Homework
- teams of 2 students -

STUDENT 1
-MÁTHÉ ANDREI-

SUBJECT 1

We choose:

$b_1 = 8$ $b_2 = 16$

$x = 119674 = 351572_{(8)}$

$y = 6526 = 14576_{(8)}$

$z = 4440767 = 43C2BF_{(16)}$

$f = 14 = E_{(16)}$

1. $x_{(b_1)} + y_{(b_1)} = b_{(b_1)}$ $b_{(b_1)} = ?$

$x_{(8)} + y_{(8)} = 351572_{(8)} + 14576_{(8)} = 366370_{(8)}$

$\begin{array}{r} 0\,0\,1\,1\,1\,0 \\ 351572_{(8)} + \\ \quad 14576_{(8)} \\ \hline 366370_{(8)} \end{array}$

- $0_{(8)} + 2_{(8)} + 6_{(8)} = 0 + 2 + 6 = 8$
- $1_{(8)} + 7_{(8)} + 7_{(8)} = 1 + 7 + 7 = 15$
- $1_{(8)} + 5_{(8)} + 5_{(8)} = 1 + 5 + 5 = 11$
- $1_{(8)} + 1_{(8)} + 4_{(8)} = 1 + 1 + 4 = 6$
- $0_{(8)} + 5_{(8)} + 1_{(8)} = 0 + 5 + 1 = 6$
- $0_{(8)} + 3_{(8)} = 0 + 3 = 3$

$8/8 = 1$ $8\%8 = 0$

$15/8 = 1$ $15\%8 = 7$

$11/8 = 1$ $11\%8 = 3$

$6/8 = 0$ $6\%8 = 6$

$6/8 = 0$ $6\%8 = 6$

$3/8 = 0$ $3\%8 = 3$

$\Rightarrow b_{(8)} = 366370_{(8)}$

2. $z_{(b_2)} \cdot f_{(b_2)} = t_{(b_2)}$ $t_{(b_2)} = ?$

$z_{(16)} \cdot f_{(16)} = 43C2BF_{(16)} \cdot E_{(16)} = 3B4A672_{(16)}$

$\begin{array}{r} 3\,3\,B\,A\,A\,D\,0 \\ 43C2BF_{(16)} \\ \cdot \quad E_{(16)} \\ \hline 3B4A672_{(16)} \end{array}$

- $0_{(16)} + F_{(16)} \cdot E_{(16)} = 0 + 15 \cdot 14 = 210$
- $D_{(16)} + B_{(16)} E_{(16)} = 13 + 11 \cdot 14 = 167$
- $A_{(16)} + 2_{(16)} \cdot E_{(16)} = 10 + 2 \cdot 14 = 38$
- $2_{(16)} + C_{(16)} \cdot E_{(16)} = 2 + 12 \cdot 14 = 170$
- $A_{(16)} + 3_{(16)} \cdot E_{(16)} = 10 + 3 \cdot 14 = 52$
- $3_{(16)} + 4_{(16)} \cdot E_{(16)} = 3 + 4 \cdot 14 = 59$

$210/16 = 13 = D_{(16)}$ $210\%16 = 2$

$167/16 = 10 = A_{(16)}$ $167\%16 = 7$

$38/16 = 2$ $38\%16 = 6$

$170/16 = 10 = A_{(16)}$ $170\%16 = 10 = A_{(16)}$

$52/16 = 3$ $52\%16 = 4$

$59/16 = 3$ $59\%16 = 11 = B_{(16)}$

$\Rightarrow t_{(16)} = 3B4A672_{(16)}$

STUDENT 2
- MATEI GONIA -

SUBJECT 1

From student 1 we have:

① $b_1 = 8$

$x = 351572_{(8)}$

$y = 14576_{(8)}$

$s = 366370_{(8)}$

② $b_2 = 16$

$z = 43C2BF_{(16)}$

$t = E_{(16)}$

$p = 3B4A672_{(16)}$

① $s - y = 366370_{(8)} - 14576_{(8)} = 351572_{(8)} = x$ => CORRECT

b. 0 0 -1 -1 -1 0

$366370_{(8)}$ -
$14576_{(8)}$
$351572_{(8)}$

$0 + 0 - 6 = -6 < 0$ → $-6 + 8 = 2$, $b = -1$

$-1 + 7 - 7 = -1 < 0$ → $-1 + 8 = 7$, $b = -1$

$-1 + 3 - 5 = -3 < 0$ → $-3 + 8 = 5$, $b = -1$

$-1 + 6 - 4 = 1 > 0$ → $b = 0$

$0 + 6 - 1 = 5 > 0$ → $b = 0$

② $p : t = 3B4A672_{(16)} : E_{(16)} = 43C2BF_{(16)} = z$ => CORRECT

$3B4A672_{(16)} \mid E_{(16)}$

3 / 3B / 34 / AA / 26 / A7 / D2 / 0

$043C2BF_{(16)}$

$03 = 0 \cdot 16 + 3 = 3$, $3 / 14 = 0$, $3 \% 14 = 3$

$3B = 3 \cdot 16 + B = 59$, $59 / 14 = 4$, $59 \% 14 = 3$

$34 = 3 \cdot 16 + 4 = 52$, $52 / 14 = 3$, $52 \% 14 = A$

$AA = A \cdot 16 + A = 170$, $170 / 14 = C$, $170 \% 14 = 2$

$26 = 2 \cdot 16 + 6 = 38$, $32 / 14 = 2$, $32 \% 14 = A$

$A7 = A \cdot 16 + 7 = 167$, $167 / 14 = B$, $167 \% 14 = D$

$D2 = D \cdot 16 + 2 = 210$, $210 / 14 = F$, $210 \% 14 = 0$

STUDENT 2
- MATEI SONIA -

SUBJECT 2

- We take the source base $b = 8$ and the destination base $h = 16$ thus $b < h$.
- The chosen number in base b is 76543,012

$$76543{,}012_{(8)} = 7A63{,}05_{(16)}$$

$7_{(8)} = 7_{(16)}$ $6_{(8)} = 6_{(16)}$ $5_{(8)} = 5_{(16)}$ $4_{(8)} = 4_{(16)}$ $3_{(8)} = 3_{(16)}$ $2_{(8)} = 2_{(16)}$

$1_{(8)} = 1_{(16)}$ $0_{(8)} = 0_{(16)}$

$$76543{,}012_{(8)} = 7_{(16)} \cdot 8^{4}_{(16)} + 6_{(16)} \cdot 8^{3}_{(16)} + 5_{(16)} \cdot 8^{2}_{(16)} + 4 \cdot 8^{1}_{(16)} + 3_{(16)} \cdot 8^{0}_{(16)} + 0_{(16)} \cdot 8^{-1}_{(16)} + 1_{(16)} \cdot 8^{-2}_{(16)} + 2_{(16)} \cdot 8^{-3}_{(16)}$$

c. 40 | 8 | 8 | 40

$0_{(16)} + 8_{(16)} : 8_{(16)} = 64$, $64 \,\%_{(16)} 16 = 0$, $64 / 16 = 4$

$\Rightarrow$ $8^{2}_{(10)} = 40_{(16)}$

c. 100 | 40 | 40 | 1000

$0_{(16)} + 4_{(16)} \cdot 4_{(16)} = 160$, $160 \,\%_{(16)} 16 = 0$, $160 / 16 = 1$

$0_{(16)} + 0_{(16)} : 4_{(16)} = 0$

$\Rightarrow$ $8^{4}_{(10)} = 1000_{(16)}$

c. 200 | 40 | 8 | 200

$0_{(16)} + 0_{(16)} \cdot 8_{(16)} = 0$

$0_{(16)} + 4_{(16)} \cdot 8_{(16)} = 32$, $32 \,\%_{(16)} 16 = 0$, $32 / 16 = 2$

$\Rightarrow$ $8^{3}_{(10)} = 200_{(16)}$

So far we have:

$$76543{,}012_{(8)} = 7_{(16)} \cdot 1000_{(16)} + 6_{(16)} \cdot 200_{(16)} + 5_{(16)} \cdot 40_{(16)} + 4 \cdot 8 + 3_{(16)} + 0_{(16)} + \frac{1}{8}_{(16)} + \frac{2}{40}_{(16)}$$

c. _ _ 0 0

7 .

1000

7000

$0 + 1 \cdot 7 = 7$, $7 : 16 = 7$, $7 / 16 = 0$
(16) (16) (16)

---

c. _ _ 0 0

6 .

200

C00

$0 + 6 \cdot 2 = 12$, $12 : 16 = C$, $12 / 16 = 0$
(16) (16) (16)

---

c. _ _ 1 0

5 .

40

140

$0 + 5 \cdot 4 = 20$, $20 : 16 = 4$ $20 / 16 = 1$
(16) (16) (16)

C _ _ 2 0

4 .

8

20

$0 + 4 \cdot 8 = 32$, $32 : 16 = 0$, $32 / 16 = 2$
(16) (16) (16)

$1 : 40 = 0,04_{(16)}$
(16) (16)

0

10

0

100

/

0

$100_{(16)} = 16^2 = 256$, $40_{(16)} = 4 \cdot 16 = 64$

$256 : 64 = 4$ r=0

$2 : 200 = 0,01_{(16)}$
(16) (16)

0

20

0

200

200

0

$200_{(16)} = 2 \cdot 16^2 = 512$

And our final result is:

$76543,012_{(8)} = 7000_{(16)} + C00_{(16)} + 140_{(16)} + 20_{(16)} + 3_{(16)} + 0_{(16)} + 0,04_{(16)} + 0,01_{(16)}$

$= 7D63,05_{(16)}$

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SUBJECT 2

From student 2 we have:

$b = 8$, $h = 16$

$y_{(16)} = 7D63,05_{(16)}$

Convert $y_{(h)}$ into base b with a precision of 3 digits.

$y_{(16)} = 7D63,05_{(16)} = 76543,012_{(8)}$

$h > b$ => we use the method of successive divisions and multiplications

a) Integer part

$7D63_{(16)} = 76543_{(8)}$

$7D63_{(16)} \mid 8_{(16)}$
$7D \quad\quad FAC_{(16)}$
$/$
56
$/$
63
$/$
3

$FAC_{(16)} \mid 8_{(16)}$
$/ \quad\quad 1F5_{(16)}$
$7A$
$/$
$2C$
$/$
4

$1F5_{(16)} \mid 8_{(16)}$
$/ \quad\quad 3E_{(16)}$
75
$/$
5

$3E_{(16)} \mid 8_{(16)}$
$/ \quad\quad 7_{(16)}$
6

$7_{(16)} \mid 8_{(16)}$
$/ \quad\quad 0_{(16)}$
7

(i_1)

- $7D_{(16)} = 7 \cdot 16 + 13 = 125$
$125 / 8 = 15 = F_{(16)}$
$125 \,\%\, 8 = 5$
- $56_{(16)} = 5 \cdot 16 + 6 = 86$
$86 / 8 = 10 = A_{(16)}$
$86 \,\%\, 8 = 6$
- $63_{(16)} = 6 \cdot 16 + 3 = 99$
$99 / 8 = 12 = C_{(16)}$
$99 \,\%\, 8 = 3$

(i_2)

- $0F_{(16)} = 0 \cdot 16 + 15 = 15$
$15 / 8 = 1$
$15 \,\%\, 8 = 7$
- $7A_{(16)} = 7 \cdot 16 + 10 = 122$
$122 / 8 = 15 = F_{(16)}$
$122 \,\%\, 8 = 2$
- $2C_{(16)} = 2 \cdot 16 + 12 = 44$
$44 / 8 = 5$
$44 \,\%\, 8 = 4$

(i_3)

- $1F_{(16)} = 1 \cdot 16 + 15 = 31$
$31 / 8 = 3$
$31 \,\%\, 8 = 7$
- $75_{(16)} = 7 \cdot 16 + 5 = 117$
$117 / 8 = 14 = E_{(16)}$
$117 \,\%\, 8 = 5$

(i_4)

- $3E_{(16)} = 3 \cdot 16 + 14 = 62$
$62 / 8 = 7$
$62 \,\%\, 8 = 6$

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b) Fractional part

$0,05_{(16)} = 0,012_{(8)}$

$0,05_{(16)} \cdot 8_{(16)} = 0,28_{(16)}$

$0,28_{(16)} \cdot 8_{(16)} = 1,40_{(16)}$

$0,40_{(16)} \cdot 8_{(16)} = 2,0_{(16)}$

(λ_1)

- $0_{(16)} + 5_{(16)} \cdot 8_{(16)} = 0 + 5 \cdot 8 = 40$ $\quad 40 / 16 = 2 \quad 40 \,\%\, 16 = 8$
- $2_{(16)} + 0_{(16)} \cdot 8_{(16)} = 2 + 0 \cdot 8 = 2$ $\quad 2 / 16 = 0 \quad 2 \,\%\, 16 = 2$

(λ_2)

- $0_{(16)} + 8_{(16)} \cdot 8_{(16)} = 0 + 8 \cdot 8 = 64$ $\quad 64 / 16 = 4 \quad 64 \,\%\, 16 = 0$
- $4_{(16)} + 2_{(16)} \cdot 8_{(16)} = 4 + 2 \cdot 8 = 20$ $\quad 20 / 16 = 1 \quad 20 \,\%\, 16 = 4$
- $1_{(16)} + 0_{(16)} \cdot 8_{(16)} = 1 + 0 \cdot 8 = 1$ $\quad 1 / 16 = 0 \quad 1 \,\%\, 16 = 1$

(λ_3)

- $0_{(16)} + 4_{(16)} \cdot 8_{(16)} = 0 + 4 \cdot 8 = 32$ $\quad 32 / 16 = 2 \quad 32 \,\%\, 16 = 0$
- $2_{(16)} + 0_{(16)} \cdot 8_{(16)} = 2 + 0 \cdot 8 = 2$ $\quad 2 / 16 = 0 \quad 2 \,\%\, 16 = 2$

From a and b => $y_{(8)} = 76543,012_{(8)}$

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SUBJECT 3 (OPTION 2)

We choose:

$x = 0,961$
$y = 0,7492$
$z = 0,8105$

Represent in direct, inverse and complementary codes on 16 bits: $x, -x, y, -y, z, -z$.

$x = 0,961 = 75402_{(8)} = 111\ 101\ 100\ 000\ 010_{(2)}$

$0,961 \cdot 8 = 7,688$
$0,688 \cdot 8 = 5,504$
$0,504 \cdot 8 = 4,032$
$0,032 \cdot 8 = 0,256$
$0,256 \cdot 8 = 2,048$

$y = 0,7492 = 57745_{(8)} = 101\ 111\ 111\ 100\ 101_{(2)}$

$0,7492 \cdot 8 = 5,9936$
$0,9936 \cdot 8 = 7,9488$
$0,9488 \cdot 8 = 7,5904$
$0,5904 \cdot 8 = 4,7232$
$0,7232 \cdot 8 = 5,7856$

$z = 0,8105 = 63676_{(8)} = 110\ 011\ 110\ 111\ 110_{(2)}$

$0,8105 \cdot 8 = 6,484$
$0,484 \cdot 8 = 3,872$
$0,872 \cdot 8 = 6,976$
$0,976 \cdot 8 = 7,808$
$0,808 \cdot 8 = 6,464$

STUDENT 1
-MÁTHÉ ANDREI-

S

POSITION	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
$[x]_{dir}=[x]_{inv}=[x]_{compl}=$	0	1	1	1	1	0	1	1	0	0	0	0	0	0	1	0
$[-x]_{dir}=$	1	1	1	1	1	0	1	1	0	0	0	0	0	0	1	0
$[-x]_{inv}=$	1	0	0	0	0	1	0	0	1	1	1	1	1	1	0	1
$[-x]_{compl}=$	1	0	0	0	0	1	0	0	1	1	1	1	1	1	1	0

S

POSITION	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
$[y]_{dir}=[y]_{inv}=[y]_{compl}=$	0	1	0	1	1	1	1	1	1	1	1	0	0	1	0	1
$[-y]_{dir}=$	1	1	0	1	1	1	1	1	1	1	1	0	0	1	0	1
$[-y]_{inv}=$	1	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0
$[-y]_{compl}=$	1	0	1	0	0	0	0	0	0	0	0	1	1	0	1	1

S

POSITION	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
$[z]_{dir}=[z]_{inv}=[z]_{compl}=$	0	1	1	0	0	1	1	1	1	0	1	1	1	1	1	0
$[-z]_{dir}=$	1	1	1	0	0	1	1	1	1	0	1	1	1	1	1	0
$[-z]_{inv}=$	1	0	0	1	1	0	0	0	0	1	0	0	0	0	0	1
$[-z]_{compl}=$	1	0	0	1	1	0	0	0	0	1	0	0	0	0	1	0

STUDENT 2
-MATEI SONIA-

SUBJECT 3

From the student 1 we have:

$[x]_{compl} = 0\ 1111\ 0110\ 0000\ 0100$ $\quad [y]_{compl} = 0\ 1011\ 1111\ 1100\ 1011$

$[-x]_{compl} = 1\ 0000\ 1001\ 1111\ 1100$ $\quad [-y]_{compl} = 1\ 0100\ 0000\ 0011\ 0101$

$[z]_{compl} = 0\ 1100\ 1111\ 0111\ 1100$

$[-z]_{compl} = 1\ 0011\ 0000\ 1000\ 0100$

$[x+y]_{compl}$

S																
0	1	1	1	1	0	1	1	0	0	0	0	0	1	0	+	
0	1	0	1	1	1	1	1	1	1	1	0	0	1	0	1	
1	1	0	1	1	0	1	0	1	1	1	0	0	1	1	1	

=> the addition of two positive numbers is negative => OVERFLOW

$1101\ 1010\ 1110\ 0111_{(2)} = -2^{16} + 2^{15} + 2^{14} + 2^{12} + 2^{11} + 2^{9} + 2^{7} + 2^{6} + 2^{5} + 2^{3} + 2^{2} + 2^{1} + 2^{0} = -9497$

$[x-y]_{compl}$

	S															
	0	1	1	1	1	0	1	1	0	0	0	0	0	1	0	+
	1	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0
1	0	0	0	1	1	0	1	1	0	0	0	1	1	1	0	0

=> the leftmost digit is lost; there isn't an overflow => CORRECT

$0001\ 1011\ 0001\ 1100_{(2)} = 2^{12} + 2^{11} + 2^{9} + 2^{8} + 2^{4} + 2^{3} + 2^{2}$

$= 6940$

$[z-x]_{compl}$

S				
0	1110	0111	1011	1110 +
1	000	0100	1111	1110
1	110	1100	1011	1100

=> CORRECT

$1110\ 1100\ 1011\ 1100_{(2)} = -2^{16}+2^{15}+2^{14}+2^{13}+2^{11}+2^{10}+2^{7}+2^{5}+2^{4}+2^{3}+2^{2} = -4932$

$[-z-x]_{compl}$

S				
1	001	1000	0100	0010 +
1	000	0100	1111	1110
1 0	001	1101	0100	0000

=> addition of two neg. numbers is positive => OVERFLOW

$0001\ 1101\ 0100\ 0000_{(2)} = 2^{12}+2^{11}+2^{10}+2^{8}+2^{6}$

$= 7488$