Workshop on Vedic Maths---module 1 (Basics)

Nikhilam Method of Multiplication

1. Base 10

```
        9      -1            13     +3            12     +2
  X     7      -3          X 14     +4             8     -2
------------------- ---------------------      ------------
        9-3 |   3            17 |   $_1$2          10     -4 = 96.
Or      7-1 |   3            18 |    2 = 182.   (10    0
Or 9+7-10 |     3                                         -4)=96
Or 10-1-3  |    3
-------------------
          6 |   3 = 63.
```

2. Base 100

```
        93     -7            88     -12           107    +7
        97     -3            94     -6            112    +12
       -----------        --------------        -------------
        90     21 = 9021     82     72 = 8272     119    84 = 11984

112    +12          63     +13          89     +79          887
-13
 84    -16          54     +4           13     +3           907
+7
-------------       ---------------     -------------       ----------
---
 96    -$_1$92 = 9408    2/67   52      92     $_{23}$7 = 1157     9*894
-91
                    33 ½   52 = 3402                        8046
-91
                                                            804509
```

3. Base 1000

```
        887    -113          1047   +47                 888    -12
        997    –3            991    -9                  888    -12
        ---------------      -------------              ---------------
        884    339 = 884339  1038   -423 = 1037577 9*876  $_1$44
                                                        7884   $_1$44 =
        788544

9997    -0003                988    -012                99979  -00021
9997    -0003                998    -002                99999  -00001
----------------             --------------             ------------------
9994     0009 = 99940009     986     024 = 986024       99978   00021
```

<u>Squaring:</u>

1. Add the positive difference from the base to the quantity or Subtract the negative
   difference from the base from the quantity.
2. Append the square of difference to the result obtained from 1 above.

3. Take carry over as per rules followed earlier, that is carry over tens in case of base 10,
and hundreds in case of base 100.ss Page 2 6/1/2008
4. Remember to multiply or divide the result obtained from 1 above, if base is other than
any power of 10.

Eg.

19	+9	$28/_{8}1$	= 361.
19	-1	18*2/1	= 361.
93	-7	86/49	= 8649.
108	+8	116/64	= 11664
989	-11	978/121	= 978121
59	+9	68÷2/81	= 3481
43	+3	46*4/9	= 1849

Square of Number ending in 5

1. Multiply number of tens with next higher integer and annex 25 to the product.

Eg: 35^2 = [3x4][25] = [12][25] = 1225
$_{5}5^2$ = [5x6][25] = [30][25] = 3025

Square of Number ending in 6

From the previous method we can calculate the squares of nos. ending in 5, so this squaring method is just an extension of that. So here te square of the no. ending in 6 is the sum of

- Square of the the previous no. i.e. ending in 5, eg in case of 36 ,it is 35^2
- The previous number ,i.e number ending in 5, in te present eg,it is 35
- The given number,in this case 36

Eg: 36^2 = 35^2 + 35+36=1225+35+36=1296

Square of Number ending in 4

Same case as the previous one of nos. ending in 6 , but with a slight modification

If it is required to find $A^{2,}$ where A=34 then $A^2 = (A+1)^2 - A - (A+1)$

Eg,

34^2 =35^2 -35-34=1225-35-34=1156

General method for squaring of Numbers :

Let's illustrate this directly with example.
Ex1. 25^2

Step1: 5^2 = 25. _, _, 5 carry 2
Step2: 2 X 5 X 2 = 20 plus carry = 22; _,25 carry 2
Step3: 2^2 = 4 plus carry = 625

Ex2. 67^2

Step1: 7^2 = 49, _,_,9 carry 4
Step2: 6X7X2 = 84 plus carry = 88; _,8,9 carry 8
Step3: 6^2 = 36 plus carry = 4489

Multiplication of Cognate numbers:

1. This is applicable to numbers with number of tens identical and units totaling together 10. e.g. 23 & 27, 73 & 77, 84 & 86, 62 & 68, 154 & 156, 173 & 177, etc.
2. Multiply number of tens with next higher integer and annex the product of units to the roduct so arrived.

Eg.

23 * 27 = 2*3/21 = 621.
153 * 157 = 15*16/21 = 24021

Multiplication with a number of 9's

Case:1 When the number of digits are same in multiplicand and in multiplier.

1. Arithmetically 1 less than the multiplicand forms left part of the answer.
2. Complement of left part forms right part of the answer.

Eg.

7*9 = 6/3
15*99 = 14/85
673*999 = 672/327

9876*9999 = 9875/0124

Case: 2 When the digits in multiplicand are less than the digits in multiplier.

1. Prefixes as many zeros as required to make both multiplicand and multiplier of same number of digits.
2. Proceed as in case 1 above.

Eg.

6*99 = 06*99 = 05/94
73*999 = 073*999 = 072/927

Case:3 When the number of digits in multiplicand are more than the number of digits in the multiplier.

1. Divide the multiplicand vertically so as to have same number of digits as in multiplier on the right side of the division.
2. Subtract 1 more than the number on left of division from the multiplicand, which gives left part of the answer.
3. Right hand part should be subtracted from the multiplier+1 to get right side part of the answer.

Eg.

43 * 9 => 4 | 3 122 * 9 => 12 | 2 111011*99 => 1110 | 11

-5 | 9+1-3 -13 | 9+1-2 -1111

38/7 = 387 109/8 = 1098 109900/89

Multiplying a number by 11.

To multiply any 2-figure number by 11 we just put the total of the two figures between the 2 figures.

26 x 11 = 286
Notice that the outer figures in 286 are the 26 being multiplied.

And the middle figure is just 2 and 6 added up

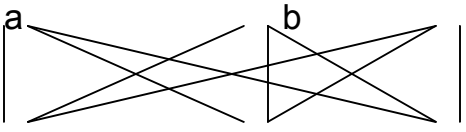
77 x 11 = 847
This involves a carry figure because 7 + 7 = 14
we get 77 x 11 = 7(1)47 = 847.

Urdhva-Tiryak for Multiplication

This is a general method applicable to any kind of multiplication. In this method starting from first digit on left, we go on multiplying crossways all digits and add them to get individual digits of the answer.
Each position is allowed only one digit, so digits in excess of one ar carried over to next multiplication-addition on the left side.

Eg.

a b c



```
f                    g                h
-------------
af  | ag+bf | ah+bg+cf | bh+cg | ch
```

1. First just first digit on left is multiplied.
2. Then First two digits from the left are multiplied and added.
3. Similarly we go on getting digits till we reach upto first and the last digits from the left.
4. Then we start moving towards right and go on reducing digits to be multiplied and get
   successive digits of the answer.

```
1   1   1            1   0   8                 5   8   2
1   1   1            1   0   8                 2   3   1
-----------          -----------               ----------------
1 | 2 | 3 | 2 |1         1 | 0 | 6 | 0 | 4                10| 1 | 3 | 4 | 2
= 12321                  1      6                3  3   1
                     ----------------          -----------------
                     1 | 1 | 6 | 6 | 4 = 11664  13| 4 | 4 | 4 | 2 =134442

7    8    5                3    2    1
3    6    2                0    5    2
----------------           ----------------
21| 6 | 7 | 6 | 0          0 | 5 | 6 | 9 | 2
  6| 7 | 4 | 1             1    1
-----------------          ----------------
28| 4 | 1 | 7 | 0 = 284170 1 | 6 | 6 | 9 | 2 = 16692

8    7    2    6    5
3    2    1    1    7
------------------------
24| 7 | 8 | 7 | 2 | 7 | 5 | 7 | 5
  3  2   3   9   6  2   4   3
---------------------------------
28| 0 | 2 | 6 | 9 | 0 | 0 | 0 | 5
```


Eg. (a+b) (a+9b) a + b $\qquad$ $x^5+3x^4+5x^3+3x^2+x+1$

a + 9b $\qquad$ $7x^5+5x^4+3x^3+x^2+3x+5$

```
                 -------- ---------      --------- ---------------------------------------------------------
```

$a^2+10ab+9b^2$

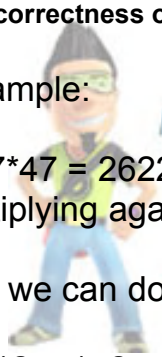
$7x^{10}+26x^9+53x^8+56x^7+33x^6+40x^5+41x^4+38x^3+19x^2+8x+5$

When a certain power is not present in any of the expression, we put zero in its place and proceed same as above.
Student should use his/her prudence in selecting the method to multiply different numbers either with the help of *Nikhilam* or with the help of *Urdhva-Tiryak*.
When, all the digits are more than 5, viniculam method is also useful.

Eg. 889*898

```
          1   1   1   1
    1   1   0   2
    ----------------
1 | 2 | 0 | 2 | 3 | 2 | 2
      7   9   8   3   2   2
```

Check for the correctness of multiplication



Take an example:

We know 57*47 = 2622, but how do we know if the multiplication is correct without multiplying again,

Here is how we can do it easily:

57 = 5+7 = 12 = 1+2 = 3 and 46 = 4+6 = 10 = 1+0 = 1.
Since we multiply 57 x 46 = 3 x 1 = 3. Check with the answer 2622 = 2+6+2+2 = 12 = 1+2 =3.