# How to design a multiplier ?

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# How to compute 4*3?

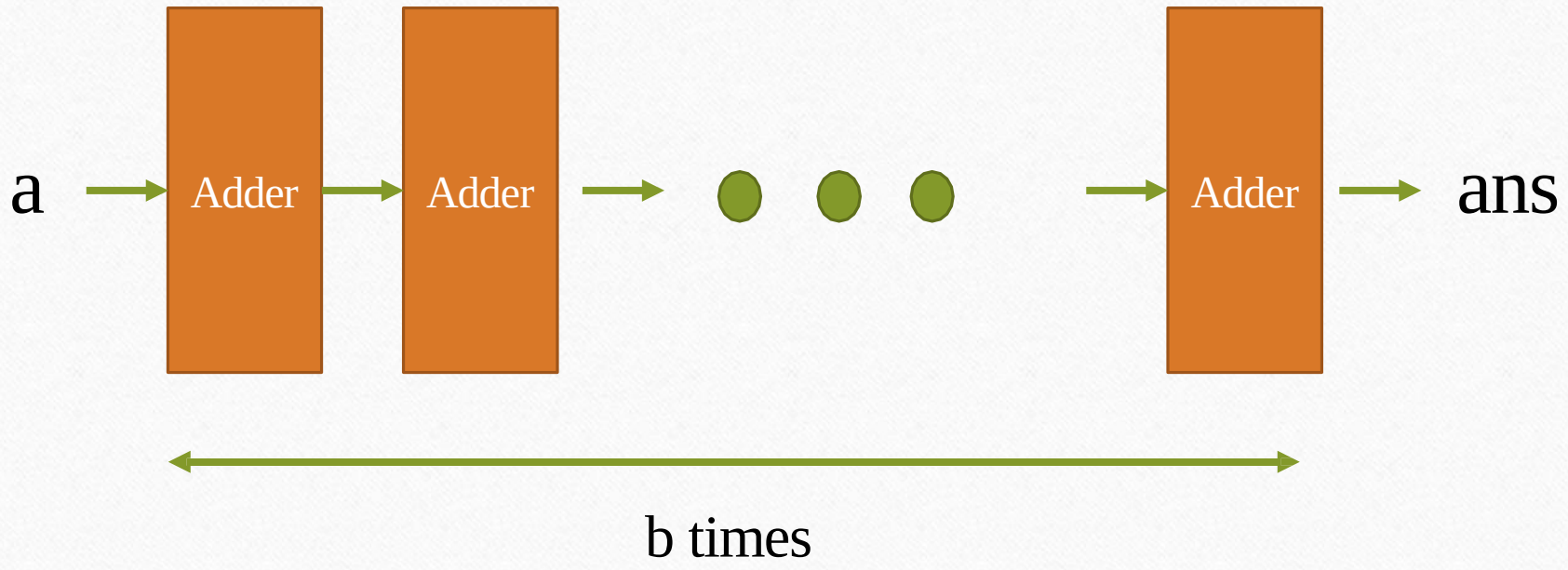
- **Easy！ Ans = 4+4+4 = 12**
- **How about 4*5 ?**
- **Ans = 4+4+4+4+4 = 20**
- **The result of multiplication is the answer of successive addition.**

# Software implementation

- **To compute a*b**
- **C++:**
  - **ans = 0;**
  - **for(int i=0;i<b;++i)**
    - **ans = ans + a;**
- **Python**
  - **ans = 0**
  - **for i in range(b):**
    - **ans = ans + a**

# Hardware implementation ?

Does it work?

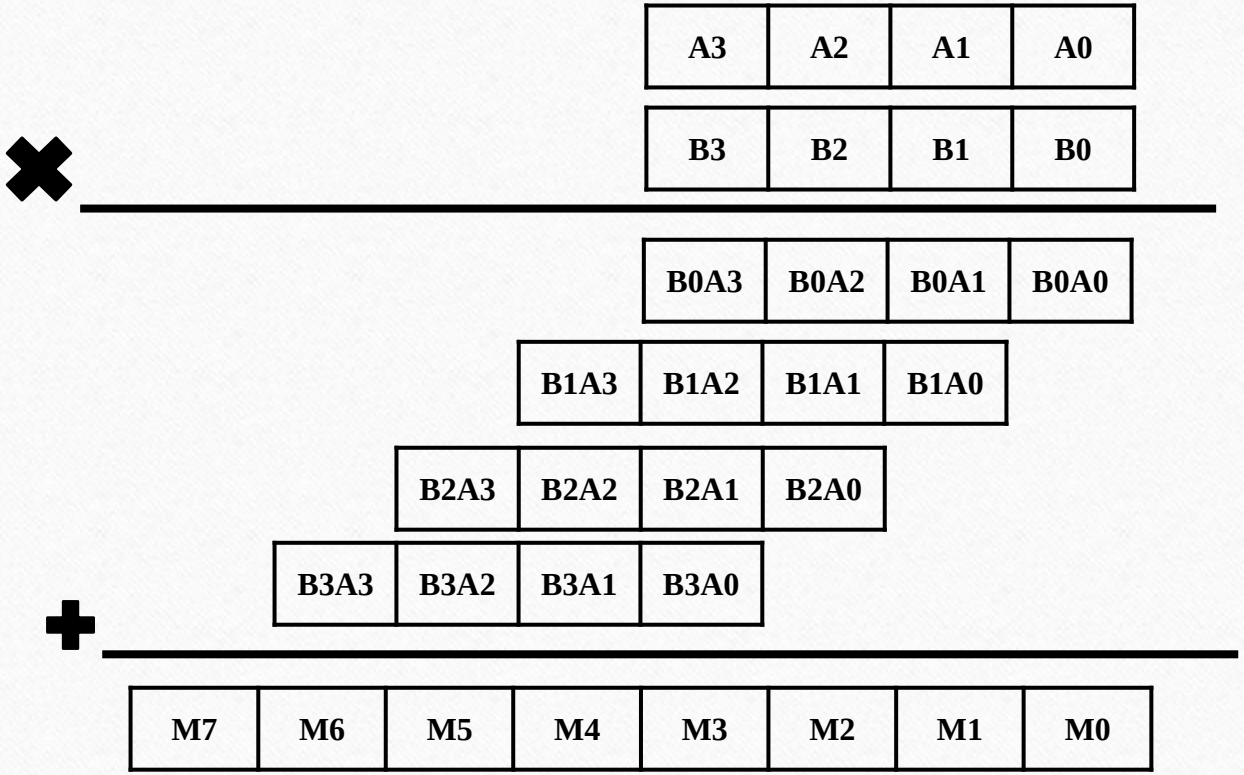


# 直式乘法

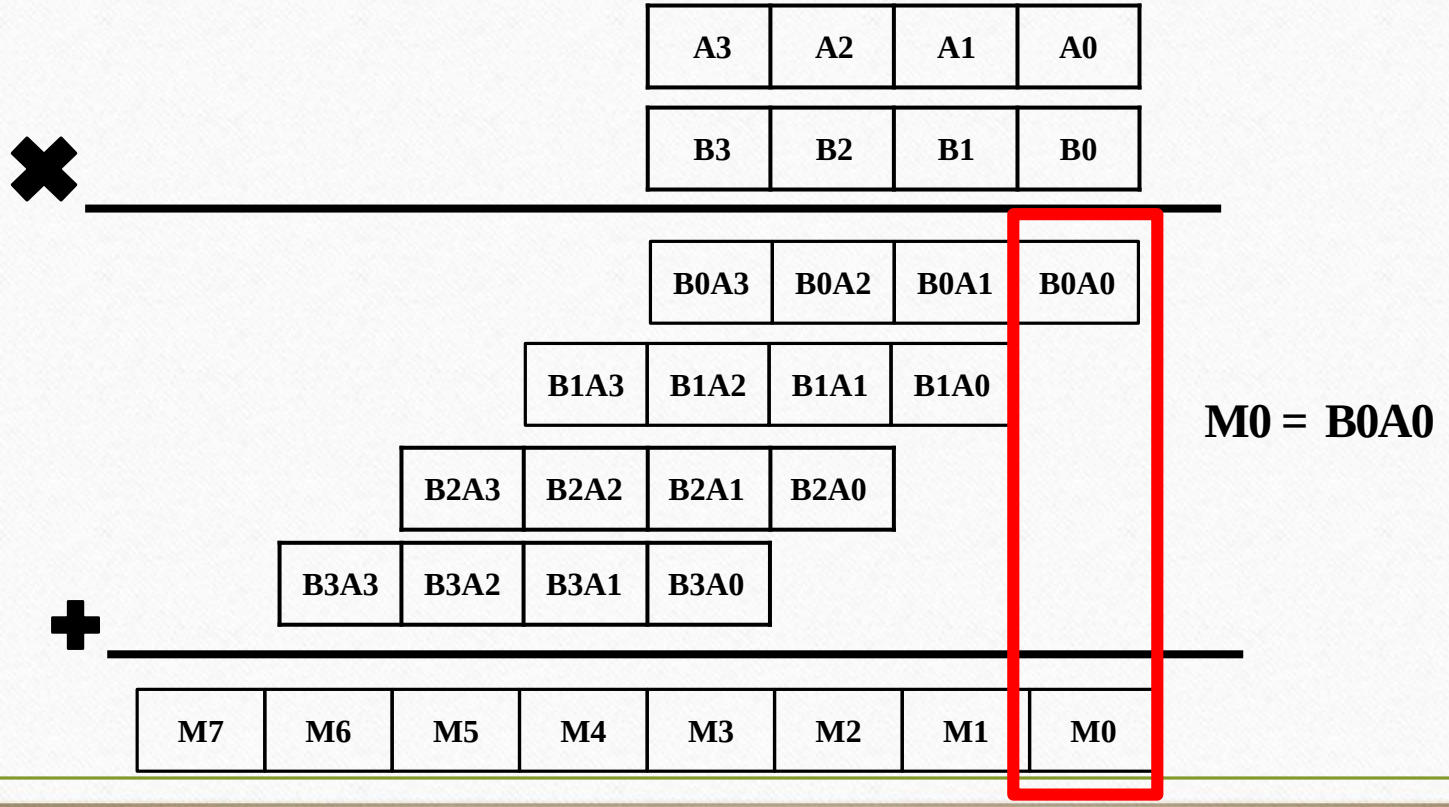
```
   123
x  264
-------
   492
  7380
 24600
-------
 32472
```

```
    1011
x   0110
--------
    0000
   10110
  101100
 0000000
--------
 1000010
```

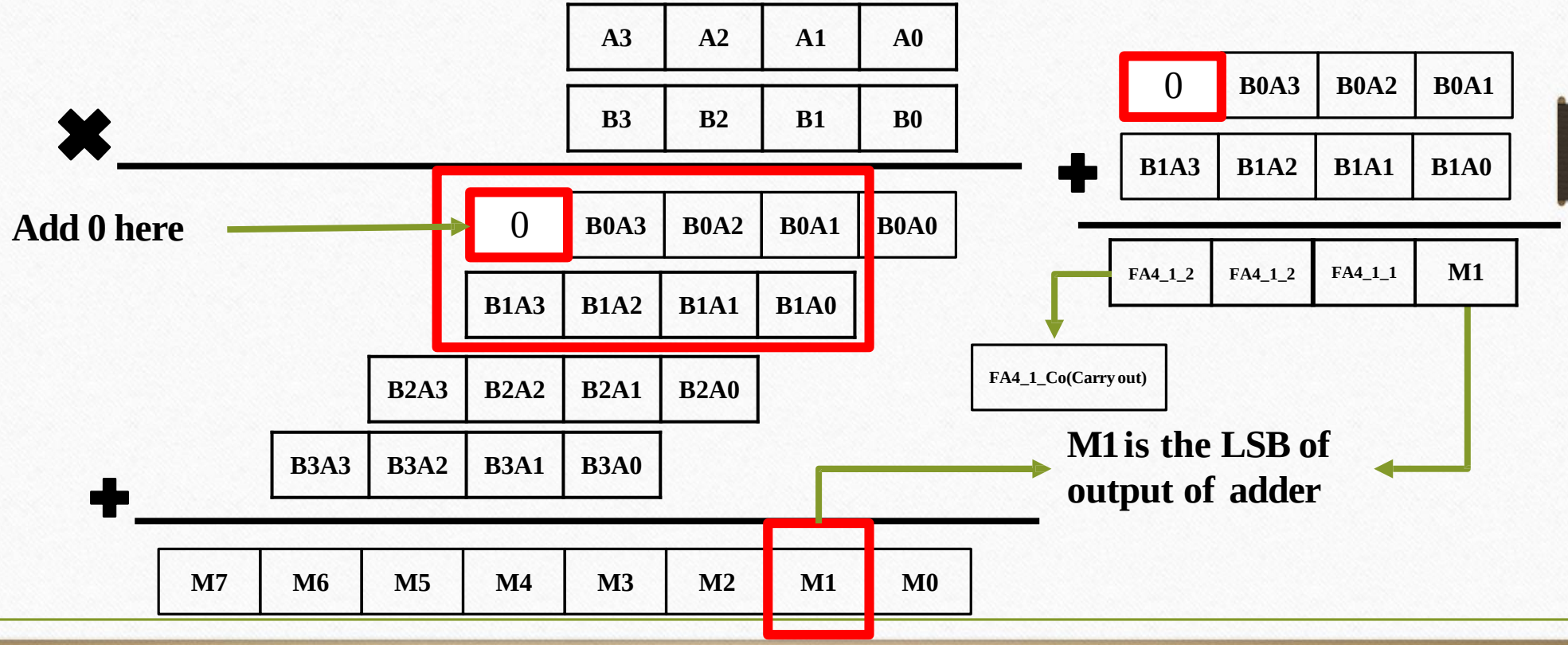
# Multiplication Detail



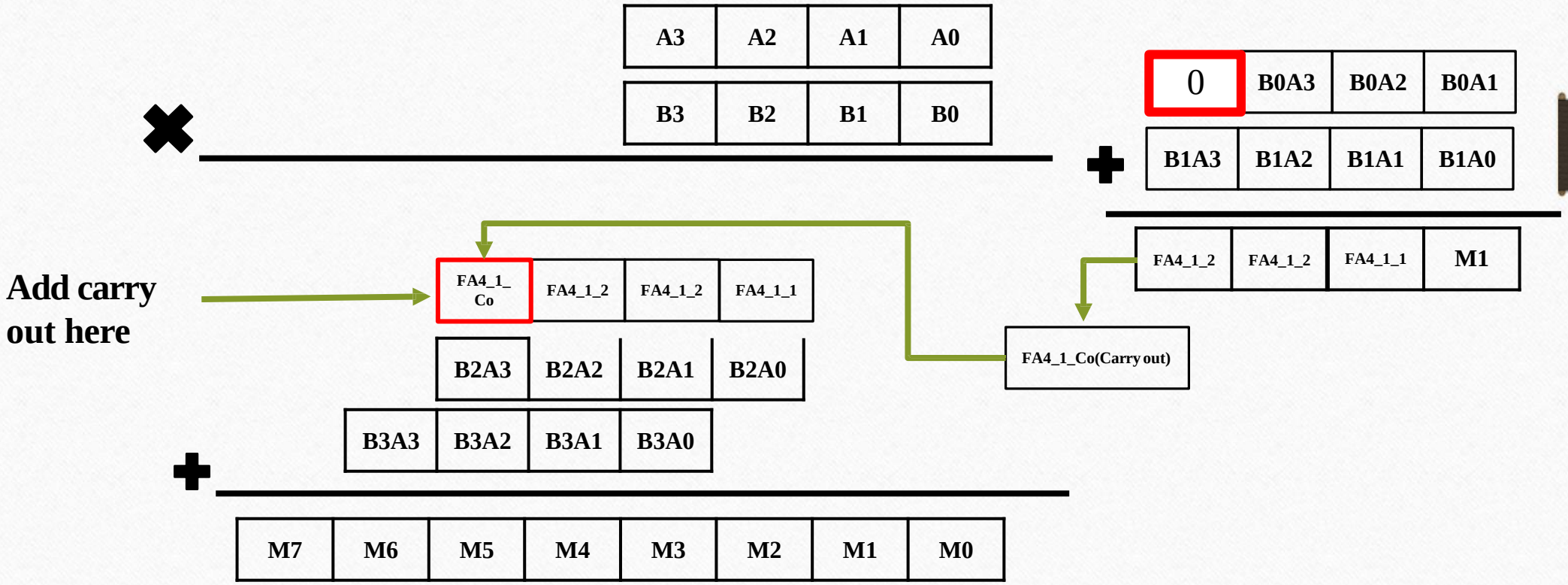
# Step 1 compute trivial term



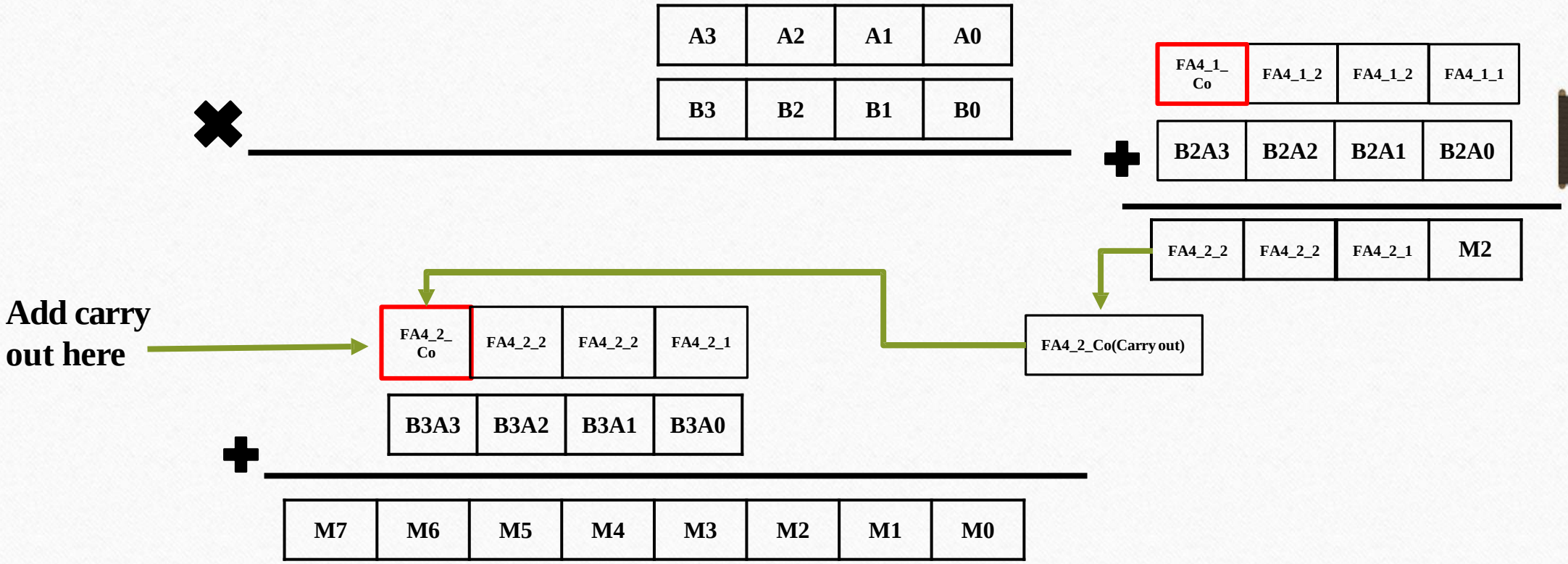
# Step 2 compute partial sum



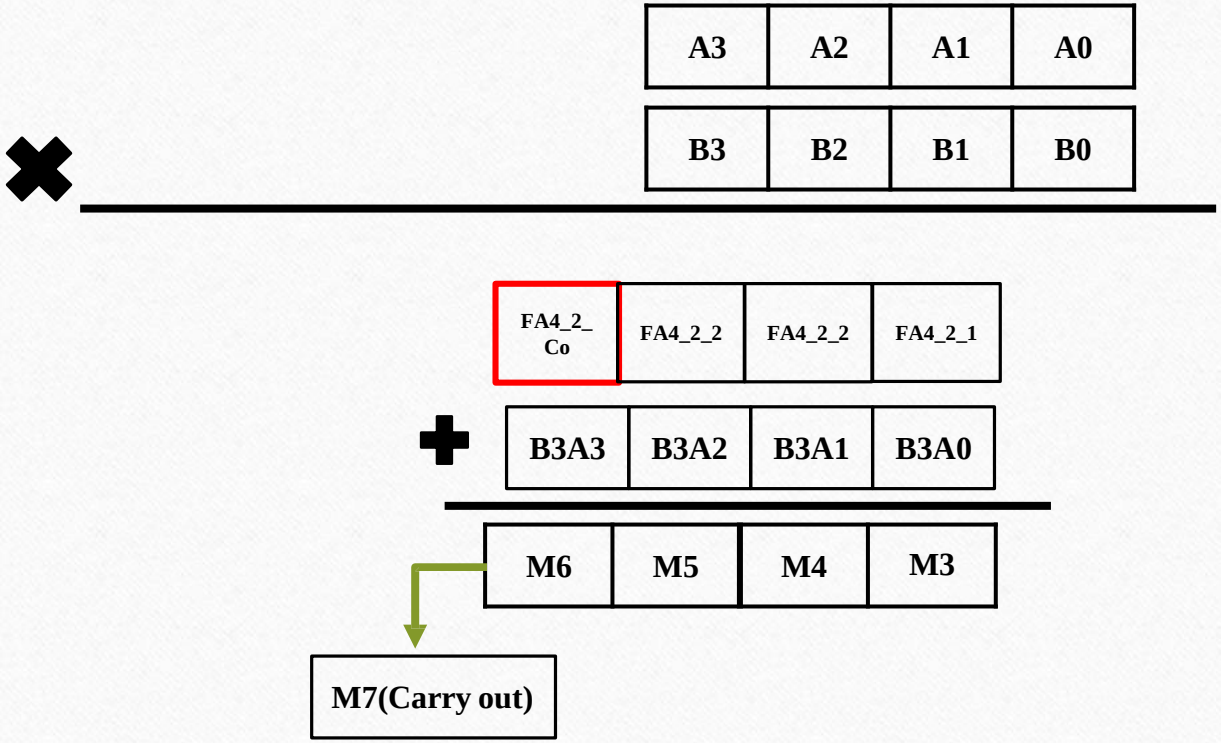
# Step 2 compute partial sum(cont.)



# Step 2 compute partial sum(cont.)

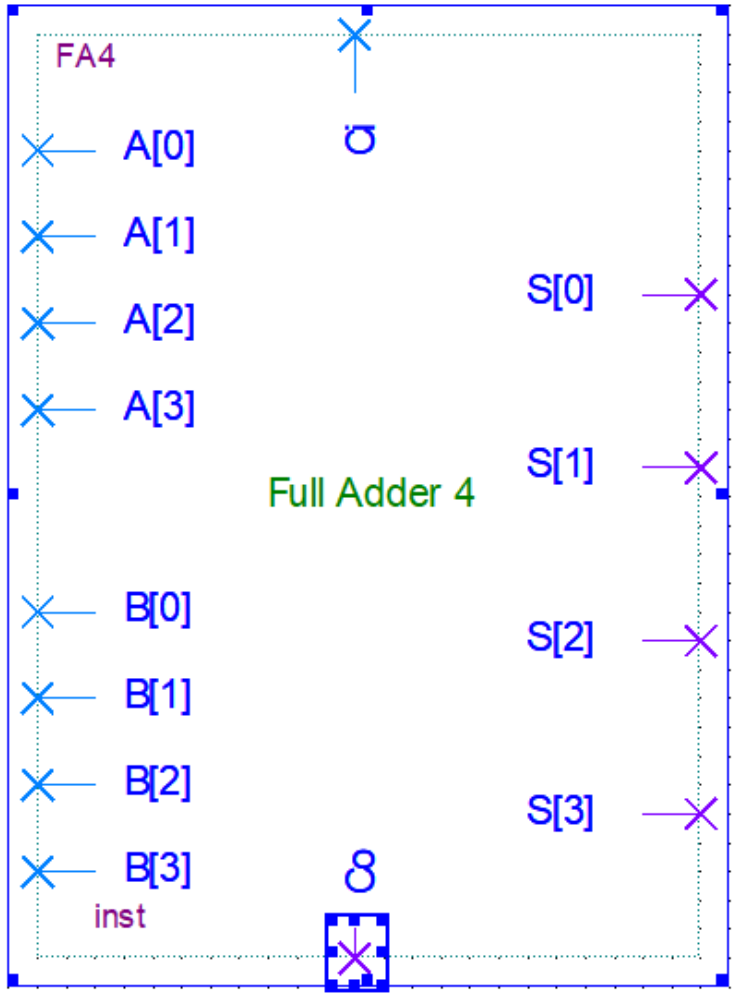


# Step 2 compute partial sum(cont.)



# How to implement multiplier on Quartus II?

- **Step 1: reuses your 4bits full adder, create a symbol of it. (FA4.bsf)**




**It's just an example, you can create it by your own way**

# Then,  draw the circuit !!

# Question?