The Mathematics Attic

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50 Years of Mathematics Teaching

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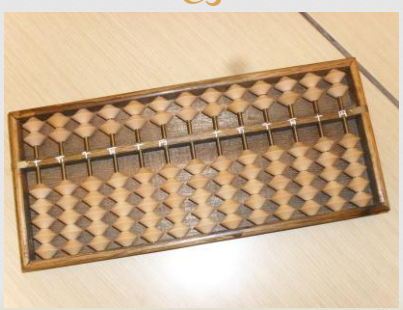

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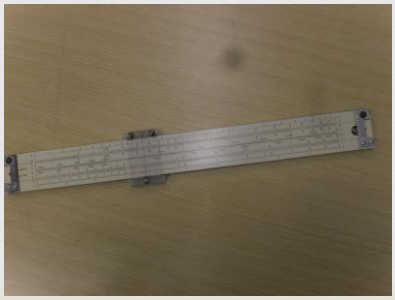

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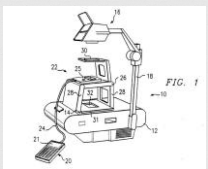


The Mathematics Attic

Current Technology

So…why???

- Extracting roots
- Rationalizing denominators
- Factoring
- Finding zeros
- Descartes Rule of Signs
- And many, many others?

So…why???

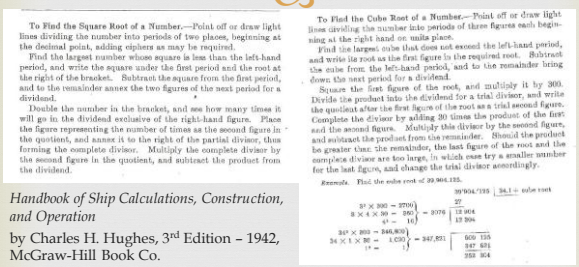
- Arguments for…
- Arguments against…

Involution and Evolution

- Involution
  - The process of raising a number to any required power.
- Evolution
  - The process of finding any required root of a number.

Academic Arithmetic by Webster Wells, S.B.
Massachusetts Institute of Technology, p. 138.
Copyright 1893

Root Abstraction Algorithms



To Find the Square Root of a Number.—Point off or draw light lines dividing the number into periods of two places, beginning at the decimal point, adding ciphers as may be required.

Find the largest number whose square is less than the left-hand period, and write the square under the first period and the root at the right of the bracket. Subtract the square from the first period, and to the remainder annex the two figures of the next period for a dividend.

Double the number in the bracket, and see how many times it will go in the dividend exclusive of the right-hand figure. Place the figure representing the number of times as the second figure in the quotient, and annex it to the right of the partial divisor, thus forming the complete divisor. Multiply the complete divisor by the second figure in the quotient, and subtract the product from the dividend.

To Find the Cube Root of a Number.—Point off or draw light lines dividing the number into periods of three figures each beginning at the right hand on units place.

Find the largest cube that does not exceed the left-hand period, and write its root as the first figure in the required root. Subtract the cube from the left-hand period, and to the remainder bring down the next period for a dividend.

Square the first figure of the root, and multiply it by 300. Divide the product into the dividend for a trial divisor, and write the quotient after the first figure of the root as a trial second figure. Complete the divisor by adding 30 times the product of the first and the second figure. Multiply this divisor by the second figure, and subtract the product from the remainder. Should the product be greater than the remainder, the last figure of the root and the complete divisor are too large, in which case try a smaller number for the last figure, and change the trial divisor accordingly.

Handbook of Ship Calculations, Construction, and Operation
by Charles H. Hughes, 3rd Edition – 1942, McGraw-Hill Book Co.
1st Edition - 1917

Square Root Algorithms

Find $\sqrt{5280}$ round to 2 places.
No calculator - batteries died!

Rationalizing Denominators

- Can be interesting from a historical perspective.
- Maybe we want to preserve the history of mathematics.
- But, we should not insist that "you can't leave a radical in the denominator!" Oh yea? Watch!

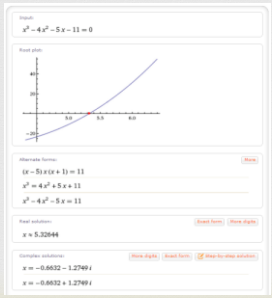
$$\frac{2}{\sqrt{5}}$$

Factoring*

- Consider ax^2+bx+c for integer values of a, b, and c ($a \neq 0$).
- For 1000 randomly chosen values, >95% were not factorable.
- So why do we spend a disproportionate amount of time teaching students how to factor? And, why do we do it without focusing on meaning, conceptual understanding, purpose, etc.?

Habib Matar and Murray Leigh, CGCC, Spring 2012 Honor's Project

Finding Zeros



Descartes's Rule of Signs

- A mathematically "beautiful" idea.
- Let's relegate either to the history of mathematics or to provide a sense making opportunity.
- But let's not pretend that it is absolutely necessary.

Math Teacher's Say the Darndest Things

- You're not allowed to subtract in algebra!
- You can't leave a radical in the denominator!
- The student didn't do the problem my way so I marked it wrong!
- You can't take the square root of a negative number!
- Some mathematicians decided that this is the way it should be ("math-magic")!
- What if your batteries are dead? Then what will you do?

Historical Perspective


Cocker's
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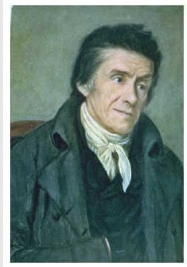
Licensed Sept. 3. 1677. Roger L'Estrange.

Cocker's Arithmetick (1677): Being a plain and familiar method suitable to the meanest capacity for the full understanding of that incomparable art, as it is now taught by the ablest schoolmasters in CITY and COUNTRY.

Historical Perspective

"I wish to wrest education from the outworn order of doddering old teaching hacks as well as from the new-fangled order of cheap artificial teaching tricks, and entrust it to the eternal powers of nature herself."

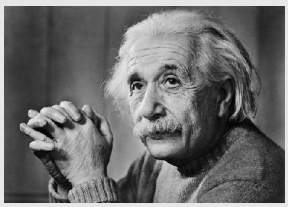
Johann Heinrich Pestalozzi
(1746 - 1827)



Historical Perspective

"Worst of all is when a school is mainly run by fear, power, and artificial authority. All it produces is a servile helot."

Albert Einstein



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