The Mathematics Attic

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50 Years of Mathematics Teaching

The Mathematics Attic

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

So...why???

Current Technology

- Arguments for...
- Arguments against...

So...why???
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

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Root Abstraction Algorithms

- *To Find the Square Root of a Number*: Write off 1 or 4 unit digits of the number in groups of two places, beginning at the left. Find the nearest perfect square whose root is not greater than the number you have written down. That number is the first digit of the square root, and the rest of it will constitute the left-hand portion of the square root. From this number subtract the square of the first digit, and you have the remainder. This is the square of the second digit or right-hand portion of the square root. Subtract this from the remainder, and you have the square of the second digit. This is the left-hand portion of the second digit, and the right-hand portion is the right-hand portion of the second digit. Subtract this from the remainder, and you have the square of the third digit. This is the right-hand portion of the third digit, and the left-hand portion is the left-hand portion of the third digit. Continue this process until you have found the number of decimal places you desire. The result will be the square root of the number.

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

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Square Root Algorithms

- 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!

\[
\frac{2}{\sqrt{5}}
\]

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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!
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.?

Factoring*

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

Finding Zeros

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.

Descartes's Rule of Signs

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 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.

“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)

“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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