1. Introduction to Memory

Problem

We require 3 digits to represent the number 255 in base 10, and 8 digits in binary. What is the smallest base that can represent 255 using only 2 digits?

Solution

The largest number base 2 can represent with 2 digits is

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

base 3

$2 \times 3^1 + 2 \times 3^0 = 6 + 2 = 8$

base 4

$3 \times 4^1 + 3 \times 4^0 = 12 + 3 = 15$

base n

$f(n) = (n-1) \times n^1 + (n-1) \times n^0$

Binary and Hexadecimal

255 is the maximum value that can be represented with 2 digits in hexadecimal (0xFF) and with 8 digits in binary (0b11111111).

This property makes hexadecimal invaluable in computer science, as it allows concatenating bytes in either base and getting the same result, something not possible with decimals.

Binary	Hexadecimal	Decimal
0b11101111	0xEF	239
0b00111001	0x39	57

0b1110111100111001 = 61241

0xEF39 = 61241

Linear memory model