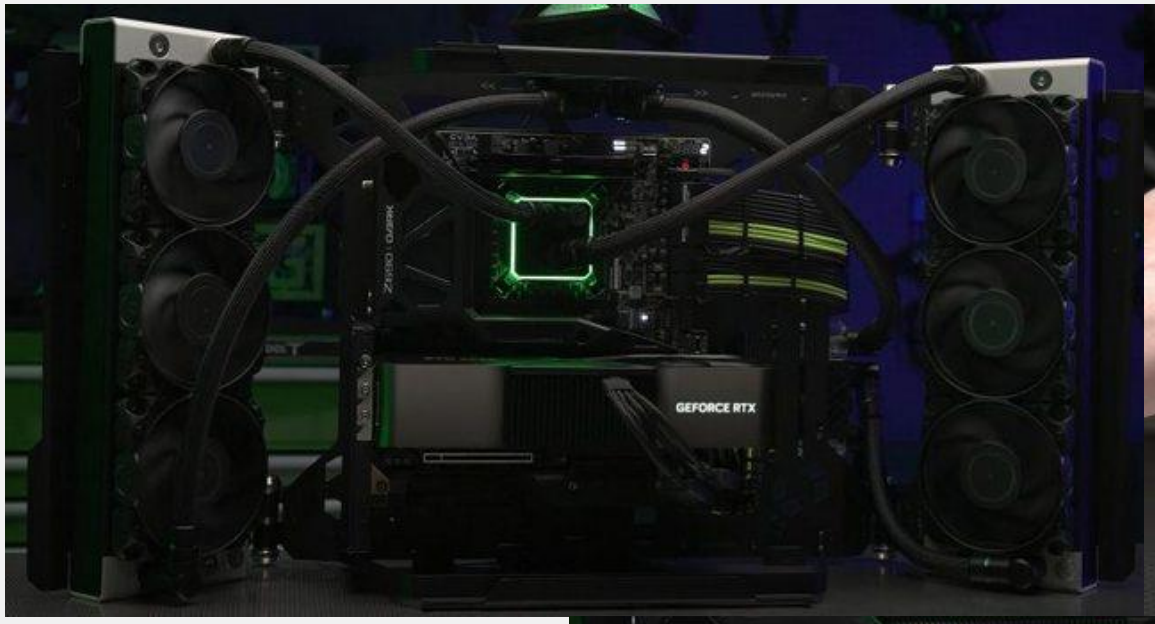
# Introduction of C

# Index



# Abstract

RTX 4090



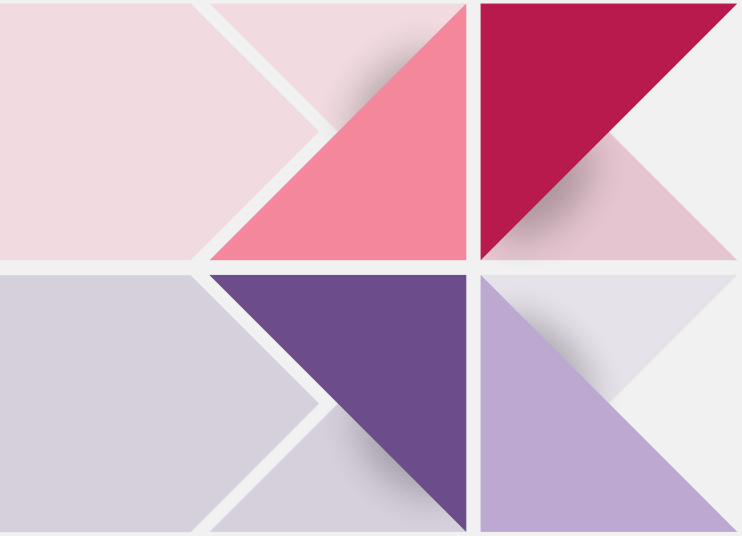



[Link]

# Abstract

RTX 4090


Link



# 01
# History

# History

## Computer Science Father

### Alan Mathison Turing

### 艾倫·麥席森·圖靈

### 1912.06 - 1954.06 (41歲)

研究領域: 數學、密碼分析、邏輯學及電腦科學 、數理生物學

運動領域: 是一位世界級的長跑運動員，馬拉松最好成績是2小時46分03秒(手動計時)，比1948年奧林匹克運動會金牌成績慢11分鐘。1948年的一次越野賽跑中，他跑贏了同年奧運會銀牌得主湯姆·理查茲。

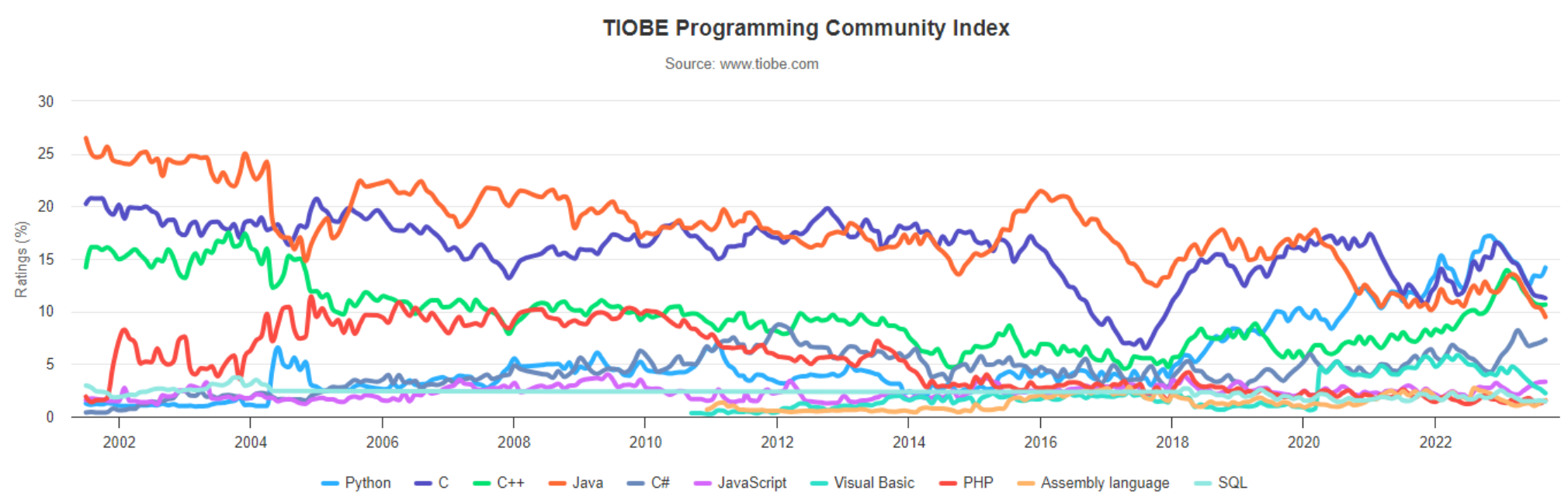


Link

# History

## Why C?

| Sep 2023 | Sep 2022 | Change | Programming Language | Ratings | Change |
|---|---|---|---|---|---|
| **1** | **1** | | **Python** | **14.16%** | **-1.58%** |
| 2 | 2 | | C | 11.27% | -2.70% |
| 3 | 4 | ▲ | C++ | 10.65% | +0.90% |
| 4 | 3 | ▼ | Java | 9.49% | -2.23% |

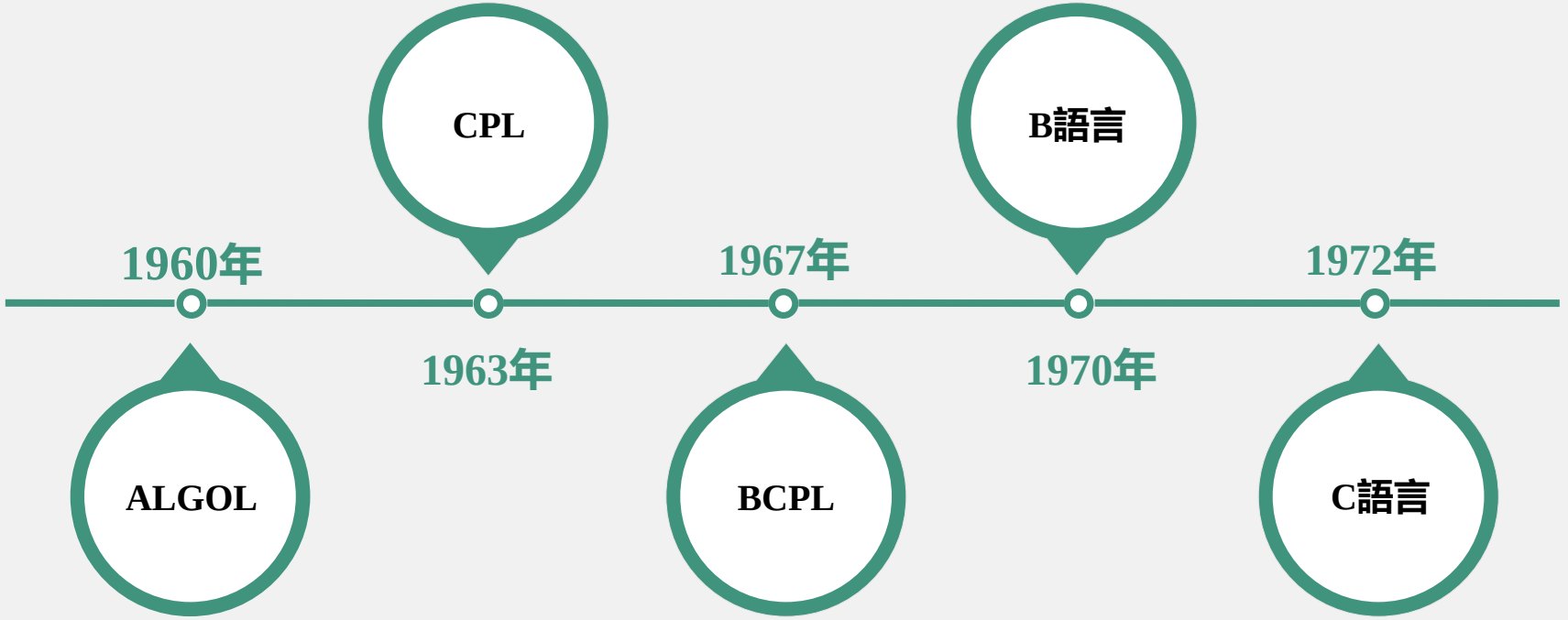



Link

# History

## Inspiration

C是美國貝爾實驗室的Dennis Ritchie以B語言為基礎所開發的，現今Windows與UNIX系列的作業系統內大部分也是用C語言設計的



# History

## Inspiration

Martin Richards

Ken Thompson Dennis Ritchie

DEC PDP-7

Link

# History

## Inspiration

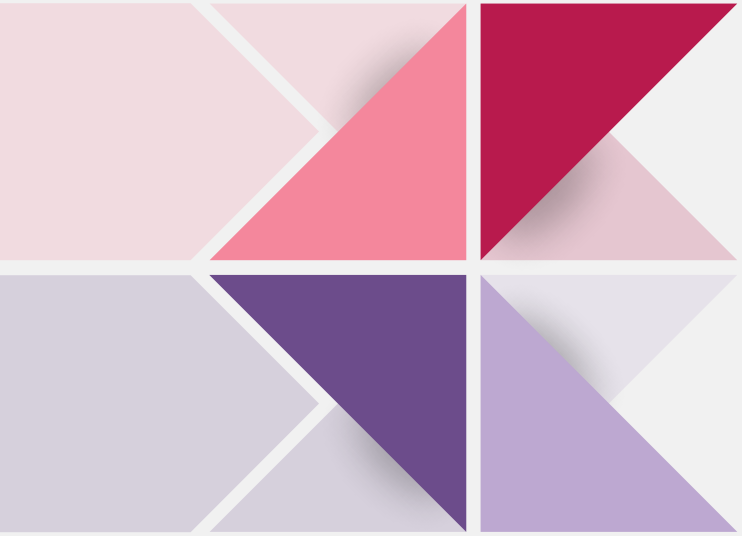
優點

1. 簡潔方便 - 只有32個關鍵字，9個控制語句
2. 允許直接存取記憶體位址，控制硬體
3. 可移植性高 - 不同機器上的C編譯程式有86%是公用程式碼，編譯程式方便移植

…

缺點

語法限制較不嚴格，使得程式安全性較低，因此從應用的角度來看，C語言使用者對於程式設計的熟練度要高一點



# 02
# Compile and Execution

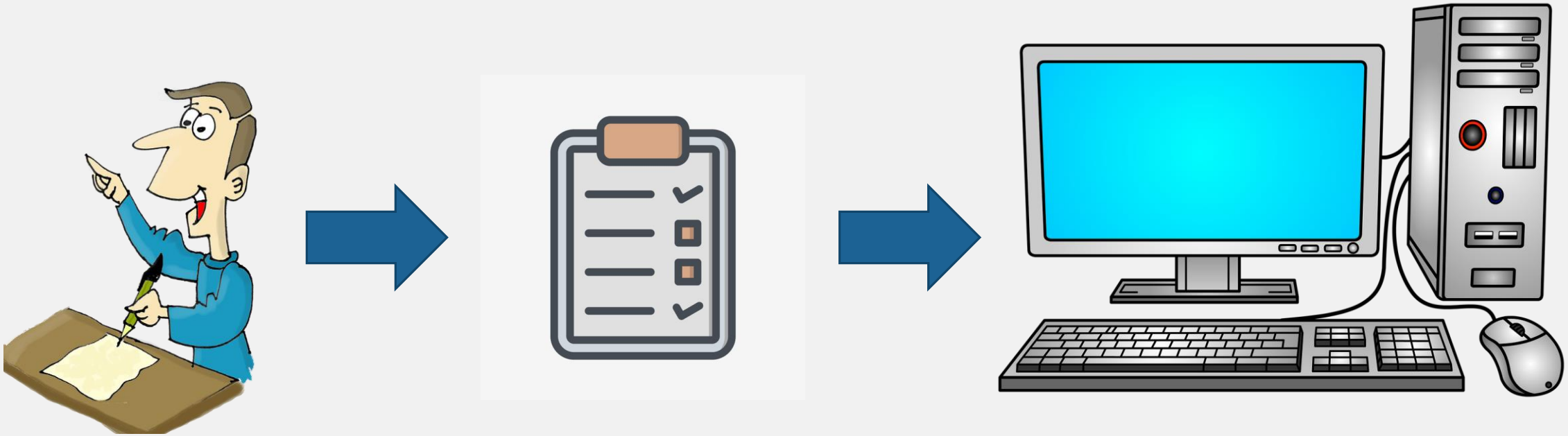
# Compile and Execution

Process

## 使用電腦完成想要的目的

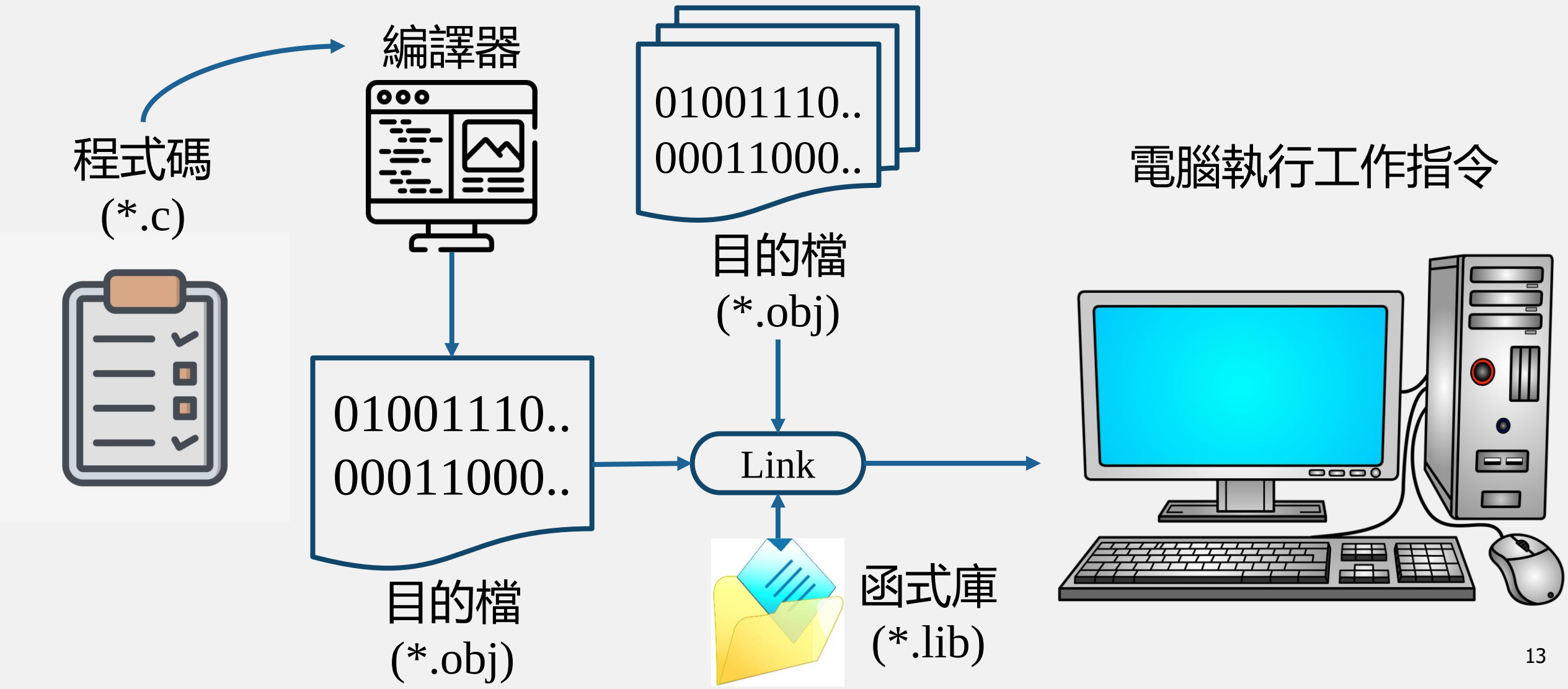
程式決定指令執行內容 (程式碼)

電腦執行工作指令



# Compile and Execution

Process



# Compile and Execution

## Environment

Programiz

Programiz
C Online Compiler

main.c

Run

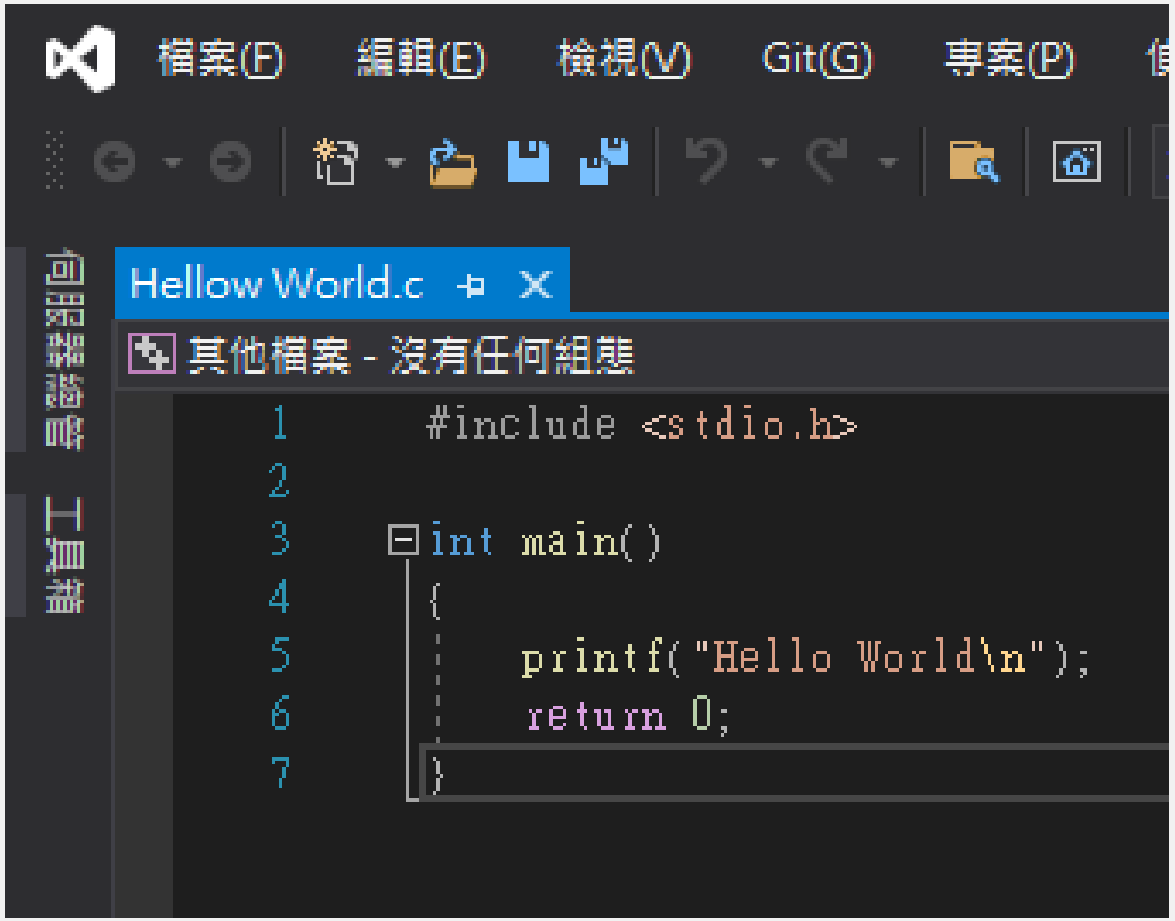
```c
// Online C compiler to run C program online
#include <stdio.h>

int main() {
    // Write C code here
    printf("Hello world");

    return 0;
}
```

Output

Clear

```
/tmp/o9Eqf17PxZ.o
Hello world
```

Visual Studio



# Compile and Execution

## Environment - Visual Studio

優點

整合了編譯器與介面

缺點

啟動慢，檔案開啟速度慢

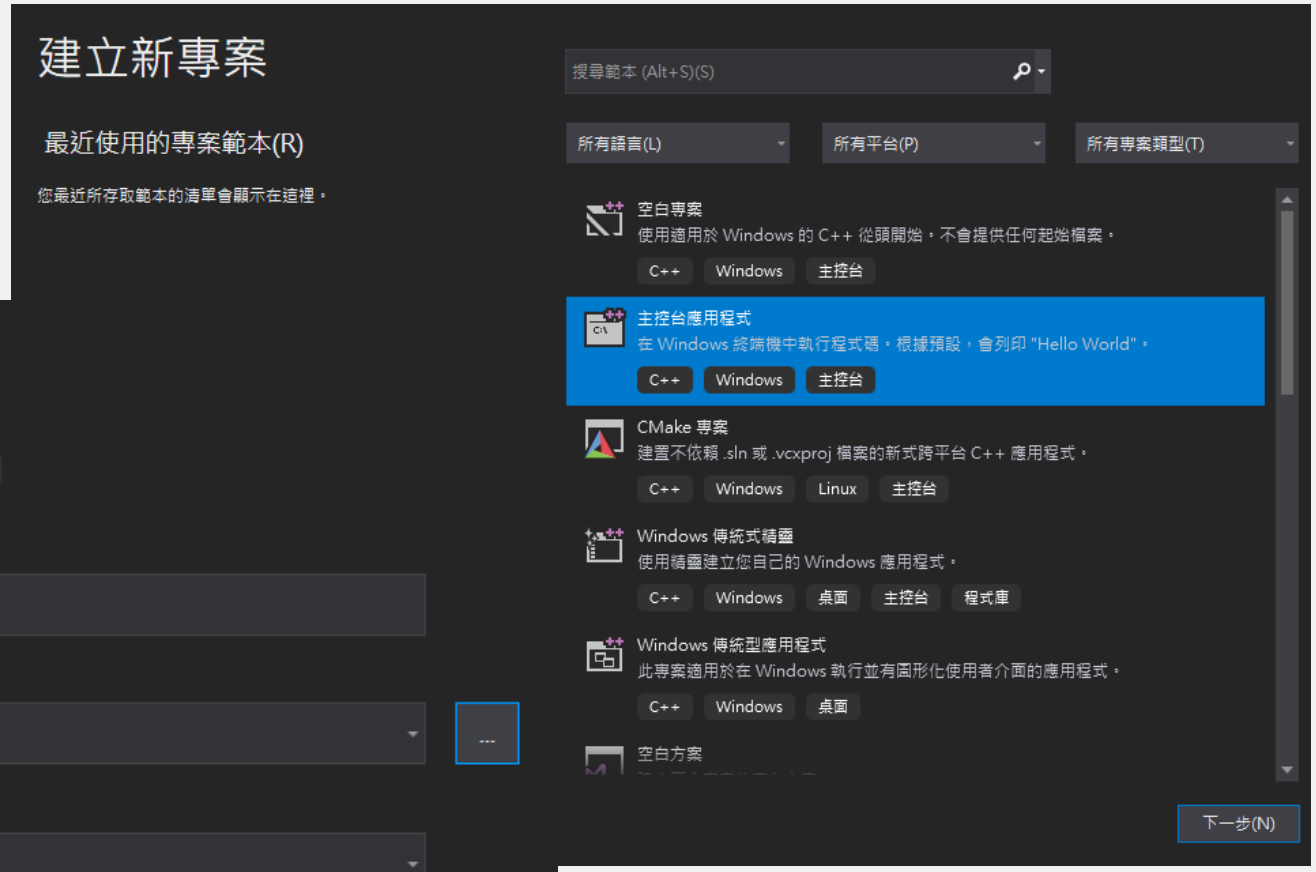
下載

# Compile and Execution

## Environment - Visual Studio

# Compile and Execution

## Environment - Visual Studio


# Compile and Execution

## Environment - Visual Studio

HellowWorld.cpp

HellowWorld (全域範圍)

```
1   // HellowWorld.cpp : 此檔案包含 'main' 函式。程式會於該處開始執行及結束執行。
2   //
3
4   #include <iostream>
5   #include <stdio.h>
6   int main()
7   {
8       printf("Hello World!\n");
9       return 0;
10  }
11
12  // 執行程式: Ctrl + F5 或 [偵錯] > [啟動但不偵錯] 功能表
13  // 偵錯程式: F5 或 [偵錯] > [啟動偵錯] 功能表
14
15  // 開始使用的提示:
16  //   1. 使用 [方案總管] 視窗，新增/管理檔案
17  //   2. 使用 [Team Explorer] 視窗，連線到原始檔控制
18  //   3. 使用 [輸出] 視窗，參閱組建輸出與其他訊息
19  //   4. 使用 [錯誤清單] 視窗，檢視錯誤
20  //   5. 前往 [專案] > [新增項目]，建立新的程式碼檔案，或是前往 [專案] > [新增現有項目]，將現有程式碼檔案新增至專案
21  //   6. 之後要再次開啟此專案時，請前往 [檔案] > [開啟] > [專案]，然後選取 .sln 檔案
22
```

建置(B) 偵錯(D) 測試(S) 分析(N) 工具(T) 延伸模組(X)

- 建置方案(B) Ctrl+Shift+B
- 重建方案(R)
- 清除方案(C)
- 為解決方案建置完整程式資料庫檔案
- 針對方案執行 Code Analysis(Y) Alt+F11
- 建置 HellowWorld(U) Ctrl+B
- 重建 HellowWorld(E)
- 清除 HellowWorld(N)
- 對 HellowWorld 執行 Code Analysis(A)
- 僅限專案(J)
- 批次建置(T)...
- 組態管理員(O)...
- 編譯(M) Ctrl+F7
- 對檔案執行 Code Analysis(F) Ctrl+Shift+Alt+F7

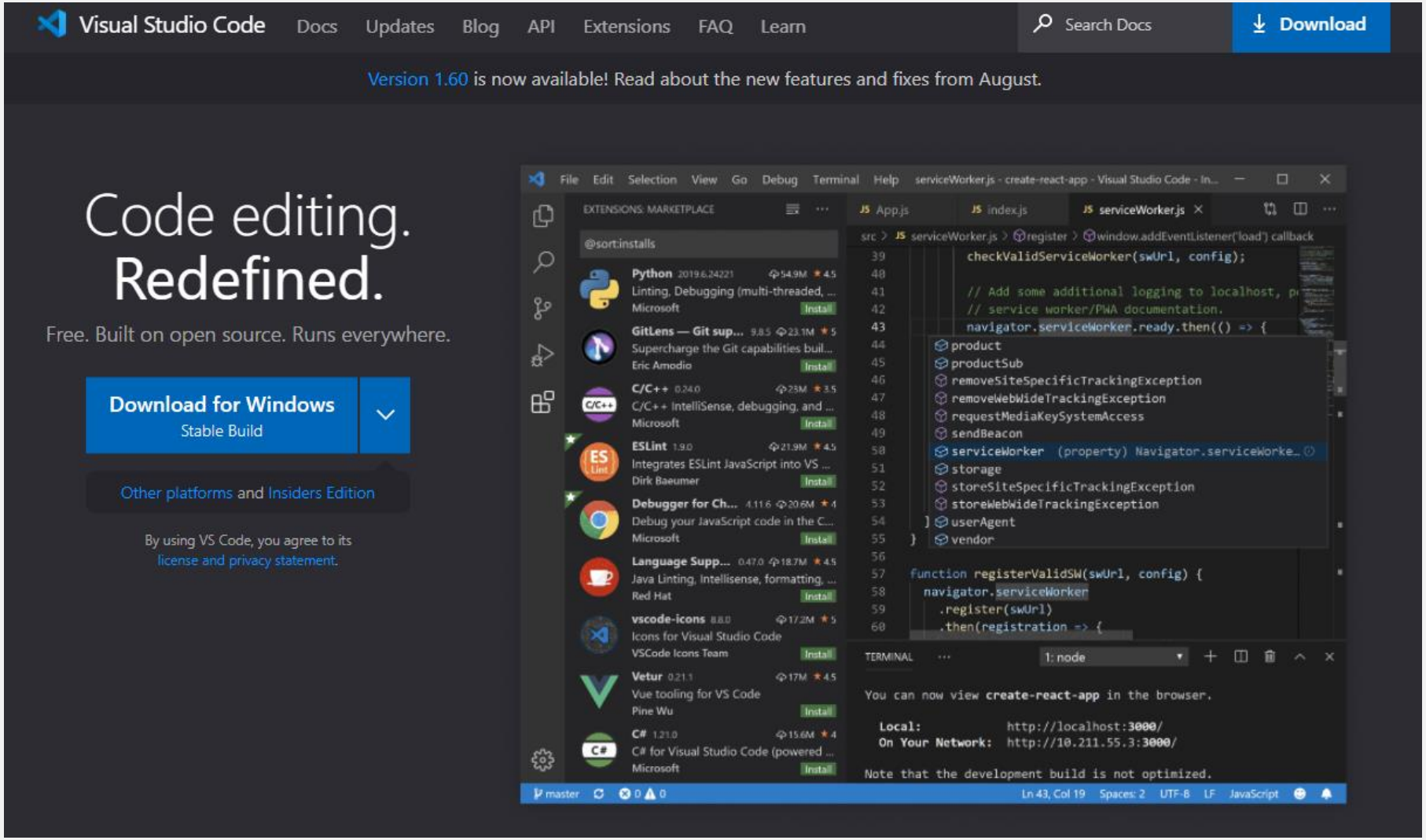
Microsoft Visual Studio 偵錯主控台

```
ello World!

):\Class\C\Example\01\HellowWorld\Debug\HellowWorld.exe (處理序 7704) 已結束，出現代碼 0。
若要在偵錯停止時自動關閉主控台，請啟用 [工具] -> [選項] -> [偵錯] -> [偵錯停止時，自動關閉主控台]。
按任意鍵關閉此視窗...
```

# Compile and Execution

## Environment - Visual Studio Code (VS Code)

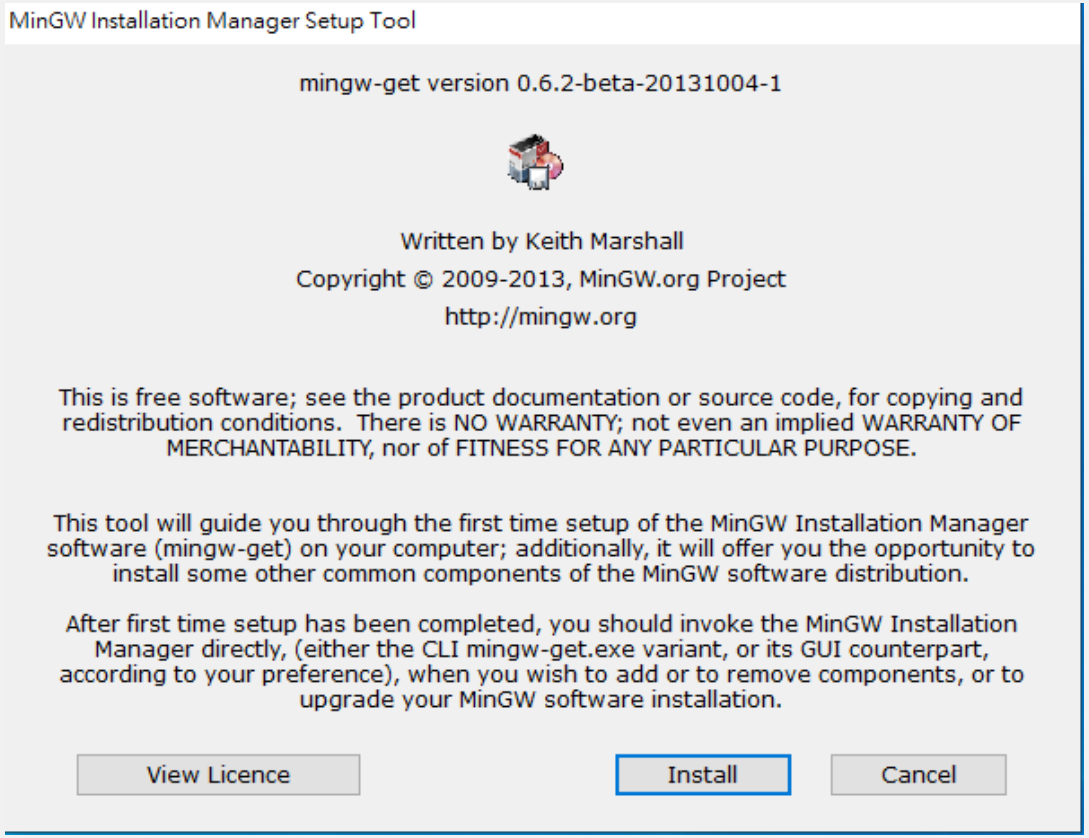
Visual Studio Code

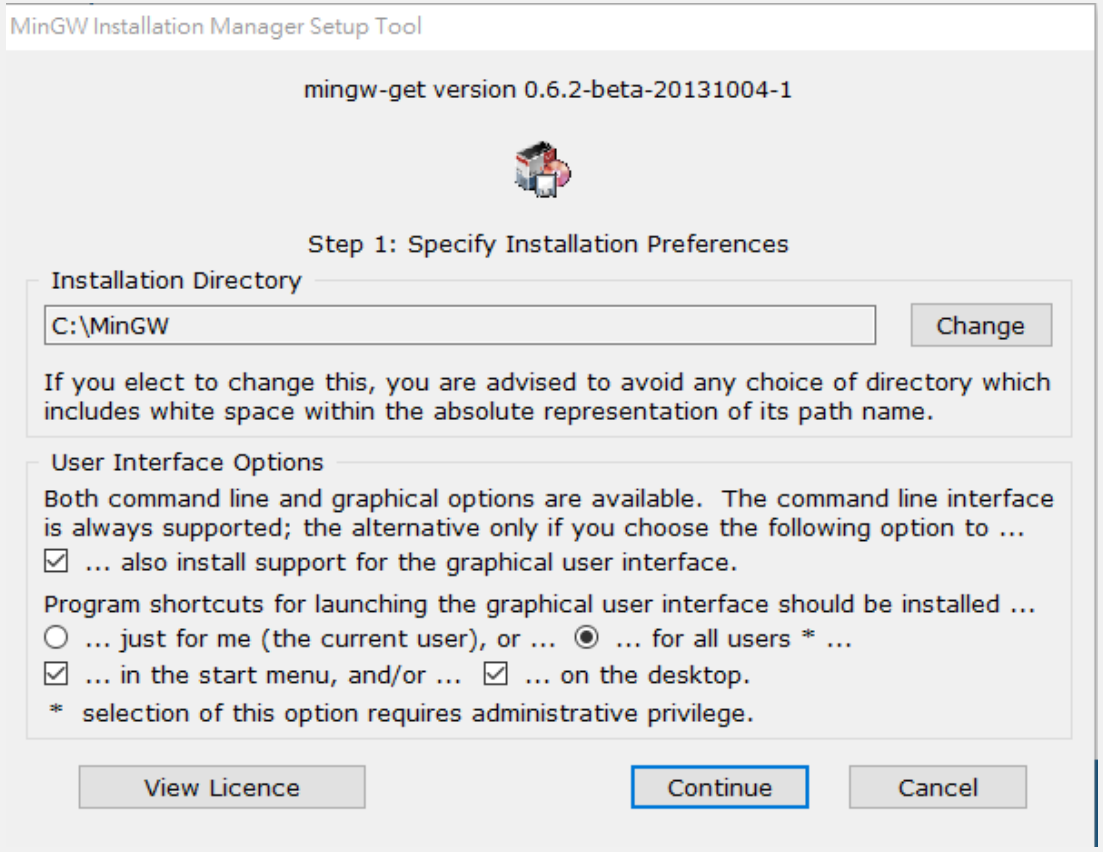


# Compile and Execution

## Environment - Compile (Mingw)

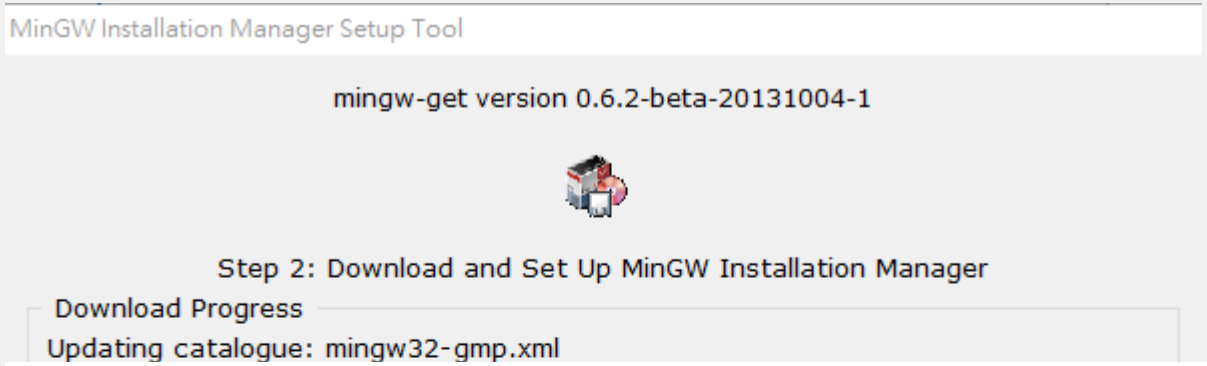
Link

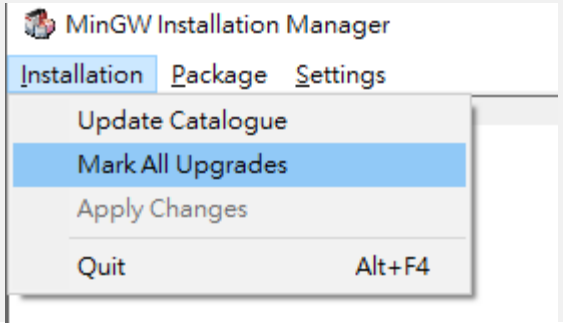


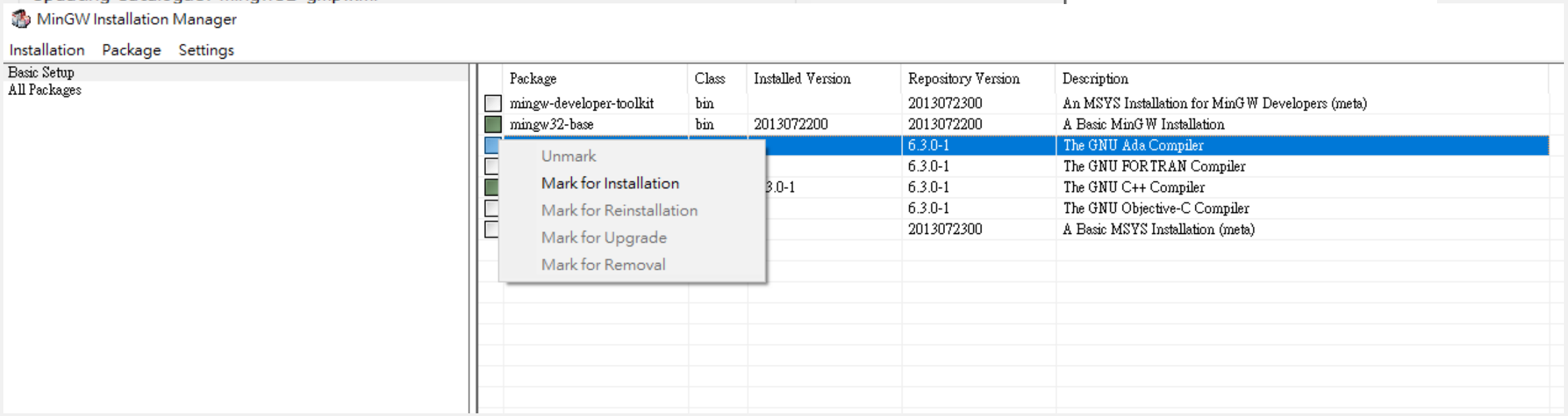



# Compile and Execution

## Environment - Compile (Mingw)

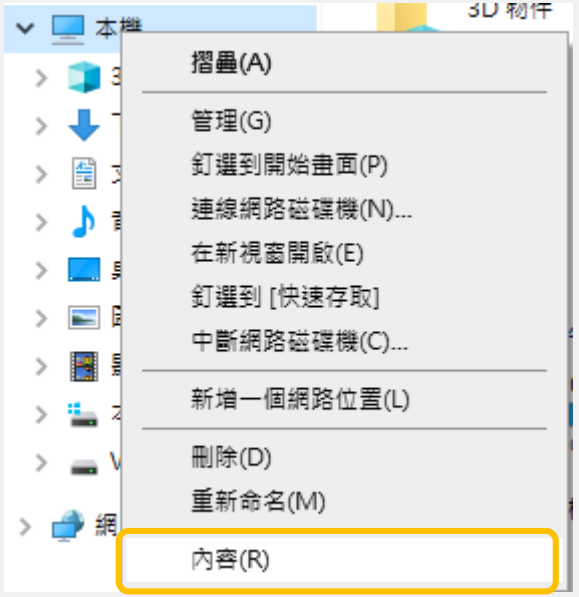


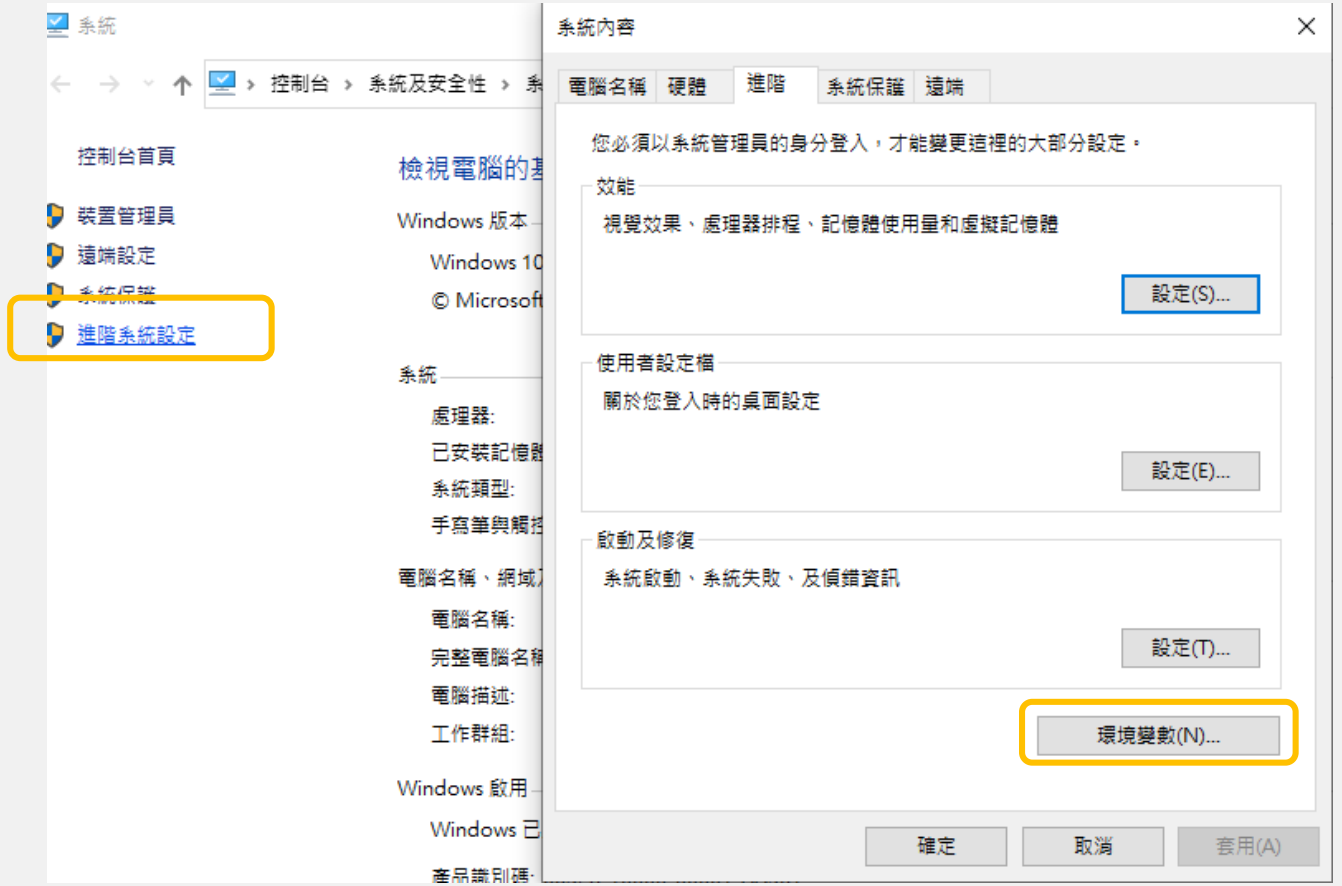



# Compile and Execution

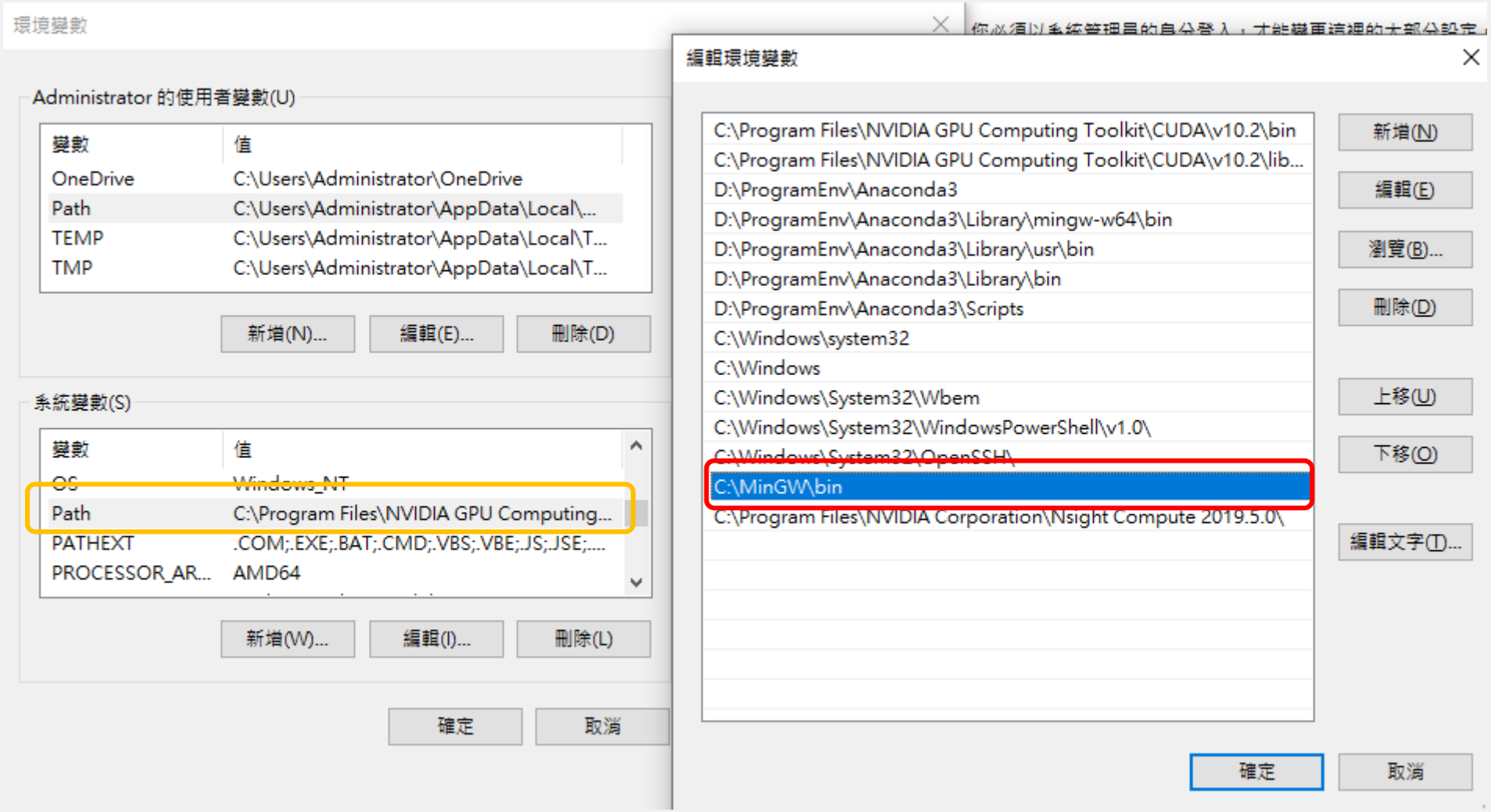
## Environment - Compile (Mingw)



# Compile and Execution

## Environment - Compile (Mingw)



# Compile and Execution

## Environment - Compile (Mingw)

# Compile and Execution

## Environment - Execution

編譯

gcc "filename.c" -o "execute_filename"

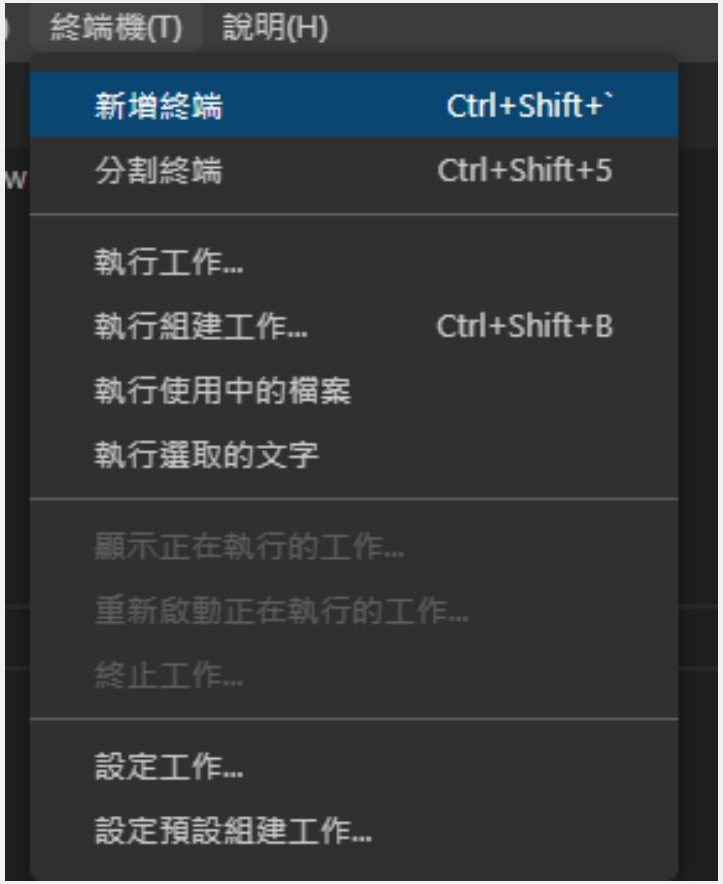

執行

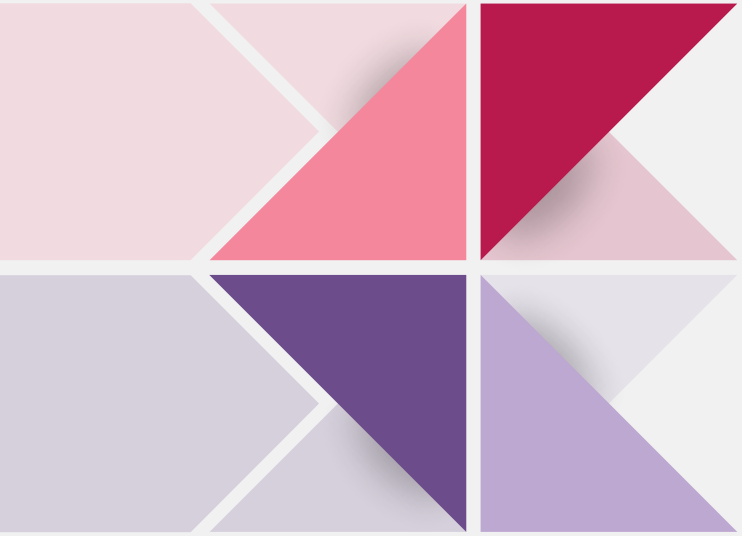
execute_filename (.exe)

```
C:\Users\Administrator\Desktop\temp>hello
hello
C:\Users\Administrator\Desktop\temp>hello.exe
hello
```

# Compile and Execution

## Environment - Execution



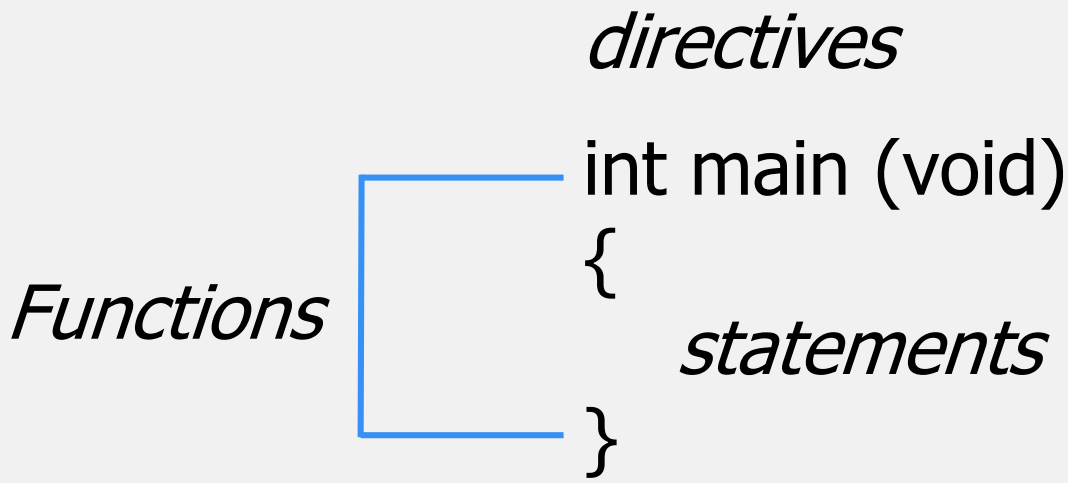
# 03
# Let's go C

# Let' go C

## Introduction

A simple C program relies on three key language features:

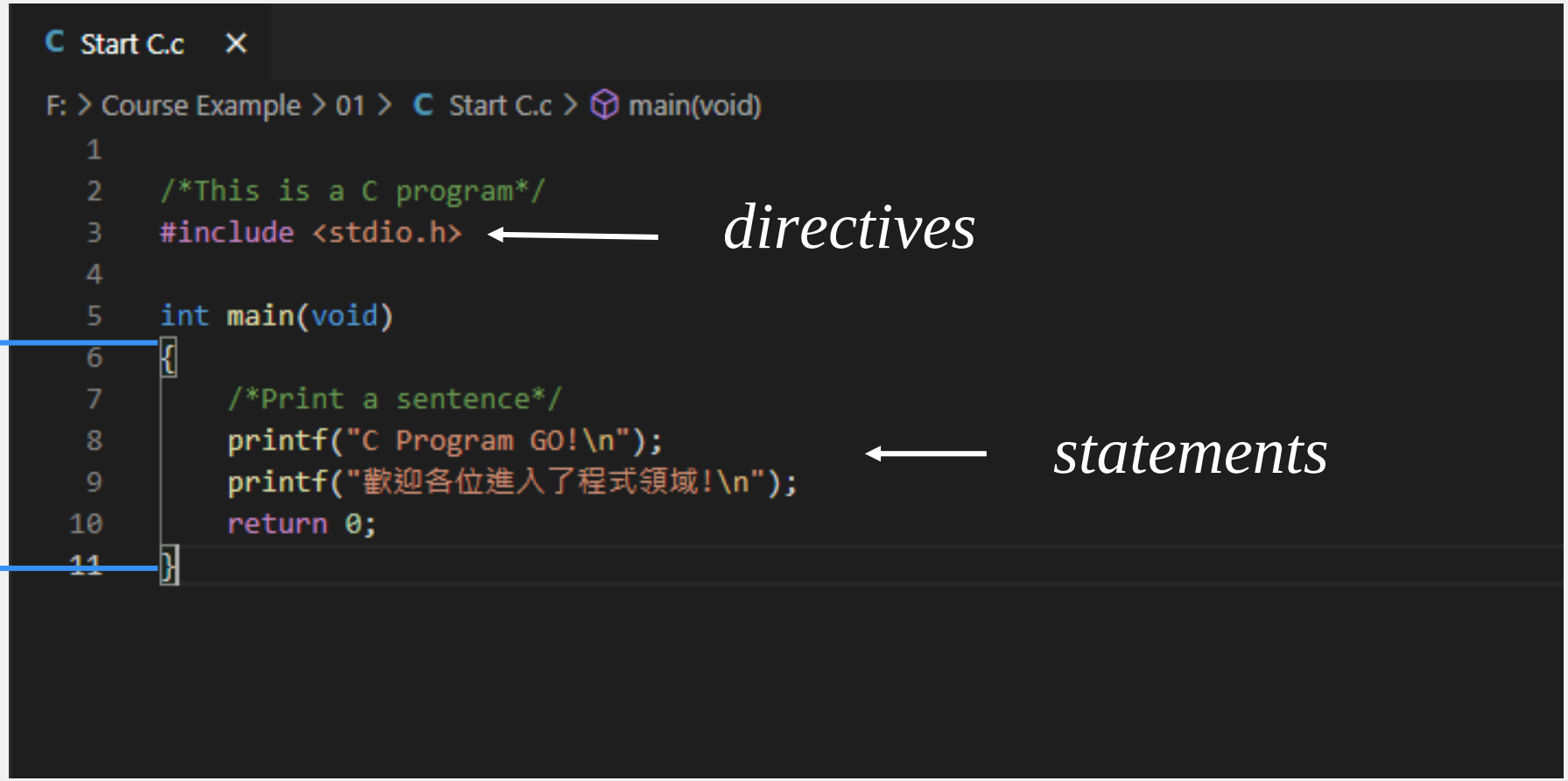
- Directives
- Functions
- Statements



# Let' go C

Introduction

## An example: File.c

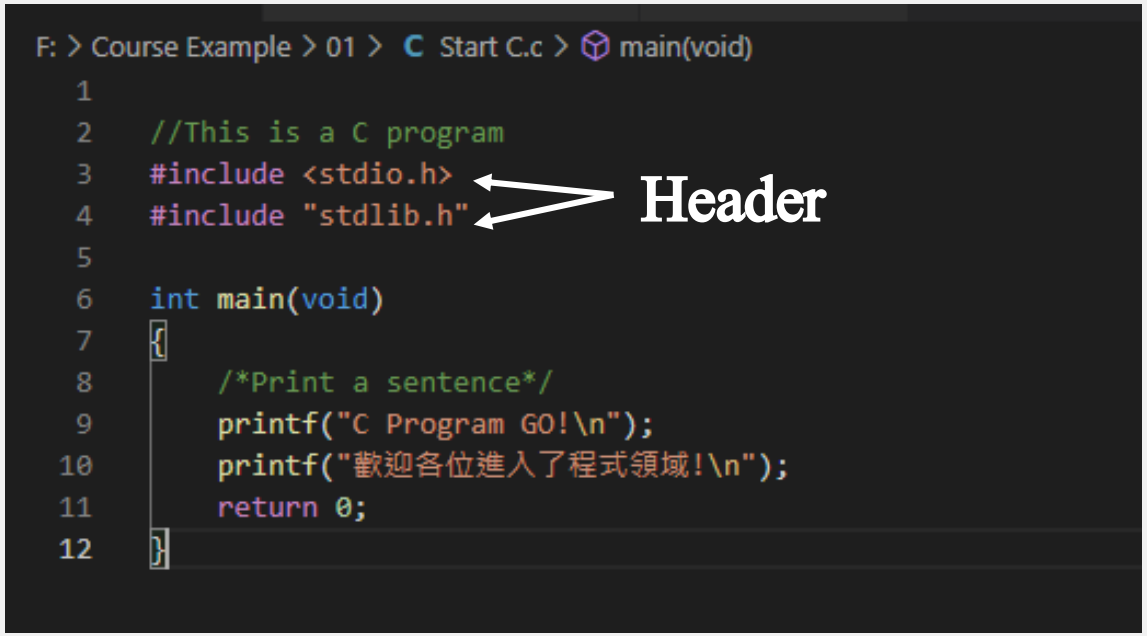


# Let' go C

## Introduction

### Directives

- Before a C program is compiled, it is first edited by a preprocessor
- Commands intended for the preprocessor are called directives
- Example:
  - #include <file>
    - ✓ Search from environment path
  - #include "file"
    - ✓ Search from current path

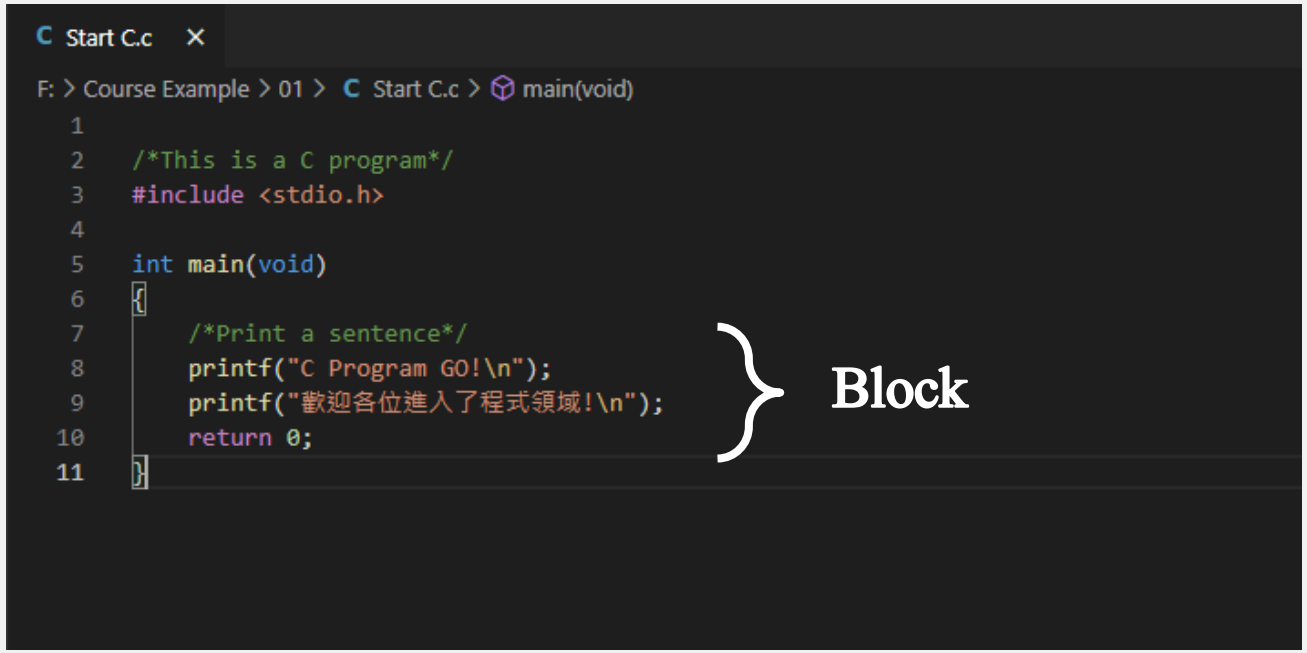


# Let' go C

## Introduction

### main() function

- The main function is mandatory and gets called automatically while the program is executed
  - ✓ main() + curly brackets
  - ✓ Block is the statement in the curly brackets



# Let' go C

## Introduction

### Statement

- It is a command to be executed
- Each statement ends with a semicolon
  - ✓ Exception: compound statement

# Let' go C

## Introduction - keywords & Identifiers

### keywords

- They are predefined and reserved words for programming with special meanings to the compiler
- They are parts of the syntax and cannot be as the identifiers

```
int money;
```

| C keywords | | | |
|---|---|---|---|
| auto | break | case | char |
| continues | do | default | const |
| double | else | enum | extern |
| for | if | goto | float |
| int | long | register | return |
| signed | static | sizeof | short |
| struct | switch | typedef | union |
| void | while | volatile | unsigned |

# Let' go C

## Introduction - keywords & Identifiers

### Identifier

- It refers to name for entity such as variable, function, structure …
- It must be unique for an entity with unique name to identify

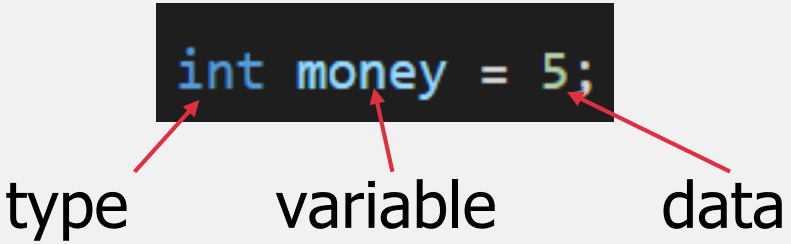
```
int money;
```

### Rules for naming a identifier

- ✓ A valid identifier have digits, letters, and underscores
- ✓ The first letter should be either a letter or an underscore
- ✓ The keywords cannot be used as identifiers
- ✓ The name of identifier should be meaningful (Not necessary)

## Variables

- Each variable should be given a unique name to indicate the storage area
- It is a symbolic representation of a memory location and is also a container to store data




### Rules for naming a variable

✓ Same as naming a identifier

## Constants

- It means a unchangeable variable is created using keyword "const"

```
const int p = 3;
p = 5;
```

```
example.c: In function 'main':
example.c:7:7: error: assignment of read-only variable 'p'
     p = 5;
       ^
```

## Data Type

- It is the declaration for variable
- It determines the type and size of data associated with variable

| Type | Size (bytes) |
|---|---|
| int | at least 2, usually 4 |
| char | 1 |
| float | 4 |
| double | 8 |
| short int | usually 2 |
| unsigned int | at least 2, usually 4 |
| long int | at least 4, usually 8 |

| Type | Size (bytes) |
|---|---|
| long long int | at least 8 |
| unsigned long int | at least 4 |
| unsigned long long int | at least 8 |
| singed char | 1 |
| unsigned char | 1 |
| long double | at least 10, usually 12 or 16 |

## Output - printf()

- The one of main output function is printf()
- The printf function must be supplied with a format string, followed by any values that are to be inserted into the string during printing

printf(*string*, *expr* 1, *expr* 2, ...);

- The format string may contain both ordinary characters and conversion specifications, which begin with the % character

```c
int p = 3;
printf("The value is %d\n", p);
```

## Output - printf()

- Conversion specifications

| Type | Specifier |
|---|---|
| int | %d, %i |
| char | %c |
| float | %f |
| double | %lf |
| short int | %hd |
| unsigned int | %u |
| long int | %ld, %li |

| Type | Size (bytes) |
|---|---|
| long long int | %lld, %lli |
| unsigned long int | %lu |
| unsigned long long int | %llu |
| singed char | %c |
| unsigned char | %c |
| long double | %Lf |

## Output - printf()

- A conversion specification can have the form %m.pX or %-m.pX, where the m and p are integer constants and X is a letter

```
printf("%10.2f\n", i);   // m = 10, p = 2, X = f

printf("%10f\n", i);   // m = 10, p = missing, X = f

printf("%f\n", i);   // m and p are miss, X = f
```

- m specifies the minimum number of characters to print

```
int i = 123;
printf("%10d\n", i);   // It will print • • • • • • • 123
```

- Putting a minus sign in front of m causes left justification

```
printf("%-10d\n", i);   // It will print 123 • • • • • • •
```

## Output - printf()

- p, depending on the choice of X, indicates the minimum number of digits to display (extra zeros are added to the beginning of the number if necessary)

```c
int i = 314;
printf("i = %.4d\n", i);

float f = 3.141592;
printf("f = %.4f\n", f);

printf("f = %10.4f\n", f);
```

```
i = 0314
f = 3.1416
f =     3.1416
```

## Input - scanf()

- The one of main output function is scanf()
- It can reads formatted input from the standard input, such as keyboards

scanf(format, *exp* 1, *exp* 2, …);

- Same as printf function, the format string may contain both ordinary characters and conversion specifications, which begin with the % character
- In exp, the & symbol which normally precedes each variable in a scanf call is usually but not always required

scanf("%d,%d", &x, &y);

## Input - scanf()

- How does scanf work?

```
scanf("%d%d%f%f", &i, &j, &x, &y);
```

```
••1¤-20•••.3¤•••-4.0e3¤
ssrsrrrsssrrssssrrrrrrs (s = skipped; r = read)
```

# Let' go C

## Introduction - Comments

### Comments

- It is a hint added by the programmer for making code easier to read
- Two ways to add comments
  - ✓ // - Single line comment
  - ✓ /*…*/ - Multi-line comments

```c
// Define a variable p
int p = 3;
/* Print value of p
   in the screen*/
printf("The value is %d\n", p);
```

# Operators

- It is a symbol to operate on a value or a variable
- C has a rich collection of operators to perform various operators, such as
  - ✓ arithmetic operators
  - ✓ relational operators
  - ✓ assignment operators
  - ✓ increment and decrement operators
  - ✓ logical operators
  - ✓ …

# Let' go C

## Introduction - Operators

| | | | |
|---|---|---|---|
| + | Addition | >> | Bit right shift |
| - | Subtraction | ++ | Prefix increment |
| * | Multiplication | -- | Prefix decrement |
| / | Division | > | Greater than |
| % | Remainder | >= | Greater than or equal |
| + | Positive | < | Less than |
| - | Negative | <= | Less than or equal |
| ~ | Complement | == | Equality |
| & | And | != | Inequality |
| \| | Or | ! | Not |
| ^ | XOR | && | Logical And |
| = | Assignment | \|\| | Logical Or |
| << | Bit left shift | | |

# Let' go C

## Introduction - Examples

1. Write a program to add numbers and print the result

```
Please enter first fraction: 5/6
Please enter second fraction: 3/4
The sum is 38/24
```

2. Write a program to read a number i satisfying $100 \leq i \leq 999$ and then print each digit in one line

```
Please input a number (100-999)
253
2
5
3
```