C++基礎語法 Unit-2

- 基本輸入與輸出
- 變數
- 算數運算
- 資料型態

建置開發環境 (IDE)

- IDE (Integrated Development Environment)
  - Code::Blocks (高中生參加的檢定、比賽中常見的編輯除錯工具)
  - Xcode (for MacOS)
- 轉寄程式碼給別人的時候 (有syntax highlighter才容易看懂)
  - Ubuntu Pastebin
- 線上程式開發工具
  - https://replit.com/
- 自修參考書：
  - C++程式設計入門(第二版)

程式編譯與執行

- 寫程式的過程，大致上分成幾個步驟，分別為
  - 編輯 (edit)
  - 編譯 (compilation or build)
  - 執行 (execution or run)
  - 除錯 (debug)
- Build and Run
  - 快捷鍵 F9 (Code::Blocks)

Online Judge 線上評測系統

- 線上題庫，練習與測試程式代碼的方便工具
  - ZeroJudge 高中生程式解題系統
  - AtCoder
  - CSES Problem Set

起手式

```cpp
#include <iostream>
using namespace std;

int main() {
    // 單行註解

    /*
       多行註解
    */

    return 0;
}
```

- #include <iostream>
- using namespace std;
- //
- /* … */
- main() { … }
- ;
- return 0;
- 注意：半形符號

輸入與輸出

- `cout`
  - 透過螢幕輸出程式執行/計算的結果
- `cin`
  - 從鍵盤取得輸入的資料
  - 資料會以「空白」或「換行符號」分割成一筆一筆

從螢幕輸出 cout


```cpp
#include <iostream>
using namespace std;

int main() {
    cout << "Hello World!\n";

    cout << "Hello World!" << endl;
    return 0;
}
```

```
Hello World!
Hello World!
Program ended with exit code: 0
```

用一對雙引號標註一個字串

“\n” (a new line)

endl (end of a line)

https://pastebin.ubuntu.com/p/JTqz7RG6V6/

從鍵盤輸入 cin

【練習】ZeroJudge a001: 哈囉

```
#include <iostream>
using namespace std;

int main() {
    string s;
    cin >> s;
    cout << "hello, " << s << "\n";
    return 0;
}

Amy
hello, Amy
Program ended with exit code: 0
```

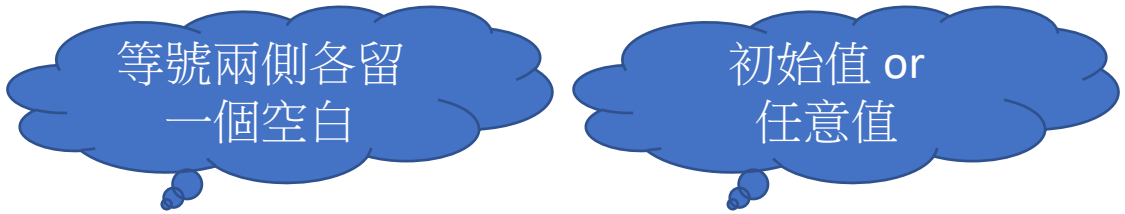
https://pastebin.ubuntu.com/p/HpjgkVrWsX/

資料型態 (data type)

資料種類	資料型態	佔用記憶體空間	數值範圍	範例	
字元	**char**	1 Byte	0 ~ 255	‘a’, ‘A’, ‘b’, ‘B’, ‘1’, ‘2’, ‘3’	
整數	short	2 Bytes	-32768 ~ 32767		
	unsigned short	2 Bytes	$0 \sim 2^{16} - 1$	0 ~ 65535	
	int	4 Bytes	$-2^{31} \sim 2^{31} - 1$	-2,147,483,648 ~ 2,147,483,647	$\sim 2 \times 10^9$
	unsigned int	4 Bytes	$0 \sim 2^{32} - 1$	0 ~ 4,294,967,295	
	long long	8 Bytes	$-2^{63} \sim 2^{63} - 1$	約-9.223372e+18 ~ 9.223372e+18	
浮點數	float	4 Bytes	- 3.4e38 ~ 3.4e38	有效位數：7位 (整數+小數)	
	double	8 Bytes	- 1.7e308 ~ 1.7e308	有效位數：16位 (整數+小數)	
布林值	**bool**	1 Byte	true 或 false		
字串	**string**			”I am a student.”	

變數宣告 (variable declaration)

- 變數必須經過宣告才能使用
  - 類別 (type)
  - 名字 (name)
  - 值 (value)
  - 位址 (address)
- 【範例】
  - `int x;`
  - `int x = 5;`
  - `int x, y, z;`
  - `int x = 0, y = 0, z = 0;`
- 變數命名
  - 英文字母、數字、底線 (_)

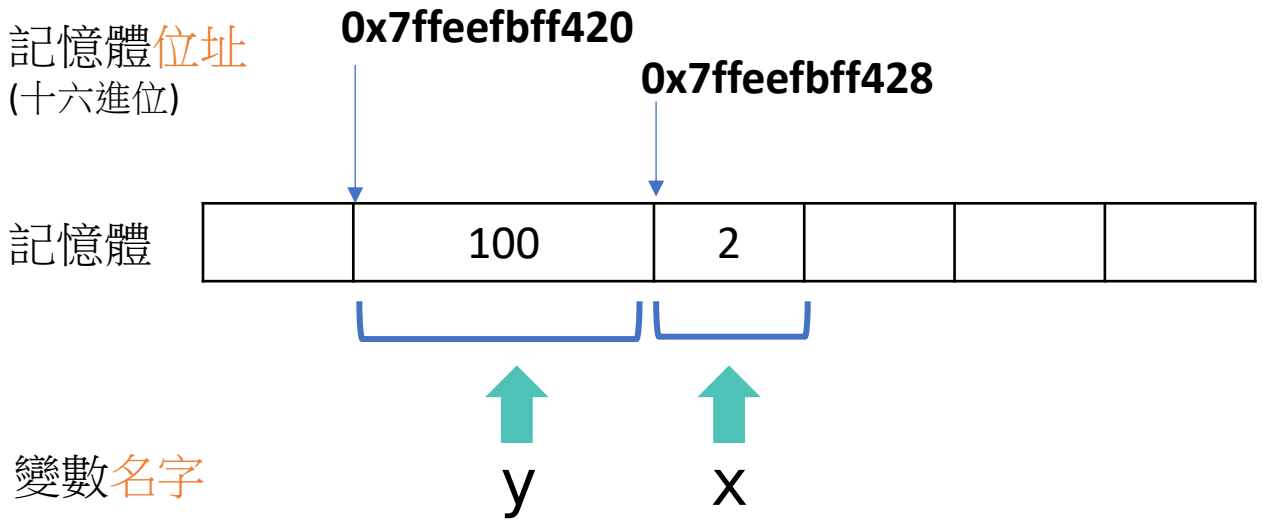


= (指派運算, assignment operator)

不是數學的
「等號」

宣告變數

```
int x = 3;

long long y = 100;
```



口訣：把「右邊的運算結果」指派給「左邊的變數」

= (指派運算, assignment operator)

Example 2-3

```cpp
#include <iostream>
using namespace std;

int main() {
    int x = 3;
    long long y = 100;
    cout << &x << " | " << sizeof(x) << "\n";
    cout << &y << " | " << sizeof(y) << "\n";
    return 0;
}
```

```
0x7ffeefbff428 | 4
0x7ffeefbff420 | 8
Program ended with exit code: 0
```

& 取址運算子
sizeof()

算數運算：+ - * /

- 加 (+) 減 (-) 乘 (*) 除 (/)
- 優先序：先乘除、後加減
- 可以利用 括號 ( ) 改變運算順序

算數運算

(Quiz)

整數除法沒有小數
（直接捨去）

```
int x = 13, y = 5;

cout << x / y << "\n";
```

2

2.6

算數運算

(Quiz)

```
double x = 13, y = 5;

cout << x / y << "\n";
```

2

2.6

算數運算

(Quiz)

```
int x = -13, y = 5;

cout << x / y << "\n";
```

−2

−3

【練習】a002: 簡易加法

Example 2-4

```cpp
#include <iostream>
using namespace std;

int main() {
    int a, b;
    cin >> a >> b;
    cout << a + b << "\n";
    return 0;
}
```

https://pastebin.ubuntu.com/p/WWBPJTMZQb/

【練習】求十位數及個位數

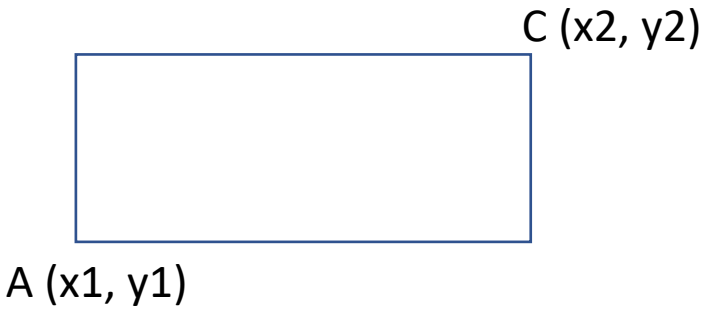
Example 2-10

```cpp
#include <iostream>
using namespace std;

int main() {
    int x; //二位數
    cin >> x;

    cout << "十位數 = " << x / 10 << "\n";
    cout << "個位數 = " << x % 10 << "\n";
    return 0;
}
```

https://pastebin.ubuntu.com/p/J64rC7WNFb/

【練習】長方形

Example 2-11




```cpp
#include <iostream>
using namespace std;

int main() {
    int x1, y1;
    int x2, y2;
    cin >> x1 >> y1;
    cin >> x2 >> y2;
    cout << "長方形面積 = " << (x2 - x1) * (y2 - y1) << "\n";
    cout << "長方形邊長 = " << 2 * ((x2 - x1) + (y2 - y1)) << "\n";
    return 0;
}
```

https://pastebin.ubuntu.com/p/H9wNYGQBKF/

【範例】找零錢 (用最少的硬幣數)

Example 2-12

```cpp
#include <iostream>
using namespace std;

int main() {
    int x; //要找的零錢，二位數
    cin >> x;
    //硬幣面額：50，10，5，1
    cout << "50元硬幣： " << x / 50 << "\n";
    x = x - (x / 50) * 50;
    cout << "10元硬幣： " << x / 10 << "\n";
    x = x - (x / 10) * 10;
    cout << "5元硬幣： " << x / 5 << "\n";
    x = x - (x / 5) * 5;
    cout << "1元硬幣： " << x << "\n";
    return 0;
}
```

溢位 (Overflow)

Example 2-5

(Quiz)

```cpp
#include <iostream>
using namespace std;

int main() {
    int x = 100000;
    int y = x;

    cout << x * y << "\n";

    cout << x * y << "\n";
    return 0;
}
```

10^{10}

$2x10^{9}$

不知道

除以零 (Divide by Zero)

Example 2-6

(Quiz)

```cpp
#include <iostream>
using namespace std;

int main() {
    int x = 10000;
    int y = 0;

    cout << x / y << "\n";
    return 0;
}
```

Thread 1: EXC_ARITHMETIC (code=EXC_I386_DIV, subcode=0x0)

0

中斷程式

∞

算數運算子：取餘 (%)

Example 2-7

```
1  #include <iostream>
2  using namespace std;
3
4  int main() {
5      cout << 7 / 3 << "\n";
6      cout << 7 % 3 << "\n";
7      return 0;
8  }
9
```

```
2
1
Program ended with exit code: 0
```

商數 (quotient)
餘數 (remainder)

$a \div b = q * b + r$

$a \div b = (a \ / \ b) * b + (a \ \% \ b)$

a, b 都是整數

算數運算子：取餘 (%)

Example 2-13
(Quiz)

- 求餘數 (%) (或稱模運算modulo/mod)
- 判斷奇偶數

```
int x = -13, y = 5;

cout << x % y << "\n";
```

求負數 (-)

負號跟數字之間不要加空白

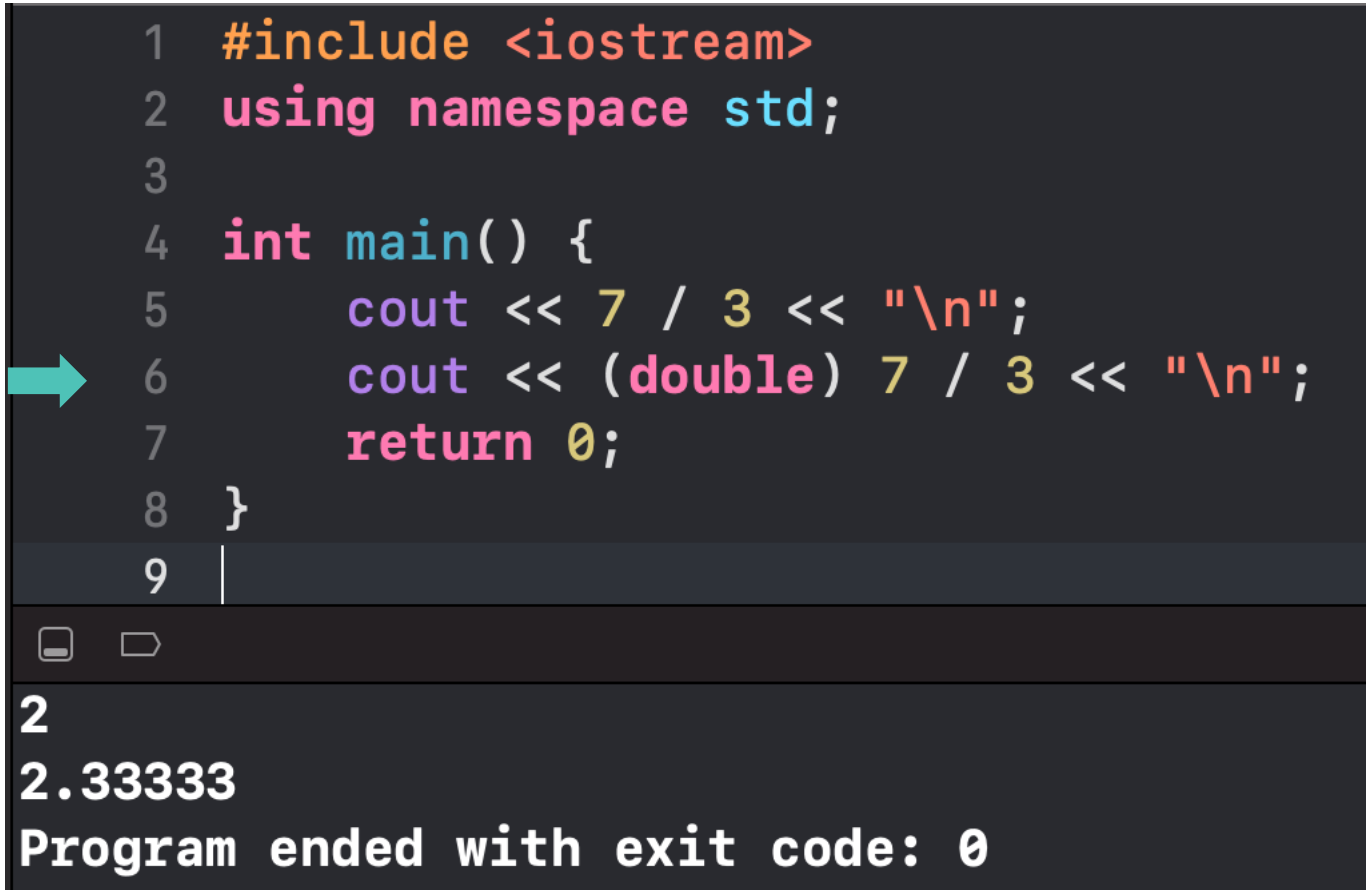
2

-3

強制資料型別轉換

Example 2-8

轉成浮點數運算



```
1  #include <iostream>
2  using namespace std;
3
4  int main() {
5      cout << 7 / 3 << "\n";
6      cout << (double) 7 / 3 << "\n";
7      return 0;
8  }
9
```

```
2
2.33333
Program ended with exit code: 0
```

控制小數點以下的位數

Example 2-9

【範例】 d051: 糟糕，我發燒了！

```cpp
#include <iostream>
#include <iomanip>
using namespace std;

int main() {
    double f;
    cin >> f;
    cout << fixed << setprecision(3) << (f - 32) * 5 / 9 << "\n";
    return 0;
}

```

```
104
40.000
Program ended with exit code: 0
```

容易犯的錯誤

```cpp
// d051: 糟糕，我發燒了！
// https://zerojudge.tw/ShowProblem?problemid=d051
#include <iostream>
#include <iomanip>
using namespace std;

int main () {
    int f = 2147483647; //華氏溫度

    //float: 有效位數：7位（整數+小數）
    //double: 有效位數：16位（整數+小數）
    float c1 = ((float)f - 32) * 5 / 9;
    double c2 = ((double)f - 32) * 5 / 9;
    double c3 = (f - 32) * 5 / 9; //overflow
    double c4 = (f - 32) / 9 * 5;

    cout << fixed << setprecision(7);
    cout << c1 << "\n";
    cout << c2 << "\n";
    cout << c3 << "\n";
    cout << c4 << "\n";

    return 0;
}
```

```
1193046528.0000000
1193046452.7777777
238609275.0000000
1193046450.0000000
```

寫作業時可能遇到的問題

d073. 分組報告 -- 板橋高中教學題

```cpp
#include <iostream>
using namespace std;

int main() {
    cin >> x;
    cout << (x/3) <<"\n";
    return 0;
}
```

#0: 10% CE ()

```
/7806911/code_7806911.cpp: In function ‘int main()’:
/7806911/code_7806911.cpp:5:12: error: ‘x’ was not declared in this
scope
     cin >> x;
            ^
```

d049. 中華民國萬歲！ -- 板橋高中教學題

```cpp
#include <iostream>
using namespace std;

int main() {
    int y;
    int x = (y-1911);
    cin >> y >> "\n";
    cout << y;
return 0;
}
```

#0: 10% CE ()

```
/7835408/code_7835408.cpp: In function ‘int main()’:
/7835408/code_7835408.cpp:7:13: error: no match for ‘operator>>’
(operand types are ‘std::basic_istream::__istream_type {aka
std::basic_istream}’ and ‘const char [2]’)
    cin >> y >> "\n";
    ~~~~~~~~~^~~~~~~
```

d050. 妳那裡現在幾點了？ -- 板橋高中教學題

```
#include <iostream>
using namespace std;
int main(){
    int h;
    cin>>h;
    cout<<(h+9)%24<<"/n";
    return 0;
}
```

\n 才是換行符號

#0: 10% WA (line:1)

您的答案為: 9/n
正確答案為: 9

#1: 10% WA (line:1)

您的答案為: 10/n
正確答案為: 10

d050. 妳那裡現在幾點了？ -- 板橋高中教學題

```cpp
#include <iostream>
using namespace std;

int main() {
    int h ;
    cin >> h ;
    cout << abs( h -15 );
    return 0;
}
```

假解
解題方法不完整

#0: 10% WA (line:1)

您的答案為: 15
正確答案為: 9

#1: 10% WA (line:1)

您的答案為: 14
正確答案為: 10