# Number System in Computer Science

A \*\*Number System\*\* is a way to represent numbers using a set of symbols or digits.   
Computers use different number systems to perform operations efficiently.  
  
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1. WHAT IS A NUMBER SYSTEM?  
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A number system defines how numbers are represented and used for calculations.  
Each number system has:  
 - A \*\*base\*\* (or radix)  
 - A \*\*set of digits\*\*  
 - \*\*Place values\*\* determined by powers of the base  
  
Example:  
 Decimal → Base 10 (Digits: 0–9)  
 Binary → Base 2 (Digits: 0,1)  
 Octal → Base 8 (Digits: 0–7)  
 Hexadecimal → Base 16 (Digits: 0–9, A–F)  
  
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2. TYPES OF NUMBER SYSTEMS  
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(1) \*\*Decimal Number System (Base 10)\*\*  
 - Most commonly used in daily life.  
 - Consists of digits from 0 to 9.  
 - Example: 472 = 4×10² + 7×10¹ + 2×10⁰ = 472  
  
(2) \*\*Binary Number System (Base 2)\*\*  
 - Used internally by computers.  
 - Consists of two digits: 0 and 1.  
 - Example: (1011)₂ = 1×2³ + 0×2² + 1×2¹ + 1×2⁰ = 11₁₀  
  
(3) \*\*Octal Number System (Base 8)\*\*  
 - Consists of digits 0–7.  
 - Example: (157)₈ = 1×8² + 5×8¹ + 7×8⁰ = 111₁₀  
  
(4) \*\*Hexadecimal Number System (Base 16)\*\*  
 - Consists of digits 0–9 and letters A–F (A=10, B=11, ..., F=15).  
 - Example: (2A3)₁₆ = 2×16² + 10×16¹ + 3×16⁰ = 675₁₀  
  
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3. CONVERSION BETWEEN NUMBER SYSTEMS  
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\*\*1. Decimal → Binary\*\*  
Divide the number by 2 and record remainders.  
Example: 10 → 1010  
  
\*\*2. Binary → Decimal\*\*  
Multiply each bit by powers of 2.  
Example: 1010 → 10  
  
\*\*3. Decimal → Octal\*\*  
Divide the number by 8 and record remainders.  
Example: 83 → 123  
  
\*\*4. Decimal → Hexadecimal\*\*  
Divide the number by 16 and record remainders.  
Example: 254 → FE  
  
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4. APPLICATIONS OF NUMBER SYSTEMS  
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- \*\*Binary\*\*: Used in computers, digital circuits, and data storage.  
- \*\*Octal\*\*: Used in shorthand representation of binary numbers.  
- \*\*Hexadecimal\*\*: Used in memory addressing, colors in HTML, debugging, etc.  
- \*\*Decimal\*\*: Used in everyday calculations.  
  
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5. EXAMPLE PYTHON PROGRAMS  
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Example 1: Convert Decimal to Binary, Octal, and Hexadecimal  
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n = int(input("Enter a number: "))  
print("Binary:", bin(n))  
print("Octal:", oct(n))  
print("Hexadecimal:", hex(n))  
  
Output (for n=25):  
Binary: 0b11001  
Octal: 0o31  
Hexadecimal: 0x19  
  
Example 2: Convert Binary to Decimal  
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binary = input("Enter a binary number: ")  
decimal = int(binary, 2)  
print("Decimal value:", decimal)  
  
Output:  
Binary: 1011 → Decimal: 11  
  
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6. SUMMARY TABLE  
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| Number System | Base | Digits Used | Example |  
|----------------|------|------------------|----------|  
| Binary | 2 | 0, 1 | 1010 |  
| Octal | 8 | 0–7 | 745 |  
| Decimal | 10 | 0–9 | 563 |  
| Hexadecimal | 16 | 0–9, A–F | 2AF |  
  
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7. CONCLUSION  
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The number system is the foundation of all computer operations.  
Understanding conversions between these systems is crucial for   
programming, networking, digital electronics, and system design.