Math Refresher
(plus some new concepts maybe)

DASC 512

Overview

- Order of Operations (PEMDAS)
- Scientific Notation
- Interval Notation
- Equation of a line
- Slope/Derivative
- Summations/Integrals
- Products
- Factorials

But first, some admin…

Syllabus

Make sure you’ve read the syllabus and watched the course intro

Order of Operations

- The order in which math operators are applied is crucial
  - Python code will execute in the correct order too
- “Please Excuse My Dear Aunt Sally”
  - Parentheses
  - Exponents
  - Multiplication/Division
  - Addition/Subtraction

$$a + b \times \left(\frac{c}{d}\right)^3 = a + \frac{bc^3}{d^3} \neq \frac{(a+b)c^3}{d^3}$$

Scientific Notation

- Very large or very small numbers are often easier to communicate with scientific notation (and Python often does this automatically)
- Scientific notation presents numbers as a multiple of a power of 10

$$2{,}000{,}000 = 2.0 \times 10^{6}$$
$$0.000002 = 2.0 \times 10^{-6}$$

- In programming, this is often represented with the letter E

$$2.0 \times 10^{6} = 2.0\,E6$$
$$2.0 \times 10^{-6} = 2.0\,E(-6)$$

Interval notation

There are several ways to say that the variable x is between the constant values a and b

Each matched statement is equivalent

$\in$: “is an element of” or “is in”

Inequality	**Interval**
$a < x < b$	$x \in (a, b)$
$a \leq x < b$	$x \in [a, b)$
$a < x \leq b$	$x \in (a, b]$
$a \leq x \leq b$	$x \in [a, b]$

Equation of a line

- Recall the equation of a line in 2 dimensions:

$$y = mx + b$$

where m is the slope of the line and b is the y-intercept

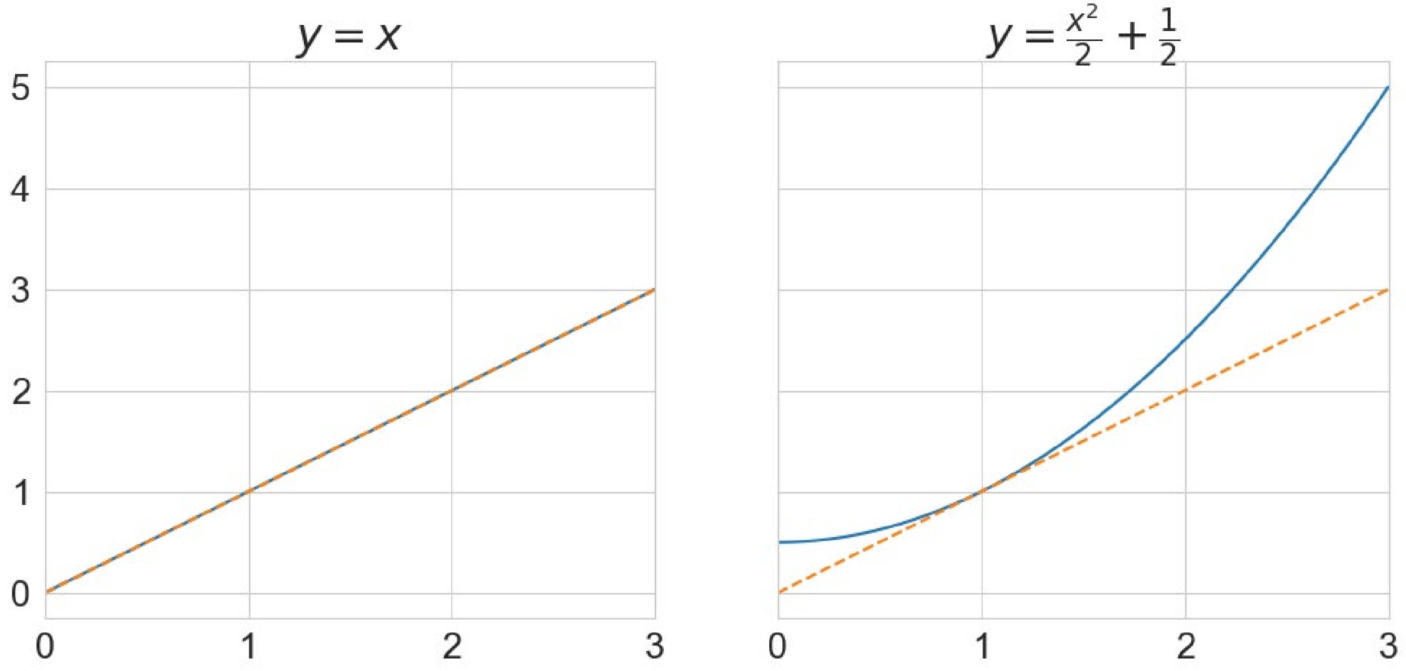
- The same formula can be extended into more dimensions:

$$y = a_1 x_1 + a_2 x_2 + \cdots + a_n x_n + b$$

where a_i is the slope of the line wrt x_i and b is the y-intercept

Derivative

- Important: You do not need calculus for this course, but this intuition may be helpful regardless
- Derivative: the slope of a function at some point $\boldsymbol{x}$
- In both cases below, the derivative at $x = 1$ is 1



Summation

- Old concept, perhaps new symbology

$$\sum_{i=1}^{n} i = 1 + 2 + \cdots + n$$

- Commonly used in more complicated expressions, such as

$$\sum_{i=1}^{n} \frac{x^i}{i} = x + \frac{x^2}{2} + \frac{x^3}{3} + \cdots + \frac{x^n}{n}$$

- For example,

$$\sum_{i=2}^{4} \frac{2^i}{i} = \frac{2^2}{2} + \frac{2^3}{3} + \frac{2^4}{4} = 2 + \frac{8}{3} + 4 = \frac{26}{3}$$

Summation

- Can also be nested within another summation

$$\sum_{i=1}^{m}\sum_{j=1}^{n} ij = (1 \times 1 + 1 \times 2 + \cdots + 1 \times n) +$$

$$(2 \times 1 + 2 \times 2 + \cdots + 2 \times n) +$$

$$\vdots$$

$$(m \times 1 + m \times 2 + \cdots + m \times n)$$

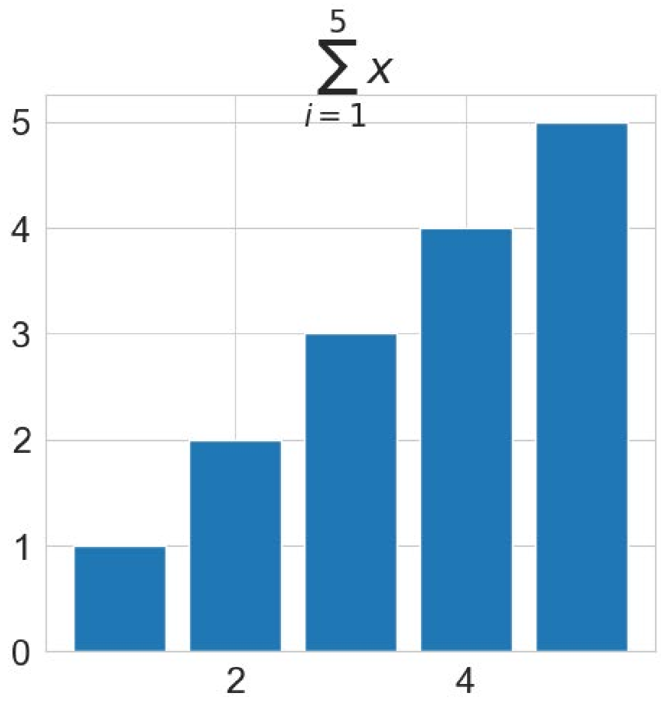
Summation

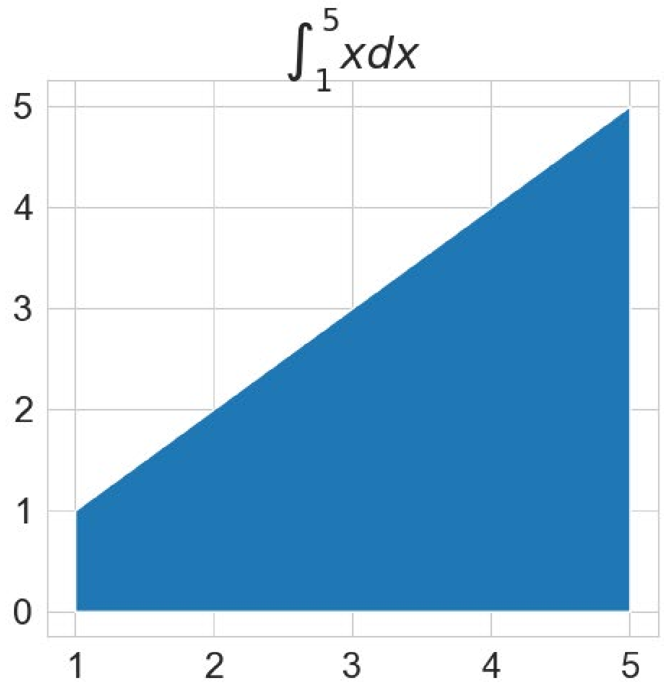
- For example,

$$\sum_{i=2}^{3}\sum_{j=5}^{6} i^j = 2^5 + 2^6 + 3^5 + 3^6 = 1068$$

Integrals

- Important: You do not need calculus for this course, but this intuition may be helpful regardless
- Integral: the area under a continuous function





Products

- Just like summation, but using multiplication instead of addition

$$\prod_{i=1}^{n} i = 1 \times 2 \times \cdots \times n$$

- For example,

$$\prod_{i=2}^{4} \frac{x^i}{i} = \frac{x^2}{2} \times \frac{x^3}{3} \times \frac{x^4}{4} = \frac{x^9}{24}$$

Factorials

- A factorial is a specific product. For integer n,

$$n! = \prod_{i=1}^{n} i = 1 \times 2 \times \cdots \times n$$

- For example,

$$5! = 1 \times 2 \times 3 \times 4 \times 5 = 120$$

Factorials

- An important note about dividing factorials, where $1 \leq m < n$:

$$\frac{n!}{m!} = \prod_{i=m+1}^{n} i = (m+1) \times (m+2) \times \cdots \times n$$

- For example:

$$\frac{7!}{5!} = 6 \times 7 = 42$$

And on that note…

Recap

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