Hexadecimal and Decimal Number System Converter

Project 6 - Group 6

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Overview

What We Built

Project Goal

A bidirectional converter between hexadecimal and decimal number systems using pure Python

Key Functions:

- `hex2int()` - Hex to Decimal
- `int2hex()` - Decimal to Hex

Constraints:

- No built-in functions
- Manual algorithm implementation
- Robust error handling

Why This Matters

Real-World Applications

- **Memory Addressing** in programming
- **Color Codes** in web design (#FF5733)
- **Network Protocols** and packet analysis
- **System Debugging** and hex dumps
- **Digital Electronics**

Number Systems

Decimal (Base-10)

Uses digits: 0-9

Positional value: 10^n

Example:

$256 = 2 \times 10^2 + 5 \times 10^1 + 6 \times 10^0$

Hexadecimal (Base-16)

Uses digits: 0-9, A-F

Positional value: 16^n

Example:

$1F = 1 \times 16^1 + 15 \times 16^0 = 31$

Hexadecimal Digits

Hex	Decimal	Hex	Decimal
0	0	8	8
1	1	9	9
2	2	A	10
3	3	B	11
4	4	C	12
5	5	D	13
6	6	E	14
7	7	F	15

Table 1: Hexadecimal to Decimal Mapping

Conversion Algorithms

Hex $\rightarrow$ Decimal

$$\sum_{i=0}^{n-1}(\text{digitValue}_i \times 16^{(n-1-i)})$$

Process:

1. Process each digit left to right
2. Multiply by 16^{position}
3. Sum all values

Decimal $\rightarrow$ Hex

Process:

1. Divide number by 16
2. Remainder $\rightarrow$ hex digit
3. Quotient $\rightarrow$ new number
4. Repeat until zero
5. Reverse digits

Hex to Decimal Implementation

```python
def hex2int(hex_str):
    hex_str = hex_str.upper()
    hex_digits = "0123456789ABCDEF"

    result = 0

    for i, char in enumerate(hex_str):
        if char not in hex_digits:
            raise ValueError(f"'{char}' is not a valid hex digit")

        digit_value = hex_digits.index(char)
        power = len(hex_str) - 1 - i
        result += digit_value * (16 ** power)

    return result

    return result

```

Key Features

- Case-insensitive input
- Input validation
- Positional value calculation
- Clear error messages

Decimal to Hex Implementation

```
def int2hex(number):
    if not number.isdigit():
        raise TypeError("Input must be an integer")

    number = int(number)
    if number == 0:
        return "0"

    hex_digits = "0123456789ABCDEF"
    result = ""

    n = number
    while n > 0:
        remainder = n % 16
        hex_digit = hex_digits[remainder]
        result = hex_digit + result
        n = n // 16

    return result

```

Key Features

- Input validation
- Special case for zero
- Repeated division algorithm
- Reverse digit collection

Error Handling

```
try:
    result = hex2int(hex_input)
    print(f"Hexadecimal '{hex_input}' = Decimal {result}")
except ValueError as e:
    print(f"Error: {e}")

```

Handled Errors

- Invalid hexadecimal characters (G, Z, etc.)
- Non-integer inputs for decimal conversion
- Invalid menu choices
- Empty inputs

Sample Conversions

Input	Output	Explanation
A	10	$10 \times 16^0 = 10$
1F	31	$1 \times 16^1 + 15 \times 16^0 = 31$
FF	255	$15 \times 16^1 + 15 \times 16^0 = 255$
26	1A	$26 \div 16 = 1$ R10 $\rightarrow$ 1A
255	FF	$255 \div 16 = 15$ R15 $\rightarrow$ FF
1000	3E8	Multiple divisions

Table 2: Conversion Examples

User Interface Demo

```
Hexadecimal and Decimal Converter
=================================

Choose an option:
1. Hexadecimal to Decimal
2. Decimal to Hexadecimal
3. Exit

Enter your choice (1-3): 1
Enter hexadecimal number: 1A
Hexadecimal '1A' = Decimal 26

Enter your choice (1-3): 2
Enter decimal number: 255
Decimal 255 = Hexadecimal 'FF'

Enter your choice (1-3): 3
Thank you for using our converter!

```

Live Demo

Let's see it in action!

Thank You!

Questions?