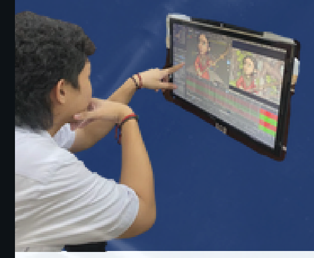
CRACK THE CODE:
YOUR MAP TO UNDERSTANDING LINEAR ALGEBRA

WHY LINEAR ALGEBRA MATTERS

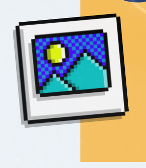
Linear Algebra is the foundation of many technologies we use today. From computer graphics and AI to cryptography and data visualization, its concepts like matrices, vectors, and transformations make complex digital processes possible. This infographic explores how linear algebra powers eight key applications across the fields of Computer Science and ICT.



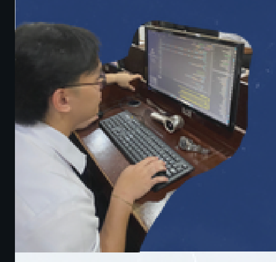
1 Computer Graphics & Animation

Matrices and transformations such as rotation, scaling, and translation are essential in creating and manipulating digital images and models. These mathematical operations allow objects in 2D or 3D spaces to move, resize, and rotate smoothly within animations and games. For instance, 3D model transformations and game character animations in software like Blender rely heavily on these linear algebra concepts.

2 Image Processing



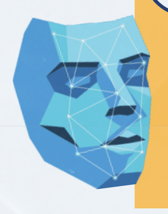
Matrix operations, eigenvalues, and singular value decomposition (SVD) play a key role in treating images as pixel matrices for analysis. These concepts help enhance, filter, or compress images while maintaining important details and structure. You can see their impact in examples like image filters, photo sharpening, and before-and-after image compression demonstrations.



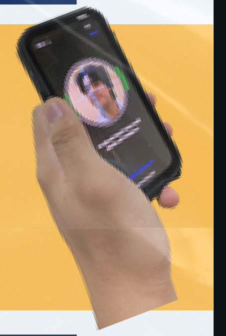
3 Machine Learning & AI

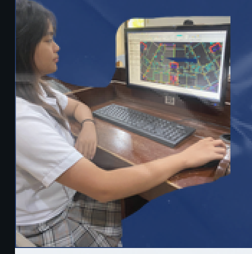
Vectors, matrix multiplication, and linear transformations are the foundation of many AI algorithms. They enable neural networks to recognize patterns, analyze data, and make predictions based on input features. Examples include neural network diagrams, AI-driven face detection, and clustered data visualizations.

4 Computer Vision



Matrix transformations and vector spaces are used in computer vision to interpret and analyze visual information from images or videos. These mathematical tools allow systems to detect objects, recognize faces, and understand motion in real-world scenes. Common examples include self-driving car vision systems, object detection boxes, and facial recognition visuals.

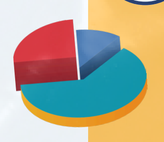




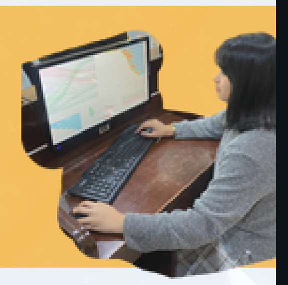
5 Computer Graphics Rendering

Dot products, cross products, and vector projections are fundamental in calculating how light interacts with 3D surfaces. These computations determine brightness, shadow, and color blending to achieve realistic rendering in graphics. Example visuals include game scene lighting, shaded 3D models, and lighting comparison renders.

6 Data Visualization & Simulations



Vectors, coordinate systems, and transformations are crucial in plotting and representing complex data relationships. They allow accurate visualizations of trends, movements, and simulations across scientific and technical fields. You can see these applications in Excel charts, 3D plots, and simulation visuals created using MATLAB or GeoGebra.



7 Cryptography

Matrix inverses and modular arithmetic are essential in encrypting and decrypting secure digital messages. Through linear transformations, they ensure that sensitive information remains confidential during transmission. Visual representations may include cryptographic matrices, encrypted text, or digital padlocks surrounded by binary code.

8 Network Analysis

Graph theory and adjacency matrices help model and study connections between entities such as users, websites, or servers. These mathematical representations enable the analysis of communication patterns, social relationships, and data traffic flow. Typical visuals include social network graphs, node-and-edge diagrams, and internet connectivity maps.

GROUP MEMBERS & CONTRIBUTIONS

Garcia Charles: Part 1-2
Gavino, Ericka: Part 7 & Designer
Carla, Joves: Part 8 & Designer
Manabat, Alexander: Part 3-4
Pinpin, Miguel: Part 5-6

REFERENCES

- Bonanzinga, V. (2022). Some applications of linear algebra and geometry in real life. arXiv. https://arxiv.org/abs/2202.10833
- "Application to Computer Graphics." (n.d.). Ximera, The Ohio State University. https://www.cfm.brown.edu/people/dobrush/cs52/Mathematica/Part7/graphics.html
- Jin, K. (2024). Applications of Linear Algebra in Artificial Neural Networks. ACM. https://dl.acm.org/doi/full/10.1145/3727993.3728025
- "Applications of Linear Algebra in Data Science." (n.d.). In The Pharma Journal (Vol. 8, Issue 2).https://www.thepharmajournal.com/archives/?year=2019&vol=8&issue=2&ArticleId=25457
- Szárnyas, G., Bader, D. A., Davis, T., Kitchen, J., Mattson, T. G., McMillan, S., Welch, E. (2021). LAGraph: Linear Algebra, Network Analysis Libraries, and the Study of Graph Algorithms. arXiv. https://arxiv.org/abs/2104.01661