

Pointers

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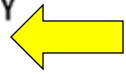
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How is Memory Used?

In a computer, memory is accessed using **addresses**.

Address	Data
0X00000000	...
...	...
0x08001F00	'a'
...	...
0X1A0088F0	642
...	...

How to Find the Address?

```
int x = 123;
```

```
&x /* ampersand */           ⇒ address of x
```

Address	Data
somewhere (&x)	123

A program **cannot** control **where** a variable (such as x) is placed. It is determined by the compiler + run time system. A program can control the value at this address.

```
x = 654;      /* change the value */
```

Address	Data
somewhere (&x)	654

```
&x = 90;      /* error, cannot change x's address */
```

Pointer

```
int x = 123;
```

```
int * p;    /* p is a pointer to an integer */
```

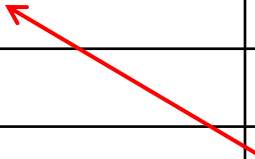
```
p = &x;    /* p points to x */
```

p → x

& x ⇒ x's address

*p ⇒ value at the address pointed by p; it is 123

Address	Data
somewhere (&x)	123
...	...
somewhere (&p)	&x



L value and R value

- L value means the left side of an assignment.
- R value means the right side of an assignment.

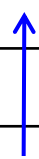
int x = 123; /* x is L value, 123 is R value */

int y = 987; /* y is L value */

x = y; /* x is L value; y is R value */

- This means
 - take the **address** of x (somewhere, we cannot control)
 - take the **value** of the address of y
 - assign the value to the address
 - result: x's value is 987.

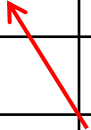
Address	Data
somewhere (&x)	123
...	...
somewhere (&y)	987



Change Values through Pointers

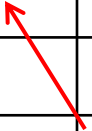
```
int x = 123;  
int * p = & x; /* p points to x */
```

Address	Data
somewhere (&x)	123
...	...
somewhere (&p)	& x



```
*p = 456;  
/* take the value of p (x's address) as the address and  
   assign 456 to this address; x becomes 456 */
```

Address	Data
somewhere (&x)	456
...	...
somewhere (&p)	& x



Pointer Operation

```
int * p;          /* p is a pointer to an integer */
```

```
int x = 123;
```

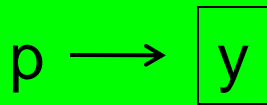
```
int y = 987;
```

```
p = & x;          /* p points to x */
```




```
*p = 456;         /* x is 456 now */
```

```
p = & y;          /* p points to y */
```




```
*p = -765;        /* y is -765 now */
```

Address	Data
somewhere (&x)	456
...	...
somewhere (&p)	& x
somewhere (&y)	987



Address	Data
somewhere (&x)	456
...	...
somewhere (&p)	& y
somewhere (&y)	-765



Common Mistake

A program cannot control addresses.

```
65 = 123;
```


```
/* cannot assign value 123 to the address 65 */
```

```
int * p = 86;
```

```
/* warning message, the
```

```
address is likely occupied by another program. */
```

Address	Data
86	...
somewhere (&p)	86



```
double d = 0.84;
```

```
int * p = & d;      /* warning message */
```

Which is correct? You may choose multiple answers.

```
int x = 6543;  
int * p = & x;
```

- ☐ A) The value of p is 6543.
- ☐ B) The address of p is 6543.
- ☐ C) The address of x is 6543.
- ☒ D) *p = 123 makes x's value 123.
- ☐ E) p = 123 makes x's value 123.
- ☐ F) & p = 123 makes x's value 123.

Correct - Click anywhere to
continue

Incorrect - Click anywhere to
continue

Your answer:

You did not answer this question

You must answer the question
before continuing

Submit

Clear

Which is correct? You may choose multiple answers.

```
int x = 123;  
int y = 567;  
int * p = & x;
```

- ☐ A) `p = y;` makes x's value 567.
- ☒ B) `p = & y;` does not change x's value nor y's value.
- ☐ C) `p = y;` makes x's value 567.
- ☐ D) `y = x;` makes x's value 567.
- ☐ E) `y = & p;` makes y's value 123.

Correct - Click anywhere to continue

Incorrect - Click anywhere to continue

Your answer:

You did not answer this question

You must answer the question before continuing

Submit

Clear

Pointer

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