Story of Usefulness from Uselessness

Session Handout: Monday, 02/12/24

Learning Objectives

🔍 Revisiting Images as Matrices

- Understand how digital images are represented as numerical matrices where each element corresponds to pixel intensity values.

✨ Operations on Images

- Explore basic operations like scaling, filtering, and transformations (e.g., rotation, cropping, or blurring).

❓ Separating the Relevant from the Irrelevant

- Discover how not all data in a matrix is equally important.
- Learn methods to identify patterns and compress data, focusing on extracting meaningful information while discarding noise.

📊 Linear Combinations in Matrices

- Dive into the concept of **linear combinations** to transform or analyze matrices.
- Applications in reducing dimensions (e.g., Principal Component Analysis) and enhancing patterns for clearer visualisation.

Brief Details

1. **Image as a Matrix**:
   Every image can be thought of as a grid of numbers (matrix). For grayscale images, each number represents brightness (0 for black, 255 for white). For color images, matrices for Red, Green, and Blue (RGB) channels are combined.

2. **Operations on Images**:

- Scaling (zooming in/out): Multiply or reduce pixel values.
- Filtering: Highlight or suppress certain features using kernels (small matrices). For example, edge detection uses specific filters to detect outlines.

3. **Relevant vs. Irrelevant Data**:

- In image processing, some regions or features of an image might carry more information than others. For example, edges and patterns often matter more than uniform regions.
- Compression techniques (like Singular Value Decomposition) prioritize significant parts of the matrix while discarding less relevant details.

4. **Linear Combinations**:

- A linear combination involves multiplying rows or columns of a matrix by constants and summing them.
- Used in dimensionality reduction (e.g., PCA), where we extract meaningful components by combining rows/columns to identify dominant patterns.