**Hosam Abdeltawab Homework 7 Due: Tuesday, Oct. 17, 2017**

**1**. Convert each of the following into a 32-bit two’s complement binary number:

1. 512ten
2. Converting from binary to decimal:

* = 256 with remainder 0
* = 128 with remainder 0
* = 64 with remainder 0
* = 32 with remainder 0
* = 16 with remainder 0
* = 8 with remainder 0
* = 4 with remainder 0
* = 2 with remainder 0
* = 1 with remainder 0
* = 0 with remainder 1 ⇑

1. Then you put the remainders next to each other starting from the most significant bit with is the las one. Then, I add zeros the left of the number to complete it to be 32-bit number.
2. 512ten = 00000000000000000000001000000000two
3. –1,023ten

* To do this: first I convert 1,023ten to binary, then get the 1’s complement of that number, and add 1 to the 1’s complement to get the 2’s complement. To get the 2’s complement right away after getting the decimal value, I start from the right of the number and copy all the zeros till the first 1 then, I copy the 1 then, I flip every 0 to a 1 and every 1 to a 0 then I just, add the sign.
* 1,023ten = 0000 0000 0000 0000 0000 0011 1111 1111two
* 1’s complement = 1111 1111 1111 1111 1111 1100 0000 0000two
* 2’s (adding 1) =1111 1111 1111 1111 1111 1100 0000 0001two

1. –4,000,000ten

* 4,000,000ten = 0000 0000 0011 1101 0000 1001 0000 0000two
* 1’s complement = 1111 1111 1100 0010 1111 0110 1111 1111two
* 2’s complement = 1111 1111 1100 0010 1111 0111 0000 0000two

**2**. Write the decimal number represented by each of the following two’s complement binary numbers:

1. (1111 1111 1111 1111 1111 1110 0000 1100) two

* The sign is negative, change to normal decimal then add the sign.
* 0000 0000 0000 0000 0000 0001 1111 0100two = 500ten
* 1111 1111 1111 1111 1111 1110 0000 1100two = -500ten

1. (1111 1111 1111 1111 1111 1111 1111 1111) two

* Sign is negative.
* 0000 0000 0000 0000 0000 0000 0000 0001two = 1ten
* 1111 1111 1111 1111 1111 1111 1111 1111two = -1ten

1. (0111 1111 1111 1111 1111 1111 1111 1111) two

* The sign is positive.
* 0111 1111 1111 1111 1111 1111 1111 1111two = 2,147,483,647ten

**3**.

* 1. For the hexadecimal number 0x 7FFF FFFA, what binary number does it represent?
* 0x7FFF FFFA = 0111 1111 1111 1111 1111 1111 1111 1010two = 2,147,483,642ten

* 1. Write the hexadecimal number represented by the following binary number:

(1100 1010 1111 1110 1111 1010 1100 1110) two

* The sign is negative
* 1100 1010 1111 1110 1111 1010 1100 1110two = 0xCAFE FACE

1. Two friends, Harry and David, are arguing. Harry says, “All integers greater than zero and exactly divisible by six have exactly two 1s in their binary representation.” David disagrees. He says, “No, but all such numbers have an even number of 1s in their binary representation.” Do you agree with Harry or with David, or with neither? Justify your answer with a proof or counterexamples.

* Both are wrong.
* For example 42 = 101010
* Which proves both of them are wrong since 42 is divisible by 6 and has three 1’s in its binary representation.

1. Bits in the memory of a computer have no inherent meaning. They mean something only under an interpretation.

Given the bit pattern:

1000 1111 1110 1111 1100 0000 0000 0000

What does it represent under each of the following interpretations?

1. A two’s complement integer?

* The sign is negative.
* 0111 0000 0001 0000 0100 0000 0000 0000two = 1,880,113,152ten
* 1000 1111 1110 1111 1100 0000 0000 0000two = -1,880113152ten

1. An unsigned integer?

* 1000 1111 1110 1111 1100 0000 0000 0000two = 2,414,854,144ten

1. A MIPS instruction?

* The first six bits are the operation code which is (35)ten which is (100011)two which is Load Word (LW rt d(rs))
* The second five bits are (rs) which are (11111)two which are (-16)ten
* The third five bits are (rt) which are (01111)two which are (15)ten
* The last sixteen bits are (d) which are (1100 0000 0000 0000)two which are (-16,384)ten
* ­(35, -16, 15, -16,384) or (LW 15 -16,384(-16))