Jeide, Matthew Date 10/10/2024 Period 2

# W9: DE 1.2.3 Binary Numbers and Conversion Worksheet

**Procedure** Must show your work neatly to earn credit. Make sure to include your work in your engineering notebook. Must show all work. If your writing is messy then type all your work below.

1. Complete the following decimal-to-binary number conversions. If available, use the base conversion feature of your calculator to check your answers.

Complete the following decimal-to-bi
problem is shown below. If available,
calculator to check your answers.

$19_{(10)} = \_\_?\_\_ _{(2)}$

Solution:

$$\begin{array}{r} 9 \\ 2\overline{)19} \end{array} \quad r=1 \leftarrow \text{LSB}$$

$$\begin{array}{r} 4 \\ 2\overline{)9} \end{array} \quad r=1$$

$$\begin{array}{r} 2 \\ 2\overline{)4} \end{array} \quad r=0$$

$$\begin{array}{r} 1 \\ 2\overline{)2} \end{array} \quad r=0$$

$$\begin{array}{r} 0 \\ 2\overline{)1} \end{array} \quad r=1 \leftarrow \text{MSB}$$

Answer: $19_{(10)} = 10011_{(2)}$

a) $17_{10}$ = 10001
b) $34_{10}$ = 100010
c) $58_{10}$ = 111010
d) $92_{10}$ = 1011100
e) $119_{10}$ = 1110111
f) $178_{10}$ = 10110010
g) $297_{10}$ = 100101001
h) $413_{10}$ = 110011101

2. Complete the following binary-to-decimal number conversions. If available, use the base conversion feature of your calculator to check your answers.

$101001_{(2)} = \_\_?\_\_ _{(10)}$

Solution:

| 1 | 0 | 1 | 0 | 0 | 1 | |
|---|---|---|---|---|---|---|
| $2^5$ | $2^4$ | $2^3$ | $2^2$ | $2^1$ | $2^0$ | } ← Bit Weighting |
| 32 | 16 | 8 | 4 | 2 | 1 | |

$32 + 0 + 8 + 0 + 0 + 1 = 41_{10}$

Answer: $101001_{(2)} = 41_{(10)}$

a) $1100_2$ = 12
b) $11010_2$ = 26
c) $111001_2$ = 57
d) $1010011_2$ = 83
e) $10000101_2$ = 133
f) $10011001_2$ = 153
g) $100100001_2$ = 289
h) $111101010_2$ = 490

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3. Perform the remaining decimal-to-binary conversions to complete the table.

| Decimal Number | Binary Number MSB LSB | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | $2^3$ | $2^2$ | $2^1$ | $2^0$ | | $2^4$ | $2^3$ | $2^2$ | $2^1$ | $2^0$ |
| 0 | 0 | 0 | 0 | 0 | 11 | 0 | 1 | 0 | 1 | 1 |
| 1 | 0 | 0 | 0 | 1 | 12 | 0 | 1 | 1 | 0 | 0 |
| 2 | 0 | 0 | 1 | 0 | 13 | 0 | 1 | 1 | 0 | 1 |
| 3 | 0 | 0 | 1 | 1 | 14 | 0 | 1 | 1 | 1 | 0 |
| 4 | 0 | 1 | 0 | 0 | 15 | 0 | 1 | 1 | 1 | 1 |
| 5 | 0 | 1 | 0 | 1 | 16 | 1 | 0 | 0 | 0 | 0 |
| 6 | 0 | 1 | 1 | 0 | 17 | 1 | 0 | 0 | 0 | 1 |
| 7 | 0 | 1 | 1 | 1 | 18 | 1 | 0 | 0 | 1 | 0 |
| 8 | 1 | 0 | 0 | 0 | 19 | 1 | 0 | 0 | 1 | 1 |
| 9 | 1 | 0 | 0 | 1 | 20 | 1 | 0 | 1 | 0 | 0 |
| 10 | 1 | 0 | 1 | 0 | 21 | 1 | 0 | 1 | 0 | 1 |

## CONCLUSION

1. The decimal number system has served humans well since the beginning of mankind maybe because early beings used their fingers to count objects. If the decimal system is so good, why do computer and other digital electronic devices use the binary number system?

Computers do not understand decimals, they can only understand things in binary (LOW or HIGH, 0 or 1).

2. Because we are using a number system other than the decimal, it is important to properly subscript our numbers (for example, $35_{10}$ , $234_{10}$ , $10010_2$ ). Why is this so important? Provide at least three examples where neglecting to subscript numbers could lead to confusion.

If we neglect to use the subscript to differentiate base 10 from base 2, it leads to some circumstances where people get confused and can get two different numbers, here are 3 examples:

1) 10 - This is 10 in decimal, this is 2 in binary.
2) 100 - This is 100 in decimal, this is 4 in binary.
3) 1000 - This is 1,000 in decimal, this is 8 in binary.

3. Without performing the binary-to-decimal conversions, which of the following two binary numbers is the larger number?

101101 (2)

011010 (2)

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4. How were you able to determine which was the larger number? Perform the binary-to-decimal conversions and check your answer. Were you correct?
   101101 = 45, 011010 = 26
   I was correct, I selected 101101 because it had the greater leading bit.

5. Examine the table that you completed in the procedure portion of the activity. What do you notice about the LSB (least-significant-bit)? What do you notice about the middle bit? What do you notice about the MSB (most significant-bit)? Do you see a pattern?
   The left-most bits are much more important than the right-most bits, the left-most bits have the greatest effect on the value of the number, while the right-most bits are just for precision.