

CL1002 – Programming Fundamentals Lab



Lab # 12

Pointers

Instructor: Engr. Muhammad Usman

Email: usman.rafiq@nu.edu.pk

Department of Computer Science,
National University of Computer and Emerging Sciences FAST Peshawar

C Pointers

Pointers are powerful features of C and C++ programming. Before we learn pointers, let's learn about addresses in C programming.

Address in C

If you have a variable `var` in your program, `&var` will give you its address in the memory.

We have used address numerous times while using the `scanf()` function.

```
scanf("%d", &var);
```

Here, the value entered by the user is stored in the address of `var` variable. Let's take a working example.

Example 1 | Address in C

```
#include <stdio.h>
int main()
{
    int var = 5;
    printf("var: %d\n", var);

    // Notice the use of & before var
    printf("address of var: %p", &var);
    return 0;
}
```

Output

var: 5

address of var: 0x7ffeb9656ca4

Note: You will probably get a different address when you run the above code.

C Pointers

Pointers (pointer variables) are special variables that are used to store addresses rather than values.

Pointer Syntax

Here is how we can declare pointers.

```
int* p;
```

Here, we have declared a pointer *p* of *int* type.

Assigning addresses to Pointers

Let's take an example.

```
int* pc, c;  
c = 5;  
pc = &c;
```

Here, 5 is assigned to the *c* variable. And, the address of *c* is assigned to the *pc* pointer.

Get Value of Thing Pointed by Pointers

To get the value of the thing pointed by the pointers, we use the *** operator. For example:

```
int* pc, c;  
c = 5;  
pc = &c;  
printf("%d", *pc);    // Output: 5
```

Here, the address of *c* is assigned to the *pc* pointer. To get the value stored in that address, we used **pc*.

Changing Value Pointed by Pointers

Let's take an example.

```
int* pc, c;  
c = 5;  
pc = &c;  
c = 1;  
printf("%d", c);      // Output: 1  
printf("%d", *pc);    // Output: 1
```

We have assigned the address of *c* to the *pc* pointer.

Then, we changed the value of *c* to 1. Since *pc* and the address of *c* is the same, **pc* gives us 1.

Let's take another example.

```
int* pc, c;  
c = 5;  
pc = &c;
```

```
*pc = 1;
printf("%d", *pc); // Ouptut: 1
printf("%d", c);   // Output: 1
```

We have assigned the address of *c* to the *pc* pointer.

Then, we changed **pc* to 1 using **pc = 1*;. Since *pc* and the address of *c* is the same, *c* will be equal to 1.

Example 2 | Working of Pointers

```
#include <stdio.h>
int main()
{
    int* pc, c;

    c = 22;
    printf("Address of c: %p\n", &c);
    printf("Value of c: %d\n\n", c); // 22

    pc = &c;
    printf("Address of pointer pc: %p\n", pc);
    printf("Content of pointer pc: %d\n\n", *pc); // 22

    c = 11;
    printf("Address of pointer pc: %p\n", pc);
    printf("Content of pointer pc: %d\n\n", *pc); // 11

    *pc = 2;
    printf("Address of c: %p\n", &c);
    printf("Value of c: %d\n\n", c); // 2
    return 0;
}
```

Output

Address of c: 0x7fff17a620fc

Value of c: 22

Address of pointer pc: 0x7fff17a620fc

Content of pointer pc: 22

Address of pointer pc: 0x7fff17a620fc

Content of pointer pc: 11

Address of c: 0x7fff17a620fc

Value of c: 2

Relationship Between Arrays and Pointers

An array is a block of sequential data. Let's write a program to print addresses of array elements.

Example 3 | Pass Arrays to Functions

```
#include <stdio.h>
int main() {
    int x[4];
    int i;

    for(i = 0; i < 4; ++i) {
        printf("&x[%d] = %p\n", i, &x[i]);
    }

    printf("Address of array x: %p", x);
    return 0;
}
```

Output

&x[0] = 0x7fffca918820

&x[1] = 0x7fffca918824

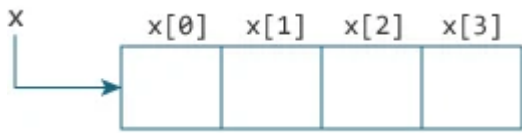
&x[2] = 0x7fffca918828

&x[3] = 0x7fffca91882c

Address of array x: 0x7fffca918820

There is a difference of 4 bytes between two consecutive elements of array x. It is because the size of *int* is 4 bytes (on our compiler).

Notice that, the address of $\&x[0]$ and x is the same. It's because the variable name x points to the first element of the array.



From the above example, it is clear that $\&x[0]$ is equivalent to x . And, $x[0]$ is equivalent to $*x$.

Similarly,

- $\&x[1]$ is equivalent to $x+1$ and $x[1]$ is equivalent to $*(x+1)$.
- $\&x[2]$ is equivalent to $x+2$ and $x[2]$ is equivalent to $*(x+2)$.
- ...
- Basically, $\&x[i]$ is equivalent to $x+i$ and $x[i]$ is equivalent to $*(x+i)$.

Example 4 | Pointers and Arrays

```
#include <stdio.h>
int main() {
    int i, x[6], sum = 0;
    printf("Enter 6 numbers:\n");

    for(i = 0; i < 6; ++i) {
        // Equivalent to scanf("%d", &x[i]);
        scanf("%d", x+i);
        // Equivalent to sum += x[i]
        sum += *(x+i);
    }
    printf("Sum = %d", sum);

    return 0;
}
```

Output

Enter 6 numbers:

2

3

4

5

6

7

Sum = 27

Example 5 | Arrays and Pointers

```
#include <stdio.h>
int main() {

    int x[5] = {1, 2, 3, 4, 5};
    int* ptr;

    // ptr is assigned the address of the third element
    ptr = &x[2];

    printf("*ptr = %d \n", *ptr);    // 3
    printf("*(ptr+1) = %d \n", *(ptr+1)); // 4
    printf("*(ptr-1) = %d", *(ptr-1)); // 2

    return 0;
}
```

Output

*ptr = 3

*(ptr+1) = 4

*(ptr-1) = 2

References:

<https://www.programiz.com/c-programming/c-pointers>

<https://www.programiz.com/c-programming/c-pointers-arrays>