課程（三）運算符及表達式

Marius Suzuki

大綱

- 算術運算子 Arithmetic Operator
- 指定運算子 Assignment Operator
- 增量賦值 Compound Assignment
- 比較運算子 Comparison Operator
- 邏輯運算子 Logic Operator
- 遞增/遞減運算子 Increment and decrement operators

算術運算子Arithmetic Operator

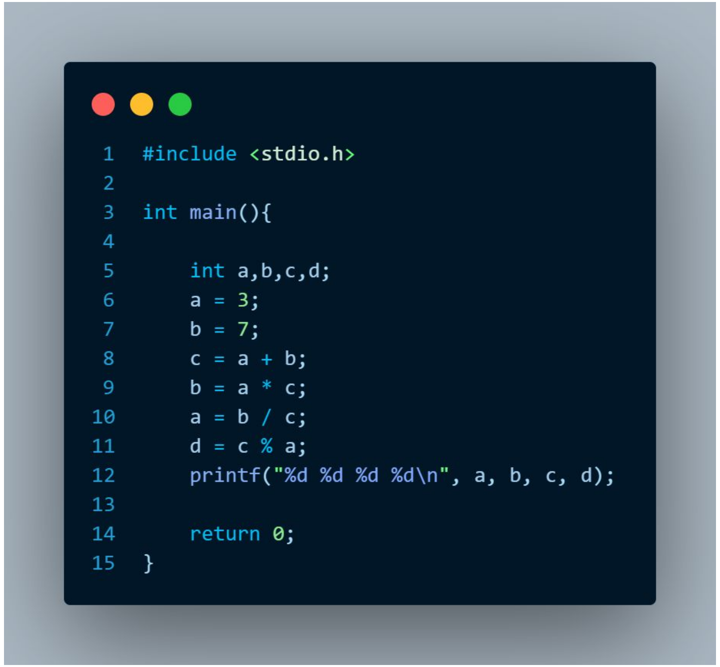
算術運算子Arithmetic Operator

- 四則運算的符號分別為 +, −, * and ／
- 括號的使用也適用於C語言
- ％ 用於計算餘數 (7 % 3 就是拿7除以3的餘數 = 1)
- 數學的先乘除後加減的原則亦適用於C語言

算術運算子Arithmetic Operator

數學運算子	C的運算子	意義	Example
+	+	加Sum	1 + 1 = 2
-	-	減Subtraction	3 - 2 = 1
×	*	乘Multiplication	4 * 3 = 12
÷	/	除Division	16 / 4 = 4
Modulo / mod	%	取餘數Calculate the remainder	16 % 7 = 2
()	()	括號Bracket	(2+3)*4 = 20

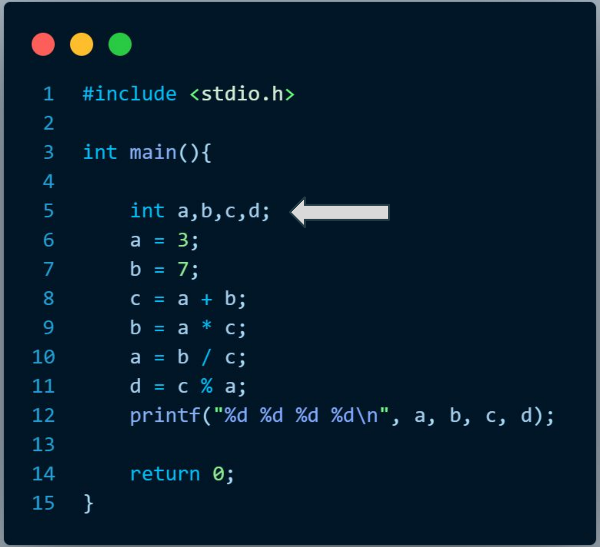
算術運算子Arithmetic Operator



```c
 1  #include <stdio.h>
 2
 3  int main(){
 4
 5      int a,b,c,d;
 6      a = 3;
 7      b = 7;
 8      c = a + b;
 9      b = a * c;
10      a = b / c;
11      d = c % a;
12      printf("%d %d %d %d\n", a, b, c, d);
13
14      return 0;
15  }
```

第12行的輸出會是什麼？

算術運算子Arithmetic Operator

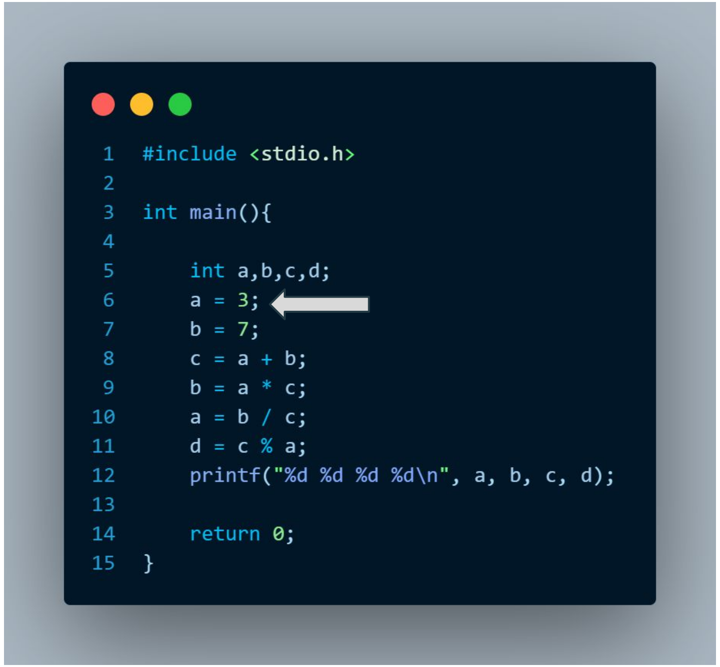


```c
 1  #include <stdio.h>
 2
 3  int main(){
 4
 5      int a,b,c,d;
 6      a = 3;
 7      b = 7;
 8      c = a + b;
 9      b = a * c;
10      a = b / c;
11      d = c % a;
12      printf("%d %d %d %d\n", a, b, c, d);
13
14      return 0;
15  }
```

第12行的輸出會是什麼？

a	b	c	d

算術運算子Arithmetic Operator

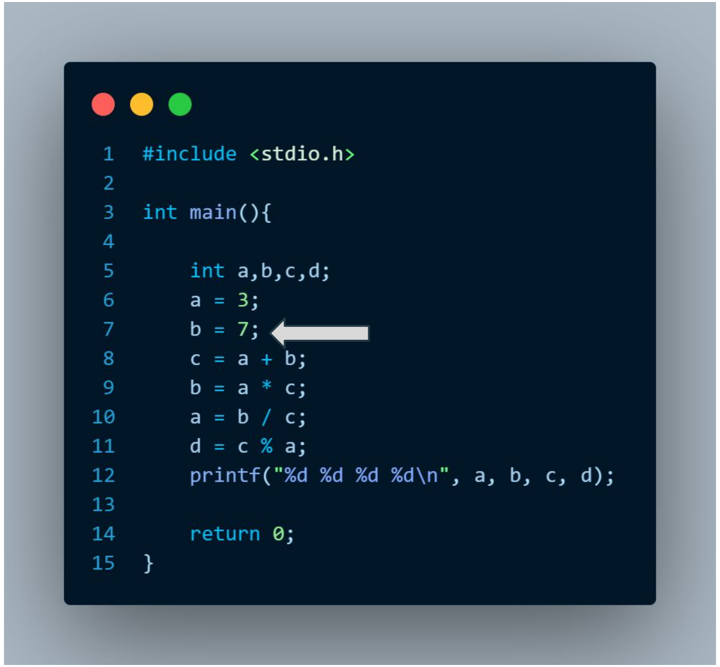


```
1   #include <stdio.h>
2
3   int main(){
4
5       int a,b,c,d;
6       a = 3;
7       b = 7;
8       c = a + b;
9       b = a * c;
10      a = b / c;
11      d = c % a;
12      printf("%d %d %d %d\n", a, b, c, d);
13
14      return 0;
15  }
```

第12行的輸出會是什麼？

a	b	c	d
3			

算術運算子Arithmetic Operator

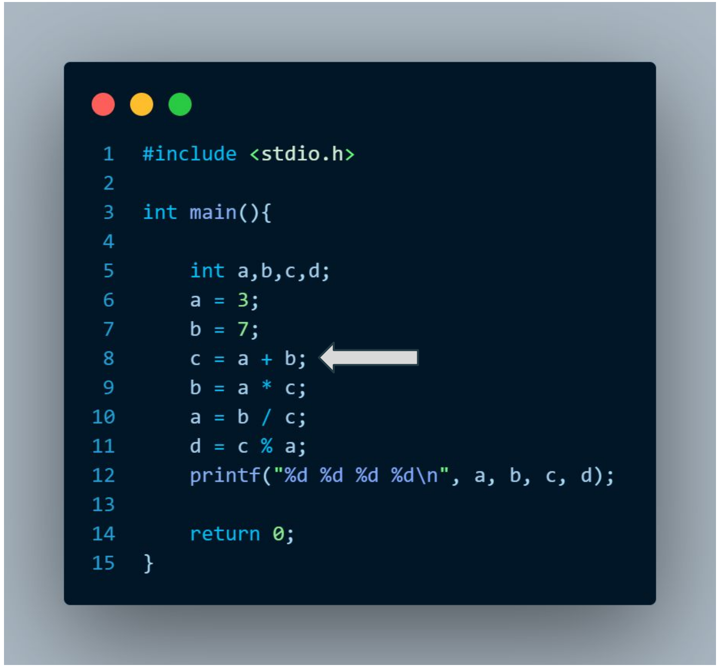


```
1  #include <stdio.h>
2
3  int main(){
4
5      int a,b,c,d;
6      a = 3;
7      b = 7;
8      c = a + b;
9      b = a * c;
10     a = b / c;
11     d = c % a;
12     printf("%d %d %d %d\n", a, b, c, d);
13
14     return 0;
15 }
```

第12行的輸出會是什麼？

a	b	c	d
3	7		

算術運算子Arithmetic Operator

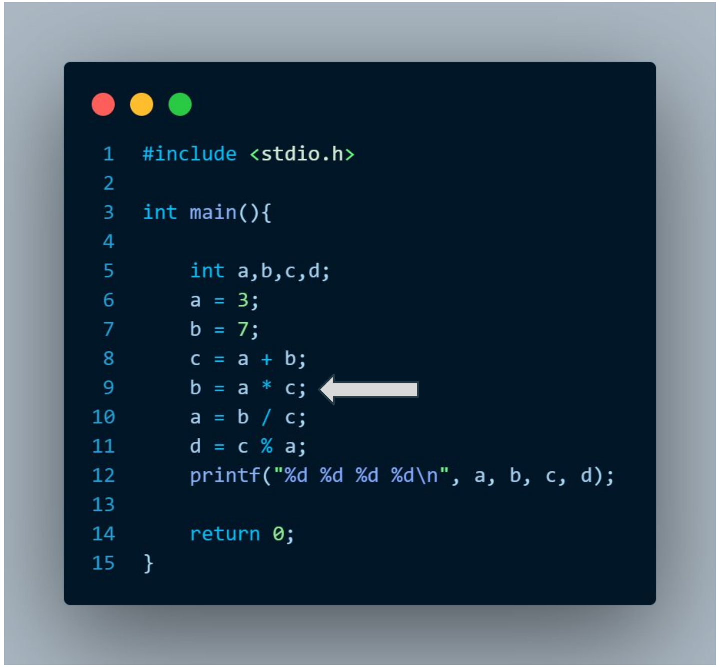


```
 1  #include <stdio.h>
 2
 3  int main(){
 4
 5      int a,b,c,d;
 6      a = 3;
 7      b = 7;
 8      c = a + b;
 9      b = a * c;
10      a = b / c;
11      d = c % a;
12      printf("%d %d %d %d\n", a, b, c, d);
13
14      return 0;
15  }
```

第12行的輸出會是什麼？

a	b	c	d
3	7	10	

算術運算子Arithmetic Operator

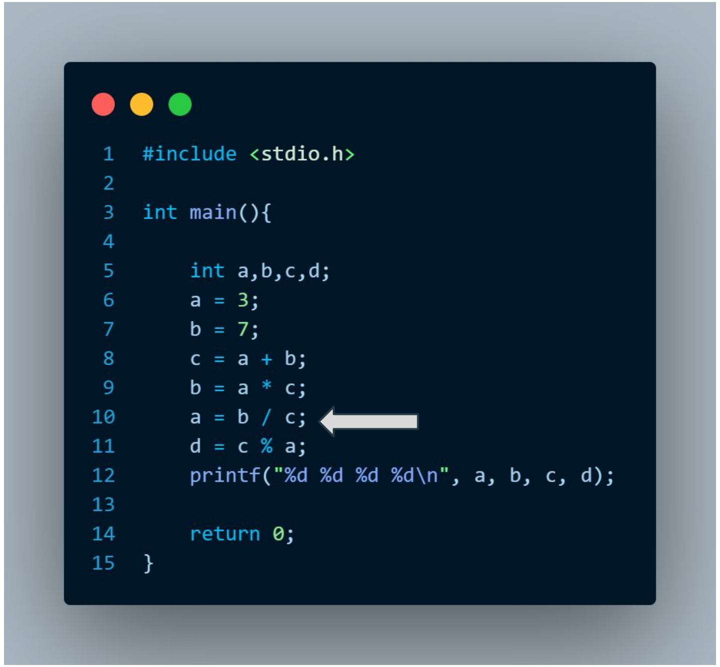


```
1  #include <stdio.h>
2
3  int main(){
4
5      int a,b,c,d;
6      a = 3;
7      b = 7;
8      c = a + b;
9      b = a * c;
10     a = b / c;
11     d = c % a;
12     printf("%d %d %d %d\n", a, b, c, d);
13
14     return 0;
15 }
```

第12行的輸出會是什麼？

a	b	c	d
3	30	10	

算術運算子Arithmetic Operator

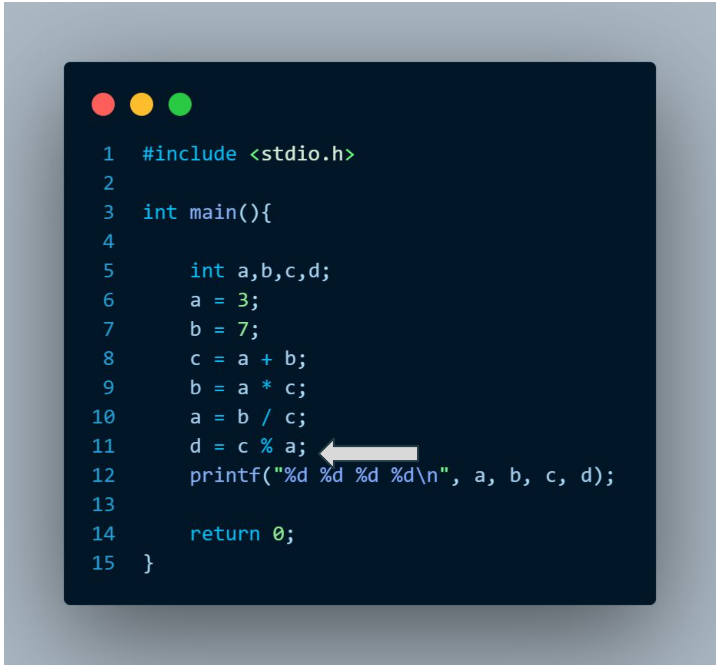


```
1  #include <stdio.h>
2
3  int main(){
4
5      int a,b,c,d;
6      a = 3;
7      b = 7;
8      c = a + b;
9      b = a * c;
10     a = b / c;
11     d = c % a;
12     printf("%d %d %d %d\n", a, b, c, d);
13
14     return 0;
15 }
```

第12行的輸出會是什麼？

a	b	c	d
3	30	10	

算術運算子Arithmetic Operator

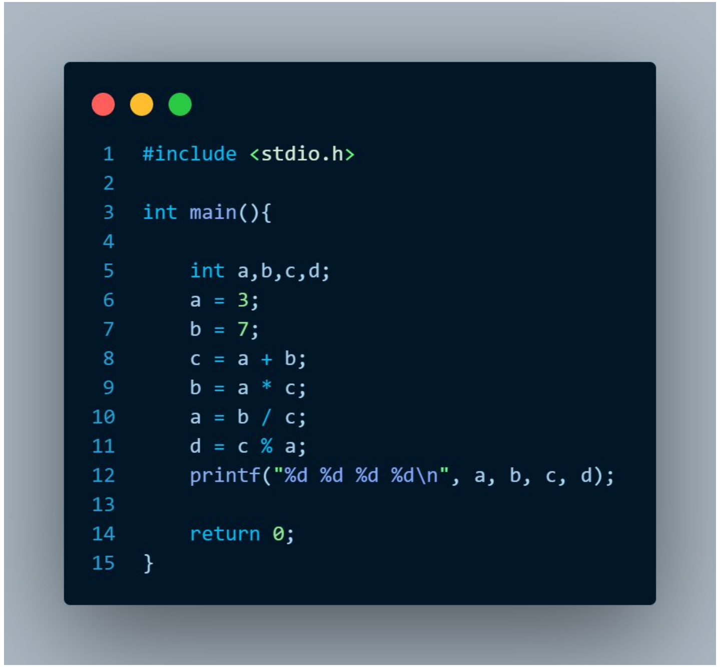


```
 1  #include <stdio.h>
 2
 3  int main(){
 4
 5      int a,b,c,d;
 6      a = 3;
 7      b = 7;
 8      c = a + b;
 9      b = a * c;
10      a = b / c;
11      d = c % a;
12      printf("%d %d %d %d\n", a, b, c, d);
13
14      return 0;
15  }
```

第12行的輸出會是什麼？

a	b	c	d
3	30	10	1

算術運算子Arithmetic Operator



```
 1  #include <stdio.h>
 2
 3  int main(){
 4
 5      int a,b,c,d;
 6      a = 3;
 7      b = 7;
 8      c = a + b;
 9      b = a * c;
10      a = b / c;
11      d = c % a;
12      printf("%d %d %d %d\n", a, b, c, d);
13
14      return 0;
15  }
```

第12行的輸出會是什麼？

Output:

3 30 10 1

指定運算子Assignment Operator

指定運算子Assignment operator

指定:【=】

- 把【=】右邊的值賦予左邊
- Examples:

```
int a = 2;     char letter = ‘A’;
```

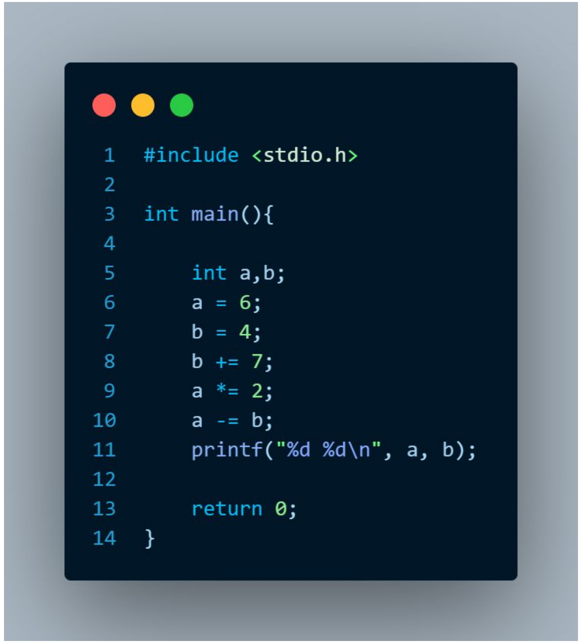
增量賦值 Compound Assignment

增量賦值Compound Assignment

Compound assignment

- 結合算術運算子(+, -, *, /) 跟 指定運算子(=)
- 類別:
  - `+=, -=, *=, /=, %=`
- Example:
  - `a += b` 相等於 `a = a + b`
  - `x *= y` 相等於 `x = x * y`

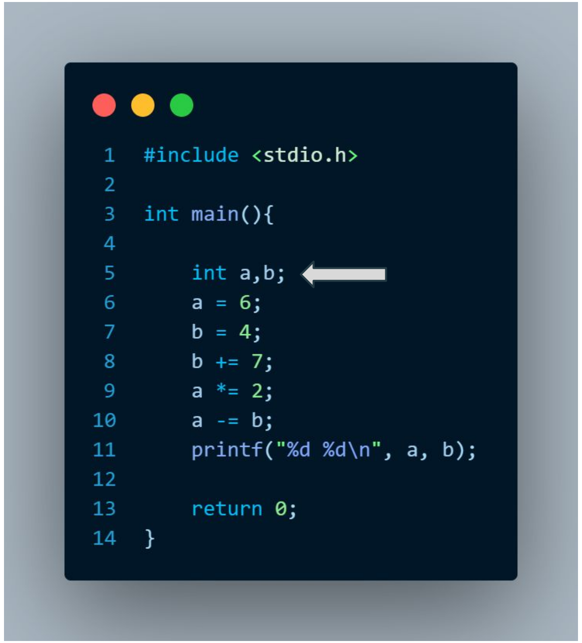
增量賦值Compound Assignment



```
 1  #include <stdio.h>
 2
 3  int main(){
 4
 5      int a,b;
 6      a = 6;
 7      b = 4;
 8      b += 7;
 9      a *= 2;
10      a -= b;
11      printf("%d %d\n", a, b);
12
13      return 0;
14  }
```

第11行的輸出是什麼？

增量賦值Compound Assignment

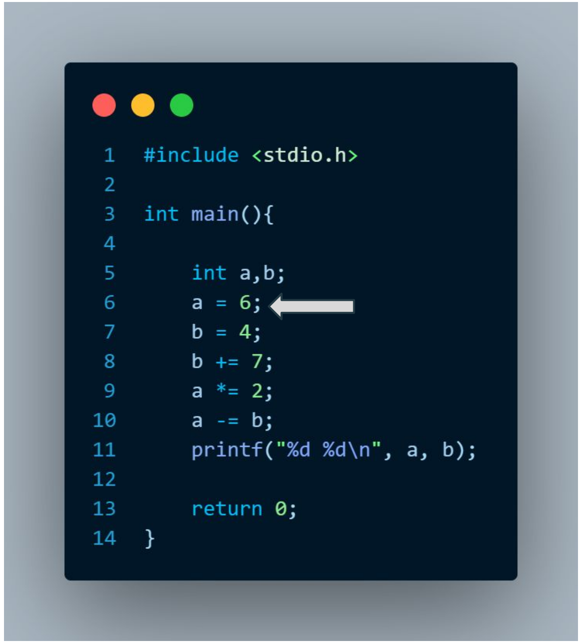


```
 1  #include <stdio.h>
 2
 3  int main(){
 4
 5      int a,b;
 6      a = 6;
 7      b = 4;
 8      b += 7;
 9      a *= 2;
10      a -= b;
11      printf("%d %d\n", a, b);
12
13      return 0;
14  }
```

第11行的輸出是什麼？

a	b

增量賦值Compound Assignment

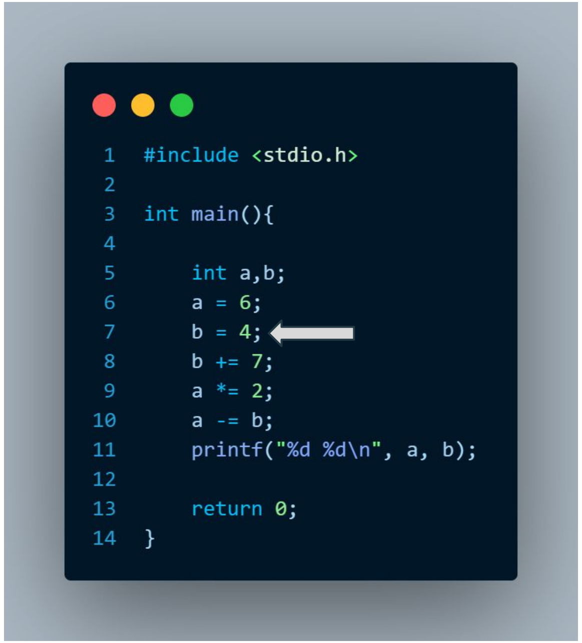


```
 1  #include <stdio.h>
 2
 3  int main(){
 4
 5      int a,b;
 6      a = 6;
 7      b = 4;
 8      b += 7;
 9      a *= 2;
10      a -= b;
11      printf("%d %d\n", a, b);
12
13      return 0;
14  }
```

第11行的輸出是什麼？

a	b
6	

增量賦值Compound Assignment

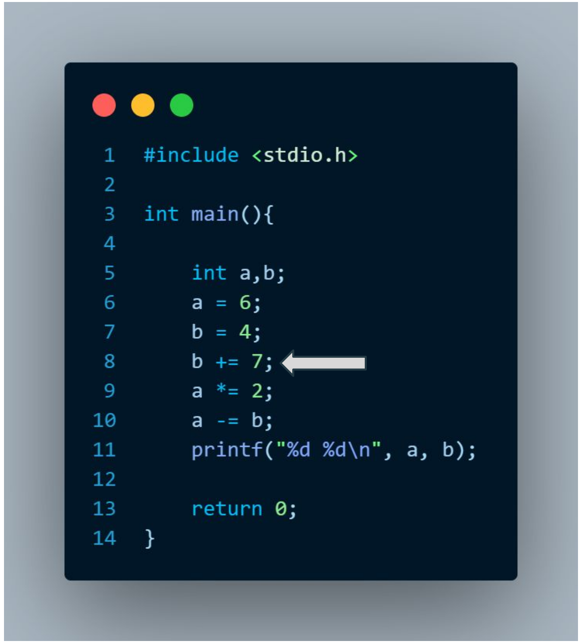


```c
 1  #include <stdio.h>
 2
 3  int main(){
 4
 5      int a,b;
 6      a = 6;
 7      b = 4;
 8      b += 7;
 9      a *= 2;
10      a -= b;
11      printf("%d %d\n", a, b);
12
13      return 0;
14  }
```

第11行的輸出是什麼？

a	b
6	4

增量賦值Compound Assignment

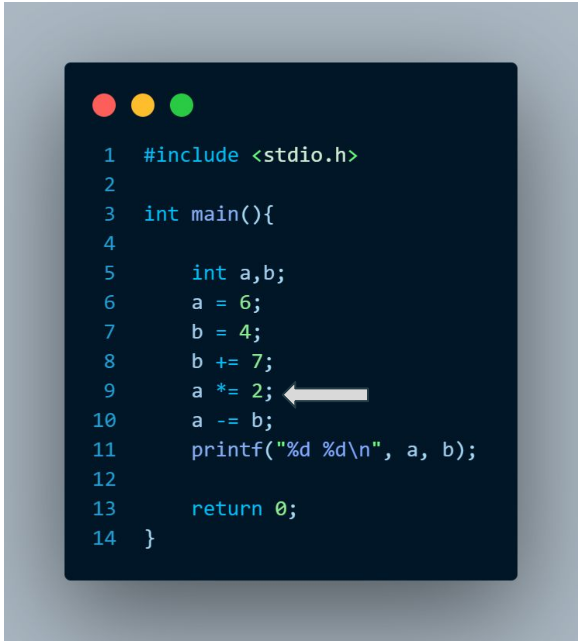


```
1   #include <stdio.h>
2
3   int main(){
4
5       int a,b;
6       a = 6;
7       b = 4;
8       b += 7; ←
9       a *= 2;
10      a -= b;
11      printf("%d %d\n", a, b);
12
13      return 0;
14  }
```

第11行的輸出是什麼？

a	b
6	11

增量賦值Compound Assignment

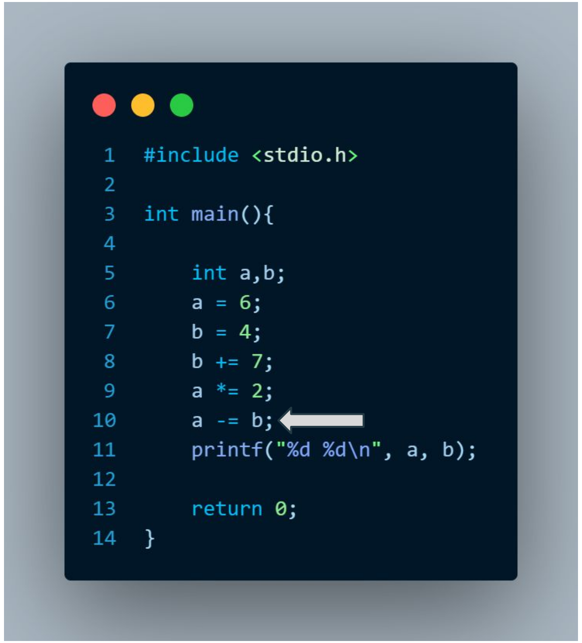


```
 1  #include <stdio.h>
 2
 3  int main(){
 4
 5      int a,b;
 6      a = 6;
 7      b = 4;
 8      b += 7;
 9      a *= 2;
10      a -= b;
11      printf("%d %d\n", a, b);
12
13      return 0;
14  }
```

第11行的輸出是什麼？

a	b
12	11

增量賦值Compound Assignment

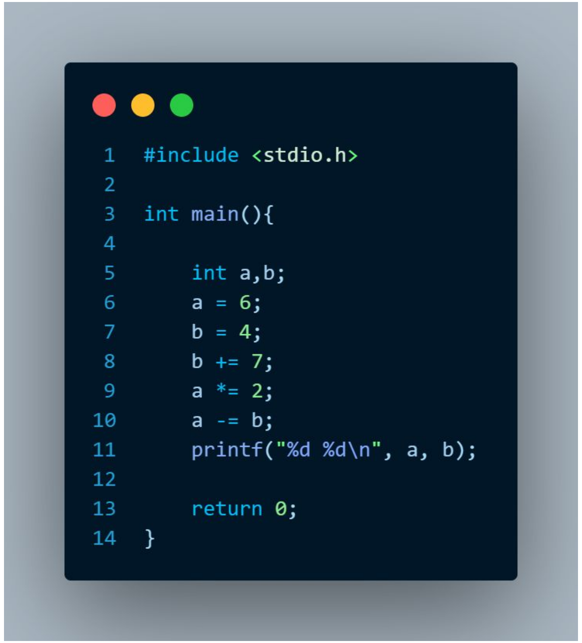


```
1   #include <stdio.h>
2
3   int main(){
4
5       int a,b;
6       a = 6;
7       b = 4;
8       b += 7;
9       a *= 2;
10      a -= b;
11      printf("%d %d\n", a, b);
12
13      return 0;
14  }
```

第11行的輸出是什麼？

a	b
1	11

增量賦值Compound Assignment



```
 1  #include <stdio.h>
 2
 3  int main(){
 4
 5      int a,b;
 6      a = 6;
 7      b = 4;
 8      b += 7;
 9      a *= 2;
10      a -= b;
11      printf("%d %d\n", a, b);
12
13      return 0;
14  }
```

第11行的輸出是什麼？

Output:

1 11

Any questions ???

比較運算子與邏輯運算子
Comparison Operator&
Logical Operators

比較與邏輯運算子

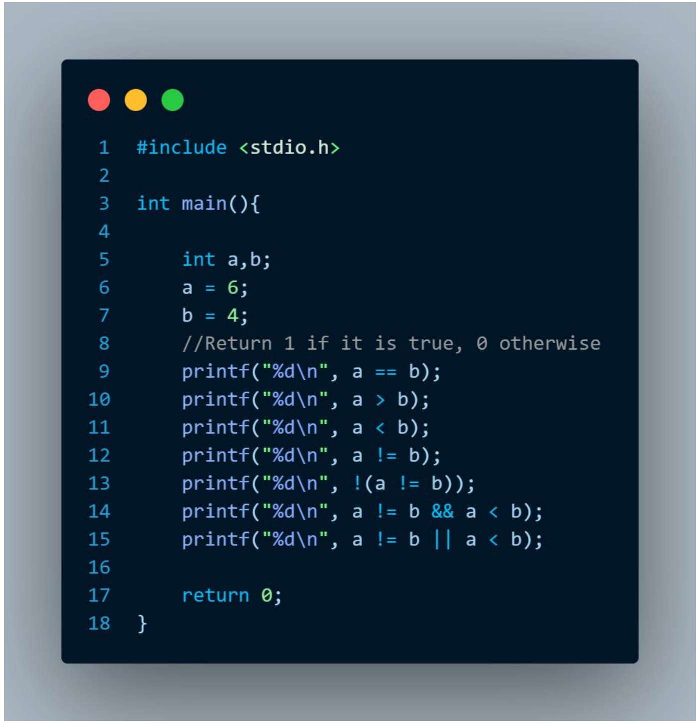
運算子	意義	範例	描述
==	Equal to	a == b	If a equals to b, return true
!=	Not equal	a != b	If a is not equal to b, return true
>	Greater than	a > b	If a is greater than b, return true
<	Smaller than	a < b	If a is smaller than b, return true
>=	Not smaller than	a >= b	If a is not smaller than b, return true
<=	Not greater than	a <= b	If a is not greater than b, return true
||	OR	a || b	If a OR b is true, return true
&&	AND	a && b	If a AND b are true, return true
!	Not	!a	If a is false, return true

比較與邏輯運算子

AND, OR ,NOT的真值表

A	B	A && B	A || B	!A
True	True	True	True	False
True	False	False	True	False
False	True	False	True	True
False	False	False	False	True

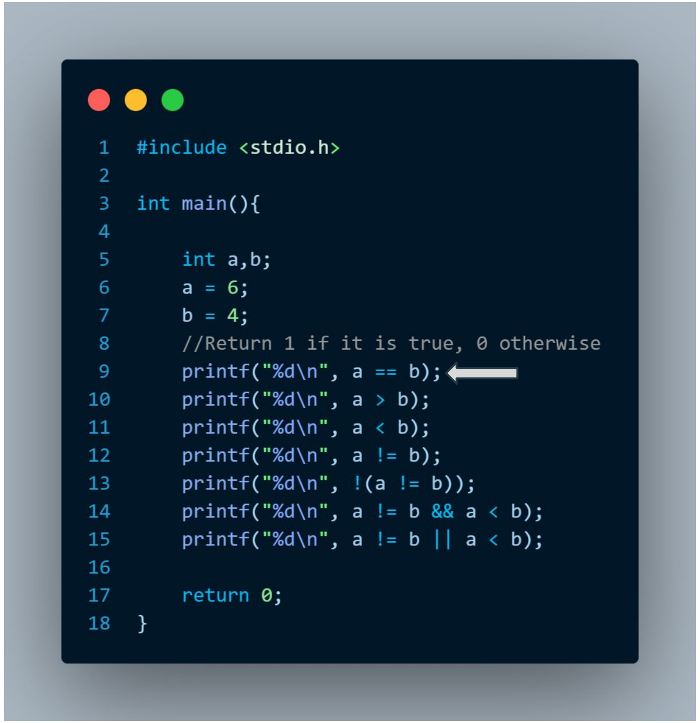
比較與邏輯運算子



```c
#include <stdio.h>

int main(){

    int a,b;
    a = 6;
    b = 4;
    //Return 1 if it is true, 0 otherwise
    printf("%d\n", a == b);
    printf("%d\n", a > b);
    printf("%d\n", a < b);
    printf("%d\n", a != b);
    printf("%d\n", !(a != b));
    printf("%d\n", a != b && a < b);
    printf("%d\n", a != b || a < b);

    return 0;
}
```

猜猜Output是什麼？

比較與邏輯運算子



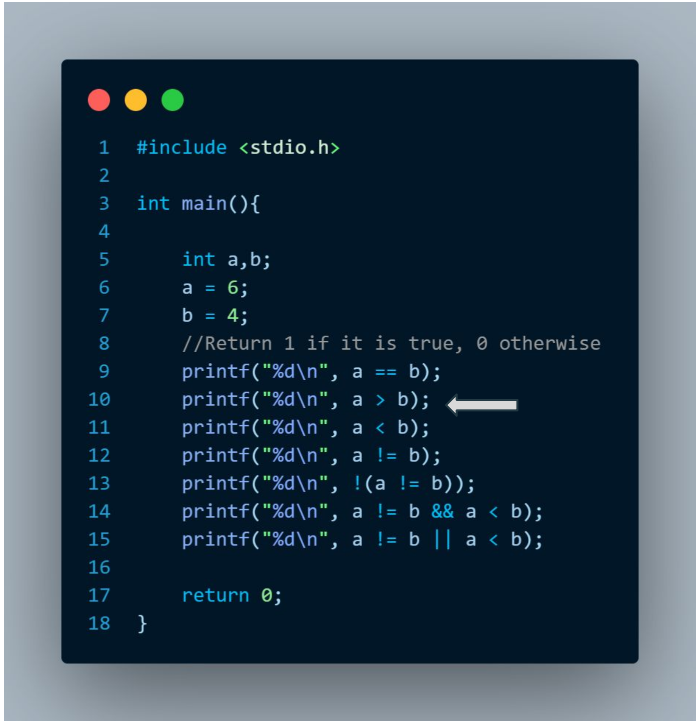
```c
#include <stdio.h>

int main(){

    int a,b;
    a = 6;
    b = 4;
    //Return 1 if it is true, 0 otherwise
    printf("%d\n", a == b);
    printf("%d\n", a > b);
    printf("%d\n", a < b);
    printf("%d\n", a != b);
    printf("%d\n", !(a != b));
    printf("%d\n", a != b && a < b);
    printf("%d\n", a != b || a < b);

    return 0;
}
```

猜猜Output是什麼？

Is 6 equal to 4?

No

比較與邏輯運算子



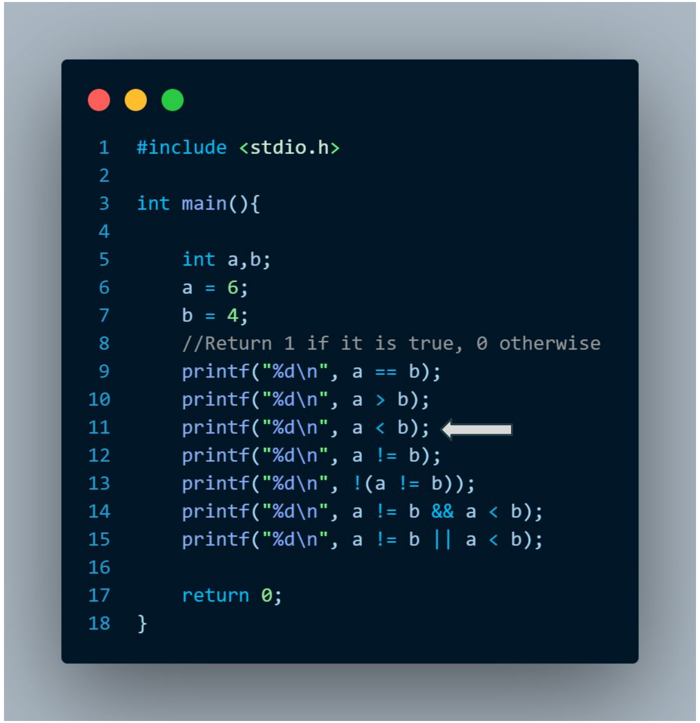
```c
#include <stdio.h>

int main(){

    int a,b;
    a = 6;
    b = 4;
    //Return 1 if it is true, 0 otherwise
    printf("%d\n", a == b);
    printf("%d\n", a > b);
    printf("%d\n", a < b);
    printf("%d\n", a != b);
    printf("%d\n", !(a != b));
    printf("%d\n", a != b && a < b);
    printf("%d\n", a != b || a < b);

    return 0;
}
```

猜猜Output是什麼？

Is 6 greater than 4?

Yes

比較與邏輯運算子

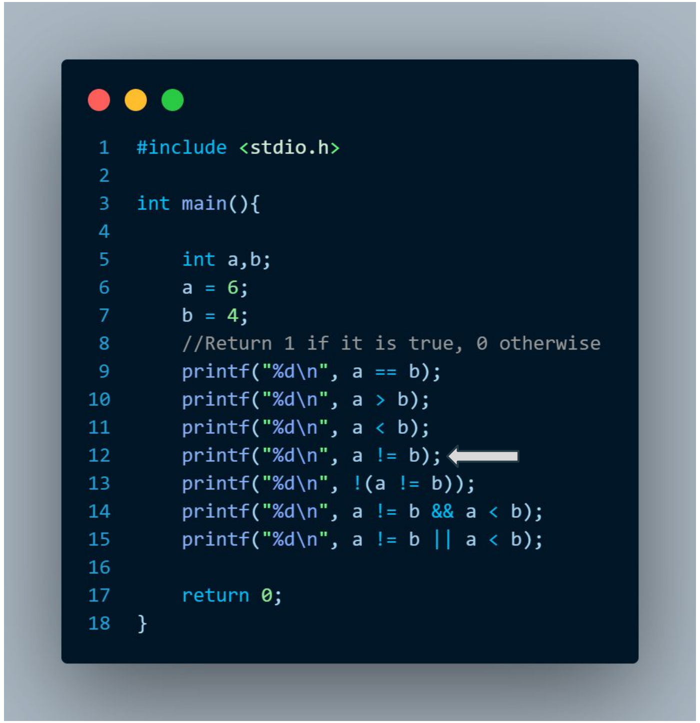


```c
#include <stdio.h>

int main(){

    int a,b;
    a = 6;
    b = 4;
    //Return 1 if it is true, 0 otherwise
    printf("%d\n", a == b);
    printf("%d\n", a > b);
    printf("%d\n", a < b);
    printf("%d\n", a != b);
    printf("%d\n", !(a != b));
    printf("%d\n", a != b && a < b);
    printf("%d\n", a != b || a < b);

    return 0;
}
```

猜猜Output是什麼？

Is 6 smaller than 4?
No

比較與邏輯運算子



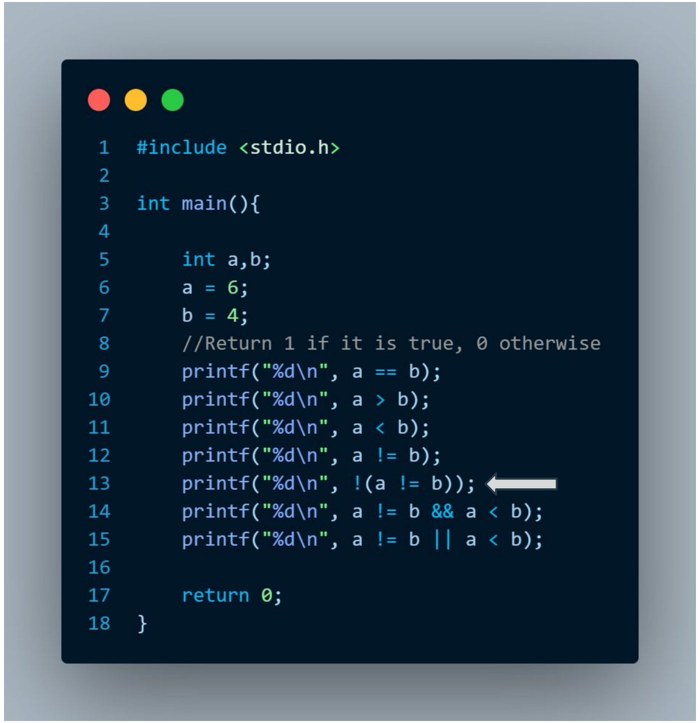
```c
#include <stdio.h>

int main(){

    int a,b;
    a = 6;
    b = 4;
    //Return 1 if it is true, 0 otherwise
    printf("%d\n", a == b);
    printf("%d\n", a > b);
    printf("%d\n", a < b);
    printf("%d\n", a != b);
    printf("%d\n", !(a != b));
    printf("%d\n", a != b && a < b);
    printf("%d\n", a != b || a < b);

    return 0;
}
```

猜猜Output是什麼？

Is 6 not equal to 4?

Yes

比較與邏輯運算子

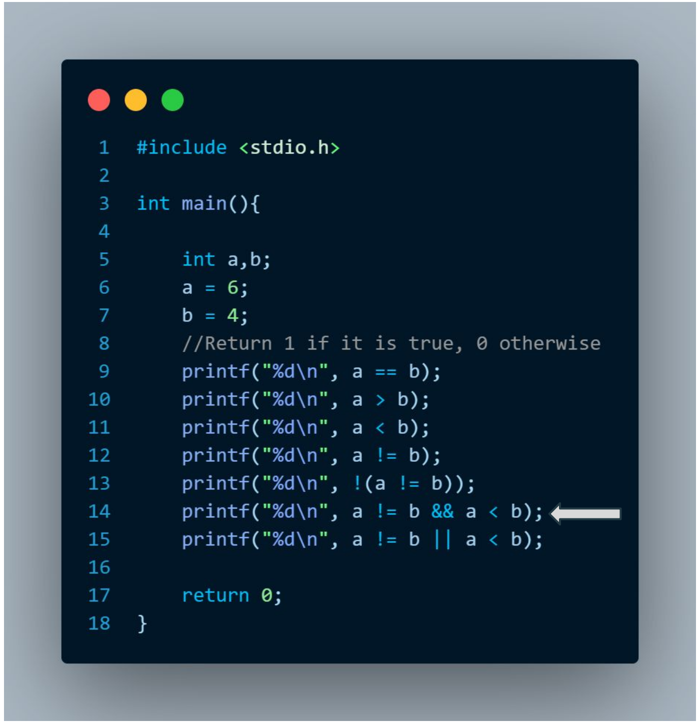


```c
#include <stdio.h>

int main(){

    int a,b;
    a = 6;
    b = 4;
    //Return 1 if it is true, 0 otherwise
    printf("%d\n", a == b);
    printf("%d\n", a > b);
    printf("%d\n", a < b);
    printf("%d\n", a != b);
    printf("%d\n", !(a != b));
    printf("%d\n", a != b && a < b);
    printf("%d\n", a != b || a < b);

    return 0;
}
```

猜猜Output是什麼？

Not(Is 6 not equal to 4?)
No

比較與邏輯運算子



```c
#include <stdio.h>

int main(){

    int a,b;
    a = 6;
    b = 4;
    //Return 1 if it is true, 0 otherwise
    printf("%d\n", a == b);
    printf("%d\n", a > b);
    printf("%d\n", a < b);
    printf("%d\n", a != b);
    printf("%d\n", !(a != b));
    printf("%d\n", a != b && a < b);
    printf("%d\n", a != b || a < b);

    return 0;
}
```

猜猜Output是什麼？

Is 6 not equal to 4?

Yes

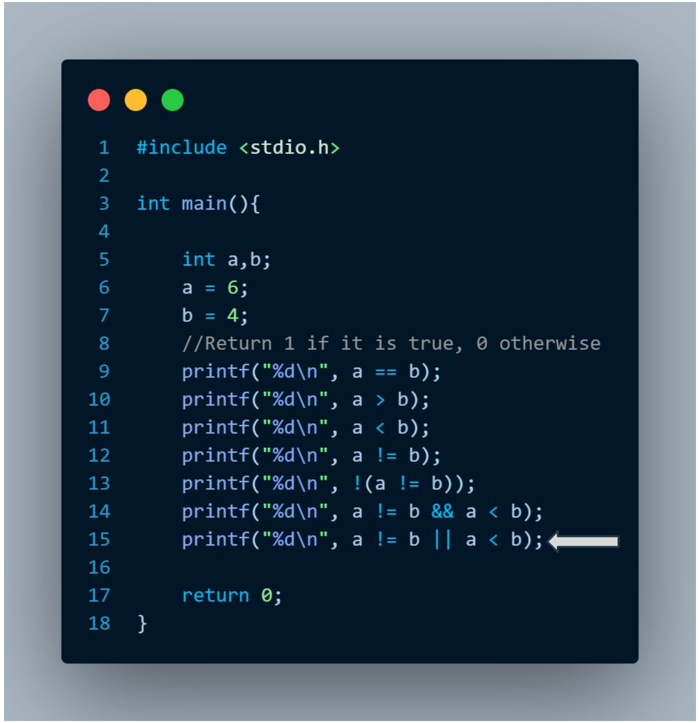
Is 6 smaller than 4?

No

Is 6 greater than 4 AND 6 not equal to 4?

No

比較與邏輯運算子



```c
#include <stdio.h>

int main(){

    int a,b;
    a = 6;
    b = 4;
    //Return 1 if it is true, 0 otherwise
    printf("%d\n", a == b);
    printf("%d\n", a > b);
    printf("%d\n", a < b);
    printf("%d\n", a != b);
    printf("%d\n", !(a != b));
    printf("%d\n", a != b && a < b);
    printf("%d\n", a != b || a < b);

    return 0;
}
```

猜猜Output是什麼？

Is 6 not equal to 4?

Yes

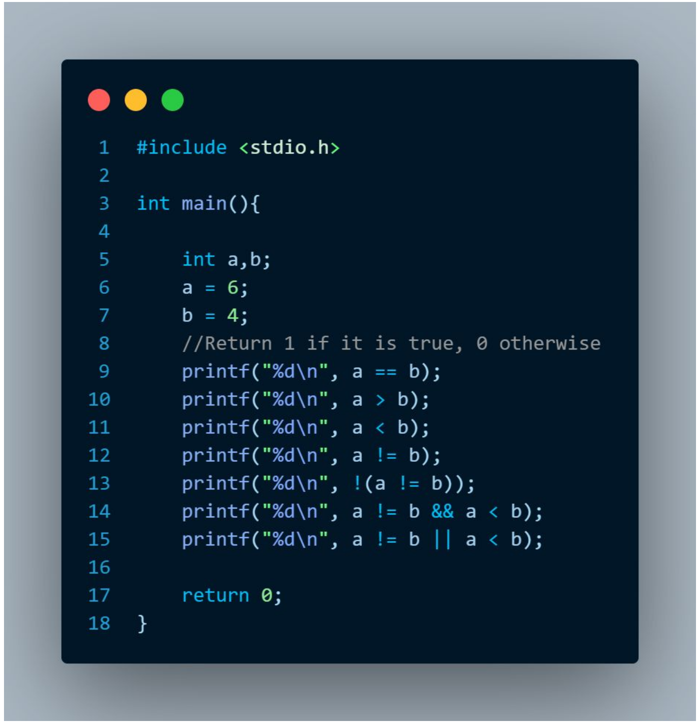
Is 6 greater than 4?

No

Is 6 greater than 4 OR 6 not equal to 4?

Yes

比較與邏輯運算子



```c
#include <stdio.h>

int main(){

    int a,b;
    a = 6;
    b = 4;
    //Return 1 if it is true, 0 otherwise
    printf("%d\n", a == b);
    printf("%d\n", a > b);
    printf("%d\n", a < b);
    printf("%d\n", a != b);
    printf("%d\n", !(a != b));
    printf("%d\n", a != b && a < b);
    printf("%d\n", a != b || a < b);

    return 0;
}
```

猜猜Output是什麼？

Output:

```
0
1
0
1
0
0
1
```

遞增/遞減運算子
Increment and decrement operators

遞增/遞減運算子

如何變數加1/減1？

- 已知方法:
  - Assignment operator 跟 Arithmetic operators
    - `a = a + 1; / a = a - 1;`
  - Compound operators
    - `a += 1; / a -= 1;`

遞增/遞減運算子

- ++ 用於加 1
- -- 用於減 1

- Syntax:

```
<name>++; ++<name>; <name>--; --<name>;
```

- Examples:

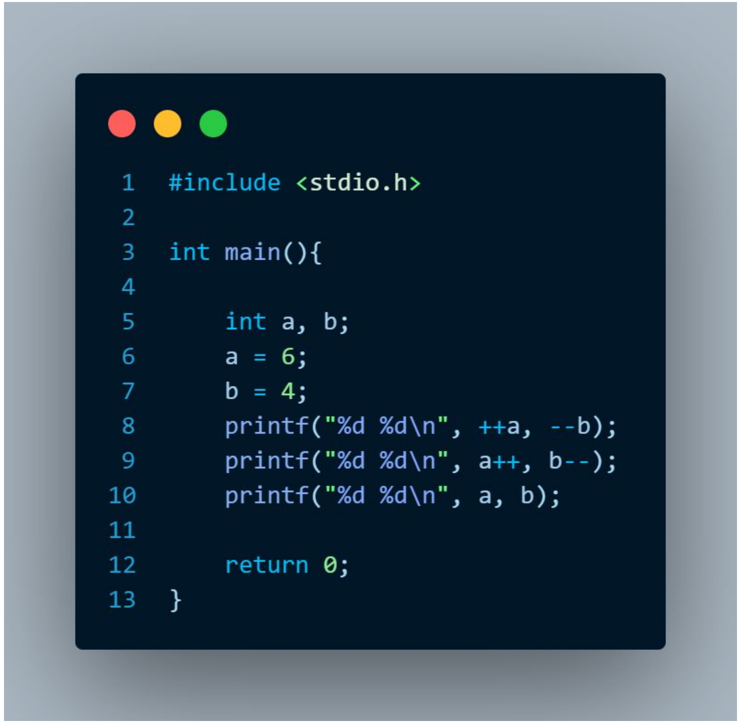
```
i++;   counter--;    ++month;   --j;
```

遞增/遞減運算子

a++ 跟 ++a / a-- 跟 --a 之間的差別

- 運算符號出現於前方
  - 先加/減1之後再輸出
- 運算符號出現於後方
  - 先輸出之後再加/減1

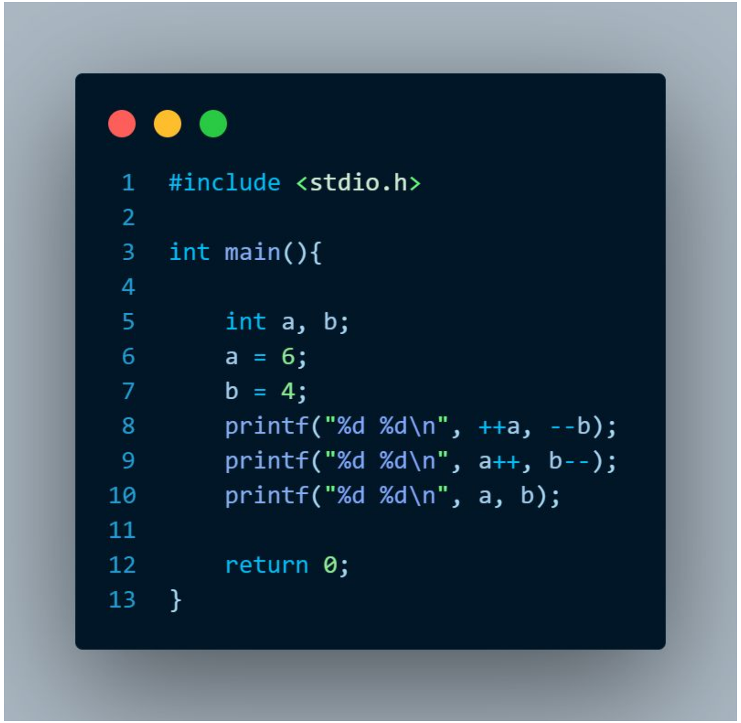
遞增/遞減運算子



```c
#include <stdio.h>

int main(){

    int a, b;
    a = 6;
    b = 4;
    printf("%d %d\n", ++a, --b);
    printf("%d %d\n", a++, b--);
    printf("%d %d\n", a, b);

    return 0;
}
```

猜猜看Output是什麼？

遞增/遞減運算子



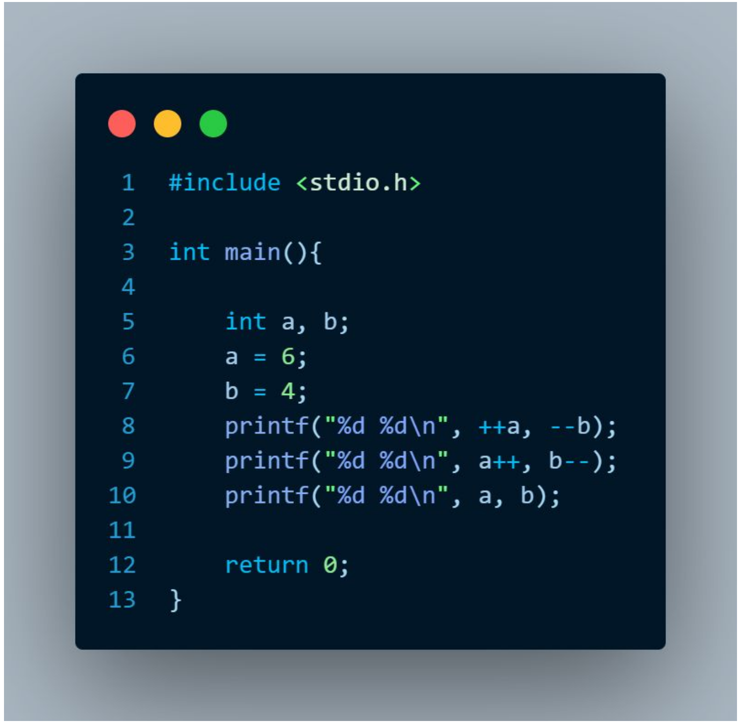
```c
#include <stdio.h>

int main(){

    int a, b;
    a = 6;
    b = 4;
    printf("%d %d\n", ++a, --b);
    printf("%d %d\n", a++, b--);
    printf("%d %d\n", a, b);

    return 0;
}
```

猜猜看Output是什麼？

Output:

7 3

遞增/遞減運算子



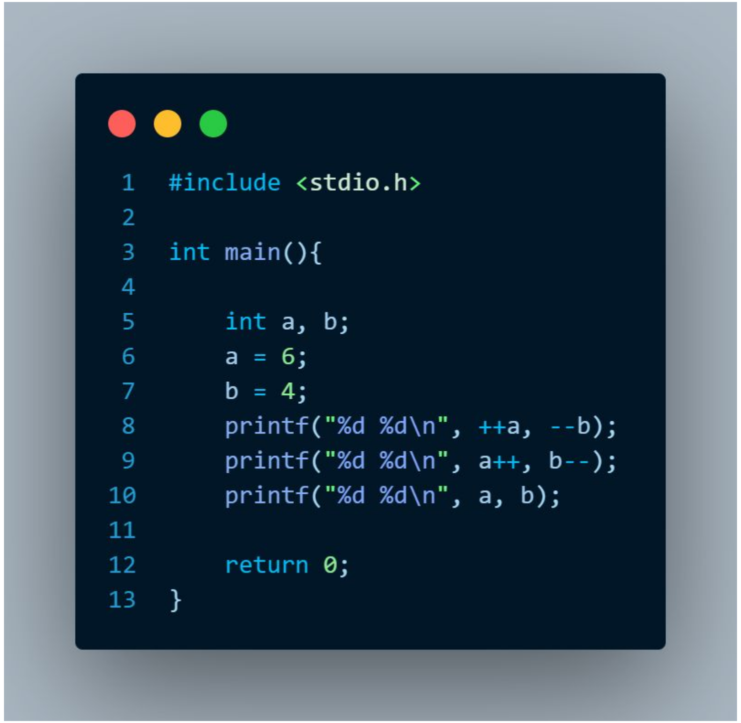
```c
#include <stdio.h>

int main(){

    int a, b;
    a = 6;
    b = 4;
    printf("%d %d\n", ++a, --b);
    printf("%d %d\n", a++, b--);
    printf("%d %d\n", a, b);

    return 0;
}
```

猜猜看Output是什麼？

Output:

```
7 3

7 3
```

遞增/遞減運算子



```c
#include <stdio.h>

int main(){

    int a, b;
    a = 6;
    b = 4;
    printf("%d %d\n", ++a, --b);
    printf("%d %d\n", a++, b--);
    printf("%d %d\n", a, b);

    return 0;
}
```

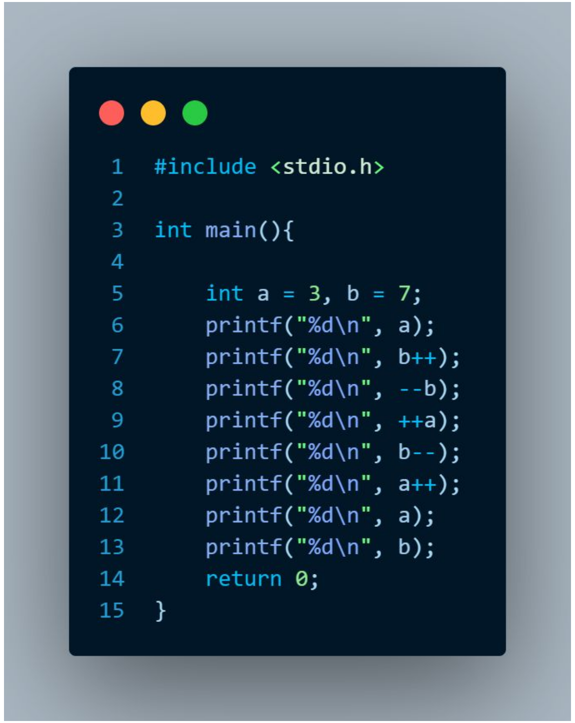
猜猜看Output是什麼？

Output:

```
7 3

7 3

8 2
```

Any questions ???

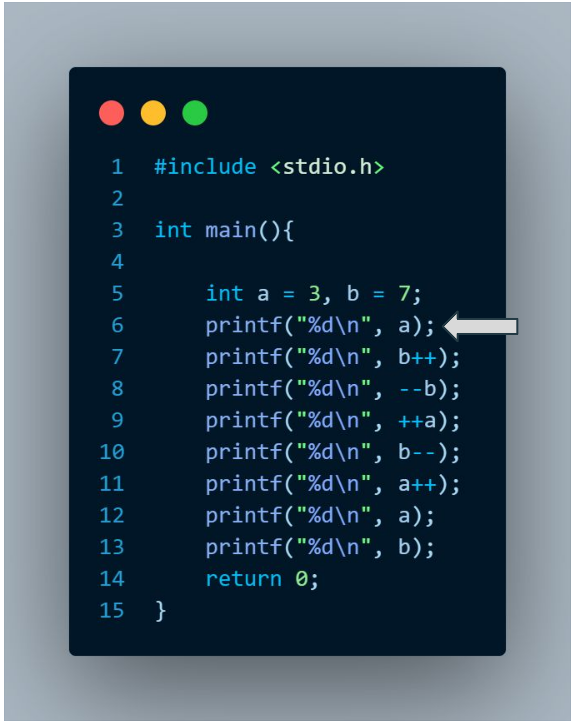
遞增/遞減運算子



```c
#include <stdio.h>

int main(){

    int a = 3, b = 7;
    printf("%d\n", a);
    printf("%d\n", b++);
    printf("%d\n", --b);
    printf("%d\n", ++a);
    printf("%d\n", b--);
    printf("%d\n", a++);
    printf("%d\n", a);
    printf("%d\n", b);
    return 0;
}
```

猜猜看Output是什麼？

遞增/遞減運算子



```c
#include <stdio.h>

int main(){

    int a = 3, b = 7;
    printf("%d\n", a);
    printf("%d\n", b++);
    printf("%d\n", --b);
    printf("%d\n", ++a);
    printf("%d\n", b--);
    printf("%d\n", a++);
    printf("%d\n", a);
    printf("%d\n", b);
    return 0;
}
```

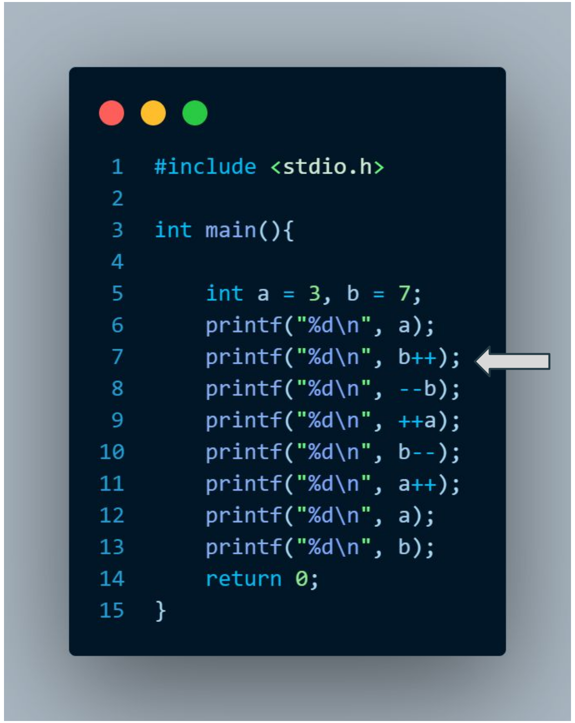
Output:

3

Value:

a	b
3	7

遞增/遞減運算子



```c
#include <stdio.h>

int main(){

    int a = 3, b = 7;
    printf("%d\n", a);
    printf("%d\n", b++);
    printf("%d\n", --b);
    printf("%d\n", ++a);
    printf("%d\n", b--);
    printf("%d\n", a++);
    printf("%d\n", a);
    printf("%d\n", b);
    return 0;
}
```

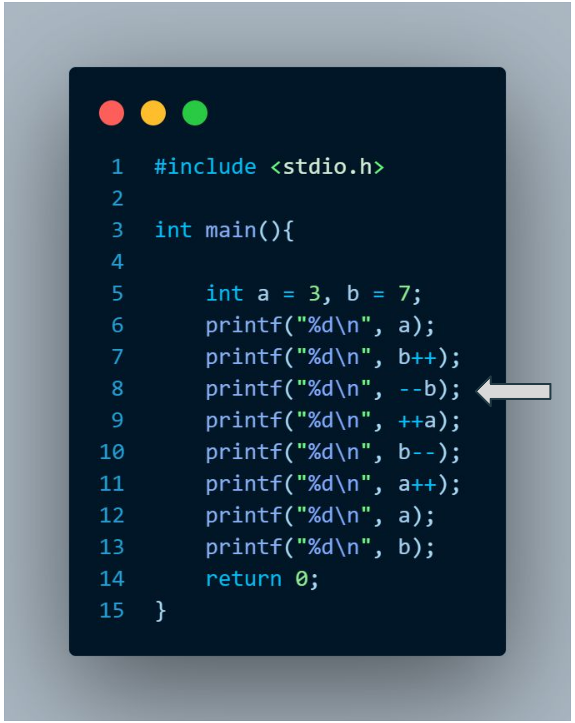
Output:

3
7

Value:

a	b
3	8

遞增/遞減運算子



```c
#include <stdio.h>

int main(){

    int a = 3, b = 7;
    printf("%d\n", a);
    printf("%d\n", b++);
    printf("%d\n", --b);
    printf("%d\n", ++a);
    printf("%d\n", b--);
    printf("%d\n", a++);
    printf("%d\n", a);
    printf("%d\n", b);
    return 0;
}
```

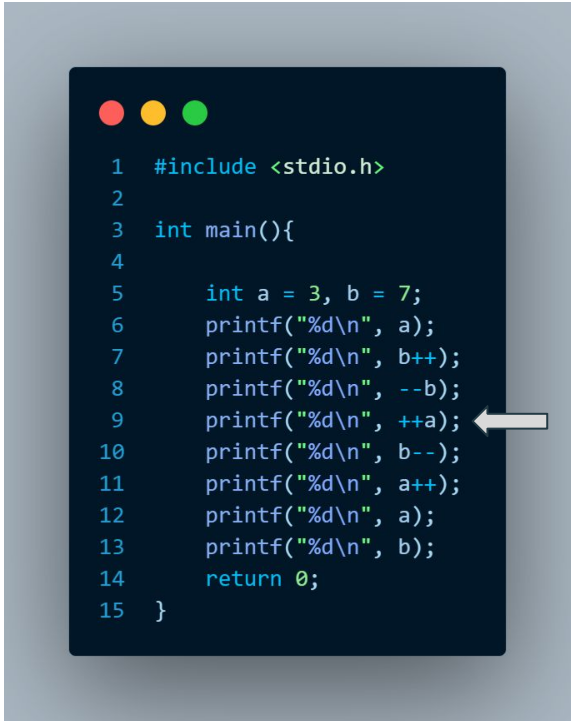
Output:

3
7
7

Value:

a	b
3	7

遞增/遞減運算子



```c
#include <stdio.h>

int main(){

    int a = 3, b = 7;
    printf("%d\n", a);
    printf("%d\n", b++);
    printf("%d\n", --b);
    printf("%d\n", ++a);
    printf("%d\n", b--);
    printf("%d\n", a++);
    printf("%d\n", a);
    printf("%d\n", b);
    return 0;
}
```

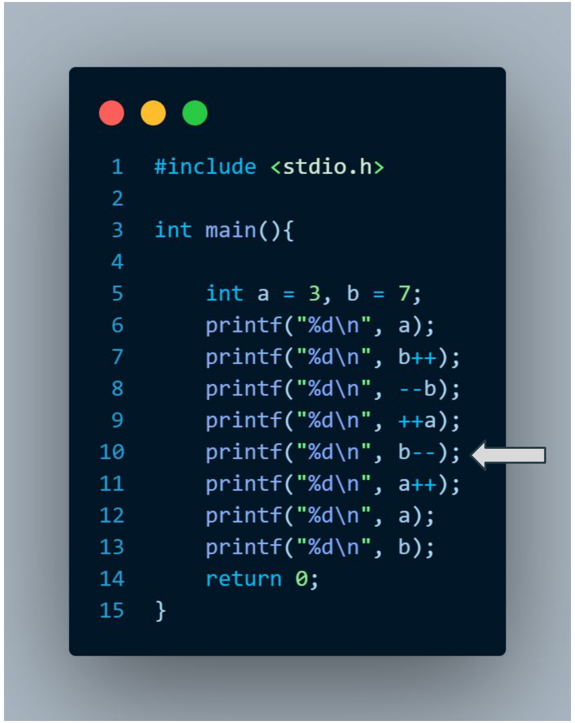
Output:

3
7
7
4

Value:

a	b
4	7

遞增/遞減運算子



```c
#include <stdio.h>

int main(){

    int a = 3, b = 7;
    printf("%d\n", a);
    printf("%d\n", b++);
    printf("%d\n", --b);
    printf("%d\n", ++a);
    printf("%d\n", b--);
    printf("%d\n", a++);
    printf("%d\n", a);
    printf("%d\n", b);
    return 0;
}
```

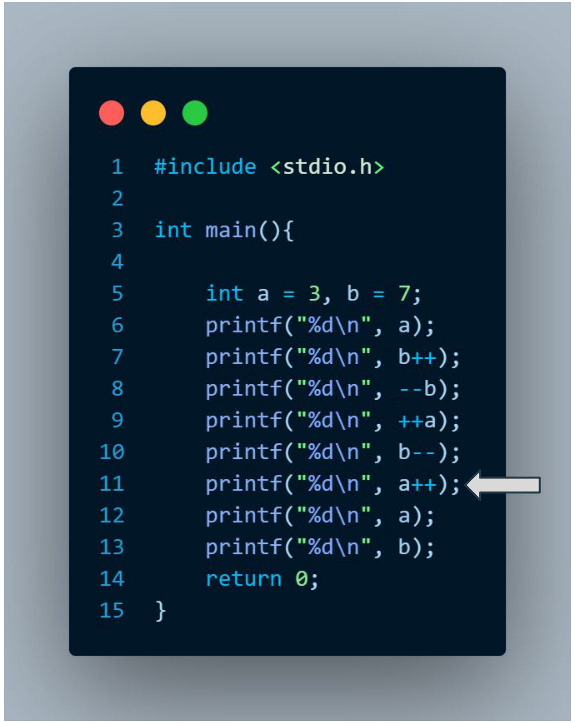
Output:

3
7
7
4
7

Value:

a	b
4	6

遞增/遞減運算子



```c
#include <stdio.h>

int main(){

    int a = 3, b = 7;
    printf("%d\n", a);
    printf("%d\n", b++);
    printf("%d\n", --b);
    printf("%d\n", ++a);
    printf("%d\n", b--);
    printf("%d\n", a++);
    printf("%d\n", a);
    printf("%d\n", b);
    return 0;
}
```

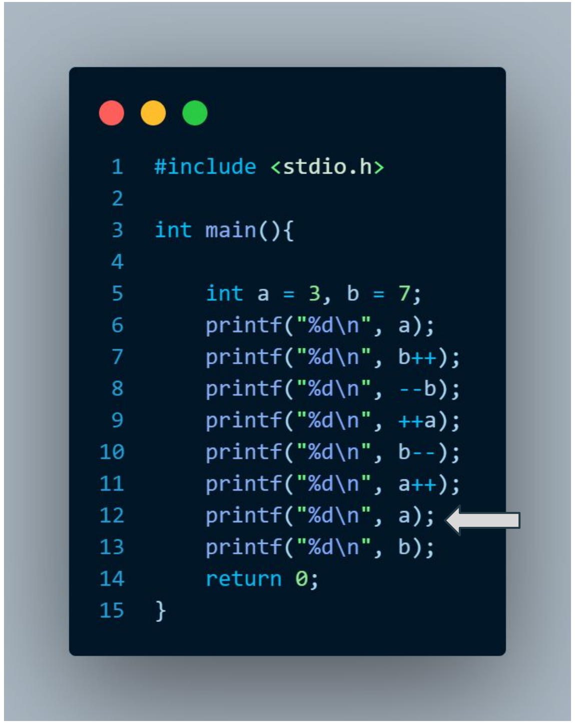
Output:

3
7
7
4
7
4

Value:

a	b
5	6

遞增/遞減運算子



```c
#include <stdio.h>

int main(){

    int a = 3, b = 7;
    printf("%d\n", a);
    printf("%d\n", b++);
    printf("%d\n", --b);
    printf("%d\n", ++a);
    printf("%d\n", b--);
    printf("%d\n", a++);
    printf("%d\n", a);
    printf("%d\n", b);
    return 0;
}
```

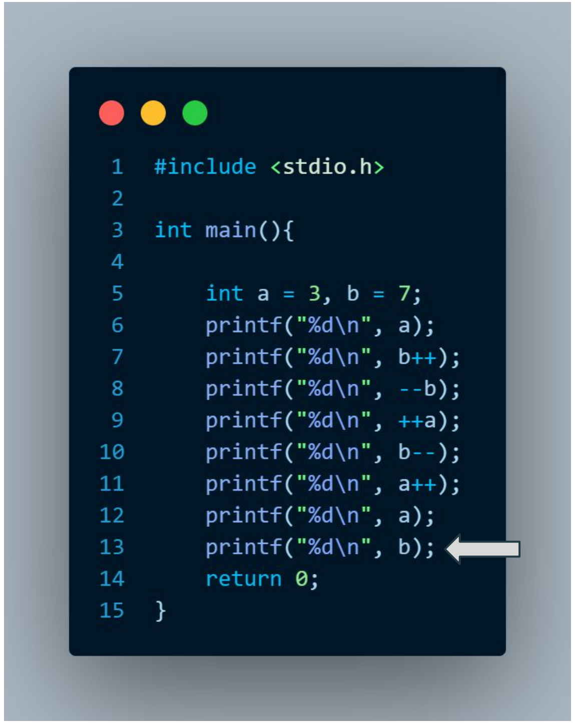
Output:

3
7
7
4
7
4
5

Value:

a	b
5	6

遞增/遞減運算子



```c
#include <stdio.h>

int main(){

    int a = 3, b = 7;
    printf("%d\n", a);
    printf("%d\n", b++);
    printf("%d\n", --b);
    printf("%d\n", ++a);
    printf("%d\n", b--);
    printf("%d\n", a++);
    printf("%d\n", a);
    printf("%d\n", b);
    return 0;
}
```

Output:

3
7
7
4
7
4
5
6

Value:

a	b
5	6

Any Questions?

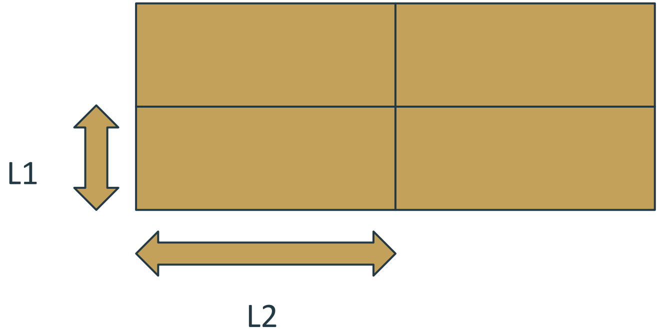
Coding Exercise

給定兩個整數，L1 和 L2。它們分別是「小矩形」的長和寬。
請撰寫一個 C 程式，計算「小矩形」和「大矩形」的面積 A1, A2和周長 P1, P2。
計算完成後，請輸出：A1 P1 A2 P2
此外，請在輸出結束時換一行。

Hints: 使用Compound Assignment

範例：

輸入：3 4　　輸出：12 14 48 28
輸入：90 18　　輸出：1620 216 6480 432



All the codes used are provided here:

https://shorturl.at/9SoBZ

END