CHAPTER II: Number Systems

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1. Introduction

Number systems are used to represent and manipulate numerical data in computer systems. Commonly used number systems include the decimal (base-10), binary (base-2), octal (base-8), and hexadecimal (base-16) systems*[6]*[6].

2. Polynomial Form

Définition **:**

Polynomial form is a method for representing numbers in computer systems. It involves expressing a number as a polynomial with coefficients multiplied by powers of the base*[6]*[6].

To watch the video click here[1]

3. Decimal Value of a Base-b Number (BD)

Définition **:**

The decimal value of a base-b number can be calculated using the polynomial form. Each digit in the number is multiplied by the corresponding power of the base and then summed*[5]*[5].

Equation:

$$D_b = d_n \times b^n + d_{n-1} \times b^{n-1} + \ldots + d_1 \times b^1 + d_0 \times b^0$$

Exemple **:**

Convert the binary number 10111011 to its decimal equivalent*[4]*[4].

$$D_{10} = 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$$

$$D_{10} = 8 + 0 + 2 + 1 = 11$$

4. Base Conversion

Définition **:**

Base conversion involves converting numbers from one base to another. Common conversions include binary-to-decimal, decimal-to-binary, binary-to-octal, octal-to-binary, binary-to-hexadecimal, and hexadecimal-to-binary*[5]*[5].

4.1. Converting a Decimal Number to a Base-b Number (BD)

Méthode **:**

To convert a decimal number to a base-b number, repeatedly divide the decimal number by the base and record the remainders. The base-b number is then formed by arranging the remainders in reverse order*[4]*[4].

4.2. Binary-Octal (BO) and Vice Versa Conversion

***Fondamental* :**

Binary and octal are both base-2 and base-8 number systems, respectively. Converting between binary and octal involves grouping binary digits into sets of three and replacing each set with its corresponding octal digit*[6]*[6].

4.3. Binary-Hexadecimal (BH) and Vice Versa Conversion

***Fondamental* :**

Binary and hexadecimal are both base-2 and base-16 number systems, respectively. Converting between binary and hexadecimal involves grouping binary digits into sets of four and replacing each set with its corresponding hexadecimal digit*[4]*[4].

5. Complementation

***Définition* :**

Complementation is a technique used in computing to represent negative numbers and perform arithmetic operations. There are two main methods of complementation: one's complement and two's complement*[5]*[5].

5.1. Signed Encoding (SE)

***Méthode* :**

Signed encoding is a method of representing positive and negative numbers using a sign bit. In signed encoding, the leftmost bit (most significant bit) of a binary number represents the sign, where 0 indicates a positive number and 1 indicates a negative number*[6]*[6].

***Exemple* :**

In a signed 8-bit encoding, the binary number 01010101 represents the positive decimal number 85, while 11010101 represents the negative decimal number −43.

5.2. One's Complement (OC)

***Méthode* :**

One's complement is a method of representing negative numbers by taking the bitwise complement (reversing all bits) of the binary representation of a positive number. In one's complement, negative numbers are denoted by setting the sign bit to 1*[5]*[5].

***Exemple* :**

To find the one's complement of 010101010, we simply flip all the bits to get 10101011, which represents −85.

1. decimal-binary-octal-hexadecimal - https://youtu.be/fNWemJMuo3o?list=PLEsisZxbZudhEu3GTlbPostQUejSobJIs

5.3. Two's Complement (TC)

Méthode **:**

Two's complement is a method of representing negative numbers by taking the one's complement of the binary representation of a positive number and adding 1. In two's complement, negative numbers are denoted by setting the sign bit to 1 and using the standard binary addition operation*[4]*[4].

Exemple **:**

To find the two's complement of 01010101, we first find the one's complement to get 101010101, then add 1 to get 101010111, which represents −85*[4]*[4].