Welcome to the Physics of Sports!!!

- This is a **project-based course** during which you will study the dynamics of a sport/athletic endeavor you are interested in
- This course is perfect for students interested in engineering, physics or sports.
- There are no pre-requisites - the course is designed to teach you all the skills you will need to be successful
- This course has no exams - all of the assessment is based on in-class activities and the projects
- This course will connect you to the real world of the sports science industry - guest speakers will join us from the Harvard Motion Capture Laboratory (MCL) & local sports franchises
- You will be provided with a sensor platform (see picture below) and will learn how to use both the sensor and video analysis to collect and analyze data (in Python) to be able to answer interesting questions about sports.

During the course, students will learn:

-How to use **Python** to plot and analyze data (no former experience necessary)

-How to use the Scientific Method to conduct a research project on a sport/athletic endeavor

-Experimental design skills

-Data analysis techniques including some basic statistics

-Data visualization

-Physics concepts of motion (kinematics and mechanics)

COURSE STRUCTURE (semester is divided into 2 parts):

Part 1: students will do activities in teams to learn how the sensors work, how to collect and analyze video and sensor data and how to apply the fundamentals of mechanics to human motion and sports

Part 2: project-work: students pick a sport/athletic endeavor, come up with a question pertaining to that sport, perform experiments using sensors/video analysis to collect data, analyze that data to answer their initial question

Course Schedule

Weekly class meetings: T/Th 11:15-12:30pm

Weeks 1-3: Representation of motion, kinematics, use of sensors, use of video analysis

Weeks 4-5: Using the sensors to explore motion (rotational dynamics, Newton's Laws, conservation principles)

Weeks 6-7: Data analysis (cleaning/ filtering data, interpreting & modeling data, statistics, presenting data)

Weeks 8-12: Project-work

Week 13: Final Project presentations

A more detailed description/syllabus is provided here:

2024 Phys of Sports Syllabus

Please email me, Kelly Miller (kmiller@seas.harvard.edu) if you are interested in taking the class and have additional questions - we can set-up a time to meet.

TEACHING TEAM

Instructor: Kelly Miller (kmiller@seas.harvard.edu)

Teaching Assistant: Max Christopher (maxchristopher@fas.harvard.edu)

Active Learning Lab Staff:

Jason Martinez (jmartinez@seas.harvard.edu)

Ben Brown (brown@seas.harvard.edu)

LInc Pedagogical Consultants:

Robert Haussman (rhaussman@seas.harvard.edu)

Salma Abu Ayyash (salma@seas.harvard.edu)

COURSE GOALS

- **Instrumentation:** The ability to use a sensor platform and video analysis to collect data
- **Quantitative Analysis**: The ability to analyze and to solve problems in science and engineering quantitatively, including use of appropriate tools, quantitative modeling, numerical problem solving, experimentation, and error analysis.
- **Teamwork**: The ability to contribute effectively in a variety of roles on teams, including diverse teams, while respecting everyoneâ€™s contributions.
- **Communication**: The ability to convey information and ideas effectively, using written, oral, and visual and graphical communication.

COURSE LOGISTICS

Textbook

The textbook for ES20R is *Physics of Sports* by Michael Lisa.

Students will not need to buy the text - we will be using *Perusall*, a collaborative and social e-book platform, to access the textbook in this course.

TEAMWORK

Teamwork creates synergy. Because the combined effect of an effective team is significantly greater than the sum of individual efforts, teams can tackle problems that are too big to solve for any individual. In the professional world, effective teamwork is paramount. For this reason, ES20R uses a team-based approach that will help you develop collaborative skills, that will help you work effectively in a team, and that will maximize your learning. As in the professional world, three important features affect your productivity and success in a team: your own effort, the effort of people you depend on, and the way you work together. Throughout the term, you will work closely with three or four of your classmates, as part of a project team.

Assessment

There are no exams in this course. Instead, your grade is determined by the continuous assessment of the activities that are part of the course, peer assessments (see below) as well as the project. All these activities and the project milestonesâ€” are evaluated on the same 3-point scale:

3 = significantly exceeds expectations

2 = meets expectations

1 = improvement needed

0 = deficient

Scoring rubrics for the specific activities and project milestones will be made available as we engage in each activity, so you will always know exactly what the expectations are.

Peer Assessment

It is important to provide constructive feedback to your teammates. During the semester you will provide an online assessment of the contributions of the members of your team (including yourself) to all the activities in class and to the project.

Accessibility

If you have a documented disability (physical or cognitive) that may impair your ability to complete assignments or otherwise participate in the course and satisfy course criteria, please meet with me at your earliest convenience to identify, discuss, and document any feasible instructional modifications or accommodations. You should also contact the Accessible Education Office (AEO) to request an official letter outlining authorized accommodations. All discussions will remain confidential, although AEO may be consulted to discuss appropriate implementation.

Use of Generative Artificial Intelligence (GAI)

This course encourages students to explore the use of generative artificial intelligence (GAI) tools such as ChatGPT for all assignments and assessments. Any such use must be appropriately acknowledged and cited. It is each studentâ€™s responsibility to assess the validity and applicability of any GAI output that is submitted; you bear the final responsibility. Violations of this policy will be considered academic misconduct. We draw your attention to the fact that different classes at Harvard could implement different AI policies, and it is the studentâ€™s responsibility to conform to expectations for each course.