exercise 04: binary math



Application Development



# Name: <your name goes here>

**Purpose**: The purpose of this assignment is to give you practice working with binary data values and the kinds of values that computers manipulate, and give you insight about the limitations of these operations and the differences between computer data values and mathematical values.

Perform each of the following activities. If you have questions, issues, or doubts, please ask for help and do not just guess!

You may want to refer to the powers of 2 listed below when answering these questions.

29 = 512; 28 = 256; 27 = 128; 26 = 64; 25 = 32; 24 = 16; 23 = 8; 22 = 4; 21 = 2; 20 = 1

1. Be sure the file name of this document starts with your School ID which is followed by a single blank and that is followed by “Exercise04.doc”.
2. Be sure you have replaced the “<your name goes here>” (including the “<” and the “>”) with your name.
3. On page 14 of our textbook, you will find the following three lines in blue, showing how to convert a binary number to decimal:

11010 = 1\*24 + 1\*23 + 0\*22 + 1\*21 + 0\*20

= 16 + 8 + 0 + 2 + 0

= 26

Using this same approach, convert the following binary number to decimal by replacing the various “?” below with the proper values:

10111 = ?\*24 + ?\*23 + ?\*22 + ?\*21 + ?\*20

= ? + ? + ? + ? + ?

= ?

1. If you were given the value “100101001”, what would be the largest power of two needed to represent this value (explain your answer)?:
2. If a computer memory location was limited to just six bits, what is the largest possible positive value that could be stored in it, assuming all bits contribute to the value (i.e. there is no sign bit)? Show your result as a binary value:

If a computer memory location was limited to just six bits, what is the largest possible positive value that could be stored in it, assuming all bits contribute to the value (i.e. there is no sign bit)? Show your result as a decimal value

1. Further down on page 14 of the textbook, you will find the protocol for converting a decimal number to binary. According to that protocol, the steps to convert 14 and 359 to binary require the following blue lines:

14 = 24\*0 + 14

14 = 24\*0 + 23\*1 + 6

14 = 24\*0 + 23\*1 + 22\*1 + 2

14 = 24\*0 + 23\*1 + 22\*1 + 21\*1 + 0

14 = 24\*0 + 23\*1 + 22\*1 + 21\*1 + 20\*0

= 0 1 1 1 0

= 0 1 1 1 0

359 = 28\*1 + 103

359 = 28\*1 + 27\*0 + 103

359 = 28\*1 + 27\*0 + 26\*1 + 39

359 = 28\*1 + 27\*0 + 26\*1 + 25\*1 + 7

359 = 28\*1 + 27\*0 + 26\*1 + 25\*1 + 24\*0 + 7

359 = 28\*1 + 27\*0 + 26\*1 + 25\*1 + 24\*0 + 23\*0 + 7

359 = 28\*1 + 27\*0 + 26\*1 + 25\*1 + 24\*0 + 23\*0 + 22\*1 + 3

359 = 28\*1 + 27\*0 + 26\*1 + 25\*1 + 24\*0 + 23\*0 + 22\*1 + 21\*1 + 1

359 = 28\*1 + 27\*0 + 26\*1 + 25\*1 + 24\*0 + 23\*0 + 22\*1 + 21\*1 + 20\*1

= 1 0 1 1 0 0 1 1 1

= 1 0 1 1 0 0 1 1 1

Using this same approach, convert the value 42 to binary:

1. If you needed to convert 83 to binary using the above approach, what would be the value of the largest power of two (show the steps to produce the answer):
2. Floating points values simulate real values by using the binary equivalent of scientific notation.

For example, for decimal (base ten) values, the number 126.75 would be written as “1.2675×102”. In binary, this value is “1111110.11” which, in scientific notation, would be represented as “1.11111011×26”.

The usual sequence of powers of two continues to the right of the decimal point and negative power of two as shown here:

… 64 32 16 8 4 2 1 ½ ¼ …

The number “126” is: 64 + 32 + 16 + 8 + 4 + 2

1×26 + 1×25 + 1×24 + 1×23 + 1×22 + 1×21 + 0×20

1 1 1 1 1 1 0

The number “.75” is: ½ + ¼

1×2-1 + 1×2-2

. 1 1

So, the number “126.75” is: 1 1 1 1 1 1 0 . 1 1, which becomes 1.11111011×26

Therefore, how would you represent the base ten number 13.25 in binary using scientific notation?

1. This is the end of the exercise. Save your work and upload this exercise to the LMS following the instructions given in Exercises 1 and 2.

(Please be sure you have changed the name at the top of this document and properly renamed it to start with your StudentID. You did this **before** you began editing it, right?)

Congratulations! You have just completed the fourth exercise.