$-\overline{abc}$

$\downarrow$

binary representation

$-\overline{abc} = ?$ $\quad = -(\underbrace{2\text{'s complement of } \overline{abc}}_{\text{binary representation of } -\overline{abc}})$

2's complement repres. of a negative number is $2^K - V$

1) $2^K - V$

$10010011 \; (= 93h = 147)$

$= -(2\text{'s complement of } 10010011) =$

$= -109$

$$\begin{array}{r} 1.0000.0000 - \\ 1001\,0011 \\ \hline 1\,0110\,1101 \end{array}$$

$\Rightarrow$ 2's complement

$\underbrace{0110}_{6}\;\underbrace{1101}_{D} = 109$

2) $$\begin{array}{r} 01101100\ + \\ 1 \\ \hline 01101101 \end{array}$$

3) 10010011   ignore all 0's and the first 1 going from right to left then negate the rest.

$\boxed{01101101}$

Derive from the 2's complement definition is the following fact that the sum of the two absolute values of the 2 complementary values in base 10 is always the cardinal of the set of values representable on that size.

4) $256 - 147 = \boxed{109}$ (only works for base 10 representation)

unsigned byte – $[0, 255]$ 2^8 values

Signed byte – $[-128, 127]$ 2^8 values

Questions for the exam:

(the value representing)
a) Which is the signed interpretation of 10010011?

b) ——————— " ——————— of 93h?

c) ——————— " ——————— of 147 in base 10?

i) 01101101

ii) −109 → correct answer for a), b)

iii) 6Dh bcs. $10010011_{(2)} = 93_{(16)}$

iv) +147

base 2, 16 are the only representations, you can't solve c), as 147 is already an interpretation in base 10.

Any number that starts in binary with 0 has the same value in both interpretations (signed and unsigned)

We have to start from a given binary repres.

a) $\overline{0xx\ldots x}$ $\quad \underset{\text{(unsigned)}}{\overline{abc}}$ - which will be the

value of this representation in the SIGNED repres.?

Answer: the same representation

Concl: there is no need for 2's complement mechanism

b) $\overline{0xx\ldots x}$ $\quad \underset{\text{(unsigned)}}{\overline{abc}}$ - which will be the

binary repres. of $-\overline{abc}$?

Answer: the 2's complement of the binary configuration

Ex: $\overline{abc} = 109$, $-\overline{abc} = -109$

$$109 = 01101101 \xrightarrow{\text{2's complement}} 10010011$$

c) $\overline{1xx\ldots}$ $\overline{abc}$ which will be the value
(unsigned)

of this representation in the SIGNED repres.

Answer: the 2's complement of the binary configuration

$-$(2's complement of the initial value) =
10010011

$= -(01101101) = -109$

d) $\overline{1xx\ldots}$ $\overline{abc}$ which will be the binary representation of $-\overline{abc}$?

Answer: the 2's complement of the initial configuration

$10010011 = 147$

$-147 = ?$

positive number not negative!!!

2's complement: 01101101 wrong answer

$-147 \notin [0, 255]$
$\notin [-128, 127]$

Conclusion: we can't represent it on a byte

Right answer: it can't fit a byte
so the configuration will be on a word:

0000 0000 1001 0011

1111 1111 0110 1101

Exception:

$$1000\,0000 \begin{cases} -128 \\ 128 \end{cases}$$

Question:
Which is the minimum number of BITS on which we can represent -147

- on n bits we may represent 2^n values

- either the unsigned values $[0, 2^{n-1})$
  signed values $[-2^{n-1}; 2^{n-1}-1]$

On 9 bits: 2^9 value $= 512$

$[0, 511]$ or $[-256, +255]$

$-147 \in [-256, 255]$