Exercises: Number Systems

Exercise 1

This exercise practices the basic skills you need to solve the subsequent exercises in number systems.

1.1 Powers

Determine the values below:

a. 10^0
b. 10^1
c. 10^4
d. 2^0
e. 2^3
f. 2^7
g. 16^0
h. 16^2
i. 16^4

1.2 Remainders

The remainder of a after division by b is written as $\mathbf{rem}(a, b)$. For example, the remainder of 35 after division by 16 is rem(35,16) = 3.

Find the remainders below:

a. $\text{rem}(16, 2)$
b. $\text{rem}(25, 2)$
c. $\text{rem}(1, 2)$
d. $\text{rem}(10, 2^2)$
e. $\text{rem}(18, 2^4)$
f. $\text{rem}(100, 2^6)$
g. $\text{rem}(54, 16)$
h. $\text{rem}(54, 16^2)$
i. $\text{rem}(508, 16^2)$

Exercise 2

Convert the following binary numbers into decimal numbers.

a. 10_2
b. 1000000_2
c. 1101_2
d. 00110_2
e. 1110111100_2
f. 1001101110110_2

Exercise 3

Convert the following decimal numbers into binary numbers.

a. 1
b. 2
c. 3
d. 10
e. 49
f. 212

Exercise 4

Convert the following hexadecimal numbers into decimal numbers.

a. 10_{16}
b. B_{16}
c. $5C_{16}$
d. $37D_{16}$
e. $1A9_{16}$
f. 5091_{16}

Exercise 5

Convert the following decimal numbers into hexadecimal numbers.

a. 1
b. 7
c. 16
d. 142
e. 1024
f. 5091

Exercise 6

Add the following numbers in binary.

a. $1110_2 + 11_2$
b. $11101_2 + 1010_2$
c. $11101_2 + 11001_2$
d. $10101101_2 + 1011101_2$

Exercise 7

Multiply the following numbers in binary.

a. $10_2 \cdot 10_2$
b. $1110_2 \cdot 11_2$
c. $1110_2 \cdot 1001_2$
d. $101101011_2 \cdot 10101110_2$

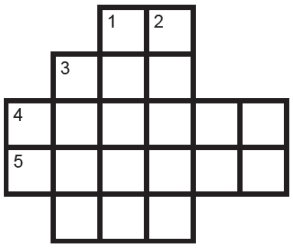
Exercise 8

Calculate the exponentiations below. Do you notice a pattern?

a. 10^2
b. 10^5
c. $(10_2)^2$
d. $(10_2)^5$
e. $(10_{16})^2$
f. $(10_{16})^5$

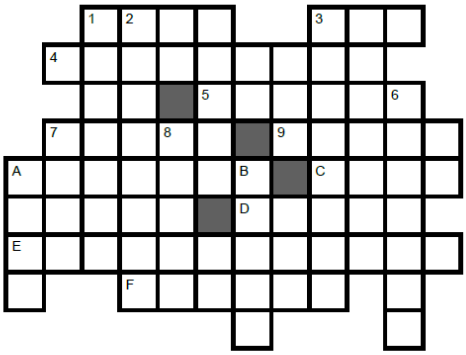
Exercise 9

Solve the "crossbins" below. The clues are in hexadecimal, the answers are in binary. Note: if your number is too short, but zeros in front!



Across
[1]: **2**
[3]: **5**
[4]: **22**
[5]: **14**

Down
[1]: **11**
[2]: **A**
[3]: **A**

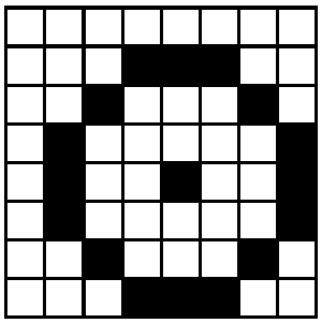


Across
[1]: **8**
[3]: **4**
[4]: **44**
[5]: **3C**
[7]: **1B**
[9]: **C**
[A]: **7F**
[C]: **E**
[D]: **1D**
[E]: **A0A**
[F]: **36**

Down
[1]: **5F**
[2]: **6D**
[3]: **BE**
[6]: **1C**
[7]: **C**
[8]: **1D**
[A]: **E**
[B]: **1A**

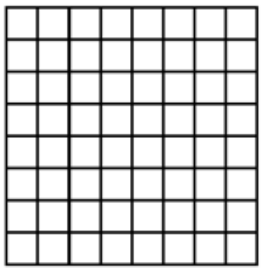
Exercise 10

The example below shows how black-and-white pictures can be represented compactly using hexadecimal and binary numbers, with 0 and 1 representing black and white pixels, respectively.



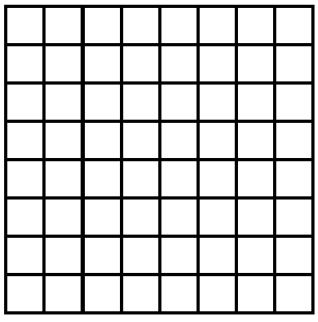
Binary	*Hex*
00000000	00
00011100	1c
00100010	22
01000001	41
01001001	49
01000001	41
00100010	22
00011100	1c

Decode the bitmap below by converting from hexadecimal to binary, and coloring the pixels.



Binary	*Hex*
	18
	7E
	FF
	DB
	FF
	24
	5A
	81

Create your own bitmap by drawing a pictures on the left and translating the pixel values first to binary and then to hexadecimal.



Binary	*Hex*