Masterclass Session Script

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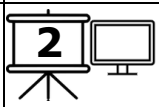
 This icon refers to the supporting slide in the presentation.

 These icons indicate there is an activity to do, or a worksheet to complete.

 This icon indicates there is a video to watch.

Bats to Bytes OTS Masterclass	Slides/ Activity
Introduction (5 minutes) Welcome to our Bats to Bytes computer science masterclass today! Today we are going to explore how computing and technology can be used in sports. I want you to start by thinking about your favourite sports. • **Who here plays a sport?** • **What's your favourite sport to play?** Now, I want you to think of one thing about your performance in that sport that you would like to improve. Maybe you want to hit a ball further, or run faster, or improve your accuracy in some way. • **Does anyone have any specific improvements they might want to share?** Well, the good news is that technology is currently helping athletes to improve their performance in new ways every day. Sport scientists and data analysts use technology to collect information about how athletes move and perform, and use that data to make improvements, sometimes even using AI to help to enhance their results. • **What technology already exists, or what new technology can you think of, that would help you improve in your favourite sport?** Today we're going to investigate how we can collect information about our movement to help us improve at our performance in sports.	
Making a step counter (15 minutes) We are going to start by collecting information about our own movement, by using these micro:bits. Micro:bits are teeny tiny computers. We can programme them to collect information on our movement, and we're going to learn how they do this by turning them into step counters. You will need to load up Makecode in an internet browser on your laptop, and then scroll down to the fashion tutorials, and find the step counter tutorial. Follow the instructions on the screen to code your own step counter, and when you are ready connect the micro:bit to the laptop, download your code, and test the step counter out! • **Why might we want to use a step counter?** To track the amount of exercise we do in a day to stay healthy. .	

What is data? (5 minutes)

- **What exactly is data?** *Data is information about the world around us – it could be facts, numbers, names, measurements, or even observations of something happening.*

We collect data for lots of reasons, but mostly it is to help us learn about our world, to answer questions, solve problems, and make decisions.

When we use data, we first have to collect it. Today we'll be collecting data using the micro:bit. After we've collected the data, it needs to be organised so we can understand it. Luckily the micro:bit also does this for us and places the data into a graph to analyse. In the analysis, we need to draw some conclusions from the data, which might help us to answer a question, or hypothesis.

Data science is used in lots of ways in sports, for example to improve player performance by analysing a player's speed, agility, or accuracy to identify strengths and weaknesses. Data is also used to come up with strategy in a game, to optimise your own game plan as well as predict your opponent's strategy, and make key decisions during the game.

Data is also used when identifying potential new talent, or to fill skill gaps in the team. On the other hand, data can be used to understand fan behaviour and preferences to increase engagement and enjoyment, and to set the pricing of tickets or sports streaming services.

Today we are going to be focusing on player performance and find ways that we can collect data to help inform decisions on how to improve performance. In these images we have different forms of collecting and organising data – for example in a boxing class the strength of different punches are taken. In the image below, the heart rate, distance and speed of someone out for a run is collected. In the image on the right, a woman is using a spirometer, where her breathing and lung strength is being studied, likely after she has exercised.

What data can we collect in sports? (5 minutes)

For each of the following sports, I want you to answer the question of what kind of data, or information, we could collect to help each person improve their performance. Aaron likes to play football, and he was to improve the accuracy of his shots on goal, so that he scores more often.

- **What data could we collect to help Aaron improve his scoring?** *We could collect data such as shot speed – how fast the ball travels, shot accuracy – does the ball go where the goalkeeper cannot reach, foot position on the ball, distance from the goal, and angle of approach.*

Lia likes to play golf, and wants to improve the strength of her golf swings so that she can make the ball travel further.

- **What data could we collect to help Lia improve her swing?** *We could collect data such as swing speed, the angle at the point of hitting the ball, the contact point between the ball and club, the spin on the ball, and Lia's body position.*

Jasmine likes to horse ride and wants to improve her riding posture so she will be more stable in the saddle.

- **What data could we collect to help Jasmine improve her posture?** *We could collect data such as recording the position of Jasmine's body whilst riding, noticing shifts in posture in different gaits (walk, trot, canter), the amount of time Jasmine can maintain her posture, and the horse's response to different postures.*

Reece likes to swim and wants to improve his swim speed so he can win more races.

- **What data could we collect to help Reece swim faster?** *We could collect data such as how long it takes Reece to complete a lap of the pool, how many strokes per minute he takes, his body's position in the water, his kick strength and rhythm, and the angle of his arms.*

What data can we collect in cricket? (5 minutes)

Great work, you have come up with lots of ways we could collect data to improve performance in different sports. Today, we are going to focus on cricket specifically.

- **Has anyone played or watched cricket before?**
- **How might someone playing cricket want to improve their skills, and how could they collect data to help with this?**

There are different skills in cricket that we might want to improve, such as batting, where you hit the ball, bowling, where you set up the ball to be hit by the batter, and fielding, where you have to catch the ball. For each of these we could collect different data, for example the speed of the ball when it is bowled, the strength with which the batter hits the ball, or count how often a play successfully catches a ball. Technology has already been implemented into cricket to help improve player's performance. Let's look at some examples.

One example of technology in cricket is LED bails on wickets. If a bail on top of a wicket is disturbed so that it no longer touches the wicket, the batter is out.

Ball tracking can also be used in cricket, to determine the speed, direction and spin on each ball hit and bowled.

Sensors can also be placed in cricket bats, to determine the angle when batting, the strength of the hit, and where the ball hits the bat. We are going to create our own cricket bat sensors today using micro:bits to collect real data each time you swing your bat. By the end of this session, you'll be feeling like a pro batter.

Micro:bit Accelerometer and three different cricket shots (10 minutes)

We're going to be using our micro:bits as movement sensors. The micro:bits have a sensor called an accelerometer inside, which measure movement and tilting in three different axes, or directions of movement. Imagine you're the micro:bit. The x axis measures tilt from left to right, like shaking your head 'no'. The y axis measures tilt forwards and backwards, like nodding your head 'yes'. And the z axis measures movement forward and backwards, like you're bringing your face close to the screen to read something and then going back again.

The micro:bit also has LED lights and buttons. The LED lights will light up on the front to tell us whether the micro:bit is recording information or not, and we will be using the A and B buttons to start and stop the micro:bit from recording our movement data.

Now it's time to see the cricket shots you'll be trying to replicate in today's challenge. We've been working with some brilliant people at Surrey Country Cricket Club, based at the Oval, and we asked a cricketer there to demonstrate three classic cricket shots for us – while using the micro:bit to collect data during each one.

Let's take a look at them together.

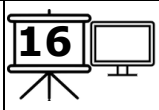
- **We can watch the video demonstrations, or if someone here is a keen cricketer, maybe you'd like to help show us what these shots look like?**

First up is the straight drive – a controlled, powerful shot where the bat moves straight down the line, right in front of the body.

Next is a defensive block, or a forward defence shot, which is a gentler move that is designed to protect a wicket rather than hit a powerful ball and score runs. It is quite similar in movement to the straight drive but stops shorter without the follow through.

And last up is the pull shot, where the bat comes across the body in a strong, sideways movement. Your challenge today will be to try out each of these shots yourself, using your micro:bit to collect your own movement data. You will then see if you can match your data to one of the cricketer's swings.

The batting challenge and results (30 minutes)



Let's go over a few important points so you know exactly how this challenge will work. Forst, remember the micro:bit uses an accelerometer to measure movement in three directions – x (side to side), y (up and down), and z (forward and backward).

When you swing the bat, the micro:bit will track these directions, and you'll be able to see that movement as a graph. Each type of swing makes a different shape on the graph, so your job is to compare your swing's graph to the three examples, and try to guess which shot matches each of the cricketer's graphs.

You will be put into groups of three, and each group will have a cricket bat, a micro:bit with the programme already loaded, a laptop, a wearable holder to keep the micro:bit on your wrist, a cable to connect the micro:bit to the laptop, and a data collection worksheet.

I'll show you now how to turn the micro:bit data collecting on and off to log your swing, and how to find the data afterwards on your laptop.

Each person will have a go at doing a shot, then after the swing they should plug in the micro:bit, open the data file, check the graph of the swing, then everyone in your team should give their opinion on which of the graphs on the sheet matches the closest to the graph of the swing. Don't forget to write down what you think on the worksheet. Be honest – even if you're not sure, it may still be useful to check your previous guesses when the next person does the same shot later. Once every team member has had a go at each shot type, your final challenge is to decide together to agree which graph on the sheet matches each shot type.

Don't forget to cheer each other and support your team!

Great work everyone, you worked fantastically in your teams. You just carried out a real piece of data analysis based on live sensor and movement data! Let's see which shots you thought matched up each of the cricketer's graphs.

Graph A was the defensive block. Graph B was the pull shot. And graph C was the straight drive.

- **Was it easy to match your data to the right graphs?**
- **Hands up who got all three correct? Two? One?**

A few things you might have noticed.

- **Sometimes two shots looked really similar on the graph, why might that be?** Maybe your swing was not quite like the one in the video, that's okay!

Even professionals don't make the exact same move every time. And sometimes the data can be noisy, maybe the micro:bit moved slightly on your wrist, or the swing was not quite as smooth, or the data logger was turned on a bit early or late.

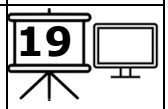
This is exactly what real sports scientists and data analysts face. Making accurate predictions takes time, multiple trials, and the right tools.

- **So, do you trust the data more than your eyes?**

- **How much would you trust a system like this to judge your performance or help you train better?**

We're now going to investigate a way we could possibly take this one step further by making our own AI model, and how your swings (even the messy ones), are really useful for training a model to spot patterns.

How can AI help us? (25 minutes)



So, what if we didn't have to manually check the graph each time we took a shot. What if the bat could tell us what kind of shot was just played and show how close to the perfect shot we were? That's where artificial intelligence can come in.

Artificial intelligence is used to train computers to spot patterns and make decisions, just like humans do. And you're now going to train your very own!

You will be using a tool called CreateAI and will help the micro:bit to recognise different cricket shots based on your own data. We're going to start by teaching it the three different cricket shots you have already done – a straight drive, a defensive block, and a pull shot. You will need to create each action, or class, separately, and then record the movement for each of these actions. You can then test your model, and make improvements, perhaps by adding more recordings of other people doing, or by adding in new actions. I will now show you how to connect your micro:bit to CreateAI, and show you how to record your first action, then it is over to you!

End of session – recap and feedback (10 minutes)

Thank you very much for joining this masterclass today, we hope you enjoyed it and learnt a lot about data science in sport! If you would like to have a go at the extension activities, we have a worksheet on batter recruitment available, or you could try out the activities using a different sport, like golf, tennis, hockey, and more!

If you have any questions, comments or thoughts we would be happy to hear them now. You can also ask the Ri, by emailing any questions to masterclasses@ri.ac.uk.