux-gate.so.1 => (0xb7857000)
libc.so.6 => /lib/i386-linux-gnu/libc.so.6 (0xb76e6000)
/lib/ld-linux.so.2 (0xb7858000)
M11212913@telnet:~/SystemSoftware$

```

```

bash: ./a: no such file or directory
M11212913@telnet:~/SystemSoftware$ ./a.out
Hello World!
M11212913@telnet:~/SystemSoftware$ ./main.out
Hello World!
M11212913@telnet:~/SystemSoftware$

```