P2: Adders and Subtractors
https://stackoverflow.com/questions/6394741/can-a-c-function-return-more-than-one-value

Adders - 06/02/21

1) Write in your logbook codes to implement simple logic gates (AND, OR, XOR) as functions in C++.

When implementing the logic gates I know that each value is either a 1 or a zero so it can use the boolean data type. This allows me to use the logical operators.

```
bool func_and(bool A, bool B)
{
    return A && B;
}
bool func_or(bool A, bool B)
{
    return A || B;
}
bool func_xor(bool A, bool B)
{
    return A ^ B;
}
```

2) Describe, using suitable flowcharts or codes, how you might create a half-adder, using the functions you have written earlier.

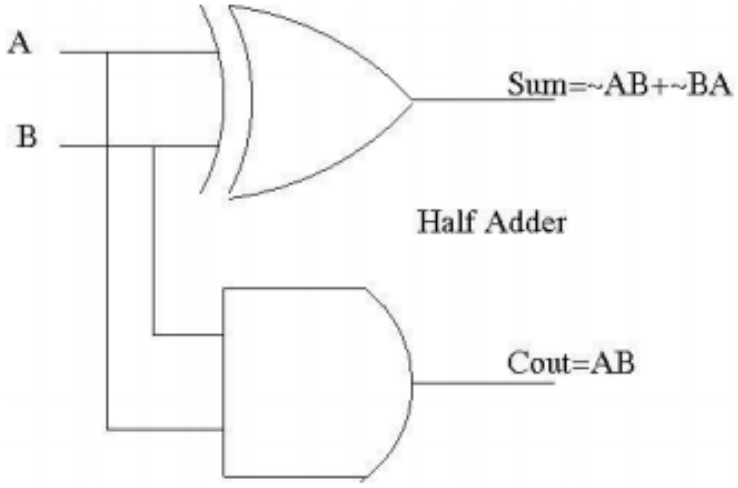


Figure 1: Half adder circuit

When implementing the half adder function I need to return more than one value. To do this I had to create a structure.

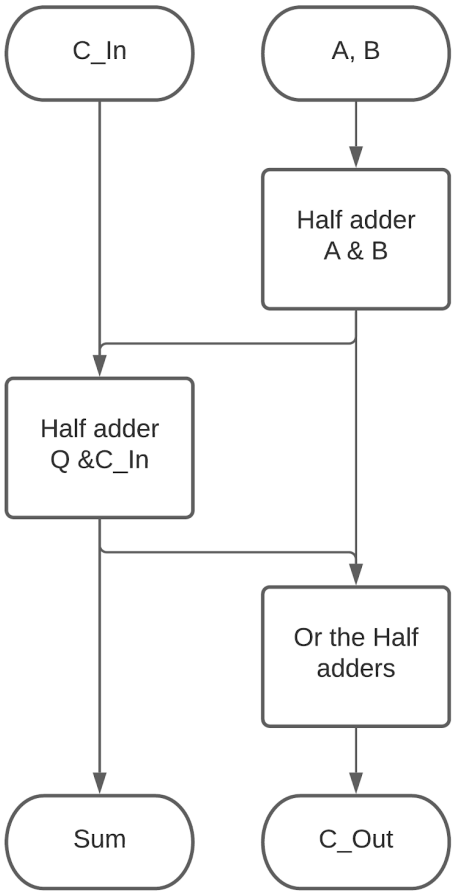
```
struct sum
{
    bool Q;
    bool c_out;
};
```

Then when creating the function, I simply called each logic gate for each of the values to be returned

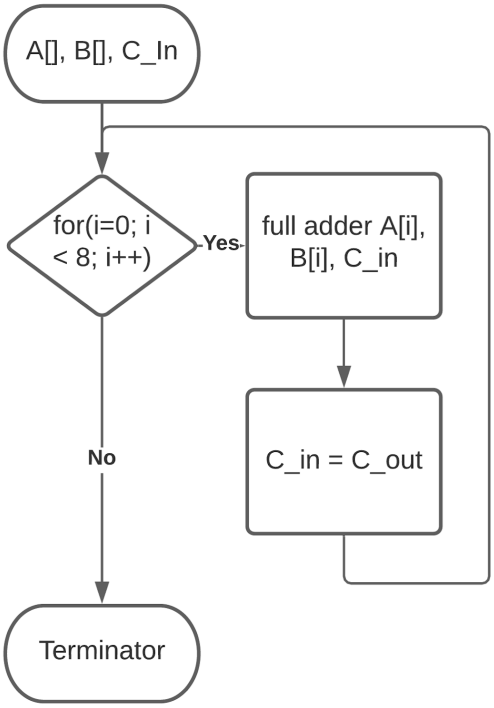
```
sum half_adder(bool A, bool B)
{
    sum result;
    result.Q = func_xor(A, B);
    result.c_out = func_and(A, B);

    return result;
}
```

3) Subsequently, draw a flowchart showing how you would implement a full-adder and an 8-bit adder with ripple propagation using full adders.



Full Adder



8-bit ripple counter