Lecture 12

Calculus in Python

Workshop 4 Review

Calculus

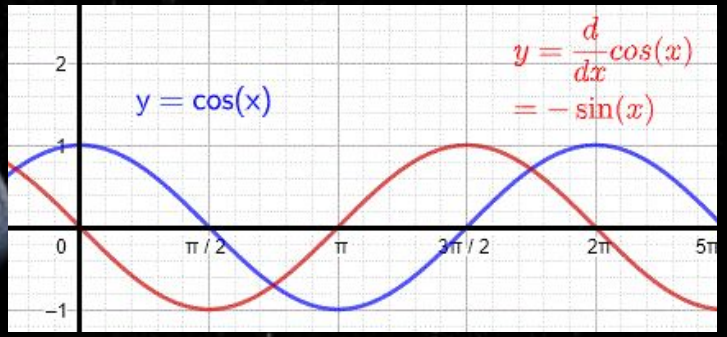
- How many of you have already taken Calc 1A/B or some form of calculus in high school?

- Calculus invented by Sir Isaac Newton ---------->

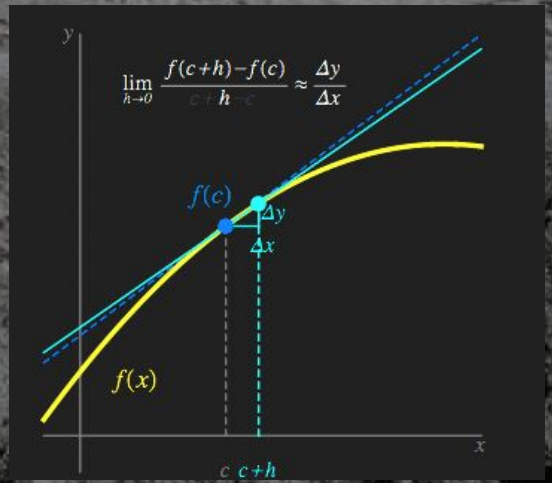
- An important aspect of physics that we can use python to approximate

Differentiation

- Used to analyse the rate of change of any function

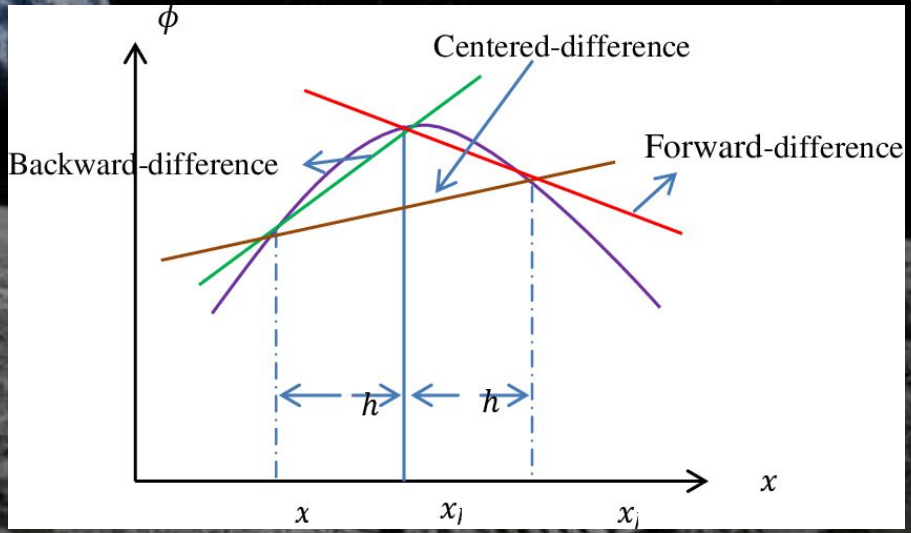


- The derivative describes the instantaneous slope of a function (slope of a single point instead of between two points)



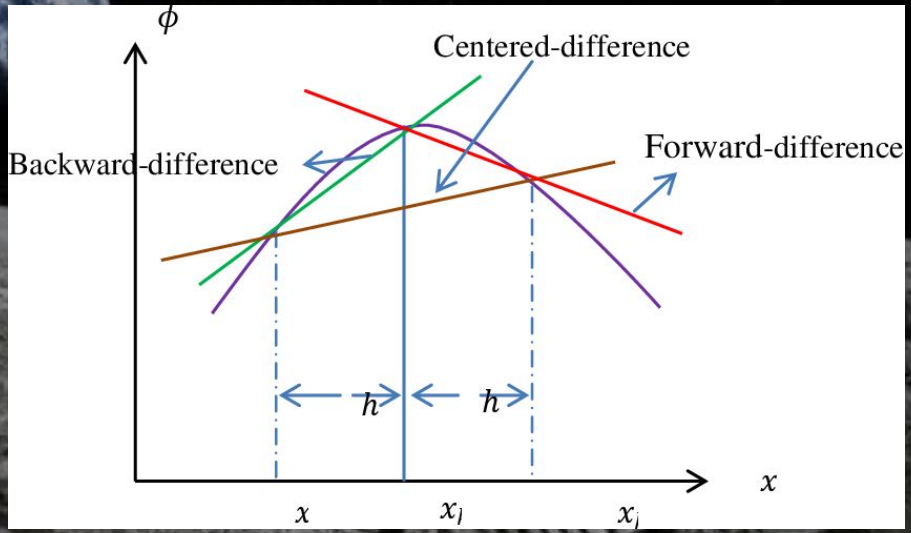
Types of Differentiation: Forward Difference

- Many of our differentiation methods we can code will be approximations
- Also known as two point difference
- Finds the approximation by calculating the slope between a single point and the next one “forward”
- $I'(t_0) = (I_1 - I_0) / (t_1 - t_0)$



Types of Differentiation: Backward Difference

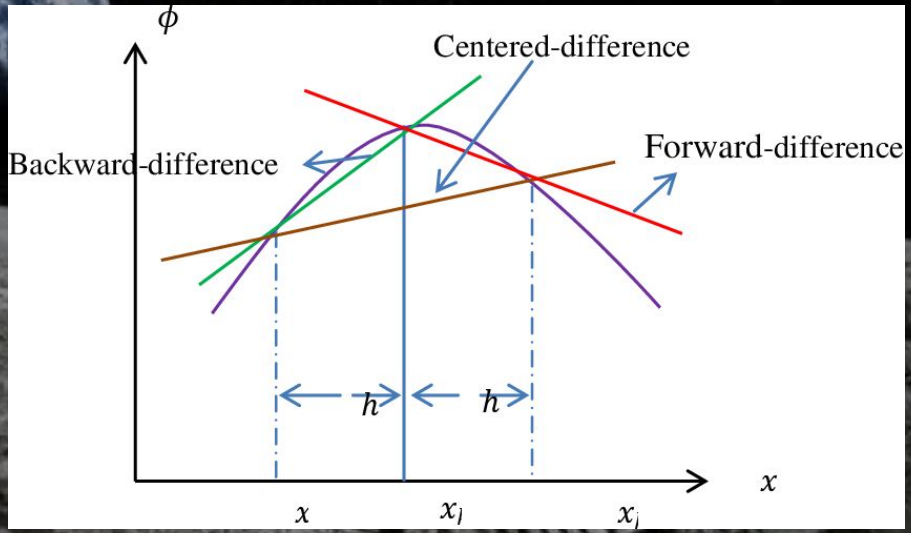
- Very similar to forward differentiation, just going in the other direction



- Finds the approximation by calculating the slope between a single point and the previous one, hence “backwards”
- $I'(t_0) = (I_0 - I_{-1}) / (t_0 - t_{-1})$

Types of Differentiation: Central Difference

- Also known as three point difference
- An average of both forward and backward differentiation
- Much more accurate approximation than the other two
- $I'(t_0) = (I_1 - I_{-1}) / (t_1 - t_{-1})$



Scipy Differentiation...

- Again, we use some packages

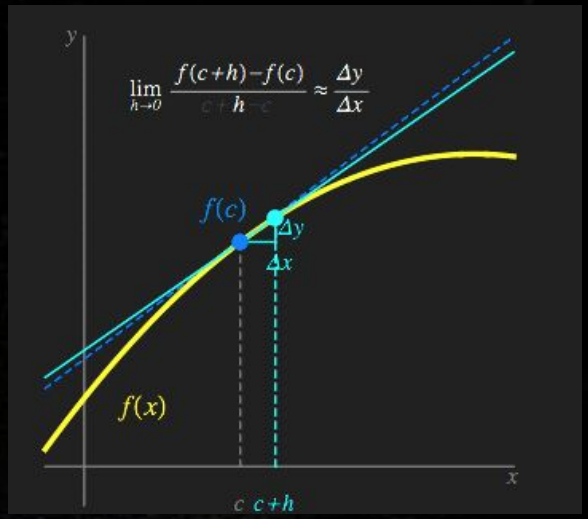
```
from scipy.misc import derivative

derivative(func, x0, dx, n)
```

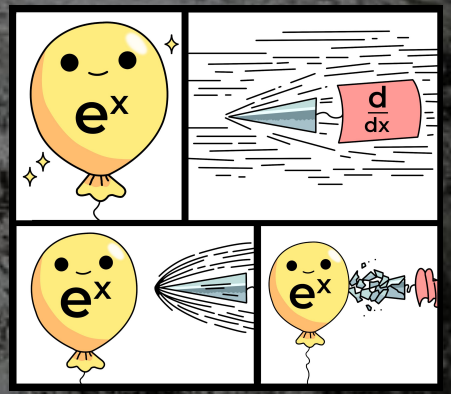
You have to define the function that you want to differentiate

The point where you want to evaluate the derivative

spacing

Order of differentiation





Two ways to define the function

- The normal way:

```
def func(x):
    return  x**2 + x
```

- Lambda

```
derivative(lambda x: x**2+x, x0=17, dx=1e-6, n=1)
```

Writing a short function of variable x


Ready for some calculus in python?
Demo Time