

Exercise 1. Represent the decimal number 245 in the following number systems:

- a. Binary (base 2)
- b. Heximal (base 6)
- c. Octal (base 8)
- d. Hexadecimal (base 16)

Exercise 2. Represent each of the following numbers in decimal:

- a. 10110110_2
- b. 4153_6
- c. 562_8
- d. $3EB_{16}$

Exercise 3. Give the range of unsigned integers that can be represented using:

- a. 16 binary digits
- b. 3 heximal digits
- c. 3 octal digits
- d. 4 hexadecimal digits

Exercise 4. List all 5-bit unsigned integers in decimal, binary, octal, and hexadecimal.

Exercise 5. Consider the decimal numbers $x = 77$ and $y = 48$.

- a. Express x and y as 8-bit binary numbers.
- b. Add x and y in binary and express the result as an 8-bit binary number.
- c. Express $-(x + y)$ as an 8-bit binary number.

Exercise 6. Give the range of signed integers that can be represented using 8 bits.

Exercise 7. List all 5-bit signed integers in decimal and binary.

Exercise 8. Represent the following half-precision (16-bit) floating-point numbers in decimal:

- a. 0 01111 0110100100
- b. 1 10000 1001001000
- c. 0 10000 0101110000

Exercise 9. Consider the string “Hello, World”.

- a. Represent the string in decimal.
- b. Represent the string in binary.
- c. Represent the string in octal.
- d. Represent the string in hexadecimal.

SOLUTIONS

Solution 1.

- a. 11110101
- b. 1050
- c. 365
- d. F5

Solution 2.

- a. 182
- b. 933
- c. 370
- d. 1003

Solution 3.

- a. $[0, 2^{16} - 1] = [0, 65535]$
- b. $[0, 6^3 - 1] = [0, 215]$
- c. $[0, 8^3 - 1] = [0, 511]$
- d. $[0, 16^4 - 1] = [0, 65535]$

Solution 4.

Dec	Bin	Oct	Hex	Dec	Bin	Oct	Hex	Dec	Bin	Oct	Hex	Dec	Bin	Oct	Hex
0	00000	00	00	8	01000	10	08	16	10000	20	10	24	11000	30	18
1	00001	01	01	9	01001	11	09	17	10001	21	11	25	11001	31	19
2	00010	02	02	10	01010	12	0A	18	10010	22	12	26	11010	32	1A
3	00011	03	03	11	01011	13	0B	19	10011	23	13	27	11011	33	1B
4	00100	04	04	12	01100	14	0C	20	10100	24	14	28	11100	34	1C
5	00101	05	05	13	01101	15	0D	21	10101	25	15	29	11101	35	1D
6	00110	06	06	14	01110	16	0E	22	10110	26	16	30	11110	36	1E
7	00111	07	07	15	01111	17	0F	23	10111	27	17	31	11111	37	FF

Solution 5.

- a. $x = 01001101$ and $y = 00110000$
- b. $x + y = 01111101$
- c. $-(x + y) = 10000011$

Solution 6. $[-2^7, 2^7 - 1] = [-128, 127]$

Solution 7.

Dec	Bin
-16	10000
-15	10001
-14	10010
-13	10011
-12	10100
-11	10101
-10	10110
-9	10111

Dec	Bin
-8	11000
-7	11001
-6	11010
-5	11011
-4	11100
-3	11101
-2	11110
-1	11111

Dec	Bin
0	00000
1	00001
2	00010
3	00011
4	00100
5	00101
6	00110
7	00111

Dec	Bin
8	01000
9	01001
10	01010
11	01011
12	01100
13	01101
14	01110
15	01111

Solution 8.

a. $(-1)^0 \cdot 2^0 \cdot (1 + 2^{-2} + 2^{-3} + 2^{-5} + 2^{-8}) = 1.4101562$

b. $(-1)^1 \cdot 2^1 \cdot (1 + 2^{-1} + 2^{-4} + 2^{-7}) = -3.140625$

c. $(-1)^0 \cdot 2^0 \cdot (1 + 2^{-2} + 2^{-4} + 2^{-5} + 2^{-6}) = 2.71875$

Solution 9.

a. 012 072 101 108 108 111 044 032 087 111 114 108 100

b. 00001100 01001000 01100101 01101100 01101100 01101111 00101100 00100000 01010111 01101111 01110010 01101100 01100100

c. 014 110 145 154 154 157 054 040 127 157 162 154 144

d. 0C 48 65 6C 6C 6F 2C 20 57 6F 72 6C 64