

Primary OTS Masterclass: Football Manager

Thank you very much for leading this Masterclass. We hope that you enjoy working with this material as much as we enjoyed putting the activities together. We do appreciate all the effort that our volunteers put into bringing inspirational Masterclasses to students around the country. Don't forget that we'd love to know your thoughts on the Masterclass.

Inspiration for this topic:

From scouting players to planning match tactics, football teams increasingly rely on technology to make smart decisions. In this workshop, students will explore how computers make decisions using algorithms, logic, and conditional statements, just like a football coach picking their starting line-up. By building and testing decision trees to pick their own football team lineup, students will uncover the principles behind machine learning models. Blending sport with computer science, this session introduces key computing concepts like algorithms, if/then logic, and random forests, while showing how data-driven decisions shape the world of professional football.

Overview of Activities:

1. Stick or twist activity
2. How do computers make choices discussion
3. Building a decision tree worksheet activity
4. What decisions do football managers make discussion
5. Creating a lineup picker activity
6. Trump card activity
7. Scratch discussion

General Masterclass resources needed:

- Register of children
- Consent forms and emergency information to hand
- Stickers and markers for name badges
- Adult register
- Ri child protection policy
- Paper and pencils
- 2 different coloured post-it notepads (for feedback at the end)
- Drinks and biscuits

Specific resources needed (enough for the number of students attending):

- 1 copy of Stick or Twist cards per pair of students (you may wish to laminate or cut these out)
- 1 copy of Worksheet 1 – Building a decision tree per student
- 1 copy of Worksheet 2 – Creating a lineup picker per pair of students
- 1 copy of Worksheet 3 – Choosing a lineup per pair of students
- 1 copy of Football trump cards per pair (each card should be cut out, you may wish to laminate) – feel free to use other football trading cards if you have them.
- Whiteboard pens (*optional, 1 per pair for the stick or twist activity if laminated*)

Support resources:

- PowerPoint slides
- Session script

Things to prepare in advance

- Gather the complete list of resources as detailed above
- Print worksheets, additional information, and any other resources as needed
- You may wish to laminate and cut out the football top trump cards in advance of the session, alongside the stick and twist worksheets.

Ask the Ri

Don't forget to collect any questions which arise, and email them to the Masterclass team at the Royal Institution: masterclasses@ri.ac.uk

Feedback

We would very much welcome your feedback on this session. If you have time, please collect feedback from the students at the end of the Masterclass and send it through to us. We would also appreciate feedback on how you have used the session, what you think worked well and what improvements would be useful.

Time plan of Masterclass:

Slides & Time	Overview	Activity (see script for further details)
Slide 1 5 minutes (5)	Football Manager Introduction	Introduce students to the topic of today's masterclass: making decisions in computing, and in sports. Ask the students what decisions they have made today. Ask if there were any specific decisions they had to make when getting ready to come to their masterclass. Allow the students to discuss and share ideas, and give some prompts, such as what clothes they chose to wear or which way of travelling they chose to take.
Slide 2-8 15 minutes (20)	Stick or Twist? Student activity to make a series of decisions using football themed cards. Stick or Twist Cards.	Hand out the Stick or Twist cards. Explain to the students that they will be given a series of items to choose from, and they will need to pick one item they think will be the key item they need to win a football game. Explain that they will be given some information, and each time they are, they can choose to stick and keep their current item, or twist and pick up a new item. If they choose to twist, they may <u>not</u> choose the item they discarded again later on in the game. Each round, players will either gain points for holding an item, have points taken away for holding an item, or keep their score the same. Read aloud the text scenario for each round. Allow the students time to decide if they are sticking with their item, or twisting. Remind them that they may not choose the item again if they decide to twist. Ask the students which items they have chosen and why, then reveal which items give and take away points. Repeat this for the 5 rounds. At the end of the game, ask the students if they found it better to stick or twist their items, and if the information got them to change their minds. Ask the students to come up with some questions they would need to ask if they were going to do this activity again, to find the best possible item to use. Examples include 'what will the weather be like', 'will it be rainy', 'are the other team better at attacking or defending'.

Slides & Time	Overview	Activity (see script for further details)
Slide 9 - 10 5 minutes (25)	Robots playing football How do computers make choices?	Ask the students what they think technology and football has in common. Explain that we are going to see how technology and football can be combined. Play the RoboCup intro video - https://youtu.be/StxIsmsgpdQE . If you do not wish to show the whole video, a good place to stop the video is at 1:42 or 2:20. Explain that RoboCup is an international competition where teams compete to build the best robot football team. Ask the students if they think this is possible. For some extra bloopers from RoboCup, show the students this clip: https://youtu.be/1h5147KLikU . Remind the students how they made decisions at the beginning of the session, and explain that computers don't make guesses like us, they have to be told what decision to make based on the information they are given. Explain that this is called logic, and it is usually given to computers in the form of if/then statements or conditionals. Give example rules/ if/then statements that robots might follow to play football. You may also wish to extend the example to include else statements. Ask the students if these rules are enough for the robot to play a full game of football. Explain that computers need complex sets of rules to follow to function without constant human involvement, and these could be given using the concept of a decision tree.
Slides 11 - 13 20 minutes (45)	Decision trees Worksheet 1 – Building a decision tree	Talk through the different features of a decision tree – the root node, branches, decision nodes, and leaf nodes. Give examples of each feature, using a football decision on whether to pass, shoot, or defend based on whether you have the ball, or if there is a defender nearby. Explain that the decision tree starts with a question and ends in an action. Go to slide 12 and show what this decision tree might look like. Note that when drawn like this, the decision tree flips, with the root node at the top of the page, and the leaf nodes at the bottom. Hand out worksheet 1 and ask the students to follow the three activities to firstly label, then fill in the blanks, then create their very own decision tree. You may need to provide extra paper for the last activity. After this activity, you may wish to get the students to share their decision trees with the rest of the group so that they get to work through each other's and build up a better idea of what makes a good decision tree.
10 minutes (55)	Break	Drinks and biscuits and comfort break.

Slides & Time	Overview	Activity (see script for further details)
Slides 15-18 10 minutes (65)	What decisions do football managers need to make during a game? Which players should take a penalty?	Discuss what decisions football managers need to make DURING a football game. Give students discussion time, then take in some answers and share the examples. Highlight that one of the most high-pressure moments a football player may face is having to take a penalty shot, and that it is up to the manager to decide who should be the players to take these. Go to slide 16 and describe the data that the students are given – football player’s name, shooting skill, confidence, hair style, and whether they scored or not. Ask the students if there’s a category where the players always score. They should be able to identify that players with spiky hair score (Alex and Cody). They may also identify that Cody has low confidence, and that led to him scoring. Use the example of the spiky hair, and explain that if we were going to pick new players based on our current information, we would probably pick players with spiky hair. Show the if/then statements that result from this. Ask the students to sketch the decision tree that would represent the if/then statements. They will need the question – is the player’s hair spiky or not, the branches ‘yes’ and ‘no’, and the leaf nodes ‘pick player to take penalty’, and ‘do not pick player to take penalty’. Go to slide 17 and show the example decision tree. Explain that we will now test the decision tree by giving it some more data – some new player to pick from. Go to slide 18 and show the new players. Ask the students to use the decision tree to select their penalty takers. They should find that Morgan and Frankie are selected. Ask the students why this might not be the best decision. They should explain that Morgan is selected, despite not having scored, and having low skill and confidence. They should also identify that Taylor is not selected, despite having high skill, confidence, and having scored in their last game. Explain what some of the limitations for using a single decision tree are – that new data may not work with a decision tree if we have overfit it, we would have to put every factor possible into the tree, and our output would always stay the same, it would not allow for new creativity.
Slides 19-20 5 minutes (70)	Random Forests	Ask the students what they think we could do to make it better, and what they think the term random forest means. Explain that it is used to describe lots of decision trees working together. Rather than just using one decision tree to make a decision, we use lots and use the outcome most often received to decide what to do. Go to slide 20 and show the students the random forest example for the penalty picker, where the players skill and confidence is also used to decide whether they are picked. Explain that this method would end up with both Taylor and Morgan being selected to take a penalty, and the other players not picked.

Slides & Time	Overview	Activity (see script for further details)
Slide 21-23 15 minutes (85)	Choosing our lineup Creating a lineup picker Worksheet 2 – Creating a lineup picker	Explain to the students that we are going to build a 5-a-side football team using decision trees we will build ourselves. Hand each pair of students a pack of football trump cards. You may wish to substitute these cards for other football trading cards you have. Explain that each card has four statistics on the card, relating to a player's speed, defence, accuracy, and stamina. Ideally, you want a well-rounded team, with generally high scores. Go to slide 22 and explain to the students that they are going to create a random forest of decision trees that will act as their lineup picker. Note to the students that this activity will not be the final draft of their team, but it will influence which players get picked to be in their team in the next activity. Explain that the students must pick up two random cards and decide which they would rather have in their team if they could choose. They will then design a decision tree that would mean a robot would pick the player they would chose and not pick the other player. Handout worksheet 2 so they can see the five decision tree templates they will need to complete. After each go, they should put the two cards aside and repeat the process four more times until all five decision trees have been created. Get them to think about how they could create a well-rounded team Go to slide 23 and show the example decision tree that would pick Sprintah over Messy, since Sprintah's speed is greater than 8, whereas Messy's speed is not.
Slide 24 10 minutes (95)	Let's test our lineup picker Worksheet 3 – Choosing a lineup	Explain to the students that they will shuffle all their cards, pick one up, and use this card to go through their five decision trees. In their table, they should note the name of the player, and the result of each decision tree on whether it suggested to pick or not pick the player. After they have gone through each decision tree with that player, they should count up the number of results that said yes to picking the player. If 3 or more decision trees said the player should be picked, then they will add that player to their team. If three or more decision trees said the player should not be picked, that player will not join their team. Ask the students to keep drawing random cards and repeating the process until they have 5 players who can join their team. After this point the students should stop choosing cards, collect their team of 5 together, and come up with their team's name, ready for a 5-a-side trump card football match.

Slides & Time	Overview	Activity (see script for further details)
Slide 25 15 minutes (110)	Trump card time!	Ask students to turn over their worksheet where they will see an empty league table. Explain to the students that they will now test their lineup against other team's lineups. Explain the rules of the trump card game: each team will use their 5 players and play against another team's 5 players. To start the match, each team will turn their own cards face down, shuffle, and place in their own team pile. Both players will then pick up the card on top of the pile, and read aloud the number for DEF, or defence. Whoever has the highest value wins that round. They should note the name of their opponent team and the result of their own round in the table on the worksheet. They should place their own card on the bottom of their pile, pick up the top card on their pile, and the person who won the last round will pick a statistic to compare (defence, speed, accuracy and stamina). If at any point the numbers are the same, the previous winner should pick another feature to compare. If both cards are the same player, the round should be considered a draw. This will continue until all players have been used, and the teams should count up their overall result (a win, loss, or draw). They can then repeat this with another opponent.
Slides 26-28 5 minutes (115)	Scratch	Show the students how decisions trees may look in block coding form using scratch. Show the first example code for a game character's movement and explain that the decision tree for this snippet of code would be written as 'Was the left arrow pressed?' – 'Yes' – 'Turn left and move ten steps'. Ask the students what might happen if the left arrow isn't pressed – the game character would stay still. Ask the students what the decision tree would look like if it included the 'no' branch. Go to slide 27 to reveal the answer. Go to slide 28 and show the students the new snippet of code. You may wish to explain the else statement. Ask the students what they think the decision tree for this would look like. Click to show that the decision tree extends off of the first 'no' branch, to provide a new decision node 'was the right arrow pressed', and two new branches leading to two new nodes.
Slide 5 minutes (120)	Further activities Feedback, tidy up, questions time Ask the Ri	Wrap up the workshop and recap the activities the students have completed. Introduce the extension material. Don't forget to collect any questions which arise, and email them to us: masterclasses@ri.ac.uk. We will send you answers as soon as possible. Then these can be reported back to the students at their next Masterclass session. We are also very grateful for any feedback you can provide us on the use of the resources, and we would love to hear your stories of how your masterclasses went!
Extension activities		If you would like to continue to explore decision tree building in Scratch, try the Top Trumps activity at www.machinelearningforkids.co.uk/worksheets.