

# **Project Proposal:**

## Sports Management for Injury Prevention, Performance, and Athlete Management Using Machine Learning

Prepared for  
**CSIS4495 Applied Research Project**  
**Section 002**

Presented to  
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# Introduction

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## I. Domain, Overview of Background, and Context of the Research

Sports injuries are a normal thing in everyday life, arising from interactions between modifiable factors (e.g., training load, strength) and non-modifiable factors (e.g., age, injury history) that fluctuate over time. Sports injuries happen to the so-called “weekend warrior” trying to squeeze in some form of exercise in some form of sports activity in an attempt to try to be fit in spite of such a busy schedule and usually injuries are just waiting to happen. Then you have the athletes, both amateur and professional, you play their respective sports at a high-level which can be demanding and taxing to the human body to the point of injury. It is a fact of life indeed in spite of all the conditioning, training, and nutrition to avoid such sports injuries.

With the advent of Artificial intelligence (AI) and Machine Learning (ML), sports injuries can be predicted which can lead to injury prevention. The application of AI and ML in sports has grown significantly in recent years. AI has been instrumental in enhancing decision-making, performance forecasting, and injury prevention in various sports disciplines. Examples include optimizing training regimens, predicting game outcomes, and evaluating injury risks through wearable devices and advanced algorithms.



## II. Framing the Problem

Here are some questions that the student has come up with to frame the problem:

1. How can ML improve injury prediction and performance optimization in sports?
2. What methods can provide personalized, data-driven insights for people?



Injuries significantly impact athletes' performance and team success. A reliable injury prediction system and performance tracker can mitigate risks, reduce downtime, and improve overall athlete outcomes.

### III. Relevant Literature and Research

Injury prevention is essential for success in sports, with significant financial investments made to achieve it. Despite these efforts, millions of athletes still experience injuries each year, highlighting the need for improvement in injury prediction. Artificial intelligence (AI) presents a promising approach by addressing the complexity of sports injuries, considering their non-linear nature, and enhancing decision-making for practitioners.

Several different machine learning (ML) models have been used to predict injuries in basketball by analyzing factors like age, past injuries, and performance metrics. Wearable devices combined with ML algorithms have shown to effectively monitor real-time physiological data to evaluate training impacts. Existing studies focus on individual aspects like injury prediction or performance forecasting but lack integration into a holistic system. Many ML models require high-quality datasets that are often inaccessible or incomplete.



#### **IV. Hypotheses, Assumptions, and Potential Benefit of Research**

An integrated sports management portal powered by machine learning (ML) will significantly enhance the accuracy of injury prediction and provide actionable insights to optimize athlete performance. The portal will leverage advanced algorithms to analyze both modifiable (e.g., training load, strength) and non-modifiable factors (e.g., age, injury history), enabling athletes to make informed decisions.

Assumptions include the availability of high-quality datasets containing relevant variables such as athlete demographics, performance metrics, and injury histories. It is also assumed that the adoption of the portal by athletes will align with the growing reliance on data-driven approaches in sports.

The potential benefits of this research are tremendous. First of all, the system is expected to reduce athlete downtime by accurately predicting injury risks and recommending preventive measures tailored to individual needs. Furthermore, the portal will improve training outcomes by enabling people like coaches to adjust regimens based on real-time performance data and risk assessments. Lastly, the research will contribute to the development of a user-friendly and customizable platform, empowering athletes to track their progress and coaches to manage multiple profiles efficiently.

By addressing the gaps in current injury prevention and performance tracking tools, this research aims to advance sports management technology and contribute to safer and more efficient athletic practices. In the long term, the portal could serve as a model for broader adoption across various sports and training environments.



# Proposed Research Project

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## I. Research Design and Objectives

### Design

Develop a web-based portal incorporating machine learning (ML) models for injury prediction, performance analytics, and training customization.

### Objectives

- a. Create a database to store athlete profiles and performance metrics.
- b. Train an ML model to predict injury risks using historical data.
- c. Build interactive dashboards for visualizing performance trends.

## II. Methodology

### Data Collection

Sources include publicly available datasets from NBA and synthetic data. Possible features include age, previous injuries, physiological metrics. Surveys and interviews of some individuals that are involved with basketball will also be conducted as part of the data collection.

### Data Analysis

Use machine learning algorithms/models for injury prediction and trend analysis.

### Justification

ML models have shown superior performance in similar studies, validating their use in this context.



### III. Technologies

#### Operating System/Platform

MacOS and Windows 11

#### Programming Languages/Frameworks

For the backend, it will be Python (machine learning algorithms to be decided)

For the frontend, it will be HMTL, CSS, and JavaScript

Possibility of using new programming languages/frameworks not yet learned by the student

#### Database

Database Management System (still deciding if MS SQL Server or MySQL will be used)

### IV. Expected Results

The expected results are:

1. Accurate injury risk predictions with recommendations
2. Practical applications which people like athletes and coaches can use



# Project

## Planning and Timeline

Here is the proposed project plan and timeline which can change depending on the status of the project.



PHASE	DURATION	MILESTONES
PHASE 1: RESEARCH AND PLANNING	1 week	<ul style="list-style-type: none"> <li>1. Determining topic of research for Applied Research Project</li> <li>2. Researching the topic and coming up with 1st draft of project proposal</li> <li>3. Finalizing project proposal</li> </ul>
PHASE 2: CRASH COURSE CODING, SOME IMPLEMENTATION, AND DATA COLLECTING	4 weeks	<ul style="list-style-type: none"> <li>1. Crash Courses on Coding with Some Implementation</li> <li>2. Collecting initial datasets, Finalizing Data Methodology</li> <li>3. Further Data Collection and Implementation</li> </ul>
PHASE 3: BUILD MINIMUM VIABLE PRODUCT AND TESTING	4 weeks	<ul style="list-style-type: none"> <li>1. Building athlete profiles and injury prediction</li> <li>2. Building integration of performance and training features</li> <li>3. Conducting testing</li> </ul>
PHASE 4: SPORTS MANAGEMENT PORTAL PILOT AND DEPLOYMENT	2 weeks	<ul style="list-style-type: none"> <li>1. Refine</li> <li>2. Gather user feedback</li> <li>3. Ready pilot and deployment</li> </ul>

# Project Contract

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DOUGLAS COLLEGE

January 24, 2025

**Padmapriya Arasanipalai Kandhadai**

Instructor/Advisor

Douglas College

700 Royal Avenue

New Westminster BC V3M 5Z5

Dear Ms. Kandhadai,

This letter serves as a formal agreement for the development and delivery of the Sports Management Portal for Injury Prevention and Performance Optimization Using Machine Learning. As outlined in the proposal, the scope includes creating a web-based platform that integrates machine learning models for injury prediction, performance analytics, and training customization.

The project will follow the timeline detailed in the proposal, with key deliverables including a functional prototype, expanded features, and a fully deployed portal by the designated milestones. All development, testing, and deployment responsibilities will be managed solely by me, and I will adhere to the agreed-upon scope and deadlines. At least six (6) hours will be spent each week working on the project.

Weekly check ins will be conducted to ensure progress aligns with the proposed plan. Any adjustments to the timeline will be promptly communicated. This agreement reflects my commitment to delivering a high-quality, impactful solution.

Excited to work on this ambitious project!

Sincerely yours,

A handwritten signature in black ink, appearing to read "Juan Carlos Katigbak".  
Juan Carlos Katigbak  
300366535  
Student

# Work Date/

## Hours Logged

Here is the table so far of the work date and hours logged for the project.

Juan Carlos Katigbak		
Date	Number of Hours	Description of work done
January 16, 2025	2	Determining topic of research for Applied Research Project
January 17, 2025	2	Initial research on topic
January 22, 2025	4	Further research on topic
January 23, 2025	3	Create 1st draft of project proposal
January 24, 2025	2	Create Github repository with file "README.md" (filled up information in there) and folders "Implementation" (with file "index.html" just to brush up on HTML code), "Misc" (with research journals related to topic including file "References.docx"), and "ReportsAndDocuments" (with files "1st Draft JuanCarlosK_Proposal.pdf", "JuanCarlosK_Proposal.pdf" and "Work Date and Hours Logs for Student) - Added all of these to repo
		Ready project proposal for submission



# Closing and References

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The Sports Management Portal for Injury Prevention and Performance Optimization represents a significant opportunity to leverage machine learning for improving athlete outcomes. By integrating injury prediction, performance tracking, and training customization into a cohesive and user-friendly platform, this project has the goal of addressing critical gaps in current sports management tools. The proposed timeline, technologies, and methodologies ensure an organized approach to achieving the objectives of the research project.

The student is committed to delivering a solution that combines cutting-edge technology with practical applications, ultimately contributing to advancements in sports management and athlete care.

Here are the references:

1. Chmait, N., & Westerbeek, H. (2021). Artificial intelligence and machine learning in sport research: An introduction for non-data scientists. *Frontiers in Sports and Active Living*, 3, Article 682287.
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4. Li, S., & Zhang, W. (2022). Evaluation method of basketball teaching and training effect based on wearable devices. *Frontiers in Physics*, 10, Article 900169.
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6. Lu, Y., Pareek, A., Lavoie-Gagne, O. Z., Forlenza, E. M., Patel, B. H., Reinholtz, A. K., Forsythe, B., & Camp, C. L. (2022). Machine learning for predicting lower extremity muscle strain in National Basketball Association athletes. *The Orthopaedic Journal of Sports Medicine*, 10(7), 2325967122111742.
7. Papageorgiou, G., Sarlis, V., & Tjortjis, C. (2024). Evaluating the effectiveness of machine learning models for performance forecasting in basketball: A comparative study. *Knowledge and Information Systems*, 66, 4333–4375.
8. Georgievski, B., & Vragic, S. (2021). Machine learning and the NBA game. *Journal of Physical Education and Sport*.