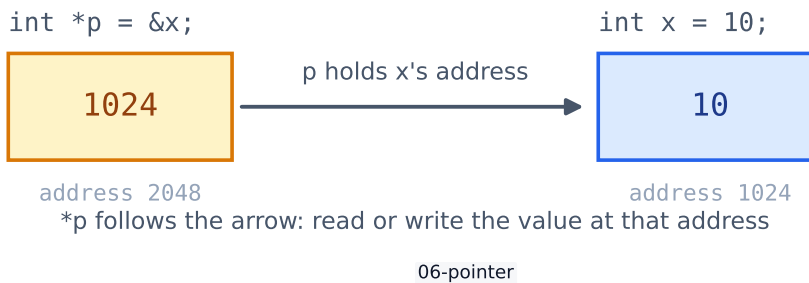


# Pointers

## C Reference

### &, \* and pass-by-pointer

A pointer stores the address of a variable. `&x` gives the address of `x`; `*p` dereferences the pointer — it reads or writes the value stored there. Passing a pointer lets a function change the caller's variable (pass-by-pointer).



*A pointer stores an address; dereferencing it follows the arrow to the value*

```
#include <stdio.h>

void addOne(int *p) {           // p holds an address
    *p = *p + 1;                // change the value at that address
}

int main(void) {
    int x = 10;
    int *ptr = &x;             // & takes the address of x
    printf("%d\n", *ptr);      // * reads the value: 10
    addOne(&x);
    printf("%d\n", x);         // 11 - changed through the pointer
    return 0;
}
```

The classic use is a swap function. Passing values only copies them — the swap is lost. Passing pointers lets the function reach the caller's variables:

```
#include <stdio.h>

void swap_values(int a, int b) {           // copies: the caller sees nothing
    int t = a; a = b; b = t;
}

void swap_pointers(int *a, int *b) {      // addresses: the swap is real
    int t = *a; *a = *b; *b = t;
}

int main(void) {
    int x = 1, y = 2;
    swap_values(x, y);
    printf("%d %d\n", x, y);             // 1 2 (unchanged!)
    swap_pointers(&x, &y);
    printf("%d %d\n", x, y);             // 2 1 (swapped)
    return 0;
}
```

An array name acts as a pointer to its first element, and pointer arithmetic steps by whole elements:

```
#include <stdio.h>

int main(void) {
    int a[] = {10, 20, 30};
    int *p = a;                          // same as &a[0]
    printf("%d\n", *p);                   // 10
    printf("%d\n", *(p + 2));             // 30 - same as a[2]
    return 0;
}
```

- NULL is the pointer that points at nothing — check for it before you dereference.

## Common mistakes

- &x is the address of x; \*p is the value stored at p.
- Never use \*p on an uninitialised or NULL pointer — it crashes or corrupts memory.
- To change a caller's variable, pass its address and write through the pointer.