

指標 Pointer

by 多拉A夢

在講指標之前……

談談『變數』

5 , 'c' , 3.4123...

『變數』

```
int a = 10;  
char c = 'z';  
float x = 3.1415926;
```



我們雖然知道…

我們雖然知道…

包包有名稱……

我們雖然知道…

包包有名稱……

包包也可以塞東西…

那包包的位置在哪呢？

記憶體位置

記憶體位置

可以想成包包的位置

我們今天不用擔心.....

要如何拿到包包的位置:D

oh ya ~

我們來看看變數是啥米...

變數

資料形態

變數的值

變數的位置

摠.... 超級多的專有名詞很難懂嗎:D

包包名稱

包包的種類

包包裡面的東西

包包的位置

舉例

```
int x = 10 ;
```

int, char, float

x = 10, 'c', 3.14159

變數的位置？

舉例

```
int x = 10 ;
```

x =

int, char, float
10, 'c', 3.14159

變數的位置？

舉例

```
int x = 10 ;
```

int, char, float

x =

10, 'C', 3.14159

那這裡？

→ 繼數的位置？

來做個簡單的實驗...

```
1 #include <cstdio>
2 #include <cstdlib>
3 #include <cstring>
4 #include <iostream>
5
6 using namespace std;
7
8 int main(){
9
10    int x = 10;
11    cout << "Value of x = " << x << endl;
12    cout << "Position of x = " << &x << endl;
13
14    return 0;
15 }
```



注意這裡有‘&’拿來抓取位置用的

我跑出來的結果：D

```
1 #include <cstdio>
2 #include <cstdlib>
3 #include <cstring>
4 #include <iostream>
5
6 using namespace std;
7
8 int main(){
9
10    int x = 10;
11    cout << "Value of x = " << x << endl;
12    cout << "Position of x = " << &x << endl;
13
14    return 0;
15 }
```

```
Value of x = 10
Position of x = 0x7fff56e4e698
```

舉例

```
int x = 10 ;
```

x =

int, char, float

10, 'C', 3.14159

實驗結果

結論上

Position of x = 0x7fff56e4e698
而且：

既然有了位置的觀念……

正式進入指標：D

What is 指標？

來Google一下圖片～



就是你想的那樣...

指標可以指著別人（X

他的概念是這樣的...

指標



小明的包包

小說

小華的包包

數學課本

小美的包包

彩色書刊

他的概念是這樣的...

指標



小華的包包

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他的概念是這樣的...



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他的概念是這樣的...



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彩色書刊

指標裡面裝的是位置

指標

位置

因此……

指標本身也是變數

裡面放的是位置

簡稱『指標變數』

有講跟沒講一樣

要指著別人……

要先知道別人在哪裡

那要如何得知呢？

來看看剛剛的實驗...

```
1 #include <cstdio>
2 #include <cstdlib>
3 #include <cstring>
4 #include <iostream>
5
6 using namespace std;
7
8 int main(){
9
10    int x = 10;
11    cout << "Value of x = " << x << endl;
12    cout << "Position of x = " << &x << endl;
13
14    return 0;
15 }
```



注意這裡有‘&’拿來抓取位置用的

這樣就知道位置了:D

```
1 #include <cstdio>
2 #include <cstdlib>
3 #include <cstring>
4 #include <iostream>
5
6 using namespace std;
7
8 int main(){
9
10    int x = 10;
11    cout << "Value of x = " << x << endl;
12    cout << "Position of x = " << &x << endl;
13
14    return 0;
15 }
```



注意這裡有‘&’拿來抓取位置用的

指標的宣告

- 宣告的方式：資料形態 * 指標變數名稱
 - 資料形態：int, float, char . . .
 - * —> 星星符號，代表指標
 - 指標變數名稱：看你想取什麼綽號 . . .
- 舉例：
 - int *ptr;
 - char *ptr;

指標的運用

- 我們分開討論指標的用法
- 『宣告』還有『不是宣告』的時候使用上有點不同

指標的運用

- 在宣告時assign value是這樣用的.....

```
6 using namespace std;
7
8 int main(){
9     int x = 10;
10    int *ptr = &x;
11
12    cout << "value of x = " << x << endl;
13    cout << "address of x = " << &x << endl;
14    cout << "value of ptr = " << ptr << endl;
15    cout << "value which ptr point to = " << *ptr << endl;
```

指標的運用

- 在『不是在宣告』時assign value是這樣用的.....

```
5
6 using namespace std;
7
8 int main(){
9     int x = 10;
10    int *ptr;
11    ptr = &x;
12
13    cout << "value of x = " << x << endl;
14    cout << "address of x = " << &x << endl;
15    cout << "value of ptr = " << ptr << endl;
16    cout << "value which ptr point to = " << *ptr << endl;
```

指標的運用

```
5
6 using namespace std;
7
8 int main(){
9     int x = 10;
10    int *ptr;
11    ptr = &x;
12
13    cout << "value of x = " << x << endl;
14    cout << "address of x = " << &x << endl;
15    cout << "value of ptr = " << ptr << endl;
16    cout << "value which ptr point to = " << *ptr << endl;
```

宣告ptr 指標變數

指標的運用

```
5
6 using namespace std;
7
8 int main(){
9     int x = 10;
10    int *ptr;
11    ptr = &x;
12
13    cout << "value of x = " << x << endl;
14    cout << "address of x = " << &x << endl;
15    cout << "value of ptr = " << ptr << endl;
16    cout << "value which ptr point to = " << *ptr << endl;
```

把 x 的位置傳給 ptr

指標的運用

```
5
6 using namespace std;
7
8 int main(){
9     int x = 10;
10    int *ptr;
11    ptr = &x;
12
13    cout << "value of x = " << x << endl;
14    cout << "address of x = " << &x << endl;
15    cout << "value of ptr = " << ptr << endl;
16    cout << "value which ptr point to = " << *ptr << endl;
```

```
value of x = 10
address of x = 0x7fff5fb84678
value of ptr = 0x7fff5fb84678
value which ptr point to = 10
```

x 的位置

指標的運用

```
5
6 using namespace std;
7
8 int main(){
9     int x = 10;
10    int *ptr;
11    ptr = &x;
12
13    cout << "value of x = " << x << endl;
14    cout << "address of x = " << &x << endl;
15    cout << "value of ptr = " << ptr << endl;
16    cout << "value which ptr point to = " << *ptr << endl;
```

```
value of x = 10
address of x = 0x7fff5fb84678
value of ptr = 0x7fff5fb84678
value which ptr point to = 10
```

ptr 這個『指標變數』裡面的值

指標的運用

```
5
6 using namespace std;
7
8 int main(){
9     int x = 10;
10    int *ptr;
11    ptr = &x;
12
13    cout << "value of x = " << x << endl;
14    cout << "address of x = " << &x << endl;
15    cout << "value of ptr = " << ptr << endl;
16    cout << "value which ptr point to = " << *ptr << endl;
```

```
value of x = 10
address of x = 0x7fff5fb84678
value of ptr = 0x7fff5fb84678
value which ptr point to = 10
```

你會發現，『ptr的值』跟『x 的位置一樣』

指標的運用

```
5
6 using namespace std;
7
8 int main(){
9     int x = 10;
10    int *ptr;
11    ptr = &x;
12
13    cout << "value of x = " << x << endl;
14    cout << "address of x = " << &x << endl;
15    cout << "value of ptr = " << ptr << endl;
16    cout << "value which ptr point to = " << *ptr << endl;
```

```
value of x = 10
address of x = 0x7fff5fb84678
value of ptr = 0x7fff5fb84678
value which ptr point to = 10
```

因為我們做了 $\text{ptr} = \&x$ ~~~

指標的運用

```
5
6 using namespace std;
7
8 int main(){
9     int x = 10;
10    int *ptr;
11    ptr = &x;
12
13    cout << "value of x = " << x << endl;
14    cout << "address of x = " << &x << endl;
15    cout << "valure of ptr = " << ptr << endl;
16    cout << "value which ptr point to = " << *ptr << endl;
```

```
value of x = 10
address of x = 0x7fff5fb84678
valure of ptr = 0x7fff5fb84678
value which ptr point to = 10
```

*ptr : 『指標變數』指到的值 (汗)

指標的運用

```
5
6 using namespace std;
7
8 int main(){
9     int x = 10;
10    int *ptr;
11    ptr = &x;
12
13    cout << "value of x = " << x << endl;
14    cout << "address of x = " << &x << endl;
15    cout << "valure of ptr = " << ptr << endl;
16    cout << "value which ptr point to = " << *ptr << endl;
```

```
value of x = 10
address of x = 0x7fff5fb84678
valure of ptr = 0x7fff5fb84678
value which ptr point to = 10
```

*ptr : 『指標變數』指到的值 (汗)

指標的運用

```
5
6 using namespace std;
7
8 int main(){
9     int x = 10;
10    int *ptr;
11    ptr = &x;
12
13    cout << "value of x = " << x << endl;
14    cout << "address of x = " << &x << endl;
15    cout << "valure of ptr = " << ptr << endl;
16    cout << "value which ptr point to = " << *ptr << endl;
```



```
value of x = 10
address of x = 0x7fff5fb84678
valure of ptr = 0x7fff5fb84678
value which ptr point to = 10
```

→這個位置的值

*ptr : 『指標變數』指到的值 (汗)

指標的運用

```
5  
6 using namespace std;  
7  
8 int main(){  
9     int x = 10;  
10    int *ptr;  
11    ptr = &x;  
12  
13    cout << "value of x = " << x << endl;  
14    cout << "address of x = " << &x << endl;  
15    cout << "valure of ptr = " << ptr << endl;  
16    cout << "value which ptr point to = " << *ptr << endl;
```

```
value of x = 10  
address of x = 0x7fff5fb84678  
valure of ptr = 0x7fff5fb84678  
value which ptr point to = 10
```

→這個位置的值

*ptr : 『指標變數』指到的值 (汗)

如果還是很難理解...

來看看圖形～～

```
int i = 100;
```

Address 1585640876

Variable



Value 100

int *ptr;

Address 1585640876

1481688492

Variable



Value

100

???

`&i` ——> 取得變數 i 的位址

`&i`

Address 1585640876

1481688492

Variable

i

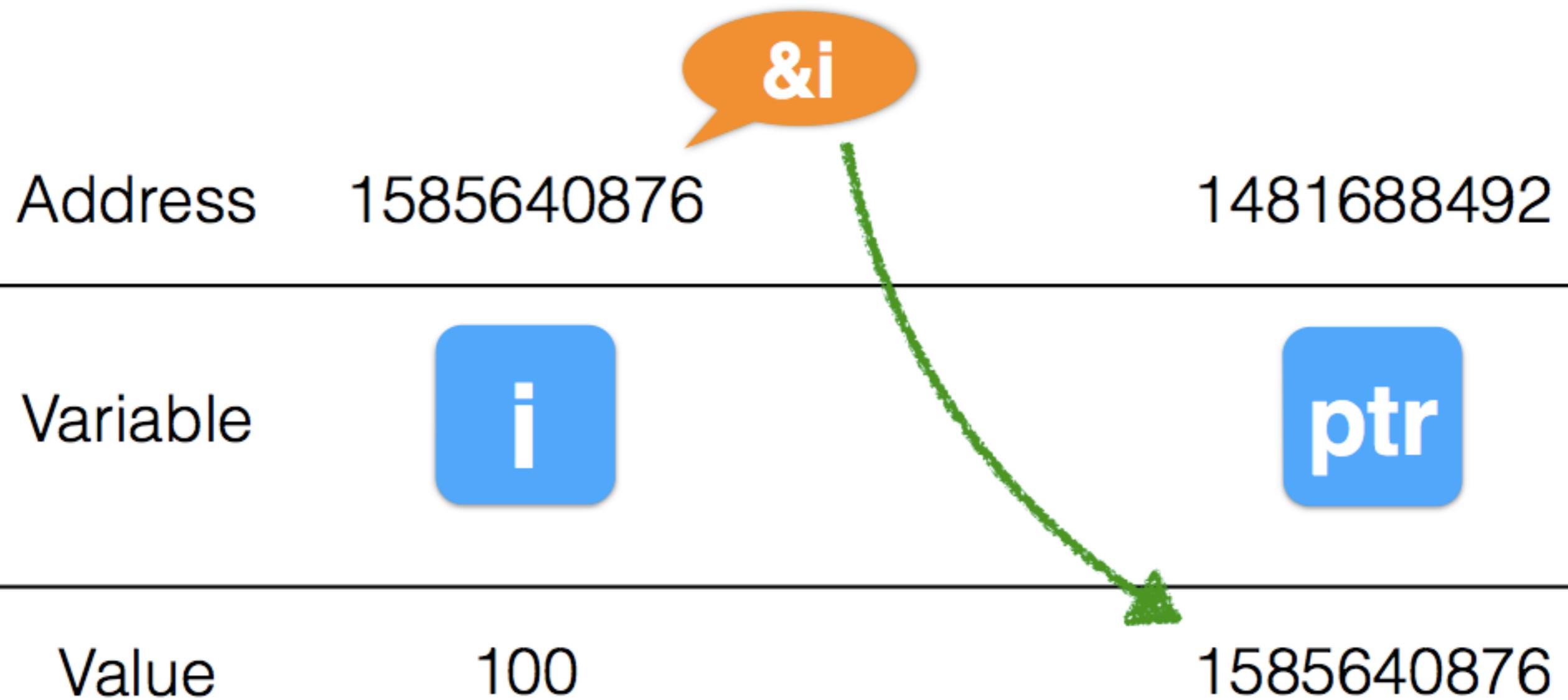
ptr

Value

100

???

`ptr = &i;`



Address	1585640876	1481688492
---------	------------	------------

Variable		
----------	---	--

Value	100	1585640876
-------	-----	------------

整理一下用法

- x 是一個變數， ptr 是一個指標變數
- $x \Rightarrow$ 變數的值
- $\&x \Rightarrow$ 取得變數的位址
- $ptr \Rightarrow$ 『指標變數』 的值
- $*ptr \Rightarrow$ 取得『指標變數』 指到的值

我們順藤摸瓜一下...

- 又是來這個例子：int x = 10; int *ptr = &x;
- 我們知道... ptr指到x的位置，***ptr** 的值等於10

我們順藤摸瓜一下...

- 又是來這個例子：`int x = 10; int *ptr = &x;`
- 我們知道... `ptr`指到`x`的位置，***ptr** 的值等於10
- 如果我們做了這樣的事情：***ptr = 1000;**
- 請問 `x` 會變成多少？

改一下剛剛的code

```
8 int main(){
9     int x = 10;
0     int *ptr;
1     ptr = &x;
2
3     cout << "value of x = " << x << endl;
4     cout << "address of x = " << &x << endl;
5     cout << "value of ptr = " << ptr << endl;
6     cout << "value which ptr point to = " << *ptr << endl;
7
8     *ptr = 100;
9
0     cout << "value of x = " << x << endl;
1     cout << "address of x = " << &x << endl;
2     cout << "value of ptr = " << ptr << endl;
3     cout << "value which ptr point to = " << *ptr << endl;
```

實驗結果

```
./a.out
value of x = 10
address of x = 0x7fff58bef638
valure of ptr = 0x7fff58bef638
value which ptr point to = 10

value of x = 100
address of x = 0x7fff58bef638
valure of ptr = 0x7fff58bef638
value which ptr point to = 100
```

比較一下...

```
value of x = 10  
address of x = 0x7fff58bef638  
valure of ptr = 0x7fff58bef638  
value which ptr point to = 10
```

```
value of x = 100  
address of x = 0x7fff58bef638  
valure of ptr = 0x7fff58bef638  
value which ptr point to = 100
```

我們順藤摸瓜一下...

- 又是來這個例子：`int x = 10; int *ptr = &x;`
- 我們知道... `ptr`指到`x`的位置，***ptr** 的值等於10
- 如果我們做了這樣的事情：***ptr = 1000;**
- 請問 `x` 會變成多少？
- 答：因為**ptr**指到的是**x**的位置，***ptr** 的值是 `x`的
 - 更改 `*ptr` 的值 等同 更改`x`的值，所以`x = 1000`

一個非常不正規的記憶法

一個非常不正規的記憶法

全家就是你家

一個非常不正規的記憶法

全家就是你家

全家的東西被偷了

一個非常不正規的記憶法

全家就是你家

全家的東西被偷了

等於我家的東西被偷了

~~亂七八糟~~

指標：指向陣列

既然一般的變數都可以了

指標：指向陣列

既然一般的變數都可以了

那陣列呢？

指標：指向陣列

```
8
9 int main(){
10     int s[] = {3,2,1,4,5};
11     int *ptr;
12     ptr = &s[0];
13     for(int i = 0; i < 5; ++i)
14         cout << i << " : " << ptr[i] << endl;
15
16     return 0;
17 }
```

- assign : 用法1 `ptr = &s[0];`
- `ptr` 當作陣列來使用 (今天先教這個)

0	:	3
1	:	2
2	:	1
3	:	4
4	:	5

指標：指向陣列

```
8 int main(){
9     int s[] = {3,2,1,4,5};
10    int *ptr;
11    ptr = s; // same as 'ptr = &s[0]'
12    for(int i = 0; i < 5; ++i)
13        cout << i << " : " << ptr[i] << endl;
14
15    return 0;
16 }
```

- assign : 用法2 `ptr = s;`
- 這個用法跟 `ptr = &s[0]` 一樣

0	:	3
1	:	2
2	:	1
3	:	4
4	:	5

指標：指向陣列

- 如果跟之前一樣，亂改東西呢？

```
8
9 int main(){
10     int s[] = {3, 2, 1, 4, 5};
11     int *ptr;
12     ptr = &s[0];
13     for(int i = 0; i < 5; ++i)
14         cout << i << " : " << ptr[i] << endl;
15
16     ptr[2] = 10000; // 改動這一行
17     for(int i = 0; i < 5; ++i)
18         cout << i << " : " << ptr[i] << endl;
19 }
```

- 大家應該都猜的到啦： D