

## Assignment 1 (Part 2)

Instructors: John Eldon

Due on: Mon Aug. 12, 11:59 PM (30 points)

Name: \_\_\_\_\_

Date: \_\_\_\_\_

**Instructions**

- This worksheet is half of PA1. You may do them in any order but we recommend attempting the initial login steps from the other part first, in case you need technical support with setup.
- Answer each problem for in the boxes provided. Any writing outside of the boxes will NOT be graded. Do not turn in responses recorded on separate sheets. All responses must be neat and legible. Illegible answers will result in zero points.
- Be sure to show your work on questions that say “Show work.” Answers without relevant work will not receive full credit. In general, work shown on *any* problem may be eligible for partial credit.
- Handwritten or typed responses are accepted. In either case, make sure all answers are in the appropriate boxes. Here is a link for information on scanning:  
[http://gradescope-static-assets.s3-us-west-2.amazonaws.com/help/submitting\\_hw\\_guide.pdf](http://gradescope-static-assets.s3-us-west-2.amazonaws.com/help/submitting_hw_guide.pdf)

**Part 2 Learning Goals**

- Base representation
- Two's complement arithmetic
- Converting between floating point and decimal systems

1. (4 points - **Correctness**) *Base Conversion & Representation*

- (a) What is the decimal number 642 when expressed in base 13? (Use A-C to represent 10-12, respectively)

- (b) Suppose you are considering what base system to work with. Your limitations are that you have a keyboard which is only able to output the following symbols:
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- Numbers from 0-9, all lowercase English alphabet letters, all uppercase English alphabet letters.
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- You must be able to represent any number in your chosen system using only the symbols that your keyboard supports. In this case, what is the largest integer base which you would be able to work in?

2. (7 points - **Correctness**) *Binary arithmetic*

- (a) For the 2's complement representation, what is the most negative decimal number (largest absolute value) that can be represented in a 9 bit wide field? (Since the number is assumed to be negative, please prefix with a "-")

- (b) Assuming an 8-bit 2's complement representation, add the following two binary numbers (in binary) and express the answer in signed decimal format (i.e. prefix your answer with a + or -). **Show your work!**

```
    00010110
+   10110110
-----
```

3. (5 points - **Correctness**) *Overflow*

Check all of the following that will **not** overflow in a 5 bit field (assume 2's complement arithmetic):

**Hint: consider checking signs first. When is overflow possible?**

☐  $11010 - 10000$

☐  $00110 - 10100$

☐  $01010 + 00011$

☐  $11101 + 00001$

☐  $00101 + 11000$

4. (14 points - **Correctness**) *Floating & fixed point numbers*

For these problems, assume a floating point representation of 8 bits, where 1 bit is the sign, 3 are the exponent, and 4 are the mantissa. The exponent bias is 4.

- (a) For the 8-bit floating point representation described above, what is the decimal equivalent of the value 0xad? **Show your work, include the sign bit, exponent, and mantissa!**

- (b) What is 2.375 in an 8-bit unsigned fixed point format, with the decimal point in the middle? (e.g. 0000.0000) **Show your work! (Note:  $2.375 = \frac{19}{8}$ .)**

- (c) Assuming the floating point representation of 8 bits described above, what is the binary equivalent of the value -2.375? (**Note:** Doing part (b) first may help.) **Show your work, include the sign bit, exponent, and mantissa!**

## Submission

Please submit your solutions in PDF form to Gradescope under the assignment titled **PA1 (Part 2): Number Systems**

## Grading

Grading will be done according to the points shown in each question. If the question says to show your work, make sure you show your work for full credit. Partial points may be awarded if you show meaningful work but have an incorrect answer.