CoGrammar

CONSOLIDATION

SKILLS FOR LIFE
SKILLS BOOTCAMPS

Department for Education

Foundational Sessions Housekeeping

- The use of disrespectful language is prohibited in the questions, this is a supportive, learning environment for all - please engage accordingly. **(FBV: Mutual Respect.)**
- No question is daft or silly - **ask them!**
- There are **Q&A sessions** midway and at the end of the session, should you wish to ask any follow-up questions. Moderators are going to be answering questions as the session progresses as well.
- If you have any questions outside of this lecture, or that are not answered during this lecture, please do submit these for upcoming Open Classes. You can submit these questions here:
  SE Open Class Questions or DS Open Class Questions

Foundational Sessions Housekeeping cont.

- For all **non-academic questions**, please submit a query: **www.hyperiondev.com/support**
- Report a **safeguarding** incident: **www.hyperiondev.com/safeguardreporting**
- We would love your **feedback** on lectures: **Feedback on Lectures**

Reminders!

GLH requirements

Guided Learning Hours

By now, ideally you should have 7 GLHs per week accrued. Remember to attend any and all sessions for support, and to ensure you reach 112 GLHs by the close of your Skills Bootcamp.

Progression Criteria

✅ Criterion 1: Initial Requirements

- Complete 15 hours of Guided Learning Hours and the first four tasks within two weeks.

✅ Criterion 2: Mid-Course Progress

- Software Engineering: Finish 14 tasks by week 8.
- Data Science: Finish 13 tasks by week 8.

✅ Criterion 3: Post-Course Progress

- Complete all mandatory tasks by 24th March 2024.
- Record an Invitation to Interview within 4 weeks of course completion, or by 30th March 2024.
- Achieve 112 GLH by 24th March 2024.

✅ Criterion 4: Employability

- Record a Final Job Outcome within 12 weeks of graduation, or by 23rd September 2024.

In the equation 3x - 7 = 14, what does the variable x represent?

A. A constant value
B. A placeholder for an unknown value
C. A mathematical operation
D. A function

The dot product of two vectors A = [3, 1] and B = [2, -2] is:

A. 8
B. -4
C. 4
D. 6

In a standard deck of 52 playing cards, what is the probability of drawing an ace (any suit)?

A. 1/13
B. 1/52
C. 1/4
D. 1/16

Sets, Functions, and Variables

Set: a collection of distinct, unordered objects also known as elements or members.

- Set that makes up the input of a function known as **domain**, and set making up the output known as the **codomain**.
- E.g. {1,2,3,4}, {cat,dog,spider}, and {cat,1,spider,4} are all sets.

Function: a relation between a set of inputs and a set of permissible outputs with the property that each input is related to at most one output.

- **Univariate functions** relate one input to at most one output (i.e. f(x) = x + 1)
- **Multivariate functions** relate multiple inputs to at most one output (i.e. f(x,z) = x - z + 1)

Variables: Symbols that represent values in mathematical expressions or algorithms.

Vectors, Matrices, and Operations

Vector: quantities having both magnitude and direction, represented as an array of numbers.

- Example: $\vec{v} = [3, 4]$ represents movement 3 units to the right and 4 units up

Matrices: rectangular arrays of numbers or expressions, used to represent complex data structures or transformations.

- A 2 x 2 matrix $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ could represent a linear Transformation in a plane

Scalar Operations: multiplying a vector by a scalar changes its magnitude but not direction.

Dot Product: a measure of the similarity of two vectors, calculated as the sum of the products of their corresponding entries.

Probability

Foundations of Probability

- **Sample Space:** The set of all possible outcomes.
- **Event:** Any subset of the sample space.

Basic Probability

- Probability of an Event: $P(E) = \frac{Number\ of\ favorable\ outcomes}{Total\ number\ of\ outcomes}$

Rules of Probability (assuming Independence and mutually exclusive):

- **Addition Rule:** P(A or B) = P(A) + P(B)
- **Multiplication Rule:** P(A and B) = P(A) x P(B)

Conditional Probability:

- Probability of an event A, given event B has occurred [P(A|B)].

Independence and Mutual Exclusion:

- Two events are independent if P(A|B) = P(A) and P(B|A) = P(B), and exclusive if P(A and B) = 0

Probability Distributions

- **Uniform:** Every outcome in the sample space is equally likely.
- **Binomial:** Probability distribution of the number of successes in a sequence of n independent experiments.
- **Normal:** Data tends to be around a central value (mean) with no bias left or right.

Permutations

Arrangement of objects where order is important.

To calculate permutations, we use $P(n,r) = \frac{n!}{(n-r)!}$

Where:

- ***n*** is the number of objects available to choose from
- ***r*** is the number of objects that are chosen
- ***!*** is the factorial.

Combinations

Selection where order doesn't matter.

To calculate combinations, we use $C(n,r) = \frac{n!}{r!(n-r)!}$

Where:

- ***n*** is the number of objects available to choose from
- ***r*** is the number of objects that are chosen
- ***!*** is the factorial

Gradients of Linear Functions

A constant value that represents the rate of change of the function.

- The gradient is calculated as the change in y over the change in x or “rise over run”:

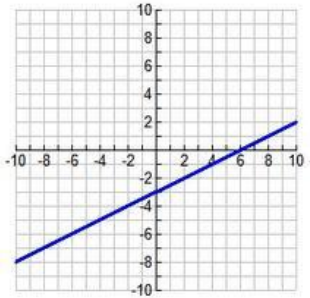
$$m = \frac{\Delta y}{\Delta x} = \frac{y_2 - y_1}{x_2 - x_1}$$

using two points on the line ($\mathbf{x_1}$, $\mathbf{y_1}$) and ($\mathbf{x_2}$, $\mathbf{y_2}$), the starting point and end point, respectively.

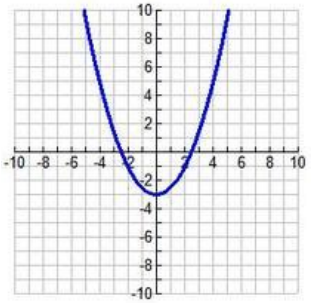
Derivatives

The rate of change of the function with respect to an independent/input variable.

- Linear functions have a **constant rate** of change/gradient, where other types of functions do not e.g. quadratic functions



Linear



Quadratic

Rules of Differentiation

- **Constant rule:** if C is a constant,

$$\frac{d}{dx}C = 0$$

- **Constant multiple rule:** if C is a constant,

$$\frac{d}{dx}Cf(x) = Cf'(x)$$

- **Power rule**

$$\frac{d}{dx}x^n = nx^{n-1}$$

- **Sum and Difference rule**

$$\frac{d}{dx}[f(x) \pm g(x)] = \frac{d}{dx}f(x) \pm \frac{d}{dx}g(x)$$

Rules of Differentiation

- **Product Rule**

$$\frac{d}{dx}[f(x)g(x)] = f(x)g'(x) + g(x)f'(x)$$

- **Quotient Rule (derived from product rule)**

$$\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{g(x)f'(x) - f(x)g'(x)}{[g(x)]^2}$$

- **Chain Rule**

$$\frac{d}{dx}f[g(x)] = f'[g(x)]g'(x)$$

How many ways can you arrange the letters in the word "MATHEMATICS"?

A. 3628800
B. 1024
C. 5040
D. 720

What is the derivative of the function $f(x) = 3x^2 + 2x + 1$?

A. $6x + 2$
B. $3x^2 + 2$
C. $6x$
D. $2x + 1$

Questions and Answers