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Daily Math Problem - DAY 1

Problem Metadata

Date: @November 11, 2025

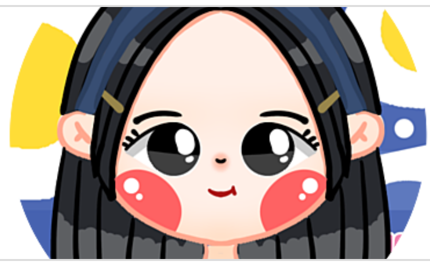
Problem Number: #1

Problem Curator: @Phanie

lymphoidcell - Overview

my archive: @myeloidcell. lymphoidcell has 10 repositories available. Follow their code on GitHub.

https://github.com/lymphoidcell



Vector Equality in $\mathbb{R}^n$

Category: Machine Learning Math - Linear Algebra

Difficulty Level: Beginner

Problem Statement

(a) The following are vectors:

$(2, -5), (7, 9), (0, 0, 0), (3, 4, 5)$

The first two vectors belong to $\mathbb{R}^2$, whereas the last two belong to $\mathbb{R}^3$.

The third is the zero vector in $\mathbb{R}^3$.

(b) Find x, y, z such that $(x - y, x + y, z - 1) = (4, 2, 3)$.

By definition of equality of vectors, corresponding entries must be equal.

Source and Attribution

Primary Source:

Schaum's Outline of Linear Algebra, Fourth Edition (Schaum's Outline Series) by Seymour Lipschutz, Marc Lipson

Related Materials:

- **Linear Algebra Done Right** by Sheldon Axler
- Other books (if any)

Motivation and Context

Vectors in $\mathbb{R}^n$ formalize “ordered lists of numbers.” Equality is **entrywise**; operations are addition and scalar multiplication. The problem above checks recognition of vector dimension and uses quality to turn one vector equation into a small linear system.

Relevance to ML/DL/AI:

- Data samples/features are vectors in $\mathbb{R}^n$.
- Zero vector, dimensionality, and componentwise equality underpin batching, broadcasting, and shape checks in NumPy/PyTorch.
- Solving for (x, y, z) from a vector equation is the same algebra used in parameter fitting with linear constraints.

Theoretical Significance:

- Definitions: $\mathbb{R}^n$, zero vector, vector equality.
- Operations: vector addition, scalar multiplication (parallelogram rule).
- Translating a vector identity to a system of linear equations.

> ***Just in case not knowing the terms**:
>
> - ‘entrywise’ means that operations or comparisons are performed on corresponding entries (elements) of vectors or matrices, one entry at a time.
> - ‘componentwise’ (also called entrywise or element-wise).

Hints and Guidance

Consider:

- Equality of vectors: $(a_1, ..., a_n) = (b_1, ..., b_n) \Leftrightarrow a_i = b_i$ for all i
- Dimensionality: a 2-tuple is in $\mathbb{R}^2$; a 3-tuple is in $\mathbb{R}^3$; $(0, \ldots, 0)$ is the zero vector.
- Approach: From $(x-y, x+y, z-1) = (4, 2, 3)$, write the three scalar equations and solve the 2×2 system for x, y, then get z.

Discussion Space

Questions:

- Any confusion about why vectors with the same multiset of numbers (e.g., $(1, 2, 3)$ vs $(2, 3, 1)$) are not equal?
- Do you see how dimension mismatches (e.g., comparing a pair to a triple) invalidate equality?

Initial Observations:

- From equality: $x - y = 4, x + y = 2 \Rightarrow x = 3, y = -1.$
- From the third component: $z - 1 = 3 \Rightarrow z = 4.$
- The first two listed vectors are in R^2; the latter two are in R^3; $(0, 0, 0)$ is the zero vector.

Status

In Progress: TBA

Solutions Available

Participant	Solution Link	Date Submitted	Notes
[Name]	[Link to solution doc]	[YYYY-MM-DD]	[Optional: approach used]

External Resources:

Source	Link	Type	Notes
[e.g., Stack Exchange]	[URL]	[Discussion / Solution / Explanation]	[Brief description]
[e.g., YouTube]	[URL]	[Video / Tutorial]	[Brief description]