ROBOTICAL

MARTY
THE ROBOT V2

Educator's Guide
Everything you need to get started

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INTRODUCING MARTY THE ROBOT

Marty is our fully programmable and customisable walking robot designed to bring learning in the classroom to life. Designed by roboticists in Scotland, Marty helps you teach STEM (Science, Technology, Engineering & Mathematics) subjects in a fun and interactive way. By promoting problem solving and creative thinking, Marty can give students an introduction to computer science whilst being adaptable and keeping students challenged through project-based learning.

You don't need to be a roboticist or programming expert to use Marty in a classroom. Our classroom solutions come with initial setup support with plenty of online tools and resources to help get you up and running in no time.

Empower students to lead their own development as they explore how Marty works through a Build-Play-Learn ideology. From using our simple guided lessons or challenging students to learn through inquiry, Marty offers cross-curricular learning for all.

Programming using languages like Scratch, Python and JavaScript, students are able to control whole movements or individual motors, read sensors, and make up their own routines for Marty to complete. For more advanced robotics projects, upgrade Marty with a Raspberry Pi computer to take the first steps to building an autonomous robot.

Marty supports students to develop STEM skills such as,

⭐ Computational thinking and programming real languages
⭐ Electronics, mechanics and engineering design
⭐ Collaboration, leadership and peer interaction
⭐ Creativity and inventive thinking
⭐ Critical thinking through exploratory analysis
⭐ Logical thinking in an engaging and creative environment
⭐ Evaluation and problem-solving skills
⭐ Opportunities to engage with a global community through ICT

By exposing young people to real world problems, Marty encourages them to think and act like budding engineers, scientists, and designers.

HOW MARTY TRANSFORMS LEARNING

The logic and principles behind coding and engineering can be daunting to explain and understand. Having a physical tool like Marty allows for these abstract concepts to become relatable – you can immediately see the results of running your code through the movements and actions of Marty.

LEARN MORE THAN CODE

Robotics, electronics, mechanical engineering, and even numeracy and literacy. Marty is a great platform for joined-up learning. Direct and script a play with Marty as the main character on stage; investigate the angles in different shapes and code Marty to navigate around them; use maths to process sensor readings and build a more intelligent robot.

PROGRESSION AS SIMPLE AS 1, 2, 3

Our online resources include activities for all skill levels, allowing teachers to focus on setting goals and progressing with students at a speed that is comfortable for you and your class. With a first taste of programming using block-based language, Scratch, Marty makes it possible to advance your learning with languages like Python that is used in industry.

YOU CAN'T TEACH PROBLEM SOLVING

But you can develop and encourage it. While learning with Marty, students are developing more than just their coding skills. Young people are supported to become collaborators, creative thinkers, problem solvers, computational thinkers and digital leaders for the future.

"Having something physical to move, away from a computer screen, helps kids better understand what happens when they input certain commands. It moves the lessons from theoretical to practical and lets you see the interaction between software and hardware. Marty is cute and engaging which makes it easy to introduce him in the classroom. But he also demonstrates how coding can be applied in the real world as he can interact with his surroundings."

Jonathan Baxter - The Flora Stevenson Primary School

"Marty has been a head turner with students! He works really well across all of the age groups at GoCode. The younger kids love his human features and can use Scratch to get up and running with Marty quickly. For the older kids they're able to explore coding in more detail by moving onto Python and see the physical connection between hardware and software."

Rushil Shah - GoCode Academy

GETTING TO KNOW MARTY

Real robots are packed with highly advanced technology, and Marty is no different. Although the technology may be complex, that doesn't mean it has to be scary or difficult to use and learn about. Marty offers advanced computing and engineering that is accessible for all ages. With big eyes, moving eyebrows and a funky way of walking, Marty is designed to have character and make the process of learning exciting. Let's explain a bit about how Marty works,

CONTROL BOARD ("BRAIN")

The control board, called RIC (Robot Interface Controller), is where all of the complex triggers and reactions happen once you program Marty. You can think of RIC as Marty's brain.

On the board, there is a network of components helping Marty to move and sense. For example, the board has an accelerometer to tell how Marty is standing and moving. It's like our own human balance systems, which tells us which way is up and can make us feel dizzy.
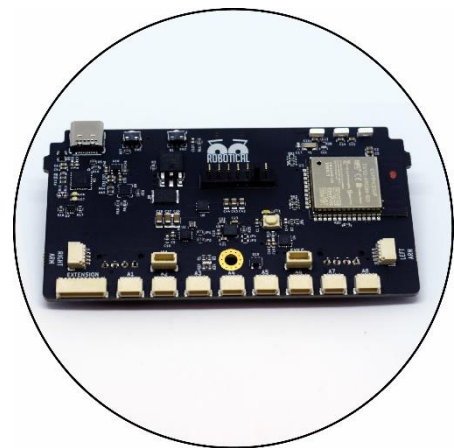
The control board also speaks to Marty's motors and sensors to find out what they are reading. Again, this is similar to our own nervous system, which receives signals from our senses. You can use Marty's brain to send signals to the servo motors and read sensors (like obstacle or position sensors) to allow Marty to physically react when sensing something – like shaking hands if there is a force on the arm.

The more sensors you add, the more Marty will be able to interact with the world, all of which is possible due to the control board brain. The control board acts as a portal for us to communicate with Marty, and Marty to communicate with the word.

SMART SERVO MOTORS ("MUSCLES")
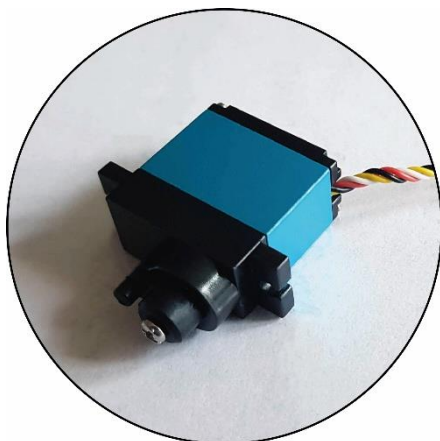
Marty has 9 smart servo motors that allow movement – 3 in each leg, 2 for the arms and 1 for the eyes. The servos have position sensors in them, allowing them to move to specific positions. This means that when you program Marty to move the motors through a series of poses, they know what to do.

No other robot in the world walks like Marty. The unique walking mechanism uses fewer motors than a traditional biped that makes Marty easier to use, and more energy efficient.

PLASTIC COMPONENTS (BODY)

There are 53 plastic parts that form Marty's skeleton, as well as creating a protective shell around Marty's vital components. The parts fit together using stainless steel nuts and bolts, making it possible to assemble and disassemble Marty several times. As well as the mechanics and physics of how Marty moves, the components open discussions and activities for design and technology lessons.
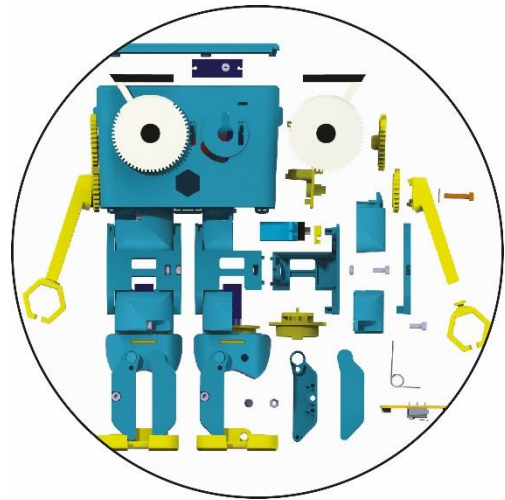
SENSORS

Any real robot needs to interact with the world around it. Industrial robots are used to perform the same movement repeatedly, but these days we expect robots to react to real life situations. Built in sensors for Marty include position and force sensors on each of the 9 motors, acceleration and tilt sensing as well as obstacle sensing and the ability to detect other nearby Martys using Infra-Red.

You could also add extra sensors, such as colour or noise sensors to help Marty navigate a room or respond to different changes in the environment. For more advanced users, it is possible to add a Raspberry Pi computer to Marty, and then attach a camera to detect faces or play football autonomously.

PERSONALITY

Marty has a unique personality that allows for an expressive little robot. Emotion by motion is possible because each "limb" is individually controlled by their specific motor. Marty's friendly face and personality helps young people engage with the activity and reduces barriers for those who may not be as comfortable when engaging with technology. From this, students can then take their first steps into considering robotics and technology as a potential future career.
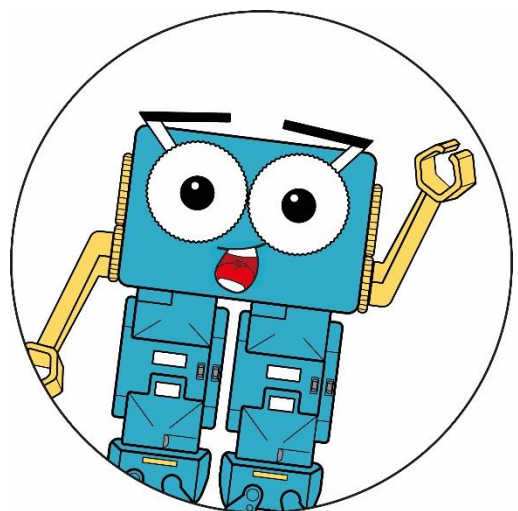
MARTY IN THE CLASSROOM

Marty is an adaptable tool that can be used across primary, secondary and even tertiary education. By sparking the excitement of young people and harnessing their infectious enthusiasm, Marty can support the promotion of STEM learning and engagement. In some schools, computer science is in danger of becoming a mundane functional experience. Marty brings back the excitement of learning about technology through hands-on interactive experiences whilst promoting a learn through play ethos.

PRIMARY SCHOOL

Marty introduces foundation concepts such as sequencing, storytelling and the relationship between instructions and operations. Lessons with Marty at this level supports,

- Identifying patterns in everyday tasks
- Using previous experiences to solve new problems
- Understand, predict and problem solve block-based programming languages
- Understand and communicate using technical languages
- Develop a sequence of instructions to align to a design brief
- Relate programming concepts to everyday tasks and activities

SECONDARY SCHOOL

Challenging students to explore more advanced concepts such as analysis of problem-solving using text-based programming languages used in industry. Lessons with Marty at this level supports,

- Analyse algorithms for correctness and identity faults
- Understand the world through computational thinking
- Design, test and build computing solutions
- Understand data structures and process real world data from sensors
- Evaluate and justify solutions including efficiency of code
- Describe aspects of a real-world computing system and compare to student's own solutions

MARTY: STUDENT RATIO

Typically, we recommend no more than two to three students per Marty. However, there are opportunities for students to work on a one-to-one basis with Marty for personal projects, or larger collaborative groups for class projects.

BUILDING MARTY THE ROBOT WITH STUDENTS

Marty has been designed to teach the whole cycle of engineering and technology from designing a product, to building and programming it. By building Marty, students can get to grips with what parts are needed to create a walking robot like Marty. Following our simple build guide allows students to develop skills like problem solving and hand-eye coordination.

Our Marty the Robot Build Guide illustrates all the steps to build a Marty. We offer 2 variations of Marty for you to build: Partly Assembled Kit, or Robot Kit. We suggest that you assemble all the separate component parts and then put them together to finish the build, starting with the Legs, progressing to the Arms and then onto the Head (if you have a Partly-Assembled Kit, the legs will arrive assembled). Once the subassemblies have been built, they can be assembled together to complete the build.

It is possible to build Marty in groups as the three subassembly sections above can all be constructed in parallel. As a guide, please use the below tables to illustrate how the robot build can be divided between groups of students.

Robot Kit

Assembly Step	Build Steps	Individual	Group of 2		Group of 3		
		Student 1	Student 1	Student 2	Student 1	Student 2	Student 3
Leg 1	1-17	X	X		X		
Leg 2	1-17	X		X		X	
Arm 1	18-21	X	X				X
Arm 2	18-21	X		X			X
Head Base	22-25	X	X				X
Final Assembly	26-32	X		X			X

Partly-Assembled Kit

Assembly Step	Build Steps	Individual	Group of 2		Group of 3		
		Student 1	Student 1	Student 2	Student 1	Student 2	Student 3
Arm 1	18-21	X	X		X		
Arm 2	18-21	X		X		X	
Head Base	22-25	X	X				X
Final Assembly	26-32	X		X			X

STORING YOUR MARTY SET

- Marty's original packaging can be repurposed as a safe storage continer. The ridgid cardboard acts to keep Marty safe and secure whilst also being stackable and compact.
- For those that require easy Marty transport between classrooms we suggest a wheeled trolley (not supplied). This can allow for a quick and organised set up in a variety of different classroom settings.

HEALTH & SAFETY

We have put Marty through rigorous safety testing. Please read the following points to help you use Marty safely in the classroom environment,

- Marty is not a toy
- Marty contains small parts which may present a choking hazard
- Do not expose Marty to extreme heat or naked flame
- Avoid excessive physical shock or vibration
- Do not immerse Marty of any of Marty's components in water and do not use in an environment where there is a possibility of Marty getting wet
- Never leave Marty charging unattended – Marty should not be charged for more than 24 hours
- Only use Marty with the supplied rechargeable battery
- Do not disassemble, deform, puncture, short circuit, modify in any way or heat the battery as improper use can result in fire
- Stop using and disconnect the battery immediately if the battery begins to bulge or becomes too hot
- Batteries must be charged with the supplied charger only – never use a modified or damaged charger
- The charging cable is not a toy
- Connect charging cables to a USB 5v DC supply
- If connecting to a transformer, only use with a transformer for toys – the transformer is not a toy
- Do not clean Marty with liquid

CODING WITH MARTY

APP CONTROL TO GET STARTED

If you're looking to start developing computational thinkers but your students are not quite ready to use Scratch, consider using the built-in remote control in our mobile app. With inquiry-based learning at the forefront, students can begin to explore the different kinds of movement that Marty is capable of.

For example, make numeracy exciting by challenging students to guess how many steps it will take Marty to walk from A to B and use the remote control to count together and find out.

You can find our app on the Google Play Store or Apple App Store under **Marty the Robot**

GET STARTED WITH SCRATCH

Scratch is the best place to start for a friendly introduction if your new to programming. It focuses on blocks of code that you can drag, drop and click together to build a program. Combining these blocks, students can build basic to complex programs to bring their Marty to life. Scratch has been designed to help people take those first steps into programming by teaching basic sequencing and thinking of programming as a list of basic instructions.

We have developed a Scratch extension that can be used specifically for Marty. You can access this either through the *Marty the Robot App* or through our *Marty Users section of the MartytheRobot.com website.*

DEVELOPING WITH PYTHON

After building confidence with Scratch, the next step for students is to make the move to text-based programming. Python is used around the world by industry and is the perfect next step for students. You can program Marty in Python using a library that we have developed called *martypy*. Libraries are collections of code that we have written for you to get the complicated things out of the way, making it easier to use and work with.

For example, *martypy* contains definitions for the *walk* function, which can be used to make Marty walk. Using our *martypy* library, you can gently introduce students to programming with Python without having to start with the more complicated parts, focusing on building their knowledge of programming and robotics.

For more information on how to get started with Python and *martypy*, go to *Marty Users on the MartytheRobot.com website* and select *Python* to view our tutorial and documentation.
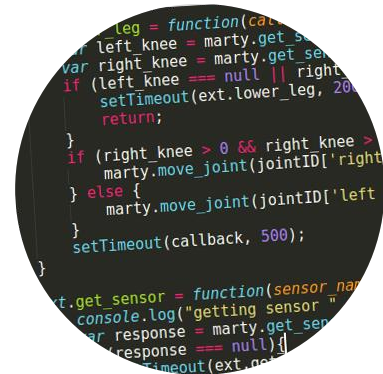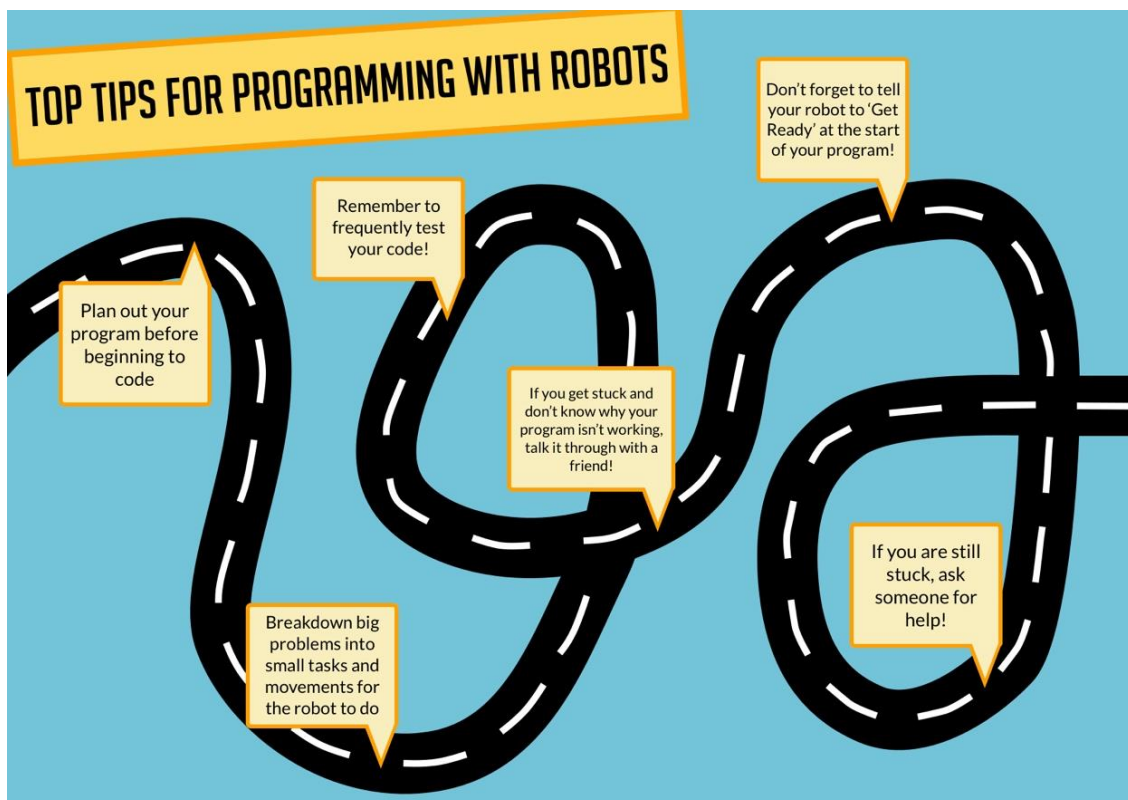
FURTHER WAYS TO CODE

Take your learning with Marty even further and challenge yourself to build a fully autonomous robot using ROS (Robot Operating System) by adding in a Raspberry Pi (a small in-expensive computer) and a camera. This gives Marty vision and lets you code your robot to play football completely by itself. ROS is a real robotics tool used in academia and industry, on some of the most advanced robots in the world.

For more information on using a Raspberry Pi with ROS and a guide to getting started, check our online guide on *the MartytheRobot.com website.*

We believe in the power of keeping our platform open so you can also code Marty using, **JavaScript** & **C++**

TOP TIPS FOR PROGRAMMING WITH ROBOTS

Don't forget to tell your robot to 'Get Ready' at the start of your program!

Remember to frequently test your code!

Plan out your program before beginning to code

If you get stuck and don't know why your program isn't working, talk it through with a friend!

If you are still stuck, ask someone for help!

Breakdown big problems into small tasks and movements for the robot to do

LESSON PLANS & RESOURCES

Built with educators in mind, our freely available resources help you to create a hands-on environment. Students can develop their problem-solving skills and creative thinking, whilst learning important concepts across the curriculum from computational thinking to robotics, numeracy, physics, and more.

Our online resources are there to support you with new and exciting cross-curricular ideas on different projects you can undertake with your students. We include the following in each of our lesson packs,

Lesson Plans
Outcomes, Resources & Learning Plans

Teacher Guides
Prompts & Questions for Delivery of Lessons

Curriculum Links
Support with Benchmarks & Frameworks

Solutions
Samples Solutions & Activity Guidelines

Powerpoint Notes
Slide Notes to Deliver our PowerPoints

All of our online lesson resources detail benchmarks and outcomes for a variety of curricula from around the world. If you are unsure how our materials map to your region's curriculum, *get in touch* and we will be happy to help where we can.

By providing you with all the learning resources that are needed to carry out a lesson, including presentation slides, sample solutions and student workbooks, you can focus on using what you need when you need it.

LEARNING & PROGRESSION

Marty the Robot has been developed to support student progression. Beginners can program Marty to carry out simple sequences of instructions and react to simple inputs. Intermediate learners can start to use real text-based programming languages and build more complex algorithms. Finally, advanced learners can use real-world robotics tools like ROS to explore building autonomous robots.

LEARNING WITH MARTY

The value of learning through play is evidenced by the freedom students have to create projects that are meaningful to them. These environments allow students to approach the task with care and interest, resulting in a deeper connection with the task and area of study, encouraging students to consider and pursue their interests further in the subject.

LEARNING THROUGH REFLECTION

At the end of each lesson, ask students to reflect (individually or as a class) on the work they completed today. Reflecting on what has been learned and what areas students feel are required for development empowers students to become involved in their personal progress. The following questions might help start a discussion,

- What problems did you encounter and how did you solve them?
- What areas do you want to improve on next time?
- What is one thing you learned today?
- What is one thing you enjoyed about today's lesson?
- What challenges might you face in the next lesson?

EXPANDING MARTY

We have already mentioned next steps for advancing student progression in terms of programming. However, there are different ways to extend Marty physically.

- Attach different sensors from our extension pack such as colour, noise, or light sensors
- Explore manufacturing and 3D design and printing by creating your own new accessory or body part for Marty. We have made all of the current plastic body parts *available to download* so you don't have to start from scratch when customising.

LEARNING PROGRESSION

Hardware Skills	Software Skills	Software Progression	Age
• Explore mechanisms	• Use logical reasoning to predict program behaviours • Explore and comment on logical processes using computational thinking	• Marty the Robot App Controller • Scratch	4-8 years
• Recognise materials • Discuss and create engineering solutions • Explore sensors	• Explain programming concepts using technical terms • Create computing solutions in response to a design brief • Identify errors and debug		8-11 years
• Design and construct assemblies • Explore and explain engineering design solutions • Understand and suggest sustainability improvements	• Select appropriate tools to fulfil a selected design solution • Understand the fundamentals of hardware and software communication	• Python • JavaScript	11-14 years
• Discuss engineering principles and their impact • Analyse material performance • Understand and create electronic circuits	• Compare algorithms for correctness and efficiency • Select the appropriate tool to fulfil a high-level computing solution with justification	• C++ • ROS (Robotic Operating System)	14-18 years
• Understand robotic principles and standards • Kinematics	• Use ROS and other advanced tools • Advanced algorithms and data processing – image processing, speech, etc.		18+

GROWING OUTSIDE OF THE CLASSROOM

If you or your students would like to learn more about programming, we recommend the following sites to find specialist tutorials. Each of these sites offers open-source learning for whoever requires them – no matter the age or development stage.

Scratch
scratch.mit.edu

Raspberry Pi
raspberrypi.org

Python
wiki.python.org/moin
trinket.io

JavaScript
javascript.info
codeacademy.com

ROS
wiki.ros.org

C++
cplusplus.com

CONNECTING EDUCATION TO COMMUNITY

As an open-source education tool, Marty has gathered a healthy community following. This community consists of makers and educators who are actively contributing to additional content. The result is a wide network of challenges and activities that can be shaped for the classroom.

If you would like to join our online Facebook Edu Community Group, please use the link below or search for the group name:

Group Name: *Robotical's Edu Community*

Group Link: *www.facebook.com/robotical/groups*

GET IN TOUCH

Education
Finlay@robotical.io

Distribution & Partnerships
Myles@robotical.io

School Sales
Ben@robotical.io

Support
robotical.io/support

For updates and more educational resources go to
Martytherobot.com

FAQ'S

WHICH OF MY CLASSES CAN I USE WITH MARTY?
Marty can be used from early primary school up to university level with the right resources and activities. For students making their first step into programming and engineering, we recommend using the block-based language Scratch before moving onto text-based languages like Python.

WHERE CAN I FIND LESSON PLANS AND MATERIALS TO HELP ME TO GET STARTED WITH MARTY IN THE CLASSROOM?
We have lots of freely available resources on our website to give you plenty of exciting and new ideas for activities to do with your Marty. From lesson plans to student workbooks and classroom printouts – we got you covered!

WHAT DEVICES CAN I USE WITH MARTY AT SCHOOL?
Marty can be connected to lots of devices in a variety of ways, however we recommend you use a Bluetooth enabled device for the most straightforward experience, be that your tablet, laptop, or desktop. If you no not have Bluetooth enabled devices available to you, please get in touch with Robotical support who can help you find the best solution for your situation.

WHAT PROGRAMMING LANGUAGES CAN MARTY BE USED WITH?
We believe in the power of keeping things open, so you can use a variety of different programming languages with Marty. For a friendly introduction to programming, we recommend using Scratch where students drag, drop and click together blocks of instructions. Moving on from there, students can start to use Python, a popular language used in industry. JavaScript can also be used for developing a webpage to communicate with Marty. For our move advanced users, we offer C++ and ROS to explore robotics in more depth.

HOW CAN I BUY MARTY?
Marty can be purchased through several different channels, including our website, education distributers and through a Robotical sales representative. The easiest way to find the best purchasing channel for you is to get in touch with our sales team - *sales@robotical.io*.

WHAT SUPPORT IS AVAILABLE?
If you come across any problems or have a question about Marty, then please get in touch. Drop us a message from our website or straight to *hello@robotical.io* and a member of the team will get back to you ASAP. If you are looking for additional support using Marty in the classroom then get in touch with our schools team who can talk you through options for organising classroom workshops and teacher training tailored for your school.

HOW MANY STUDENTS PER MARTY SHOULD I HAVE?
We recommend having between 2-3 students per Marty although this will depend on the activity that you are running.
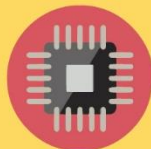
For
KIDS, MAKERS &
EDUCATORS

See Marty in action at robotical.io

Smart	Educational	Expandable	Programmable	Interactive