Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

School of Statistics and Computer Science

Machine Learning to go *nyoom*

Using Machine Learning to evaluate rowing training and predict training outcomes or performances

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A Final Year Project submitted in partial fulfilment
of the requirements for the degree of
BA(Mod) in Science in Computer Science

Declaration

I hereby declare that this Final Year Project is entirely my own work and that it has not been submitted as an exercise for a degree at this or any other university.

I have read and I understand the plagiarism provisions in the General Regulations of the University Calendar for the current year, found at `http://www.tcd.ie/calendar`.

I have completed the Online Tutorial on avoiding plagiarism 'Ready Steady Write', located at `http://tcd-ie.libguides.com/plagiarism/ready-steady-write`.

I consent / do not consent to the examiner retaining a copy of the thesis beyond the examining period, should they so wish (EU GDPR May 2018).

Signed: _____ Date: _____

Abstract

A short summary of the problem investigated, the approach taken and the key findings. This should not be more that around 400 words.

This must be on a separate page.

Lay Abstract

Similar to the actual abstract in terms of the information, but written for a non-specialist. So no jargon, no acronyms. Explain to a member of the general public what this project entailed. Should be no longer than the actual abstract.

This must be on a separate page.

Acknowledgements

Thanks Everyone!

You should acknowledge any help that you have received (for example from technical staff), or input provided by, for example, a company.

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Nomenclature

A	Area of the wing	m^2
B		
C	Roman letters first, with capitals...	
a	then lower case.	
b		
c		
Γ	Followed by Greek capitals...	
α	then lower case greek symbols.	
β		
ϵ		
TLA	Finally, three letter acronyms and other abbreviations arranged alphabetically	

If a parameter has a typical unit that is used throughout your report, then it should be included here on the right hand side.

If you have a very mathematical report, then you may wish to divide the nomenclature list into functions and variables, and then sub- and super-scripts.

If you have a large number of acronyms, check out to make that more robust.

Note that Roman mathematical symbols are typically in a serif font in italics.

1 Introduction

This document provides a template for the preparation of final year project reports. The objective is to provide clear guidance to you, the students, and also to provide uniformity to the project reports, to facilitate equitable grading. This LaTeX template uses a sans-serif font to aid accessibility..

The font colour for Chapter headings is "Pantone Blue", which is the colour used in TCD documents. The page number appears at the bottom of each page starting at 1 on the first page of the Introduction chapter. If you are not familiar with concepts like styles, captioning, cross-referencing, and how to generate tables of contents, figures etc. in LaTeX, the Overleaf guides are a useful start at:
`https://www.overleaf.com/learn/latex/Learn_LaTeX_in_30_minutes`

1.1 Headings, sections and subsections

Chapters should be divided into appropriate subsections. LaTeX makes the numbering much easier and it is all built in. Headings should incorporate the Chapter number into them as is done here.

1.1.1 Subsection name style

The subsections, if used, should be numbered sequentially within each section. You should really try to avoid using sub- subsections, but if you do they should not be numbered.

1.2 Length of the report

The page margins is set to 2.54 cm top, bottom, left and right. There may be a table or figure for which it is sensible to deviate from these margins, but in general the main text should be formatted within the specified margins. The body of the report should be organised into several chapters. There are a number of chapters that you must have: an introduction; a background or literature review chapter; and a conclusion chapter. The focus

of the other chapters will depend on your specific project. Refer to the issued guidelines for the page limit. This limit does not usually include the front matter, references list and any appendices. In other words, from the first page of the Introduction to the last page of the Conclusions chapters must be less than the given limit for MAI. If you exceed these page limits or deviate significantly from this format, you will lose marks.

1.3 Contents of the Introduction

The introduction presents the nature of the problem under consideration, the context of the problem to the wider field and the scope of the project. The objectives of the project should be clearly stated.

1.4 Contents of the background chapter

The second chapter is typically a literature review, or survey of the state of the art, or a detailed assessment of the context and background for the project. The exact nature of this chapter depends on the topic and/or methods of the project. It is essential that the work of other people is properly cited. This will be discussed in detail in Chapter 2 below. Note that you should use references wherever is appropriate through the report, not just in the literature review chapter.

1.5 The Conclusions chapter

The final chapter should give a short summary of the key methods, results and findings in your project. You should also briefly identify what, if any, future work might be executed to resolve unanswered questions or to advance the study beyond the scope that you identified in Chapter 1.

2 Background

2.1 Introduction to Sports Science

Introduction to sports science below, including introduction to vocabulary and concepts.

2.1.1 Characteristics of Rowing

Rowing is an Olympic sport, raced in shells across a 2,000 metre course. It is classed as a power-endurance sport, requiring large blocks of training for anerobic metabolism, aerobic capacity, and muscular strength, endurance and power [1]. **Further info about rowing, including training volume (can I reference myself?)**

2.1.2 Training Principles

A discussion on the training approach generally

2.1.3 Energy Systems

An understanding of the aerobic and anerobic Systems

2.1.4 Physiological Response to Training

Adapations and that

2.1.5 Further training related sections

Discuss the need to include subsections for over reaching/training, detraining, tapering, etc.

2.1.6 Heart Rate Variablity

An explanation of HRV and how its used in training, include correlation with training load here, can include data from Churchill (2014) [4] here.

2.1.7 Performance

How it is measured, what feeds into it.

2.1.8 Summary

Does what it says on the box.

2.2 A Review of Systems Modelling

A review of models that already exist, including history of modelling, starting with Bannister et al. [2], and including Edelmann-nusser et al. [3] and their comments on the efficacy of a linear systems model on an inherently non-linear biological behaviour. Essentially go through the steps done by Churchill (2014) [4].

2.2.1 Impulse-Response Models

Limitations to the Impulse-Response Model

2.2.2 Alternative Models

Artifcial Neural Network (ANN) approaches.

2.2.3 Quantifying Training Load

2.2.4 Quantifying Performance

3 Data Collection and Management

Discussing approaches to data collection, key decisions in generating the model, eg. building a model which can be run with minimal effort by the users.

4 The Model

4.1 Model Considerations

What led to the final model, difficulties, and data Considerations

4.2 The Implementation

Details about the model, including some examples of outputs (on my own data?)

5 Evaluation

Evaluation of methods and model.

6 Conclusion

Did we do what we set out to do.

Bibliography

[1] S. A. Ingham, G. P. Whyte, K. Jones, and A. M. Nevill, "Determinants of 2, 000 m rowing ergometer performance in elite rowers," *European Journal of Applied Physiology*, vol. 88, no. 3, pp. 243–246, Dec. 2002. [Online]. Available: https://doi.org/10.1007/s00421-002-0699-9

[2] E. W. Banister, T. W. Calvert, M. V. Savage, and T. Bach, "A systems model of the effects of training on physical performance," *IEEE Transactions on Systems, Man, and Cybernetics*, vol. SMC-6, no. 2, pp. 94–102, Feb. 1976. [Online]. Available: https://doi.org/10.1109/tsmc.1976.5409179

[3] J. Edelmann-nusser, A. Hohmann, and B. Henneberg, "Modeling and prediction of competitive performance in swimming upon neural networks," *European Journal of Sport Science*, vol. 2, no. 2, pp. 1–10, Apr. 2002. [Online]. Available: https://doi.org/10.1080/17461390200072201

[4] T. Churchill, "Modelling athletic training and performance," Ph.D. dissertation, University of Canberra, Australian Capital Territory, Australia, 2014.

A1 Appendix

You may use appendices to include relevant background information, such as calibration certificates, derivations of key equations or presentation of a particular data reduction method. You should not use the appendices to dump large amounts of additional results or data which are not properly discussed. If these results are really relevant, then they should appear in the main body of the report.

A1.1 Appendix numbering

Appendices are numbered sequentially, A1, A2, A3... The sections, figures and tables within appendices are numbered in the same way as in the main text. For example, the first figure in Appendix A1 would be Figure A1.1. Equations continue the numbering from the main text.