CS 198-52: Additional Topics on the Structure and Interpretation of Computer Programs

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Logistics

- This is a totally optional set of lectures covering additional topics in 61A
- Can enroll 1 unit of P/NP credit in CS 198-52, CCN 33438
    - We'll give you permission numbers to enrol
- To pass, need to complete homeworks
- Feel free to audit!

About Caroline

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    - 3rd year CS PhD student
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About Jenny

- Jenny Wang (she/her/hers)
  - Senior, Business + CS
    - Never coded before coming to college
- Office Hours: 4-5 Tuesday
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Iterative Improvement

Computing Square Roots

Idea: Iteratively refine a guess x about the square root of a

Update: $$x = \frac{x + \frac{a}{x}}{2}$$

This is also known as the Babylonian Method

Question:

What initial value should we bind to x?

How do we know when we're finished?

Demo

Computing Cube Roots

Idea: Iteratively refine a guess x about the cube root of a

Update: $$x = \frac{2 \cdot x + \frac{a}{x^2}}{3}$$

Question:

What initial value should we bind to x?

How do we know when we're finished?

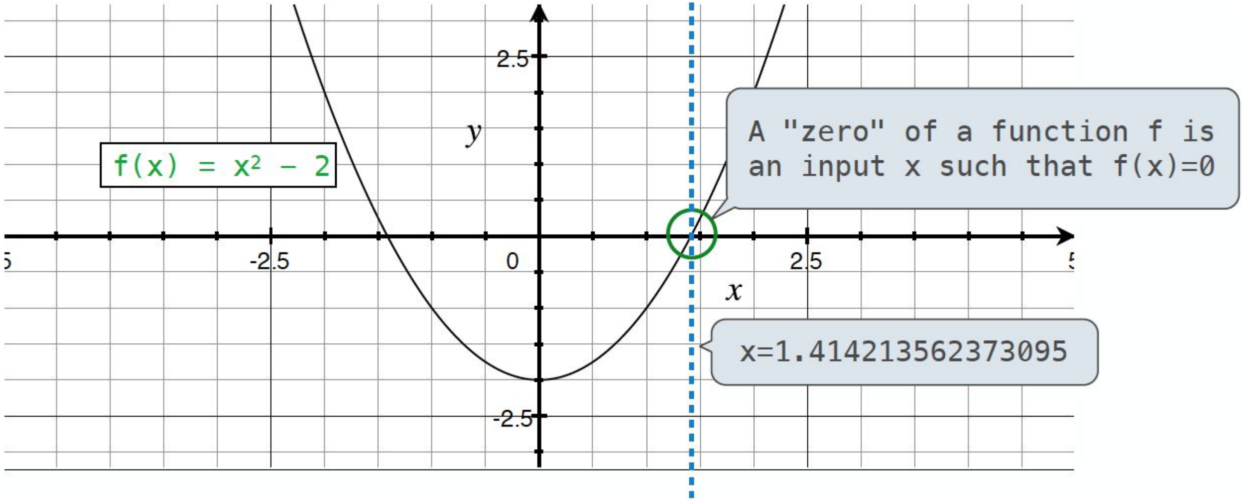
Demo

Newton's Method

Background

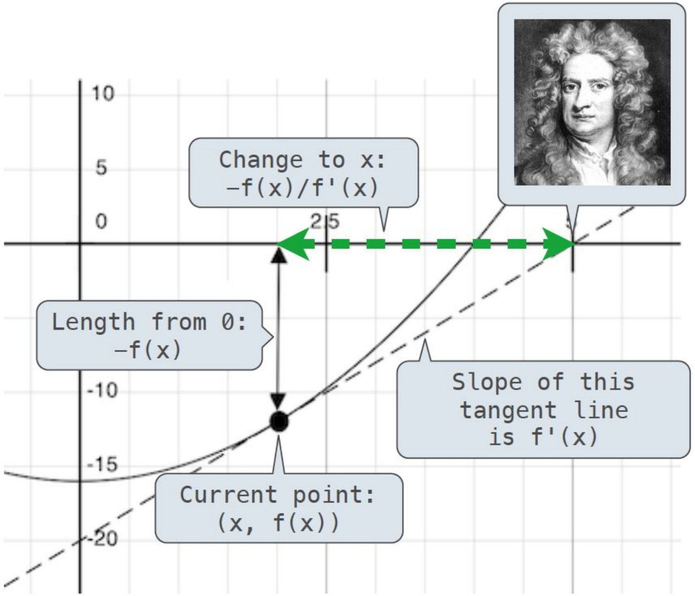
What is Newton's Method: a method that quickly finds accurate approximations to zeroes of differentiable functions

Application: a method for computing square roots, cube roots, etc.



The positive zero of $f(x) = x^2 - a$ is $\sqrt{a}$. (We're solving the equation $x^2 = a$.)

Newton's Method



Given a function f and initial guess x,

Repeatedly improve x by:

Computing the value of f at the guess: $f(x)$

Computing the derivative of f at the guess: $f'(x)$

Update guess x to be: $x - \frac{f(x)}{f'(x)}$

Finish when $f(x) = 0$, or when it's close enough

Implementing Newton's Method

To find the square root of 2:

We set $a = 2$, and so we'd get $f(x) = x^2 - 2$, therefore we also get $f'(x) = 2x$

We represent this in python through the use of lambda notations:

`f = lambda x: x * x - 2`   and   `df = lambda x: 2 * x`

To find the square root of 729:

$g(x) = x^3 - 729$, $f'(x) = 3x^2$

`g = lambda x: x * x * x - 729`   and   `dg = lambda x: 3 * x * x`

Demo