

Switching Circuit & Logic Design

Lecture 5 : Introduction to number theory



Things to cover

- Number theory

Book : Fundamentals of Digital Circuits, A. Anand Kumar

Number Theory

- Base / radix
- Decimal
- Binary
- Octal
- Hexadecimal

Counting with Binary

- 0, 1
- 00, 01, 10, 11
- 000, 001, 010, 011, 100, 101, 110, 111
- ...

Conversion of Decimal to Binary

- Before decimal point
- After decimal point

Addition in Binary system

- $0 + 0 = 0$
- $0 + 1 = 1$
- $1 + 0 = 1$
- $1 + 1 = 10$: Carry 1

Subtraction in Binary System

- $0 - 0 = 0$
- $1 - 1 = 0$
- $1 - 0 = 1$
- $0 - 1 = 1$ with a borrow of 1

How adder can
Do ?

Negative decimal number

- Sign bit
- 1's complement
- 2's complement

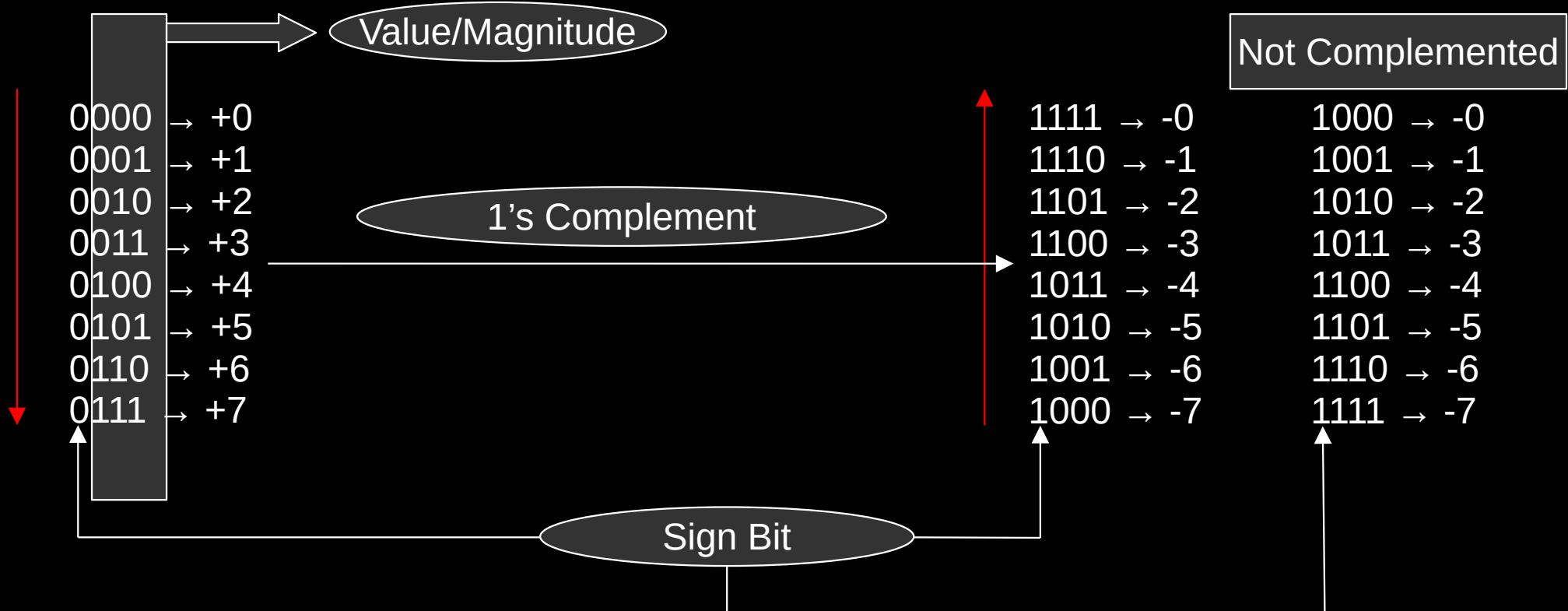
Sign bit

- Most significant bit (MSB)
- Least significant bit (LSB)
- Unsigned and signed

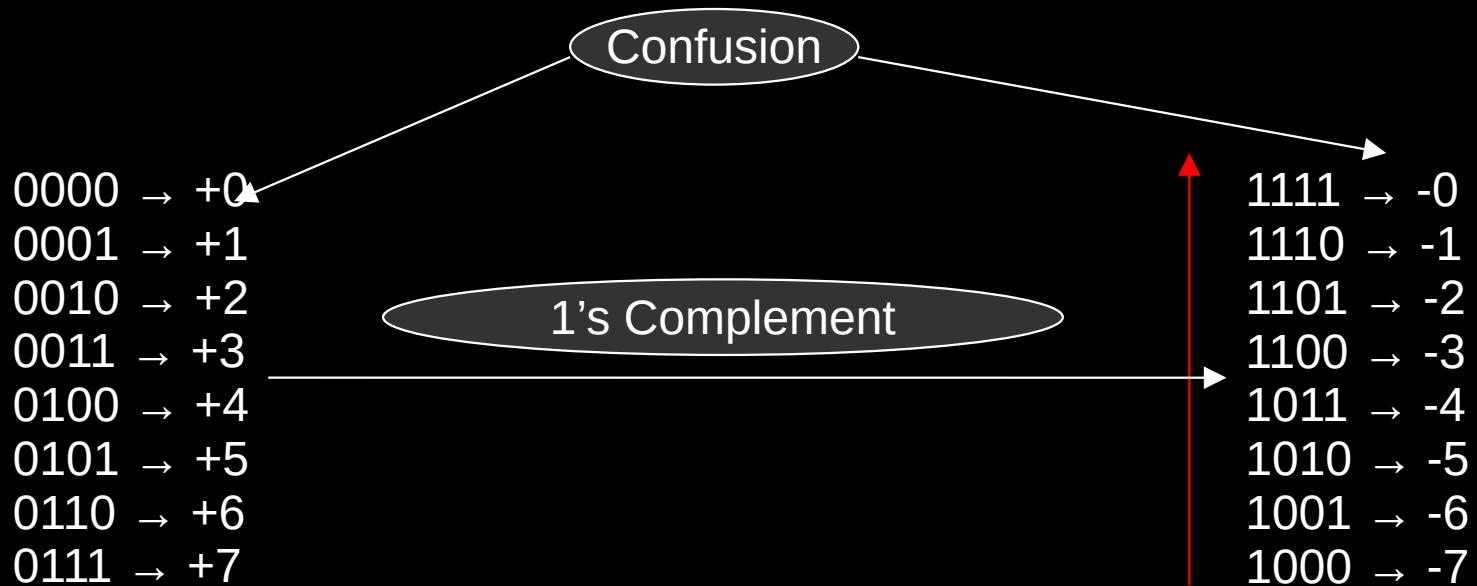
1's Complement

$1 \rightarrow 0$
 $0 \rightarrow 1$

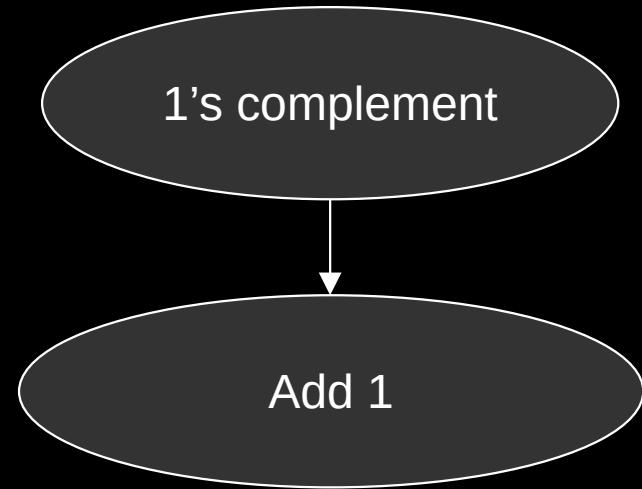
1's Complement



1's Complement



2's Complement



2's Complement

| |
|-----------|
| 0000 → +0 |
| 0001 → +1 |
| 0010 → +2 |
| 0011 → +3 |
| 0100 → +4 |
| 0101 → +5 |
| 0110 → +6 |
| 0111 → +7 |

1's Complement

| |
|-----------|
| 1111 → -0 |
| 1110 → -1 |
| 1101 → -2 |
| 1100 → -3 |
| 1011 → -4 |
| 1010 → -5 |
| 1001 → -6 |
| 1000 → -7 |

Add 1

| |
|-----------|
| 0000 → -0 |
| 1111 → -1 |
| 1110 → -2 |
| 1101 → -3 |
| 1100 → -4 |
| 1011 → -5 |
| 1010 → -6 |
| 1001 → -7 |

1000 cannot exist !!!

Other number systems

- Decimal to octal, hexadecimal
- Octal to decimal
- Hexadecimal to decimal