Student surname, first name

Student number: 

Marker surname, first name

Marker student number: 

Instructions

1. Complete this tutorial on paper and bring your completed worksheet to the tutorial session on the due date specified above. Tutorials completed in pencil will not be marked.

2. Note: loose pages will not be accepted! All pages of your tutorial must be stapled together before you come to the tutorial.

3. You must stay for the duration of the tutorial session and peer mark another student’s worksheet, which will be given to you. Note that you must mark in pen and not in pencil. Bring a pen to the tutorial.

4. If you arrive late, you will not be allowed to join the tutorial marking session and you will get 0 for the tutorial.

5. If you do not mark another worksheet, you will not obtain any marks for the tutorial.

6. Maximum mark is 38.

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<th>1</th>
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This tutorial will test your understanding of signed integer and floating point representation.

1. If you subtract 14 from -18 in 6-bit two’s complement notation, will overflow occur? Explain your answer.

2. Draw a table consisting of 4 columns. In the first column list all possible binary numbers using 3 bits. In the second column, list the decimal equivalent of each binary number assuming a one’s complement representation. In the third column list the decimal equivalent of each binary number assuming a two’s complement representation. In the fourth column list the decimal equivalent of each binary number assuming an excess-3 representation.

3. Convert $-25_{10}$ to binary using a 6-bit excess-31 notation.

4. What is the range of decimal integers that can be represented using a 6-bit excess-31 encoding?
5. (a) Use Booth’s algorithm to calculate $11000_2 \times 00111_2$ (where both numbers are 5-bit two’s complement integers). Show the intermediate value to be added for each step of the process.

(b) Use Booth’s algorithm to calculate $00111_2 \times 11000_2$ (where both numbers are 5-bit two’s complement integers). Show the intermediate value to be added for each step of the process.
6. Assuming two’s complement representation, use arithmetic shifting to perform the following:
   (a) Double the value 000101012.
   (b) Divide the value 110010102 in half.

7. Assume the following floating-point number representation: a sign bit, a 3-bit exponent and a 4-bit significand. No bits are implied, there is no biasing, exponents use two’s complement notation, and exponents of all zeros and all ones are allowed. What is the largest positive and the smallest positive number (in decimal) that can be stored on this system if the storage is normalized?
8. Assume we are using the simple model for floating-point representation as given in the textbook (a 14-bit format, a single sign bit for the number, 5 bits for the exponent with a bias of 15, a normalized significand of 8 bits).

(a) Show how the computer would represent the numbers 100.0\textsubscript{10} and 0.25\textsubscript{10} using this floating-point format. Show all your working.

(b) Show how the computer would add the two floating-point numbers above by changing one of the numbers so they are both expressed using the same power of 2. Also give the decimal value of the sum that is actually stored as a result.