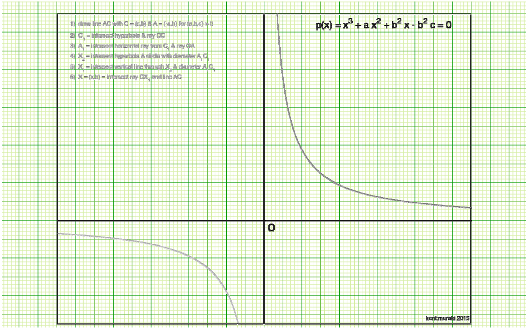
What was Mathematics before there was X?

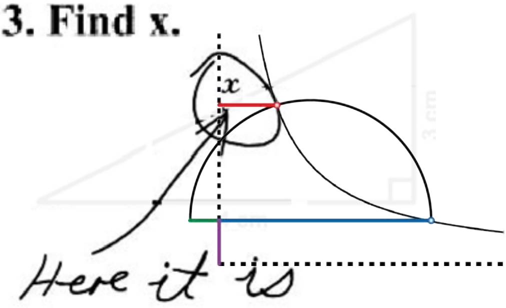
- choose 3 positive numbers: a, b, c (so the points fit comfortably on the page)
- follow instructions 1-6



- D J Muraki
- T Archibald

What was Mathematics before there was X?

- an 11^{th} century geometric solution of a cubic by Omar Khayyam

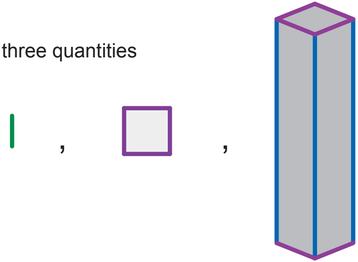


- D J Muraki
- D A Kent (Drake University, Des Moines IA)

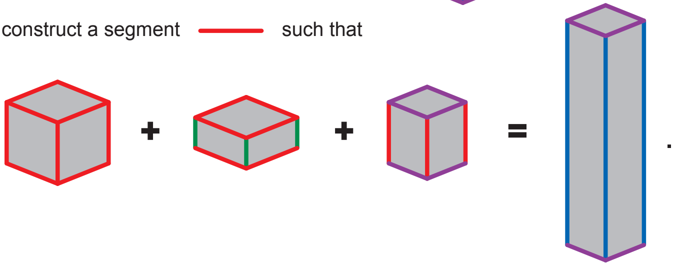
A solid cube plus squares plus edges equal to a number

Geometric Statement of a Cubic Equation

Problem: Given three quantities



construct a segment such that

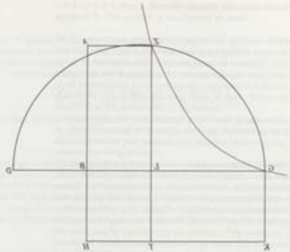


A Textbook Proof

6.B3 Omar Khayyam on the solution of cubic equations

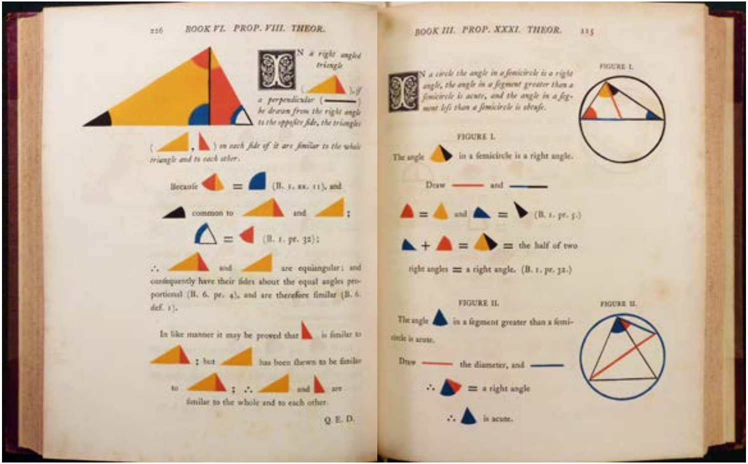
A solid cube plus squares plus edges equal to a number.

We draw *BH* to represent the side of a square equal to the given sum of the edges, and construct a solid whose base is the square of *BH*, and which equals the given number. Let its height *BG* be perpendicular to *BH*. We draw *BD* equal to the given sum of the squares and along *BG* produced, and draw on *DG* as diameter a semicircle *DZG*, and complete the area *BK*, and draw through the point *G* a hyperbola with the lines *BH* and *HK* as asymptotes. It will intersect the circle at the point *G* because it intersects the line tangential to it [the circle], i.e., *GK*. It must therefore intersect it [the circle] at another point. Let it intersect it [the circle] at *Z* whose position would then be known, because the positions of the circle and the conic are known. From *Z* we draw perpendiculars *ZT* and *ZA* to *HK* and *HA*. Therefore the area *ZH* equals the area *BK*. Now make *HL* common. There remains [after subtraction of *HL*] the area *ZB* equal to the area *LK*. Thus the proportion of *ZL* to *LG* equals the proportion of *HB* to *BL*, because *HB* equals *TL*; and their squares are also proportional. But the proportion of the square of *ZL* to the square of *LG* is equal to the proportion of *DL* to *LG*, because of the circle. Therefore the proportion of the square of *HB* to the square of *BL* would be equal to the proportion of *DL* to *LG*. Therefore the solid whose base is the square of *HB* and whose height is *LG* would equal the solid whose base is the square of *BL* and whose height is *DL*. But this latter solid is equal to the cube of *BL* plus the solid whose base is the square of *BL* and whose height is *BD*, which is equal to the given sum of the squares. Now we make common [we add] the solid whose base is the square of *HB* and whose height is *BL*, which is equal to the sum of the roots. Therefore the solid whose base is the square of *HB* and whose height is *BG*, which we drew equal to the given number, is equal to the solid cube of *BL* plus [a sum] equal to the given sum of its edges plus [a sum] equal to the given sum of its squares; and that is what we wished to demonstrate.



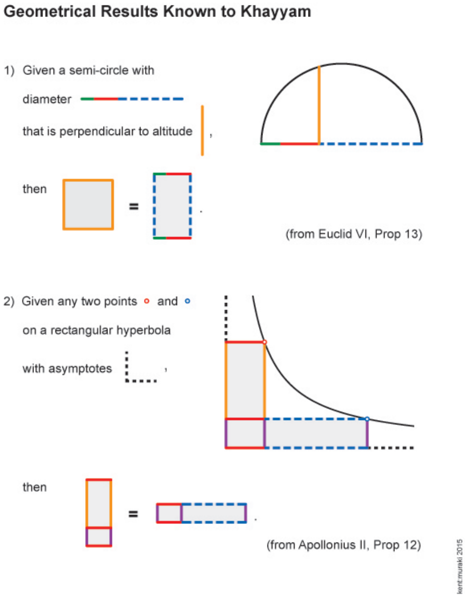
- ▷ most textbooks introduce alphabetic notations in their geometric narratives . . .

Geometry without Alphabetic Notations

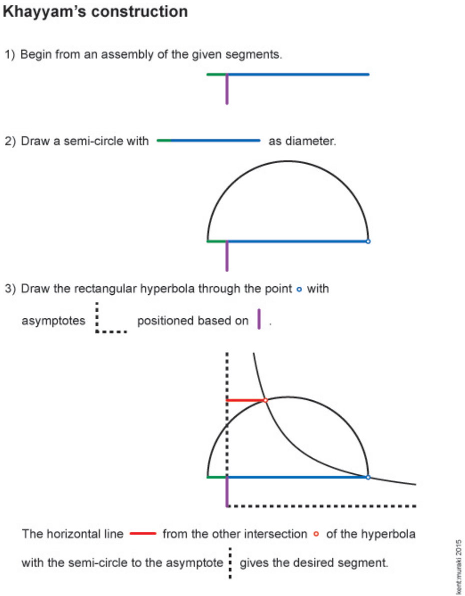


▷ . . . one noteworthy exception is the 1847 colour edition of Euclid by Oliver Byrne

Khayyam did his Homework: Euclid & Apollonius



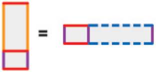
Khayyam's Construction



Khayyam's Proof

1) From each of ∘ and ∘ , draw the rectangles formed with the asymptotes,

with .

2) By the equal area lemma for the hyperbola,  .

Subtract common area  , so that  .

3) Restate the equality of areas in terms of ratios of segments,

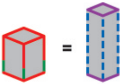
 .

Pictographic Proof, Part 2

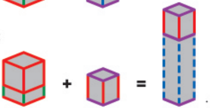
Then the squares are also proportional,

The second equality follows from the equal area lemma for the semi-circle.
Simplify the new ratio using the common side,

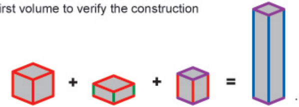
4) Restate the equality of ratios in terms of volumes,



Add  to both sides, so that



Lastly, restore 
and unstack the first volume to verify the construction



Coming Soon . . . Spring 2016

MATH 380: History of Math

- ▷ T Archibald
- ▷ MWF 9:30-10:20

MATH 302: Computing with Mathematics

- ▷ Modern Mythologies in Mathematics
- ▷ D Muraki
- ▷ MWF 10:30-11:20

Computing with Mathematics (MATH 302) • **Abstract** • **Spring 2016**

Modern Mythologies in Mathematics

You tell people that you are taking math classes at SFU, and they say, "You study math, you must know a lot about . . ." But even after having succeeded in all of the lower-division courses, calculus and linear algebra, many students are not aware about how this math actually impacts the world around us.

But modern life really does rely on technology and hence, the mathematics that is the quantitative foundation that makes it all work so amazingly. For example, chaos theory is often used to explain the complexity of weather forecasting; Fourier theory forms the basis for modern signal processing; and Google was born from the largest linear algebra problem ever conceived.

This course builds from two popular books about math in the real world, *In Pursuit of the Unknown: 17 Equations that Changed the World*, by Ian Stewart and *9 Algorithms that Changed the Future: the Ingenious Ideas that Drive Today's Computers*, by John MacCormick. But we will dive deeper, and experience in more detail how our knowledge of the calculus and linear algebra fits into these popularized narratives.

So if you enjoy learning new mathematics and the stories that make them part of our everyday lives, think Math 302.

Course prerequisites: Math 251 (Calc III) and Math 232/240 (Linear Algebra). Some elementary computing experience (Maple and Matlab) advantageous.

Further information & updates: www.math.sfu.ca/~muraki

These images are visual representations of three themes in the popular books by Stewart and MacCormick. Which three of the following do you think these represent: data compression, relativity, information theory, chaos, quantum mechanics, and error-correcting codes?