Preparing Smart Teachers to Teach with SMART™ Technology

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Description of Presentation

Appropriate use of technology is an essential component of preparing pre-service teachers to teach mathematics. We will share smart technology lessons, activities, strategies, and tools we have used in our work with pre-service mathematics teachers at the elementary, middle school, and secondary levels.

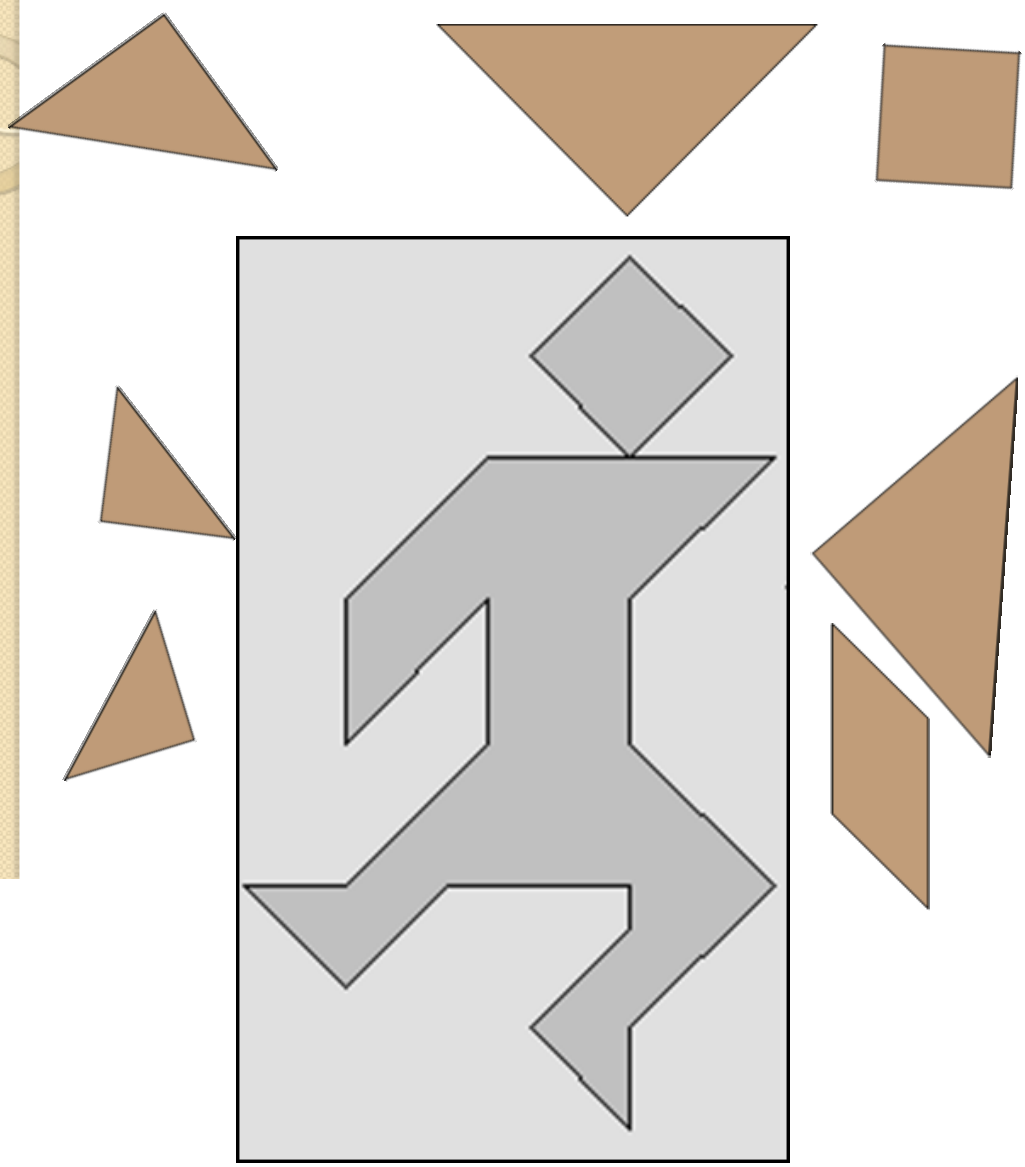
Agenda

- Example from Geometry
- Example from Algebra
- Example from Number Theory
- Example from Fraction Concepts

Examples from Geometry

- Methods Course for PreK - 4 Education Majors
- Lesson: Teaching Geometry concepts
  - Four NCTM content goals for geometry
    Shapes and properties
    Transformations
    Location
    Visualization
  - Five van Hiele levels of geometric thought
    0: Visualization
    1: Analysis
    2: Informal Deduction
    3: Deduction
    4: Rigor

Shapes and Properties - Level 0



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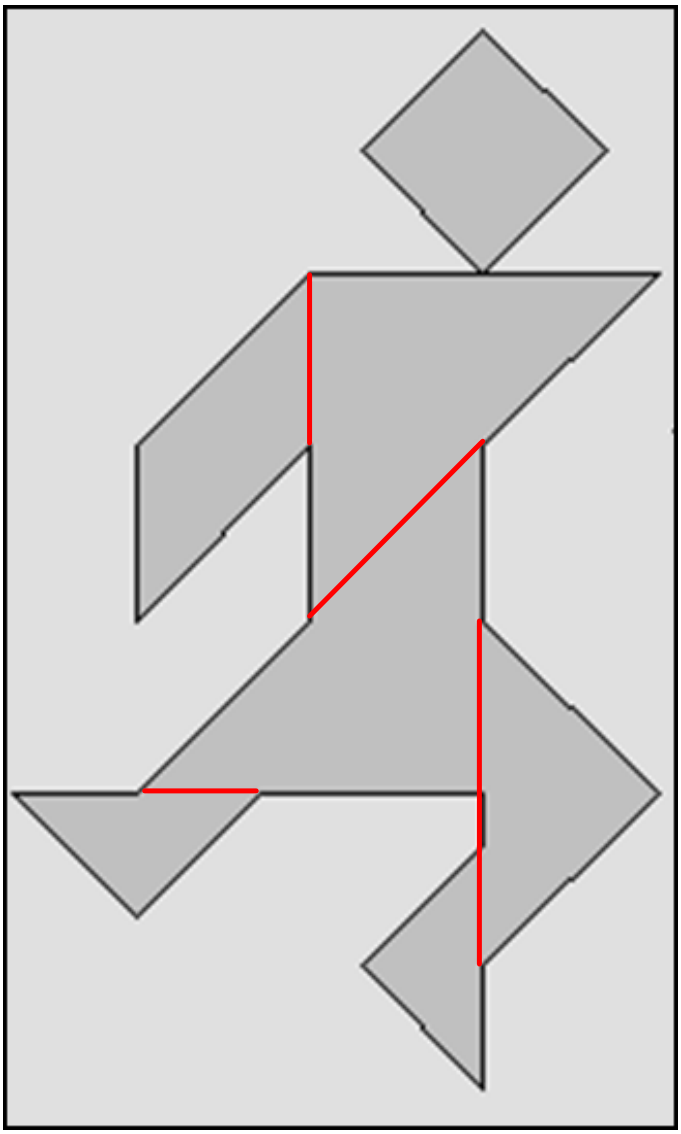
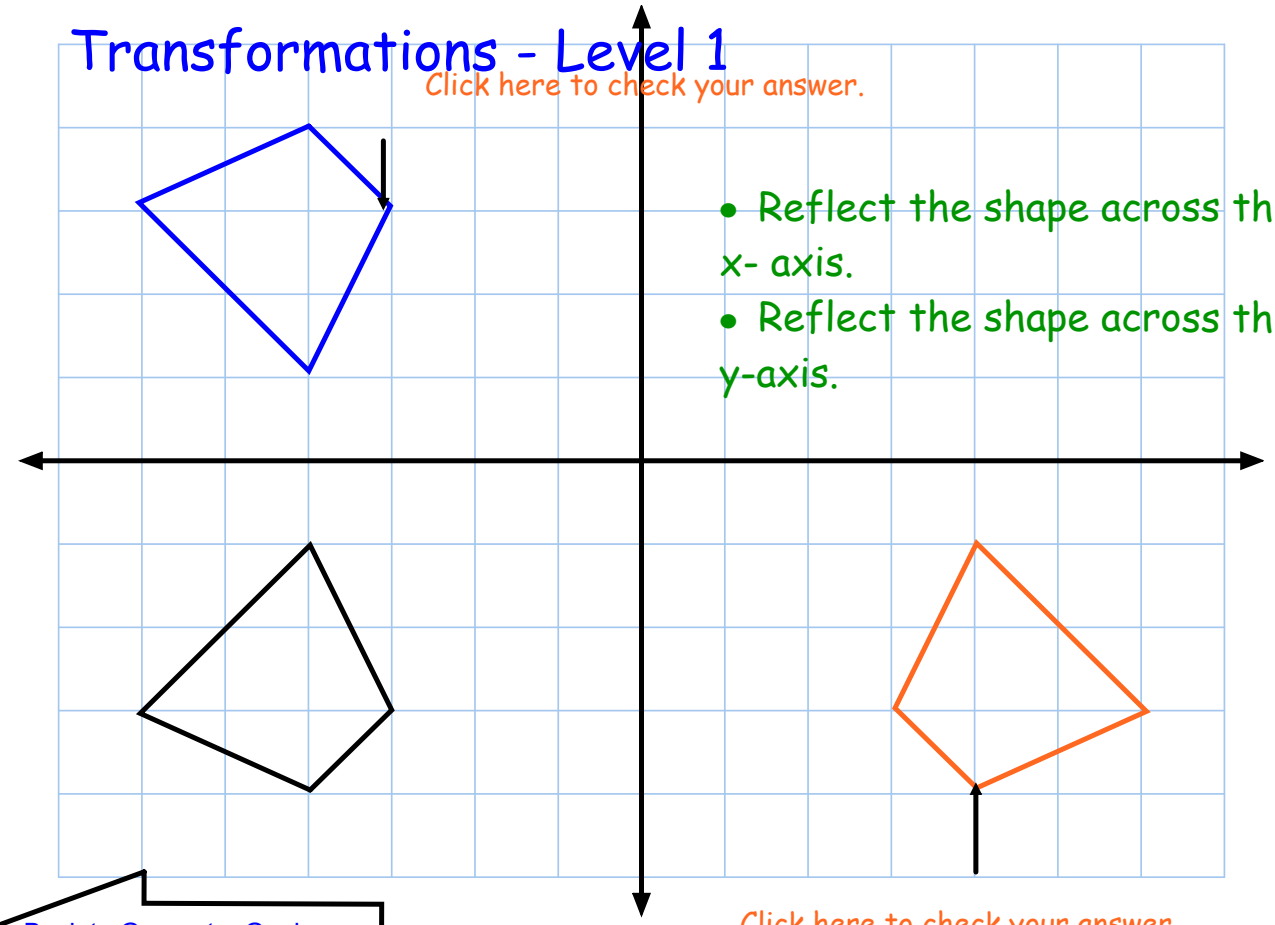


Shapes and Properties - Level 1

Back to Geometry Goals

Transformations - Level 1

Click here to check your answer.



- Reflect the shape across the x- axis.
- Reflect the shape across the y-axis.

Back to Geometry Goals

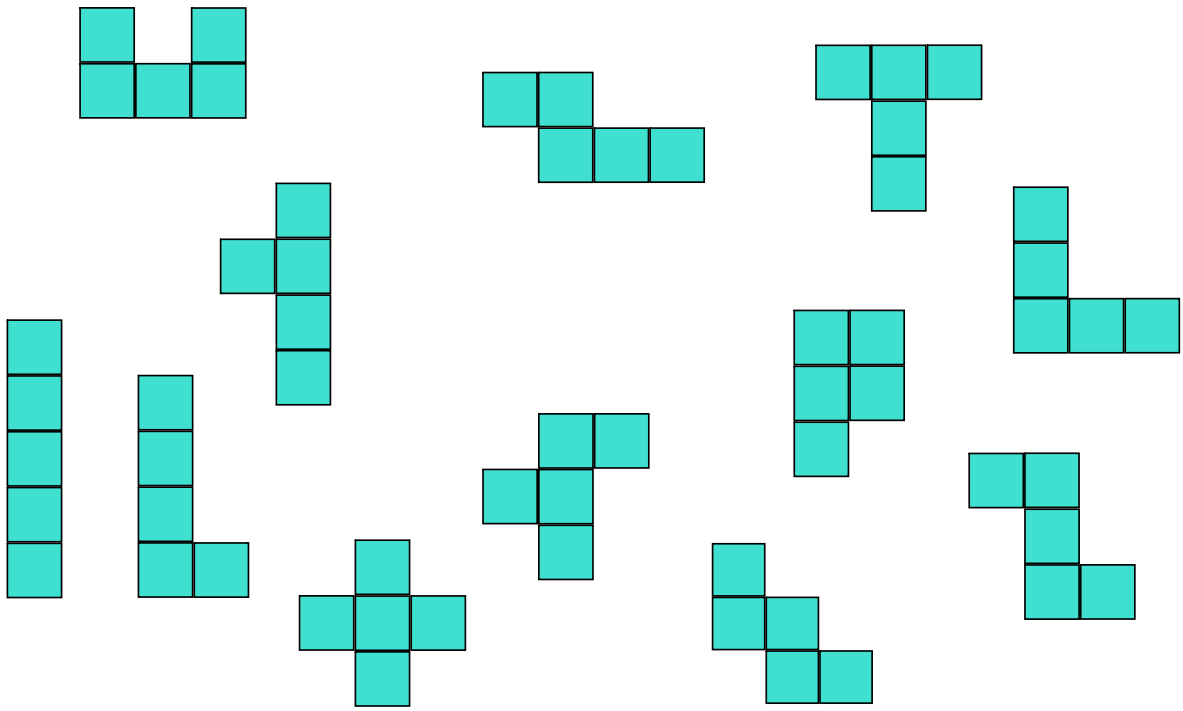
Click here to check your answer.

Visualization - Level 0

Pentominoes

Using 5 squares, make as many DIFFERENT shapes as you can.
Each square must share a side with at least one other square.

Click here to check your answer.



Examples from Algebra

- Grades 4 through 8 Algebra Course
- Modeling the simplification of expressions.
  - Distributive property
  - Adding and subtracting polynomials
  - Multiplying and factoring polynomials
- Graphing equations

Distributive Property

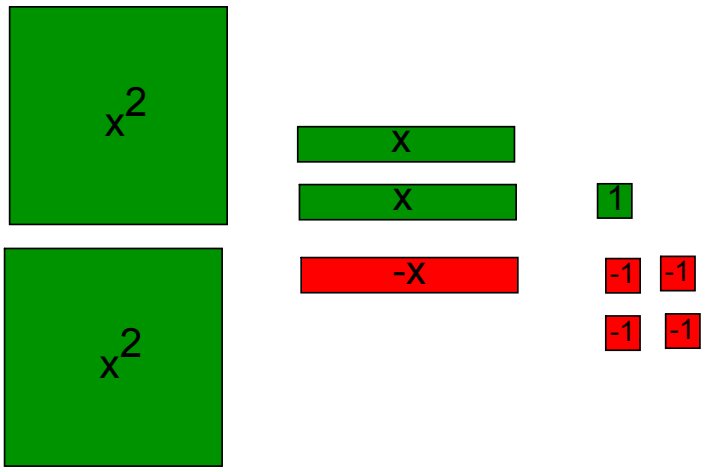
Use the same concept that was applied with multiplication of integers, think of the first factor as the counter.

The same rules apply.

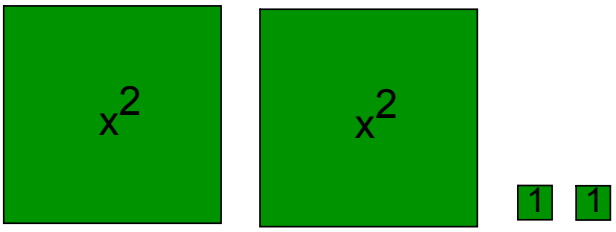
$3(x + 2)$

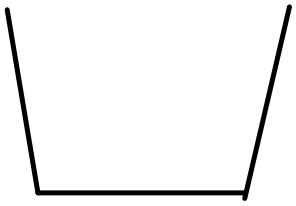
Addition and Subtraction of Polynomials

1. $(x^2 + 2x + 1) + (x^2 - x - 4)$



4. $(2x^2 + 2) - (x^2 + 2x - 1)$

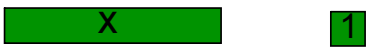




Substitution

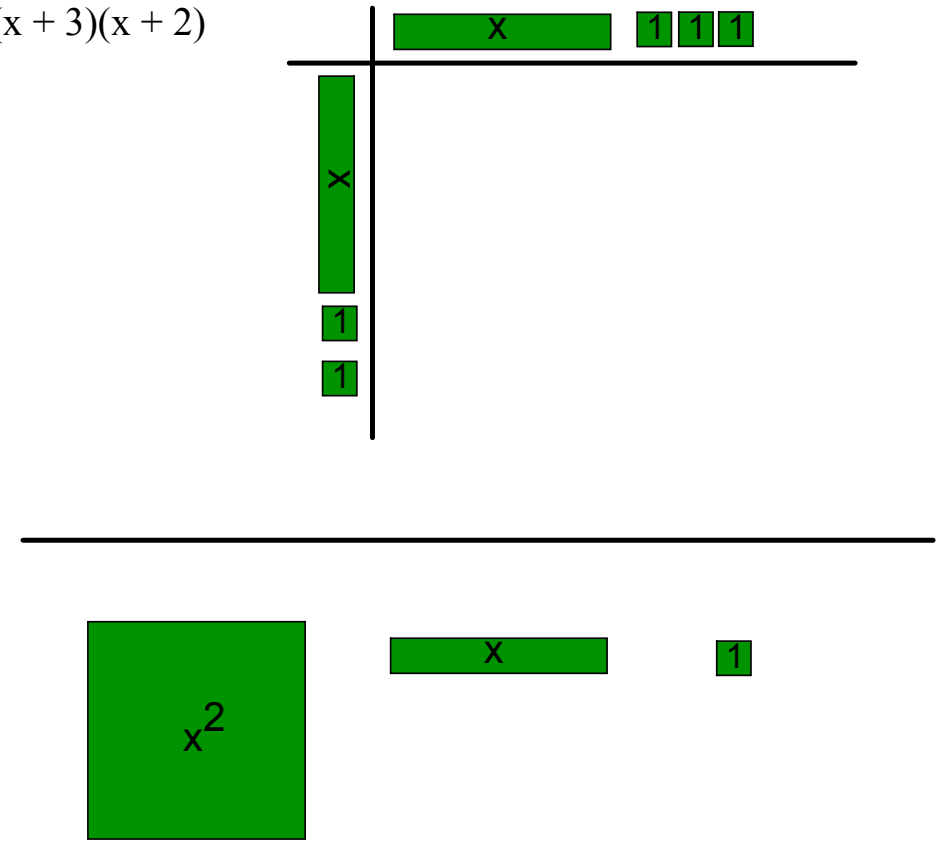
Algebra tiles can be used to model substitution. Represent original expression with tiles. Then replace each rectangle with the appropriate tile value. Combine like terms.

$3 + 2x$ let $x = 4$

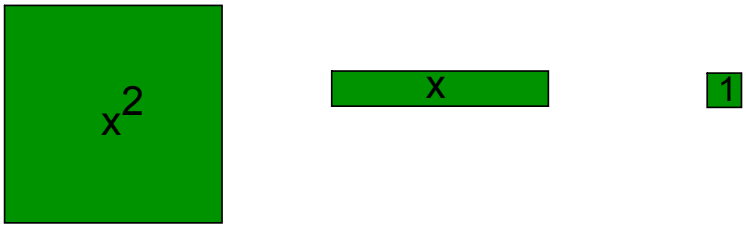


Multiplication Binomials--Using Algebra Tiles

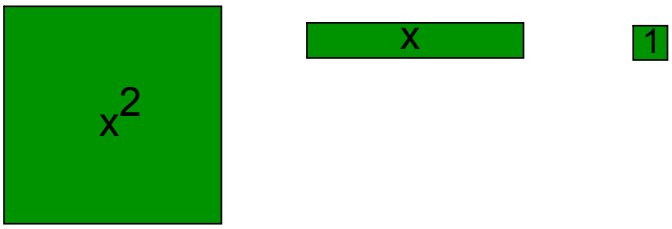
$(x + 3)(x + 2)$



Make a collection of 2 big squares, 7 rectangles, and 6 ones.
How many ways can they be arranged? Which set looks aesthetically pleasing (in a rectangle)? What are the dimensions of the rectangle?
This will lead to factoring.



3. $x^2 + 6x + 8$

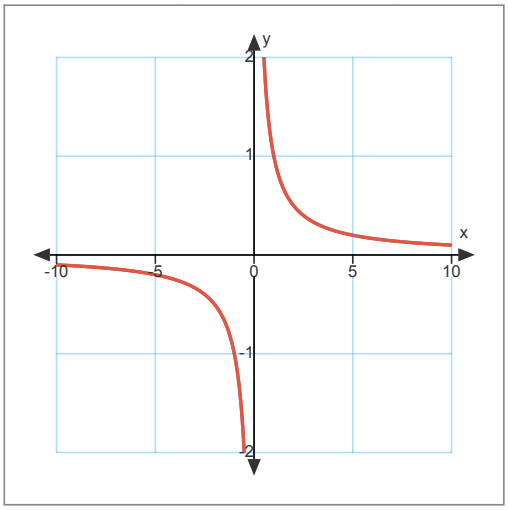


A **rational function** is a function f that is a quotient of two polynomials, that is,

$$f(x) = \frac{p(x)}{q(x)}$$

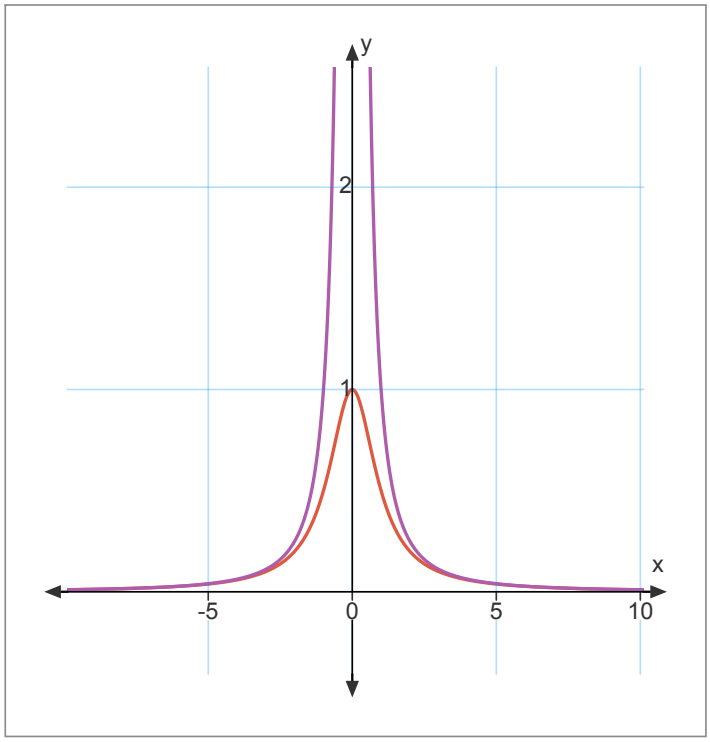
where p(x) and q(x) are polynomials and where q(x) is not the zero polynomial. The domain of f consists of all inputs x for which q(x)≠ 0.

$$\frac{1}{x}$$



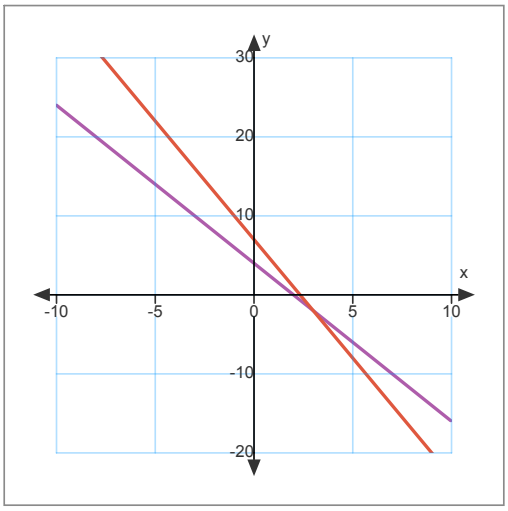
$$\frac{1}{x^2}$$

$$\frac{1}{x^2+1}$$



$-2x+4$

$-3x+7$



Example from Number Theory

- Introduction to Number Theory for secondary mathematics education majors
- Lesson: introduction to divisibility and proof techniques

Some Other Number Theory Magicians

Diophantus of Alexandria

Euclid

Fibonacci

Euler

Carl Friedrich Gauss

Diophantus of Alexandria

Born: about 200
Died: about 284

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Diophantus, often known as the 'father of algebra', is best known for his *Arithmetica*, a work on the solution of algebraic equations and on the theory of numbers. However, essentially nothing is known of his life and there has been much debate regarding the date at which he lived.

There are a few limits which can be put on the dates of Diophantus's life. On the one hand Diophantus quotes the definition of a polygonal number from the work of Hypsicles so he must have written this later than 150 BC. On the other hand Theon of Alexandria, the father of Hypatia, quotes one of Diophantus's definitions so this means that Diophantus wrote no later than 350 AD. However this leaves a span of 500 years, so we have not narrowed down Diophantus's dates a great deal by these pieces of information.

There is another piece of information which was accepted for many years as giving fairly accurate dates. Heath [3] quotes from a letter by Michael Psellus who lived in the last half of the 11th century. Psellus wrote (Heath's translation in [3]):-

> *Diophantus dealt with [Egyptian arithmetic] more accurately, but the very learned Anatolius collected the most essential parts of the doctrine as stated by Diophantus in a different way and in the most succinct form, dedicating his work to Diophantus.*

Psellus also describes in this letter the fact that Diophantus gave different names to powers of the unknown to those given by the Egyptians. This letter was first published by Paul Tannery in [7] and in that work he comments that he believes that Psellus is quoting from a commentary on Diophantus which is now lost and was probably written by Hypatia. However, the quote given above has been used to date Diophantus using the theory that the Anatolius referred to here is the bishop of Laodicea who was a writer and teacher of mathematics and lived in the third century. From this it was deduced that Diophantus wrote around 250 AD and the dates we have given for him are based on this argument.

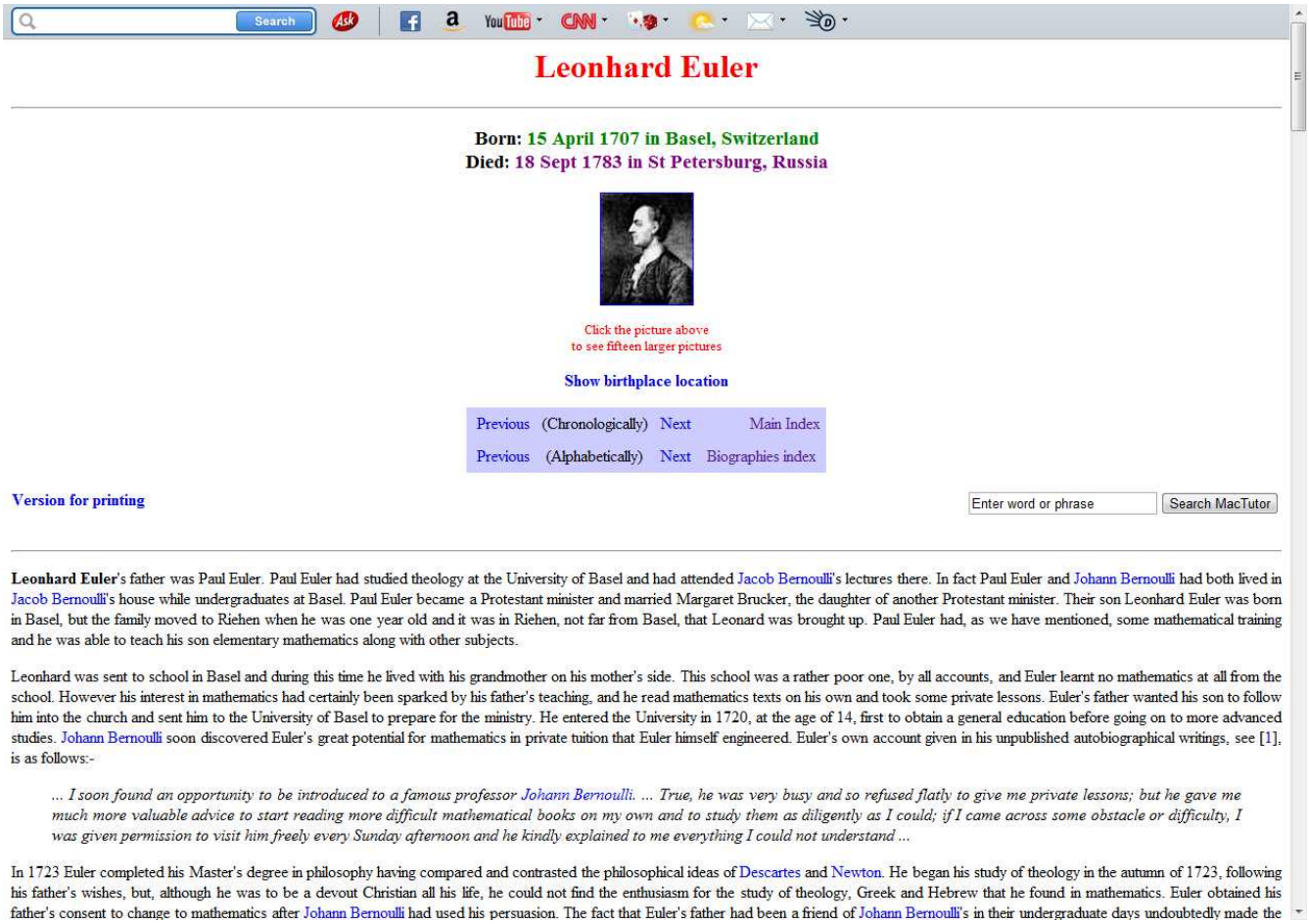
Knorr in [16] criticises this interpretation, however:-

> *But one immediately suspects something is amiss: it seems peculiar that someone would compile an abridgement of another man's work and then dedicate it to him, while the qualification "in a different way", in itself vacuous, ought to be redundant, in view of the terms "most essential" and "most succinct".*

Knorr gives a different translation of the same passage (showing how difficult the study of Greek mathematics is for anyone who is not an expert in classical Greek) which has a remarkably different meaning:-

> *Diophantus dealt with [Egyptian arithmetic] more accurately, but the very learned Anatolius, having collected the most essential parts of that man's doctrine, to a different Diophantus most succinctly addressed it.*

The conclusion of Knorr as to Diophantus's dates is [16]:-



Leonhard Euler

Born: 15 April 1707 in Basel, Switzerland
Died: 18 Sept 1783 in St Petersburg, Russia

Click the picture above
to see fifteen larger pictures

Show birthplace location

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Leonhard Euler's father was Paul Euler. Paul Euler had studied theology at the University of Basel and had attended Jacob Bernoulli's lectures there. In fact Paul Euler and Johann Bernoulli had both lived in Jacob Bernoulli's house while undergraduates at Basel. Paul Euler became a Protestant minister and married Margaret Brucker, the daughter of another Protestant minister. Their son Leonhard Euler was born in Basel, but the family moved to Riehen when he was one year old and it was in Riehen, not far from Basel, that Leonard was brought up. Paul Euler had, as we have mentioned, some mathematical training and he was able to teach his son elementary mathematics along with other subjects.

Leonhard was sent to school in Basel and during this time he lived with his grandmother on his mother's side. This school was a rather poor one, by all accounts, and Euler learnt no mathematics at all from the school. However his interest in mathematics had certainly been sparked by his father's teaching, and he read mathematics texts on his own and took some private lessons. Euler's father wanted his son to follow him into the church and sent him to the University of Basel to prepare for the ministry. He entered the University in 1720, at the age of 14, first to obtain a general education before going on to more advanced studies. Johann Bernoulli soon discovered Euler's great potential for mathematics in private tuition that Euler himself engineered. Euler's own account given in his unpublished autobiographical writings, see [1], is as follows:-

> *... I soon found an opportunity to be introduced to a famous professor Johann Bernoulli. ... True, he was very busy and so refused flatly to give me private lessons; but he gave me much more valuable advice to start reading more difficult mathematical books on my own and to study them as diligently as I could; if I came across some obstacle or difficulty, I was given permission to visit him freely every Sunday afternoon and he kindly explained to me everything I could not understand ...*

In 1723 Euler completed his Master's degree in philosophy having compared and contrasted the philosophical ideas of Descartes and Newton. He began his study of theology in the autumn of 1723, following his father's wishes, but, although he was to be a devout Christian all his life, he could not find the enthusiasm for the study of theology, Greek and Hebrew that he found in mathematics. Euler obtained his father's consent to change to mathematics after Johann Bernoulli had used his persuasion. The fact that Euler's father had been a friend of Johann Bernoulli's in their undergraduate days undoubtedly made the

Onto some magic with numbers ...

Was this really a magic trick?

Is there a pattern you notice?

Definition: An integer b is **divisible** by an integer $a \neq 0$ if and only if $b = a\,c$ for some integer c.

Theorem:
An integer is divisible by 9
if and only if the sum of its digits is divisible by 9

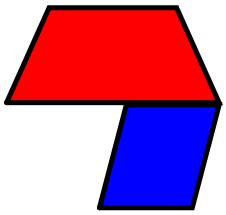
Making a Video of the Class

Class April 18 2011.wmv

Examples from Fraction Concepts

Smart Pen background

Fraction Concepts
Task 1:



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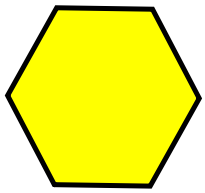

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Video of Task 1

Attachments

fractions1.pdf