Pointers in C

What is a Pointer?

A pointer is a variable used to store a *memory address*.

For example, in 64MB of RAM, there are 64 x 2^{20} = 67,108,864 bytes.

The addresses of these bytes will range from 0 to 67,108,863.

A variable of type **`int`** will occupy 4 bytes of memory.

The address of the *first byte* of these 4 bytes is the address of the variable.

The Address Operator (&)

```c
#include<stdio.h>

int main()
{
    int i = 12;

    printf("Address of i = %u\n", &i);
    printf("Value of i = %d\n", i);

    return 0;
}
```

Expected Output

```
Address of i = 6356748
Value of i = 12
```

Declaring a Pointer Variable

```
data_type *pointer_name;
```

Here are some examples for declaring pointers:

```
int *ip;
float *fp;
```

Assigning an Address to a Pointer

This example shows how to assign an address to a pointer:

```
int *ip, i = 10;
float *fp, f = 12.2;

ip = &i;
fp = &f;
```

The Dereferencing Operator (*)

```c
#include<stdio.h>

int main()
{
    int i = 12;
    int *ip = &i;

    printf("Address of i = %u\n", ip);
    printf("Value of i = %d\n", *ip);

    return 0;
}
```

Expected Output

```
Address of i = 6356748
Value of i = 12
```

Function Call by Reference

Addresses of the actual arguments are passed to arguments in the function header.

The calling and called functions are both using *pointers* that point to the *same data*.

Any changes made by the *called* function also affect the values in the *calling function*.

Example

```c
#include<stdio.h>

void change_values(int *xp, int *yp);

int main()
{
    int x = 10, y = 20;

    printf("Initial value of x in main() = %d\n", x);
    printf("Initial value of y in main() = %d\n\n", y);

    change_values(&x, &y);

    printf("Final value of x in main() = %d\n", x);
    printf("Final value of y in main() = %d\n\n", y);

    return 0;
}
```

Example

```
void change_values(int *xp, int *yp)
{
    *xp += 1;
    *yp += 1;

    printf("Value of x in function = %d\n", *xp);
    printf("Value of y in function = %d\n\n", *yp);
}
```

Example

Expected Output

```
Initial value of x in main() = 10
Initial value of y in main() = 20

Value of x in function = 11
Value of y in function = 21

Final value of x in main() = 11
Final value of y in main() = 21
```

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