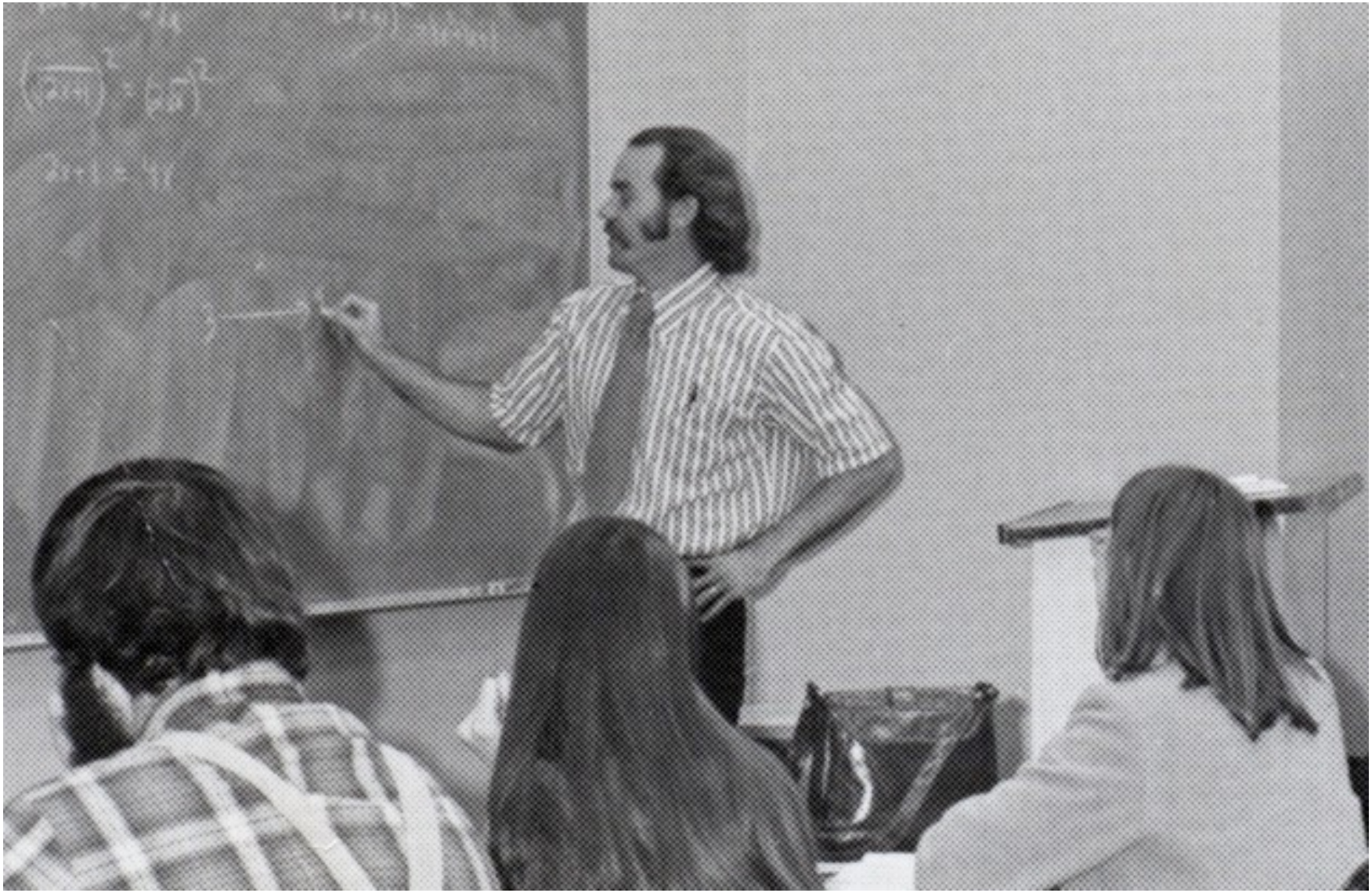
Islam and Mathematics: A Story of Cooperation and Peace

Pat McKeague

August 2016

Presentation Slides: www.mckeague.com



Cuesta College 1974

Elementary Algebra Themes

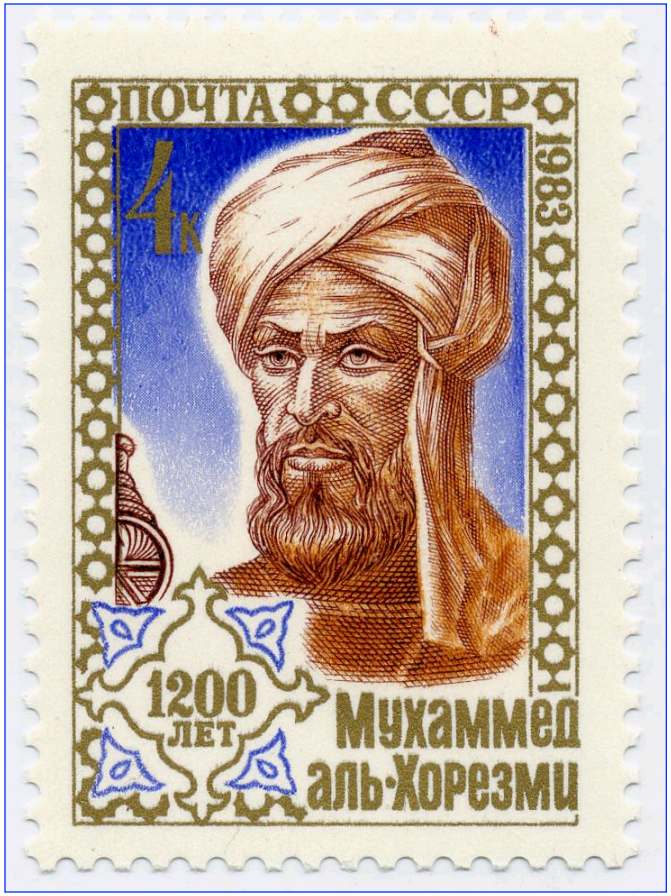
Method I reserve five minutes of each class session to bring in the things that you think are interesting in, and around, mathematics.

Target Audiences

- **All Students**
- **Student like me in the 60s**
- **Muslim Student**

Why do We Call it Algebra?

Postage stamp issued by the Soviet Union in 1983, to mark the 1200th anniversary of the birth of Al-Khwarizmi in 783.



Khwarizmi
is now
Khiva
in Uzbekistan

Abu Ja'far Mohammed ibn Musa Al-Khwarizmi

Father of Ja'far, Mohammed, son of Moses, native of the town of Al-Khwarizmi

A Page from Al-Khwarizmi's Book in 820

The Compendious Book on Calculation by Completion and Balancing

Al-Kitāb al-mukhtaṣar fī hīsāb al-ğabr wa'l-muqābala

(Arabic)

Merriam-Webster's
COLLEGIATE® DICTIONARY

Atlas | Reverse Dictionary | Rhyming Dictionary
Collegiate® Dictionary | Collegiate® Thesaurus | Unabridged

algebra

Main Entry: **alǵeábra**
Pronunciation: `'al-j&-br&`
Function: *noun*
Etymology: Medieval Latin, from Arabic *al-jabr,* literally, the reduction
1 : a generalization of arithmetic in which lett representing numbers are combined according the rules of arithmetic
2 : any of various systems or branches of mathematics or logic concerned with the properties and relationships of abstract entitie (as complex numbers, matrices, sets, vectors, groups, rings, or fields) manipulated in symbo form under operations often analogous to thos of arithmetic

Merriam-Webster SINCE 1828

Simple Definition of ALGORITHM

Popularity: Top 20% of words

: a set of steps that are followed in order to solve a mathematical problem or to complete a computer process

Medieval Latin; Old French, from Medieval Latin *algorismus,* from Arabic *al-khuwārizmi,* from *al-Khwārizmī fl* A.D. 825 Islamic mathematician

First Known Use: 1926

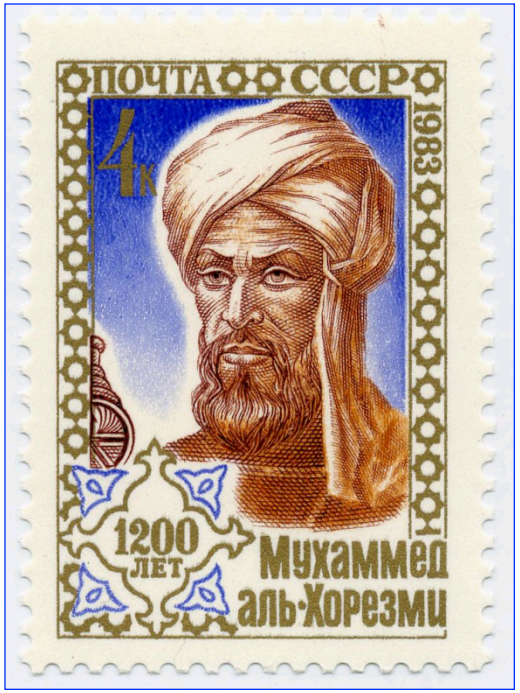
That was a five-minute piece of a theme.

Completing the Square

What is the square which combined with ten of its roots will give a sum total of 39?

Solve $x^2 + 10x = 39$

The manner of solving this type of equation is to take one-half of the roots just mentioned. Now the roots in the problem before us are 10. *Therefore take* 5, *which multiplied by itself gives* 25, *an amount which you add to* 39 *giving* 64. *Having taken then the square root of this which is* 8, *subtract from it half the roots,* 5 *leaving* 3. *The number* 3 *therefore represents one root of this square*



$$x^2 + 10x = 39$$

$$x^2 + 10x + 25 = 39 + 25$$

$$(x+5)^2 = 64$$

$$x + 5 = 8 \text{ or } x + 5 = -8$$

$$x = 3 \quad \text{or} \quad x = -13$$

The First Day of Class

Number Sequences
and
Inductive Reasoning

Sequence of Odd Numbers

1, 3, 5, 7, . . .

Sequence of Squares

1, 4, 9, 16, . . .

Odds: 1, 3, 5, 7, . . .

Squares: 1, 4, 9, 16, . . .

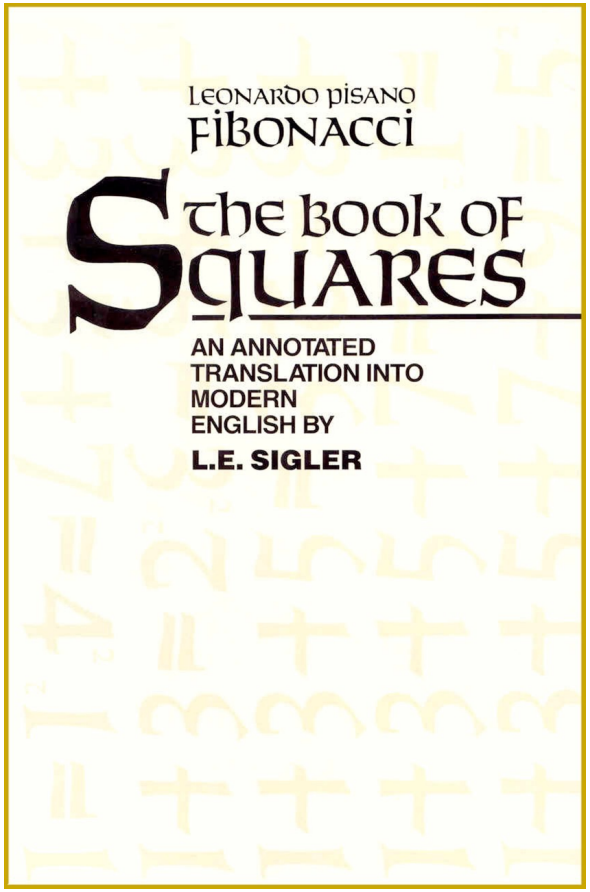
$$1 = 1 = 1^2$$

$$1 + 3 = 4 = 2^2$$

$$1 + 3 + 5 = 9 = 3^2$$

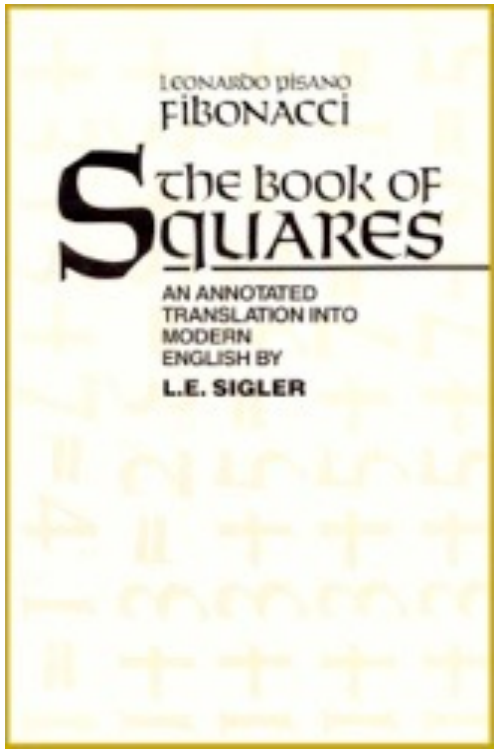
$$1 + 3 + 5 + 7 = 16 = 4^2$$

$$1 + 3 + 5 + 7 + 9 = 25 = 5^2$$



Building Squares from Odd Numbers

Introduction I thought about the origin of all square numbers and discovered that they arise out of the increasing sequence of odd numbers; for the unity is a square and from it is made the first square, namely 1; to this unity is added 3, making the second square, namely 4, with root 2; if to the sum is added the third odd number, namely 5, the third square is created, namely 9, with root 3; and thus sums of consecutive odd numbers and a sequence of squares always arise together in order.

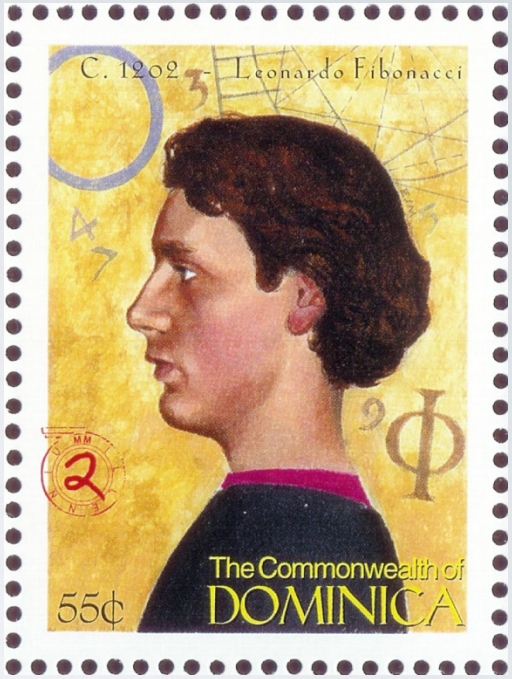


Tony Tasset
***Button Progression*, 1986**

This Will Have Been: Art, Love & Politics in the 1980s

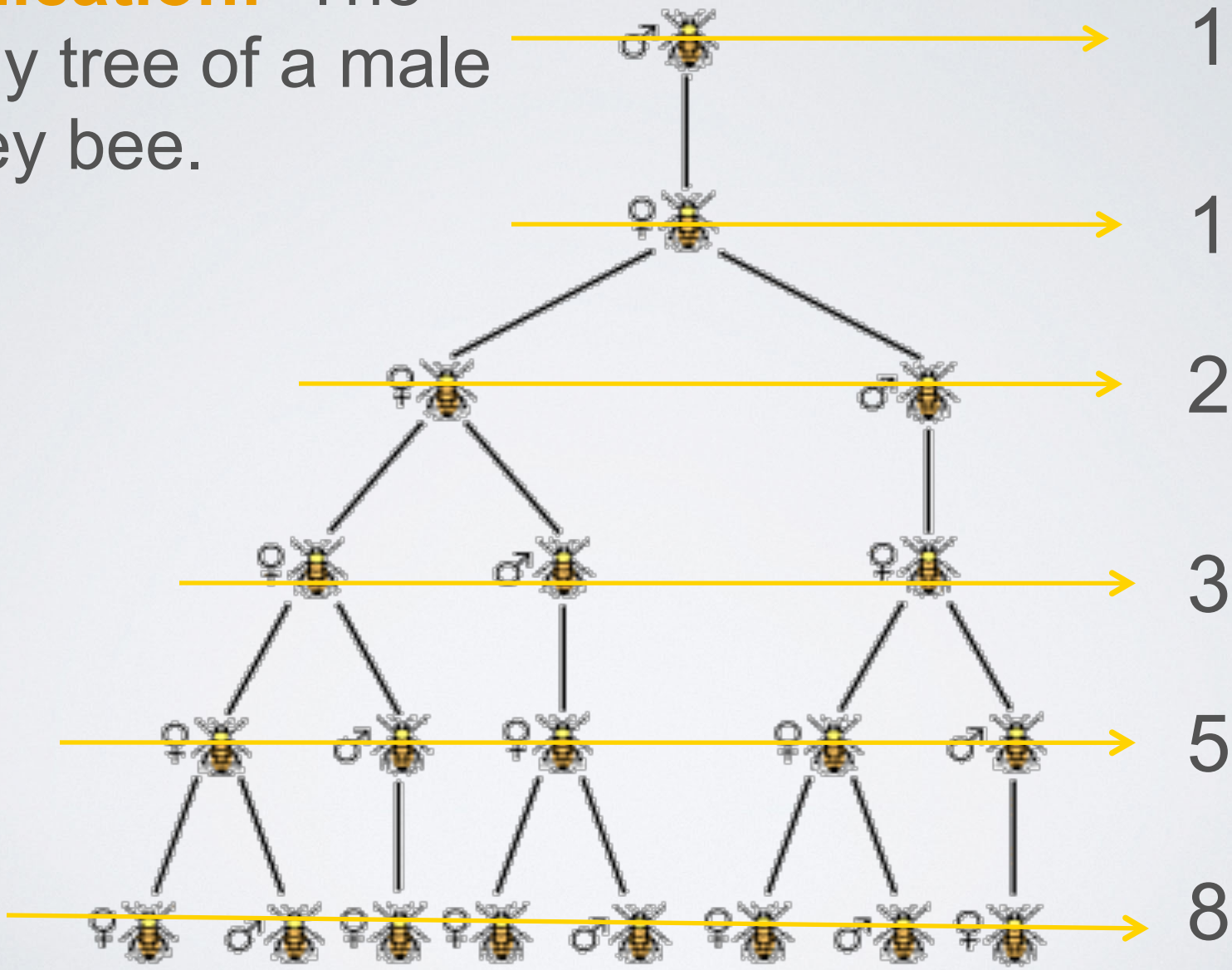
Fibonacci Sequence

1, 1, 2, 3, 5, 8, . . .

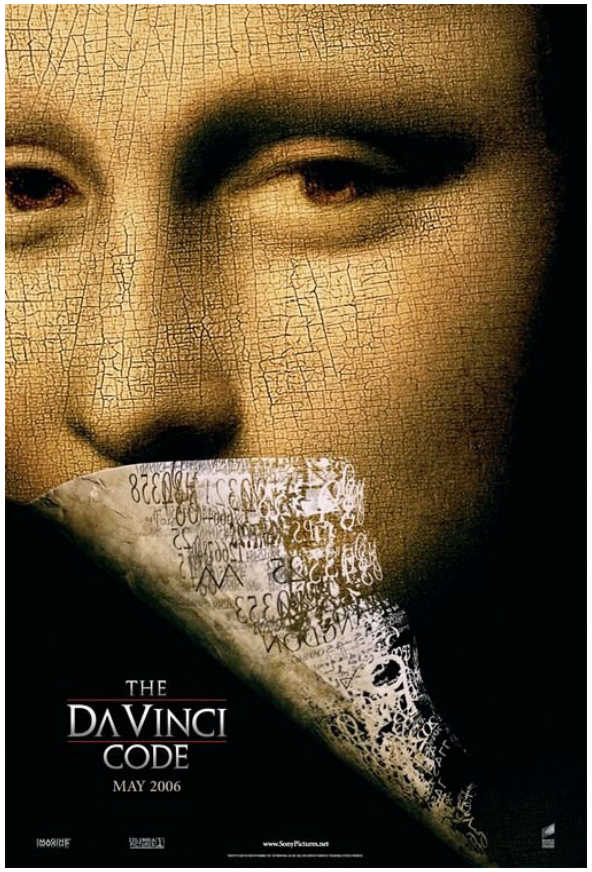


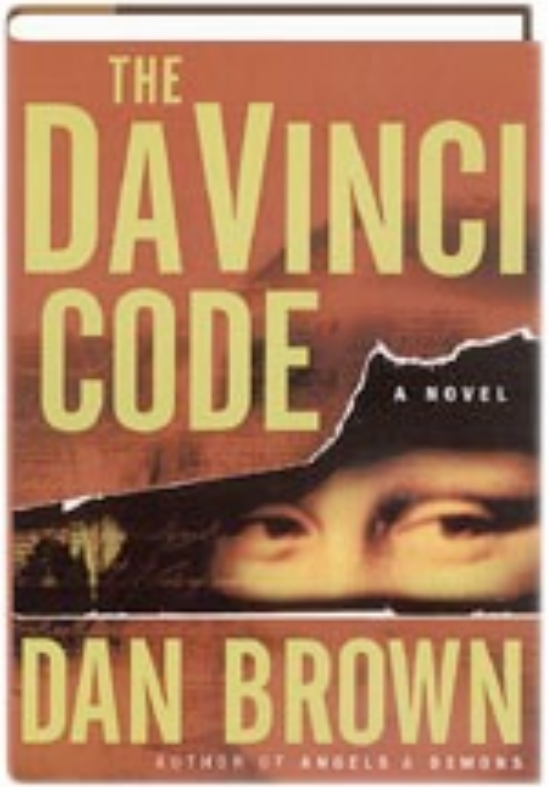
Application The number of bees in the family tree of a male honey bee.

Application: The family tree of a male honey bee.



Mathematics Around Us





13-3-2-21-1-1-8-5

O Draconian devil!

Oh, lame saint!

Let's travel to the birthplace of Al-Khwarizmi

(I want to show you something interesting.)


© 2010 Tele Atlas
© 2010 Europa Technologies
US Dept of State Geographer
© 2010 Google
©2010 Google


Georgia
Armenia
Azerbaijan
Khiva
Uzbekistan
Kyrgy
Tajikistan
Turkmenistan
Baghdad, Iraq
Afghanistan
Iraq
Iran
Kuwait
Pakistan
© 2010 Geocentre Consulting
© 2010 Europa Technologies
© 2010 Basarsoft
US Dept of State Geographer
Google

What is going on in Baghdad that would inspire someone to write an algebra book?

The House of Wisdom (750 CE)

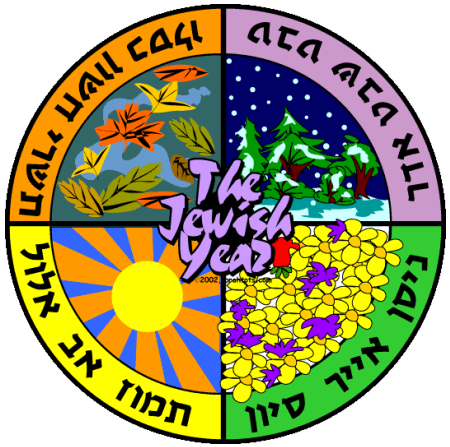
The House of Wisdom was a powerhouse of intellectual exploration and discussion. At one time it held four hundred thousand books. The scholars in the House of Wisdom discovered algebra; were adept at astronomy and navigation; studied the humanities, zoology and geography; as well as medicine, alchemy and chemistry. They translated all the Greek scientific and philosophical texts including those of Aristotle, Pythagoras, Plato, Hippocrates, and Euclid.

13th century Arabic translation of *Materia Medica*

Postage Stamp
Issued by Tunisia in 1979


Pisa
Khiva
Baghdad, Iraq
Alexandria, Egypt
Medina
Mecca
© 2010 Basarsoft
© 2010 Europa Technologies
© 2010 Tele Atlas
US Dept of State Geographer
©2010 Google

Modern Jewish Calendar



Between 70 CE and 1178 CE, the observation-based calendar was gradually replaced by a mathematically calculated one as described by the Muslim astronomer al-Khwarizmi (c. 780–850 CE) in 823.

Al-Khwarizmi's study of the Jewish calendar, *Risāla fi istikhrāj taʾrīkh al-yahūd* "Extraction of the Jewish Era" describes the 19-year intercalation cycle, the rules for determining on what day of the week the first day of the month Tishrī shall fall, the interval between the Jewish era (creation of Adam) and the Seleucid era, and the rules for determining the mean longitude of the sun and the moon using the Jewish calendar.

Omar Khayyam

Solving cubic equations by intersecting a circle with a hyperbola.

Whoever thinks algebra is a trick in obtaining unknowns has thought it in vain. No attention should be paid to the fact that algebra and geometry are different in appearance. Algebras are geometric facts which are proved by propositions five and six of Book two of Elements.

—Omar Khayyam
1048 - 1131

The Moving Finger writes, and, having writ,
Moves on: nor all thy Piety nor Wit
Shall lure it back to cancel half a Line,
Nor all thy Tears wash out a Word of it.

Omar Khayyam

BOOK EXCERPT | FEBRUARY 13, 2009, 8:01 P.M. ET

'The House of Wisdom: How the Arabs Transformed Western Civilization'

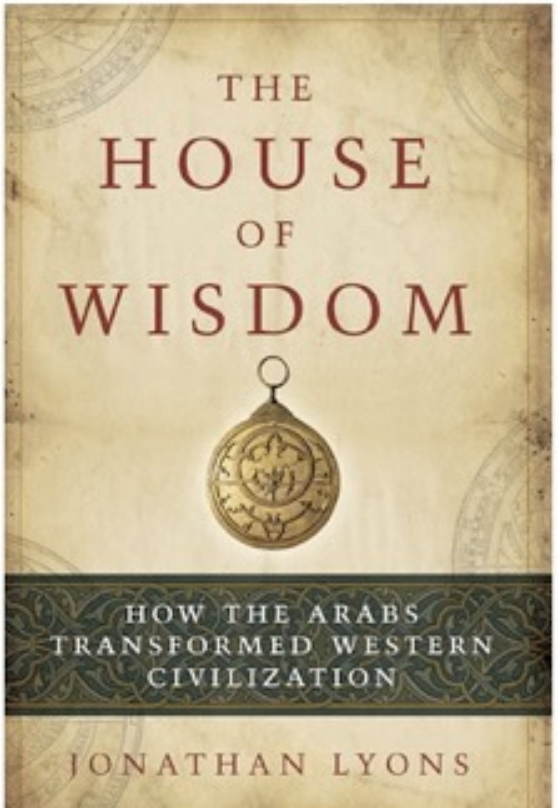
By Jonathan Lyons

Article | Comments

Email | Printer Friendly | Share: Yahoo Buzz | Text Size

Chapter Two: The Earth is like a Wheel

Seven years before the earthquake that shook the moral foundations of Crusader Antioch, Adelard surveyed the world around him and pronounced it rotten. His recent studies at the famed French cathedral school at Tours had provided him with the best education of his day. He enjoyed the support and patronage of the powerful bishop of Bath, the French court physician and scholar John de Villula. He practiced the art of hunting with falcons, a sign of his noble rank and the life of leisure it generally afforded. And he was an accomplished musician, who years later still fondly recalled the time he had been invited to play the cithara, a forerunner of the guitar, for the queen.



In short, Adelard of Bath was the model country gentleman. His father, Fastrad, was one of Bishop John's richest tenants and most senior aides, ensuring a life of privilege for his son. The family appears sporadically in official documents of Church and state. The Pipe Rolls, or royal accounts, later list Adelard as the beneficiary of a pension from the revenues of Whiltshire, in southwest England. Still, young Adelard saw little of value in the contemporary world, and he despaired at the state of Western learning in particular. "When I examine the famous writings of the ancients – not all of them, but most – and compare their talents with the knowledge of the moderns, I judge the ancients eloquent, and call the moderns dumb," he proclaimed in the opening line of his coming-of-age essay and first known work, On the Same and the Different.

Adelard's disdain for the "the moderns" was understandable, for the West at the end of the eleventh century was a mess. Daily life staggered under the burden of rampant violence and social instability. Bands of mercenaries, answerable neither to king nor God, prowled the countryside, their commanders' word the only law of the land. Across Europe, primitive farming techniques could no longer keep pace with a growing population, while antiquated inheritance laws left many impoverished and desperate. Violence – inflamed by the weakness of central political authority and uninhibited by the tenuous moral grip of the Catholic Church – was the currency of the day. As Pope Urban had acknowledged at Clermont when he called the First Crusade, religious leaders were helpless to halt the chaos across the continent. The best the Church could do was to redirect its flock's baser nature against the infidels to the East.

People Who Viewed This Also Viewed
On WSJ.com | In My Network
Book Excerpt: 'Aladdin's Lamp'

Why establish the House of Wisdom?

The Muslim Empire
622-750

The Spread of Islam. The rapid spread of Islam created within a century a unified cultural and economic zone from India to the Atlantic Ocean within.

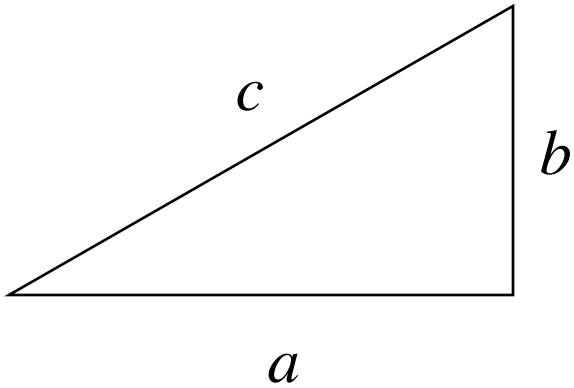
The ink of the scholar is more holy than the blood of the martyr

The Prophet Muhammad

I’m Catholic

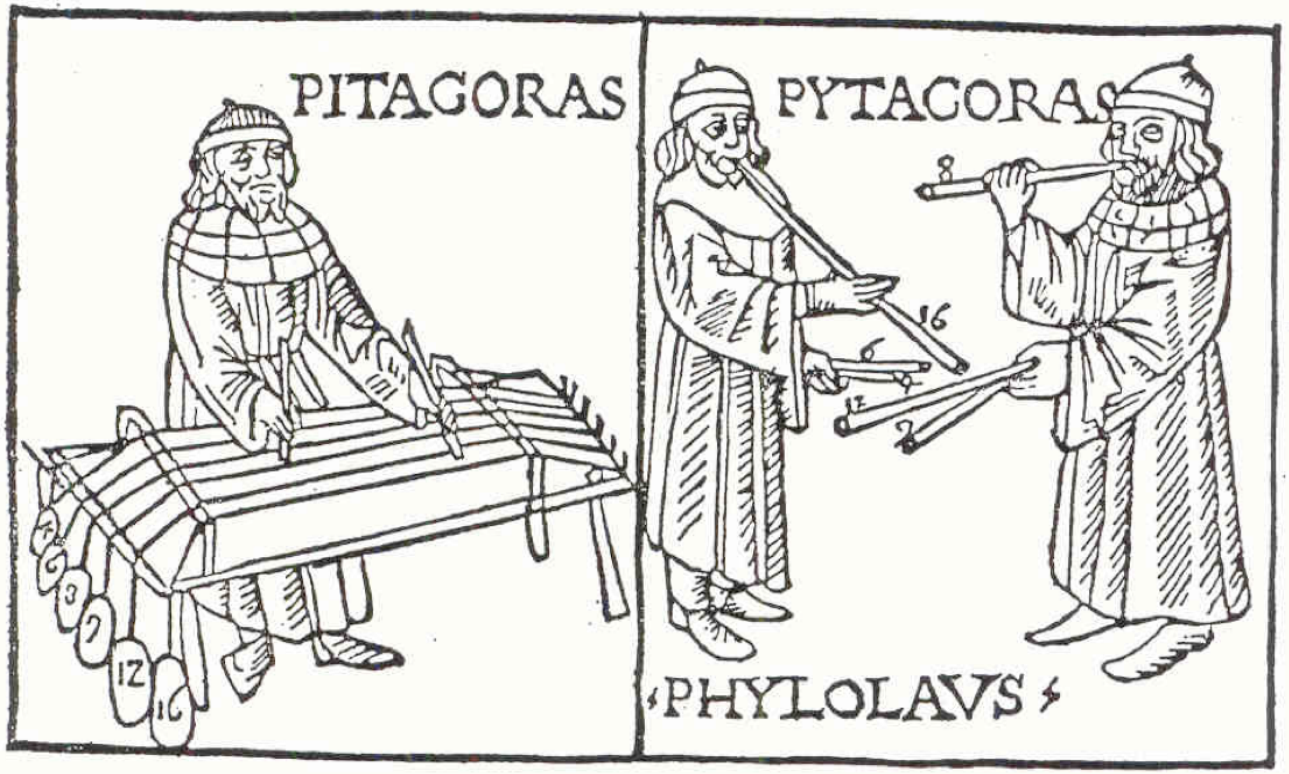
Pythagorean Theorem

In any right triangle, the square of the longest side (the hypotenuse) is equal to the sum of the squares of the other two sides (the legs).



$$c^2 = a^2 + b^2$$

Pythagoras and Music



PYTHAGORAS THE MUSICIAN

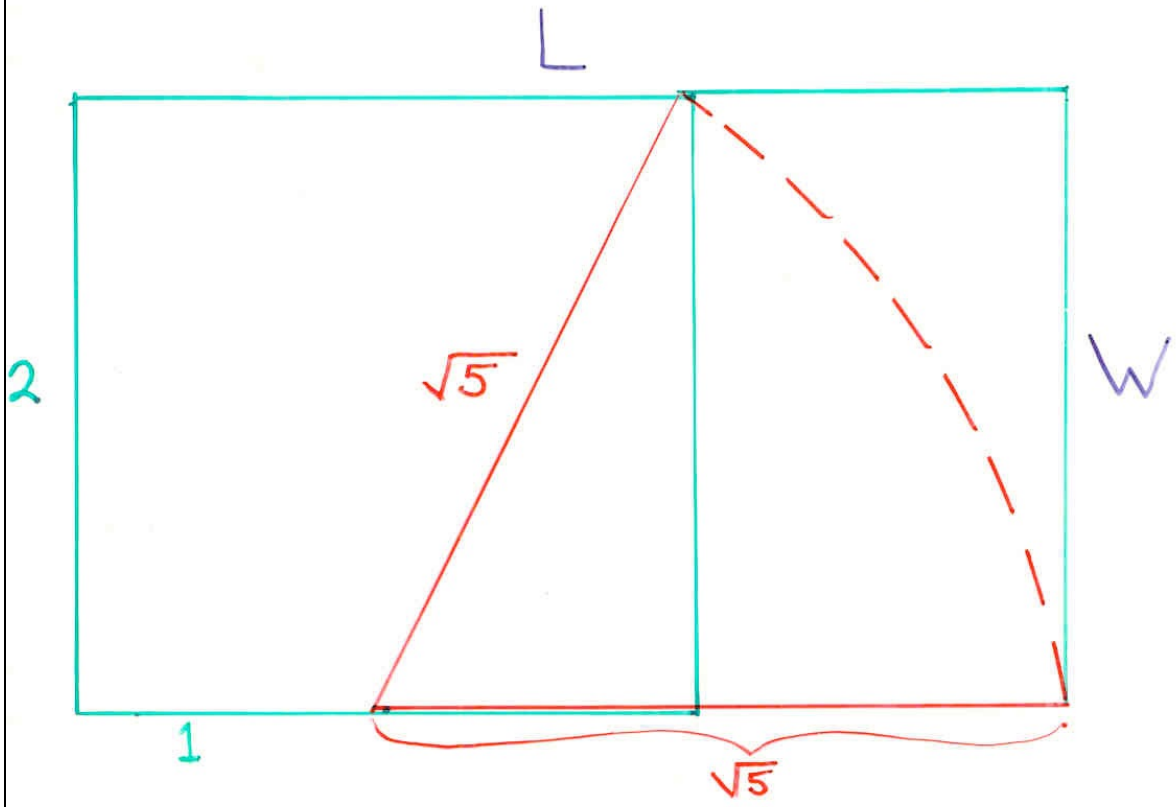
From F. Gafurius, *Theorica Musice*, Milan, 1492. One of the first crude attempts to portray Pythagoras by means of a woodcut, and the first to portray him as a musician.

Pythagoras and Shakespeare

Thou almost mak'st me waver in my faith,
To hold opinion with Pythagoras,
That souls of animals infuse themselves
Into the trunks of men.

Merchant of Venice

The Golden Rectangle



$$\text{Golden Ratio} = \frac{L}{W} = \frac{1+\sqrt{5}}{2}$$

$$\approx 1.618$$

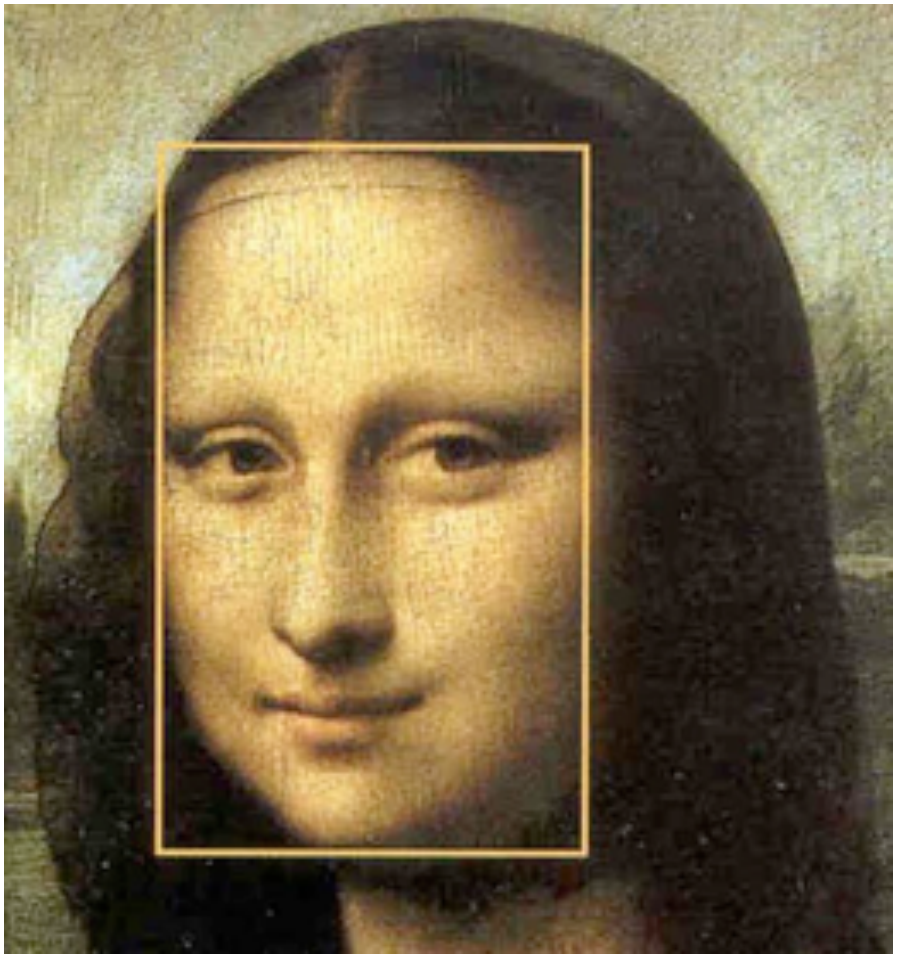
Al-Samawal

Born: about 1130 in Baghdad, Iraq
Died: about 1180 in Maragha, Iran

The golden ratio is

$$\frac{\sqrt{125}-5}{15-\sqrt{125}}$$

$$\begin{aligned}
\frac{\sqrt{125}-5}{15-\sqrt{125}} &= \frac{5\sqrt{5}-5}{15-5\sqrt{5}} \\
&= \frac{5(\sqrt{5}-1)}{5(3-\sqrt{5})} \\
&= \frac{\sqrt{5}-1}{3-\sqrt{5}} \times \frac{3+\sqrt{5}}{3+\sqrt{5}} \\
&= \frac{3\sqrt{5}+5-3-\sqrt{5}}{9-3\sqrt{5}+3\sqrt{5}-5} \\
&= \frac{2\sqrt{5}+2}{4} \\
&= \frac{2(\sqrt{5}+1)}{2\times 2} \\
&= \frac{1+\sqrt{5}}{2}
\end{aligned}$$



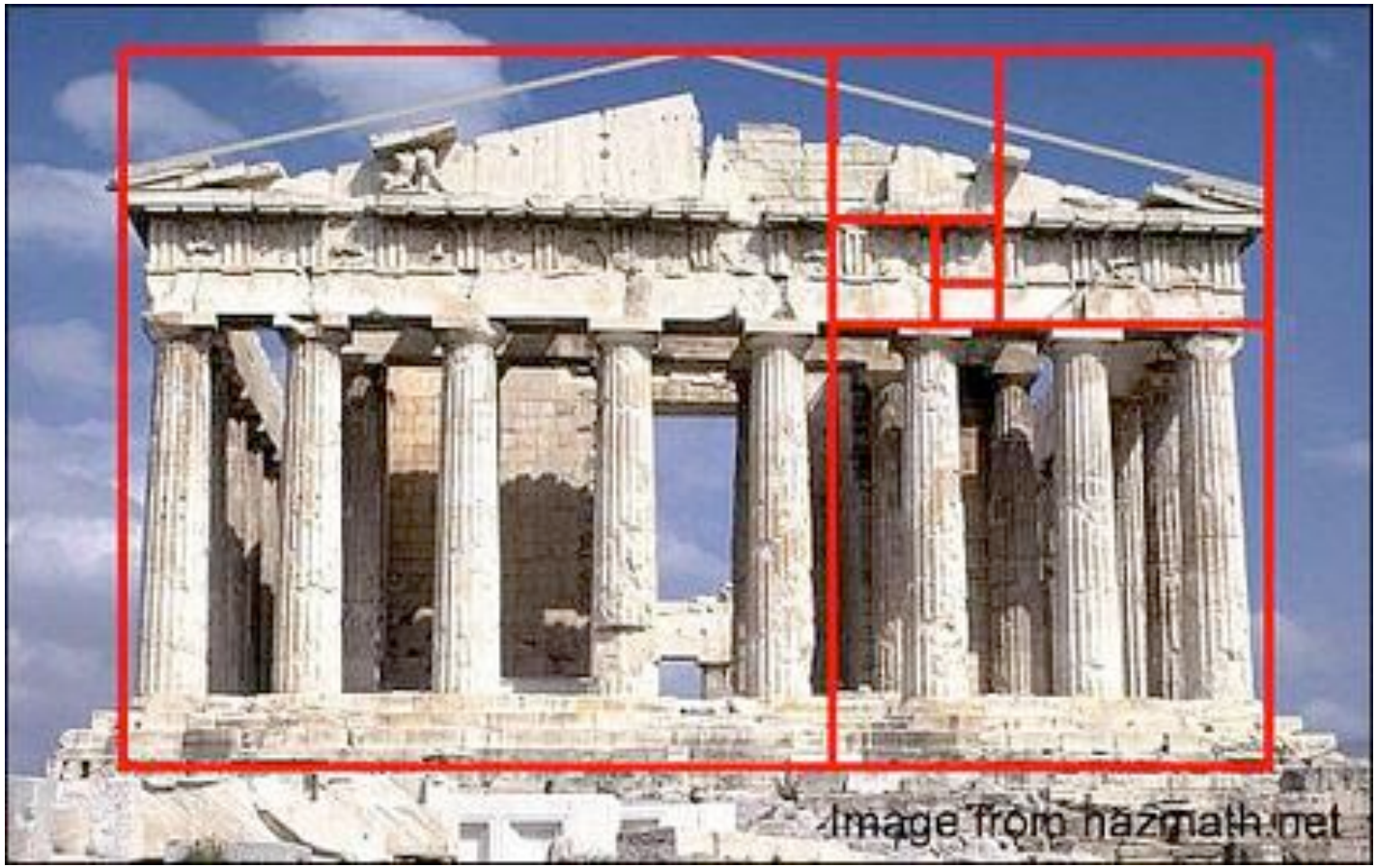
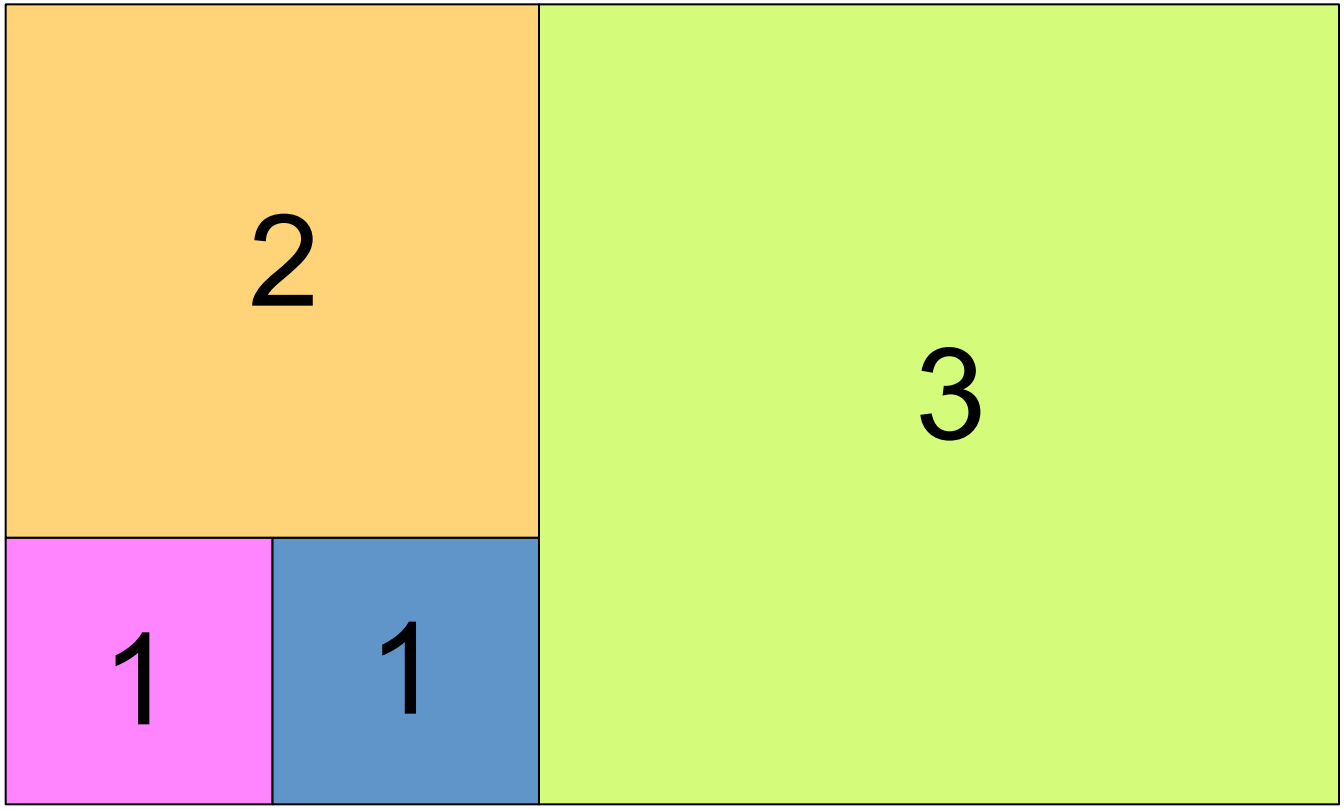
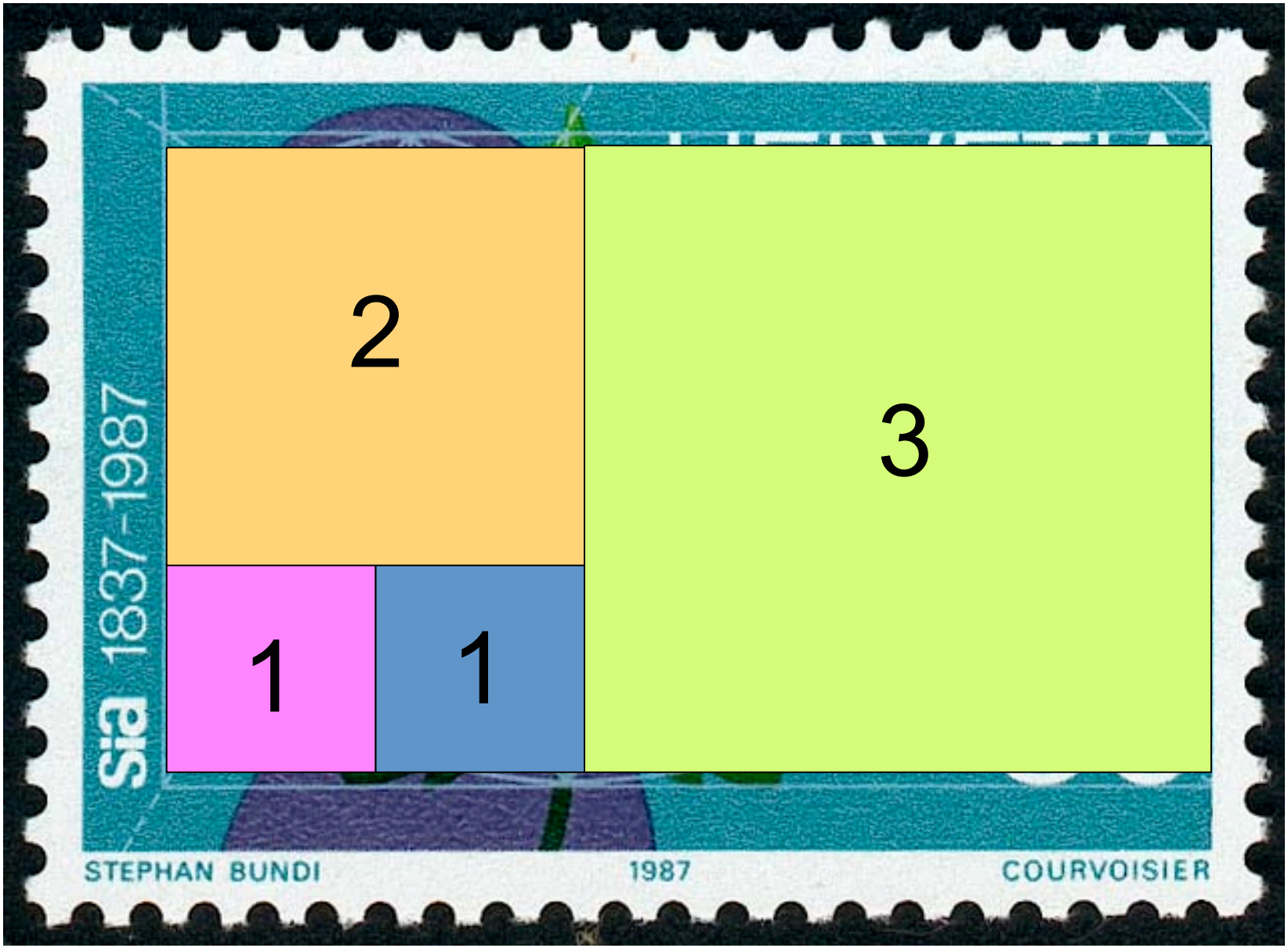


Image from hazmath.net

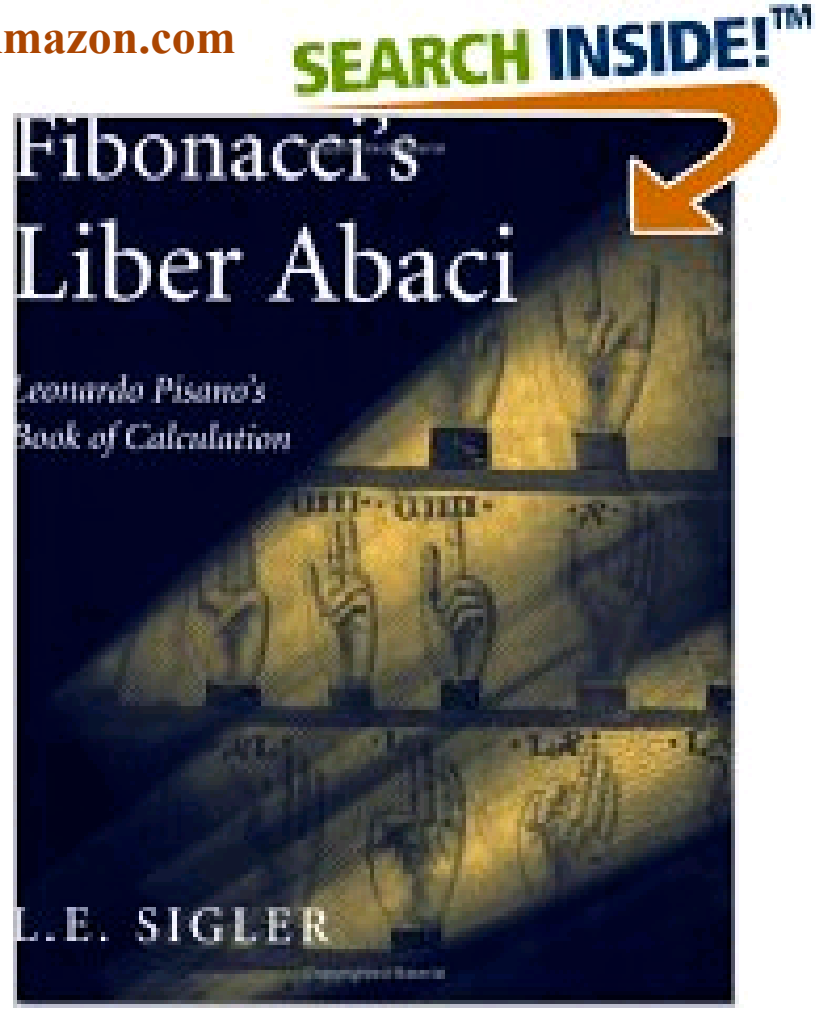

HELVETIA
Sia 1837–1987
80
STEPHAN BUNDI
1987
COURVOISIER

Approaching the Golden Rectangle with the Fibonacci Sequence




2
3
1
1
Sra 1837-1987
STEPHAN BUNDI
1987
COURVOISIER

Amazon.com



First published in 1202

This translation: 2003

MAA Online, March 2003:

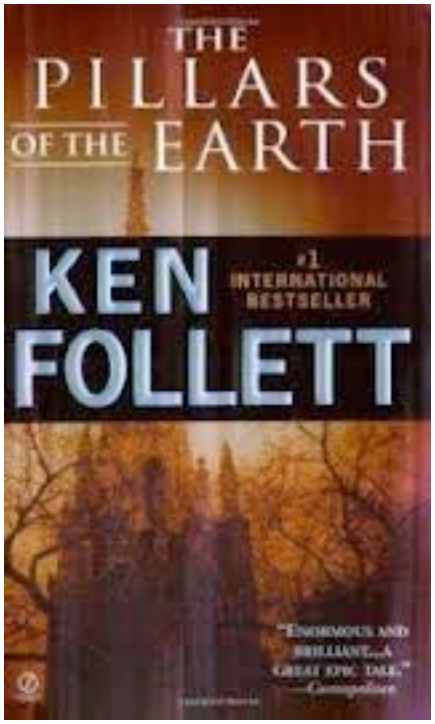
"The *Liber abaci* of Leonardo Pisano (today commonly called Fibonacci) is one of the fundamental works of European mathematics. No other book did more to establish the basic framework of arithmetic and algebra as they developed in the Western world."


Pisa
Khiva
Baghdad, Iraq
Alexandria, Egypt
Medina
Mecca
© 2010 Europa Technologies
© 2010 Tele Atlas
US Dept of State Geographer
© 2010 Basarsoft
©2010 Google


Khiva
Pisa
Toledo, Spain
Bejaia, Algeria
Baghdad, Iraq
Alexandria, Egypt
Medina
Mecca
US Dept of State Geographer
© 2010 Tele Atlas
© 2010 Basarsoft
© 2010 Europa Technologies
Google

School of Translation

Ken Follett, *The Pillars of the Earth*, Page 688: Jack was living with a small group of English clerics in Toledo. They were part of an international community of scholars that included Jews, Mulsims and Arab Christians. The Englishmen were occupied translating works of mathematics from Arabic into Latin, so they could be read by Christians. There was an atmosphere of feverish excitement among them as they discovered and explored the treasure-house of Arab learning, and they had casually welcomed Jack as a student: they admitted into their circle anyone who understood what they were doing and shared their enthusiasm for it.



What were they like?

Toledo, Spain
School of Translation, 1150

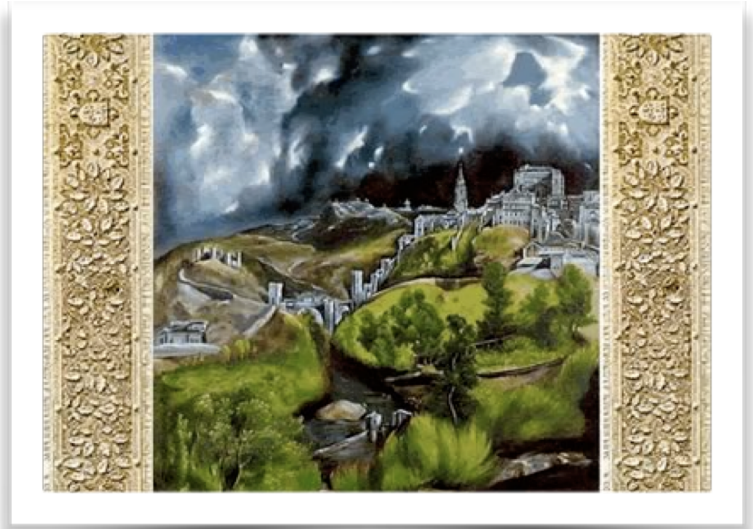
View of Toledo by El Greco

Keith Devlin:
Latin was the language of the European scholars, and thus the target language for the translations. Since few European scholars knew Arabic, however, the translation was often done in two stages, with a Jewish scholar living in Spain translating from the Arabic to some common language and the visiting scholar then translating from that language into Latin. In the same way, many ancient Greek texts, from Aristotle to Euclid, were also translated into Latin, whereupon they began to make an impact in the West

The Middle East in the Media

The Small Picture, that we get from the media, takes place over a short period of time. It polarizes us. It is not a hopeful picture.

The Big Picture takes place over a longer period of time. It is not polarizing. In fact, the more we study history, the more we find ourselves identifying with people from the past.



View of Toledo by El Greco

Elementary Algebra Themes

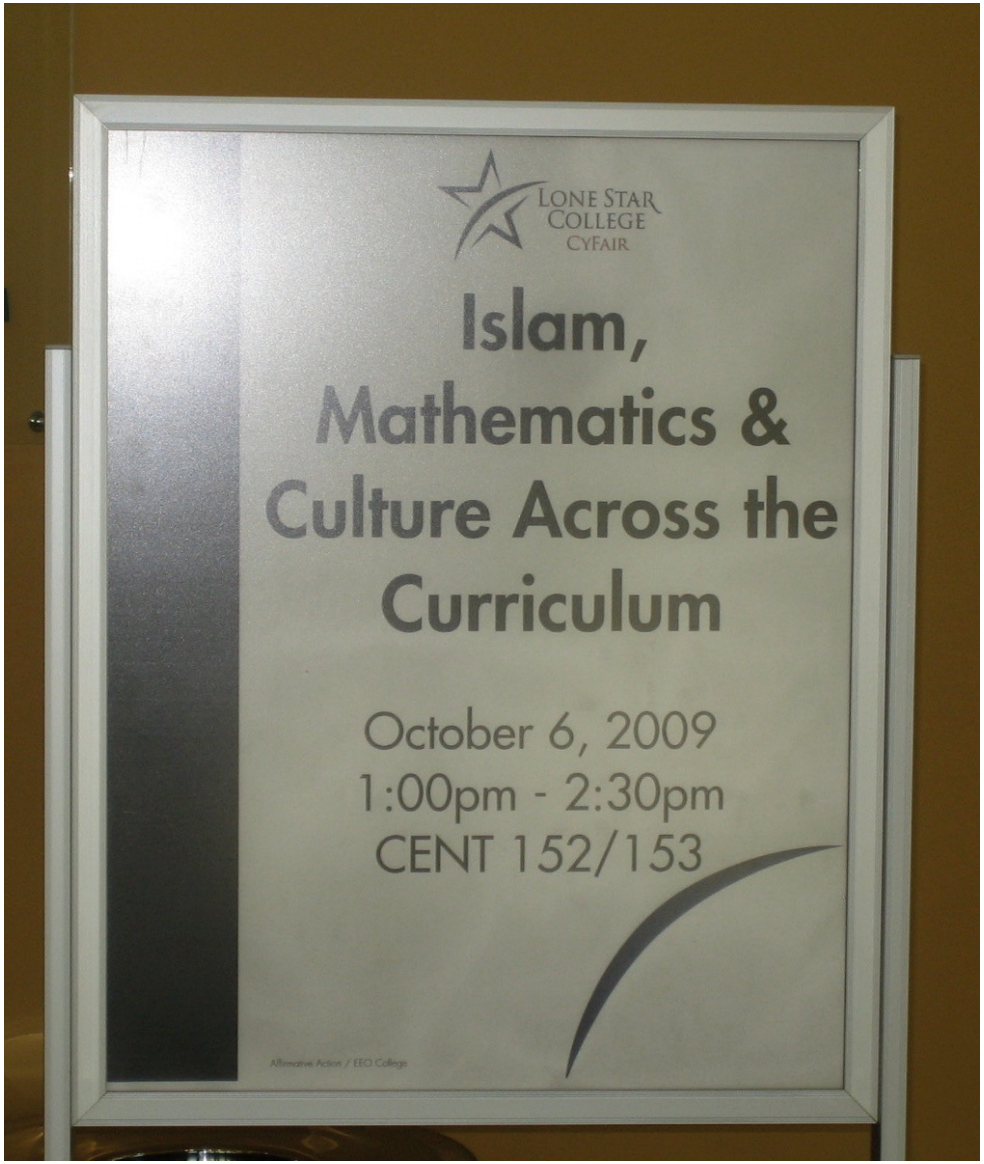
Method I reserve five minutes of each class session to bring in the things that you think are interesting in, and around, mathematics.

Target Audiences

- **All Students**
- **Student like me in the 60s**
- **Muslim Student**

The End

Speaking to Students


LONE STAR
COLLEGE
CYFAIR
Islam,
Mathematics &
Culture Across the
Curriculum
October 6, 2009
1:00pm - 2:30pm
CENT 152/153
Affirmative Action / EEO College


Mathematics Around Us
DAVINCI CODE
DAN BROWN
13-3-2-21-1-1-8-5
O Draconian devil!
Oh, lame saint!


Great Expectations
AUGUST 24-25, 2009