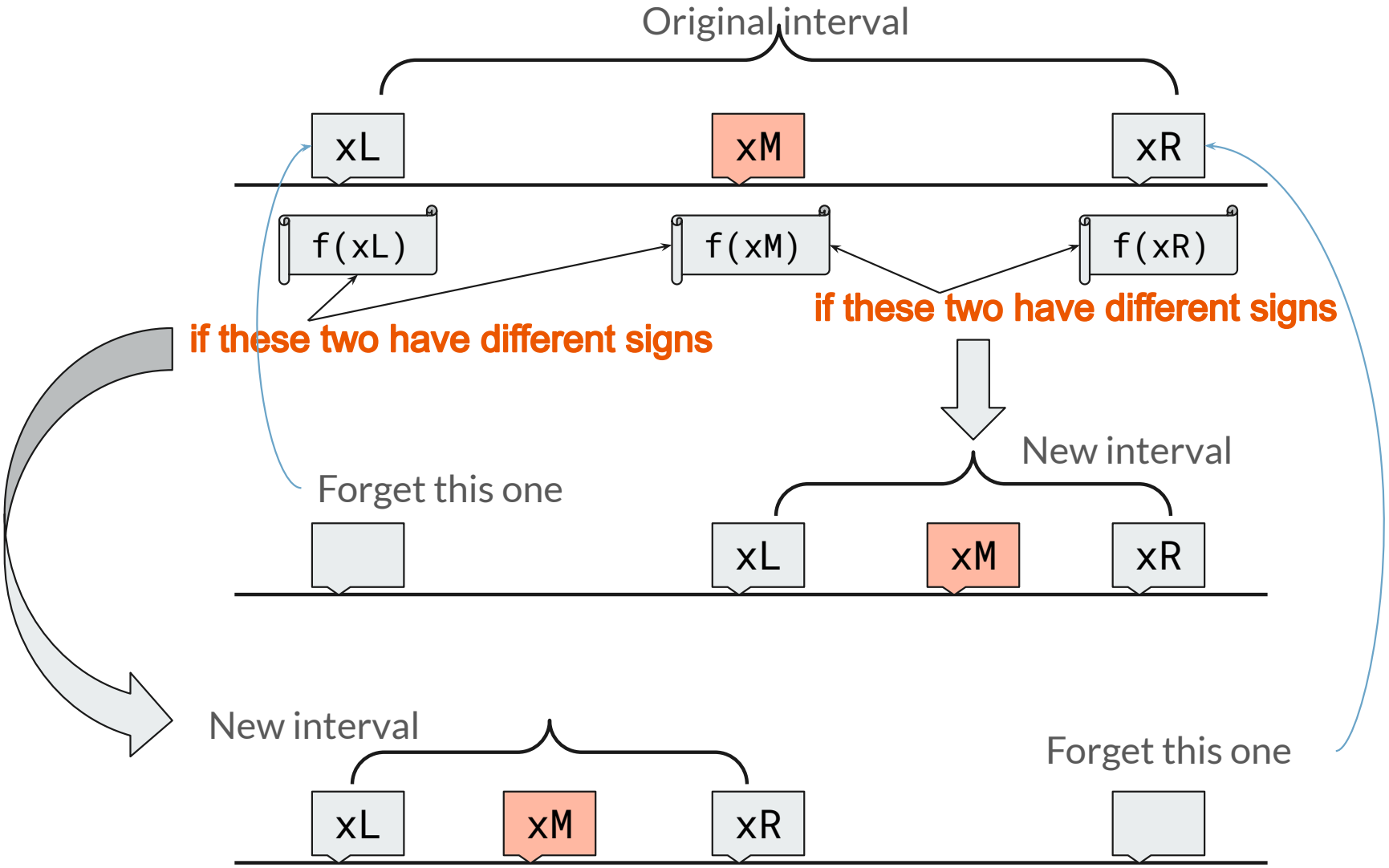
ENGR 21:
Computer Engineering Fundamentals

Lecture 12
Thursday, October 09, 2025

Recall Bisection Method



Root-finding method #2: The Secant Method

Root-finding Technique 2: The Secant Method for finding x where $f(x) = 0$

1. Start with two estimates of the root
2. Evaluate the function at both those estimates
3. Draw a straight line between the two points. This is an estimate of the function's behavior.
4. Locate the point where this line crosses the x-axis. Call this x_3
5. Let (x_3, f_3) be a new point. Forget about (x_1, f_1).
6. Repeat the process, with (x_2, f_2) and (x_3, f_3)

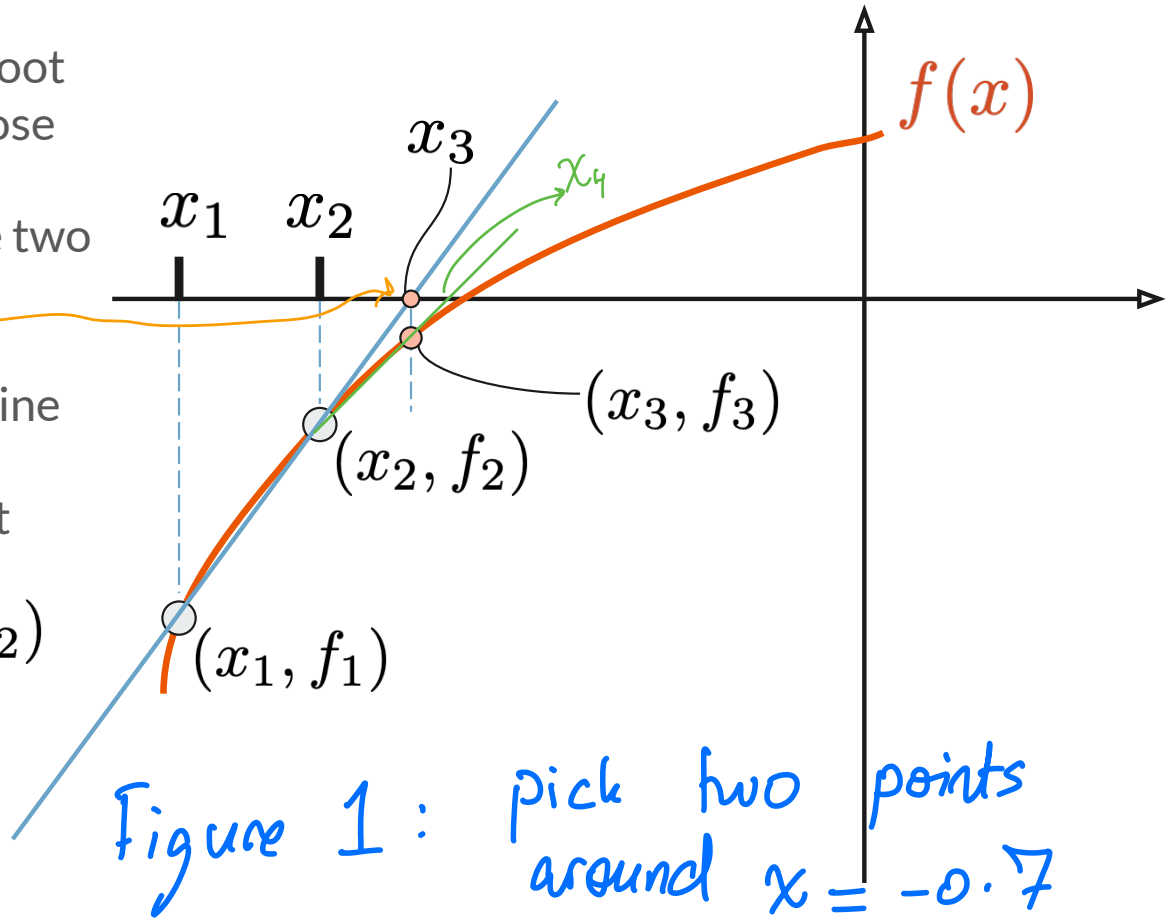


Figure 1: pick two points around $x = -0.7$

Let $f(x_j) = f_j$

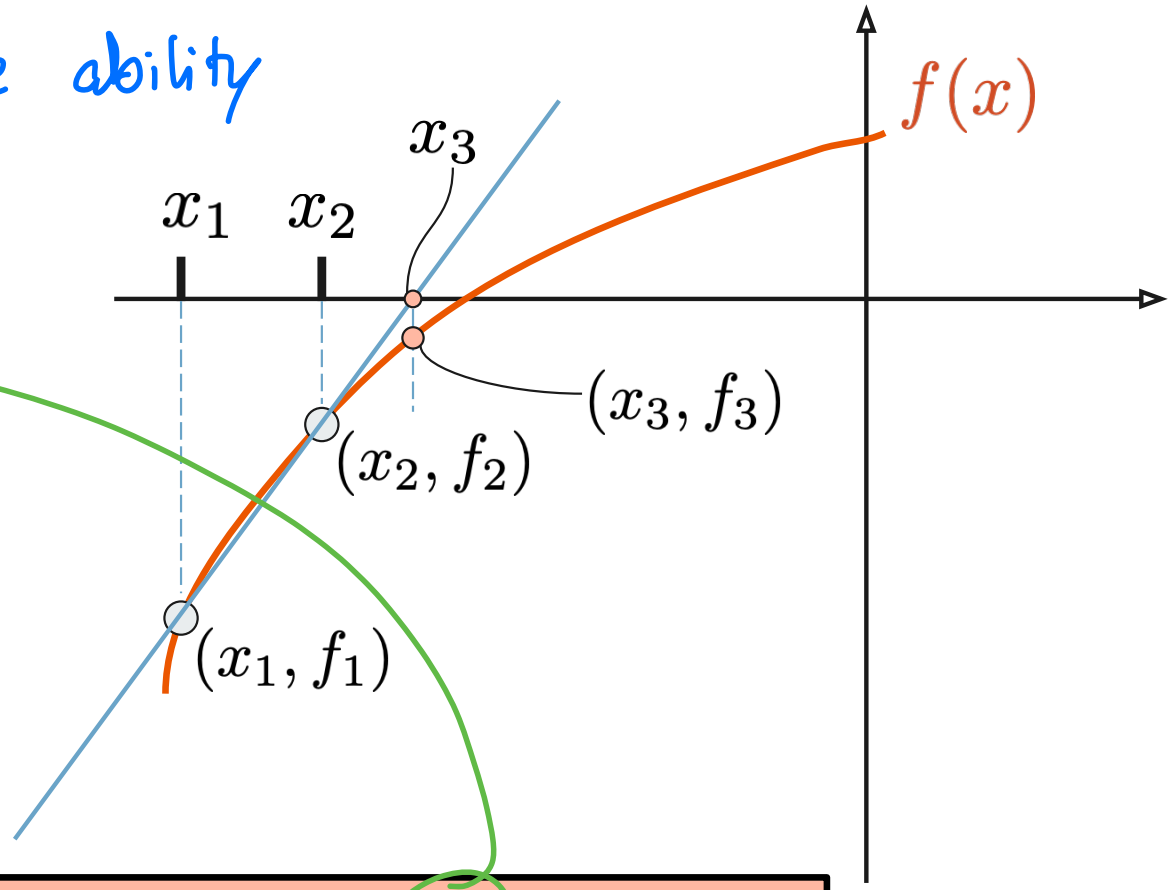
Summary of Secant Method for finding the value of x where $f(x) = 0$

Given x_1, x_2 and the ability to calculate any $f(x)$

Can you write down a formula for x_3 ?

$x_3 =$ (some expression that contains x_1 x_2 f_1 f_2)

$$x_3 = x_1 - f_1 \frac{(x_2 - x_1)}{(f_2 - f_1)}$$

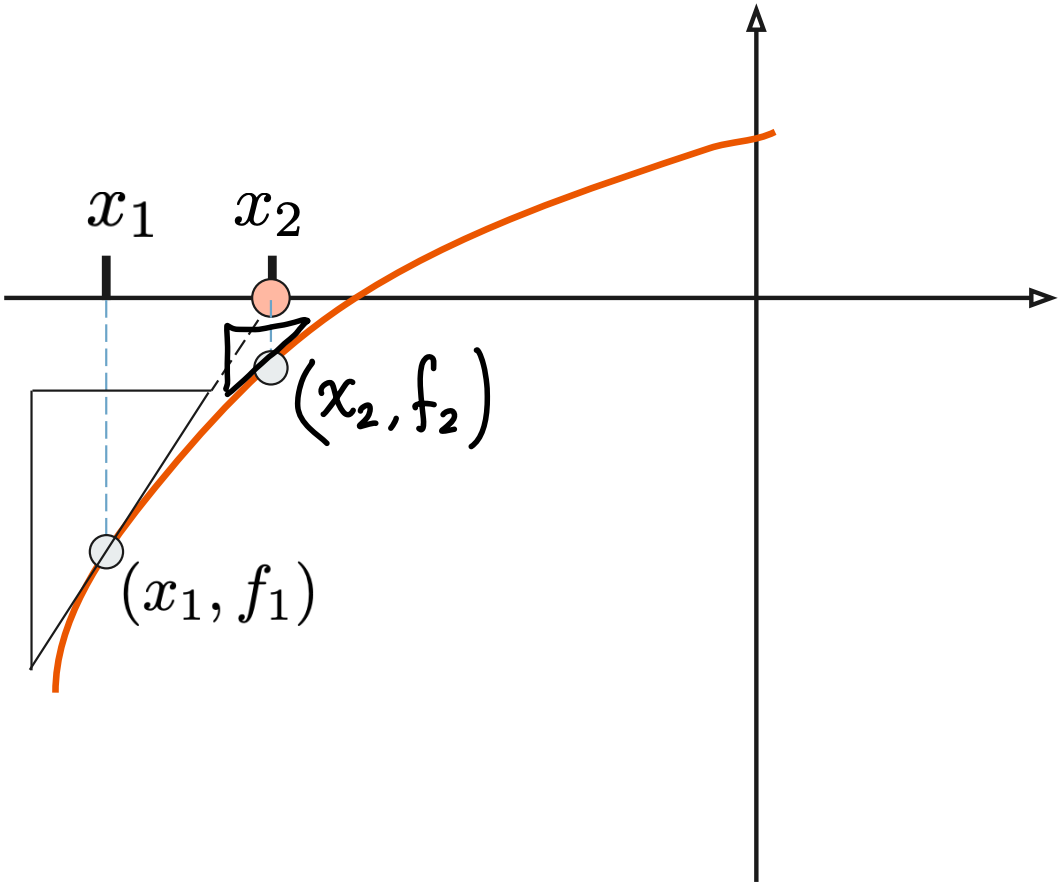


Given (x1, f1) **and** (x2, f2), **find** (x3, f3)
Then repeat using (x2, f2) **and** (x3, f3).

Root-finding method #3: Newton's Method

Root-finding Technique 3: Newton's Method for finding x where $f(x) = 0$

1. Evaluate the function at your first guess
2. Make a straight line that has the same slope as f(x) does at (x1,f1)
3. Find location where this line intersects x-axis. This is the 2nd guess, call it x2.
4. Repeat



Let $f(x_j) = f_j$

Summary of Newton's Method for finding the value of x where $f(x) = 0$

$x_{i+1} = (\ldots)$

an expression that contains $\{x_i, f(x_i), f'(x_i)\}$

$$x_{i+1} = x_i - \frac{f(x_i)}{f'(x_i)}$$

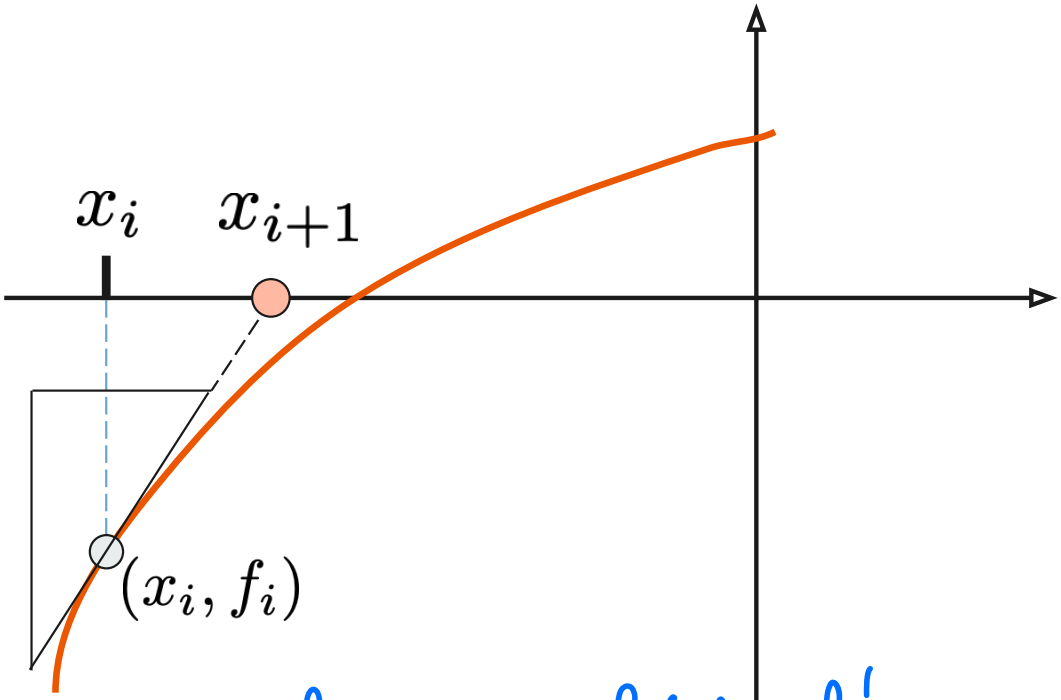


Figure 2: start Newton's method with $x = 2$

Need to know functions $f(x)$, $f'(x)$.

Let $f(x_j) = f_j$

Given x1, f(x1) **and** f'(x1), **find** x2
Then repeat using x2, f(x2) **and** f'(x2).