Default Arguments

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Default Arguments

- You want to write a function that calculates the weight of concrete blocks
    - You have arguments for height, width, length
    - Then you realize that concrete blocks can be hollow
    - that the answer could be given in kg and in pounds
    - that dimensions could be in inches or cms
- Function template:
    - `def weight_block(height, width, length, cm, solid, measure):`

Default Arguments

- You realize that your site almost exclusively
  - uses solid blocks
  - uses kgs for weights
  - and cms for length

Default Arguments

- You can make this the default values

    -
      ```
      def weight( height,
                  width,
                  length,
                  solid=True
                  cm=True,
                  kg=True
                 )
      ```
    - The function now has three mandatory parameters (height, width, length) and three optional parameters.

Default Arguments

```
def weight(height, width, length, solid=True, cm=True, kg=True)
```

- Example Calls:
  - `weight(5,10,100,solid=False)`
    - Parameters are height: 5, width: 10, length: 100, solid: False, cm: True, kg: True
  - `weight(width=5, length=10, height=100, solid=False)`
    - Parameters are height: 100, width: 5, length 10, solid: False, cm: True, kg: True
    - Notice that you cannot have positional arguments following named arguments

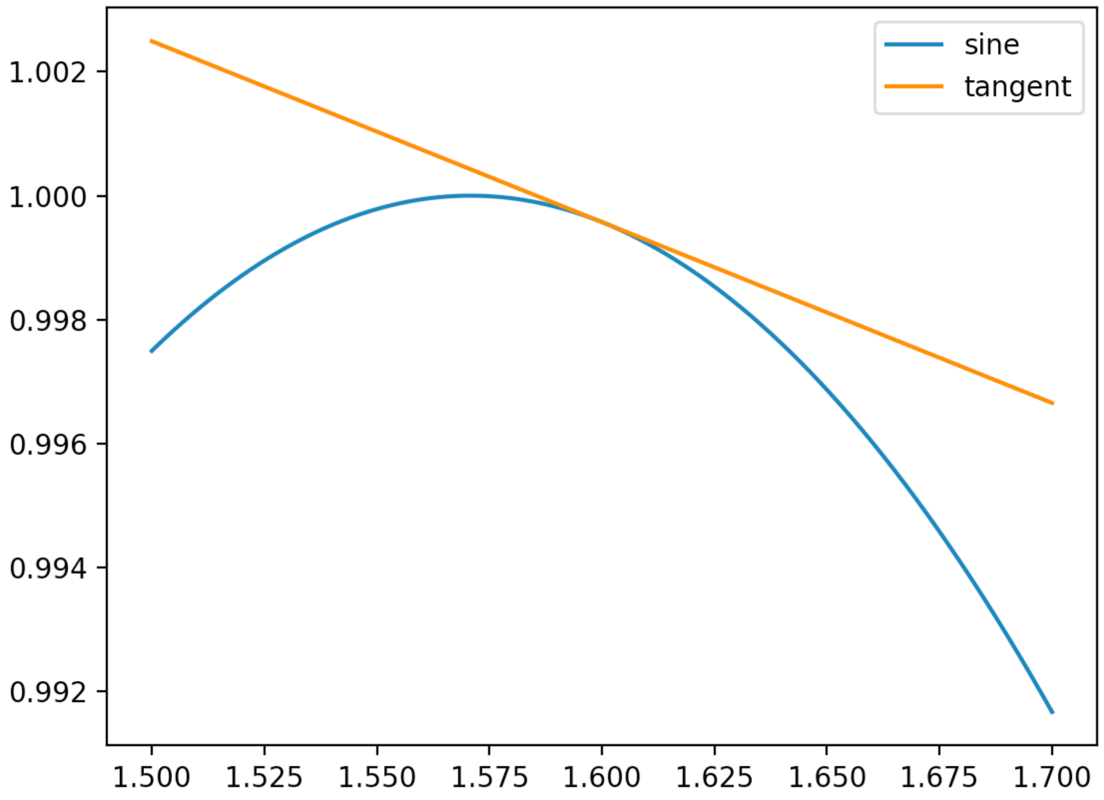
Default Arguments

```
def weight(height, width, length, solid=True, cm=True, kg=True)
```

- Example Calls:
  - `weight(5,10,100,cm=False, kg=False)`
    - Parameters are height: 5, width: 10, length: 100, solid: True, cm: False, kg: False
  - `weight(width=5, length=10, height=100, kg=False)`
    - Parameters are height: 100, width: 5, length 10, solid: True, cm: True, kg: False
    -

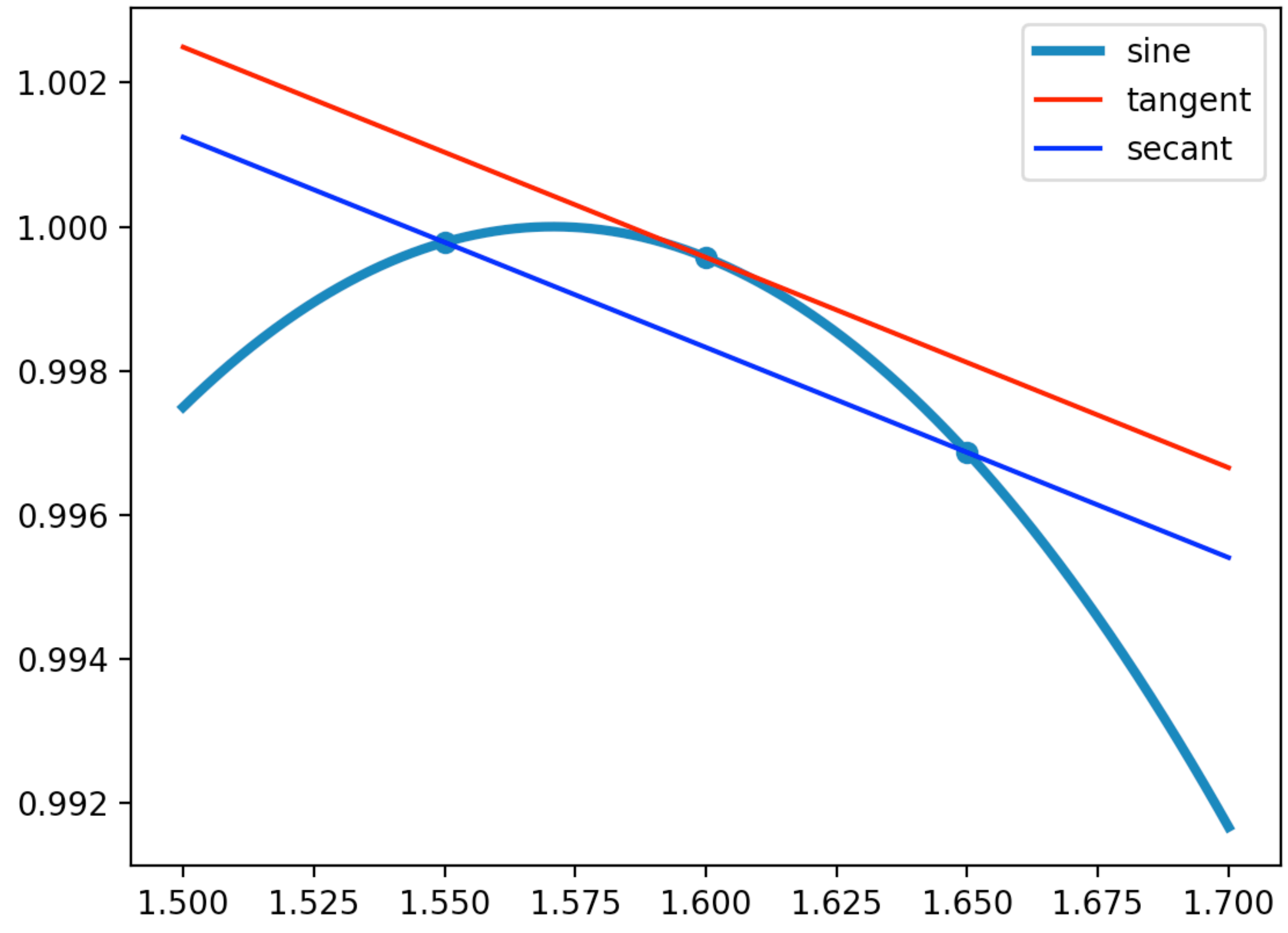
Numerical Differentiation

- The derivative of a function is defined to be the slope tangent to the function at a given point
- Example:
- The slope of the tangent of the sine function at 1.6 is about -0.03.



Numerical Differentiation

- For numerical calculation, we replace the tangent with a secant that cuts through two points on the graph of the function



The red line is the tangent, going through (1.6, sin(1.6))

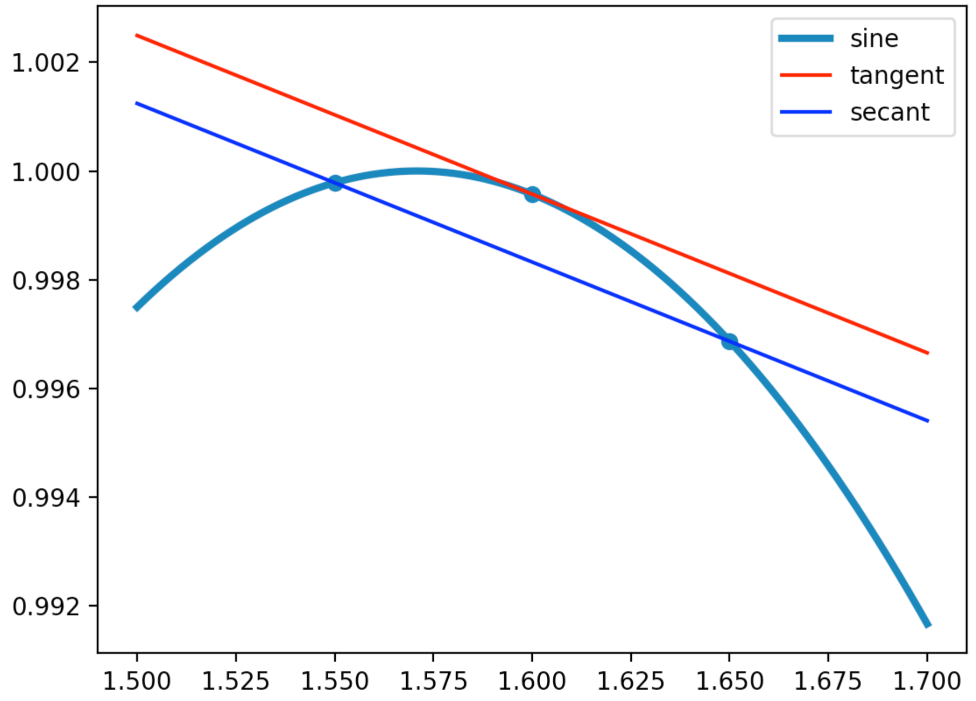
The blue line is a secant, going through two points on the graph of sine.

The points are (1.55, sin(1.55)) and (1.65, sin(1.65))

The slope of the two lines are almost identical.

Numerical Differentiation

- To get more accuracy:
  - Move the two points defining the secant closer together
  - But when we do this, we have more inaccuracies because the slope of the secant is given as difference of the y-values over difference of the x-values



Numerical Differentiation

- The formula for the secant at points $\left(x_0 - \delta, f(x_0 - \delta)\right)$ and $\left(x_0 + \delta, f(x_0 + \delta)\right)$ is
- $\dfrac{f(x_0 + \delta) - f(x_0 - \delta)}{2\delta}$
- We want δ to be small, but not so small that it causes numerical errors

Default Arguments

- Given the size of floating point numbers $\delta = 10^{-6}$ is about right.
  - But sometimes we want to be able to change it, so we use a default argument.
- Our function is now

-
  ```
  def derivative(func, x0, delta=1E-6):
      return (func(x0+delta)-func(x0-delta))/(2*delta)
  ```

Default Arguments

- Let's try it out on the sine function

```
import math

def derivative(func, x0, delta=1E-5):
    return (func(x0+delta)-func(x0-delta))/(2*delta)

for i in range(20):
    x = 1.4+i/10
    print(x, abs(derivative(math.sin, x)- math.cos(x)), sep='\t')
```

- Deviations are around 10^{-12}

Default Arguments for print

- print has three default arguments that we can set:
    - end: what is printed at the end of the statement
        - default is a new line
    - sep: what is printed between the values
        - default value is a white space
    - file: where the file is printed.
        - default value is standard output, i.e. the shell
        - But can be used to write to a file

Default Arguments

- math.log also has a default argument, the base
  - default value is e
  - `math.log(5, math.e)` same as `math.log(5)`
    - Natural logarithm of 5
  - `math.log(5,2)`
    - Logarithm base 2: $\log_2(5)$