Unit 2.2

Binary addition

After we have addition, we can do any other operation almost for “free”.

Addition mechanic

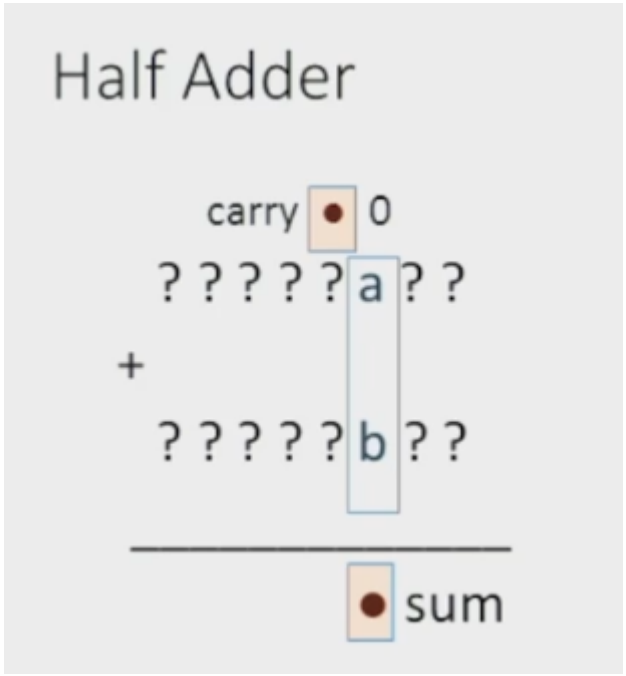
```
      1 1 1
       -|-|-|-|
  0 0 0 1 0 1 0 1
+ 0 1 0 1 1 1 0 0
  ---------------
  0 1 1 1 0 0 0 1
```

Just add the forst two bits.
0 + 1 = 1, no carry.
0 + 0 = 0.
1 + 1 = 2, write down 0 and carry 1.
1 + 0 + (1) = 2, write down 0 and carry 1.
1 + 1 + (1) = 3, write down 1 and carry 1.
0 + 0 + (1) = 1, no carry. 1 + 0 = 1. 0 + 0 = 0.

If there is a carry at the last bit, the overflow is usually dropped. So this kind of addition is not integer addition. It is depended on the size of the word.

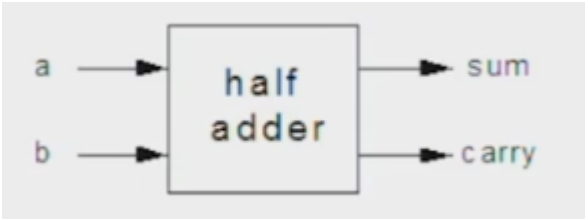
Adders

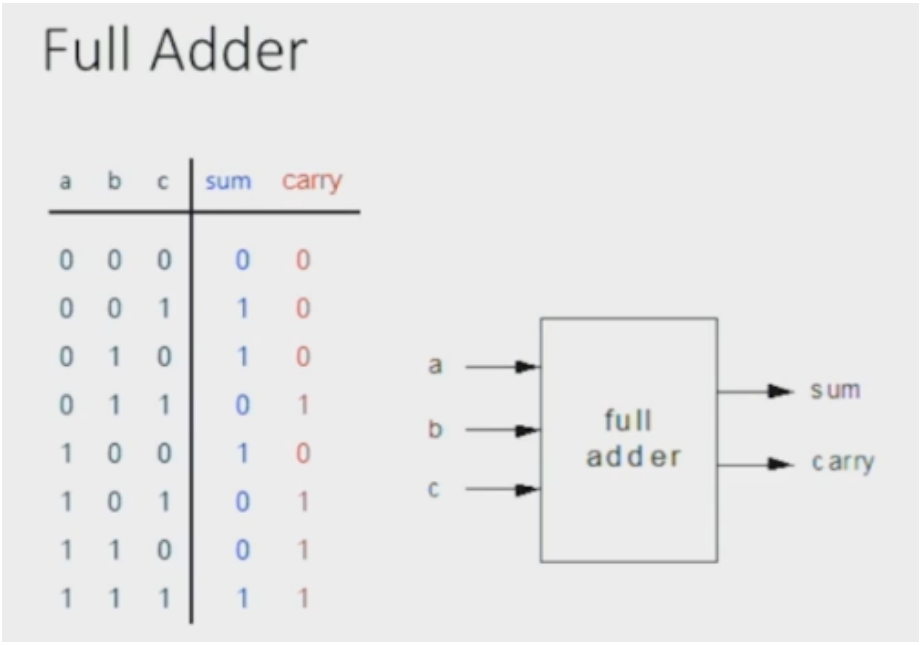
1. Half adder - adds two bits
2. Full adder - adds three bits
3. Adder - adds two numbers


Half Adder
carry 0
? ? ? ? ? a ? ?
+
? ? ? ? ? b ? ?
sum

Half adder


Half Adder
a b sum carry
0 0 0 0
0 1 1 0
1 0 1 0
1 1 0 1


a
b
half adder
sum
carry



Full adder
Adds two bits plus a carry.

Multi-bit adder combination of 16 full adders (15 full and 1 half for the right most bit). Returns a 16 bit bus number.