C++ For C Coders 4

Data Structures
C++ for C Coders

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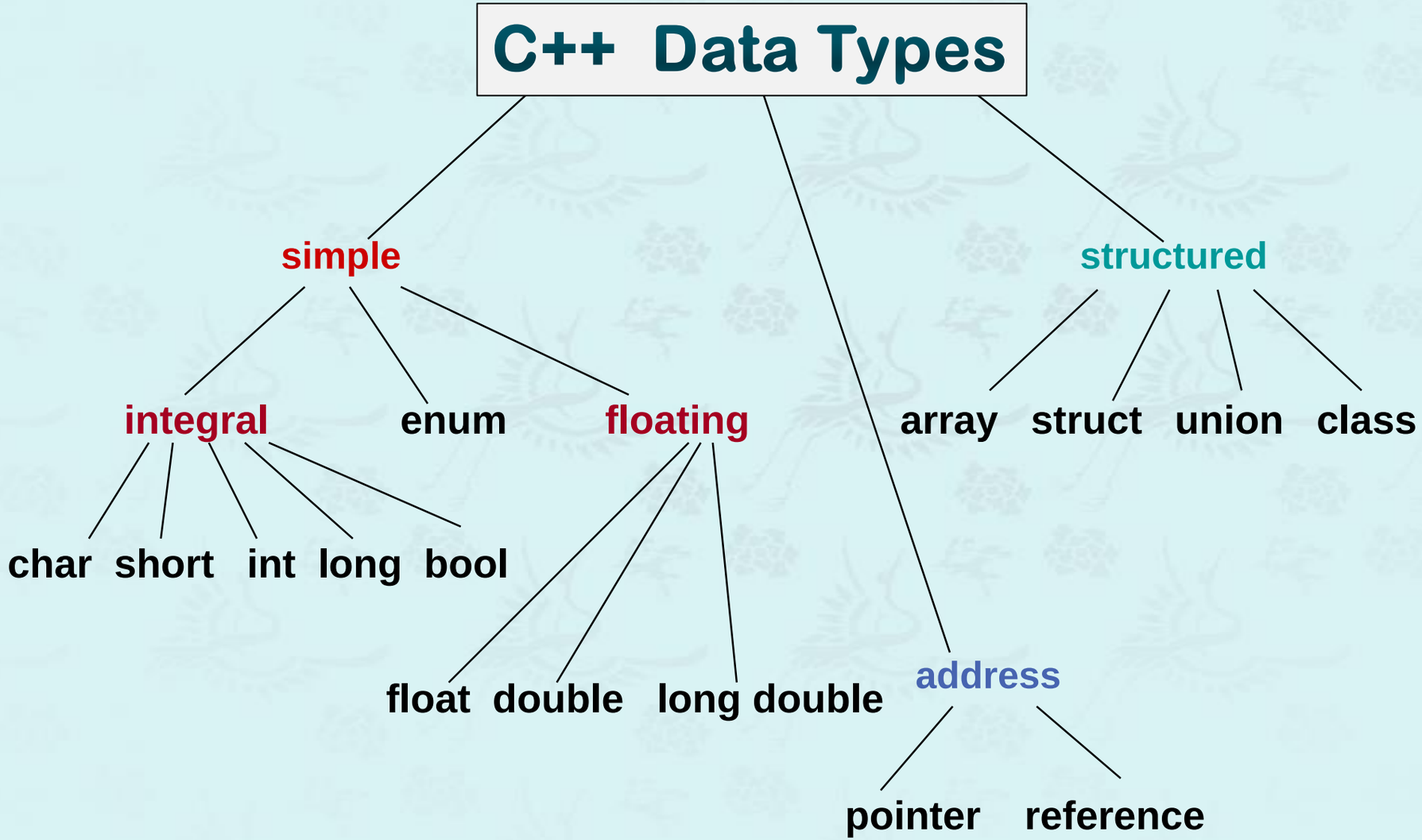
pointer
address-of operator
reference & dereference operators

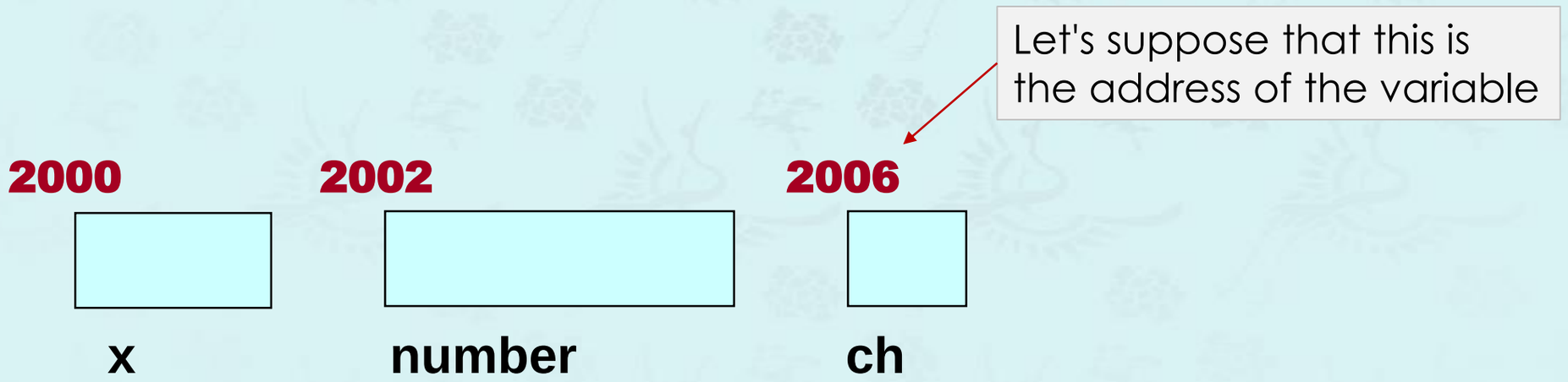
C++ Data Types


C++ Data Types
simple
structured
integral
enum
floating
array
struct
union
class
char
short
int
long
bool
float
double
long double
address
pointer
reference

Addresses in Memory

- When a variable **is declared**, enough memory to hold a value of that type **is allocated** for it at an unused memory location.

```
int          x;
double       number;
char         ch;
```



Obtaining Memory Addresses

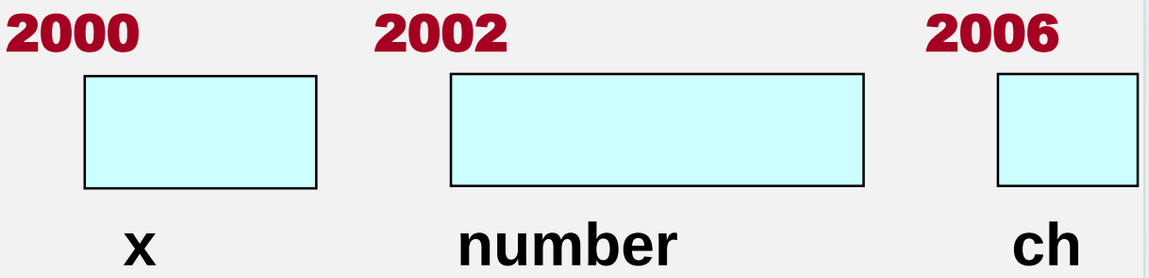
- The address of a *non-array variable* can be obtained by using the **address-of operator &**
- You can **print** the address or **save** it in a variable, which is called a pointer.

```
int       x;
double    number;
char      ch;

cout << "Address of x is " << &x << endl;

int    *p = &x;

cout << "Address of x is " << ___ << endl;
```




```
x is an _______
&x is an _______
p is an _______
*p is an _______
```

What is a pointer variable?

- A pointer variable is a variable whose value is **the address** of a location in memory.

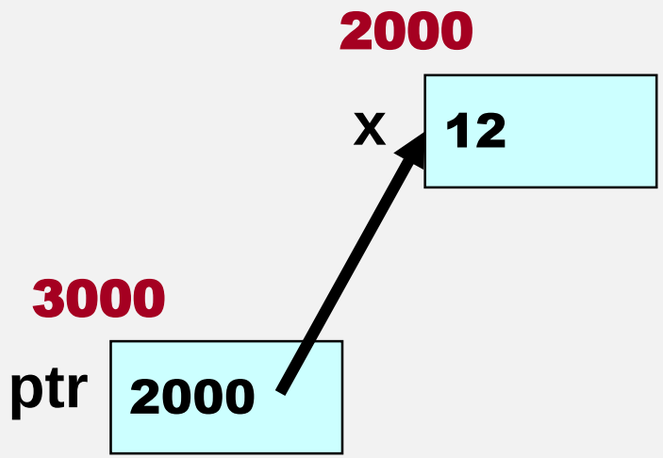
- To declare a pointer variable, you must specify the type of value that the pointer will point to, for example,

```
int   *ptr; // ptr can hold the address of an int
char  *q;   // q can hold the address of a char
```

Using a Pointer Variable

```
int  x;
x = 12;

int  *ptr;
ptr = &x;
```



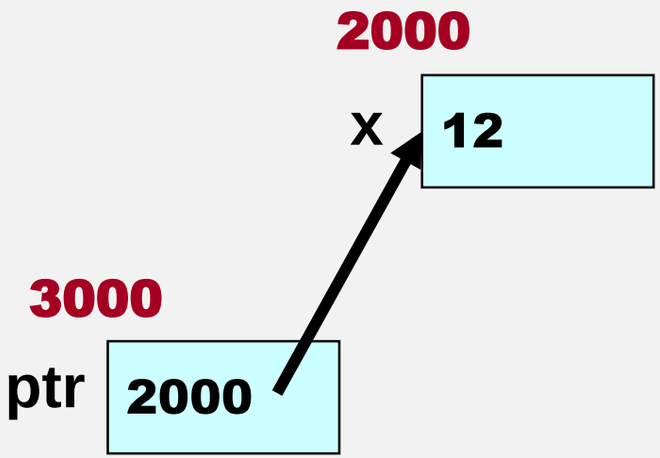
- NOTE: Because ptr holds the address of x, we say that ptr "points to" x

Using the Dereference Operator *

```
int  x;
x = 12;

int  *ptr;
ptr = &x;

cout << *ptr
```



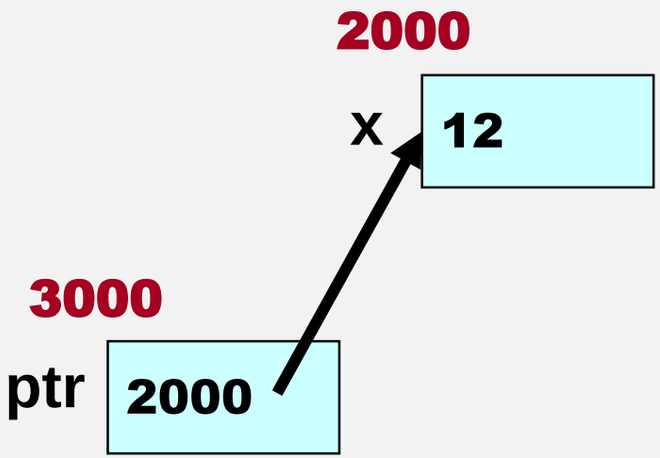
- NOTE: The value pointed to by ptr is denoted by *ptr

Using the Dereference Operator *

```
int  x;
x = 12;

int  *ptr;
ptr = &x;

*ptr = 5;
```



- NOTE: changes the value at the address ptr points to 5

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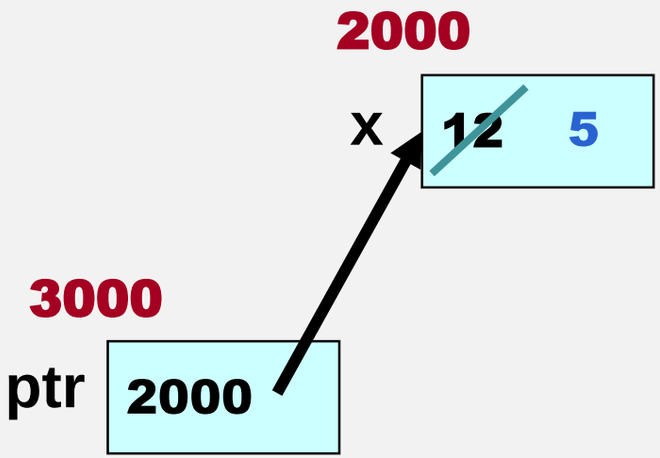


- NOTE: changes the value at the address ptr points to 5

Self –Test on Pointers

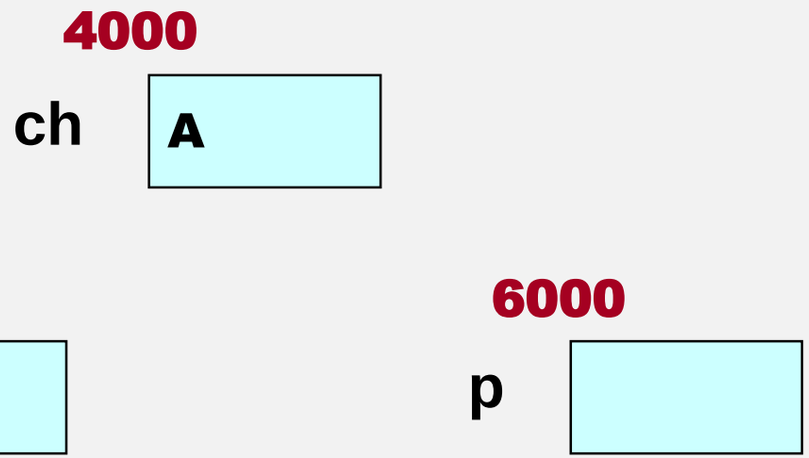
Complete the diagram and fix it if necessary.

```
char  ch;
ch = 'A';

char *q;
q = &ch;

*q = 'Z';
char *p;

p = q;
```



Self–Test on Pointers

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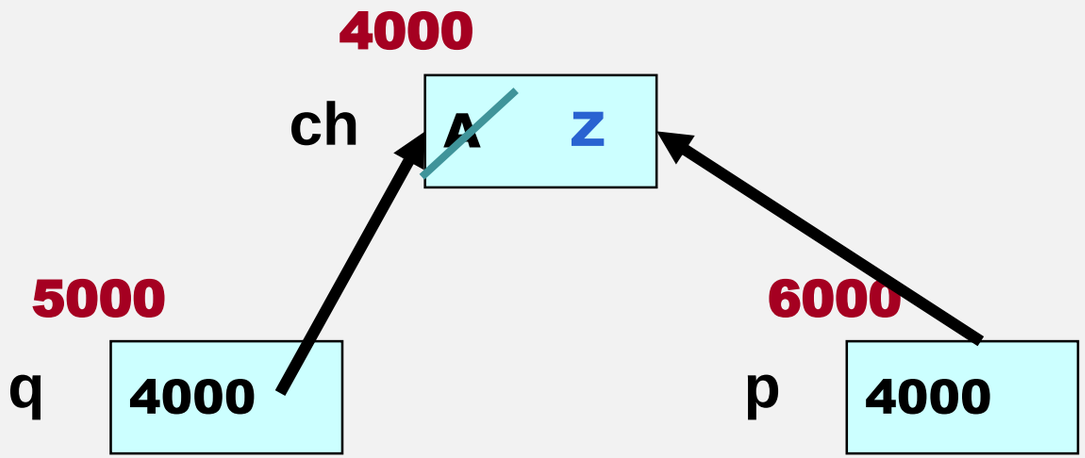
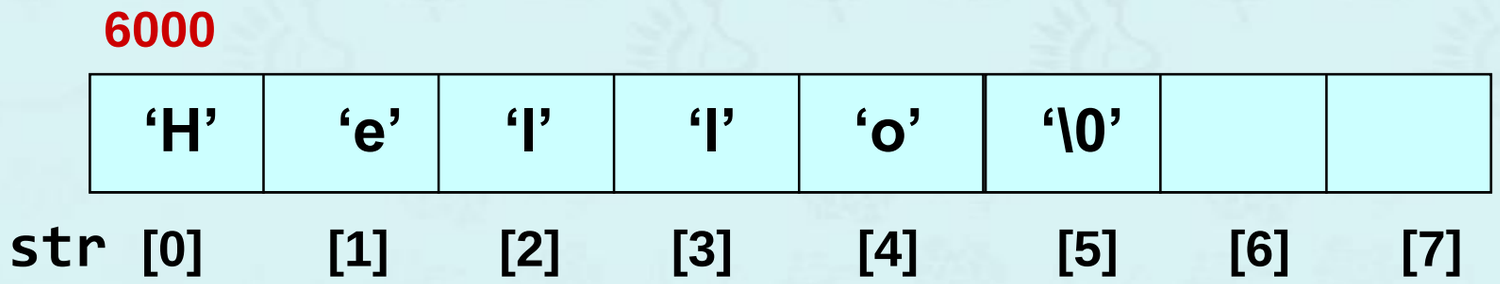


- NOTE: now p and q both point to ch.

Recall that . . .

```
char  str[8];
```

- **`str`** is the base address of the array.
- We say **`str`** is **a pointer** because its value is an address.
- It is a pointer constant because the value of **`str`** itself cannot be changed by assignment. It "points" to the memory location of a char.



Using a Pointer to Access the Elements of a String

```
char   msg[] ="Hello";
char*  ptr;
ptr   = msg;
*ptr  = 'M' ;
ptr++;

*ptr = 'a';
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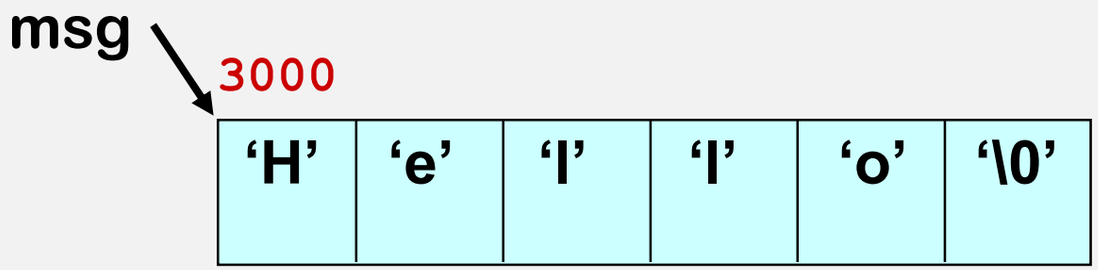

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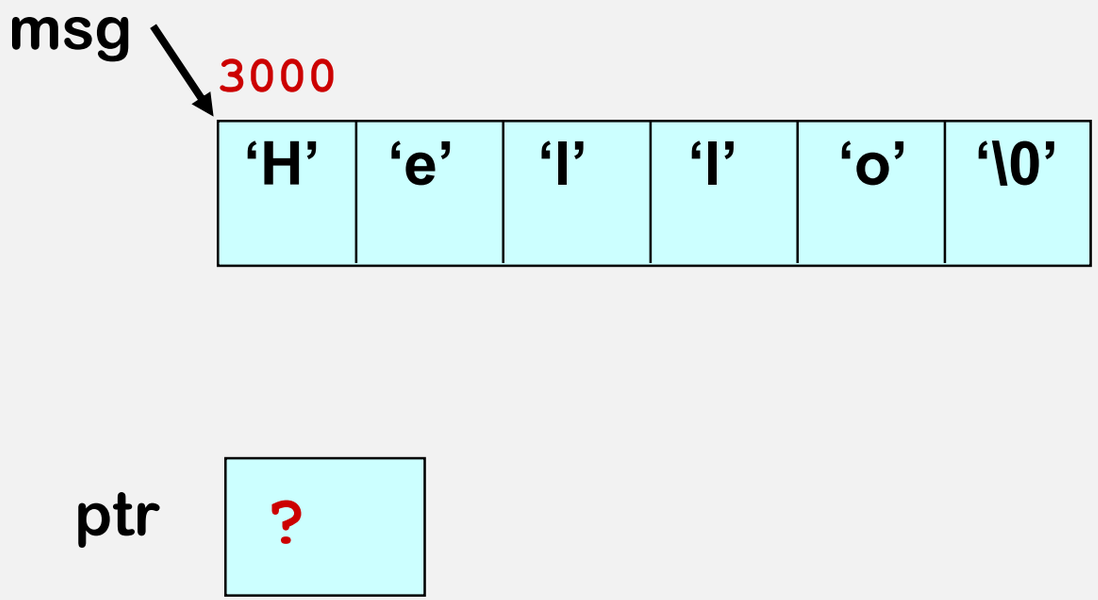

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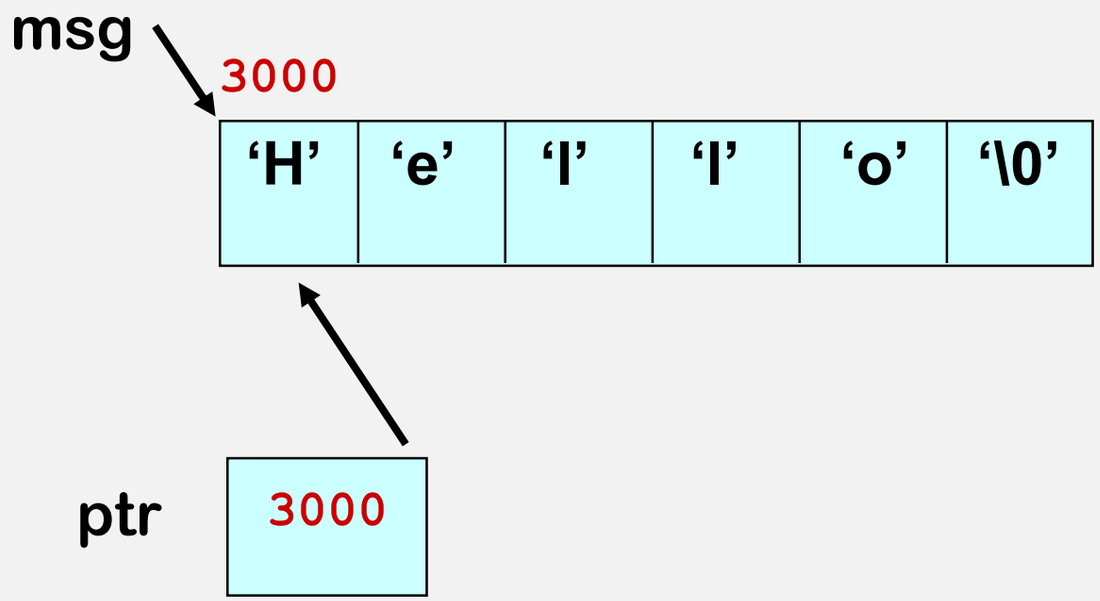

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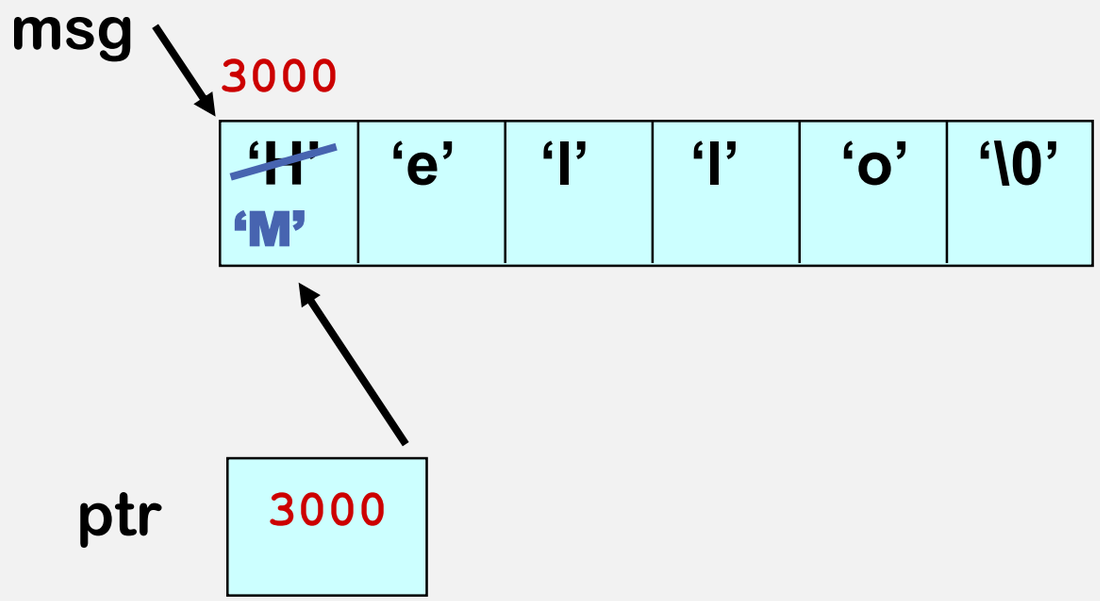

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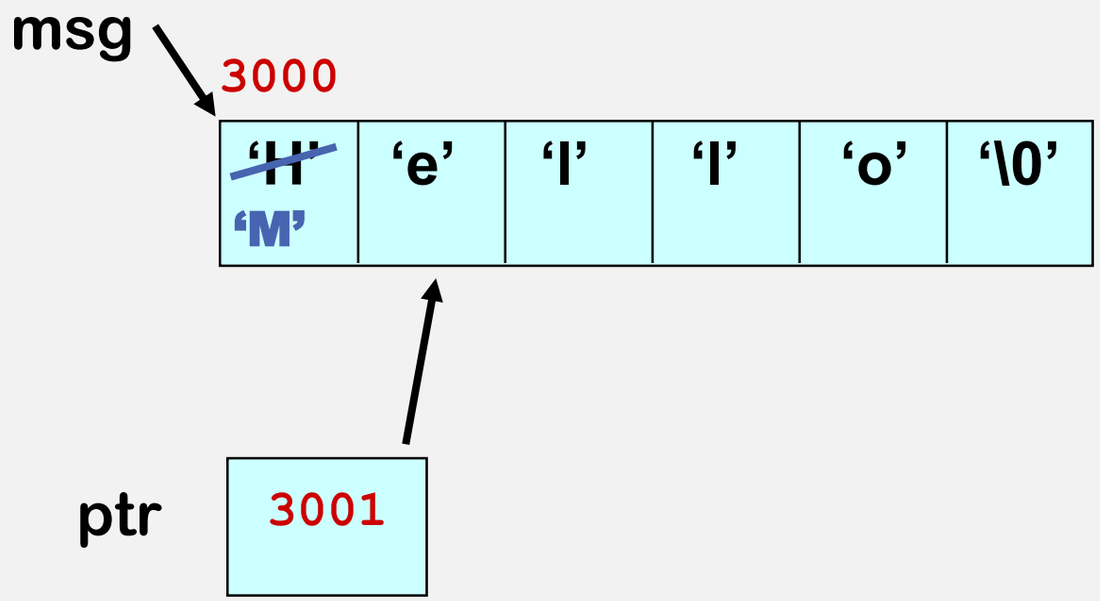

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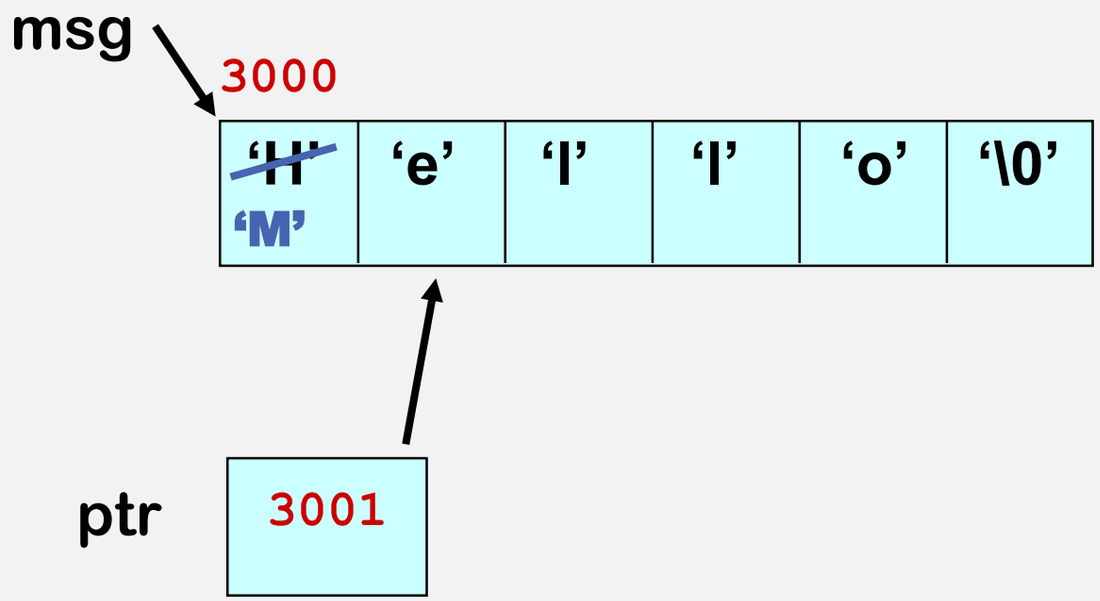

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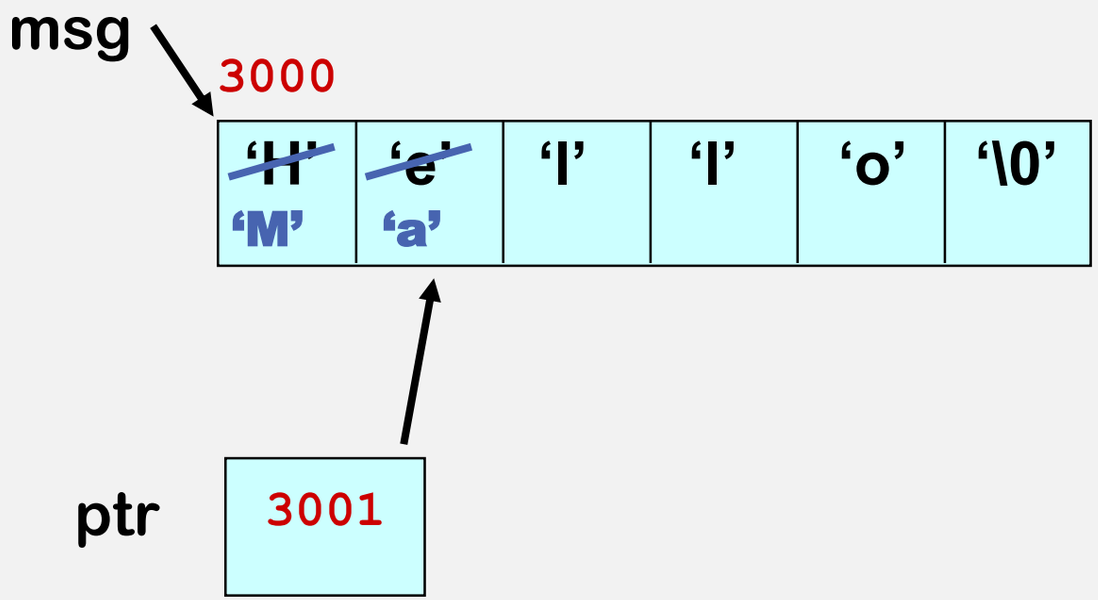

Reference Variables in C++, but not in C

- Reference variable = alias for another variable
  - Contains the address of a variable (like a pointer)
  - No need to perform any dereferencing (unlike a pointer)
  - Must be initialized when it is declared

```
int x = 5;
int &z = x;              // z is another name for x
int &y ;                 // Error: reference must be initialized
cout << x << endl;       // prints 5
cout << z << endl;       // prints 5

z = 9;                   // same as x = 9;

cout << x << endl;       // prints 9
cout << z << endl;       // prints 9
```

Why Reference Variables

- Are primarily used as function parameters

- Advantages of using references:
  - you don't have to pass the address of a variable
  - you don't have to dereference the variable inside the called function

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```
void swap(int *a, int *b) {
  int temp = *a;       // (2)
  *a = *b;             // (3)
  *b = temp;
}
```

```
void swap(int& a, int& b) {
  int temp = a;        // (2)
  a = b;               // (3)
  b = temp;
}
```

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