Number System (Contd.)

OCTAL AND HEXADECIMAL ADDITION AND SUBTRACTION

Octal chart for addition

0	1	2	3	4	5	6	7
1	2	3	4	5	6	7	10
2	3	4	5	6	7	10	11
3	4	5	6	7	10	11	12
4	5	6	7	10	11	12	13
5	6	7	10	11	12	13	14
6	7	10	11	12	13	14	15
7	10	11	12	13	14	15	16

When we are said to add two octal numbers, we need to follow the above chart. For example, Suppose you have to add $(14.45)_8$ and $(34.26)_8$, then what we have to do?
Now look into the above chart, and then add the digits like this:

1 1 (Carry)
14.45
+ 34.26
50.73

So, $(14.45)_8 + (34.26)_8 = (50.73)_8$

Now there is another method, in which we will add the numbers as per decimal value and then follow the given steps:

Step 1: If the sum <= 7, no change
Step 2: If the sum >7, add 2 with the sum

Let us take the previous example-
$(14.45)_8 + (34.26)_8$
6+5 = 11>7 ⇒ 11+2 = 13 (3 as sum and 1 as carry)
4+3 = 7 ⇒ No change
4+4 = 8>7 ⇒ 8+2 = 10 (0 as sum and 1 as carry)
2+3 = 5<7 ⇒ No change

OCTAL SUBTRACTION

Steps for Octal subtraction using 7's complement: (similar to 1's complement)

Let us take two Octal numbers, A= $(50.73)_8$ and B= $(34.26)_8$

Step 1: Balance both the numbers A and B.

Step 2: Get seven's complement of B (77.77 – 34.26)
43.51

Step 3: Add A with 7's complement of B
50.73
43.51
114.44

Step 4: If we get a carry in the sum, then add it with the LSB of the sum.
14.44
1
14.45
Thus $(14.45)_8$ is the final answer.

Step 4 (b): If there is no carry then, get 7's complement of the sum and that will be the answer with a minus (-) sign.

Steps for Octal subtraction using 8's complement: (similar to 2's complement)

Let us take two Octal numbers, A= $(50.73)_8$ and B= $(34.26)_8$

Step 1: Balance both the numbers A and B.

Step 2: Get seven's complement of B (77.77 – 34.26) = 43.51
Now get eight's complement = 43.51 + 1(in LSB) = 43.52

Step 3: Add A with 7's complement of B
50.73
43.52
114.45

Step 4: If we get a carry in the sum, then ignore it.
Thus $(14.45)_8$ is the final answer.

Step 4 (b): If there is no carry then, get 8's complement of the sum and that will be the answer with a minus (-) sign.

Hexadecimal chart for addition

0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	10
2	3	4	5	6	7	8	9	A	B	C	D	E	F	10	11
3	4	5	6	7	8	9	A	B	C	D	E	F	10	11	12
4	5	6	7	8	9	A	B	C	D	E	F	10	11	12	13
5	6	7	8	9	A	B	C	D	E	F	10	11	12	13	14
6	7	8	9	A	B	C	D	E	F	10	11	12	13	14	15
7	8	9	A	B	C	D	E	F	10	11	12	13	14	15	16
8	9	A	B	C	D	E	F	10	11	12	13	14	15	16	17
9	A	B	C	D	E	F	10	11	12	13	14	15	16	17	18
A	B	C	D	E	F	10	11	12	13	14	15	16	17	18	19
B	C	D	E	F	10	11	12	13	14	15	16	17	18	19	1A
C	D	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B
D	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C
E	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D
F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E

Like Octal addition, there are two ways to perform Hexadecimal addition.

1. Follow the above chart and do the addition
2. Add in decimal form and then do the following changes:
    a. If Sum<=9, No change
    b. If Sum is in between 10 to 15, replace it with A to F accordingly
    c. If Sum is in between 16 to 25, Subtract 6 from the Sum
    d. If Sum>25, Sum= ((Sum – 6) – 10) + 1 as Carry

For example:~

$(BD.AF)_{16} + (A6.CE)_{16} = ?$

Solution:

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  11  1          (Carry)
  BD.AF
+ A6.CE
 164.7D
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Working:

15+14 = 29 – 6 = 23 – 10 = 13 (D) + 1 carry
11+12 = 23 – 6 = 17 (Sum = 7, Carry =1)
14+ 6 = 20 – 6 = 14 (Sum = 4, Carry =1)
12+10 = 22 – 6 = 16 (Sum = 6, Carry =1)

$(F3.D5)_{16} + (AC.7E)_{16} = ?$

Solution:

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    F3.D5
  +AC.7E
   1A0.53
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Working:

14+5 = 19 – 6 = 13 (Sum=3, carry=1)
14+7 = 21 – 6 = 15 (Sum=5, carry=1)
4+12 = 16 – 6 = 10 (Sum=0, carry=1)
16+10 = 26 – 6 = 20 – 10 = 10 (A) + 1 carry

HEXADECIMAL SUBTRACTION

Steps for Hexadecimal subtraction using 15's complement: (similar to 1's complement)

Let us take two hexadecimal numbers, A= $(1A0.53)_{16}$ and B= $(F3.D5)_{16}$

Step 1: Balance both the numbers A and B. i.e., 1A0.53 – 0F3.D5

Step 2: Get 15's complement of B (FFF.FF – 0F3.D5)
F0C.2A

Step 3: Add A with 15's complement of B
1A0.53
F0C.2A
10AC.7D

Step 4: Since we get a carry in the sum, add it with the LSB of the sum.
0AC.7D
1
0AC.7E
Thus $(AC.7E)_{16}$ is the final answer.

Step 4 (b): If there is no carry then, get 15's complement of the sum and that will be the answer with a minus (-) sign.

Task:

- Add $(23.107)_8 + (123.123)_8$
- Add $(15A)_{16} + (E79)_{16}$
- Subtract $(50.73)_8 – (34.26)_8$ using 7's and 8's complement.
- Subtract $(F3.D5)_{16} – (1A0.53)_{16}$ using 15's complement.
- Subtract $(1A0.53)_{16} – (F3.D5)_{16}$ using 16's complement.

--THANK YOU --