unsigned multiplication

-
```
       0111     (7)
   x   1100     (12)
   ------------
       0000
      0000x
     0111xx
    0111xxx
   ------------
   1010100      (84)
```

place value shifting = multiplication by 2.

- 2's complement multiplication

if multiplier is +ve then proceed as such
else.

```
(-5)       1011      multiplicand
(-3)       1101      multiplier
       ----------
       11111011
       0000000x
       111011xx
       00101xxx   <- negated multiplicand
       ----------
       00001111
```

−ve ∴ 2's complement

$1011 \times (1000 + 0101)$, where $1000 = -8$ and $0101 = +5$

sign extension

negated multiplicand

division

```
       11
11 ) 1001
    - 11
    ----
       11
     - 11
     ----
       00
```

9/3 = 3

for signed, convert to unsigned and then add sign

```
  11111010
  00110xxx
  ---------
1 00101010
```

L6 practice problems

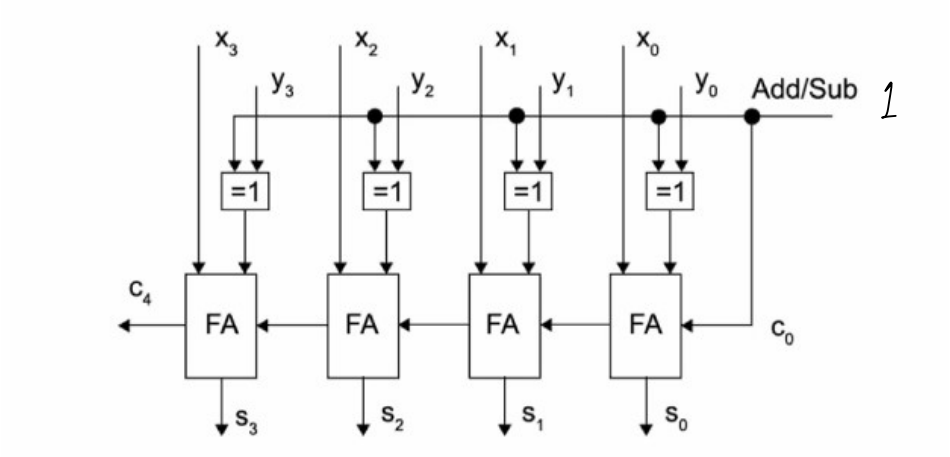
1. Perform the following unsigned addition operation. Each 8-bit unsigned input is represented in hexadecimal. Give the decimal equivalent of the input values and also of the result.

9F + 4E

2. Perform the following signed 2's complement addition. Each 8-bit signed input is represented in hexadecimal. Give the decimal equivalent of the input values and also of the result.

9F + 4E

3. Illustrate how the signed 2's complement subtraction of the decimal values (3 – 7) is carried out in the following circuit by indicating the logic level (i.e. 0 or 1) at every input and output (including carry signals) on the circuit.



4. Draw the diagram of a 6-bit wide 2's complement adder/subtractor circuit using six full adders.