

# **Project Proposal:**

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

Prepared for

**CSIS4495 Applied Research Project  
Section 002**

Presented to  
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**CSIS4495 Section 002**

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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 which could be some form of sports activity in an attempt to improve fitness in spite of such a busy schedule. The “weekend warrior” is usually at a high risk for injuries that are just waiting to happen. Then you have the athletes, both amateur and professional, who play their respective sports at a high-level which can be demanding and taxing to their bodies to the point of exhaustion and that too can lead to injuries. It is a fact of life indeed in spite of all the conditioning, training, and nutrition present nowadays to be able 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 which can lead to advantages for both athletes and coaches in their respective sport. AI has been a boon in performance forecasting and injury prevention in various sports. Examples include optimizing training regimens and evaluating injury risks through 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 data-driven insights for athletes?

Injuries significantly impact athletes' performance thus a reliable injury prediction system can reduce risks and improve overall athlete performance.



### III. Relevant Literature and Research

In a study done by researchers Robin Owen, Julian A. Owen, and Seren L. Evans[1], they mentioned that preventing injuries is important to be successful in sports and a lot of investment is made to be able to do this. Despite all of these, injuries still remain a significant challenge. Millions of athletes around the world suffer from injuries every year even if there are scientifically backed prevention strategies. The researchers point out that this sport injury prediction is something that can still be improved and this is where Artificial Intelligence (AI) comes into play. AI offers a promising path forward to provide a comprehensive view of the complexity of sports injuries. Recent advancements of AI and Machine Learning (ML) have become a pivotal part of sports medicine research which provides a better analysis of huge quantities of data to be able to make predictive models of injury. AI and ML can handle imbalanced datasets common in sports injury studies and account for risk factors, assessing their role in predicting injuries.

The same AI and ML technologies are used in one of the major sports leagues in the world which is based in North America and this is the National Basketball Association or the NBA for short. In another study done by researchers Yining Lu, Ayoosh Pareek, Ophelie Z. Lavoie-Gagne, Enrico M. Forlenza, Bhavik H. Patel, Anna K. Reinholtz, Brian Forsythe, and Christopher L. Camp[2], they wanted to know about time-loss lower extremity muscle strains (LEMSs) in the NBA and to determine the validity of a ML model in predicting injury risk. Their study involved using various ML models some of which outperformed other ML models by means of achieving high accuracy and reliability. The ML models that did well provided actionable insights which can help physicians assess individual injury risks and inform prevention strategies through a web-based application. The findings highlight the potential of ML to revolutionize injury prevention and management in sports, though further validation and improvement are needed for broader application.



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

An integrated sports management portal powered by ML will significantly improve the accuracy of injury prediction and provide insights to optimize athlete performance. The portal will leverage 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 such as those from the NBA containing relevant variables like athlete demographics, performance metrics, and injury histories. It also assumes 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 immense. 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 the 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 done using NBA data such as in the study of Yining Lu, Ayoosh Pareek, Ophelie Z. Lavoie-Gagne, Enrico M. Forlenza, Bhavik H. Patel, Anna K. Reinholtz, Brian Forsythe, and Christopher L. Camp[2] show that this proposed research project can be done as well as make it more holistic by means of including performance and training with injury prediction thus making the application broader.



### 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

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## Planning and Timeline

Here is the proposed project plan and timeline which can change depending on the status of the project. Microsoft Planner's "Kanban" board is used by the student for the project plan and has been shared with the advisor. This is the link: [https://planner.cloud.microsoft/webui/plan/-/MiFRcg4FUyIMKB\\_joZkhGQAFh8S/view/board?tid=3af48838-cd53-4507-9e7f-fc6dac355e33](https://planner.cloud.microsoft/webui/plan/-/MiFRcg4FUyIMKB_joZkhGQAFh8S/view/board?tid=3af48838-cd53-4507-9e7f-fc6dac355e33)



PHASE	DURATION	MILESTONES
PHASE 1: RESEARCH AND PLANNING	1 week	<ol 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></ol>
PHASE 2: CRASH COURSE CODING, SOME IMPLEMENTATION, AND DATA COLLECTING	4 weeks	<ol 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></ol>
PHASE 3: BUILD MINIMUM VIABLE PRODUCT AND TESTING	4 weeks	<ol 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></ol>
PHASE 4: SPORTS MANAGEMENT PORTAL PILOT AND DEPLOYMENT	2 weeks	<ol style="list-style-type: none"><li>1. Refine</li><li>2. Gather user feedback</li><li>3. Ready pilot and deployment</li></ol>

# Project Contract

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January 26, 2025

**Padmapriya Arasanipalai Kandhadai**  
Instructor/Advisor  
Douglas College  
700 Royal Avenue  
New Westminster BC V3M 5Z5

Douglas College  
700 Royal Avenue  
New Westminster BC V3M 5Z5

Dear Ms. Kandhadai,

This letter serves as an agreement for the development and delivery of the Sports Management Portal for Injury Prevention, Performance, and Athlete Management 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,

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
		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 "JuanCarlosK_Proposal.pdf" and "Work Date and Hours Logs for Student") - Added all of these to repo
January 24, 2025	2	Added all of these to repo
January 26, 2025	3	Ready project proposal for submission



# Closing and References

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The Sports Management Portal for Injury Prevention, Performance, and Athlete Management Using Machine Learning represents a significant opportunity to leverage ML 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.

Here are the references:

1. Owen, R., Owen, J. A., & Evans, S. (2024). Artificial intelligence for sport injury prediction. In Artificial Intelligence for Sport Injury Prediction. Springer.
2. 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), 23259671221111742.
3. 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.
4. 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.
5. Dindorf, C., Bartaguz, E., Gassmann, F., & Fröhlich, M. (2022). Conceptual structure and current trends in artificial intelligence, machine learning, and deep learning research in sports: A bibliometric review. Preprint.
6. Li, S., & Zhang, W. (2022). Evaluation method of basketball teaching and training effect based on wearable devices. *Frontiers in Physics*, 10, Article 900169.
7. Yang, X. (2024). Construction of measurement index system of basketball players' specific physical fitness training based on AI intelligence and neural network. *Molecular & Cellular Biomechanics*, 21(1), 250.
8. Georgievski, B., & Vrtagic, S. (2021). Machine learning and the NBA game. *Journal of Physical Education and Sport*.