Problem Session 1

- 1. 2012-2013 1. midterm 1.soru
- a. A is a 4-bit and B is an 8-bit, signed, binary integer, which are given as follows:

 $A=(8)_{16}$ and $B=(FA)_{16}$.

Perform necessary operations on binary numbers to compare the absolute values (|A|, |B|) of two numbers. Decide which number has the greater absolute value by interpreting the obtained binary result. Explain the operations and interpretation of the result.

b. Assume that the numbers A and B are unsigned, and answer the same question.

α.

A= 1000 Sign extension to obtain 8-bit A= 1111 1000

B= 1111 1010 (Because Hex F=1111. Hex A=1010)

Both numbers are negative (sign =1)

To obtain absolute values we apply 2's complement operations.

2's complement of A= 1111 1000 : 0000 0111 + 1 = 0000 1000 = |A|

2's complement of B= 1111 1010: 0000 0101 + 1 = 0000 0110 = |B|

To compare the absolute values we perform |A| - |B| = |A| + 2's complement of |B|

|A|: 0000 1000

2's complement of |B|: + 1111 1010 1 000 0010

Interpretation:

Absolute values are unsigned numbers. Therefore we investigate the carry (barrow). Carry=1, that means no barrow. Consequently |A| > |B|

Ь.

A= 1000 Extension to obtain 8-bit A= 000 1000 (A is unsigned)

B= 1111 1010

As the numbers are unsigned A= |A|, and B= |B|

To compare the numbers we perform A-B=A+2's complement of B

A: 0000 1000

2's complement of B: + 0000 0110

0000 1110

Interpretation:

Absolute values are unsigned numbers. Therefore we investigate the carry (barrow). Carry=0, that means barrow. Consequently A < B and |A| < |B|

2. 2011-2012 1.midterm 1.soru

- a. A and B are two 8-bit, signed, binary integers. B is given as B=1001 1101. If we perform the operation A-B according to 2's complement method overflow occurs and the most significant bit of the 8-bit result is 1.
- What is the sign of A (positive or negative)? Why?
- Write the smallest possible integer A that can constitute this situation (result and overflow).
- b. A and B are two 8-bit, unsigned, binary integers. After the operation A-B according to 2's complement method the obtained result is a 9-bit number: 1 1001 0110.
 Which is true A>B or A<B? Why?</p>
- a. B is negative, result is negative, there is an overflow, and operation is subtraction
- i) Overflow condition: pos neg = neg , therefore A must be positive. [10 points]

ii) A = 0xxx xxxx 0xxx xxxx

B= 1001 1101 2's comp. + 0110 0011 smallest possible A= 0001 1101

R= 1xxx xxxx 1xxx xxxx

[10 points]

The same solution by thinking in decimal:

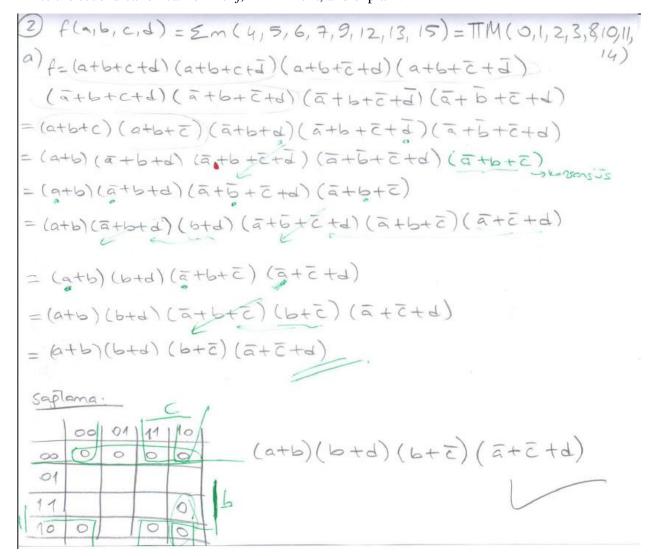
 $B=(-99)_{10}$, to generate an overflow result must be at least +128. (Note that result seems to be negative, but due to overflow the real sign of the result is positive.)

A-99=128, smallest possible $A=(29)_{10} = 0001 \ 1101$

b. The carry bit is 1. It means no borrow. Therefore A>B. [10 points]

3. There is a logical function below.

 $f(a,b,c,d) = \sum m (4,5,6,7,9,12,13,15)$ Write the second canonical form of f, minimize it, and explain.



- 4. 2011-2012 Final 1.soru a.
- a) Minimize the following function <u>using axioms and theorems</u>.

$$f(A,B,C,D)=A'B'CD+AB'CD+AC'D+AC'D'+A'B'CD'+ABCD+ACD'$$

$$f(A,B,C,D)=A'B'CD+AB'CD+AC'D+AC'D'+A'B'CD'+ABCD+ACD'$$

$$=(A'+A)B'CD + AC'(D+D') + A'B'CD' + ABCD + ACD'$$
 (Inverse)

$$=(B'+AB)CD + AC' + A'B'CD' + ACD'$$
 (absorbtion)

=
$$B'CD + A(CD + C') + (A'B'+A) CD'$$
 (absorbtion)

$$= B'CD + AD + AC' + B'CD' + ACD'$$

$$= B'CD + AD + B'CD' + A(C'+CD')$$
 (absorbtion)

$$= B'CD + AD + B'CD' + AC' + AD'$$

$$= B'C(D + D') + A(D+C'+D') (inverse)$$