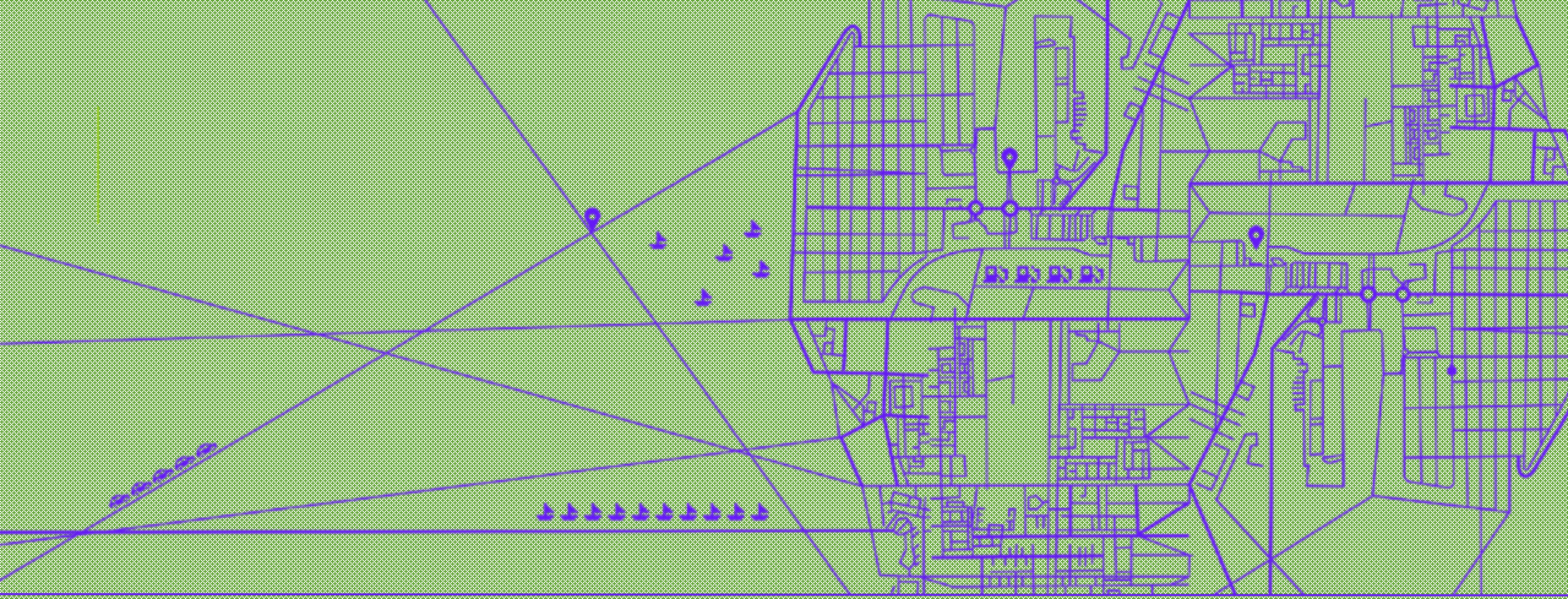

TOPIC 8: INTRODUCTION TO NUMBER SYSTEMS

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OUTLINE

- Binary Number System
- Hexadecimal Number System
- Adding in Binary
- Multiplying in Binary
- Converting from Binary to Hexadecimal

BINARY NUMBER SYSTEM

The decimal number system (Base 10) uses 10 digits (0, 1, 2, 3, 4, 5, 6, 7, 8, and 9) and the binary number system (Base 2) uses only 2 digits (0 and 1).

Example 1: Convert 249 to Binary?

Solution:

2	4	9
10^2	10^1	10^0

2(100) + 4(10) + 9(1)

1	1	1	1	1	0	0	1
2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

1(128) + 1(64) + 1(32) + 1(16) + 1(8) + 0(4) + 0(2) + 1(1)

Question 1: Convert 450 to Binary?

Example 2: Convert 1110001110 to Decimal?

Solution:

1	1	1	0	0	0	1	1	1	0
↓	↓	↓	↓	↓	↓	↓	↓	↓	↓
2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

$512 + 256 + 128 + 8 + 4 + 2 = 910$

Question 2: Convert 1011101110 to Decimal?

HEXADECIMAL NUMBER SYSTEM

The hexadecimal number system is a Base 16 number system which uses 16 digits (0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E and F) where A = 10, B = 11, C = 12, D = 13, E = 14 and F = 15.

Example 3: Convert 249 to Hexadecimal?

Solution: $\underline{2}\ \underline{4}\ \underline{9}$  $\underline{F}\ \underline{9}$

$10^2\ 10^1\ 10^0$ $16^1\ 16^0$

$2(100) + 4(10) + 9(1)$ $15(16) + 9(1)$

Question 3: Convert 450 to Hexadecimal?

Example 4: Convert A E 7 to Decimal?

Solution: A E 7

16^2 16^1 16^0

10(16)(16) + 14(16) + 7(1)

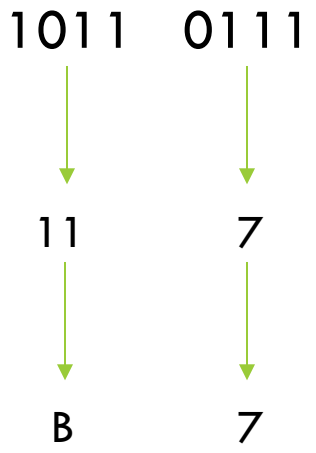
10(256) + 14(16) + 7 = 2791

Question 4: Convert F3C to Decimal?

BINARY TO HEXADECIMAL

- Start at the rightmost digit and break the binary number up into groups of four digits. These are known as nibbles.
- Next, convert each group of four digits into decimal.
- Convert each decimal value into its hex equivalent.
- Put the hex digits together.

Example 5: Convert 10110111 into hexadecimal?



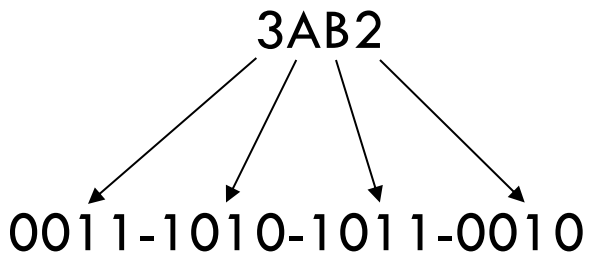
Question 5: Convert 111000110 into hexadecimal?

HEXADECIMAL TO BINARY

- Split the hexadecimal number into individual values.
- Convert each hexadecimal value into its decimal equivalent.
- Next, convert each decimal digit into binary, making sure to write four digits for each value.
- Combine all four digits to make one binary number.

Example 6: Convert 3AB2 to Binary?

Solution:



Question 6: Convert D9E6 to Binary?

ADDING IN BINARY

Example 7: Add 1011 and 111 in Binary?

Solution: 1011 2 (decimal) = 10 (binary)

+111 3 (decimal) = 11 (binary)

10010

In decimal, 1011 = 1+2+0+8 = 11 and 111 = 1+2+4 = 7. Therefore, total is 18. Check, 10010 = 0+2+0+0+16 = 18.

Question 7: Add 1011101 and 101101?

Question 7: Add 1011101 and 101101?

Solution:

1011101
+101101
10001010

Check: In decimal, 1011101 = 1+0+4+8+16+0+64 =93 and 101101 = 1+4+8+32 = 45. Therefore, total is 138. 10001010 = 0+2+0+8+0+0+0+128 = 138.

MULTIPLYING IN BINARY

Standard multiplication also applies to the Binary System. You just need to know that zero times zero is zero, one times zero is zero and one times one is one.

Example 8: Multiply 1001 and 101?

Solution:

$$\begin{array}{r} 1001 \\ \times 101 \\ \hline 1001 \\ 0000\ - \\ 1001\ --\ \\ \hline 101101 \end{array}$$

Check: 1001 is 9 and 101 is 5 in the decimal system. Therefore, 9×5=45.
101101 = 1+0+4+8+0+32 = 45

Question 8: Multiply 110110 and 111?

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