**Homework Teams**

*Student 1: Vlad Bogdan-Tudor*

*Student 2: Vlad Mircea-Dragoș*

**Subject 1: operations**

Students will work with two bases: b1 and b2, one of them is less than 10 and the other one is 16, b1>2, b2>2.

* Student 1 chooses b1, b2, x, y, z, f and performs the operations:

x(b1) + y(b1) = s(b1), x has 6 digits and y has 5 digits

z(b2)\* f(b2) = p(b2), z has 6 digits, f is a digit, f≠1, f≠0.

* Student 2 receives s, y, p, f, from Student 1 and performs the following operations to verify the correctness of the results obtained by Student 1:

s(b1) - y(b1)= ? (b1)

p(b2) : f(b2)= ? (b2)

**Student 1: Vlad Bogdan-Tudor**

b1 = 8

x(8) = 745631(8)

­y(8) = 35472(8)

x(8) + y(8) = 745631(8) + 745631(8) = 1003323(8)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Positions (i)** | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| **Operation** | **Base(b**) | **Carries (c)** |  |  |  | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| **+** | **8** | **x** |  |  |  |  | 7 | 4 | 5 | 6 | 3 | 1 |
|  |  | **y** |  |  |  |  |  | 3 | 5 | 4 | 7 | 2 |
|  |  | **Sum (s)** |  |  |  | 1 | 0 | 0 | 3 | 3 | 2 | 3 |

i = 0: c0 = 0

1(8) + 2(8) + c0 =1 + 2 + 0 =3;3 div 8 = 0 ==> c1 = 0 ; 3 mod 8 = 3; s0 = 3(8)

i = 1: c1 = 0

3(8) + 7(8) + c1 = 3 + 7 + 0=10;10 div 8 = 1 ==> c2 = 1 ; 10 mod 8 = 2; s1 = 2(8)

i = 2: c2 = 1

6(8) + 4(8) + c2 = 6 + 4 + 1=11;11 div 8 = 1 ==> c3 = 1 ; 11 mod 8 = 3; s2 = 3(8)

i = 3: c3 = 1

5(8) + 5(8) + c3 = 5 + 5 + 1=11;11 div 8 = 1 ==> c4 = 1 ; 11 mod 8 = 3; s3 = 3(8)

i = 4: c4 = 1

4(8) + 3(8) + c4 = 4 + 3 + 1=8;8 div 8 = 1 ==> c5 = 1 ; 8 mod 8 = 0; s4 = 0(8)

i = 5: c5 = 1

7(8) + 0(8) + c5 = 7 + 0 + 1=8;8 div 8 = 1 ==> c6 = 1 ; 8 mod 8 = 0; s5 = 0(8)

i = 6: c6 = 1

0(8) + 0(8) + c6 = 0 + 0 + 1=1;1 div 8 = 0 ==> c7 = 0 ; 1 mod 8 = 1; s6 = 1(8)

b2 = 16

z(16) = 5AEF9B(16)

­f(16) = 7(16)

z(16)\* f(16) = 5AEF9B(16) \* 7(16) = 27C8D3D(16)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Positions (i)** | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| **Operation** | **Base(b**) | **Carries (c)** |  |  |  | 2 | 4 | 6 | 6 | 4 | 4 | 0 |
| **\*** | **16** | **z** |  |  |  |  | 5 | A | E | F | 9 | B |
|  |  | **f** |  |  |  |  |  |  |  |  |  | 7 |
|  |  | **Product (p)** |  |  |  | 2 | 7 | C | 8 | D | 3 | D |

i = 0: c0 = 0

B(16)\*7(16)+0(16)= 11\*7= 77 ; 77 mod 16 = 13 = D(16), 77 div 16 = 4 = 4(16) ==> c1 = 4(16)

i = 1: c1 = 4

9(16)\*7(16)+4(16)= 9 \* 7 + 4= 67 ; 67 mod 16 = 3 = 3(16), 67 div 16 = 4 = 4(16) ==> c2 = 4(16)

i = 2: c2 = 4

F(16)\*7(16)+4(16)= 15 \* 7 + 4= 109 ; 109 mod 16 = 13 = D(16), 109 div 16 = 6 = 6(16) ==> c3 = 6(16)

i = 3: c2 = 6

E(16)\*7(16)+6(16)= 14 \* 7 + 6= 104 ; 104 mod 16 = 8 = 8 (16), 104 div 16 = 6 = 6(16) ==> c4 = 6(16)

i = 4: c3 = 6

A(16)\*7(16)+6(16)= 10 \* 7 + 6= 76 ; 76 mod 16 = 12 = C (16), 76 div 16 = 4 = 4(16) ==> c5 = 4(16)

i = 5: c4 = 4

5(16)\*7(16)+4(16)= 5 \* 7 + 4= 39 ; 39 mod 16 = 7 = 7(16), 39 div 16 = 2 = 2(16) ==> c6 = 2(16)

i = 6: c5 = 2

0(16)\*7(16)+2(16)= 0 \* 7 + 2= 2 ; 2 mod 16 = 2 = 2(16), 2 div 16 = 0 = 0(16) ==> c7 = 0(16)

**Student 2: Vlad Mircea-Dragoș**

s(8)= 1003323(8)

­y(8) = 35472(8)

s(8) - y(8) = 1003323(8) - 35472(8) = 745631(8)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Positions (i)** | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
| **Operation** | **Base (b)** | **Borrows (c)** |  |  |  | 1 | 1 | 1 | 1 | 1 | 0 | 0 |
| **-** | **8** | **s** |  |  |  | 1 | 0 | 0 | 3 | 3 | 2 | 3 |
|  |  | **y** |  |  |  | 0 | 0 | 3 | 5 | 4 | 7 | 2 |
|  |  | **Difference(d)** |  |  |  |  | 7 | 4 | 5 | 6 | 3 | 1 |

D10 = 3-0-2 = 1>0, then d0 = 1, c1 = 0

D10 = 2-0-7 = -5<0, then d1 = -5+8 = 3 , c2 = 1

D10 = 3-1-4 = -2<0, then d2 = -2+8 = 6, c3 = 1

D10 = 3-1-5 = -3<0, then d3 = -3+8 = 5, c4 = 1

D10 = 0-1-3 = -4<0, then d4 = -4+8 = 4, c5 = 1

D10 = 0-1-0 = -1<0, then d5 = -1+8 = 7, c6 = 1

D10 = 1-1-0 = 0

b2 = 16

p(16) = 27C8D3D(16)

­f(16) = 7(16)

p(16) : f(16) = 27C8D3D(16) : 7(16) = 5AEF9B(16)

027C8D3D(16)  | 7(16)

       /               | 05AEF9B(16)

         27

         /

          4C

           /

 68           

  /

              6D

    /

           43

           /

 4D           

  /

              0

**Calculations:**

02(16) = 2, 2 div 7= 0, 2 mod 7= 2

27(16) = 2\*16^1+7 = 39, 39 div 7 = 5, 39 mod 7 = 4

4C(16) = 4\*16^1+12 = 76, 76 div 7 = 10 = A(16), 76 mod 7 = 6

68(16) = 6\*16^1+8 = 104, 104 div 7 = 14 = E(16), 104 mod 7 = 6

6D(16) = 6\*16^1+13 = 109, 109 div 7 = 15 = F(16), 109 mod 7 = 4

43(16) = 4\*16^1+3 = 67, 67 div 7 = 9, 67 mod 7 = 4

4D(16) = 4\*16^1+13 = 77, 77 div 7 = 11 = B(16), 77 mod 7 = 0

**Subject 2: conversions of real numbers choosing the appropriate methods**

Student 2:

* chooses b (source base) and h (destination base) such that b ≠ 10, h ≠ 10 and b < h.
* chooses the initial real number x(b) having 5 digits at the integer part and 3 digits at the fractional part
* converts x(b) into base h, with a precision of 3 digits, obtaining y(h)

Student 1:

* + receives y(h) from Student 2 and converts y(h) into base b, with a precision of 3

digits to verify the correctness of the result obtained by Student 2

-Don’t use rapid conversions!

-Don’t use base 10 as an intermediate base!

**Student 2: Vlad Mircea-Dragoș**

b = 5

h = 16

x(5) = 44313,214(5)

We will use the ***Substitution method***

* calculations in the destination base
* it is recommended for *b < h*, *b* (source base),  *h*(destination base)

N(b) = (amam-1...a1a0, a-1...a-n) = N’(h)

*Steps:*

- all the digits from the source representation are converted into the destination base:

(ai)(b) = (a’i)(h), i = -n,…,-1,0,…,m-1

- the base b is converted into base h:

b = (b’)(h)

- we calculate in base h the following sum:

(N’)(h) = (a’0)(h)\*(b’)(h)0+(a’1)(h)\*(b’)(h)1+…+(a’m)(h)\*(b’)(h)m +

+(a’-1)(h)\*(b’)(h)-1+…+(a’-n)(h)\*(b’)(h)-n

44313,214(5) =

4(5) = 4(16), 3(5) = 3(16), 1(5) = 1(16), 2(5) = 2(16)

**!!!Calculations are in base 16!**

44313,214(5) = 4(16)\*5(16)^4+4(16)\*5(16)^3+3(16)\*5(16)^2+1(16)\*5(16)^1+3(16)\*5(16)^0+

+2(16)\*5(16)^(-1)+1(16)\*5(16)^(-2)+4(16)\*5(16)^(-3) =

**=** 9C4(16)+1F4(16)+4B(16)+5(16)+3(16) +0,666(16) +0,0A3(16) +0,083(16)

**= C0B,78C**(16)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 0 |  |  |  | 2 | 0 |  |  | 2 | 4 | 0 |  |  | 1 | 0 |  |  | 1 | 3 | 0 |  |  |  | 1 | 0 | 0 |  |  |
|  | 5 | \* |  |  | 1 | 9 | \* |  |  | 7 | D | \* |  | 1 | 9 | **\*** |  |  | 7 | D | \* |  |  | 2 | 7 | 1 | \* |  |
|  | 5 |  |  |  |  | 5 |  |  |  |  | 5 |  |  |  | 3 |  |  |  |  | 4 |  |  |  |  |  | 4 |  |  |
| 1 | 9 |  |  |  | 7 | D |  |  | 2 | 7 | 1 |  |  | 4 | B |  |  | 1 | F | 4 |  |  |  | 9 | C | 4 |  |  |

5(16)\*5(16)+0(16) = 5\*5 = 25, 25 mod 16 = 9, 25 div 16 = 1

5(16)\*0(16)+1(16) = 1

5(16)^2 = 19(16)

25\*5 = 125, 125 mod 16 = 13 = D(16), 125 div 16 = 7

9(16)\*5(16)+0(16) = 9\*5 = 45, 45 mod 16 = 13 = D(16), 45 div 16 = 2

5(16)\*1(16)+2(16) = 5\*1 + 2 = 7

5(16)^3 = 7D(16)

D(16)\*5(16)+0(16) = 13\*5 = 65, 65 mod 16 = 1, 65 div 16 = 4

7(16)\*5(16)+4(16) = 7\*5+4 = 39, 39 mod 16 = 7, 39 div 16 = 2

0(16)\*5(16)+2(16) = 2

5(16)^4 = 271(16)

9(16)\*3(16)+0(16) = 9\*3 = 27, 27 mod 16 = 11 = B(16), 27 div 16 = 1

1(16)\*3(16)+1(16) = 1\*3+1 = 4

19(16)\*3(16) = 4B(16)

D(16)\*4(16)+0(16) = 13\*4 = 52, 52 mod 16 = 4, 52 div 16 = 3

7(16)\*4(16)+3(16) = 7\*4=3 = 31, 31 mod 16 = 15 = F(16), 31 div 16 = 1

0(16)\*4(16)+1 = 1

7D(16)\*4(16) = 1F4(16)

1(16)\*4(16)+0(16) = 1\*4 = 4, 4 mod 16 = 4, 4 div 16 = 0

7(16)\*4(16)+0(16) = 7\*4 = 28, 28 mod 16 = 12 = C(16), 28 div 16 = 1

2(16)\*4(16)+1(16) = 2\*4+1 = 9, 9 mod 16 = 9, 9 div 16 = 0

271(16)\*4(16) = 9C4(16)

|  |  |  |
| --- | --- | --- |
| 2,00(16) |  5(16)    /            | 0,666      20      /      20   /  20 | 1,00(16) | 5(16)  /            | 0,333  10      /  10   /  10 | 0,333  | 5(8)  /            | 0,0A3  03    33  /  13   /    4 |
| 4,00(16) |  5(16)    /            | 0,CCC      40      /      40   /  40 | 0,CCC(16) |  5(16)    /            | 0,28F      C      /      2C   /  4C | 0,28F(16) |  5(16)    /            | 0,083      2      /      28   /  0F |

20(16) = 2\*16+0= 32, 32 div 5 = 6, 32 mod 5 = 2

20(16) = 2\*16+0= 32, 32 div 5 = 6, 32 mod 5 = 2

20(16) = 2\*16+0= 32, 32 div 5 = 6, 32 mod 5 = 2

2(16)\*5(16)^(-1) = 0,666(16)

10(16) = 1\*16+0 = 16, 16 div 5 = 3, 16 mod 5 = 1

10(16) = 1\*16+0 = 16, 16 div 5 = 3, 16 mod 5 = 1

10(16) = 1\*16+0 = 16, 16 div 5 = 3, 16 mod 5 = 1

33(16) = 3\*16+3 = 51, 51 div 5= 10 = A(16) , 51 mod 5 = 1

13(16) = 1\*16+3 = 19, 19 div 5= 3, 19 mod 5 = 4

1(16)\*5(16)^(-2) = 0,0A3(16)

40(16) = 4\*16+0= 64, 64 div 5 = 12 = C(16), 64 mod 5 = 4

40(16) = 4\*16+0= 64, 64 div 5 = 12 = C(16), 64 mod 5 = 4

40(16) = 4\*16+0= 64, 64 div 5 = 12 = C(16), 64 mod 5 = 4

C(16) = 12, 12 div 5 = 2, 13 mod 5 = 2

2C(16) = 2\*16+12 = 44, 44 div 5 = 8, 44 mod 5 = 4

4C(16) = 4\*16+12 = 76, 76 div 5 = 15 = F(16), 76 mod 5 = 1

28(16) = 2\*16+8 = 40, 40 div 5 = 8, 40 mod 5 = 0

F(16) = 15, 15 div 5 = 3, 15 mod 5 = 0

4(16)\*5(16)^(-3) = 0,083(16)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| c | 2 | 1 | 0 |  | 1 | 0 | 0 |
|  | 9 | C | 4 | , | 0 | 0 | 0 |
|  | 1 | F | 4 | , | 0 | 0 | 0 |
|  |  | 4 | B | , | 0 | 0 | 0 |
|  |  |  | 5 | , | 0 | 0 | 0 |
|  |  |  | 3 | , | 0 | 0 | 0 |
|  |  |  | 0 | , | 6 | 6 | 6 |
|  |  |  | 0 | , | 0 | A | 3 |
|  |  |  | 0 | , | 0 | 8 | 3 |
|  | C | 0 | B | , | 7 | 8 | C |

6(16)+3(16)+3(16) = 6+3+3 = 12 = C(16)

6(16)+A(16)+8(16) = 6+10+8 = 24, 24 div 16 = 1, 24 mod 16 = 8

6(16)+1(16) = 6+1 = 7

4(16)+4(16)+B(16)+5(16)+3(16) = 4+4+11+5+3 = 27, 27 div 16 = 1, 27 mod 16 = 11 = B(16)

C(16)+F(16)+4(16)+1(16) = 12+15+4+1 = 32, 32 div 16 = 2, 32 mod 16 = 0

9(16)+1(16)+2(16) = 9+1+2 = 12, 12 div 16 = 0, 12 mod 16 = 12 = C(16)

**Student 1: Vlad Bogdan-Tudor**

y(16) = C0B,78C(16)

b = 16

h = 5

We will use the ***the method of successive divisions/multiplications***

* calculations in the source base (b)
* it is recommended for *b > h*, *b* (source base),  *h*(destination base)

N(b) = (amam-1...a1a0, a-1...a-n)(b) = N’(h)

* for the integer part the method of successive divisions by the

destination base (h) is applied

* for the fractional part we apply a complementary method:

successive multiplications by the destination base (h)

**The method of successive divisions:**

* the integer part is divided by h (destination base) obtaining a quotient and a remainder.
* the quotient is divided by h obtaining a new quotient an a new remainder, …
* the process of successive divisions ends when 0 is obtained as quotient.
* the remainders, in the reverse order of obtaining them, are the digits of the new representation in base h.

**The method of successive multiplications:**

* the fractional part is multiplied by h obtaining a number with an integer part and a fractional one
* we continue with the multiplication of this new fractional part,...
* the process of the successive multiplications continues until one of the following conditions is satisfied:

a) the fractional part becomes 0;

b) an established number of digits of the fractional part were calculated

c) periodicity is obtained.

* the integer parts, in the order of obtaining them are the digits of the fractional part in the destination representation.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| C0B(16) | :5(16) | 268(16) | :5(16) | 7B(16) | :5(16) | 18(16) | :5(16) | 4(16) | :5(16) |
| 20 | 268(16) | 26 | 07B(16) | 2B | 18(16) | 18 | 04(16) | 4 | 0 |
| 2B | | 38 | | 3 | | 4 | |  | |
| 3 | | 1 | |  | |  | |  | |
|  | |  | |  | |  | |  | |
|  | |  | |  | |  | |  | |

**Calculations are in base 16:**

C(16)= 12; 12 div 5 = 2; 12 mod 5 = 2

20(16) = 2 \* 16 + 0 \* 1 = 32; 32 div 5 = 6; 32 mod 5 = 2

2B(16) = 2 \* 16 + 11 \* 1 = 43; 43 div 5 = 8; 43 mod 5 = 3

2(16) = 2; 2 div 5 = 0; 2 mod 5 = 2

26(16) = 2 \* 16 + 6 \* 1 = 38; 38 div 5 = 7; 38 mod 5 = 3

38(16) = 3 \* 16 + 8 \* 1 = 56; 56 div 5 = 11 = B(16); 56 mod 5 = 1

7(16) = 7; 7 div 5 = 1; 7 mod 5 = 2

2B­(16) = 2 \* 16 + 11 \* 1 = 43; 43 div 5 = 8; 43 mod 5 = 3

1(16) = 1; 1 div 5 = 0; 1 mod 5 = 1

18(16) = 1 \* 16 + 8 \* 1 = 24; 24 div 5 = 4; 24 mod 5 = 4

4(16) = 4; 4 div 5 = 0; 4 mod 5 = 4

So, for the integer part we have: C0B(16)  = 44313(5)

**Conversion of the fractional part**   0,78C(16) ~= 0,213(5)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2 | 2 | 3 | 0 |  |  | 1 | 3 | 3 | 0 |  |  | 3 | 3 | 3 | 0 |  |  |
| **0,** | 7 | 8 | C | **\*** |  | 0, | 5 | B | C | **\*** |  | 0, | C | A | C | **\*** |  |
|  |  |  | 5 |  |  |  |  |  | 5 |  |  |  |  |  | 5 |  |  |
| 2, | 5 | B | C |  |  | 1, | C | A | C |  |  | 3, | F | 5 | C |  |  |

**Calculations are in base 16:**

0,78C(16) \* 5(16) = 2,5BC(16)

C(16) \* 5 + 0 = 12 \* 5 = 60; 60 div 16 = 3; 60 mod 16 = 12 = C(16)

8 \* 5 + 3 = 43; 43 div 16 = 2; 43 mod 16 = 11 = B(16)

7 \* 5 + 2 = 37; 37 div 16 = 2; 37 mod 16 = 5

0 \* 5 + 2 = 2; 2 div 5 = 0; 2 mod 5 = 2

0,5BC(16) \* 5(16) = 1,CAC(16)

C(16) \* 5 + 0 = 12 \* 5 = 60; 60 div 16 = 3; 60 mod 16 = 12 = C(16)

B(16) \* 5 + 3 = 11 \* 5 + 3 = 55 + 3 = 58; 58 div 16 = 3; 58 mod 16 = 10 = A (16)

5 \* 5 + 3 = 28; 28 div 16 = 1; 28 mod 16 = 12 = C(16)

0 \* 5 + 1 = 1; 1 div 16 = 0; 1 mod 16 = 1

0,CAC(16) \* 5(16) =

C(16) \* 5 + 0 = 12 \* 5 = 60; 60 div 16 = 3; 60 mod 16 = 12 = C(16)

A(16) \* 5 + 3 = 10 \* 5 + 3 = 53; 53 div 16 = 3; 53 mod 16 = 5

C(16) \* 5 + 3 = 12 \* 5 + 3 = 60 + 3 = 63; 63 div 16 = 3; 63 mod 16 = 15 = F(16)

0 \* 5 + 3 = 3; 3 div 16 = 0; 3 mod 16 = 3

Therefore, we have: C0B,78C(16)  **=~** 44313,213(5) with a precision of 3 digits.

**Subject 3: representations**

Option 4: floating-point representation of real numbers, with mantissa>1

* + Student 1:
    - chooses a real number x in decimal, with 5 digits at the integer part and 2 digits at the fractional part.
    - represents x in floating-point notation, SP, mantissa >1
    - writes the content of the memory location in hexadecimal: M(16)
  + Student 2:
    - receives M(16) from Student 1and finds the real decimal number having M(16) as its floating-point representation, SP, mantissa >1, to verify the correctness of the result obtained by Student 1

**Student 1: Vlad Bogdan-Tudor**

X = 56432,54

In order to convert the decimal number X = 56432,54 into binary we will use ***the method of successive divisions/multiplications.*** Calculations are performed in the source base 10.

To make the conversion shorter and faster, we will use base 8 as an intermediate base.

Firstly, we need to represent the integer part 56432

For this part, we will have do successive divisions by the destination base 8, and then using rapid conversions we will replace each digit from this number in base 8 by the corresponding group of 3 binary digits (adding if necessary insignificant zeros to the left).

56432 = 156160(8) = 001 101 110 001 110 000(2)

56432 / 8 = 7054 remainder 0

7054 / 8 = 881 remainder 6

881 / 8 = 110 remainder 1

110 / 8 = 13 remainder 6

13 / 8 = 1 remainder 5

1 / 8 = 0 remainder 1

Now, we need to represent the fractional part 0,54

For this, we will have to do successive multiplications by the destination base 8, and then using rapid conversions we will replace each digit from this number in base 8 by the corresponding group of 3 binary digits (adding if necessary insignificant zeros to the right, not applicable in our case, we will do one more divion to get better precision).

0,54 = 0,424365(8) = 0,100010100011110101(2)

0,54 \* 8 = 4,32

0,32 \* 8 = 2,56

0,56 \* 8 = 4,48

0,48 \* 8 = 3,84

0,84 \* 8 = 6,72

0,72 \* 8 = 5,76

So now we have:

56432,54 = 1101110001110000,100010100011110101(2)

= 1,101110001110000100010100011110101(2) \* 215

e = 15 (exponent)

q = 127 (bias)

c = e + q = 15 + 127 = 142 = 128 + 8 + 4 + 2 = 2^7 + 2^3 + 2^2 + 2^1 = 10001110(2)

m > 1 so we have 1 hidden bit! The bit 1 before the “,” (before the comma) is not represented internally.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| S | c=e+127 (8 bits)  ->  ,  <-  mantissa (23 bits) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | | 0 | 1 | 0 | 1 | | 1 | 1 | 0 | 0 | | 0 | 1 | 1 | 1 | | 0 | 0 | 0 | 0 | | 1 | 0 | 0 | 0 | | 1 | 0 | 1 | 0 | |
| 4 | | | | 7 | | | | 5 | | | | | C | | | | | 7 | | | | | 0 | | | | | 8 | | | | | A | | | | |

We can notice that the memory content in hexadecimal is 475C708A

**Student 2: Vlad Mircea-Dragoș**

I received the number M(16) = 475C708A(16)

We will use now the rapid conversions to convert the M number from base 16 to base 2:

M(2) = 01000111010111000111000010001010(2)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| S | c=e+127 (8 bits)  ->   ,  <-  mantissa (23 bits) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 0 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | | 0 | 1 | 0 | 1 | | 1 | 1 | 0 | 0 | | 0 | 1 | 1 | 1 | | 0 | 0 | 0 | 0 | | 1 | 0 | 0 | 0 | | 1 | 0 | 1 | 0 | |
| 4 | | | | 7 | | | | 5 | | | | | C | | | | | 7 | | | | | 0 | | | | | 8 | | | | | A | | | | |

S = 0 ==> the decimal number is positive

c = 10001110(2) = 2^7+2^3+2^2+2^1 = 128+8+4+2 = 142

c = e+q

q = 127(bias)

==> e = c-q = 142-127 = 15(exponent)

mantissa>1 ==> 1 is the hidden bit

X = 1,10111000111000010001010(2)\*2^15 = 1101110001110000,10001010(2)

1101110001110000(2)  = 1\*2^4+1\*2^5+1\*2^6+1\*2^10+1\*2^11+1\*2^12+1\*2^14+1\*2^15 =

= 32768+16384+4096+2048+1024+64+32+16 = 56432

0,10001010(2) = 1\*2^(-1)+1\*2^(-5)+1\*2^(-7) = 0,5+0,03125+0,0078125 = 0,5390625 **=~** 0, 54

So we obtained the number 56432,54 , which is the correct result.