1 Model 1: Binary Number Representation

Questions: 11 | Allocated Time: 5 minutes

Problem 1. How many *binary digits* (a.k.a. *bits*) are needed to represent the following decimal numbers:

2 2

5 3

7 3

10 4

Problem 2. List the decimal numbers (between zero and eleven) where the size of the binary representation increases vs. the previous one, and show their binary representation

2 4 8

Problem 3. What is the **smallest** number that will *require* a certain number of bits? Give your answer in decimal.

5 bits 16

6 bits 32

7 bits 64

Problem 4. Complete the following table to show the binary representation of the numbers 11 to 15, using your knowledge of binary patterns you explored in the previous questions.

Decimal	Binary
11	1011
12	1100
13	1101
14	1110
15	1111

Problem 5. What is the decimal representation of the binary number 11001? Show your work by first showing the binary digits times the place value, and then adding them together:

$$1 \cdot 2^4 + 1 \cdot 2^3 + 0 \cdot 2^2 + 0 \cdot 2^1 + 1 \cdot 2^0 = 16 + 8 + 1 = 25$$

Problem 6. What possible values can a single hexadecimal digit have? For example, a single bit can have the value 0 or 1, while a single decimal digit can have values between 0 and 9.

From 0 to 15

Problem 7. Give the hexadecimal and decimal representations of the first number to *require* 3 hex digits.

- Hexadecimal: 0x100
- Decimal: 256

Problem 8. What is the hexadecimal representation of the decimal number 21?

0x15

Problem 9. What is the binary representation of the following hex numbers? Translate it in groups of four bits (which equal one hex digit):

- `0xCAFE` = 1100 1010 1111 1110
- `0x8BADF00D` = 1000 1011 1010 1101 1111 0000 0000 1101

Problem 10. What is the result of these binary operations?

- 0*b*1010 & 0*b*1100 = 0*b*1000
- 0*b*1010 | 0*b*1100 = 0*b*1110
- 0*b*1010 *xor* 0*b*1100 = 0*b*0110
- x = 0b10
  x = (x « 2) | x
  x = (x « 4) | x