References

Now, we'll learn what references are and how they differ from pointers.

WE'LL COVER THE FOLLOWING

> A reference is an alias for an existing variable. It can be created using the `&` operator.

Once created, the reference can be used instead of the actual variable. Altering the value of the reference is equivalent to altering the referenced variable.

```
#include <iostream>

int main() {
  int i = 20;
  int& iRef = i;
  std::cout << "i: " << i << std::endl;
  std::cout << "iRef: " << iRef << std::endl;

  std::cout << std::endl;

  iRef = 30; // Altering the reference

  std::cout << "i: " << i << std::endl;
  std::cout << "iRef: " << iRef << std::endl;
}
```

References vs. pointers

There is a lot of overlap between pointers and references but the two have

some stark differences as well.

A reference is never `NULL`. Therefore, it must always be initialized by having an existing variable assigned to it. The following lines would not work:

```
int& intRef;
int& intRef = NULL;
```

References behave like constant pointers. A reference always refers to its initial variable. The value of the variable can change but the reference cannot be assigned to another variable.

Like pointers, a reference can only be initialized by a variable of the same type.

References as parameters

References allow functions to modify the value of a variable. When a normal variable is passed to a function, a copy of its value is made and the variable itself remains untouched. However, if a reference is passed, the actual value of the variable is used and can therefore be modified.

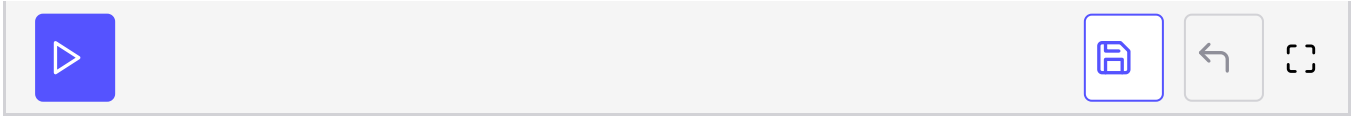
```
#include <iostream>

void xchg(int& x, int& y){ // Reference parameters
  int t = x;
  x = y;
  y = t;
}

int main() {
  int a = 10;
  int b = 20;
  std::cout << "a: " << a << std::endl;
  std::cout << "b: " << b << std::endl;

  xchg(a, b);
  std::cout << std::endl;

  std::cout << "a: " << a << std::endl;
  std::cout << "b: " << b << std::endl;
}
```



This functionality is also very useful when dealing with a large argument.

Passing it by value would mean that a copy has to be made in the function.

This is memory-intensive.

A reference to the argument would prevent unnecessary copying.

That is all about pointers. In the next chapter, we'll deal with **automatic type deduction** in C++.