

**MAT-207: Discrete Mathematics – Assignment 2**

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- 1) Find the decimal equivalent to the following binary numbers: 10101, 100101, and 11010. Given a binary number, how would you decide whether it is an even number or an odd number?

a) 10101

$$16 + 4 + 1 = 21$$

b) 100101

$$32 + 4 + 1 = 37$$

c) 11010

$$16 + 8 + 2 = 26$$

The first digit of the binary number ( $2^0$ ) will determine if a number is an odd or even value,

- 2) Find the binary representation (using both forward and backward methods) of the following decimal numbers: 28, 43, 100, and 81.

28	100

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43	81
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- 3) How many binary digits are in the number  $2^{128} + 1$ ?

A positive integer  $N$  has  $k$  bits when  $2^{k-1} \leq N \leq 2^k - 1$  and can be written in a form of logarithm in base 2 as:

$$k = \lfloor \log_2(N) \rfloor + 1$$

Where  $k$ , the number of bits, is equal to floor of the logarithm of base 2 of  $N$ , which is the highest power of two in the binary representation of  $N$ , and  $+1$  takes the exponent to the next higher of two which essentially accounts for the  $2^0$ th place of your binary power.

We can apply the equation below.

$$k = \lfloor \log_2(2^{128} + 1) \rfloor + 1$$

$$k = 129 \text{ digits}$$

Our answer is 129 digits.

- 4) How many binary digits are in the number  $2^{128} - 1$ ?

We can apply the same procedure as shown in (3).

$$k = \lfloor \log_2(N) \rfloor + 1$$

$$k = \lfloor \log_2(2^{128} - 1) \rfloor + 1$$

$$k = 129 \text{ digits}$$

- 5) Translate each of the following decimal numbers into a base 3 representation: 13, 15, 21, 27, 30, and 80.

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13	15
21	27
30	80

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- 6) What can you say about the base 3 representation of a decimal number that when divided by 9 leaves a remainder of 7?

We can express this question into the equation below:

$$x = 9n + 7; n = 1, 2, 3, \dots$$

Here is a range from  $n = 1$  to  $n = 7$ .

Expression	$x$ in base 10	$x$ In base 2
$x = 9(1) + 7$	16	121
$x = 9(2) + 7$	25	221
$x = 9(3) + 7$	34	1021
$x = 9(4) + 7$	43	1121
$x = 9(5) + 7$	52	1221
$x = 9(6) + 7$	61	2021
$x = 9(7) + 7$	70	2121

The first two digits ( $2^0$  and  $2^1$ ) have the same value of  $(21)_3$  while the third digit ( $2^2$ ) and onwards displays a normal incrementation in base 3.

- 7) Find the base 5 representation of the following binary numbers: 1100102, using backward method.

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- 8) Convert 210223 to base 6 representation, using forward method.