Modeling Functions
Using Functions Without Actually Calling Them

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Tip of the Day

▶ Good luck on final exams!

Objectives

▶ Learn how to create “anonymous functions”
  ▶ and learn why you might want to do such a thing
▶ Find the minimums and zeros of a function
▶ Consider the skills you have learned!
You don’t have to name your numbers!

► Suppose for some reason you wanted a function \( f \) to calculate \( \frac{x^2 + y^3}{5} \).
► How would you write it?

One Candidate:

```matlab
function [answer] = f(x,y)
    two = 2 ;
    three = 3 ;
    five = 5;
    answer = (x ^ . two + y ^ . three) / five
end
```
► What’s wrong with the above code?
Turns out, you don’t have to name functions either!

- It was inconvenient to give names to each of those integers.
  - Sometimes it’s inconvenient to give names to functions also.

- Syntax:
  - The @ sign
  - List of all parameters in parenthesis
  - The expression to evaluate and return

Example:
@\((x, y)\) \(2 \times x + y\)

To call it:
\(\>(@\((x, y)\) \(2 \times x + y\))(5, 3)\)
13
Example: Twice

Let’s define a function twice that
- takes another function \( f \) and
- a value \( x \) and
- output the value \( f(f(x)) \)

Our twice function:

```matlab
function [result] = twice(f,x)
    result = f(f(x))
end
```

Challenge: try to write a function that adds one to its parameter, and call twice on it.
- Don’t give the function a name!
Answer:

twice.m

function [result] = twice(f,x)
    result = f(f(x))
end

Calling it:

> twice(@(x) x + 1, 10)
12
We can actually name these if we want....

- Consider $\text{inc}$ (short for “increment”):

  Code:

  $$\text{inc} = @(x) x + 1$$

  - Is there an advantage to writing it this way?
  - Can you write twice this way?
Answer:

Handled version of twice:

```matlab
twice = @(f,x) f(f(x));
```

One advantage is we don’t have to create a whole new file.

```matlab>
twice(@(x) x + 1, 10)
12
```

This other syntax works too:

```matlab>
twice(inc, 10)
12
```
Passing in built-in functions

- If the function is build-in and we want to pass it to another function, we need to use @ as well.
  - If you “say the name” of a built-in, matlab assumes you mean to call the function.

Built-in functions are different....

> twice(cos,0)
error: Invalid call to cos. Correct usage is:

    -- cos (X)

Using the @ fixes things.

> twice(@cos,0)
ans = 0.5403
Challenge

Write a function repeatedly that does this:

\[ \text{\texttt{> \texttt{repeatedly(@cos,0)}}} \]
\[ \text{\texttt{ans = 0.7391}} \]

- You don’t have to use @ in your function, but let’s talk first about how you will do this.
Some useful function handle functions...

- Use `fplot` to plot a function and have `matlab` figure out the domain.
- Use `fminbnd` to find the minimum of a function.
  - Give function, left, right
- Use `fzero` to find a zero of a function.
  - Give function, initial guess
What have you learned?

► Consider what we have covered. What do you anticipate will be useful later?