

# A Square and Things: Quadratic Equations

By

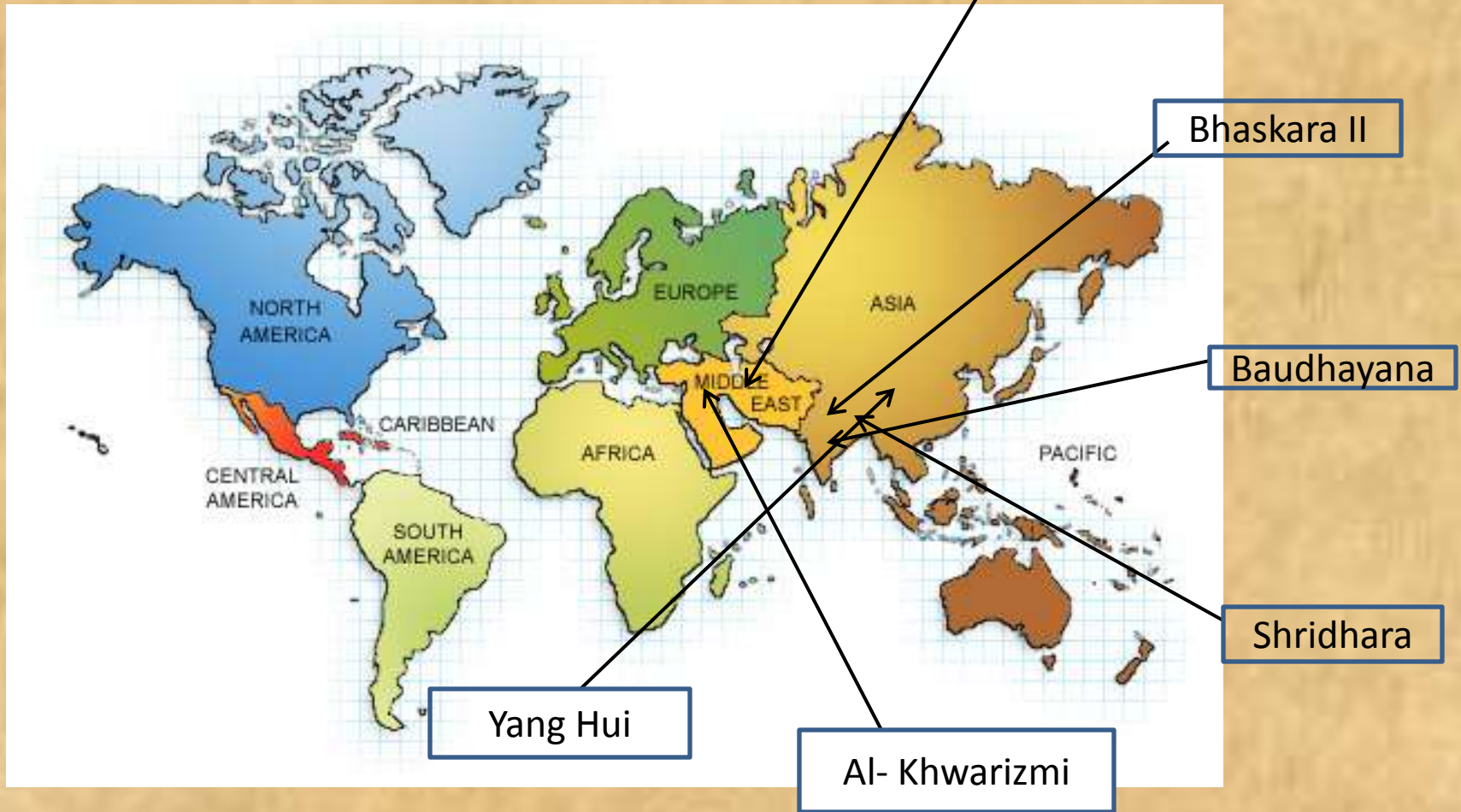
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# Timeline for people using some form of Quadratic Equations

- 2000 BC – 1600BC- Babylonians
- 800 BC- Baudhayana
- 825 AD-- Al-Khwārizmī
- 9<sup>th</sup> Century-- Shridhara
- 1150 AD- Bhaskara II
- 1275 AD- Yang Hui

# Location



# Babylonians

- Earliest evidence of the quadratic equation came from the Babylonians.
- One equation they used was similar to our quadratic equation.
- The equation they used was:
  - $x^2 + bx = c$
  - Realized that the solution to  $x^2 + bx = c$  was:
$$x = -\frac{b}{2} + \sqrt{\left(\frac{b}{2}\right)^2 + c}$$
  - Said  $c$  was always positive

# Baudhayana (800 BC)

- Nothing was known about him except for 1 thing:
  - Author of a sulbasutra
  - oldest sulbasutra remaining
- Sulbasutra are:
  - Books about religious rules
- The only math in the sulbasutra dealt with the construction of altars.

# Baudhayana (Continued)

- His sulbasutra was a 3 chapter book. It includes the following:
  - First person to use two forms of quadratic equations
    - Forms were  $ax^2=c$  and  $ax^2 +bx= c$
  - Geometric solutions of a linear equation that dealt with 1 unknown
  - Several values for  $\pi$
  - Gives an approximate value for the square root of 2
    - $577/408$ , or 1.414215686
    - correct up to 5 decimal places for the square root of 2

# Muhammad Ibn Musa Al-Khwarizmi (780 – 850)

- Considered the founder of algebra
- Born in Uzbekistan,
- Lived in Baghdad
- Was a scholar in “The House of Wisdom”
- Most of his work was done between 813 and 833
- Wrote *Kitab al-Jabr wa-l-Mugabala* (The Compendious Book on Calculation by Completion and Balancing)

# Al-Khwarizmi Continued

- The *Kitab* was written in 830
- First book on the systematic solution of quadratic equations
- Where algebra derived from
- Al-jabr (Completion)
- Al-muqābala (Balancing)

# Problem

- *One square, and ten roots of the same, are equal to thirty-nine dirhems. That is to say, what must be the square which, when increased by ten of its own roots, amounts to thirty-nine?*

# Solution

- You halve the number of the roots, which in the present instance yields five. This you multiply by itself; the product is twenty-five. Add this to thirty-nine; the sum is sixty-four. Now take the root of this, which is eight, and subtract from it half the number of the roots, which is five; the remainder is three. This is the root of the square which you sought for; the square itself is nine.*

$$x = \sqrt{5^2 + 39} - 5 = \sqrt{25 + 39} - 5 = \sqrt{64} - 5 = 8 - 5 = 3$$

# Our Notation

$$x^2 + 10x = 39$$

$$x^2 + 10x - 39 = 0$$

$$x = \sqrt{\left(\frac{b}{2}\right)^2 + c} - \frac{b}{2}$$

$$x = -\frac{b}{2} \pm \sqrt{\left(\frac{b}{2}\right)^2 + c} = \frac{-b \pm \sqrt{b^2 + 4c}}{2}$$

# Shridhara

- Came up with rule for solving quadratic equations
  - One of the first mathematicians to do so
- Wrote:
  1. Trisatika
  2. Patiganita
  - Books had theories on how to solve several different equations.

# Bhaskara II

- Also known as Bhaskaracharya
  - Bhaskaracharya mean “Bhaskara the teacher”
- Solved quadratic equations that dealt with more than 1 unknown.
- Known as the founder of the quadratic equation
- did math that dealt with negative values
- Dealt with adding, subtracting, and multiplying 0's in his equations

# Bhaskara II (Continued)

- The form he used for the quadratic equation was  $ax^2 + bx = y^2$
- Also, dealt with the form  $ax^2 + bx + c = y$ 
  - The solution to this form was credited to William Brouncker(1657)
    - Reason: Brouncker solution was more difficult

# Yang Hui

- (1238-1298AD)
- A Chinese mathematician from Qiantang, Zhejiang province
- First instance of negative coefficients in quadratic equations
- *Yang Hui Suanfa*
- Attributes his work on quadratic equations to Liu Yi

# Today's Quadratic Equation

- Today's form of the quadratic equation:
- This formula means we will have two solutions which are:
  - And

# Timeline of how the Quadratic Equation evolved over Time

- 2000 BC- 1600 BC--  $x^2 + bx = c$  and
- 800 BC --  $ax^2$  and  $ax^2 + bx = c$
- 825 AD -- Al-Khwārizmī's form of the quadratic equation was in words.
- 1150 AD--  $ax^2 + bx = y^2$  and saw the form  $ax^2 + bx + c = y$  by Bhaskara, even though it wasn't popular yet.
- 1275 AD-- first instance of negative coefficients in quadratic equations(Yang Hui)
- 1657 AD--  $ax^2 + bx + c = y$  became well known by William Brouncker.
- Today---

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