Multiplication

Magic or Madness

Multiplication is a quick (and accurate) technique to solve repeated addition calculations

Long Multiplication

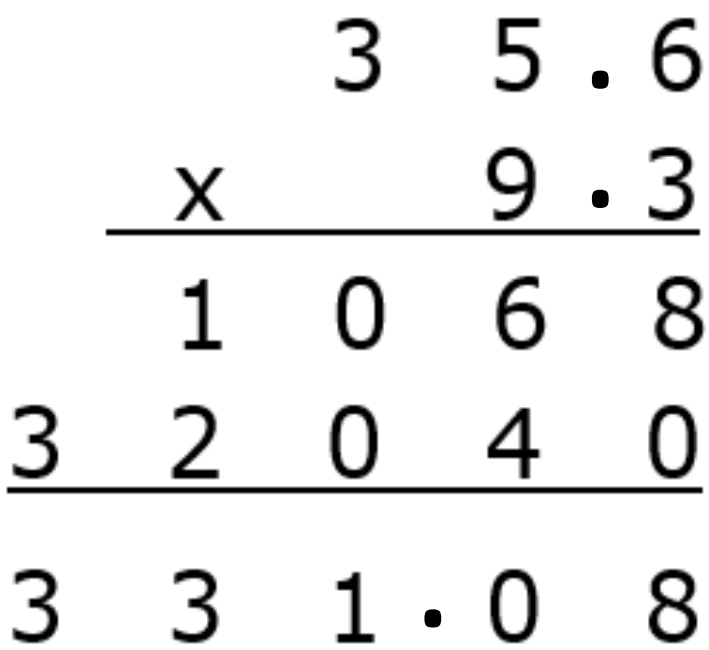
Magic or Madness?

Column Multiplication

356 x 93

			3	5	6
	x			9	3
		1	0	6	8
	3	2	0	4	0
	3	3	1	0	8

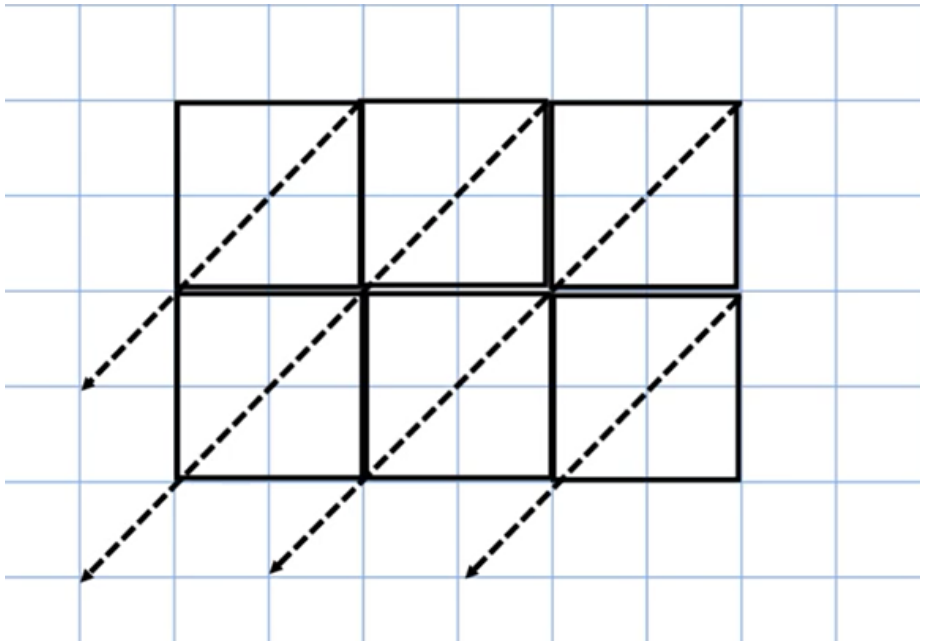
Column Multiplication - decimal



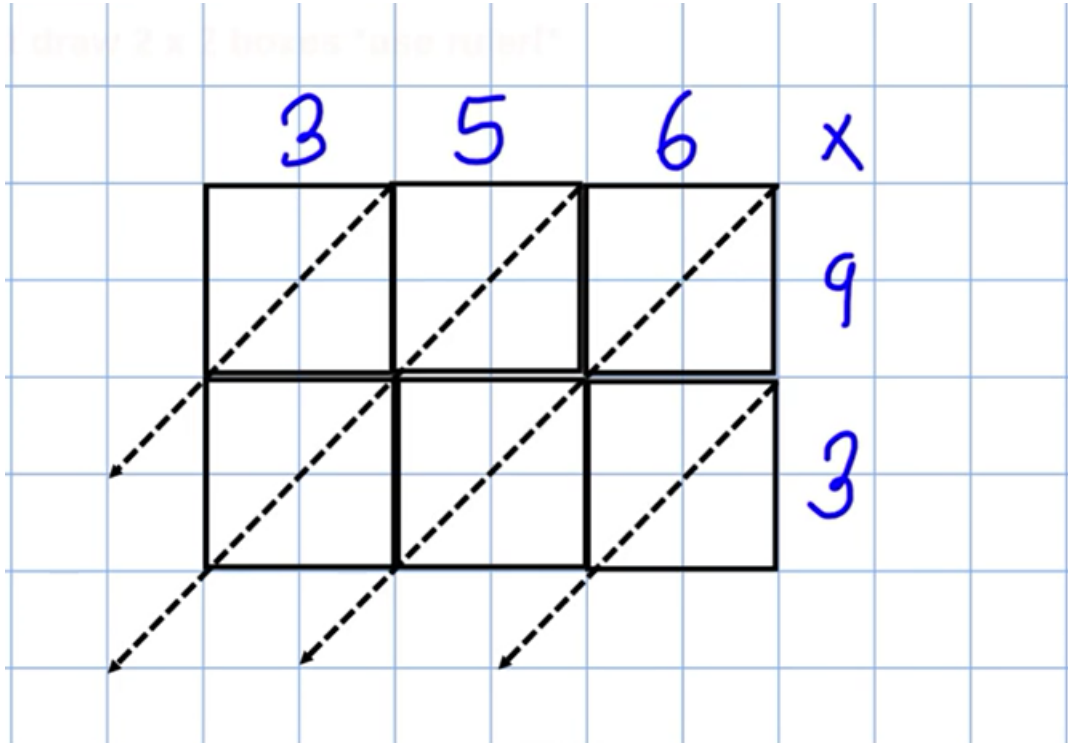
‘Traditional’ Method ?

Madness ?

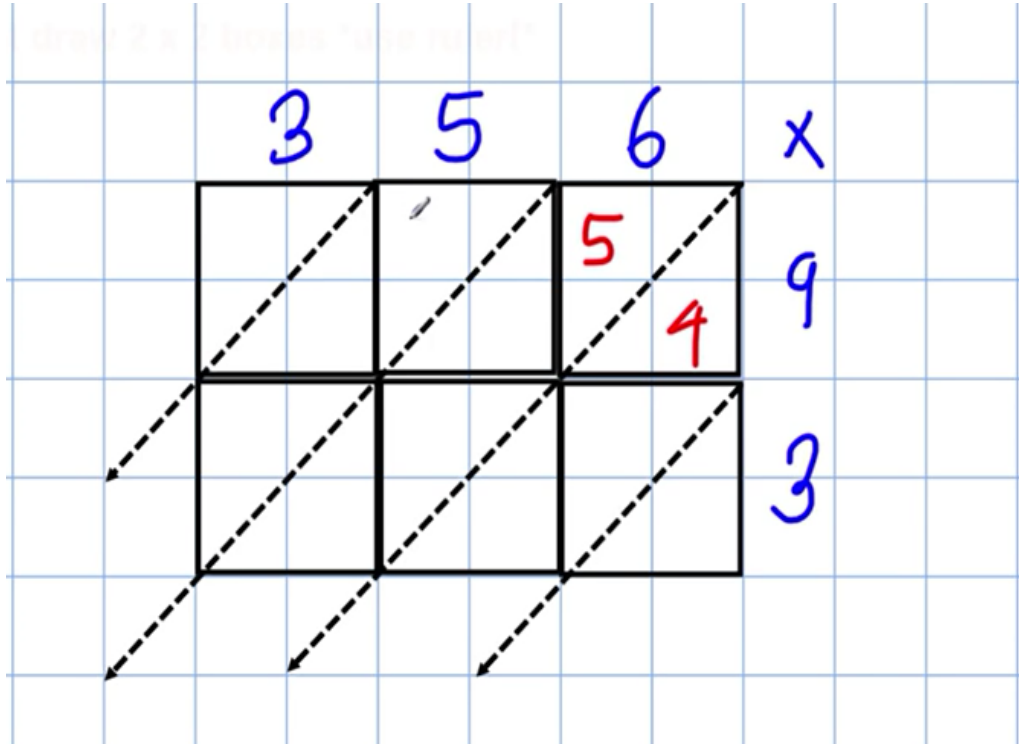
Gelosia Multiplication 356 x 93



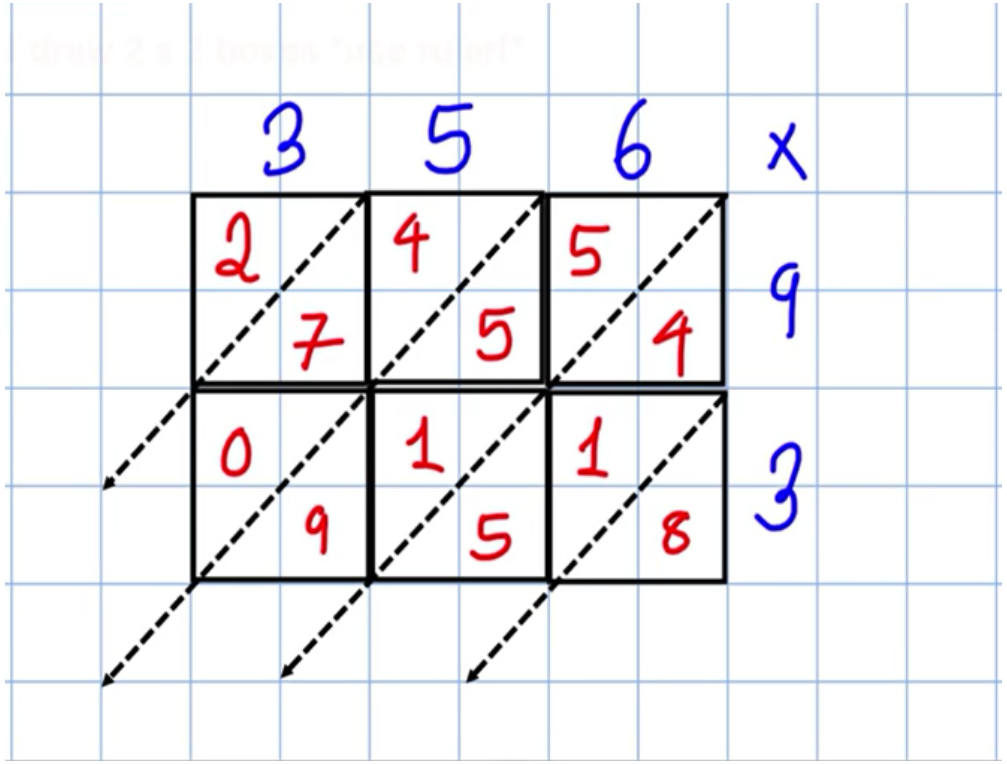
Gelosia Multiplication 356 x 93



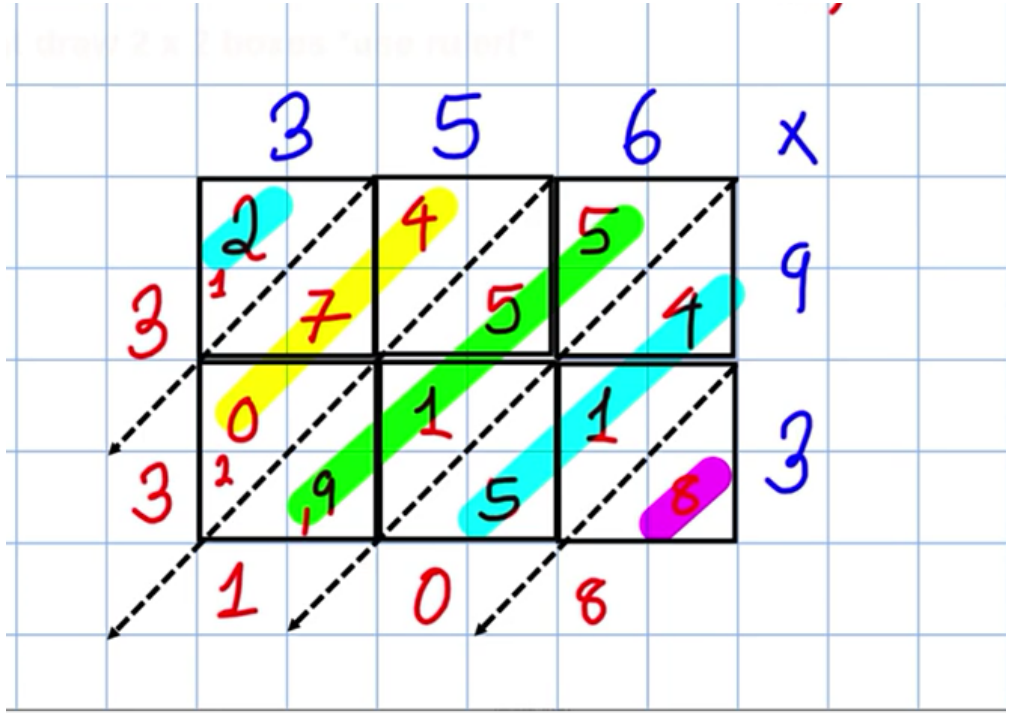
Gelosia Multiplication



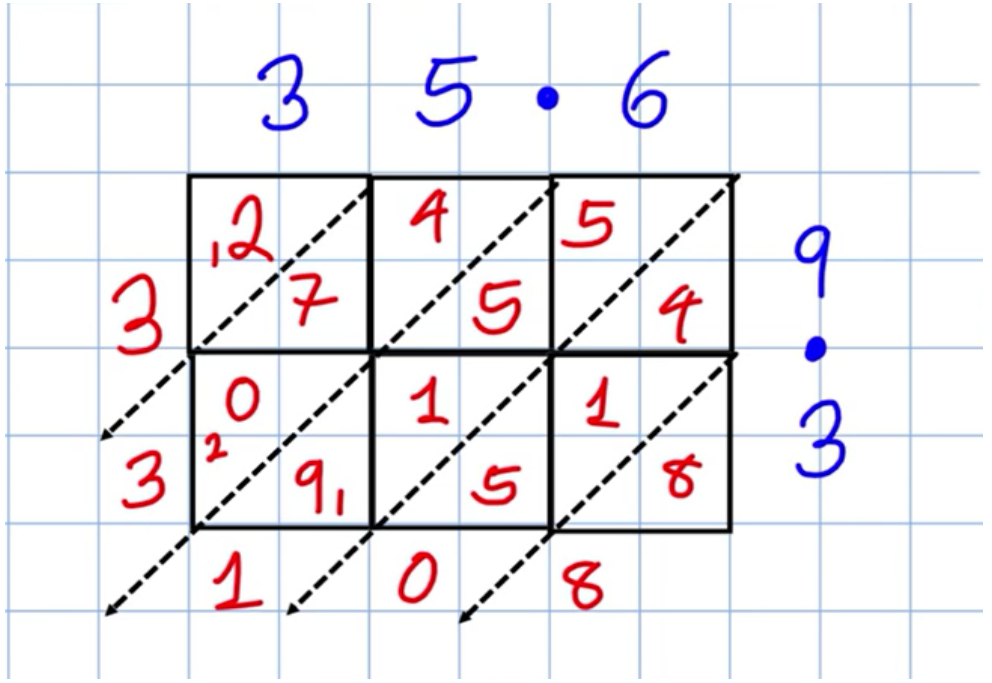
Gelosia Multiplication



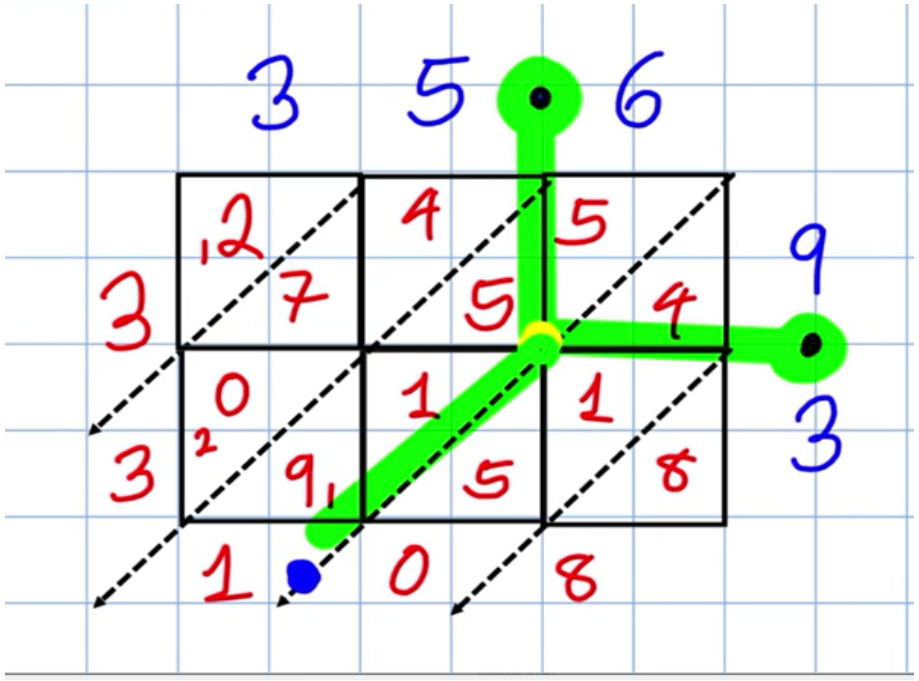
Gelosia Multiplication



Gelosia Multiplication - decimal



Gelosia Multiplication - decimal



Answer and decimal point all line-up – MAGIC !

Column Multiplication

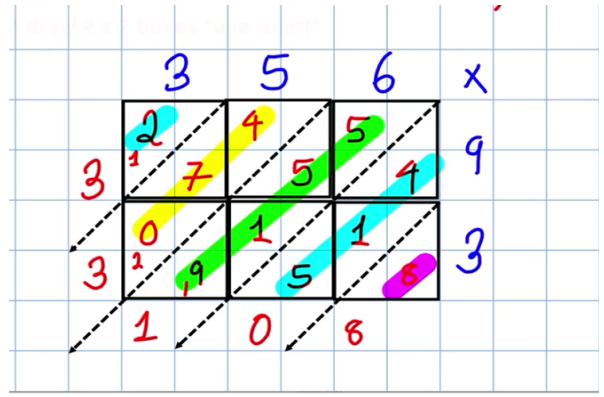
Origin – Europe **18th Century**

$$\begin{array}{rrrrr} & & 3 & 5 & 6 \\ & \times & & 9 & 3 \\ \hline & 1 & 0 & 6 & 8 \\ 3 & 2 & 0 & 4 & 0 \\ \hline 3 & 3 & 1 & 0 & 8 \end{array}$$

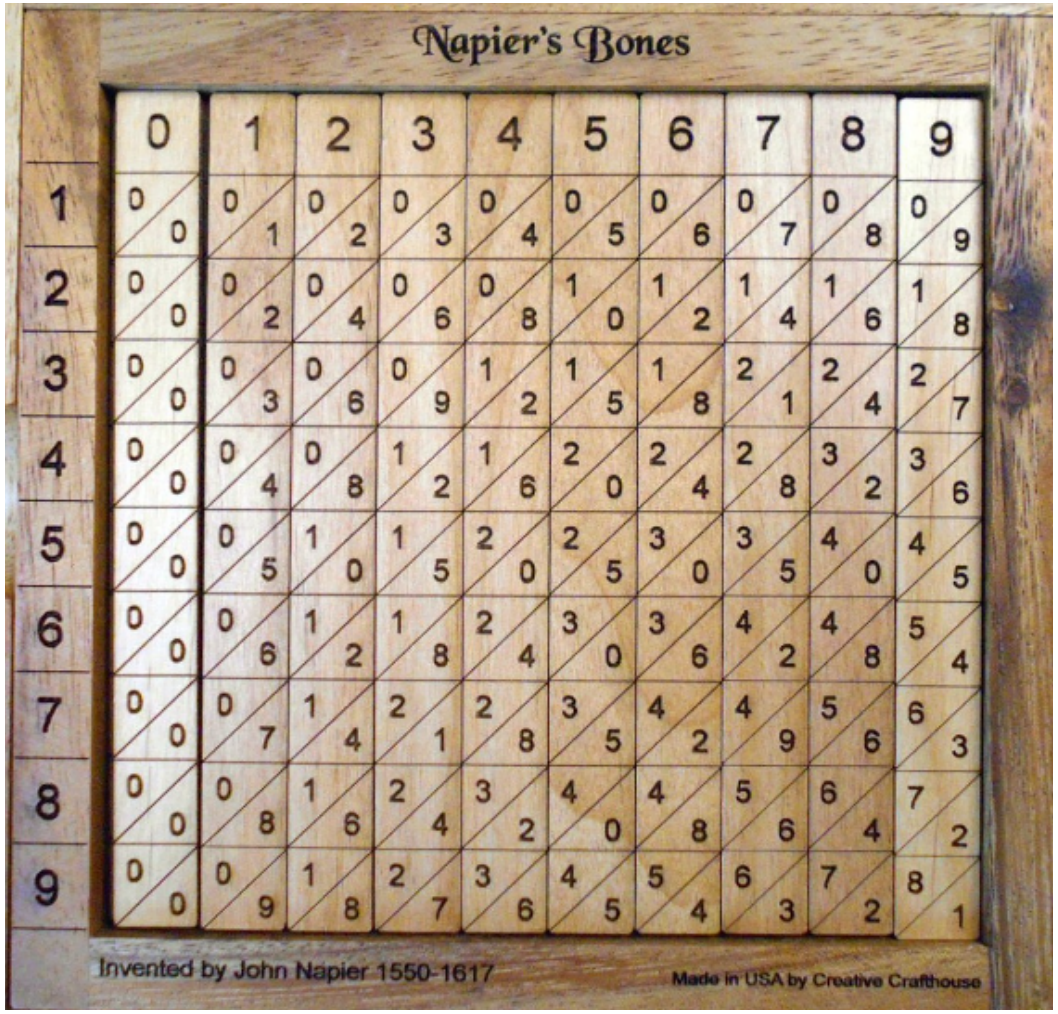
Gelosia Multiplication

Origin – from Hindu Mathematics

In Europe from **13th Century**



Napier’s Bones – Gelosia aid



Gelosia – 13th Century

Napier – 16th Century

Napier’s Bones – Gelosia aid

Gelosia – 13th Century

Napier – 16th Century
Developed his calculating aid for use by the growing artisans and merchants. Originally made from bone

Medieval Italy: Gelosia = Grid

Gelosia = Grid

Gelosia
=
Jealousy

Russian Multiplication – halving & doubling

356	x	93	Question
178	x	186	RHS even – ignore LHS
89	x	372	
44	x	744	RHS even – ignore LHS
22	x	1488	RHS even – ignore LHS
11	x	2976	
5	x	5952	
2	x	11904	RHS even – ignore LHS
1	x	23808	
		33108	answer – sum LHS

Egyptian Multiplication - doubling

1 X 356

2 X 712

4 X 1424

8 X 2848

16 X 5696

32 X 11392

64 X 22784

Blue values ignored as values 2 and 32 not required to make multiplier 93

64 + 16 + 8 + 4 + 1 ≡ 93

22784 + 5696 + 2848 + 1424 + 356 ≡ 33108

Egyptian Multiplication - doubling

1	X	356
2	X	712
4	X	1424
8	X	2848
16	X	5696
32	X	11392
64	X	22784

Ahmes Papyrus (Rhind) 1500BC

‘Multiplication’ – follows from Egyptian – ‘duplation’

64 + 16 + 8 + 4 + 1 = 93

22784 + 5696 + 2848 + 1424 + 356 = 33108

Alternative Grid – origin: 20th century

3	5	6	
27000	4500	540	9
900	150	18	3

300	50	6	
27000	4500	540	90
900	150	18	3

27000
4500
540
900
150
18
33108

Does not easily extend to decimal place calculations!

Why?

Amazing Multiplication

$$
\begin{aligned}
51 \times 51 &= 2601 \\
52 \times 52 &= 2704 \\
53 \times 53 &= 2809 \\
54 \times 54 &= 2916 \\
55 \times 55 &= 3025 \\
56 \times 56 &= 3136 \\
&\vdots
\end{aligned}
$$

What is the value of 57×57?

Multiplication – Magic !

$$
\begin{aligned}
51 \times 51 &= 2601 \\
52 \times 52 &= 2704 \\
53 \times 53 &= 2809 \\
54 \times 54 &= 2916 \\
55 \times 55 &= 3025 \\
56 \times 56 &= 3136 \\
&\vdots
\end{aligned}
$$

What is the value of 57×57?

Consider the perfect square,

$$
\begin{aligned}
N_n &= (50+n)^2 \qquad \text{where } n \in \mathbb{N} \\
&= 2500 + 100n + n^2 \\
&= (25+n) \times 100 + n^2 \\
\implies N_7 &= (25+7) \times 100 + 49 \\
&= \boxed{3249}
\end{aligned}
$$

Long Multiplication

Magic or Madness

Elaine Smith & Lynda Goldenberg