Module-2.

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1) $9AC2 = 16^3 \times 9 + 16^2 \times 10 + 16 \times 12 + 16^0 \times 2$
$= 36864 + 2560 + 192 + 2$
$= 39618$

2) **r's complement:**

Given a number N, with base = r
No. of digits of N is m.

$\therefore$ r's complement of $N = r^m - N$
$= (r-1)$'s complement $+1$

For example, $(74)_{10}$.
10's complement of $74 = 10^2 - 74 = 100 - 74$
$= 26$

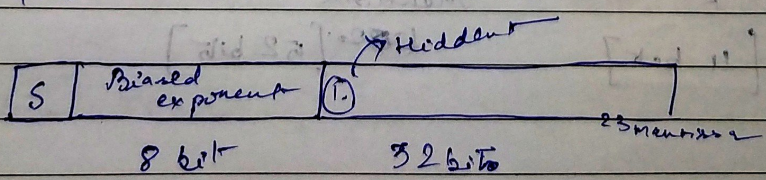
(r-1)'s complement:

Given a number N,
No. of digits of N is m.
base = r

Thus, (r-1)'s complement $= (r^m - 1 - N)$

E.g., $(74)_{10}$.
9's complement of $74 = 10^2 - 1 - 74 = 100 - 1 - 74$
$= 25$

5) -7.5



$7 = 011$
$.5 \times 2 = 1.0 \rightarrow 1.$

$\therefore$ $7.5 = \cancel{111.10}$ $111.10 = 1.111 \times 2^2$

$E' = 2$

$E = E' + 127 = 2 + 127 = 129$

$= 10000001$

The corresponding IEEE 754 single precision representation

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1	10000001	(1.) 1110000 0
S	E	
1 bit	8 bit	23 bit

6) 6.25

$6 = 110$

$.25 \times 2 = 0.50 \longrightarrow 0$

$0.50 \times 2 = 1.00 \longrightarrow 1$

Thus, $6.25 = 110.01$

~~1.1000~~

$= 1.1001 \times 2^2$

$= 1.\underbrace{100100......0}_{\text{Mantissa}} \times 2^2$

$E' = 2$

$E = E' + ~~127~~\ 1023 = 2 + 1023$

$= 1025$

$= 10000000001$

0	10000000001	1.1001000....0
S	E	Mantissa
[1 bit]	[11 bit]	~~…~~ [52 bits]

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7) The drawbacks of sign-magnitude representation are:-

(i) There are two representations for 0 (zero) → $(0000\ 0000)_2$ (+0) and $(1000\ 0000)_2$, leading to inefficiency & confusion.

(ii) Positive and negative integers ~~as~~ need to be processed separately.

9) $A = (85)_{10}$, $B = (27)_{10}$

Using 10's complement.

$A - B = A + (-B)$

$= 85 +$ 10's complement of $(27)_{10}$

$= 85 + 73$

$= \boxed{1}58$

(extra carry bit, result is positive)

[10's complement of $(27)_{10} = 10^2 - 27 = 100 - 27 = 73$]

Actual result $= (58)_{10}$

Using 9's complement method.

$A - B = A + (-B)$

$= 85 +$ 9's complement of $(27)_{10}$

$= 85 + \cancel{72}\ 73$

$= \cancel{162}\ \boxed{1}58$

extra carry bit

[9's complement of $(27)_{10} = \cancel{82}\ 73$]

Actual result $= (58)_{10}$

85
+77
162
+1
163

10) We have, 17.75

$17 = 10001$

$.75 \times 2 = 1.50 \rightarrow 1$

$0.50 \times 2 = 1.00 \rightarrow 1$

$(17.75)_{10} = (10001.11)_2$

12) ~~7's complement of 375 = 7^2~~

$(375)_{10}$

$r = 10$, $m = 3$

7's complement of $375 = 7^3 - 375$

$= 343 - 375$

$= -32$

13) 8's complement of $375 = 8^3 - 375$

$= 512 - 375$

$= 137$

14) 8's complement of $370 = 8^3 - 370$

$= 512 - 370$

$= 242$

15) $x - 1 = (377)_8$

$x = ?$

$$\begin{array}{r} (377)_8 \\ +(1)_8 \\ \hline 400 \end{array}$$

$(7)_8 = (7)_{10}$

$(1)_8 = (1)_{10}$

$= (8)_{10}$

$= (10)_8$

$(377)_8 = 3\times 8^2 + 7\times 8^1 + 7\times 8^0$

$= 192 + 56 + 7$

$= (255)_{10}$

$x - (1)_{10} = 255$

$\Rightarrow x = 255 + 1 = 256$

$(256)_{10} = (400)_8$

(6) $x + 1 = (2340)_5$

$x = (2340)_5 - (1)_5$

$$\begin{array}{r} 2340 \\ -1 \\ \hline 2334 \end{array}$$

$(2340)_8 = (345)_{10}$

$(x+1) = (345)_{10} \Rightarrow x = (344)_{10}$

$$\begin{array}{l|l} 5 & 344 \\ \hline 5 & 68 \rightarrow 4 \\ \hline 5 & 13 \rightarrow 3 \\ \hline 5 & 2 \rightarrow 3 \\ \hline 5 & 2 \rightarrow 2 \\ \hline & 0 \end{array}$$

$= (2334)_5$

3) Subtracting $(1011)_2$ from $(101)_2$ using 1's complement method.

→ $(1011)_2 - (101)_2$

1's complement of $(101)_2 = (010)_2$

$$\begin{array}{r} 101 \\ +010 \\ \hline 111 \end{array}$$

$(101)_2 - (1011)_2$

1's complement of $(1011)_2 = (0100)_2$

```
  101
 0100
-----
[1]001
```

$= -001$

4) $(1011)_2 - (101)_2$

2's complement of $(101)_2$:-

```
                101
1's complement  010
               ----
                111
               + 1
               ----
             [1]000
```

```
 1011
+ 000
-----
  011  → Ans.
```

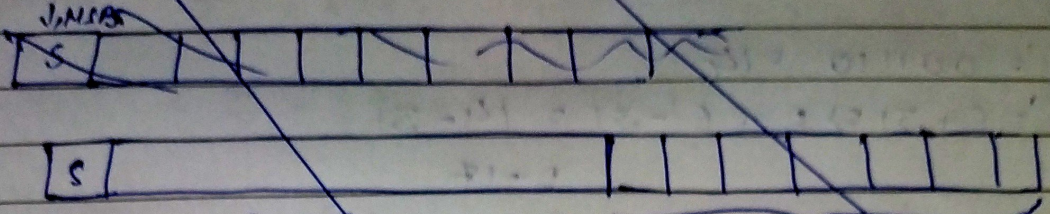
$(101)_2 - (1011)_2$.

2's complement of $(1011)_2$:-

```
            1011
1's comp : 0100
           -----
             111
             +1
           -----
             000
```

```
  101
+ 000
-----
  101
```

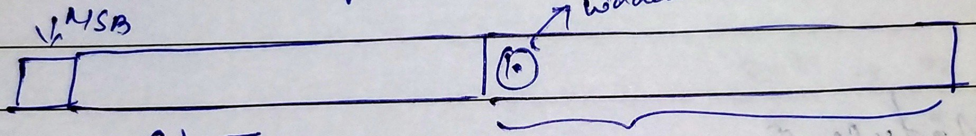
~~MSB sign bit~~
~~9 LSBs are mantissa~~
~~6 LSBs are exponent in excess 31.~~



~~6 bits exponent (excess 31 format)~~

~~9 bit Mantissa~~

ii) 16 bit representation
MSB sign bit.
9 LSBs are mantissa
6 LSBs are exponent in excess 31.



6 bits exponent (excess 31 format)

9 bit mantissa

(i). $-1.5 \times 10^2 = -150$ sign bit = 1.

(150 to binary value)

$150 = 10010110 = 1.0010110 \times 2^7$

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$= 1.001011000$

$(1 + \text{Mantissa})$

Exponent, ~~Ekt~~ $E = 7$

$E' = E + 31 = 38 = 100110$

sign-bit	E'	Mantissa
1	100110	(1) 001011 000

→ hidden

(ii) ~~$E' = 100110$~~

(ii) $E' = 001110 = 14$

$E' = E + 31 \Rightarrow E = E' - 31 = 14 - 31$

$= -17$

$M = 110000000$

$= 1.110000000$

$= 1.1100 \ldots\ldots 0$

$N = 1.11 \times 2^{-17}$

$= M * 2^{E}$

~~$= 1.11 * 2^{-17}$~~

$= (1\,1100000)_2$

Module-5.

7)
```
(1) int i, j, k=0;
(2) for (i = n/2; i <= n; i++) {
(3) for (j = 2; j <= n; j = j*2) {
(4) k = k + n/2;
    }
}
```

cost	time
c1	1
c2	$(n/2 + 1)$
c3	$\sum_{i=n/2} (n/2 + 1)\, x_i$
c4	$n/2$

Total cost

$n = 10$

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Total cost $= C_1 \times 1 + C_2 \times (n/2+1) + C_3 \sum_{i=n/2}^{n} i(n/2+1) + C_4 \times n/2$

$= C_1 + C_2\left(\frac{n}{2}+1\right) + C_3\left(\frac{n}{2}+1\right)\sum_{i=n/2}^{n} i + C_4 \times \left(\frac{n}{2}+1\right)$

$n = 10 \quad \sum_{i=5}^{10} i = 5+6+\dots+10 = \frac{n}{2} + \left(\frac{n}{2}+1\right) + \dots + n$

$= \frac{n}{2} + \left(\frac{n}{2}+1\right) + \left(\frac{n}{2}+2\right) + \dots + \left(\frac{n}{2}+\frac{n}{2}\right)$

$= \left(\frac{n}{2}+0\right) + \left(\frac{n^2}{2}+1\right) + \left(\frac{n^2}{2}+2\right) + \dots + \left(\frac{n}{2}+\frac{n}{2}\right)$

$= \frac{n}{2} \times \frac{n}{2} + \left[0+1+2 \dots + \frac{n}{2}\right]$

$= \frac{n^2}{4} + \frac{\frac{n}{2}\left(\frac{n}{2}+1\right)}{2}$

$= \frac{n^2}{4} + \frac{\frac{n^2}{4} + n/2}{2} = \frac{n^2}{4} + \frac{n^2}{8} + \frac{n}{4}$

$= \frac{3n^2}{8} + \frac{n}{4}$

$= C_1 + C_2 \times \left(\frac{n}{2}+1\right) + C_3\left[\frac{3n^2}{8} + \frac{n}{4}\right]$

$= n^2 \times \left[\frac{3}{8}C_3\right] + n\left[\frac{C_2}{2} + \frac{C_3}{4} + \frac{C_4}{2}\right] + \left[C_1 + C_2 + C_4\right]$

$= an^2 + bn + c$

$= \Theta(n^2) = \Omega(n^2) = O(n^2)$

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