Leonardo of Pisa ("Fibonacci") (c. 1170–1250)

("Son of Bonacci")

His father was a merchant and a customs official, posted to a trading post in Algeria. Leonardo learned the Hindu-Arabic system there, and he later travelled through the Mediterranean.

He wrote four principal works that have survived and others (eg a commentary of Euclid) that have not.

Liber Abaci "The Book of the Abacus" or "The Book of Computation"

(1st Edition c 1202 – no copies have survived)
(2nd Edition c 1228 – 7 copies have survived with fragments of about as many others)

↳ a book on how do without one by using the improved efficiency of the Hindu-Arabic number system.

It's a textbook on the Hindu-Arabic number system and doing arithmetic in it. Examples and problems are drawn from commerce eg measurement, currency conversion, interest calculations & so on.

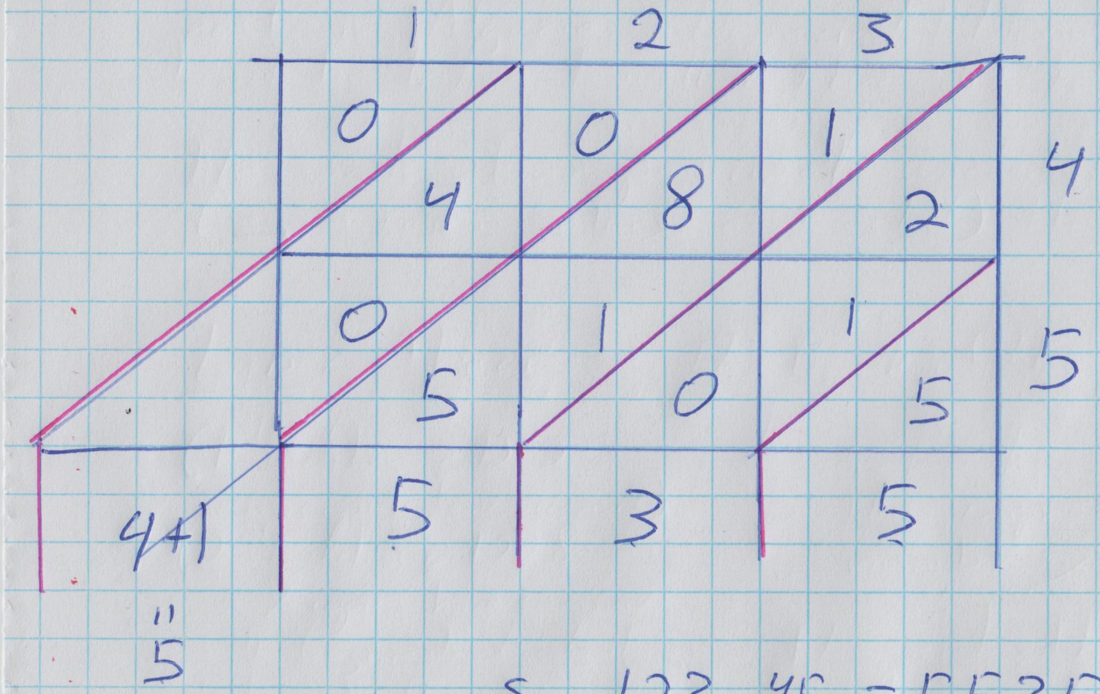
Has some sections with more purely mathematical problems: Chinese Remainder Theorem, perfect & prime numbers, sums of arithmetic series, finding approximations to irrationals, solving simultaneous linear equations, geometry & so on.

The famous Rabbit problem that leads to the Fibonacci sequence
$a_0 = 1 \quad a_1 = 1 \quad a_n = a_{n-1} + a_{n-2}$. $(n \geq 2)$
occurs in this section.

Lattice multiplication (Fibonacci style)

(– likely adapted from al-Kwarizmi's Algebra)

– method for multiplying Hindu-Arabic numbers



$$
\begin{array}{r}
123 \\
\times\ 45 \\
\hline
1615 \\
4920 \\
\hline
5535
\end{array}
$$

"long multiplication"

So $123 \times 45 = 5535$

The Hindu-Arabic system caught on faster among merchants (and officials dealing with them) and traders than among scholars and other officials.

<u>Practica Geometriae</u> (c. 1220) - a collection of geometry problems with solutions, with a focus on applications (surveying, construction, ...)

<u>Flos</u> (1225) - Consists to algebra problems posed by Johannes of Palermo for a math contest sponsored by the Holy Roman Emperor Frederic II ("Barbarossa").

- Fibonacci was the only one of the contestants to solve all the problems

<u>eg</u>
- Find all the rational numbers r s.t. $r^2 \pm 5$ is a rational <u>square</u>.
- $x^3 + 2x^2 + 10x = 20$ (solve for x)

Liber quadratorum "Book of Squares"

(1225)

(survived as a single manuscript.)

– algebra, solving Diophantine equation (finding integer & rational solutions)

Best known for Fibonacci's Identity:

$$(a^2+b^2)(c^2+d^2) = (ac-bd)^2+(ad+bc)^2$$
$$= (ac+bd)^2+(ad-bc)^2$$

[An even more general form occurs in Brahmagupta's work]

(one consequence is that the sums of two squares are closed under multiplication)

Some very original parts, eg congruous numbers

An integer is <u>congruous</u> if it has the form

$ab(a-b)(a+b)$ if $a+b$ is even

or $4ab(a-b)(a+b)$ if $a-b$ is odd.

He showed that if n is congruous, then 24 divides n, and that if $x^2+n=y^2$ & $x^2-n=z^2$, then n must be congruous. [This is one of the early precursors of modular arithmetic.]