History of Mathematics

Math 395 Spring 2010 Fowler 310 MWF 10:30am - 11:25am

http://faculty.oxy.edu/ron/math/395/10/

Class 17: **Monday March 15**

TITLE Medieval Mathematics
CURRENT READING: Katz, §10
NEXT READING: Katz, §11

Homework #7 DUE Monday March 22 (5pm)
Katz, p. 318: #3,#11,#12. p. 359: #2, #3. EXTRA CREDIT: page 359, #15, #31.

SUMMARY
We will look at the medieval period of the Middles Ages (sometimes called "the Dark Ages" between the fall of Rome (476 CE) to the Renaissance (the middle of the15th century), roughly 1000 years.

The *quadrivium* and the seven liberal arts
One of the only concepts that survived the Dark Ages was the idea that to be a civilized, educated man one needed to learn the quadrivium (arithmetic, geometry, music and astronomy). Boethius (480-524) added to this a trivium (grammar, rhetoric and logic) which together are known as the liberal arts.

Translations
There was almost no mathematical texts available in Europe during this time, but eventually the classic works of the Euclid's *Elements,* Ptolemy's *Almagest,* Archimedes' *Measurement of the Circle* and al-Khwarizmi's *Algebra* and *Arithmetic* were translated into Latin (see Katz, p. 327).

Leonardo of Pisa also known as **Fibonacci** (c. 1170-1240)
Liber abbaci (Book of Calculation) was first published in 1202. In it, Leonardo demonstrates the algorithms for how to use the Hindu-Arabic numerals and strongly advocates that fellow merchants like him adopt their use and abandon Roman numerals. *Liber abbaci* discusses "the nine Indian figures" and the sign 0, "which is called *zephirium* in Arabic." It's from this word that we get the word zero.

Note that the title of Leonardo's book had nothing to do with the calculating device known as an abacus. However, later in the 14th century people who did calculations were called *maestri d'abbaco* or abacists.

Fibonacci sequence

The most famous problem in *Liber abbaci* is often called "the rabbit problem":

> How many pairs of rabbits can be bred in one year from one pair? A certain person places one pair of rabbits in a certain place surrounded on all sides by a wall. We want to know how many pairs can be bred from that pair in one year, assuming it is their nature that each month they give birth to another pair, and in the second month after birth, each new pair can also breed.

Leonardo gave the sequence **1, 2, 3, 5, 8, 13, 21 34, 55, 89, 144, 233, 377**

Let's try to solve some of the other classic problems of Leonardo

EXAMPLE

"Suppose a lion can eat a sheep in 4 hours, a leopard can eat a sheep in 5 hours, and a bear can eat a sheep in 6 hours. How long will it take the three animals to eat one sheep together?"

Answer: $\mathbf{1\frac{23}{37}}$ **hours.**

Exercise

"Two men have some money. The first says to the second: 'If you give me one *denarius,* we will each have the same amount.' The second says to the first, 'If you give me one *denarius,* I will have ten times as much as you.' How much does each have?"

Answer: $\mathbf{1\frac{4}{9}}$ **denarius and** $\mathbf{3\frac{4}{9}}$ **denarius.**

GroupWork

"Suppose there are four men such that the first, second, and third together have 27 denarii; the second, third, and fourth together have 31; the third, fourth, and first have 34; and the fourth, first and second have 37. How much does each have?"