Introduction to Computer Science
Fall 2022
#14

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Topics

- Problem Solving with Programming Language
- C Programming
  - C Basics
    - Variables
    - Flow of Control
    - Function Basics
    - Programming with Arrays
    - Strings
    - Structures
    - Streams and File I/O
- Google Cloud Platform/Cloud Shell Editor (gcc/g++/Makefile)
- Google Cloud Platform/Cloud Source Repositories (git)

好好学习 C++!

Solving problem, baby!

Problem Solving with Programming Language

- Main goal is to **solve problem**
  - Programming language is NOT important
  - Can use any PL to solve your problem
  - Why C
    - You can deploy anything by using C
    - Anything you imagined
  - C is a common PL in the world

電腦對於**資工人**來說

- 電腦他什麼都不會
- 除非...
- We have to tell a computer what to do!
- We tell a computer what to do by **writing** a computer **program** (or **algorithm**)
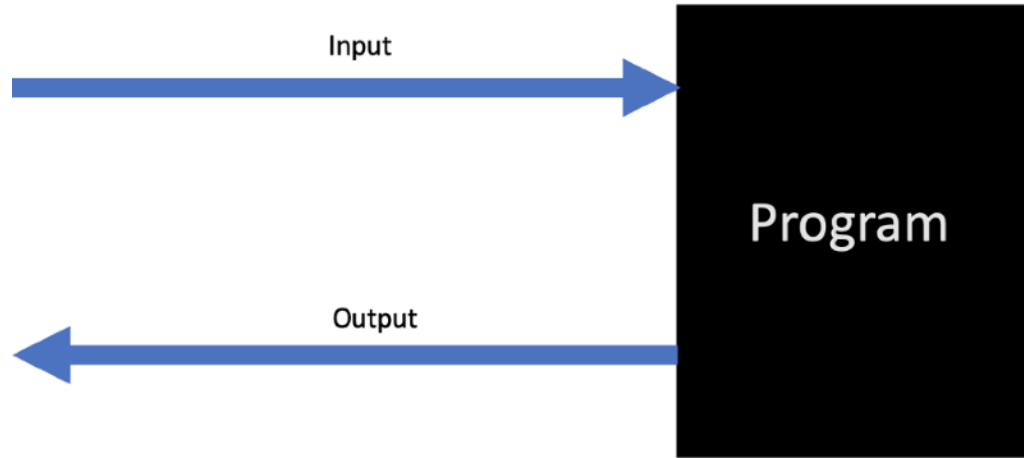
Algorithms (演算法)

- A **step-by-step** problem-solving procedure, especially an established, recursive <u>computational procedure</u> for solving a problem in <u>**a finite number of steps**</u>

Problem Solving

- What is problem solving?
  - Input
  - Output

Input →

Program

Output ←

<u>Problem Solving in your head!</u>

- <u>Tell a computer what to do to solve a problem</u>
  - You can imagine a computer in your head!
  - You have to learn this!
  - You can write down the code without a complier!
  - Divide and conquer
    - 把大步驟**切割**成小步驟然後**解決**小步驟
    - 在你腦中無法解決？
      - 再切割一次
      - 直到你可以想像問題在你腦中運行並解決他

<u>Problem Solving in your head!</u>

- 給你一堆數字，找到最大的哪個
  - 『11, 23, 13, 54, 25, 61, 27, 18, 34, 17』
- 假設你是一台電腦！
  - 你要怎麼做！
  - 閉上的你眼
    - 想像一下！

Find the max number

- Input: 『11, 23, 13, 54, 25, 61, 27, 18, 34, 17』
- 想像：
  - 需要一個Loop (迴圈)，跑 n 次，每跑一次減 1
  - 遇到目前最大的存起來
  - 直到Loop結束，減到零

  Find_max_number
  O(n)

- Output: 61

n=10

問題：當n很大很大時怎麼辦？

Find the max and min number

- Input: 『11, 23, 13, 54, 25, 61, 27, 18, 34, 17』
- 想像：
  - 一個類似的問題
  - 兩個Loop
    - 各跑一次
- Output: 61, 11
- Can we do better?

61 = Find_max_number

11 = Find_min_number

O(**2n**) = O(**n**)

問題：可以用一個迴圈嗎？

Problem Solving

- 拆解問題，想像問題
    - Input
    - Output
    - **Before you do anything**
        - **Understand and define the problem first!**
        - **Understand and define the problem first!**
        - **Understand and define the problem first!**
    - Think the problem in your head
        - Running it **by steps** in your head

C Programming

- Dennis Ritchie, Bell Lab, 1972
- General-purpose
- Structured programming
- A successor to the PL B
- **Easy** to learn but **Hard** to master
  - 自由度太高，什麼都可以。
- Very **efficient** programming language

THE C PROGRAMMING LANGUAGE

C 使用環境設定

- 環境設定

  - 先用線上的編譯環境

  - 之後會介紹GCP和怎麼在雲端上編譯C

  - 透過下面的網站，可以馬上開始練習 C

  https://www.programiz.com/c-programming/online-compiler/

  https://www.onlinegdb.com/online_c_compiler

https://www.onlinegdb.com/

Helle, world in C

- Input: None
- Output: 印出 **"Helle, world！"**
- 拆解問題，想像問題
  - 沒有Input
  - 要電腦印出 一串字 **"Helle, world！"**
  - 也就是output "Helle, world！"

```c
#include <stdio.h>

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

Hello, World

...Program finished with exit code 0
Press ENTER to exit console.

Main function
程式的進入點
一定要存在的 function

一個function
所以有
Input : void
Return: int 0

所以 main是有input的
我們之後會介紹
需要用到pointer 指標

```c
1  #include <stdio.h>
2
3  int main(void) {
4      printf("Hello, World\n");
5      return 0;
6  }
7
```

Hello, World

...Program finished with exit code 0
Press ENTER to exit console.

有**分號**；
請注意！

```
1  #include <stdio.h>
2
3  int main(void) {
4      printf("Hello, World\n");
5      return 0;
6  }
7
```

Hello, World

...Program finished with exit code 0
Press ENTER to exit console.

printf function

一個function
所以有
Input：要印的字
Return: ??
等等試試看 return是什麼

Input
"Hello, World\n"

```
1   #include <stdio.h>
2
3   int main(void) {
4       printf("Hello, World\n");
5       return 0;
6   }
7
```

```
Hello, World


...Program finished with exit code 0
Press ENTER to exit console.
```

Main function

Return: int 0
為什麼要回傳 0 ？
回傳給誰？
有什麼用？
可以不要回傳嗎？

```c
#include <stdio.h>

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

```
Hello, World

...Program finished with exit code 0
Press ENTER to exit console.
```

function
的範圍 (scope)
void func() {

}

請注意code style
不要寫出不一樣的style

CJ 21

```c
#include <stdio.h>

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

Main function output

印出要印的字串

怎麼知道要印在這裡？

或者是為什麼會印在這裡？

Hello, World

...Program finished with exit code 0
Press ENTER to exit console.

```c
#include <stdio.h>

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

Hello, World

...Program finished with exit code 0
Press ENTER to exit console.

Console
stdout
也是
stdin
stderr
當你打開一個
terminal (SSH)
他就是一個
console

```c
1  #include <stdio.h>
2
3  int main(void) {
4      printf("Hello, World\n");
5      return 0;
6  }
7
```

Header file
Standart IO
Input/Output
File operations
一個程式預設有
stdin
stdout
stderr
定義在這個檔案裡

Hello, World

...Program finished with exit code 0
Press ENTER to exit console.

CJ 24

```c
#include <stdio.h>

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

```
Hello, World

...Program finished with exit code 0
Press ENTER to exit console.
```

printf function

這裡指印到file

印到哪個file?

預設就是
stdout

```c
#include <stdio.h>

int main()
{
    printf("顯示字元          = %c\n", 'A');
    printf("顯示字元編碼      = %d\n", 'A');
    printf("顯示字元編碼      = %c\n", 65);
    printf("顯示十進位整數    = %d\n", 15);
    printf("顯示十六進位整數= %X\n", 15);
    printf("顯示十六進位整數= %x\n", 15);
    printf("字串              = %s\n", "顯示字串");
    return 0;
}
```

```
顯示字元          = A
顯示字元編碼      = 65
顯示字元編碼      = A
顯示十進位整數    = 15
顯示十六進位整數= F
顯示十六進位整數= f
字串              = 顯示字串
```

printf(),
this function
%i

printf 處理2, 8, 16 進位

```c
#include <stdio.h>
int main(void) {
    printf("二進位    %d\n", 0b11);
    printf("八進位    %d\n", 070);
    printf("十六進位 %d\n", 0xFF);
    return 0;
}
```

```
二進位    3
八進位    56
十六進位  255

...Program finished with exit code 0
Press ENTER to exit console.
```

```c
#include <stdio.h>

int main() {
    printf("顯示字元            = %c\n", 'A');
    printf("顯示字元編碼        = %d\n", 'A');
    printf("顯示字元編碼        = %c\n", 65);
    printf("顯示十進位整數      = %d\n", 15);
    printf("顯示十六進位整數= %X\n", 15);
    printf("顯示十六進位整數= %x\n", 15);
    printf("字串                = %s\n", "顯示字串");
    return 0;
}
```

printf(),
this function
這是一個非常重要的
function

```
顯示字元            = A
顯示字元編碼        = 65
顯示字元編碼        = A
顯示十進位整數      = 15
顯示十六進位整數= F
顯示十六進位整數= f
字串                = 顯示字串

...Program finished with exit code 0
Press ENTER to exit console.
```

```c
#include <stdio.h>
int main() {
    printf("\t\t %s Love %s\n", "IU", "CGU");
    return 0;
}
```

```
                IU Love CGU

...Program finished with exit code 0
Press ENTER to exit console.
```

怎麼知道一個執行檔？

- Windows
  - .exe
  - .com
- Linux
  -

```
-rwxr-xr-x  1 cjw  staff   359B 10 17  2004 seedcheck.pl
-rwxr-xr-x  1 cjw  staff   1.2K  2  4  2005 showbw.pl
-rwxr-xr-x  1 cjw  staff   1.0K 10 17  2004 timefinish.pl
-rwxr-xr-x  1 cjw  staff   2.8K  6 20  2005 timeseries.pl
-rwxr-xr-x  1 cjw  staff   409B 10 17  2004 tmp111.tex
-rwxr-xr-x  1 cjw  staff   1.9K  2  7  2005 unfinished.pl
-rwxr-xr-x     cjw  staff   272B 10 17  2004 vssver.scc
```
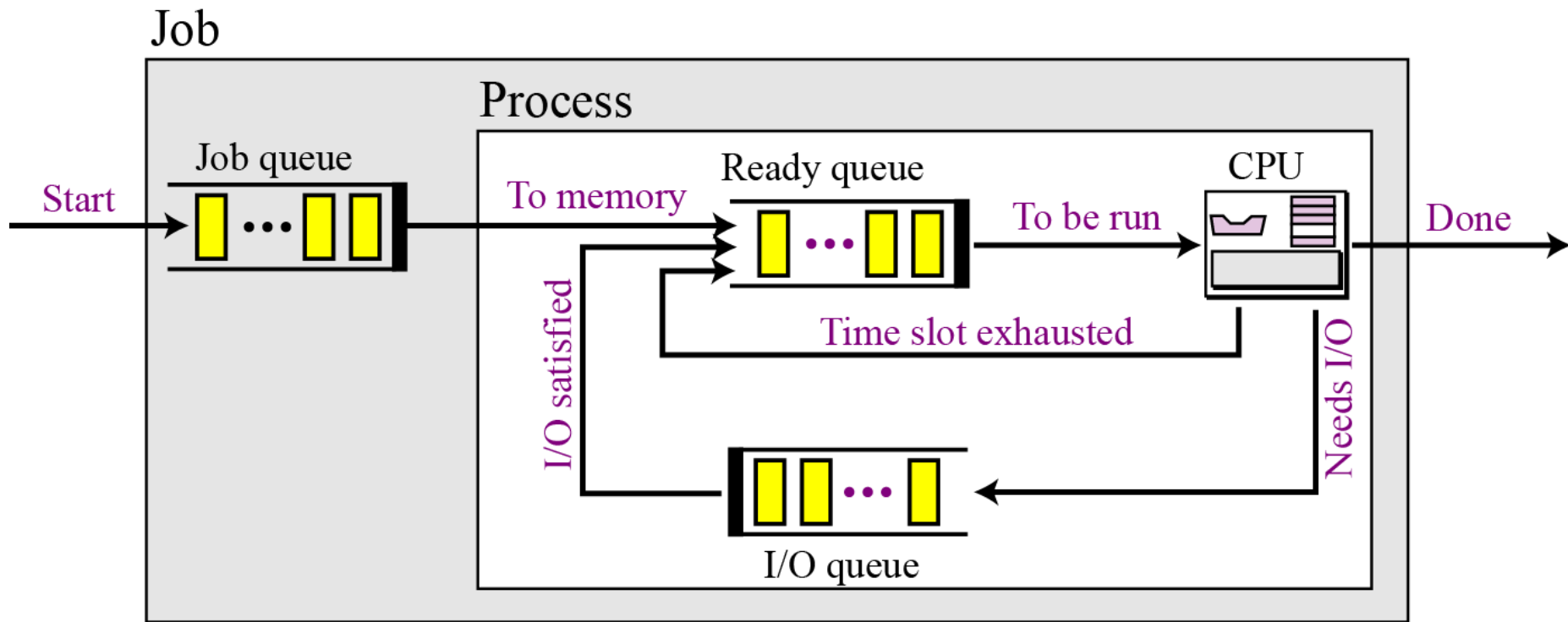
ELF檔案

- 可執行檔案的標準檔案格式
- 編譯後形成一種告訴OS
  - 我可以被執行
  - 我可以被載進記憶體執行

ELF Header
.text
.data
.bss
Other sections
Section header table
String table
Relocation tables
Symbol table

```
$ hexdump -C max.o
00000000  7f 45 4c 46 01 01 01 00  00 00 00 00 00 00 00 00  |.ELF............|
00000010  01 00 03 00 01 00 00 00  00 00 00 00 00 00 00 00  |................|
00000020  c8 00 00 00 00 00 00 00  34 00 00 00 00 00 28 00  |........4.....(.|
```

程式編譯好後開始執行

Printf 技巧

對齊

```c
#include <stdio.h>
int main(void) {
    printf("十進位 %4d\n", 1);
    printf("十進位 %4d\n", 10);
    printf("十進位 %4d\n", 100);
    printf("十進位 %4d\n", 1000);
    return 0;
}
```

```
十進位    1
十進位   10
十進位  100
十進位 1000

...Program finished with exit code 0
Press ENTER to exit console.
```

Printf
浮點數

```c
#include <stdio.h>
int main(void) {
    printf("浮點數: %8.4f\n", 123.45);
    printf("浮點數: %8.4f\n", 12.345);
    printf("浮點數: %8.4f\n", 1.2345);
    return 0;
}
```

```
浮點數: 123.4500
浮點數:  12.3450
浮點數:   1.2345


...Program finished with exit code 0
Press ENTER to exit console.
```

Printf
控制空白

```c
#include <stdio.h>
int main(void) {
    printf("%*d\n", 1, 1);
    printf("%*d\n", 2, 1);
    printf("%*d\n", 3, 1);
    return 0;
}
```

```
1
 1
  1

...Program finished with exit code 0
Press ENTER to exit console.
```

Printf
前面補零

```c
#include <stdio.h>
int main(void) {
    printf("%0*d\n", 4, 1);
    printf("%0*d\n", 4, 10);
    printf("%0*d\n", 4, 100);
    return 0;
}
```

```
0001
0010
0100


...Program finished with exit code 0
Press ENTER to exit console.
```

Printf
控制
顯示
字串長度

```c
1  #include <stdio.h>
2  int main(void) {
3      printf("%.*s\n", 12, "ILOVECGUCSIE");
4      printf("%.*s\n", 5, "ILOVECGUCSIE");
5      printf("%.*s\n", 1, "ILOVECGUCSIE");
6      return 0;
7  }
```

```
ILOVECGUCSIE
ILOVE
I


...Program finished with exit code 0
Press ENTER to exit console.
```

Printf
特殊符號
%
"
'
\
\a

```c
#include <stdio.h>
int main(void) {
    printf("%.2f%%\n", 1.2);
    printf("%.2f\"\n", 1.234);
    printf("%.2f\'\n", 1.234);
    printf("%.2f\\\n", 1.234);
    printf("%.2f\a", 1.234);
    return 0;
}
```

```
1.20%
1.23"
1.23'
1.23\
1.23

...Program finished with exit code 0
Press ENTER to exit console.
```

```c
#include <stdio.h>
int main(void) {
    printf("教師： %4s\t課程：%8s\n", "AAAA", "BBB");
    printf("教師： %4s\t課程：%8s\n", "AA", "BBBBBBB");
    printf("學校： %4s\t系所： %4s\t教師： %4s\t課程：%8s\n",
                        "CGU",
                        "CSIE",
                        "CJWU",
                        "CS");
    return 0;
}
```

Whitespace

NO Tab!

input

教師： AAAA   課程：   BBB
教師：   AA   課程： BBBBBBB
學校： CGU   系所： CSIE   教師： CJWU   課程：   CS

A Line Should Not Exceed 70 Characters

如果我們要印10個0
Printf

```
0000000000

...Program finished with exit code 0
Press ENTER to exit console.
```

Printf 印10個0

```
1  #include <stdio.h>
2  int main(void) {
3      printf("%0*d", 10, 0);
4      return 0;
5  }
6
```

```
0000000000

...Program finished with exit code 0
Press ENTER to exit console.
```

Conclusion

- Problem Solving with Programming Language
- C Programming
- C Basics
  - Main function
  - printf

C++開發者在學習 python的時候：

Python開發者在學習 C++的時候：

Why we learn C/C++

練習 printf

一定要練習，這幾年你程式

output應該都是**console**

https://www.programiz.com/c-programming/online-compiler/

https://www.onlinegdb.com/online_c_compiler

請打開online complier 試一下！

https://www.programiz.com/c-programming/online-compiler/

```c
#include <stdio.h>

int main() {
    printf("%d\n", printf("IU\n"));
    return 0;
}
```

這會跑出什麼？

```c
#include <stdio.h>
int
main(){int i,n[]={((((1<<1)<<(1<<1)<<(1<<
1)<<(1<<(1>>1))))+((1<<1)<<(1<<1))), (((1
<<1)<<(1<<1)<<(1<<1)<<(1<<1))-((1<<1)<<(
1<<1)<<(1<<1))+((1<<1)<<(1<<(1>>1)))+ (1
<<(1>>1))),(((1<<1)<<(1<<1)<<(1<<1)<< (1
<<1))-((1<<1)<<(1<<1)<<(1<<(1>>1)))- ((1
<<1)<<(1<<(1>>1)))),(((1<<1)<<(1<<1)<<(1
<<1)<<(1<<1))-((1<<1)<<(1<<1)<<(1<<(1>>1
)))-((1<<1)<<(1<<(1>>1)))),(((1<<1)<< (1
<<1)<<(1<<1)<(1<<1))-((1<<1)<<(1<<1)<<(
1<<(1>>1)))-(1<<(1>>1))),(((1<<1)<<(1<<1
)<<(1<<1))+((1<<1)<<(1<<1)<<(1<<(1>>1)))
-((1<<1)<<(1<<(1>>1)))),((1<<1)<< (1<<1)
<<(1<<1)),(((1<<1)<<(1<<1)<<(1<<1)<<(1<<
1))-((1<<1)<<(1<<1))-(1<<(1>>1))),(((1<<
1)<<(1<<1)<<(1<<1)<<(1<<1))-((1<<1)<< (1
<<1)<<(1<<(1>>1)))-(1<<(1>>1))), (((1<<1
)<<(1<<1)<<(1<<1)<<(1<<1))- ((1<<1)<< (1
<<1)<<(1<<(1>>1)))+(1<<1)), (((1<<1)<< (
1<<1)<<(1<<1)<< (1<<1))-((1<<1)<< (1<<1)
<<(1<<(1>>1)))-((1<<1) <<(1<< (1>>1)))),
(((1<<1)<< (1<<1)<<(1<<1)<< (1<<1))- ((1
<<1)<<(1<<1)<<(1<<1))+((1<<1)<< (1<<(1>>
1)))), (((1<<1)<<(1<<1) <<(1<<1))+(1<<(1
>>1))),(((1<<1)<<(1<<1))+((1<<1)<< (1<<(
1>>1))) + (1<< (1>>1)))}; for(i=(1>>1));i
<(((1<<1) <<(1<<1))+((1 <<1)<< (1<<(1>>1
))) + (1<<1)); i++) printf("%c", n[i]); }
```

C是很恐怖的

```c
#include <stdio.h>
int
main(){int i,n□={((((1<<1)<<(1<<1)<<(1<<
1)<<(1<<(1>>1))))+((1<<1)<<(1<<1))), (((1
<<1)<<(1<<1)<<(1<<1)<<(1<<1))-((1<<1)<<(
1<<1)<<(1<<1))+((1<<1)<<(1<<(1>>1)))+ (1
<<(1>>1))),(((1<<1)<<(1<<1)<<(1<<1)<< (1
<<1))-((1<<1)<<(1<<1)<<(1<<(1>>1)))- ((1
<<1)<<(1<<(1>>1)))),(((1<<1)<<(1<<1)<<(1
<<1)<<(1<<1))-((1<<1)<<(1<<1)<<(1<<(1>>1
)))-((1<<1)<<(1<<(1>>1)))),(((1<<1)<< (1
<<1)<<(1<<1)<<(1<<1))-((1<<1)<<(1<<1)<<(
1<<(1>>1)))-(1<<(1>>1))),(((1<<1)<<(1<<1
)<<(1<<1))+((1<<1)<<(1<<1)<<(1<<(1>>1)))
-((1<<1)<<(1<<(1>>1)))),((1<<1)<< (1<<1)
<<(1<<1)),(((1<<1)<<(1<<1)<<(1<<1)<<(1<<
1))-((1<<1)<<(1<<1))-(1<<(1>>1))),(((1<<
1)<<(1<<1)<<(1<<1)<<(1<<1))-((1<<1)<< (1
<<1)<<(1<<(1>>1)))-(1<<(1>>1))), (((1<<1
)<<(1<<1)<<(1<<1)<<(1<<1))- ((1<<1)<< (1
<<1)<<(1<<(1>>1)))+(1<<1)), (((1<<1)<< (
1<<1)<<(1<<1)<< (1<<1))-((1<<1)<< (1<<1)
<<(1<<(1>>1)))-((1<<1) <<(1<< (1>>1)))),
(((1<<1)<< (1<<1)<<(1<<1)<< (1<<1))- ((1
<<1)<<(1<<1)<<(1<<1))+((1<<1)<< (1<<(1>>
1)))), (((1<<1)<<(1<<1) <<(1<<1))+(1<<(1
>>1))),(((1<<1)<<(1<<1))+((1<<1)<< (1<<(
1>>1))) + (1<< (1>>1)))}; for(i=(1>>1);i
<(((1<<1) <<(1<<1))+((1 <<1)<< (1<<(1>>1
))) + (1<<1)); i++) printf("%c", n[i]); }
```

C是很恐怖的

這是Hello, World!

```
Hello, world!

...Program finished with exit code 0
Press ENTER to exit console.□
```

```c
1  #include <stdio.h>
2  #define _____ }
3  #define _____ putchar
4  #define _____ main
5  #define _____R int
6  #define _(a) _____(a);
7  #define _____ _____R _____(){
8  #define __ _____ _(0x48)_(0x65)_(0x6C)_(0x6C)
9  #define ___ _(0x6F)_(0x2C)_(0x20)_(0x77)_(0x6F)
10 #define ____ _(0x72)_(0x6C)_(0x64)_(0x21)
11 #define _____ __ ___ ____ _____
12 #include<stdio.h>
13 _____
```

Hello, world!

...Program finished with exit code 0
Press ENTER to exit console.

C是很恐怖的
這也是Hello, World!

QZ#1

- 印出一個五個星星的正方形
- 請commit 到你的 github
- main.c

```c
#include <stdio.h>

int main() {


    return 0;
}
```

```
*****
*****
*****
*****
*****
```

Thanks!

Open for any questions

CJ Wu

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