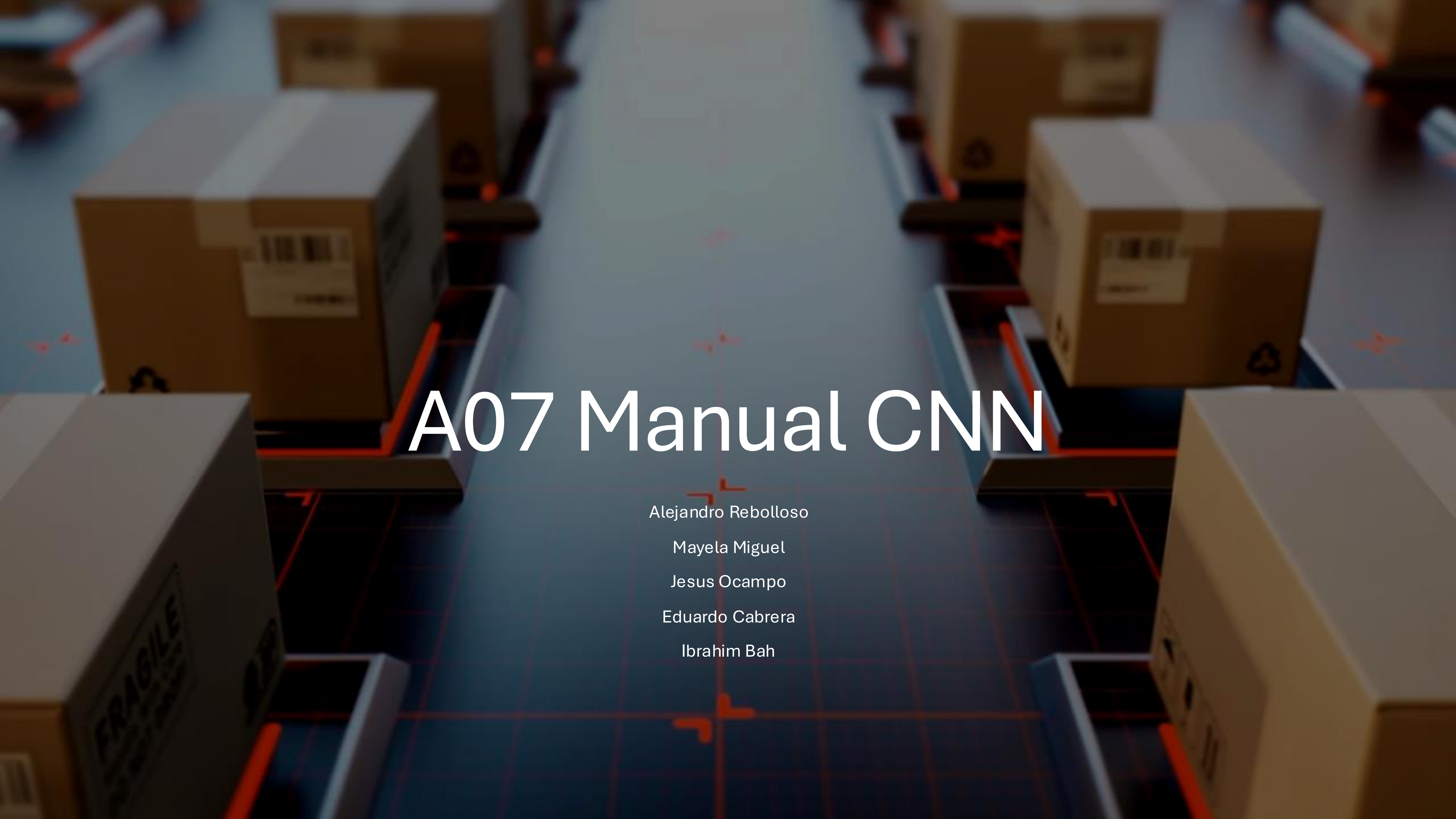

A07 Manual CNN

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Step 1: Creating an Image

- This is an 8 x 8 grid representing a simplified image. Each cell contains pixel values (0 for black, 1 for white).
- Ex: The image represents a simple square shape.

0	0	1	1	1	1	0	0
0	0	1	1	1	1	0	0
0	0	1	1	1	1	0	0
0	0	1	1	1	1	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

Step 2: Design Filters

- Two 3x3 filters were created to detect edges: one for vertical edges and one for horizontal edges.
- The vertical filter identifies transitions from 0s to 1s horizontally, while the horizontal filter detects transitions vertically.
- By applying both filters to an image, we can capture the presence and direction of edges effectively.

Vertical Edge Filter		
-1	0	1
-1	0	1
-1	0	1

Horizontal Edge Filter		
-1	-1	-1
0	0	0
1	1	1

Convolve Manually

-1	-1	-1	1	1	1	0	0
0	0	0	1	1	1	0	0
1	1	1	1	1	1	0	0
0	0	1	1	1	1	0	0
0	0	0	0	-1	0	1	0
0	0	0	0	-1	0	1	0
0	0	0	0	-1	0	1	0
0	0	0	0	0	0	0	0

- We will use these filters and slide them across the image and perform the convolution operation manually.
- Understanding Fundamentals: It helps build a strong foundational understanding of how convolution works, including the mathematical principles behind filtering and feature extraction in images.
- Manually performing convolution allows you to better understand the effects of different filters and how they alter images, making it easier to debug issues in automated implementations or to design custom filters.

Vertical Edge Filter Results

Before

0	0	1	1	1	1	0	0
0	0	1	1	1	1	0	0
0	0	1	1	1	1	0	0
0	0	1	1	1	1	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

After

3	6	0	0	0	0
3	6	0	0	0	0
3	6	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0

Horizontal Edge Filter Results

Before

0	0	1	1	1	1	0	0
0	0	1	1	1	1	0	0
0	0	1	1	1	1	0	0
0	0	1	1	1	1	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0

After

1	2	0	0	0	0
1	2	0	0	0	0
1	2	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	0	0	0	0

Interpretations

- In the convolution process, we apply a vertical edge filter and horizontal edge filter to the binary matrix to detect vertical and horizontal edges within the image. The input matrix, which had a square drawn in it with the use of binary numbers, is processed by sliding the filter across it. At each position, the filter multiplies its values with the corresponding pixel values from the matrix, and the results of these multiplications are summed to produce a single output pixel value. High output values indicate strong vertical edges where there is a significant change in pixel intensity, such as a transition from 1 (white) to 0(black).
- Conversely, areas where pixel values remain consistent will yield lower or zero output values, indicating no edges present. The resulting output matrix highlights the locations of vertical edges, thus providing insight into the boundaries and structures within the original matrix. By identifying these edges, we can better understand the shapes and contours present in the image, making the convolution process a powerful tool in image processing and analysis. We also see that the output is smaller than the original grid we started with which was 8x8. The reason why is because our filters were 3x3 and it did not fully fit in the 8x8 grid.

Interpretations

- When you apply both filters to the same matrix, the outputs vary because each filter is sensitive to changes in different orientations. If the matrix has strong vertical structures (like columns of 1s), the vertical filter will yield high values where those edges are detected, while the horizontal filter may produce lower values if there are fewer significant horizontal transitions. If there are clear horizontal changes, the horizontal filter will produce higher outputs in those regions, while the vertical filter may show low values.