

Section 1.2: Binary and Hexadecimal

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binary: base 2, so only has digits: 0, 1

decimal	binary
0	0
1	1
2	10_2
3	11_2
4	100_2
5	101_2
6	110_2
7	111_2
8	1000_2
9	1001_2
10	1010_2

in computing, each digit is a bit
(binary digit)

example: convert to decimal:

$$\begin{aligned} a) \quad 101110_2 &= 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0 \\ &= 32 + 0 + 8 + 4 + 2 + 0 \\ &= 46 \end{aligned}$$

hexadecimal: base 16

decimal	hexadecimal:
0	0
1	1
2	2
3	3

1	.
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	A ₁₆
11	B ₁₆
12	C ₁₆
13	D ₁₆
14	E ₁₆
15	F ₁₆
16	10 ₁₆

we use these 6 extra symbols to complete the set of allowed digits

so BEAD₁₆ is a number! how big is it?

can skip this step

$$\begin{aligned}
 \text{BEAD}_{16} &= B \times 16^3 + E \times 16^2 + A \times 16^1 + D \times 16^0 \\
 &= 11 \times 16^3 + 14 \times 16^2 + 10 \times 16^1 + 13 \\
 &= 48\,813
 \end{aligned}$$

examples: convert to decimal:

$$a) \quad 15_{16} = 1 \times 16 + 5 = 21$$

$$b) \quad 98003_{16} = 9 \times 16^4 + 8 \times 16^3 + 0 + 0 + 3 = 622\,595$$

$$c) \quad B055_{16} = 11 \times 16^3 + 0 + 5 \times 16^1 + 5 \times 16^0 = 45\,141$$

digression: will not be tested

other notations:

$A5_{16} = 0xA5$ zero lower case letter x
used in Unix and C-based programming

similarly,

$101_2 = 0b101$
 $73_8 = 0o73$

Unicode: Euro € is U+20AC hexadecimal number

RGB colour model: make colours by adding red, green, and blue primary colours together

- used for computer displays, TVs, cameras

note: colour printers are subtractive

(cyan, magenta, yellow)

RGB codes are written as a triplet:

(red value, green, blue)

↑ ↑ ↑

these numbers go from 0 to 255

0 to FF_{16}

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Some numbers written in hexadecimal