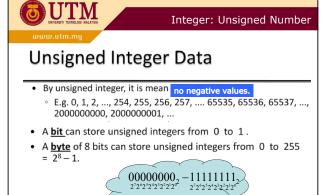




# **Integer Representation**

- Numbers can be represented as a combination of a value, or magnitude and sign, plus or minus
- Unsigned integer
- Signed integer

3



128+64+32+16+8+4+2+1



### Integer: Unsigned Number

- In binary arithmetic, if the length of the number is restricted to 8 digits (0s and 1s), the largest value is 1111 1111<sub>2</sub> = 255, and the smallest is 0
- A <u>word</u> of 16 bits can store unsigned integers from 0 to 65535 =  $2^{16} 1$ .
- In binary arithmetic, if the length of the number is restricted to 16 digits (0s and 1s), the largest value is 1111 1111 1111 1111<sub>2</sub> = 65535, and the smallest is 0.

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#### Integer: Unsigned Number

#### www.utm.my

The range of number depend on the total number of bits used, n. For positive number yang range is from 0 to  $2^{n}$ -1.

#### Example

Find the range of binary numbers that can be represented by 10 bits.

Number of bits, n = 10

00 0000 0000  $\le x \le 11$  1111 1111  $0 \le x \le 2^{10} - 1$   $0 \le x \le 1023$ 

e



Integer: Unsigned Number

# **Upper and Lower Bound**

No of Bits	Lower Bound	Upper Bound, 2 <sup>n</sup> − 1	Range
4 bits	0	$2^4 - 1 = 15$	0 → 15
8 bits	0	$2^8 - 1 = 255$	0 → 255
10 bits	0	$2^{10} - 1 = 1023$	0 → 1023

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#### Integer: Unsigned Number

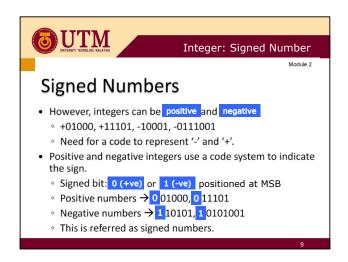
#### www.utm.mu

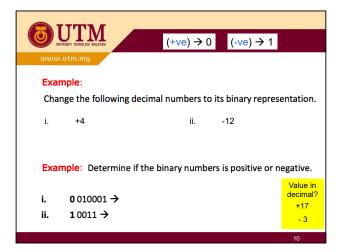
### Example:

Find the lower and the upper bound of a 12-bit binary system.

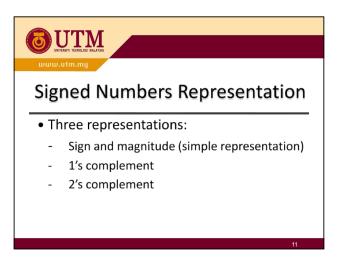
- -Lower bound = 0
- -Upper bound  $=2^n 1 = 2^{12} 1 = 4096 1 = 4095$
- -Therefore the range is 0 → 4095

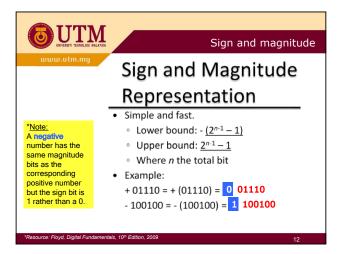
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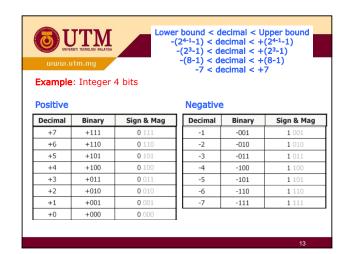


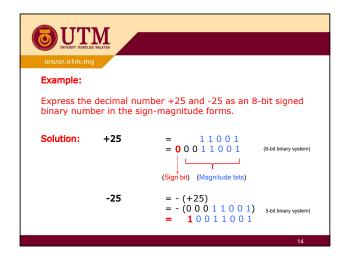
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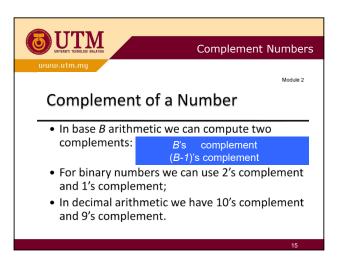


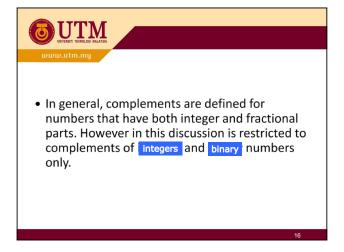


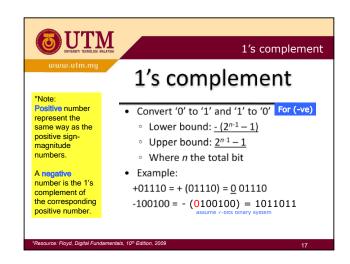
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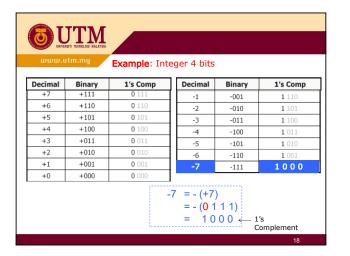


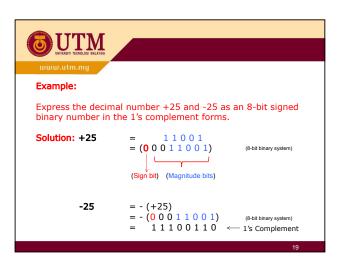


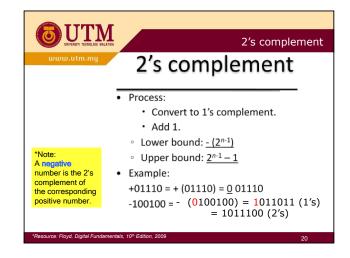


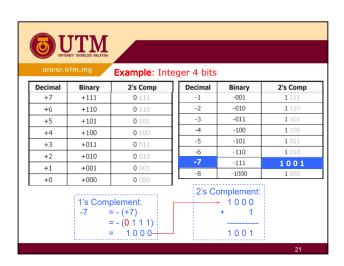


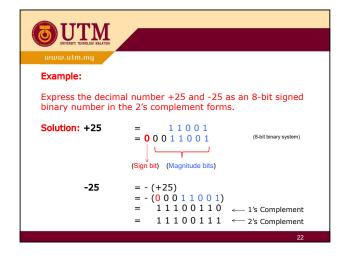


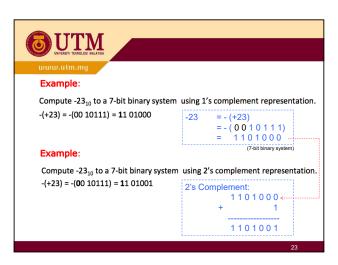


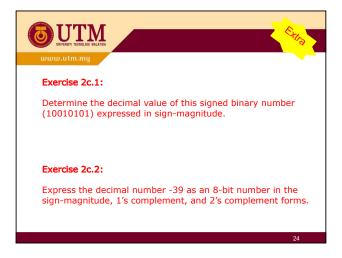


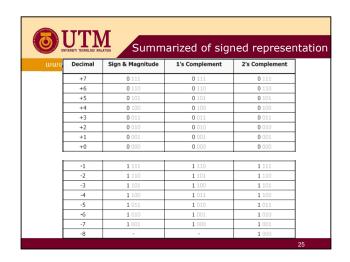


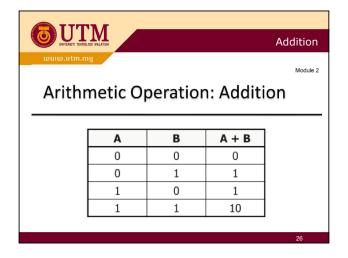


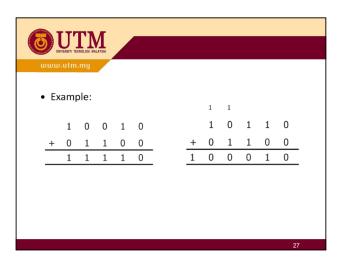


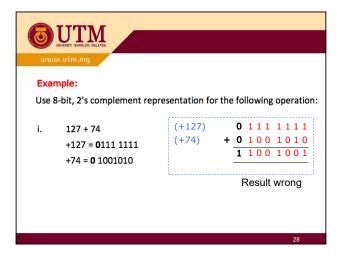












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