

Pointers in C Language

Module 01 - Pointers in C Language



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A pointer is a variable that contains the address of a variable.  
A **pointer** is a variable in C that stores the **memory address** of another variable. Instead of directly storing a value, pointers store the location of the value in memory.



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**Why Pointers Are Useful:**

1. **Efficient memory usage:** Pointers allow direct access to memory, which can make programs faster.
2. **Dynamic memory allocation:** Allocate memory during runtime.
3. **Sharing data between functions:** Pass memory locations instead of copying large data.
4. **Building complex data structures:** Like linked lists, trees, and graphs.



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**Key Concepts of Pointers:**

**1. Declaring a Pointer**

To declare a pointer, use the \* symbol before the variable name.

```
int *ptr; // Declares a pointer to an integer  
Here, ptr can store the address of an integer.
```

**2. Pointer Initialization**

You assign the address of a variable to a pointer using the & operator:

```
int num = 10;  
int *ptr = &num; // Pointer ptr stores the address of num
```

- &num means "address of num."
- ptr now holds the memory address of num.

**3. Accessing the Value (Dereferencing)**

To access the value at the memory location stored in a pointer, use the \* operator (dereference):

```
printf("%d", *ptr); // Prints the value of num (10)
```

- \*ptr means "value at the address stored in ptr."



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Example Program: Basics of Pointers

```
c Copy code
#include <stdio.h>

int main() {
    int num = 20;          // Declare an integer variable
    int *ptr = &num;      // Pointer storing the address of num

    printf("Value of num: %d\n", num);    // Print value of num
    printf("Address of num: %p\n", &num); // Print address of num
    printf("Pointer ptr stores: %p\n", ptr); // Address stored in ptr
    printf("Value at address ptr: %d\n", *ptr); // Value at address in ptr (dereferencing)

    return 0;
}
```

Output:

```
Copy code
Value of num: 20
Address of num: 0x7ffee7b56c54 (Example; actual address will vary)
Pointer ptr stores: 0x7ffee7b56c54
Value at address ptr: 20
```

Pointers and Address

**What is an Address?**

Every variable in a program is stored in the computer's memory. The memory is like a series of boxes, and each box has a unique number, called its address. This address tells us where the variable is stored.

For example:

```
int num = 10;
```

Here:

- The value 10 is stored in the memory.
- The memory box where 10 is stored has an address, such as 1001.

**What is a Pointer?**

A pointer is a special variable that stores the address of another variable instead of a value.

For example:



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```
int num = 10;  
int *ptr = &num; // Pointer ptr stores the address of num  
Here:
```

- &num means “the address of num”.
- ptr stores the address of num.

**Key Operators in Pointers:**

**1. & (Address-of Operator):**

- Gets the memory address of a variable.

```
int x = 5;  
int *ptr = &x; // ptr stores the address of x
```

**2. \* (Dereference Operator):**

- Accesses the value at the memory address stored by the pointer.  
int y = \*ptr; // y is now 5 (value stored at ptr's address)

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## Introduction to 'C' Language

Solved Example 1: Write a program to use a pointer to display and modify the value of an integer

Code

```
c Copy code
#include <stdio.h>

int main() {
    int num = 50;           // Declare an integer variable
    int *ptr = &num;      // Declare a pointer and store the address of num

    // Display the initial value and address of num
    printf("Initial value of num: %d\n", num);
    printf("Address of num: %p\n", ptr);

    // Modify the value of num using the pointer
    *ptr = 100;           // Change the value of num through the pointer

    // Display the updated value of num
    printf("Updated value of num: %d\n", num);

    return 0;
}
```

Output

```
Copy code
Initial value of num: 50
Address of num: 0x7ffe... (this will vary)
Updated value of num: 100
```

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Solved Example 2: Write a program to add two numbers using Pointers

Solution:

```
#include <stdio.h>

int main() {
    int a, b, sum;      // Declare variables
    int *p1, *p2, *pSum; // Declare pointers

    // Assign addresses of variables to pointers
    p1 = &a;
    p2 = &b;
    pSum = &sum;

    // Input two numbers
    printf("Enter first number: ");
    scanf("%d", p1); // Use pointer p1 to store input in a

    printf("Enter second number: ");
    scanf("%d", p2); // Use pointer p2 to store input in b

    // Calculate the sum using pointers
    *pSum = *p1 + *p2;

    // Display the result
    printf("The sum of %d and %d is %d\n", *p1, *p2, *pSum);

    return 0;
}
```

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