School of Computer Science and Statistics
Research Ethics Application

Part A

Project Title: **Machine Learning to go *Nyoom*: Using Machine Learning to evaluate rowing training and predict training outcomes or performance**

Name of Lead Researcher (student in case of project work): **Liam Junkermann**

Name of Supervisor: **Dr. Lucy Hederman**

TCD Email: **junkerml@tcd.ie** Contact Tel. No.: **+353 089 484 2123**

Course Name and Code (if applicable): **Integrated Computer Science**

Estimated Start Date of survey/research: **ASAP**

I confirm that I will (where relevant):

- Familiarize myself with the Data Protection Act and the College Good Research Practice guidelines `http://www.tcd.ie/info_compliance/dp/legislation.php`
- Tell participants that any recordings, e.g. audio/video/photographs, will not be identifiable unless prior written permission has been given. I will obtain permission for specific reuse (in papers, talks, etc.)
- Provide participants with an information sheet (or web-page for web-based experiments) that describes the main procedures (a copy of the information sheet must be included with this application)
- Obtain informed consent for participation (a copy of the informed consent form must be included with this application)
- Should the research be observational, ask participants for their consent to be observed
- Tell participants that their participation is voluntary
- Tell participants that they may withdraw at any time and for any reason without penalty
- Give participants the option of omitting questions they do not wish to answer if a questionnaire is used
- Tell participants that their data will be treated with full confidentiality and that, if published, it will not be identified as theirs
- On request, debrief participants at the end of their participation (i.e. give them a brief explanation of the study)
- Verify that participants are 18 years or older and competent to supply consent.
- If the study involves participants viewing video displays then I will verify that they understand that if they or anyone in their family has a history of epilepsy then the participant is proceeding at their own risk
- Declare any potential conflict of interest to participants.
- Inform participants that in the extremely unlikely event that illicit activity is reported to me during the study I will be obliged to report it to appropriate authorities.
- Act in accordance with the information provided (i.e. if I tell participants I will not do something, then I will not do it).

Signed: _____ Date: October 19, 2023

Liam Junkermann
Lead Researcher (student in case of project work)

Part B

Please answer the following questions.		***Yes/No***
Has this research application or any application of a similar nature connected to this research project been refused ethical approval by another review committee of the College (or at the institutions of any collaborators)?		No
Will your project involve photographing participants or electronic audio or video recordings?		No
Will your project deliberately involve misleading participants in any way?		No
Does this study contain commercially sensitive material?		No
Is there a risk of participants experiencing either physical or psychological distress or discomfort? If yes, give details on a separate sheet and state what you will tell them to do if they should experience any such problems (e.g. who they can contact for help).		No
Does your study involve any of the following?	Children (under 18 years of age)	No
	People with intellectual or communication difficulties	No
	Patients	No

School of Computer Science and Statistics
Research Ethical Application Form

Details of the Research Project Proposal must be submitted as a separate document to include the following information:

1. Title of project
2. Purpose of project including academic rationale
3. Brief description of methods and measurements to be used
4. Participants - recruitment methods, number, age, gender, exclusion/inclusion criteria, including statistical justification for numbers of participants
5. Debriefing arrangements
6. A clear concise statement of the ethical considerations raised by the project and how you intend to deal with them
7. Cite any relevant legislation relevant to the project with the method of compliance e.g. Data Protection Act etc.

Part C

I confirm that the materials I have submitted provided a complete and accurate account of the research I propose to conduct in this context, including my assessment of the ethical ramifications.

Signed: _____ Date: October 19, 2023

Liam Junkermann
Lead Researcher (student in case of project work)

There is an obligation on the lead researcher to bring to the attention of the SCSS Research Ethics Committee any issues with ethical implications not clearly covered above.

Part D

If external or other TCD Ethics Committee approval has been received, please complete below.

External/TCD ethical approval has been received and no further ethical approval is required from the School's Research Ethical Committee. I have attached a copy of the external ethical approval for the School's Research Unit.

Signed: _____ Date: _____

Lead Researcher (student in case of project work)

Part E

If the research is proposed by an undergraduate or postgraduate student, please have the below section completed.

I confirm, as an academic supervisor of this proposed research that the documents at hand are complete (i.e. each item on the submission checklist is accounted for) and are in a form that is suitable for review by the SCSS Research Ethics Committee

Signed: _____ Date: _____

Supervisor

CHECKLIST

Please ensure that you have submitted the following documents with your application:

1.	SCSS Ethical **Application Form**	Yes
2.	**Participant's Information Sheet** must include the following: ▪ Declarations from Part A of the application form; ▪ Details provided to participants about how they were selected to participate; ▪ Declaration of all conflicts of interest.	Yes
3.	**Participant's Consent Form** must include the following: ▪ Declarations from Part A of the application form; ▪ Researchers' contact details provided for counter-signature (your participant will keep one copy of the signed consent form and return a copy to you).	Yes
4.	**Research Project Proposal** must include the following: ▪ You must inform the Ethics Committee **who** your intended participants are i.e. are they your work colleagues, class mates etc. ▪ How will you recruit the participants i.e. **how** do you intend asking people to take part in your research? For example, will you stand on Pearse Street asking passers-by? ▪ If your participants are under the age of 18, you must seek both parental/guardian AND child consent.	Yes
5.	Intended **questionnaire**/survey/interview, protocol/screenshots/representative materials (as appropriate)	No
6.	**URL** to intended on-line survey (as appropriate)	No

Notes on Conflict of Interest

1. If your intended participants are work colleagues, you must declare a potential conflict of interest: you are taking advantage of your existing relationships in order to make progress in your research. It is best to acknowledge this in your invitation to participants.
2. If your research is also intended to direct commercial or other exploitation, this must be declared. For example, *"Please be advised that this research is being conducted by an employee of the company that supplies the product or service which form an object of study within the research."*

Notes for questionnaires and interviews

1. If your questionnaire is paper based, you must have the following opt-out clause on the top of each page of the questionnaire: *"Each question is optional. Feel free to omit a response to any question; however the researcher would be grateful if all questions are responded to."*
2. If you questionnaire is **on-line**, the first page of your questionnaire must repeat the content of the information sheet. This must be followed by the consent form. If the participant does not agree to the consent, they must automatically be exited from the questionnaire.
3. Each question must be **optional**.
4. The participant must have the option to '**not submit, exit without submitting**' at the final submission point on your questionnaire.
5. If you have open-ended questions on your questionnaire you must warn the participant against naming **third parties**: *"Please do not name third parties in any open text field of the questionnaire. Any such replies will be anonymised."*
6. You must inform your participants regarding illicit activity: *"In the extremely unlikely event that illicit activity is reported I will be obliged to report it to appropriate authorities."*

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

Information Sheet for Participants

Title of Research Project:

Machine Learning to go *Nyoom*:
Using Machine Learning to evaluate rowing training and predict training outcomes or performances

Name of Lead Researcher: Liam Junkermann

Email: junkerml@tcd.ie

Phone Number: +353 089 484 2123

Name of Supervisor: Dr. Lucy Hederman

You are invited to participate in a research project as part of a final year project for the partial fulfilment of an Integrated Computer Science undergraduate Degree at Trinity College Dublin. This project aims to determine if, and how, machine learning can be used to quantify rowing training, and its outcomes and performances. This can be used to improve training effectiveness for individual athletes allowing them to adjust their training according to how their bodies respond to different training loads.

Please ensure that you read all information below before deciding to participate in this project. Please feel free to ask any questions that you may have, as it is important that you clearly understand what participating in this project involves.

You are under no obligation to participate in this project. It is voluntary, and your decision to take part or otherwise will not result in any penalty against you.

The sharing of data is optional. You can withdraw from the project at any time before the project submission in April 2024, even after it has started. After the submission, it will no longer be possible to exclude your data.

All information gathered as part of this project will be pseudonymised when presented as results. Participant names will be pseudonymised, with code names being used instead of the participants' own names. The researcher will securely maintain a translation key to facilitate exclusion of participant's data from the project if requested or to provide feedback which may be the result of a model which has been trained by the researcher. All information pertaining to this project will be removed from the researcher's personal devices and cloud storage once the results of the report have been ratified by the exam board. At this point, the researcher will delete all data gathered for the purposes of this project unless otherwise requested by participants.

What is the purpose of this project?

Quantifying the effect of training on the body is something which trained athletes try to do daily to make their training as efficient as possible to hit their fitness and performance goals. As technology has evolved, different systems and approaches to quantify metrics like load and recovery have been developed. Original models and systems used a linear approach to model these biological processes and adaptations. The formative model for modelling human performance, developed by Eric Bannister, has been supported and built upon many times since its publication in 1975. This model is, unfortunately, incomplete due to its linear nature. Machine Learning has been introduced to the field of study in an attempt to increase both the accuracy of performance modelling, and the number of variables which can be used in the model. This project aims to develop a model which can be used to quantify training load and recovery, and predict performance based on the available training and recovery data. The goal is to make participants' individual training more effective to drive stronger performances. By participating in this project, you are contributing to the completion of the researcher's undergraduate degree.

Who is organising the project?

Liam Junkermann is the principle researcher and is receiving academic supervision from Dr. Lucy Hederman of the School of Computer Science and Statistics in Trinity College Dublin.

Why am I being asked to partake in this project

You are being asked to partake in this project as you are a rower with intentions to compete, at a minimum, at a national level this season. As a result, you will be committing to 8-12+ training sessions per week where consistent data may be collected, this paired with semi-regular benchmark tests (eg. 6k r20, 30min r20, 6k Open, 2k Open), can provide the researcher with different options to measure model success and provide feedback to you, the athlete.

What will my role in the project entail?

To participate in this project, you will be asked to provide data through various pipelines built by the researcher. The researcher will be collecting any and all training and recovery data you might have available from the time of joining until time of submission in April 2024. Most of the data collection will happen through automatic API collection pipelines, but may also include manual entry through a training log. Data will be collected with an initial signup where you will login to any accounts, such as Polar, Concept2 Logbook, Strava, or Whoop – anywhere you might log your training. The goal is to collect as much relevant data as possible. Once the signup is completed on your data will be collected without any further engagement from you. You may also asked to engage in monitoring to collect relevant information about changes in oxygen utilisation zones (as a result of a lactate test), information about illness or injury, and any other information the researcher might find relevant.

What are the benefits of my taking part in this project?

By participating in this project, you are providing invaluable data to the researcher, which ultimately could benefit you in providing feedback on your training, and understanding which trends in your training produce stronger results.

What are the risks in me taking part in this project?

There are no expected risks associated with taking part in this project. Agreeing or declining to participate in this project will not impact you in any way. Collected data will remain pseudonymised and will be disposed of once the report has been ratified by the exam board, unless otherwise requested by participants.

Will it cost me to take part of this project?

There are no monetary costs associated with participation in this project. There may be a small time commitment to setup data collection, and periodic check-ins for training related data, such as heart rate zones and the result of HP testing such as lactate or VO2 max testing.

Is this project confidential?

All information collected for the purposes of this project will be treated with the strictest of confidence. Any data collected will be stored securely, in an unidentifiable form, and deleted from the researcher's personal devices and cloud storage, unless otherwise requested by participants, when the project is complete and has been ratified by the exam board.

Participants' names will be masked with code names being used instead of participants' own names before being presented as results. The researcher will make every attempt to obfuscate any training plans which may become apparent in raw data. The researcher will securely maintain a translation key to facilitate the exclusion of a participant's data if requested or to provide feedback which may be the result of a model which has been trained by the researcher. No information will be shared with anyone other than the principal researcher in any manner that may be easily identifiable. All data will be stored securely for the duration of the project and will be deleted from the researcher's personal devices and cloud storage, unless otherwise requested by the participant, once the study has concluded in April 2024 and the project has been ratified by the exam board.

The researcher is aware that some squads or athletes may have policies regarding the sharing of training data, all data provided to the researcher for the purposes of this project will only be accessed by the researcher and only de-pseudonymised on the request of the participant for the purposes of providing training feedback or to delete a participants data.

Are there any conflicts of interest in this project?

This project forms part of the principle researcher's undergraduate degree in Integrated Computer Science at Trinity College Dublin. By participating in this project, you are contributing to the completion of this degree.

Where can I get further information regarding this project?

If you have any queries or concerns regarding this project now, or at any point in the future, please contact the researcher via email at junkerml@tcd.ie.

Thank you for taking the time to read this information sheet.

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Project Informed Consent Form

Lead Researcher: Liam Junkermann

Background of Research: The development of a machine learning model to evaluate rowing training to predict training outcomes and performances. This research is being carried out as part of a final year project for the fulfilment of an Integrated Computer Science degree at Trinity College Dublin.

Procedures of this Project: During the course of this project you will be asked to share your wearable and training data through an online portal. Additionally you may be asked to complete some monitoring tasks.

Publication: There will be a final report submitted to the School of Computer Science and Statistics at Trinity College Dublin. Individual data may be included in the final report pseudonymised.

Declaration:

- I am 18 years or older and am competent to provide consent.
- I have read, or had read to me, a document providing information about this research and this consent form.
- I have had the opportunity to ask questions and all my questions have been answered to my satisfaction and I understand the description of the research that is being provided to me.
- I agree that my data is to be used for scientific purposes and I have no objection that my data is published in scientific publications in a way that does not reveal my identity.
- I understand that if I make illicit activities known, these will be reported to appropriate authorities.
- I freely and voluntarily agree to be part of this research study, though without prejudice to my legal and ethical rights.
- I have received a copy of this agreement.

Participant's Name In Bold: _____

Participant's Signature: _____

Statement of Researcher's Responsibility: I have explained the nature and purpose of this research project, the procedures to be undertaken and any risks which may be involved. I have offered to answer any questions and thoroughly answered any such questions. I believe that the participant understands my explanation and has freely given their informed consent.

Signed: _____ Date: _____
Liam Junkermann

Researcher's Contact Information:

Email: junkerml@tcd.ie
Telephone: +353 089 484 2123

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Outline of Research Proposal

Title of Project
Machine Learning to go *Nyoom*: Using Machine Learning to evaluate rowing training and predict training outcomes or performance

Dates and Duration
This project will run from ASAP until April 2024.

Purpose and Academic Rationale

The purpose of this project is to develop a machine learning model which can quantify rowing training load more effectively to predict the resulting outcomes and performances from a certain training program. The formative Human Performance Model from 1975 relied on a linear model, only using Fitness and Fatigue as inputs. The linear model for human performance is inherently flawed as adaptations to training load are far more complex. Since then, technology has evolved to allow researchers to build more complex and effective models of human performance. The development in machine learning allows models to be trained on sports specific data to extrapolate what training plans work, and provide individualised feedback using the data available.

At present, no tool like this exists for Rowing. Given the cardiovascular intensity of training, many strain models built for sports generally overestimate the strain, or fatigue, of a given training session. Additionally there is some disagreement about which approach to training is best. The most popular approaches for endurance training being pyramidal or periodization. These approaches guide what percentage of time spent training should be spent in various heart rate zones.

Rowing training is uniquely placed to be used to train a machine learning model. With countless hours spent on the rowing machine (erg) each week, most often with a heart rate monitor (HRM) connected, most pre-elite and elite athletes have granular, stroke to stroke, data about their training. Given the prevalence of using heart rate to train many athletes also wear heart rate monitors on the water, with some also using Stroke Coaches (GPS computers which various metrics on the water such as speed, stroke rate, in some cases power, and has the capability to connect to HRMs) to record distance, time, and speed. Given the time and energy commitment required for rowing many athletes also use fitness tracking wearables (eg. Polar Watches, Whoop Straps, etc.) to collect data about recovery and sleep. Considering this volume of data, a machine learning approach to analyse and provide feedback, and predictions, on a given training block or to help work to a given goal.

Procedures of the Project

There will be two steps to the project

1. **Data Collection**
   Participants will be asked to do a once-off sign up process which will enable automatic collection of their wearable and training data through the use of APIs. Participants may be asked to do weekly monitoring each week to provide supplemental data. The goal of the data collection step is to be as unintrusive to the athletes as possible. Their data will be collected and analysed on the researchers personal computer, before being transferred to cloud storage, in a pseudonymised format, to allow for processing in the machine learning step.
2. **Data Processing and Model Generation**
   Once a sufficient amount of data has been collected, the researcher will engage in processing the data and developing a model. Data will continue to be collected to continue add to the data available to the model. Any findings from the model will be released to the participants. The researcher will maintain a translation key securely on their local machine in order to provide this feedback, and in the event that a participant asks for their data to be deleted.

Participants

The participants for this project will be recruited through word of mouth and text messages. The researcher is an active member of a Dublin senior rowing squad with friends and former teammates in other squads in Ireland and the United States of America who can be recruited for the project.

The criteria that a participant must meet in order to take part in this project:

- Be at least 18 years old.
- Be training for Rowing at least 8 times per week (>45 minutes per session)
- Have competed at a minimum of national level

Debriefing Arrangements

All participants in this project will be debriefed through a written document explaining the process to them. If requested, participants will receive results of the project once the project is completed.

Ethical Considerations

There are some ethical considerations which arise from the project with regards to participation, data collection and protection.

Participation Participation in this project is entirely voluntary. If a participant no longer feels comfortable sharing their data, they may withdraw at any time, even after the project has commenced, with all of their data being removed from the researchers personal device and cloud storage.

Data Collection and Protection All data collected is done through authorised APIs, secured with the participants log in and an API key provided to the researcher. The data is then processed to pseudonymised, by removing any names or user ids and replacing them with randomly generated keys for each participant. The data is then stored in an encrypted cloud storage provider. A translation key list will be stored securely and encrypted on the researchers personal device. The researcher is aware that some squads may have policies regarding the sharing of training data, all data provided to the researcher for the purposes of this project will only be accessed by the researcher and only de-pseudonymised on the request of the participant for the purposes of providing training feedback or to delete a participants data.

Legislation

All data gathered as part of this study will be held and maintained in accordance with the General Data Protection Regulation (GDPR). All participants will be anonymised before being included in results. Information gathered throughout the study will be stored securely, which only the researcher will have access to.