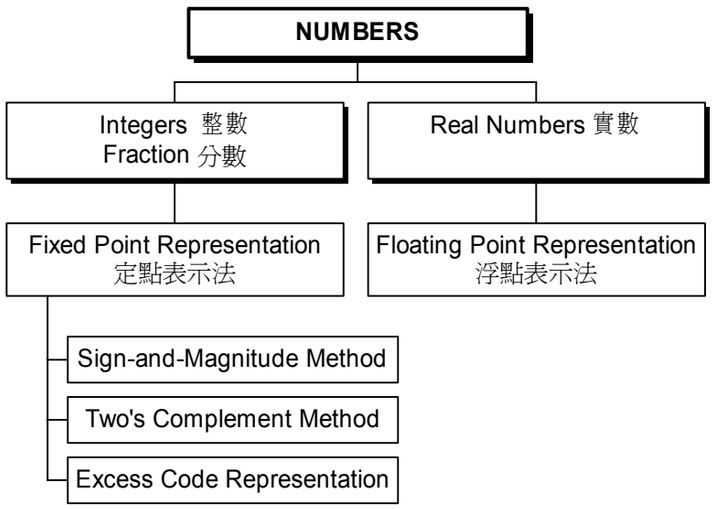
FORM 4 COMPUTER STUDIES
Chapter 6: Fixed Point Representation Of Numbers

March, 01

6.1 CODING DIFFERENT TYPES OF NUMBERS

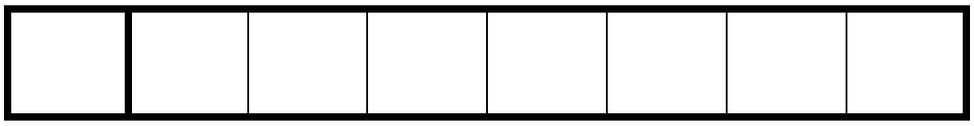


6.2 SIGN-AND-MAGNITUDE METHOD

- the negative denary number -57 can be separated into two parts:

_____ _____ (numerical value)

- In the sign-and magnitude method,



Sign bit (MSB)

Magnitude (binary equivalent of the magnitude of the number)

- e.g.

Binary	Denary
00000010	+2
10000010	-2
10001000	-8
00001000	+8

- e.g. Using Sign-and-Magnitude coding and 8-bit binary code, express the following number's:

  (a) +28
  (b) -36

Step 1: Convert the magnitude of the number into binary	
(a) 28 = 11100	(b) 36 = 100100
Step 2: Add leading zero's until the binary code contains 7 bits	
Step 3: Add "0" (when positive) or "1" (when negative) to the binary code as MSB	

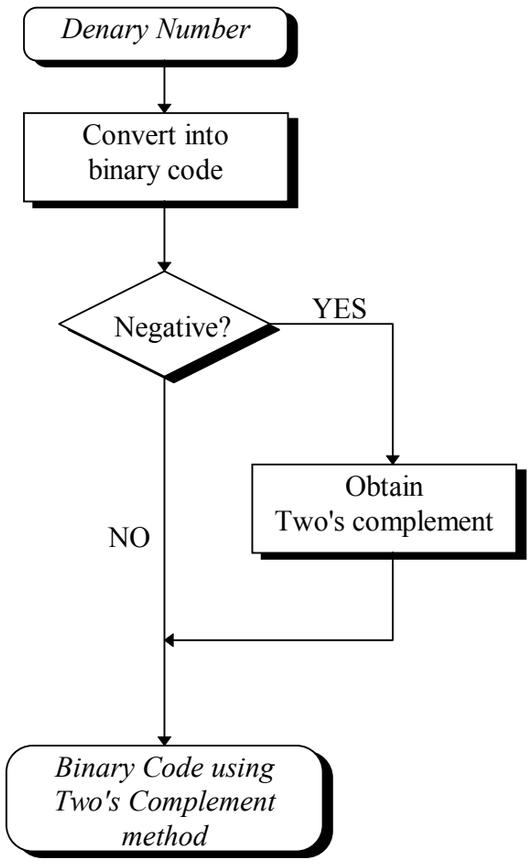
6.3 TWO'S COMPLEMENT METHOD

6.3.1 Algorithm of changing from a positive binary code to its negative in two's complement

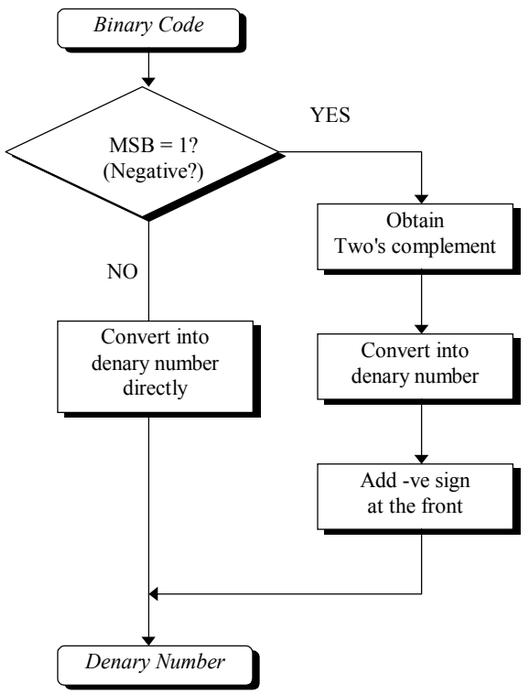
Step 1: Invert all the bits (i.e. change all 0's to 1's and all 1's to 0's)

Step 2: Add the resulting binary code by 1

Convert an denary number into its 8-bit binary code using two's complement representation



Convert the two's complement code into the corresponding denary code



6.3.2 Two's Complement Representation Binary Arithmetic

- The following four examples show binary addition and subtraction in an 8-bit word. Subtraction is carried out by negation-and-addition, i.e. **`x - y = x + (-y)`**

(a)

	50	00110010
-	83	+ 10101101

(correct / incorrect)

(b)

	50	00110010
+	83	+ 01010011

(correct / incorrect)

(c)

	83	01010011
-	50	+ 11001110

(correct / incorrect)

(c)

-	83	10101101
-	50	+ 11001110

(correct / incorrect)

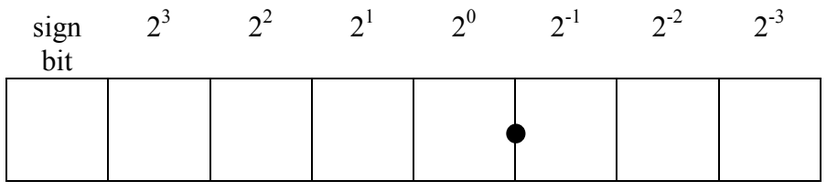
- The results of cases (b) and (d) are (correct / incorrect) . They are examples of _____ error. This means that the result is outside the range of numbers that can be represented.

6.3.3 Two's Complement Representation vs. Sign-And-Magnitude

	Two's Complement	*Sign-and-Magnitude*
Range (8 bit)	-128 to +127	-127 to +127
Advantage	Subtraction can be performed by addition. Hence common circuit can be used.	Simple and easy to understand
Disadvantages	More difficult to understand	Sign bit and the magnitude parts are handled separately Design of the circuit used for addition and subtraction is more complicated
Note	"Zero" has only ONE representation 00000000.	"Zero" may have two different representations 00000000 and 10000000.

6.4 BINARY FRACTION

- Binary point may be fixed at and desired position within the word
- e.g. Assume the binary point is fixed between bits 2 and 3 in an 8-bit word. Sign-and-magnitude coding is used.



- Example: Express (a) 01100.110_2 and (b) 10011.001_2 in decimal.

(a)	(b)

- To convert a decimal fraction to binary, we use a method of repeated multiplication by 2.

(a) 0.8125_{10} $= 0.1101_2$	(b) 0.4_{10} $= 0.011001100110.....$

END OF CHAPTER 6