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Amaury Gutiérrez Acosta

FECHA

FIRMA

A la ε-cercanía.

- A Lety por plantar la semilla de lo que soy.
- A Ricardo por regar esa semilla, no sería nada sin ti.
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- Al lector casual, en caso de que existas, este trabajo fué pensado para ti, para compartir mi experiencia descubriendo este mundo, si le das una oportunidad y lo disfrutas, todo habrá valido la pena. Recuerda...

Don't Panic

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Chapter 1

Some catchy name

> Good work is not done by 'humble' men. (...) A man's first duty, a young man's at any rate, is to be ambitious.
>
> A Mathematician's Apology
> G. H. Hardy

This is the introduction of this work, here we will give a short summary of the other chapters.

Chapter 2

Some catchy name

> Archimides will be remembered
> when Aeschylus is forgotten, because
> languages die and mathematical
> ideas do not.
>
> A Mathematician's Apology
> G. H. Hardy

In this chapter we talk about the state of the art in computer vision and how it has been used for remote sensing problems. We also give a brief account of natural disaster assesment, and how are these machine techniques applied in this sense. We use Sandy Huricane as a study case because of the data that was publicly made available by the NOAA.

2.1 Computer vision

2.2 Remote sensing

In late years the groundbreaking advances in computer vision have had a tremendous impact in other science fields. In particular, we are interested in landcover classification.

2.3 Damage Assessment

Chapter 3

Some catchy name

> We may say, roughly, that a mathematical idea is 'significant' if it can be connectted, in a natural and illuminating way, with a large complex of other mathematical ideas.
>
> A Mathematician's Apology
> G. H. Hardy

In this chapter we will talk about the implementation of our experiment. The details of the pipeline architecture, and the techniques used to obtain and curate data. Details on the data munging and preprocessing are also given.

3.1 Ingestion

We built a system to ingest the images from the NOAA service. It lazily downloads the images by checking first if the file is already present in the temporary folder. If the file does not exists it downloads it, then the system tries to add it to the database and persistent file system. To maintain a coherent one to one mapping between the database and the file system, the process of adding a new scene must be successful both in the database and in the filesystem, otherwise the file is erased from both, and the state of the system remains as it was before the ingestion atempt.

3.2 Training data

Aerial tagged data is scarce. In particular, for the purpose of our experiment, we don't have any useful metadata on the images. We propose a method to tag samples of the scenes using crowd sourcing. We built a service that crops samples from the images and exposes them to a online application that lets any user with access to tag an image. We have three categories: the image has water in it, the image does not have water in it, and it is not possible to tell. When a possitive answer is obtained, the sistem persist de image in the data base with the information of from which scene was it extracted.

3.3 Data augmentation

Given the nature of our task, it is hard to adquire the tagged images. To increment the size of our training data set even more, we use a technique known as data augmentation. It relies on the fact that affine transformations do not change the content of the scenes, however a transformed scene appears as a completely new one to the classifier.

The images where rotated by 10 degrees, and reflected by the x-axis and the y-axis this gives us a $x144$ factor, this means that for each tagged image, the training corpus is incremented by 144 images. The problem with this aproach is that when a square image is rotated, some information on the corners is lost so we have to adjust the original image so that we can still crop a complete square from the desired size from it. For our experiment, the input size for the neural network is 227×227 pixels, so the original images must be at least $\sqrt{2}$ times 227 on each side. This way no matter how we rotate the original image, we can still crop a 227×227 from the center of the rotation without losing any data.

Chapter 4

Some catchy name

A mathematical proof should resemble a simple and clear-cut constellation, not a scattered cluster in the Milky Way.

A Mathematician's Apology
G. H. Hardy

chapter 4

Chapter 5

Some catchy name

A mathematican, like a painter or a poet, is a maker of patterns. The mathematician's patterns, like painter's or the poet's, must be *beautiful*; the ideas, like the colours or the words, must fit together in a harmonious way.

A Mathematician's Apology
G. H. Hardy

chapter 5

Chapter 6

Some catchy name

If intellectual curiosity, professional pride, and ambition are the dominant incentives to research, then assuderedly no one has a fairer chance of gratifying them than a mathematician.

A Mathematician's Apology
G. H. Hardy

chapter 6

Chapter 7

Some catchy name

(...) it is obvious that irrationals are uninteresting to an engineer, since he is concerned only with aproximations, and all approximations are rational.

A Mathematician's Apology
G. H. Hardy

chapter 7

Chapter 8

Some catchy name

I believe that mathematical reality lies outside us, that our function is to discover or *observe* it, and that the theorems which we prove, and which we describe grandiloquently as our 'creations', are simply our notes of our observations.

A Mathematician's Apology
G. H. Hardy

chapter 7

Appendix A

chapter a

Appendix B

chapter a

Appendix C

chapter a

Bibliography