Problem Sheet: Binary Arithmetic

AIN-1

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1. (a) Express the following values in standard base 2 notation:

   a) $4\frac{1}{2}$, *b)* $2\frac{3}{4}$, *c)* $1\frac{1}{8}$, *d)* $\frac{5}{16}$, *e)* $5\frac{5}{8}$

   (b) Express the following values in base 10 notation:

   a) 11.01, *b)* 101.11, *c)* 10.1, *d)* 110.011, *e)* 0.101

   (c) Perform the following additions in standard base 2:

   - 11011 + 1100
   - 1010.001 + 1.101
   - 11111 + 0001
   - 111.11 + 00.01

2. (a) Convert each of the following two's complement representations to its equivalent base 10 representation:

   a) 00011, *b)* 01111, *c)* 11100, *d)* 11010, *e)* 00000, *f)* 10000

   (b) Convert each of the following base 10 numbers to the equivalent 8-bit length two's complement:

   a) 16, *b)* -6, *c)* -17, *d)* 13, *e)* -1, *f)* 0

3. Perform the following operations on 4-bit two's complement numbers. Indicate which operations lead to overflow (and thus incorrect answers):

   a) 0100 + 0011, *b)* 0101 + 0110, *c)* 1010 + 1010, *d)* 1010 + 0111, *e)* 0111 + 0001

4. Translate each of the following expressions from base 10 to 4-bit two's complement notation and carry out the operation.

   a) 6 - (-1), *b)* 3 - (-2), *c)* 4 - 6, *d)* 2 - (-4), *e)* 1 - 5

5. (a) Convert each of the following base 10 representations to its equivalent excess 16 representation:

   a) -12, *b)* 0, *c)* 10, *d)* -8, *e)* 9

   (b) Convert each of the following excess 32 representations to its equivalent base 10 representation:

   a) 011111, *b)* 100110, *c)* 111000, *d)* 000101, *e)* 010101

6. (a) Decode the following bit patterns using the 8-bit floating point format:

   a) 01001010, *b)* 01101101, *c)* 00111001, *d)* 11011100, *e)* 10101011

   (b) Encode the following values into 8-bit floating point format:

   a) $2\frac{3}{4}$, *b)* $5\frac{1}{4}$, *c)* $\frac{3}{4}$, *d)* $-3\frac{1}{2}$, *e)* $-4\frac{3}{8}$