

COMP 101 Assignment 2: Representations

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1. Take your student ID and compute the sum of all its digits. This value will be manipulated in subsequent questions, so make sure that you get this right. In subsequent exercises, this will be called your **SPECIAL NUMBER**

$$7 + 0 + 4 + 9 + 6 + 6 + 4 = 36$$

(1 mark)

2. Take your **SPECIAL NUMBER** and encode it as an 8-bit unsigned binary number.

$$36_{10} = 00100100_2$$

(1 mark)

3. Decode the 8-bit binary number 10110100_2 , which is currently in an unsigned binary representation, into decimal.

$$10110100 = 2^7 + 2^5 + 2^4 + 2^2 = 128 + 32 + 16 + 4 = 180$$

(1 mark)

4. Using 8-bit two's complement binary arithmetic, compute the following operations, showing full working and **make note of any potentially unexpected results or errors** (with an explanation of what has happened in the operation):

- a) $100_{10} - 89_{10}$ and express the result in decimal.

$$100_{10} = 01100100_2$$

$$89_{10} = 01011001_2$$

$$-89_{10} = 10100110_2 + 1_2 = 10100111_2$$

$$100_{10} - 89_{10} = 01100100_2 + 10100111_2 = 100001011_2 \text{ (forget the 1 at the start because we want 8 bit encoding)}$$

$$= 00001011_2 = 11_{10}$$

- b) $129_{10} - 100_{10}$ and express the result in decimal.

$$129_{10} = 10000001 \text{ (If unsigned = 129 but if signed = -127 because of overflow)}$$

$$100_{10} = 01100100_2$$

$$-100_{10} = 10011011_2 + 1_2 = 10011100_2$$

$$129_{10} - 100_{10} = 10000001_2 + 10011100_2 = 100011101_2 = 29_{10} \text{ (Assuming that you use unsigned 129)}$$

- c) $100_{10} + 100_{10}$ and express the result in decimal.

$$100_{10} = 01100100_2$$

$$100_{10} + 100_{10} = 01100100_2 + 01100100_2 = 11001000_2 \text{ (If unsigned = 200 but if signed = -56, you get an overflow error)}$$

(5 marks)

5. Convert the following single precision IEEE 754-encoded binary value into its equivalent decimal value: $0100001000101000000000000000000_2$

1st bit (Sign) 0 = +

2nd to 8th bits (Exponent) $10000100_2 = 132_{10}$

Rest of the bits (Mantissa) $0101_2 = \frac{1}{4} + \frac{1}{16} = 0.25 + 0.0625 = 0.3125_{10}$

Result = $1.3125 * 2^{(132-127)} = 42_{10}$

(3 marks)

6. Examine your **SPECIAL NUMBER** to obtain the following value:
- if all the digits in your number are multiples of two, then multiply your SPECIAL NUMBER by -1 (i.e., take its negative); otherwise
 - if any digit in your number is not a multiple of two, then use your SPECIAL NUMBER without change.

Encode your (possibly negated) **SPECIAL NUMBER** into a 32-bit (single precision) IEEE 754 floating point value. Be sure to include a breakdown of the role that each component of the representation is performing.

A) Positive so $s = 0$

B) $36_{10} = 00100100_2$

C) Left 5 Places, $1.00100 * (2^5)$

Stored Number = $5 + 127 = 132_{10} = 10000100_2$

D) Result: 01000010000100_2

(4 marks)

7. Dates are important human concept, and handling them effectively and accurately is the bane of many a programmer! Describe the internal data representation of two different representations for dates that are currently used in industry:
- the representation that Microsoft Excel uses to manipulate date and time information; and
 - Oracle's internal representation of the DATE data type.

In order to do this, you may need to reference some external sources that have not been discussed in classes - be sure to reference any sources that you use in your research in an appropriate format (e.g., APA, or footnotes with appropriate details).

Microsoft Excel stores its dates as an integer which is calculated by counting every single day past 1900-Jan-0. The date 1900-Jan-1 is represented by the number 1. However 0 does not represent 1899-Dec-31¹. The Oracle database has an inbuilt set of date and time datatypes that store both date and time information. The Oracle database has a bunch of inbuilt functions to manipulate the date and time².

(5 marks)

¹ Dates and Times in Excel.

<http://www.cpearson.com/excel/datetime.htm>

² Feuerstien, S. (2012, January - February) Working with Dates in PL/SQL. Oracle Magazine.

<http://www.oracle.com/technetwork/issue-archive/2012/12-jan/o12plsql-1408561.html>