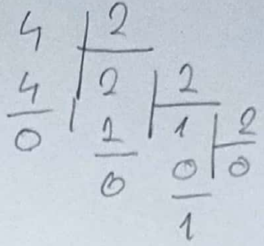
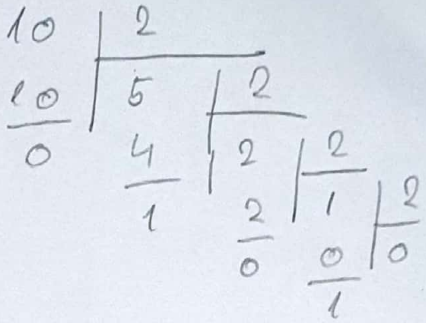
1 Convert the following numbers from base 10 to 2 and then to 16; 4, 10, 15, 32

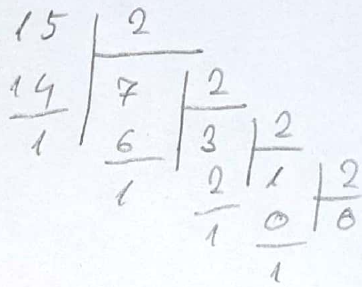
$4 = 100_{(2)} = 4_{(16)}$



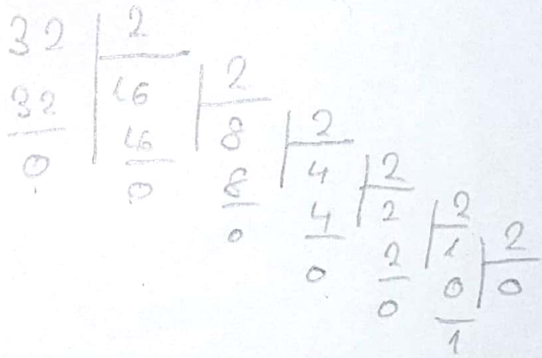
$10 = 1010_{(2)} = A_{(16)}$



$15 = 1111_{(2)} = F_{(16)}$



$32 = 100000_{(2)}$



$100000 = 20_{(16)}$

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2. Convert the following numbers from base 10 to 16 and then to 2: 3, 11, 16, 17

$3 = 3_{(16)} = 11_{(2)}$

$11 = B_{(16)} = 1011_{(2)}$

$16 = 10_{(16)} = 10000_{(2)}$

$1_{(16)} = 0001_{(2)}$

$17 = 11_{(16)} = 10001_{(2)}$

8. Write the 8-bits unsigned representation for the following numbers: 8, 67, 230

$8 = 0000\,1000_{(2)}$

$67 = 0100\,0011_{(2)}$

$230 = 1110\,0110_{(2)}$

$\boxed{9}$ Write the 16-bits signed representation for the following numbers: −6, −121, 70

−6

We represent 6 in binary then we use the first alternative rule for the complementary code to get the representation of −6

$$
\begin{array}{l|l}
6 & 2 \\
\underline{6} & 3 \mid 2 \\
0 & \underline{2} \quad 1 \mid 2 \\
 & 1 \quad \underline{0} \quad 0 \\
 & \quad\quad 1
\end{array}
$$

$6 = 0000\ 0000\ 0000\ 0110_{(2)} \Rightarrow$

$\Rightarrow -6 = 1111\ 1111\ 1111\ 1010_{(2)}$

−121

$$
\begin{array}{l|l}
121 & 2 \\
\underline{120} & 60 \mid 2 \\
1 & \underline{60} \quad 30 \mid 2 \\
 & 0 \quad \underline{30} \quad 15 \mid 2 \\
 & \quad\ \ 0 \quad \underline{14} \quad 7 \mid 2 \\
 & \quad\quad\quad 1 \quad \underline{6} \quad 3 \mid 2 \\
 & \quad\quad\quad\quad\ 1 \quad \underline{2} \quad 1 \mid 2 \\
 & \quad\quad\quad\quad\quad\ 1 \quad \underline{0} \quad 0 \\
 & \quad\quad\quad\quad\quad\quad\ 1
\end{array}
$$

$121 = 0000\ 0000\ 0111\ 1001_{(2)} \Rightarrow$

$\Rightarrow -121 = 1111\ 1111\ 1000\ 0111_{(2)}$

70

$$
\begin{array}{l|l}
70 & 2 \\
\underline{70} & 35 \mid 2 \\
0 & \underline{34} \quad 17 \mid 2 \\
 & 1 \quad \underline{16} \quad 8 \mid 2 \\
 & \quad\ 1 \quad \underline{8} \quad 4 \mid 2 \\
 & \quad\quad\ 0 \quad \underline{4} \quad 2 \mid 2 \\
 & \quad\quad\quad 0 \quad \underline{2} \quad 1 \mid 2 \\
 & \quad\quad\quad\quad 0 \quad \underline{0} \quad 0 \\
 & \quad\quad\quad\quad\quad 1
\end{array}
$$

$70 = 0000\ 0000\ 0100\ 0110_{(2)}$

Check if:

7

- $9A7D_{(16)}$ and $7583_{(16)}$ are complementary in a location of 2 bytes

$9A7D_{(16)} = 1001\ 1010\ 0111\ 1101_{(2)}$

$9_{(16)} = 1001_{(2)}$

$10_{(16)} = 1010_{(2)}$

$7_{(16)} = 0111_{(2)}$

$13_{(16)} = 1101_{(2)}$

$7583_{(16)} = 0111\ 0101\ 1000\ 0011_{(2)}$

$7 = 0111_{(2)}$

$5 = 0101_{(2)}$

$8 = 1000_{(2)}$

$3 = 0011_{(2)}$

Let's determine the complementary code of $9A7D_{(16)}$ using the first alternative (from right to left leave all bits unchanged up to the first 1 included and then invert the rest of the bits)

$1001\ 1010\ 0111\ 1101_{(2)}$

$\downarrow$

$0110\ 0101\ 1000\ 0011_{(2)}$ which is not equal to

$0111\ 0101\ 1000\ 0011_{(2)}$ $\Rightarrow$ The two numbers are not complementary

$7583_{(16)}$

• $4BA1_{(16)}$ and $5C93_{(16)}$ are complementary in a location of 2 bytes

$4BA1_{(16)} = 0100\ 1011\ 1010\ 0001_{(2)}$

$5C93_{(16)} = 0101\ 1100\ 1001\ 0011_{(2)}$

Let's determine the complementary code of $4BA1_{(16)}$ by subtracting the binary content from 1000 --- 0

$$\begin{array}{r} 1\ 0000\ 0000\ 0000\ 0000_{(2)}\ - \\ 0100\ 1011\ 1010\ 0001_{(2)} \\ \hline 1011\ 0100\ 0101\ 1111_{(2)} \end{array}$$

which is not equal to the binary representation of $5C93_{(16)}$ =>

=> The two numbers are not complementary

• $7F_{(16)}$ and $81_{(16)}$ are complementary in a location of 1 byte

Let's determine the complementary code of $7F_{(16)}$ by subtracting the hexadecimal content from 100 --- 0

$$\begin{array}{r} 100_{(16)}\ - \\ 7F_{(16)} \\ \hline 81_{(16)} \end{array}$$

which is equal to the second number =>

=> The two numbers are complementary

• $000F095D_{(16)}$ and $FFF0F6A3_{(16)}$ are complementary in a location of 4 bytes.

$000F095D_{(16)} =$

$= 0000\ 0000\ 0000\ 1111\ 0000\ 1001\ 0101\ 1101_{(2)}$

$FFF0F6A3_{(16)} =$

$= 1111\ 1111\ 1111\ 0000\ 1111\ 0110\ 1010\ 0011_{(2)}$

Let's determine the complementary code of $000F095D_{(16)}$ by inverting all bits of the representation and then adding 1 to the obtained value

$0000\ 0000\ 0000\ 1111\ 0000\ 1001\ 0101\ 1101_{(2)}$

↓ inverting bits

$1111\ 1111\ 1111\ 0000\ 1111\ 0110\ 1010\ 0010_{(2)} +$

1

$1111\ 1111\ 1111\ 0000\ 1111\ 0110\ 1010\ 0011_{(2)}$

which is equal to binary representation of $FFF0F6AB_{(16)} \Rightarrow$

$\Rightarrow$ The two numbers are complementary

• $732A_{(16)}$ and $4E58_{(16)}$ are complementary in a location of 2 bytes

Let's determine the complementary code of $732A_{(16)}$ by subtracting the hexadecimal content from 100 --- 0

$$
\begin{array}{r}
10000_{(16)} - \\
732A_{(16)} \\
\hline
8CD6_{(16)}
\end{array}
$$

which is not equal to $4E58_{(16)}$ =>

=> The two numbers are not complementary