Bits of Architecture

Integer Basics

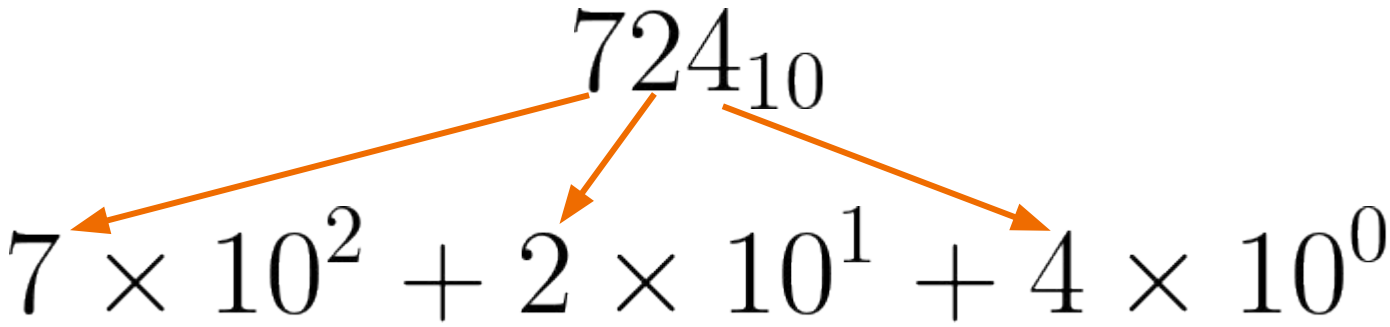
How Do We Represent Numbers?

Base 10 Numbers (Decimal)

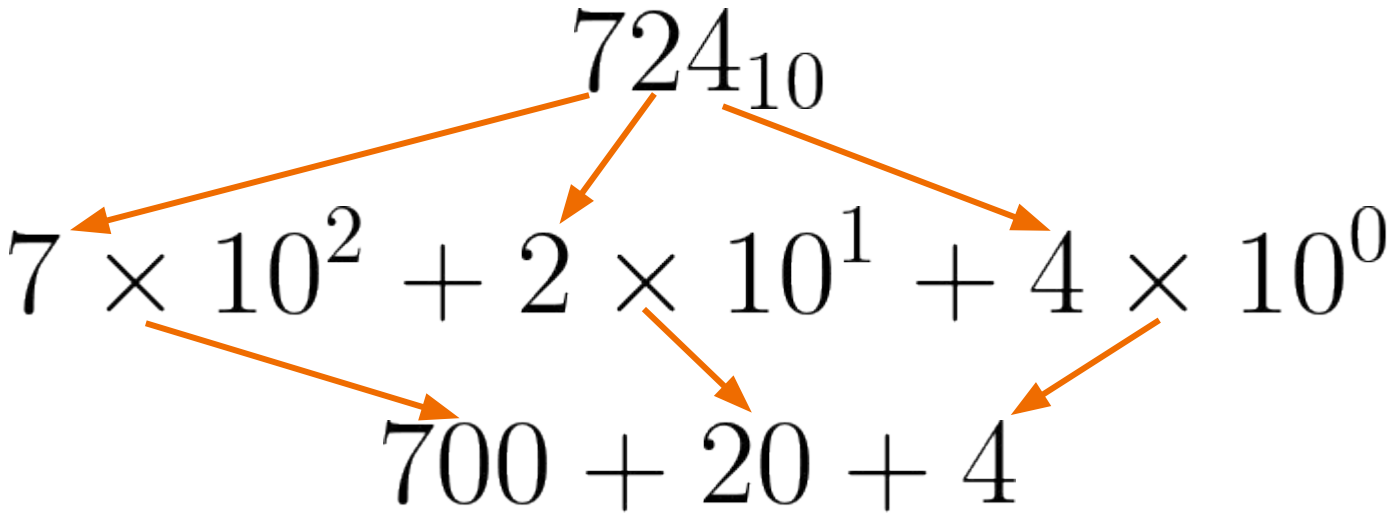
Decimal Numbers

$$724_{10}$$

Decimal Numbers



Decimal Numbers



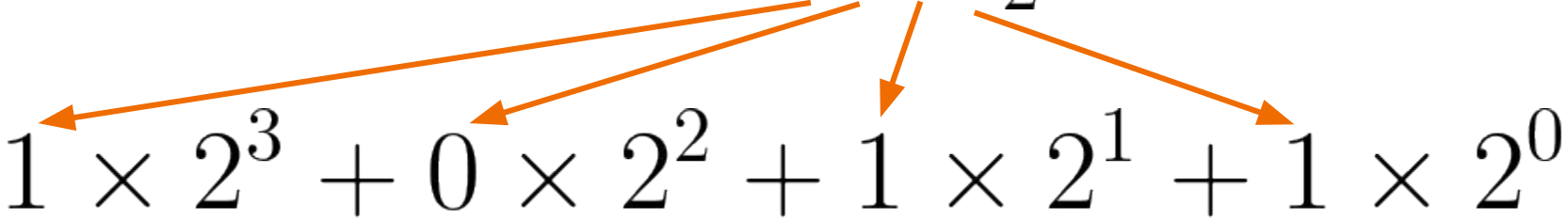
Base 2 Numbers (Binary)

Binary Numbers - Unsigned Integers

$$11 = 1011_2$$

Binary Numbers - Unsigned Integers

$$11 = 1011_2$$



$$1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$$

Binary Numbers - Unsigned Integers

$$11 = 1011_2$$

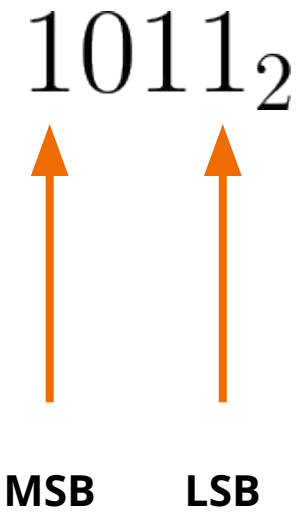
$$1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$$

$$8 + 0 + 2 + 1$$

Some Terminology…

Binary Numbers

- **Least Significant Bit (LSB)**
  - Rightmost bit
  - Smallest power (typically 0)
- **Most Significant Bit (MSB)**
  - Leftmost bit
  - Largest power



What About Signed Numbers?

Binary Numbers - Signed Integers

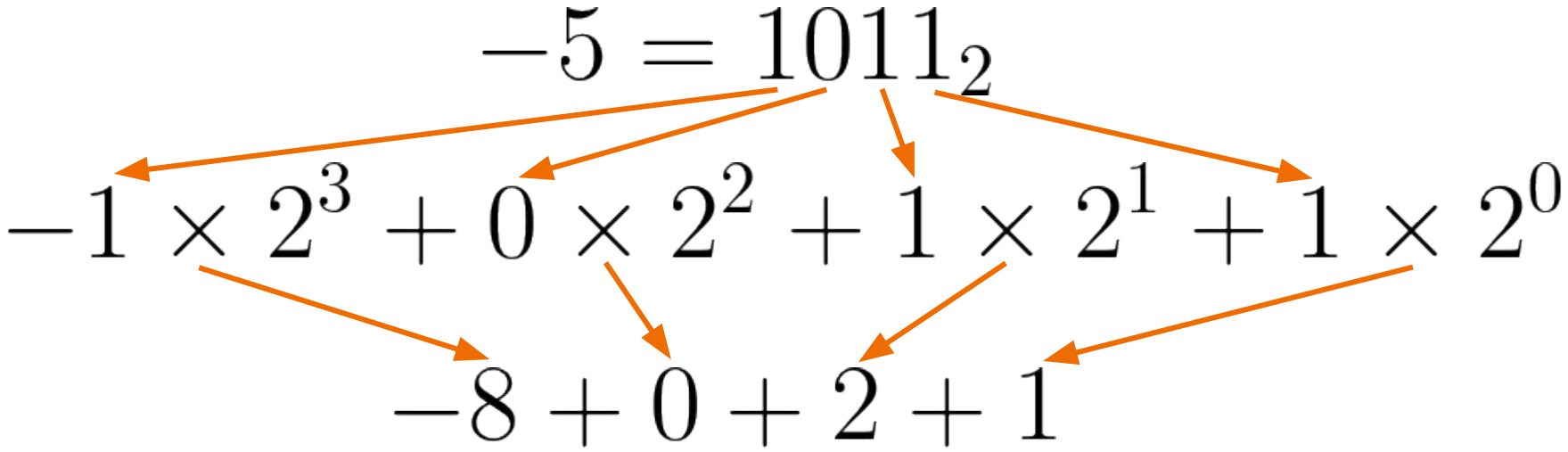
$$-5 = 1011_2$$

Binary Numbers - Signed Integers

$$-5 = 1011_2$$

$$-1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$$

Binary Numbers - Signed Integers



What Range of Values Can We Represent?

Range of Integer Numbers

$$Range_{Unsigned} = 0 \rightarrow 2^n - 1$$

$$Min_{4bit} = 0000_2 \quad Max_{4bit} = 1111_2$$

Range of Integer Numbers

$$Range_{Signed} = -2^{n-1} \rightarrow 2^{n-1} - 1$$

$$Min_{4bit} = 1000_2 \;\; Max_{4bit} = 0111_2$$