Architecture CS, Assignment 1
Number Representation

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1. For each of the following formuale execute these steps:
   - Give the result of the addition in 10 bits binary (showing the binary way the result was achived).
   - Specify if there is an overflow in the calculation for both if the numbers are unsigned or in 2's complement.
   - Translate the completed formula twice to 'normal' decimal (yes, showing the way), once assuming the numbers are unsigned and once assuming they are in 2's complement.

   (a) $(\texttt{0110011000})_2 + (\texttt{1010011001})_2 = (?)_2$
   (b) $(\texttt{0010011010})_2 + (\texttt{0101100100})_2 = (?)_2$
   (c) $(\texttt{1011101010})_2 + (\texttt{0011110001})_2 = (?)_2$
   (d) $(\texttt{1100101110})_2 + (\texttt{0110101110})_2 = (?)_2$
   (e) $(\texttt{1000000001})_2 + (\texttt{1001010100})_2 = (?)_2$

2. For each of the following formuale execute these steps:
   - Give the result of the subtraction in 10 bits binary (showing the binary way the result was achived).
   - Specify if there is an overflow in the calculation for both if the numbers are unsigned or in 2's complement.
   - Translate the completed formula twice to 'normal' decimal (yes, showing the way), once assuming the numbers are unsigned and once assuming they are in 2's complement.

   (a) $(\texttt{1001011110})_2 - (\texttt{1010110011})_2 = (?)_2$
   (b) $(\texttt{1110110011})_2 - (\texttt{1011001100})_2 = (?)_2$
   (c) $(\texttt{1110111001})_2 - (\texttt{1010100011})_2 = (?)_2$
   (d) $(\texttt{0111001101})_2 - (\texttt{0110000100})_2 = (?)_2$

(e) $(\texttt{1011100000})_2 - (\texttt{0101000011})_2 = (?)_2$

3. For each of the following formuale execute these steps:

   - Give the result of the multiplication in 10 bits binary (showing the binary way the result was achived) assuming the numbers are unsigned.
   - Give the result of the multiplication in 10 bits binary (showing the binary way the result was achived) assuming the numbers are in 2's complement, this means:
     - Convert negative multiplicands to positive ones (2's complement)
     - Multiply the non-negative numbers
     - If the result should be negative (as in school) convert the result to negative
   - Translate the completed formula twice to 'normal' decimal (yes, showing the way), once assuming the numbers are unsigned and once assuming they are in 2's complement.

   What do the results hint?

   (a) $(\texttt{1111110001})_2 \times (\texttt{0000001010})_2 = (?)_2$
   (b) $(\texttt{1111111000})_2 \times (\texttt{0000011010})_2 = (?)_2$
   (c) $(\texttt{0000001001})_2 \times (\texttt{0000001101})_2 = (?)_2$
   (d) $(\texttt{0000001011})_2 \times (\texttt{1111100010})_2 = (?)_2$
   (e) $(\texttt{1111101100})_2 \times (\texttt{1111100010})_2 = (?)_2$

4. For each of the following formulae execute the division in binary (show the way, yes)

   (a) $(\texttt{1011010})_2 \div (\texttt{1111})_2 = (?)_2$
   (b) $(\texttt{10010110})_2 \div (\texttt{1010})_2 = (?)_2$
   (c) $(\texttt{100000101})_2 \div (\texttt{11101})_2 = (?)_2$
   (d) $(\texttt{100011000})_2 \div (\texttt{11100})_2 = (?)_2$
   (e) $(\texttt{111110})_2 \div (\texttt{10})_2 = (?)_2$

5. Execute the following floating point multiplications in binary (showing the way). The exponents arithmetic can be carried out in decimal.

   (a) $(\texttt{7F2C0000})_{16\,bin32} \times (\texttt{BAE00000})_{16\,bin32} = (?)_{16\,bin32}$
   (b) $(\texttt{33400000})_{16\,bin32} \times (\texttt{48200000})_{16\,bin32} = (?)_{16\,bin32}$
   (c) $(\texttt{E0FC0000})_{16\,bin32} \times (\texttt{A8C80000})_{16\,bin32} = (?)_{16\,bin32}$
   (d) $(\texttt{FD580000})_{16\,bin32} \times (\texttt{BDC40000})_{16\,bin32} = (?)_{16\,bin32}$
   (e) $(\texttt{8E600000})_{16\,bin32} \times (\texttt{67540000})_{16\,bin32} = (?)_{16\,bin32}$

6. Execute the following floating point additions in binary (showing the way). The exponents arithmetic can be carried out in decimal.

   (a) $(\texttt{B7180000})_{16\,bin32} + (\texttt{B4F80000})_{16\,bin32} = (?)_{16\,bin32}$
   (b) $(\texttt{D9800000})_{16\,bin32} + (\texttt{D8480000})_{16\,bin32} = (?)_{16\,bin32}$
   (c) $(\texttt{4B4C0000})_{16\,bin32} + (\texttt{C8D40000})_{16\,bin32} = (?)_{16\,bin32}$
   (d) $(\texttt{46540000})_{16\,bin32} + (\texttt{48800000})_{16\,bin32} = (?)_{16\,bin32}$
   (e) $(\texttt{14A80000})_{16\,bin32} + (\texttt{13F00000})_{16\,bin32} = (?)_{16\,bin32}$

7. Execute the following floating point subtractions in binary (showing the way). The exponents arithmetic can be carried out in decimal.

   (a) $(\texttt{FC7C0000})_{16\,bin32} - (\texttt{FBFC0000})_{16\,bin32} = (?)_{16\,bin32}$
   (b) $(\texttt{2AD00000})_{16\,bin32} - (\texttt{29200000})_{16\,bin32} = (?)_{16\,bin32}$
   (c) $(\texttt{2DA80000})_{16\,bin32} - (\texttt{AB1C0000})_{16\,bin32} = (?)_{16\,bin32}$
   (d) $(\texttt{5C900000})_{16\,bin32} - (\texttt{60300000})_{16\,bin32} = (?)_{16\,bin32}$
   (e) $(\texttt{12F00000})_{16\,bin32} - (\texttt{94600000})_{16\,bin32} = (?)_{16\,bin32}$

8. Execute the following floating point divisions in binary (showing the way). The exponents arithmetic can be carried out in decimal.

   (a) $(\texttt{D309D000})_{16\,bin32} \div (\texttt{9C8C0000})_{16\,bin32} = (?)_{16\,bin32}$
   (b) $(\texttt{9E5C8000})_{16\,bin32} \div (\texttt{CBA80000})_{16\,bin32} = (?)_{16\,bin32}$
   (c) $(\texttt{E5B2C000})_{16\,bin32} \div (\texttt{B9DC0000})_{16\,bin32} = (?)_{16\,bin32}$
   (d) $(\texttt{DF130000})_{16\,bin32} \div (\texttt{F7C00000})_{16\,bin32} = (?)_{16\,bin32}$
   (e) $(\texttt{3D340000})_{16\,bin32} \div (\texttt{F5200000})_{16\,bin32} = (?)_{16\,bin32}$