61A Extra Lecture 13

Announcements

Prediction

Regression

Given a set of (x, y) pairs, find a function f(x) that returns good y values

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pairs = [(1656, 215.0), (896, 105.0), (1329, 172.0), ...]
```

Square feet

Price (thousands)

Data from home sales records in Ames, Iowa

Measuring error: |y-f(x)| or $(y-f(x))^2$ are both typical

Over the whole set of (x, y) pairs, we can compute the mean of the squared error

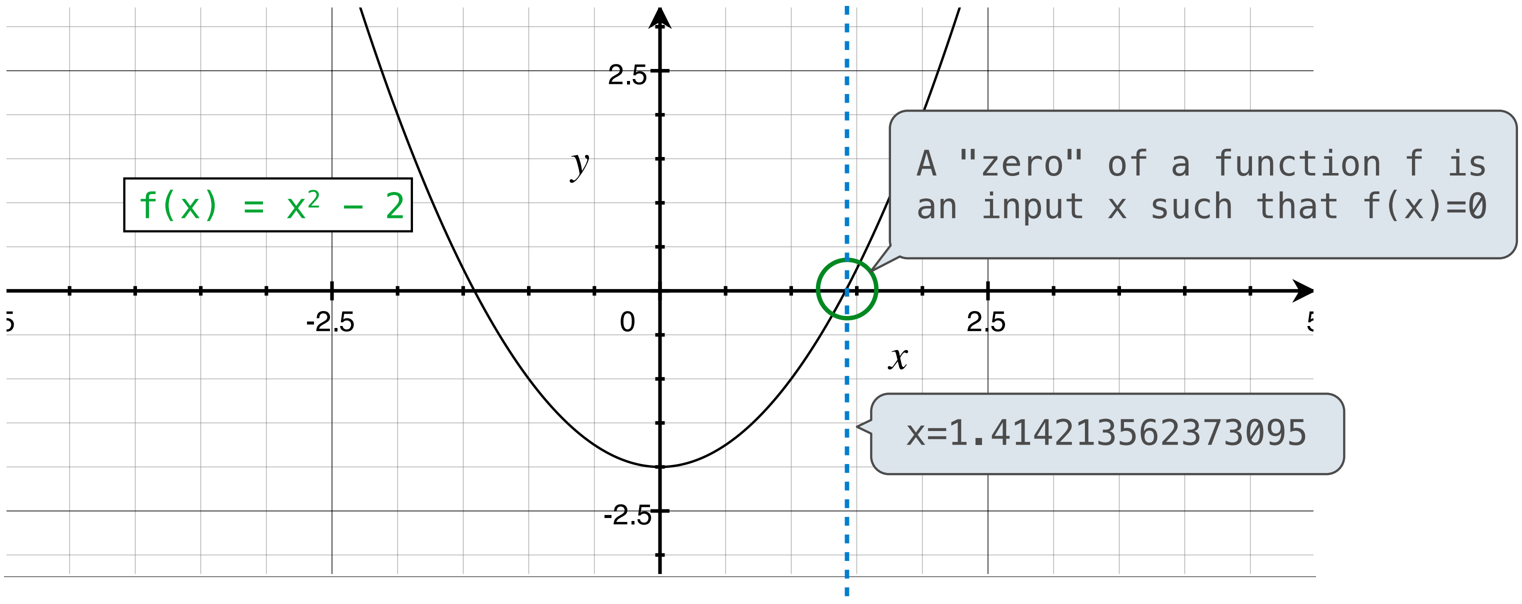
Squared error has the wrong units, so it's common to take the square root

The result is the "root mean squared error" of a predictor f on a set of (x, y) pairs

(Demo)

Purpose of Newton's Method

Quickly finds accurate approximations to zeroes of differentiable functions!



Application: Find the minimum of a function by finding the zero of its derivative

Approximate Differentiation

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Differentiation can be performed
symbolically or numerically
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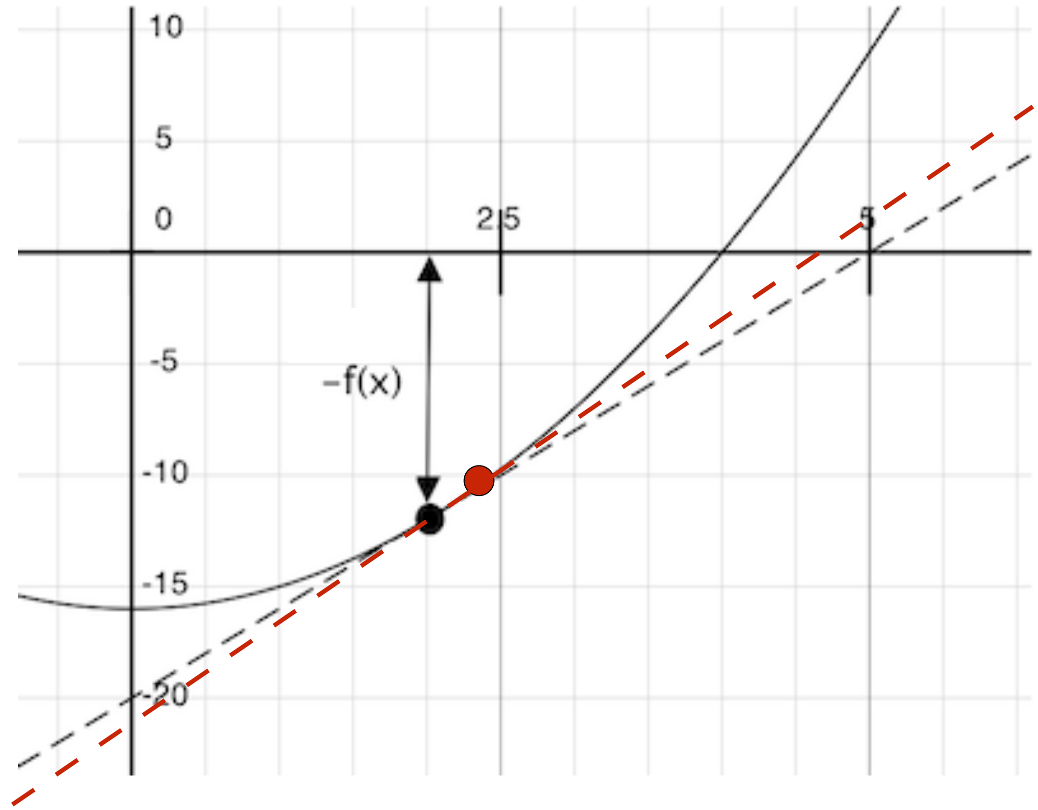
$f(x) = x^2 - 16$

$f'(x) = 2x$

$f'(2) = 4$

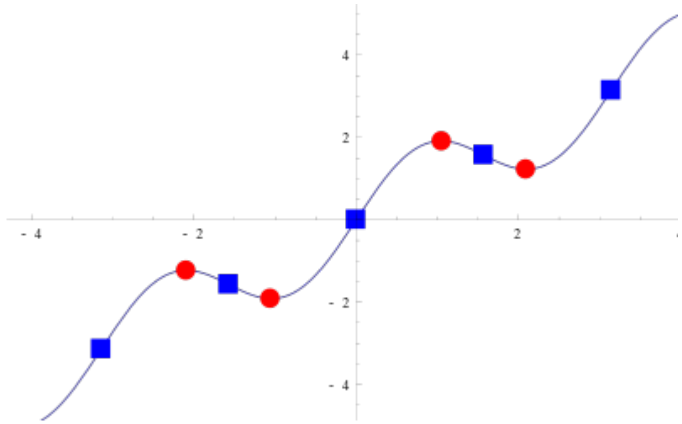
$$f'(x) = \lim_{a \to 0} \frac{f(x+a) - f(x)}{a}$$

$$f'(x) \approx \frac{f(x+a) - f(x)}{a} \quad \text{(if } a \text{ is small)}$$



Critical Points

Maxima, minima, and inflection points of a differentiable function occur when the derivative is 0



The global minimum of convex functions that are (mostly) twice-differentiable can be computed numerically using techniques that are similar to Newton's method

(Demo)

http://upload.wikimedia.org/wikipedia/commons/f/fd/Stationary_vs_inflection_pts.svg

Multiple Linear Regression

Given a set of (xs, y) pairs, find a linear function f(xs) that returns good y values

A linear function has the form **w** • **xs** + *b* for vectors **w** and **xs** and scalar *b*

(Demo)

Note: Root mean squared error can be optimized through linear algebra alone, but numerical optimization works for a much larger class of related error measures