Convert The Following (6 Points) A. \(100.0011_{2} \) To Octal, Decimal, And Hexadecimal B. 146 To Binary,

Convert The Following (6 Points) A. \(100.0011_{2} \) To Octal, Decimal, And Hexadecimal B. 146 To Binary, is a common type of problem in computer science and digital electronics, testing understanding of number systems and conversions. Mastering these conversions is essential for students, professionals, and enthusiasts working with digital systems, programming, and data representation. In this comprehensive guide, we will explore step-by-step methods to convert binary numbers to octal, decimal, and hexadecimal systems, as well as converting decimal numbers to binary. We will also discuss the importance of these conversions, their applications, and tips to perform them efficiently.

Understanding Number Systems

Before diving into conversions, it’s crucial to understand the various number systems involved.

Binary Number System (Base-2)

- Uses only two digits: 0 and 1.
- Fundamental to digital electronics and computing.
- Example: \(100.0011_{2} \).

Octal Number System (Base-8)

- Uses digits 0 through 7.
- Often used to simplify binary representations.
- Example: 146 in decimal is 226 in octal.

Decimal Number System (Base-10)

- The standard numbering system in everyday life.
- Uses digits 0 through 9.
- Example: 146.

Hexadecimal Number System (Base-16)

- Uses digits 0-9 and letters A-F (A=10, F=15).
- Commonly used in programming, memory addressing.
- Example: \(100.0011_{2} \) can convert to hexadecimal.

Part A: Converting 100.0011_{2} To Octal, Decimal, And Hexadecimal

Let's analyze the binary number 100.0011_{2} step-by-step.

Step 1: Convert Binary to Decimal

Converting a binary fractional number to decimal involves summing powers of 2 for both integer and fractional parts.

Integer Part: 100_{2}
- Digits: 1, 0, 0.

Calculations:
- $1 \times 2^{2} = 4$
- $0 \times 2^{1} = 0$
- $0 \times 2^{0} = 0$

Sum: $4 + 0 + 0 = 4$

Fractional Part: 0.0011_{2}
- Digits: 0, 0, 1, 1.

Calculations:
- $0 \times 2^{-1} = 0$
- $0 \times 2^{-2} = 0$
- $1 \times 2^{-3} = 1/8 = 0.125$
- $1 \times 2^{-4} = 1/16 = 0.0625$

Sum: $0.125 + 0.0625 = 0.1875$

Total Decimal Value:
- 4 + 0.1875 = 4.1875

Step 2: Convert Binary to Octal

Conversion from binary to octal involves grouping binary digits into sets of three, starting from the decimal point.

Integer Part:
- Binary: 100
- Already a group of three, so directly convert:

$100_{2} = 4_{8}$

Fractional Part:

- Binary: 0011

To convert fractional parts:
- Pad with zeros to make complete groups of three:
0011 becomes $001\, 100$ (adding zeros, but since only four bits, pad with zeros to right for fractional part):

Actually, for fractional parts, group from left to right in threes:

- 0.0011

Pad with zeros to the right to make multiples of three:
- $0.001\, 100$

But it's more straightforward to process fractional binary directly:

- 0.0011_{2}

Group as:

- First group: 001 → 1_{8}
- Second group: 100 → 4_{8}

But since only four bits after decimal, pad with zeros:

- $0.001\, 100$

Alternatively, process as:

- 0.0011

Multiply fractional part by 8 repeatedly:

- $0.0011_{2} = 0.1875_{10}$

Now, convert 0.1875_{10} to octal:

- Multiply by 8:

$0.1875 \times 8 = 1.5$ → digit = 1, fractional part = 0.5

- Multiply fractional part 0.5 by 8:

$0.5 \times 8 = 4.0$ → digit = 4, fractional part = 0

Thus, fractional octal digits: 1 and 4.

Therefore, fractional part in octal: 0.14_{8}

Final Octal Representation:

- Integer part: 4
- Fractional part: 0.14

Combined: 4.14_{8}

Step 3: Convert Binary to Hexadecimal

Hexadecimal groups bits in fours, starting from the decimal point.

Integer Part:
- 100_{2}

Pad with zeros to make 4 bits:
- 0100_{2}

Convert:
- $0100_{2} = 4_{16}$

Fractional Part:
- 0011_{2} (already 4 bits)

Convert:
- $0011_{2} = 3_{16}$

Combined: 4.3_{16}

Summary of Part A

Conversion	Result
Binary to Decimal	4.1875
Binary to Octal	4.14$_8$
Binary to Hexadecimal	4.3$_{16}$

Part B: Converting 146 to Binary

This is a straightforward conversion from decimal to binary.

Step 1: Divide by 2 repeatedly

1. $146 \div 2 = 73$ remainder 0
2. $73 \div 2 = 36$ remainder 1

3. $36 \div 2 = 18$ remainder 0
4. $18 \div 2 = 9$ remainder 0
5. $9 \div 2 = 4$ remainder 1
6. $4 \div 2 = 2$ remainder 0
7. $2 \div 2 = 1$ remainder 0
8. $1 \div 2 = 0$ remainder 1

Step 2: Write remainders in reverse order:

From last to first:
- 1 0 0 1 0 0 1 0

So, $146_{10} = 10010010_{2}$.

Summary of Conversion of 146 to Binary

- 146 in decimal is 10010010 in binary.

Additional Tips for Number System Conversions

- Use grouping for binary-to-octal and binary-to-hexadecimal conversions.
- Pad with zeros to align groups properly.
- Break down fractional parts with repeated multiplication for decimal-to-binary or binary-to-decimal conversions.
- Practice with different numbers to build confidence and speed.

Applications of Number System Conversions

Understanding these conversions is vital across multiple domains:

1. Computer Programming: Writing and debugging low-level code often requires handling different number systems.
2. Digital Electronics: Circuit design and analysis use binary, octal, and hexadecimal.
3. Memory Addressing: Hexadecimal simplifies complex binary addresses.
4. Data Encoding and Compression: Efficient data representation relies on these conversions.
5. Networking: IP addresses and subnetting often involve conversions between binary and decimal.

Conclusion

Mastering conversions between binary, octal, decimal, and hexadecimal systems is fundamental for anyone working with digital systems, programming, or electronics. By following systematic methods—such as grouping bits, repeatedly dividing or multiplying, and understanding positional values—you can perform conversions accurately and efficiently. Practice regularly and familiarize yourself with the tools and techniques discussed to become proficient in number system conversions, which are indispensable skills in the tech-driven world.

Remember, whether converting \(100.0011_{2} \) to octal, decimal, hexadecimal, or turning 146 into binary, the key lies in understanding the underlying principles and practicing these methods consistently.

Frequently Asked Questions

How do you convert the binary number 100.0011_2 to decimal?

To convert 100.0011_2 to decimal, evaluate each digit's value: $(1\times2^{2}) + (0\times2^{1}) + (0\times2^{0}) + (0\times2^{-1}) + (1\times2^{-2}) + (1\times2^{-3})$. This simplifies to 4 + 0 + 0 + 0 + 0.25 + 0.125 = 4.375 in decimal.

What is the process to convert 100.0011_2 to octal?

First, group the binary digits in sets of three from the binary point: for the integer part, 100 becomes 100; for the fractional part, 0011 becomes 001 and 1 (pad with zeros to make complete groups). Convert each group: 100_2 = 4 in octal, 001_2 = 1, 100_2 = 4, resulting in 4.14 in octal.

How can 100.0011_2 be converted to hexadecimal?

Group the binary digits in sets of four from the binary point: 100.0011 becomes 0100.0011 (pad with zeros if needed). Convert each group: 0100_2 = 4, 0011_2 = 3. Therefore, the hexadecimal equivalent is 0x4.3.

What is the decimal equivalent of 100.0011_2?

As calculated earlier, 100.0011_2 equals 4.375 in decimal.

How do you convert the decimal number 146 to binary?

Divide 146 repeatedly by 2 and record the remainders: 146 ÷ 2 = 73 R0; 73 ÷ 2 = 36 R1; 36 ÷ 2 = 18 R0; 18 ÷ 2= 9 R0; 9 ÷ 2= 4 R1; 4 ÷ 2= 2 R0; 2 ÷ 2= 1 R0; 1 ÷ 2= 0 R1. Reading remainders from bottom to top, 146 in binary is 10010010_2.

What is the step-by-step process to convert 146 to binary?

Divide 146 by 2 repeatedly, record remainders, and then read the remainders from bottom to top to get 10010010_2.

Can you convert decimal 146 directly to octal?

Yes. Divide 146 by 8: 146 ÷ 8 = 18 R2; 18 ÷ 8= 2 R2; 2 ÷ 8= 0 R2. Reading from bottom to top, 146 in octal is 222_8.

What is the hexadecimal equivalent of decimal 146?

Divide 146 by 16: 146 ÷ 16= 9 R2; 9 ÷ 16= 0 R9. Reading remainders bottom to top, 146 in hexadecimal is 0x92.

Why is understanding number system conversions important in computer science?

Number system conversions are fundamental for understanding how data is represented, stored, and processed in computers, enabling tasks like programming, debugging, and designing digital systems.

What tools or methods can simplify converting between binary, octal, decimal, and hexadecimal?

Using calculators, conversion tables, or software tools like programming languages (Python, etc.) can streamline conversions. Understanding the grouping and place value rules also helps in manual conversions.

Additional Resources

Convert The Following (6 Points) A. \(100.0011_{2} \) To Octal, Decimal, And Hexadecimal B. 146 To Binary

Understanding number system conversions is fundamental in computer science and digital electronics. Whether you're a student learning the basics or a professional working with low-level programming, being able to convert between different numeral systems—binary, octal, decimal, and hexadecimal—is crucial. This article provides a comprehensive review of how to convert the binary number \(100.0011_{2} \) into octal, decimal, and hexadecimal, and how to convert the decimal number 146 into its binary representation. We will delve into each conversion process step-by-step, highlight key features, and discuss the significance of understanding these conversions.

Part A: Converting \(100.0011_{2} \) to Octal, Decimal,

and Hexadecimal

The binary number 100.0011_{2} represents a fractional binary value that warrants careful conversion into other numeral systems. Binary numbers are base-2, using only 0s and 1s, and are the foundation of digital computing. Converting such numbers into octal (base-8), decimal (base-10), and hexadecimal (base-16) provides a more human-readable form and is essential for understanding how data is represented and manipulated in various contexts.

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1. Converting Binary 100.0011_{2} to Decimal

Step-by-step process:

- Integer part: 100_{2}

- The binary number 100 can be expanded as:

$$
(1 \times 2^2) + (0 \times 2^1) + (0 \times 2^0) = 4 + 0 + 0 = 4
$$

- Fractional part: 0.0011_{2}

- Each digit after the decimal point represents a negative power of 2:

$$
(0 \times 2^{-1}) + (0 \times 2^{-2}) + (1 \times 2^{-3}) + (1 \times 2^{-4})
$$

- Calculating:

$$
0 + 0 + \frac{1}{8} + \frac{1}{16} = \frac{1}{8} + \frac{1}{16} = \frac{2}{16} + \frac{1}{16} = \frac{3}{16} = 0.1875
$$

- Combined result:

$$
4 + 0.1875 = \boxed{4.1875}
$$

Features:

- Precise and straightforward method.
- Useful for understanding fractional binary representations.

Pros/Cons:

- Pros: Accurate for any binary fractional number.
- Cons: Can become cumbersome with longer fractional parts.

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2. Converting 100.0011_{2} to Octal

Approach:

- Group binary digits into sets of three bits, starting from the decimal point, to convert directly to octal.

Steps:

- Integer part: 100_{2}

- Group into triplets (from right to left):

$$
100 \rightarrow 100
$$

- Since only three digits, padding is unnecessary.

- Convert 100_{2} to octal:

$$
100_{2} = (1 \times 2^2) + (0 \times 2^1) + (0 \times 2^0) = 4
$$

- Fractional part: 0011_{2}

- Pad fractional bits to the right with zeros to make triplets:

$$
0011 \rightarrow 001 \text{ and } 100
$$

- Note: For fractional parts, group bits in triplets starting immediately after the decimal point:

- 001 (first three bits after decimal)

- Remaining bits: 1, pad with zeros:

$$
1 \rightarrow 100
$$

- Convert fractional groups:

- $001_{2} = 1_{8}$

- $100_{2} = 4_{8}$

- Combine:

$$
\text{Octal fractional part} = 0.14
$$

- Final octal representation:

$$
100.0011_{2} \approx \boxed{4.14_{8}}
$$

Features and Notes:

- Direct conversion via grouping simplifies the process.
- Only valid for finite binary fractions that can be grouped neatly.

Pros/Cons:

- Pros: Efficient, avoids decimal conversion.
- Cons: May require padding for longer fractions, less straightforward with repeating fractions.

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3. Converting 100.0011_{2} to Hexadecimal

Approach:

- Group bits into sets of four, starting from the decimal point for both integer and fractional parts.

Steps:

- Integer part: 100_{2}

- Pad to four bits:

$$
0100
$$

- Convert to hexadecimal:

\[

$$
0100_{2} = 4_{16}
$$

- Fractional part: 0011_{2}

- Already four bits, so no padding needed.

- Convert:

$$
0011_{2} = 3_{16}
$$

- Combine:

$$
100.0011_{2} \approx \boxed{4.3_{16}}
$$

Features:

- Hexadecimal conversion is straightforward due to the 4-bit grouping aligning with hex digits.
- Suitable for representing binary data compactly.

Pros/Cons:

- Pros: Easy and quick for fixed-length binary fractions.
- Cons: Less intuitive for longer or repeating binary fractions.

Part B: Converting 146 to Binary

Converting a decimal integer like 146 into binary involves successive division by 2 and recording remainders.

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1. Step-by-step Conversion of 146 to Binary

Process:

- Divide 146 by 2:

$$
146 \div 2 = 73 \text{ with remainder } 0
$$

- Divide 73 by 2:

$$
73 \div 2 = 36 \text{ with remainder } 1
$$

- Divide 36 by 2:

$$
36 \div 2 = 18 \text{ with remainder } 0
$$

- Divide 18 by 2:

$$
18 \div 2 = 9 \text{ with remainder } 0
$$

- Divide 9 by 2:

$$
9 \div 2 = 4 \text{ with remainder } 1
$$

- Divide 4 by 2:

$$
4 \div 2 = 2 \text{ with remainder } 0
$$

- Divide 2 by 2:

$$
2 \div 2 = 1 \text{ with remainder } 0
$$

- Divide 1 by 2:

$$
1 \div 2 = 0 \text{ with remainder } 1
$$

Reading remainders from last to first:

$$
146_{10} = 10010010_{2}
$$

Features and Significance:

- Binary representation: 10010010_2
- Applications: Useful in low-level programming, digital design, and understanding how data is stored.

Pros and Cons of Decimal to Binary Conversion

Pros:

- Fundamental for understanding digital logic.
- Critical for programming embedded systems.

Cons:

- Manual conversion can be tedious for large numbers.
- Requires practice to perform efficiently.

Summary of Key Takeaways

- Converting binary fractions to decimal involves summing powers of 2 for each fractional digit.
- Grouping binary digits into triplets or quadruplets simplifies conversions to octal and hexadecimal, respectively.
- Decimal to binary conversion via successive division is straightforward but can be time-consuming for large numbers.

- Mastery of these conversions enhances understanding of how computers process and represent data.

Conclusion

The ability to convert between different number systems is a vital skill in computer science, electronics, and mathematics. This review has detailed the step-by-step processes of converting 100.0011_{2} into octal, decimal, and hexadecimal, as well as transforming 146 from decimal into binary. Each method has its features, advantages, and limitations, emphasizing the importance of choosing the right approach based on context. Whether dealing with fractional parts or large integers, mastering these conversions ensures a deeper understanding of digital systems and enhances problem-solving skills in technical fields.

[Convert The Following 6 Points A 100 0011 2 To Octal Decimal And Hexadecimal B 146 To Binary]()

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