# **TITLE (A SHORT DESCRIPTION OF THE PROJECT, BEWEEN 8 AND 12 WORDS)**

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**For each version of this report: 1. Detele all text in red. 2. Adjust spaces among words and paragraphs. 3. Change the color of all the texts to black.**

**Red text =** Comments

**Black text =** Simón and Mauricio’s contribution

**Green text** = To complete for the 1st deliverable

**Blue text**  = To complete for the 2nd deliverable

**Violet text** = To complete for the 3rd deliverable

# **ABSTRACT**

To write an abstract, you should answer the following questions in a single paragraph: What is the problem? Why is the problem important? Which are the related problems? Which is the algorithm you proposed? What results did you achieve? What are the conclusions of this work? The abstract should have **at most 200 words**. (*In this semester, you should summarize here execution times, memory consumption, compression ratio and accurracy*).

## **Keywords**

|  |
| --- |
| Compression algorithms, machine learning, deep learning,  precision livestock farming, animal health. |

# **1. INTRODUCTION**

Explain the motivation, in the real world, that leads to the problem. Include some history of this problem. *(In this semester, motivation is why we need to compress images to classify animal health in the context of precision livestock farming).*

# **1.1. Problem**

In a few words, explain the problem, the impact that has in society and why it is important to solve the problem. *(In this semester, the problem is to compress images to classify animal health in the context of precision livestock farming).*

**1.2 Solution**

In this work, we used a convolutional neural network to classify animal health, in cattle, in the context of precision livestock farming (PLF). A common problem in PLF is that networking infraestructure is very limited, thus data compression is required.

Explain, briefly, your solution to the problem *(In this semester, the solution is an implementation of compression algorithms. Which algorithms did you choose? Why?)*

**1.3 Article structure**

In what follows, in Section 2, we present related work to the problem. Later, in Section 3, we present the data sets and methods used in this research. In Section 4, we present the algorithm design. After, in Section 5, we present the results. Finally, in Section 6, we discuss the results and we propose some future work directions.

**2. RELATED WORK**

## In what follows, we explain four related works on the domain of animal-health classification and image compression in the context of PLF.

## Explain four (4) articles related to the problem described in Section 1.1. You may find the related problems in scientific journals. Consider Google Scholar for your search. *(In this semester, related work is research on animal-health classification and data compression, in the context of PLF).*

## **3.1 Write a title for the first related problem**

You should mention the problem they solved, the algorithm they used, the metrics they obtained, and the ACM citation.

## **3.2 Write a title for the second related problem**

You should mention the problem they solved, the algorithm they used, the metric they obtained, and the ACM citation.

## **3.3 Write a title for the third related problem**

You should mention the problem they solved, the algorithm they used, the metrics they obtained, and the ACM citation.

## **3.4 Wite a title for the fourth related problem**

You should mention the problem they solved, the algorithm they used, the metrics they obtained, and the ACM citation.

## **3. MATERIALS AND METHODS**

In this section, we explain how the data was collected and processed and, after, different image-compression algorithm alternatives to solve improve animal-health classification.

## **3.1 Data Collection and Processing**

We collected data from Google Images and Bing Images divided into two groups: healthy cattle and sick cattle. For healthy cattle, the search string was “cow”. For sick cattle, the search string was “cow + sick”.

In the next step, both groups of images were transformed into grayscale using Python OpenCV and they were transformed into Comma Separated Values (CSV) files. It was found out that the datasets were balanced.

The dataset was divided into 70% for training and 30% for testing. Datasets are available at [https://github.com/mauriciotoro/ST0245-Eafit/tree/master/proyecto/dataset](https://github.com/mauriciotoro/ST0245-Eafit/tree/master/proyecto/datasets)s .

Finally, using the training data set, we trained a convolutional neural network for binary image-classification using Google Teachable Machine available at <https://teachablemachine.withgoogle.com/train/image>.

## **3.2 Lossy Image-compression alternatives**

## In what follows, we present different algorithms used to compress images. *(In this semester, examples of such algorithms are Seam carving, image scaling, discrete cosine transform, wavelet compression and fractal compression).*

**3.2.1 Name of the first algorithm**

Please explain the algorithm, its complexity and include a vector Figure.

**3.2.2 Name of the second algorithm**

Please explain the algorithm, its complexity and include a vector Figure.

**3.2.3 Name of the third algorithm**

Please explain the algorithm, its complexity and include a vector Figure.

**3.2.4 Name of the fourth algorithm**

Please explain the algorithm, its complexity and include a vector Figure.

## **3.3 Lossless Image-compression alternatives**

## In what follows, we present different algorithms used to compress images. *(In this semester, examples of such algorithms are Borrows & Wheeler Transform, LZ77, LZ78, Huffman coding and LZS).*

**3.3.1 Name of the first algorithm**

Please explain the algorithm, its complexity and include a vector Figure.

**3.3.2 Name of the second algorithm**

Please explain the algorithm, its complexity and include a vector Figure.

**3.3.3 Name of the third algorithm**

Please explain the algorithm, its complexity and include a vector Figure.

**3.3.4 Name of the fourth algorithm**

Please explain the algorithm, its complexity and include a vector Figure.

## **4. ALGORITHM DESIGN AND IMPLEMENTATION**

## In what follows, we explain the data structures and the algorithms used in this work. The implementations of the data structures and algorithms are available at Github[[1]](#footnote-2).

## **4.1 Data Structures**

## Explain the data structure used to make the image compression and make a figure explaining it. Do not use figures from the Internet. *(In this semester, example of the data structures are trees and hash tables)*

**Figure 1:** Huffman tree generated from the exact frequencies of the text "this” (Please, feel free to change this Figure if you use a different data structure).

**4.2 Algorithms**

In this work, we propose a compression algorithm which is a combination of a lossy image-compression algorithm and a lossless image-compression algorithm. We also explain how decompression for the proposed algorithm works.

Explain the design of the algorithms to solve the problem and make a figure. Do not use figures from the Internet, make your own. *(In this semester, one algorithm must be a lossy image-compression algorithm such as image scaling, seam carving or wavelet compression and the second algorithm must be a lossless image-compression algorithm such as Huffman coding, LZS or LZ77).*

**4.2.1 Lossy image-compression algorithm**

Explain, briefly, how did apply a lossy image-compression algorithm such as seam carving or image scaling. Explain also decompression.

**Figure 2:** Image scaling using bi-lineal interpolation. (Please, feel free to change this Figure if you use a different data structure).

**4.2.2 Lossless image-compression algorithm**

Explain, briefly, how did you apply a lossless image-compression algorithm such as Huffman coding, LZS or LZ77. Explain also decompression.

**4.3** **Complexity analysis of the algorithms**

Explain, in your own words, the analysis for the worst case using O notation. How did you calculate such complexities. Please explain briefly.

|  |  |
| --- | --- |
| **Algorithm** | **Time Complexity** |
| Compression | O(N2\*M2) |
| Decompression | O(N3\*M\*2N) |

**Table 2:** Time Complexity of the image-compression and image-decompression algorithms. *(Please explain what do N and M mean in this problem).*

|  |  |
| --- | --- |
| **Algorithm** | **Memory Complexity** |
| Compression | O(N\*M\*2N ) |
| Decompression | O(2M\*2N) |

**Table 3:** Memory Complexity of the image-compression and image-decompression algorithms. *(Please explain what do N and M mean in this problem).*

**4.4 Design criteria of the algorithm**

Explain why the algorithm was designed that way. Use objective criteria. Objective criteria are based on efficiency, which is measured in terms of time and memory consumption. Examples of non-objective criteria are: “I was sick”, “it was the first data structure that I found on the Internet”, “I did it on the last day before deadline”, etc. Remember: This is 40% of the project grading.

**5. RESULTS**

**5.1 Model evaluation**

In this section, we present some metrics to evaluate the model. Accuracy is the ratio of number of correct predictions to the total number of input samples. Precision. is the ratio of successful students identified correctly by the model to successful students identified by the model. Finally, Recall is the ratio of successful students identified correctly by the model to successful students in the data set.

**5.1.1 Evaluation on training data set**

In what follows, we present the evaluation metrics for the training data set in Table 3.

|  |  |
| --- | --- |
|  | ***Training data set*** |
| *Accuracy* | 0.02 |
| *Precision* | 0.03 |
| *Recall* | 0.01 |

## **Table 3.** Binary image-classification model evaluation on the training data set.

**5.1.2 Evaluation on test data set**

In what follows, we present the evaluation metrics for the testing dataset in Table 4 without compression and, in Table 5, with compression.

|  |  |
| --- | --- |
|  | ***Testing data set*** |
| *Accuracy* | 0.01 |
| *Precision* | 0.012 |
| *Recall* | 0.013 |

## **Table 4.** Binary image-classification model evaluation on the testing data set without image compression.

|  |  |
| --- | --- |
|  | ***Testing data set*** |
| *Accuracy* | 0.001 |
| *Precision* | 0.0012 |
| *Recall* | 0.0013 |

## **Table 5.** Model evaluation on the testing data set with image compression.

**5.2 Execution times**

In what follows we explain the relation of the average execution time and average file size of the images in the data set, in Table 6.

Compute execution time for each image in Github. Report average execution time Vs average file size.

## 

|  |  |  |
| --- | --- | --- |
|  | ***Average execution time (s)*** | ***Average  file size (MB)*** |
| *Compression* | 100.2 s | 12.4 MB |
| *Decompression* | 800.1 s | 12.4 MB |

## **Table 6:** Execution time of the *(Please write the name of the algorithms, for instance, seam carving & LZ77)* algorithms for different images in the data set.

## **5.3 Memory consumption**

We present memory consumption of the compression and decompression algorithms in Table 7.

|  |  |  |
| --- | --- | --- |
|  | ***Average memory consumption (MB)*** | ***Average file size (MB)*** |
| Compression | 634 MB | 3.12 MB |
| Decompression | 9 MB | 878.12 MB |

## **Table 7:** Average Memory consumption of all the images in the data set for both compression and decompression.

## To measure memory consumption, you should use a profiler. A very good one for Java is VisualVM, developed by Oracle, <http://docs.oracle.com/javase/7/docs/technotes/guides/visualvm/profiler.html>. For Python, use C Profiler.

## **5.3 Compression ratio**

We present the average compression ratio of the compression algorithm in Table 8.

|  |  |  |
| --- | --- | --- |
|  | ***Healthy Cattle*** | ***Sick Cattle*** |
| Average compression ratio | 1:23 | 1:34 |

## **Table 8:** Rounded Average Compression Ratio of all the images of Healthy Cattle and Sick Cattle.

## **6. DISCUSSION OF THE RESULTS**

Explain the results obtained. Are precision, accuracy and sensibility appropriate for this problem? Is the model over-fitting? Is memory consumption and time consumption appropriate? Is compression ratio appropriate? Does compression changes significantly precision on the test data set? *(In this semester, according to the results, can this improve animal-health classification in the context of PLF?)*

**6.1 Future work**

Answer, what would you like to improve in the future? How would you like to improve your algorithm and its implementation? What about using discrete cosine transform or wavelet compression?

# **ACKNOWLEDGEMENTS**

Identify the kind of acknowledgment you want to write: for a person or for an institution. Consider the following guidelines: 1. Name of teacher is not mentioned because he is an author. 2. You should not mention websites of authors of articles that you have not contacted. 3. You should mention students, teachers from other courses that helped you.

As an example: This research was supported/partially supported by [Name of Foundation, Grant maker, Donor].

We thank for assistance with [particular technique, methodology] to [Name Surname, position, institution name] for comments that greatly improved the manuscript.

# **REFERENCES**

Reference sourced using ACM reference format. Read ACM guidelines in <http://bit.ly/2pZnE5g>

As an example, consider this two references:

1.Adobe Acrobat Reader 7, Be sure that the references sections text is Ragged Right, Not Justified. <http://www.adobe.com/products/acrobat/>.

2. Fischer, G. and Nakakoji, K. Amplifying designers’ creativity with domainoriented design environments. in Dartnall, T. ed. Artificial Intelligence and Creativity: An Interdisciplinary Approach, Kluwer Academic Publishers, Dordrecht, 1994, 343-364.

Please remove the references above, they are only an example.

1. <http://www.github.com/> ????????? /proyecto/ [↑](#footnote-ref-2)