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# A New Method for Decimal - Binary Conversion: Interpret as Octal - Binary Conversion

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## Abstract

In digital technology designs and digital machine operations normally people use binary number system instead of decimal number system. Digital devices work with digital technologies that use digital signals to communicate between devices. This is the reason why decimal to binary conversion becomes so important. By converting decimal into binary, it would be very easy to convert the binary number into octal or hexadecimal. So far the division by base-2 has been used as a standard method to convert decimal numbers into binary numbers. This research brings a different method for conducting decimal to binary conversion where this conversion could be done using octal number system. Octal number system helps interpret decimal into octal and the octal into binary. Literature studies, comparisons, analysis and evaluation have been made to derive the solution for this alternative new method. This method is reliable and flexible to use for education, learning process, even for programming.

*Keywords: Binary conversion; decimal conversion; decimal to binary conversion; digital system; binary system.*

## 1 Introduction

Numbering system is the most exciting and important topic in digital system. To be able to design and understand the concept of digital circuit, we should really ought to know the numbers that stand behind the theory [1,2,3,4,5,6,7,8,9].

There are 4 (four) numbers that are generally mentioned and learned in digital system i.e. Decimal, Binary, Octal and Hexadecimal. Users and programmers usually are familiar with decimal and computers with binary. Besides those two numbers, we also have octal and hexadecimal which are quite important for assembling and programming [10,11,12,13].

In order to communicate with a computer, user must use machine languages or programs so the computer will understand the information or instructions. For some specific programs, both octal and hexadecimal plays an essential part [7,8,9,10,14]. That is why we also have to know how to make a good conversion among of them.

The basic conversion that we have to know is decimal conversion, how to convert decimal numbers into binary numbers. There is a standard method for this conversion. It is called base division (divide by base). Binary is a base-2 number so we will use a divide by base 2 method. Let's see the following example of equation 1 and equation 2:

$$100 = \ldots\ldots_2 \qquad (1)$$

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$$
\begin{array}{c|c|c}
2 & 100 & 0 \\
2 & 50 & 0 \\
2 & 25 & 1 \\
2 & 12 & 0 \\
2 & 6 & 0 \\
2 & 3 & 1 \\
 & 1 &
\end{array}
$$

$$100 = 1100100_2 \tag{2}$$

Now we will try to derive the octal number for the binary number in equation 3. The easiest way to convert is to divide the bits of binary number into groups of three as given in equation 4. Then write their octal number as shown in equation 5.

$$1100100_2 = \ldots\ldots 8 \tag{3}$$

$$\frac{001}{1} \quad \frac{100}{4} \quad \frac{100}{4} \tag{4}$$

$$1100100_2 = 144_8 \tag{5}$$

## 2 Literature Reviews

Low to high speed-computing machines work with binary numbers. Original data will be converted from decimal to binary and processed to perform computations.

Speed of conversion mostly is very important for users, computers and machines to finish important tasks and improve memory space besides safety and other factors also need to be considered for better human civilization. Speed of computer can be increased by more rapid orders and minimum number of orders to be executed [8.10].

A BIDEC method can be implemented for simple high-speed devices, a serial binary-decimal conversion algorithm with a shift followed by a parallel modification of the data being converted. The conversion requires two operations per binary bit but is theoretically capable of working at one operation per bit. Another method is a binary to decimal conversion based on the divisibility of $2^8 - 1$ by 5 which is suitable for one-byte and two-byte processors based on several observations [7,12].

In electrical engineering field, both binary and decimal numbers are fundamental in optical computing systems and used for different arithmetical manipulations. Therefore decimal to binary conversion is very important [9].

For computation in signal processing applications, arithmetic operations like addition and multiplication are the most important part. Mathematical operations can be computed with increased speed in Residue Number System (RNS) [11].

Conversions for a binary equivalent code of octal or hexadecimal inputs can be done using Xilinx Programmable Logic Devices. Arithmetic operations and other operations can be added to this system [13].

Based on those previous literature reviews, author conducted a research and derived a new method, a decimal-binary conversion algorithm that can be implemented with series/parallel register, a shift of data and binary arithmetic addition.

## 3 Aims

This paper introduces a new method for decimal to binary conversion that uses the conversion of octal to binary number [3,4,5,6]. It might be the faster way to solve the digital conversion problems especially for greater decimal numbers. This alternative method gives a new point of view and surely will be a good contribution in digital transformations especially for the development of science and technology [2,14].

## 4 Method

Using the standard method for an octal-binary conversion, the author derives a new conversion method for a decimal to binary conversion.

## 5 Discussion and Results

Before we start the conversion, we have to take a look first at this Table 1 of binary numbers:

**Table 1. Binary Numbers (Number 1-24)**

| DECIMAL | BINARY |
|---|---|
| 1 | 1 |
| 2 | 10 |
| 3 | 11 |
| 4 | 100 |
| 5 | 101 |
| 6 | 110 |
| 7 | 111 |
| 8 | 1000 |
| 9 | 1001 |
| 10 | 1010 |
| 11 | 1011 |
| 12 | 1100 |
| 13 | 1101 |
| 14 | 1110 |
| 15 | 1111 |
| 16 | 10000 |
| 17 | 10001 |
| 18 | 10010 |
| 19 | 10011 |
| 20 | 10100 |
| 21 | 10101 |
| 22 | 10110 |
| 23 | 10111 |
| 24 | 11000 |

For the same table I will add another column for binary - **derived from decimal that seen as octal** - numbers (Binary*). Pay attention to the given sequences, number 10 until 24 shows in Table 2. So actually the decimal numbers are treated as an octal numbers.

**Table 2. Decimal as octal to binary conversion (Number 1- 24)**

| DECIMAL | BINARY* | BINARY |
|---|---|---|
| 1 | 000 | 1 |
| 2 | 001 | 10 |
| 3 | 011 | 11 |
| 4 | 100 | 100 |
| 5 | 101 | 101 |
| 6 | 110 | 110 |
| 7 | 111 | 111 |
| 8 | 1000 | 1000 |
| 9 | 1001 | 1001 |
| 10 | 001 000 | 1010 |
| 11 | 001 001 | 1011 |
| 12 | 001 010 | 1100 |
| 13 | 001 011 | 1101 |
| 14 | 001 100 | 1110 |
| 15 | 001 101 | 1111 |
| 16 | 001 110 | 10000 |
| 17 | 001 111 | 10001 |
| 18 | 10010 | 10010 |
| 19 | 10011 | 10011 |
| 20 | 010 000 | 10100 |
| 21 | 010 001 | 10101 |
| 22 | 010 010 | 10110 |
| 23 | 010 011 | 10111 |
| 24 | 010 100 | 11000 |

I marked the binary numbers 8, 9, 18 and 19 because number 8 and 9 are 4-bit length and not octal numbers. However, that is not actually a problem. We will try to look again those numbers later. Let's pay attention first at the other numbers.

Learning from the given table, we can draw a logical relation between octal and binary numbers and make both of them finally have the same pattern. Table 3 shows this specific relation. The true binary numbers are in the right column. We will modify the octal numbers into true binary numbers.

**Table 3. The relations between decimal-octal binary and true binary numbers**

| DECIMAL | BINARY* | ADDITION | BINARY |
|---|---|---|---|
| 10 | 001 000 | 1000 + 10 | 1010 |
| 11 | 001 001 | 1001 + 10 | 1011 |
| 12 | 001 010 | 1010 + 10 | 1100 |
| 13 | 001 011 | 1011 + 10 | 1101 |
| 14 | 001 100 | 1100 + 10 | 1110 |
| 15 | 001 101 | 1101 + 10 | 1111 |
| 16 | 001 110 | 1110 + 10 | 10000 |
| 17 | 001 111 | 1111 + 10 | 10001 |
| 18 | 10010 | | 10010 |
| 19 | 10011 | | 10011 |
| 20 | 010 000 | 10000 + 100 | 10100 |
| 21 | 010 001 | 10001 + 100 | 10101 |
| 22 | 010 010 | 10010 + 100 | 10110 |
| 23 | 010 011 | 10011 + 100 | 10111 |
| 24 | 010 100 | 10100 + 100 | 11000 |
| 31 | 011 001 | 11001 + 110 | 11111 |
| 35 | 011 101 | 11101 + 110 | 100011 |

From the calculations in Table 3 and by doing the same comparison to each decimal number, we could find a relation pattern and derive a method for decimal to binary conversion using octal to binary conversion as briefly described in equation 6 to 10.

$$10 = \mathbf{1010_2}: \quad \begin{array}{r} 1000 \\ 1 \\ \hline \mathbf{1010} \end{array} + \qquad (6)$$

$$25 = \mathbf{11001_2}: \quad \begin{array}{r} 10101 \\ 10 \\ \hline \mathbf{11001} \end{array} + \qquad (7)$$

$$35 = \mathbf{100011_2}: \quad \begin{array}{r} 11101 \\ 11 \\ \hline \mathbf{100011} \end{array} + \qquad (8)$$

$$100 = \mathbf{1100100_2}: \quad \begin{array}{r} 1000000 \\ 1010 \\ \hline 1010100 \\ 1 \\ \hline \mathbf{1100100} \end{array} \begin{array}{l} \\ + \\ \\ \\ + \end{array} \qquad (9)$$

$$535 = \mathbf{1000010111_2}: \quad \begin{array}{r} 101011101 \\ 110101 \\ \hline 111000111 \\ 101 \\ \hline \mathbf{1000010111} \end{array} \begin{array}{l} \\ + \\ \\ \\ + \end{array} \qquad (10)$$

What about decimal 8 and 9? We just memorize their binary number just like we memorize the binary number of decimal 1 to 7. Also what about decimal numbers that have digit 8 or 9? Can't we solve them? Of course we can. The solution is explained clearly in equation 11 to 15.

$$18 = \mathbf{10010_2}: \quad \begin{array}{r} 1 \\ 1000 \\ \hline 10000 \\ 1 \\ \hline \mathbf{10010} \end{array} \begin{array}{l} \\ + \\ \\ \\ + \end{array} \qquad (11)$$

$$19 = \mathbf{10011_2}: \quad \begin{array}{r} 1 \\ 1001 \\ \hline 10001 \\ 1 \\ \hline \mathbf{10011} \end{array} \begin{array}{l} \\ + \\ \\ \\ + \end{array} \qquad (12)$$

$$94 = \mathbf{1011110_2}: \quad \begin{array}{r} 1001100 \\ 1001 \\ \hline \mathbf{1011110} \end{array} + \qquad (13)$$

$$195 = \mathbf{11000011_2}: \quad \begin{array}{r} 1 \\ 1001101 \\ \hline 10001101 \\ 10011 \\ \hline 10110011 \\ 1 \\ \hline \mathbf{11000011} \end{array} \begin{array}{l} \\ + \\ \\ + \\ \\ + \end{array} \quad (14) \qquad \text{or} \qquad \begin{array}{r} 1 \\ 1001101 \\ \hline 10001101 \\ 1 \\ \hline 10011101 \\ 10011 \\ \hline \mathbf{11000011} \end{array} \begin{array}{l} \\ + \\ \\ + \\ \\ + \end{array} \quad (15)$$

# 6 Conclusions

A new different method for decimal to binary conversion could be derived using a standard octal to binary conversion method where a decimal number is treated as an octal number. Octal number system helps interpret decimal into octal and the octal into binary.

This logical method is easy to understand and also reliable and flexible to use in learning the process of converting digital numbering system especially decimal to binary numbers, and would be expected to be implemented in future works such as algorithm, programming, machine learning and artificial intelligent.

Hopefully this basic research may be useful for learners, teachers, scientists and practitioners.


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# Competing Interests

Author has declared that no competing interests exist.


# References


[1] Maini AK. Digital electronics: principles, devices and applications. John Wiley and Sons, Ltd.; 2007.

[2] Satzinger JW, Jackson RB, Burd SD. System analysis and design in a changing world. Cengage Learning; 2008.

[3] Hidayat. Sistem digital. Bandung: Penerbit Informatika; 2018.

[4] Hardianto Karya Buku Dosen. Sistem digital: analisis, desain dan implementasi. Sekolah Tinggi Teknologi Bontang; 2020.

[5] Widianto ED. Sistem digital: analisis, desain dan implementasi. Yogyakarta: Penerbit Graha Ilmu; 2014.

[6] Alfita R. Sistem digital: teori dan aplikasi. Yogyakarta: Deepublish; 2016.

[7] Couleur JF. BIDEC - a binary-to-decimal or decimal-to-binary converter. IRE Transactions on Electronic Computers. 1958;4:313-6.

[8] Koons F, Lubkin S. Conversion of numbers from decimal to binary form in the EDVAC. Mathematical Tables and Other Aids to Computation. 1949;3(26):427-31.

[9] Mukhopadhyay S. An optical conversion system: from binary to decimal and decimal to binary. Optics Communications. 1990;76(5-6):309-12.

[10] Detmer RC. Introduction to 80x86 assembly language and computer architecture. Jones and Bartlett Publishers; 2001.

[11] I.A.E.M.E. Residue number system and its application to signal processing for high speed computation. IAEME Publications; 2020.
Available: https://www.academia.edu/45623088/https://www.academia.edu/45623088/

[12] Arazi B, Naccache D. Binary-to-decimal conversion based on the divisibility of 28 - 1 by 5. Electronics Letters. 1992;28(23): 2151.
Available: https://doi.orq/10.1049/EL:19921381

[13] Deshpande CV, Jha CK. Conversion of number systems using Xilinx. American Journal of Engineering Research. 2015;4(8):212-215.
Available:https://www.ajer.orghttps://www.ajer.org

[14] Kadir A. Dasar logika pemrograman komputer: panduan berbasis flowchart menggunakan flowgorithm. Jakarta: PT Elex Media Komputindo; 2017.

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