

Project 1: Bisection

Outline

```
function cooldrive    % this is the driver
% set a, t and a range of L and b and find x
% and plot x^2 against L
return
```

```
function x = cool(a,b,t,L) % for a given a, b, t, and L find x
% code bisection
return
```

(Most of the work comes in writing this function)

```
function val = coolfun(x,L) % for a given x and L evaluate "cool"
val = sin(x*L) + x*cos(x*L);
return
```

coolfun is given to you, right here.

How do you evaluate coolfun (sin(x*L)+x*cos(x*L)) from within the function cool?

Functions

- Calling a function from within another function
function x = cool(a,b,t,L)

...

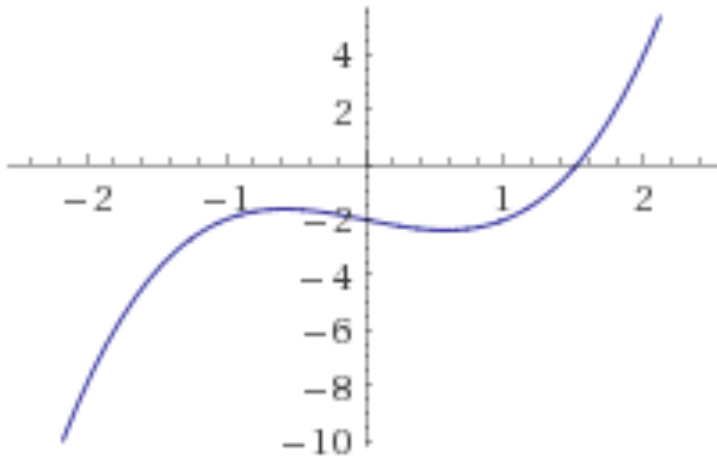
now we need to evaluate at x!

fx = coolfun(x,L)←

The above line calls coolfun.

- Function arguments: letters as placeholders
- Keep track of arguments and variables between functions.

Bisection



1. Find midpoint
2. If root is to the left of the midpoint [i.e. $f(a)f(x) < 0$], move b to the current position of the midpoint, so the root will be somewhere in the middle of a and b .
3. If root is to the right of the midpoint [i.e. $f(b)f(x) < 0$], move a to the current position of the midpoint, so the root will be somewhere in the middle of a and b .

1. If $f(a)f(b) > 0$ inform the user that a solution may not exist in $[a, b]$ and exit.
2. Set $x = (a + b)/2$. While $|f(x)| > t$ do
3. If $f(a)f(x) < 0$ set $b = x$ else set $a = x$. Go to step 2.

Bisection Example: $x^3 - x - 2$

Iter	a	b	x	f(x)
1	1	2	1.5	-0.125
2	1.5	2	1.75	1.61
3	1.5	1.75	1.625	.666
4				.2522
5				.0591
6				-0.034
7				.01225
8				-.0109
9				$5.1 \cdot 10^{-4}$

If tol = 0.05, we stop at iter:

If tol = 0.1, we stop at iter:

If tol = 0.001, we stop at iter:

(Real root $x^* = 1.5214$)

Coding Bisection

1. If $f(a)f(b) > 0$ inform the user that a solution may not exist in $[a, b]$ and exit.
2. Set $x = (a + b)/2$. While $|f(x)| > t$ do
3. If $f(a)f(x) < 0$ set $b = x$ else set $a = x$. Go to step 2.

How to code each of these steps?

→ Anytime you see $f(a)$, $f(x)$, etc., how do you find that value?

Storing data in your driver

```
for cnt = 1:31
    L(cnt) = 1 + (cnt-1)/10;
    x(cnt) = cool(a,b,t,L(cnt));
end
plot(L,x.^2)
```

The trouble with this loop however is that Equation (1) may have more than one root between $a = 0.1$ and $b = 3$. I recommend that you move one or both of these as you change L .

This is another way of saying you need (automated) new starting guesses every time you change the length. How can we do this to make sure there's only ever one root in between a and b ?

Quiz Questions

- Discuss in small groups
- Pose lingering questions to all of us

Other Matters

- Read my comments on owlspace
- What to do if code overflows to the next line? (...)
- Publishing