جامعة المستقبل
AL MUSTAQBAL UNIVERSITY

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Department of Cyber Security

Subject: Data Structure

Class: Second

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Lecture: 6

C++ Pointers

Study Year: 2024-2025

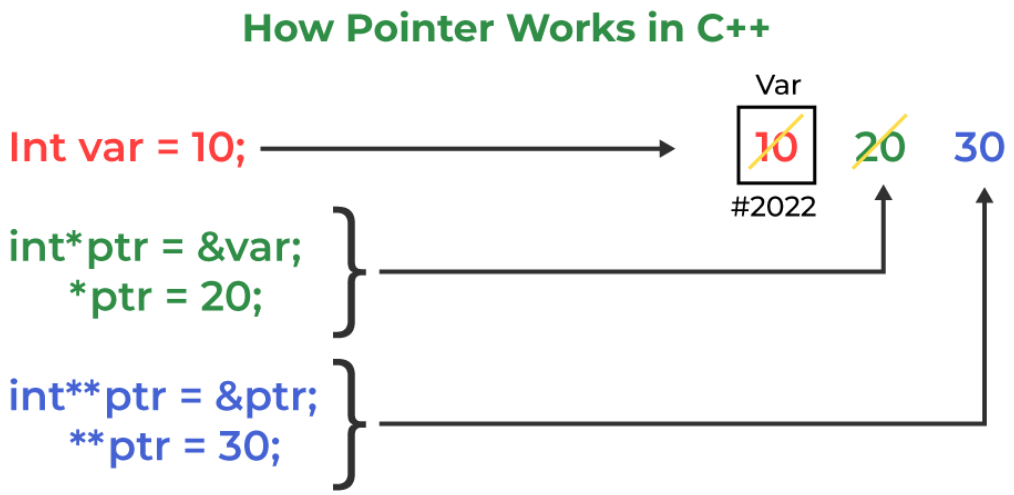
C++ Pointers

Pointers are symbolic representations of addresses. They enable programs to simulate call-by-reference as well as to create and manipulate dynamic data structures. Iterating over elements in arrays or other data structures is one of the main use of pointers.

The address of the variable you're working with is assigned to the pointer variable that points to the same data type (such as an int or string).

Syntax:

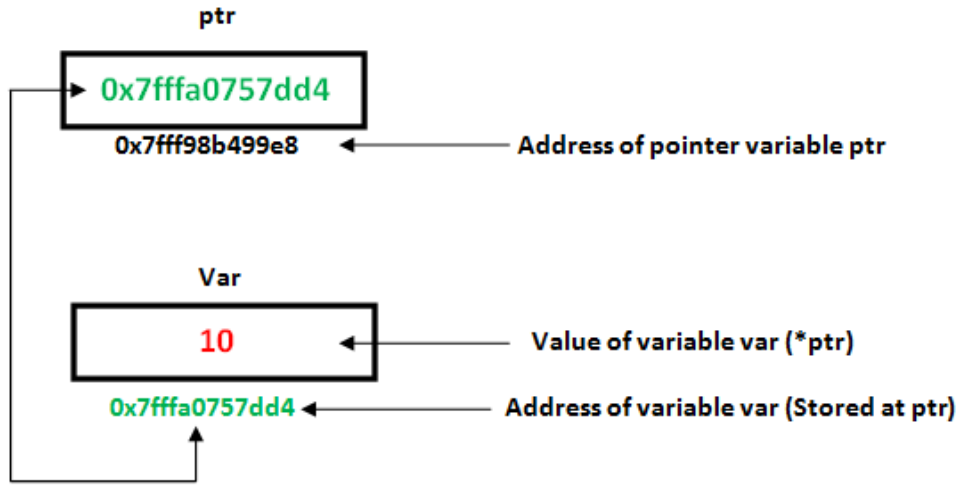
```
datatype *var_name;
int *ptr;   // ptr can point to an address which holds int
data
```



How to use a pointer?

- Define a pointer variable
- Assigning the address of a variable to a pointer using the unary operator (&) which returns the address of that variable.
- Accessing the value stored in the address using unary operator (*) which returns the value of the variable located at the address specified by its operand.

The reason we associate data type with a pointer is **that it knows how many bytes the data is stored in**. When we increment a pointer, we increase the pointer by the size of the data type to which it points. To master the use of pointers and their applications, explore the **C++ Course** for comprehensive lessons and hands-on examples.




```cpp
// C++ program to illustrate Pointers

#include <bits/stdc++.h>
using namespace std;
void geeks()
{
    int var = 20;

    // declare pointer variable
    int* ptr;

    // note that data type of ptr and var must be same
    ptr = &var;

    // assign the address of a variable to a pointer
    cout << "Value at ptr = " << ptr << "\n";
    cout << "Value at var = " << var << "\n";
    cout << "Value at *ptr = " << *ptr << "\n";
}
// Driver program
int main()
{
  geeks();
  return 0;
}
```

Output

```
Value at ptr = 0x7ffe454c08cc

Value at var = 20

Value at *ptr = 20
```

References and Pointers

There are 3 ways to pass C++ arguments to a function:

- Call-By-Value
- Call-By-Reference with a Pointer Argument
- Call-By-Reference with a Reference Argument

```
// C++ program to illustrate call-by-methods

#include <bits/stdc++.h>
using namespace std;

// Pass-by-Value
int square1(int n)
{
    // Address of n in square1() is not the same as n1 in
    // main()
    cout << "address of n1 in square1(): " << &n << "\n";

    // clone modified inside the function
    n *= n;
    return n;
}
// Pass-by-Reference with Pointer Arguments
void square2(int* n)
{
    // Address of n in square2() is the same as n2 in main()
    cout << "address of n2 in square2(): " << n << "\n";

    // Explicit de-referencing to get the value pointed-to
    *n *= *n;
}
// Pass-by-Reference with Reference Arguments
void square3(int& n)
{
    // Address of n in square3() is the same as n3 in main()
    cout << "address of n3 in square3(): " << &n << "\n";

    // Implicit de-referencing (without '*')
    n *= n;
}
void geeks()
```

```
{
    // Call-by-Value
    int n1 = 8;
    cout << "address of n1 in main(): " << &n1 << "\n";
    cout << "Square of n1: " << square1(n1) << "\n";
    cout << "No change in n1: " << n1 << "\n";

    // Call-by-Reference with Pointer Arguments
    int n2 = 8;
    cout << "address of n2 in main(): " << &n2 << "\n";
    square2(&n2);
    cout << "Square of n2: " << n2 << "\n";
    cout << "Change reflected in n2: " << n2 << "\n";

    // Call-by-Reference with Reference Arguments
    int n3 = 8;
    cout << "address of n3 in main(): " << &n3 << "\n";
    square3(n3);
    cout << "Square of n3: " << n3 << "\n";
    cout << "Change reflected in n3: " << n3 << "\n";
}
// Driver program
int main() { geeks(); }
```

Output

```
address of n1 in main(): 0x7fffa7e2de64

address of n1 in square1(): 0x7fffa7e2de4c

Square of n1: 64

No change in n1: 8

address of n2 in main(): 0x7fffa7e2de68

address of n2 in square2(): 0x7fffa7e2de68

Square of n2: 64

Change reflected in n2: 64

address of n3 in main(): 0x7fffa7e2de6c

address of n3 in square3(): 0x7fffa7e2de6c

Square of n3: 64

Change reflected in n3: 64
```