Assignment_3 Solution (from textbook)

3.1 What is 5ED4 -07A4 when these values represent unsigned 16-bit hexadecimal numbers? The result should be written in hexadecimal. Show your work.
5730h

3.2 What is 5ED4 -07A4 when these values represent signed 16-bit hexadecimal numbers stored in sign-magnitude format? The result should be written in hexadecimal. Show your work.

The sign-magnitude binary format is the simplest conceptual format. To represent a number in sign-magnitude, we simply use the leftmost bit to represent the sign, where 0 means positive, and the remaining bits to represent the magnitude (absolute value). To negate sign-magnitude numbers, simply toggle the sign bit. Note that this leads to having two representations for the number zero.

5730h

3.3 Convert 5ED4 into a binary number. What makes base 16 (hexadecimal) an attractive numbering system for representing values in computers?

0101111011010100

The attraction is that each hex digit contains one of 16 different characters

(0–9, A–E). Since with 4 binary bits you can represent 16 different patterns,

in hex each digit requires exactly 4 binary bits. And bytes are by definition 8

bits long, so two hex digits are all that are required to represent the contents

of 1 byte.

3.7 Assume 185 and 122 are signed 8-bit decimal integers stored in sign-magnitude format. Calculate 185 -122. Is there overflow, underflow, or neither?

185 -> 10111001 (which actually is -57 in the sign-magnitude format)

122 -> 01111010 (which is 122 in the sign-magnitude format)

Overflow (result -179, which does not fit into an SM 8-bit format)

Instructor's note: This problem is vague. Actually, a value of 185 (decimal) can't be represented by an 8-bit sign-magnitude format in the first place. Again, this problem (from a famous textbook) tells us that don't blindly trust anyone.

3.9 Assume 151 and 214 are signed 8-bit decimal integers stored in two's complement format. Calculate 151+214 using saturating arithmetic. The result should be written in decimal. Show your work.

151 -> 10010111 (a negative number, what is the value of this negative number? Well, we need to find its corresponding positive value first. Step 1 (flip all the bits -> 01101000, step 2 add one -> 01101001 so the corresponding positive value is 105. Thus, the bit pattern 10010111 (we are told that it is in 2's complement format) represents -105.

-105 - 42 = -128 (can be -147, but it saturated, note the biggest negative number in an 8-bit 2's complement format is 10000000 which is -128)

3.10 Assume 151 and 214 are signed 8-bit decimal integers stored in two's complement format. Calculate 151-214 using saturating arithmetic. The result should be written in decimal. Show your work.

-105 – (-42) = -105+42 = -63

3.11 Assume 151 and 214 are unsigned 8-bit integers. Calculate 151+214 using saturating arithmetic. The result should be written in decimal. Show your work.

151 + 214 = 255 (can be 365, but it saturated)

3.20 What decimal number does the bit pattern **0×0C000000** represent if it is a two's complement integer? An unsigned integer?

201326592 in both cases.

3.21 If the bit pattern 0×0C000000 is placed into the Instruction Register, what MIPS instruction will be executed?

jal 0x00000000

3.22 What decimal number does the bit pattern 0×0C000000 represent if it is a floating point number? Use the IEEE 754 standard.

0×0C000000 = 0000 1100 0000 0000 0000 0000 0000 0000

= 0 0001 1000 0000 0000 0000 0000 0000 000

sign is positive

exp = 0×18 = 24

exp - 127 = - 103

there is a hidden 1

fraction = 0

answer = $1.0 \times 2^{(-103)}$