matata studio

ADVANCED
Teacher Manual

AI, Coding and Robotics

with Nous AI Set

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The Artificial Intelligence Education form MatataStudio

Founded in July 2017, MatataStudio (from MATATALAB) is striving to provide innovative learning and entertainment experiences through technology, and empowers children with the skills, mindset, and confidence to excel in arapidly evolving world.

MatataStudio is a platform full of fun, excitement, and as an educator, potential. Throughout these 12 lessons you will see how robotics can be used to teach your students AI in ways that are sure to inspire. The students will experience a variety of artificial intelligence technologies and functions, including machine learning, neural networks, machine vision, speech recognition, image recognition, ChatGPT, AIGC, and Autonomous driving capabilities. Besides, they will also learn and apply the 4 steps of Machine Learning: model creations, data acquisition, model deployment, and programming.

We iterate by making mistakes, evaluating them, revising our plans, and trying again. We continue to do that until we get it right. The value of this process cannot be understated. Iteration is not just how we learn to code, but how we learn.

This constant state of failure and improvement though does not have to be painful. By using the robot, you can turn errors into opportunities for students to see not a mistake but a chance to try again. They will learn from these moments and savor their successes. Also critical in this learning is what educators call "21st Century Skills". These are a core set of competencies educators believe modern students are going to need to have more than anything. They include Teamwork, Collaboration, Creativity, Imagination, Critical Thinking, and Problem Solving. The near future is fraught with complex issues that the current generation of students are going to have to resolve. The future also is likely to be filled with countless opportunities to, literally, do things that are out of this world.

How to Use this Book!

Welcome! We've worked incredibly hard to make this book not only fun to read but easy to follow and understand. If you've written or delivered a lesson plan before, none of the sections of this guide should be unfamiliar to you. Each lesson has four or five sections:

Identify the Problem, Guided Practice, Independent Practice, (Extended Practice) and Wrap Up. By working this way, students are engaged right at the start with a fun conversation to prepare them for what is to come. Guided Practice gives you the opportunity to demonstrate a skill or technique you will be using in this lesson. Independent Practice is when we expect your students to take what they have observed and discussed and do it on their own. Finally, in Wrap Up, we summarize the learning experience, talk about successes and challenges, and what might be next in the learning process.

In each lesson, we will lists the "AI Issue" and "AI VOCA" for you and your students to get familiar with some AI concepts, and improve the digital literacy. In the back of the book, we've aligned each lesson to 5 Big Ideas in AI, ISTE and CSTA. We've also provided for you some great videos and resources you can use along the way. We hope you love these lessons as much as we do, and we can't wait to see all the great work you do!

01 Hello Nous!

ISSUE: Modular, electronic components, structural parts, robot construction
CORE IDEA: None
BASIC LESSON
Difficulty: ★★ Duration: 60 min
Data: None
Required Items: Nous Hub, Nous Camera Module, 2 Nous Servo Modules, and the parts to build a Nous Robot

Nous is a modular artificial intelligence educational set that supports a variety of artificial intelligence technologies and functions. In this lesson, we will first understand the electronic modules and structural components of Nous, and then use them to build the main form of the Nous Robot. Finally, students will experience the Nous Hub's preset functions.

1. Identify a Problem (5min)
2. Guided Practice (25min)
   - Study electronic modules for the Nous
   - Study structural components of Nous
3. Independent Practice (20min)
   - Build the Nous Robot per the construction manual
4. Wrap-up (10min)
   - Explore the Nous Hub's preset functions

Learning outcomes:

TSWBAT: the students will be able to

- Understand the Nous' characteristics.
- Learn the electronic modules for the Nous AI Set: Nous Hub, Nous Camera Module, Nous Servo Module.
- Become familiar with the structural components of the Nous AI Set and be able to build a Nous Robot per the construction manual.
- Explore the Nous' preset functions, such as MatataChat, human face detection, etc., and learn about some basic AI functions.

Identify a problem

5 min

The Nous AI Set is a modular artificial intelligence educational set. In addition to basic robot programming control, it supports a variety of artificial intelligence technologies and functions, including machine learning, neural networks, machine vision, speech recognition, ChatGPT, AIGC, and Autonomous driving capabilities. Additionally, it also supports data collection, AI model training and deployment, as well as graphical programming and Python programming. The robot is designed with a metal structure that is also compatible with building block structures and features an expandable electronic module system. Here, we first watch a Nous case video collection to experience the main functions of Nous.https://youtu.be/-MhDVfrA3HQ

Nous consists of two parts: hardware and software. The hardware includes the electronic modules, structural components, etc. that we see out of the box, and the software is MatataCode, a programming platform specifically designed to control Nous. In this lesson, we will first understand Nous' hardware part.

As mentioned, the Nous AI Set is a modular set. Various robot forms can be built from these electronic modules and structural components. In this lesson, we will first learn the modules and components, and then use them to build the Nous Robot.

Guided Practice

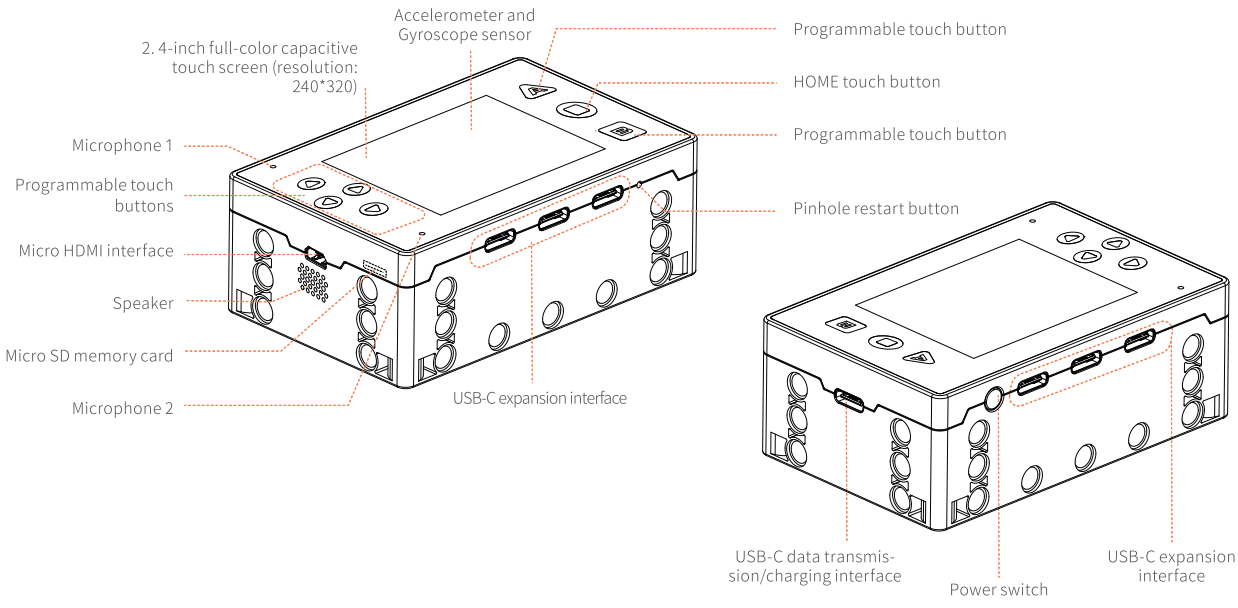
25 min

In this chapter, the teacher will lead students to become familiar with the electronic modules and structural components of Nous.

1. Study electronic modules of Nous

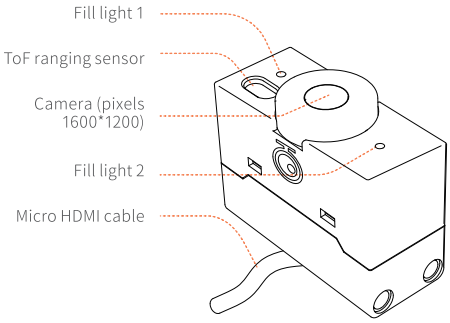
- Nous Hub

Nous Hub is the core of the Nous and acts as the Nous's brain. As shown in the picture, in the front, there is a 320 x 240,2.4-inch full-color capacitive touch screen, 6 programmable touch buttons on both sides of the touch screen, including "up, down, left, right" and "A, B", as well as a "Home" touch button. In addition, Nous Hub also contains two microphones, a speaker, 6 type-C expansion ports, a data transmission interface to connect Nous Camera to Nous Hub, and a data transmission interface to connect Nous Hub to MatataCode/computer devices (both interfaces can be used to charge Nous Hub). Of course, we can also see the orange switch button in the upper right corner, and the pinhole reset button in the lower right corner of Nous Hub. Additionally, there is a gyroscope inside Nous Hub which can't be seen.



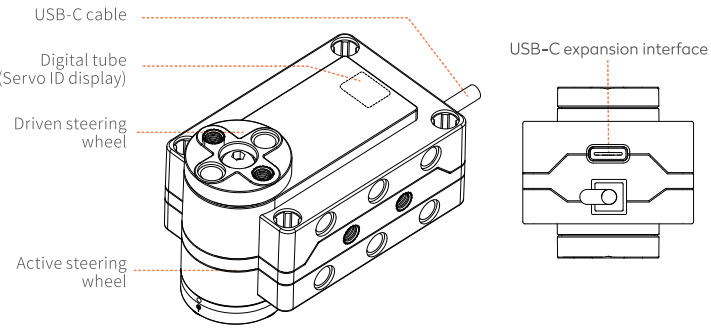
- Nous Camera Module

Nous Camera is the Nous' eyes. As shown in the picture, in addition to the camera, we can also see two camera fill lights and a ToF (Time of Flight) ranging sensor.



- Nous Servo Module

Nous Servo Module has motor mode and servo mode, which can meet a variety of usage scenarios.



2. Study structural components of Nous

The list of Nous structural parts is as follows. We can see that it mainly includes: double-hole beams, square-hole beams, connecting pieces, brackets, tires, plastic sleeves, screws, etc.

Structural Components of Nous

Name	Picture	Qty
camera bracket		1
3×3 L-shaped bracket		5
1×4 square hole beam		2
2×2 double hole beam		1
2×3 double hole beam		2
2×4 double hole beam		1
2×5 double hole beam		2
2×6 double hole beam		2

Name	Picture	Qty
universal wheel		1
transmission fixed plate		2
Ø4-60mm axis		1
Ø7-2mm plastic sleeve		6
Ø7-4mm plastic sleeve		6
Ø7-8mm plastic sleeve		6
Ø7-10mm plastic sleeve		4
M4-6mm screw		14

135° single head connecting piece		2
3×6 connecting piece		1
Ø68mm tire		2
Ø58mm wheel hub		2

M4-12mm screw		30
M4-16mm screw		14
M4-20mm screw		4
M4 nut		6

Independent Practice

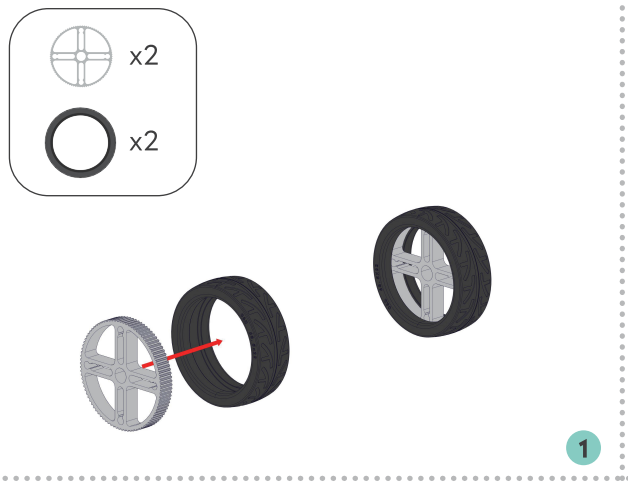
20 min

Students independently build Nous Robot, the main form of Nous, according to the construction steps.

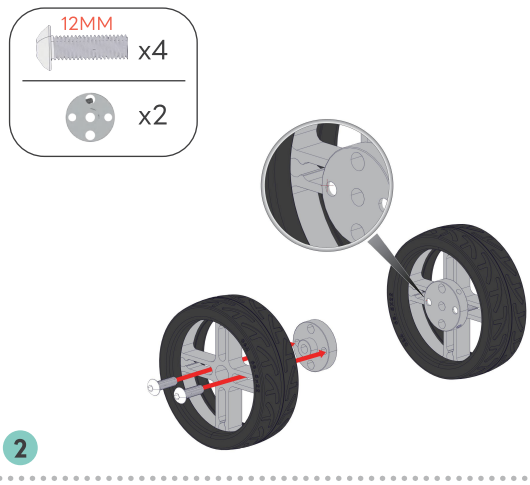
Parts List for Nous Robot

Name	Picture	Qty	Name	Picture	Qty
Nous Hub		1	universal wheel		1
Nous servo module		2	transmission fixed plate		2
Nous camera module		1	Ø7-2mm plastic sleeve		2
			Ø7-4mm plastic sleeve		4

3×3 L-shaped bracket		1	Ø7-10mm plastic sleeve		2
2×2 double hole beam		1	M4-6mm screw		4
2×4 double hole beam		1	M4-12mm screw		12
2×6 double hole beam		1	M4-16mm screw		10
3×6 connecting piece		1	Ø68mm tire		2
			Ø58mm wheel hub		2



1



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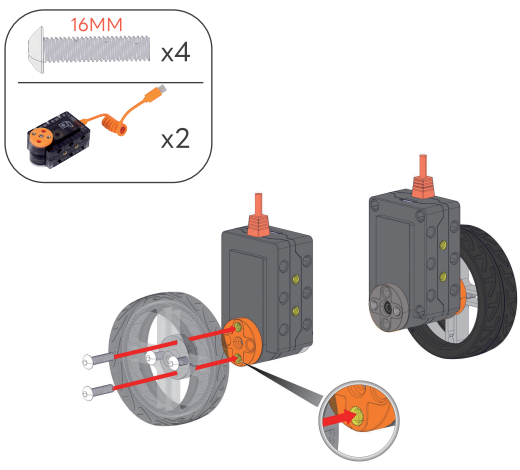

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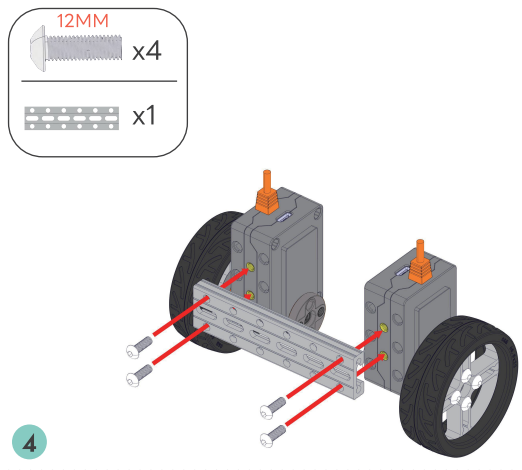
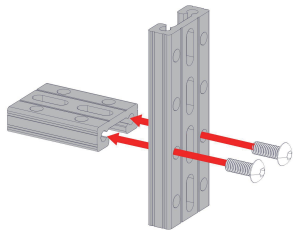


4

12MM x2

x1

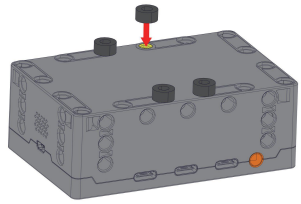
x1



5

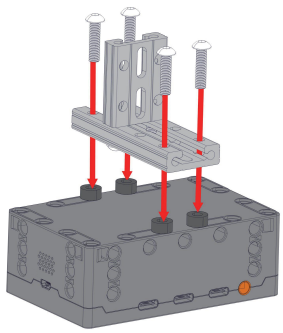
4MM x4

x1



6

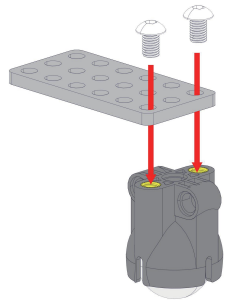
16MM x4



7

6MM x2

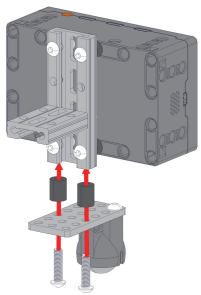
x1 x1



8

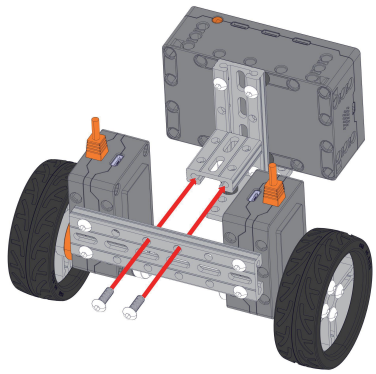
16MM x2

10MM x2



9

12MM x2



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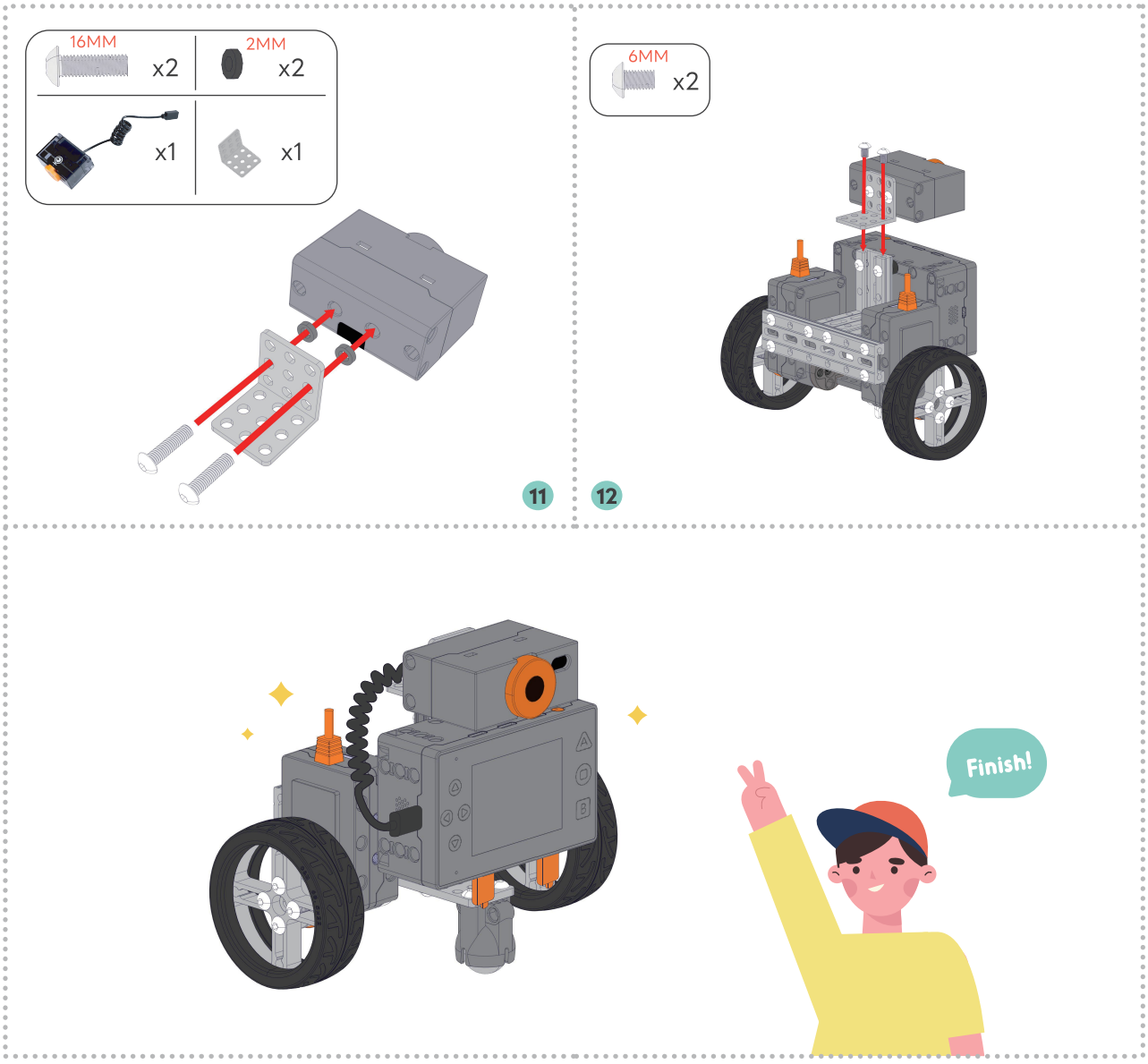


Wrap-up

10 min

Students can freely explore the Nous Hub's preset functions, especially the AI functions such as MatataChat, facial recognition, and AprilTag recognition. Here, facial recognition and AprilTag recognition are just simple recognitions. We can see the positioning box that appears on the screen during recognition. In the next lesson, we will program and experience these functions more intuitively. In the following learning process, we will use these AI functions to complete more complex AI projects such as facial tracking and autonomous driving.

02
Basic Coding for Nous

ISSUE: Coding Platform,MatataCode
CORE IDEA: Perception
BASIC LESSON
Difficulty: ★★ Duration: 90 min
Data: None
Required Items: Nous Robot,PC or Pad,USB cable, AprilTag cards

Nous' programming platform, MatataCode, supports both graphical programming and Python programming. In addition to basic programming, it also supports AI functions such as computer vision, embedded machine learning (Tiny ML), etc. In this lesson, we will first become familiar with the functions of MatataCode, study the firmware upgrade, learn about connection, and program downloads. Then, try to write simple programs for Nous using graphical programming language and run these programs.

1. Identify a problem (5 min)
2. Guided Practice (30 min)
   - Overview of programming platform features
   - Firmware upgrade
   - Connect and download programs
   - Become familiar with the types of the programming coding blocks
3. Independent Practice (50 min)
   - Write simple programs for Nous Robot
4. Wrap-up (5 min)

Learning outcomes:

TSWBAT: the students will be able to

- Understand the Nous programming platform, master the major functionality and the role of each function.
- Learn how to upgrade the firmware.
- Get familiar with the graphical programming coding blocks, especially visual and screen coding blocks.
- Be able to write simple programs for Nous Robot and run these programs.

AI VOCA

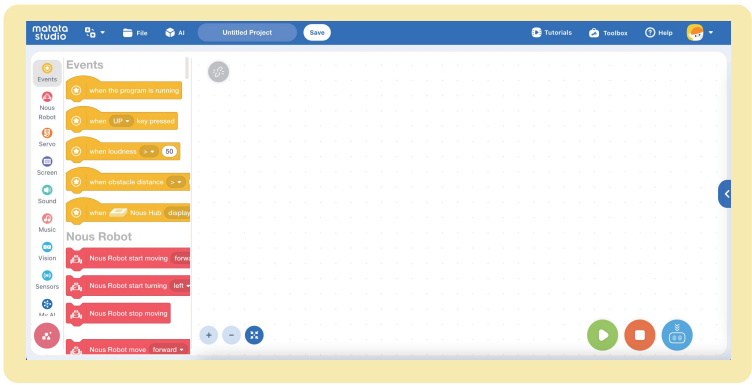
- Perception: Nous can "see" image information.
- Natural Interaction: Nous Robot can realize facial recognition, AprilTag recognition, and other AI functions to interact with people.

Identify a problem

5 min

In the last class, we learned about the hardware part of Nous and built Nous Robot. In this lesson, we'll get familiar with the programming platform of Nous, MatataCode. Master the connection method between Nous and MatataCode, try to use graphical programming language to write simple programs for Nous, and run these programs.

MatataCode App



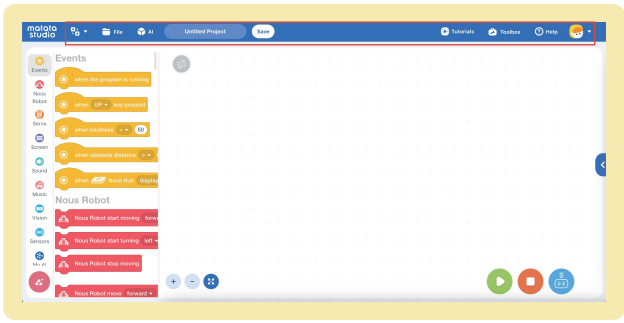
Guided Practice

30 min

In this chapter, the teacher will lead students to become familiar with the Nous' programming platform, MatataCode, and master how to use MatataCode to program Nous. Nous' programming platform, MatataCode, has a website version and APP version. The URL of the web version is https://nous.matatastudio.com/. After entering the website, we can download the APP version from the application download in the "Toolbox".

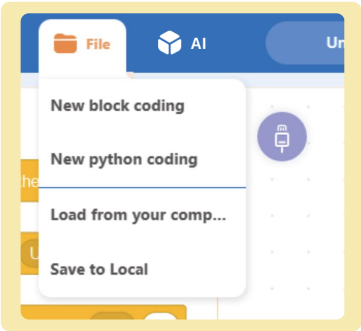
1. Overview of MatataCode's functions.

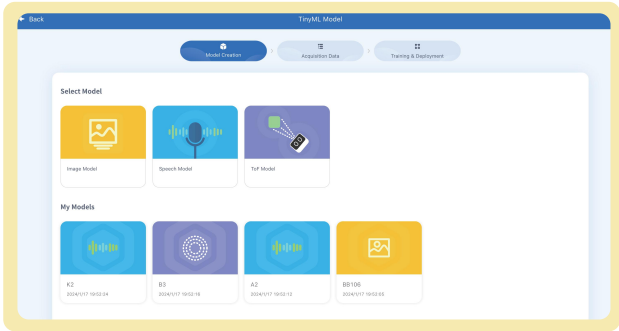
When we open the Nous programming platform, we can see a page as shown below. The menu bar above the page contains "language", "file", "AI", a place to change the file name, "save", "tutorials", "toolbox" and "my account".

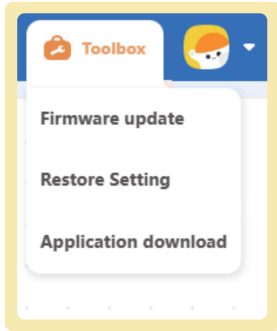


Among them, you need to pay attention to the following toolbars: "File" contains four functions: new block coding, new Python coding, load from your computer(mc format program), and save to the local (mc format program); Press "AI" and you will see the drop-down menu which includes "Tiny ML model". It is the entrance to create embedded machine learning models, which we will explain later; "Tutorials" is the entrance to cases; "Toolbox" has three functions: firmware upgrade, restore setting, and application download.

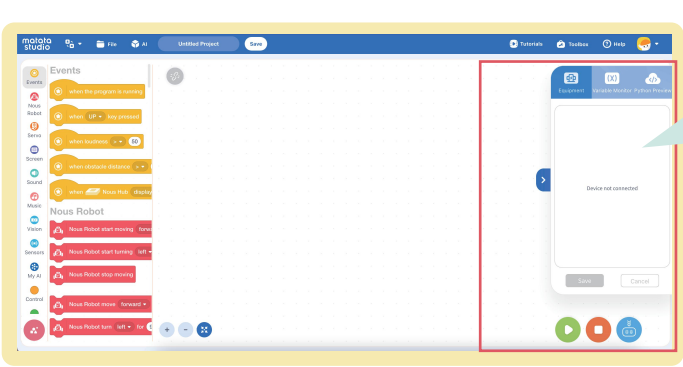
In addition, after registering an account in the "My Account", we can save personally written programs into our own online account for easy recall anytime and anywhere. When registering an account, to ensure network security, we need to set an appropriate account name and password.





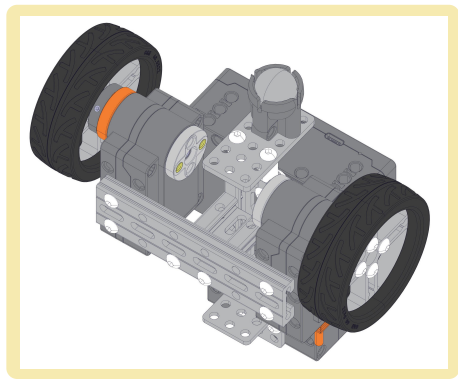


On the right side of the page, there are mainly three functions: equipment, variable monitor, and Python preview. The equipment is mainly used to modify the ID number of the servo. In the variable monitor, you can mainly see the variables or lists used in programming. The Python preview function can help us become familiar with the corresponding Python text program that will be used after completing the graphical programming.

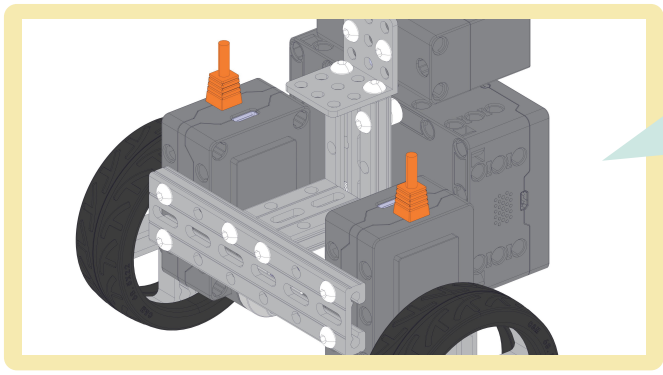


Here you need to pay special attention to how to modify the servo ID.

Nous Robot uses the rotation of two Nous servos to rotate the wheels, and then cooperates with a universal wheel to control the Nous Robot's forward, backward, left and right turns. Nous servo should have its own ID. During programming, the rotation speed and direction of the servo and tires can be controlled by the corresponding ID, allowing the robot to move freely in different directions.

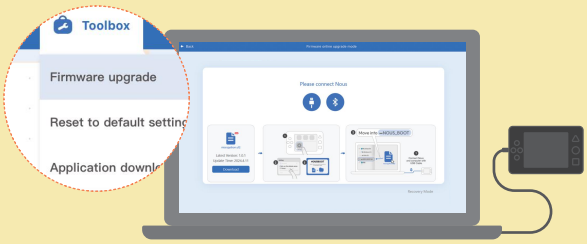


After turning on the Nous Robot, you can see the corresponding ID on the inside of each Nous servo. The IDs of the two servos maybe the same or they maybe different. Note that when two servos have the same ID, only one ID will appear in "equipment". Now, you first need to disconnect one Nous servo, change the ID of the connected Nous servo to a different ID, and then connect the other servo for modifications.

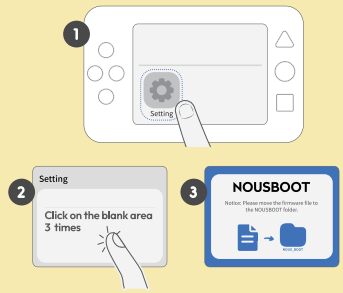


2. Learn how to upgrade the firmware.

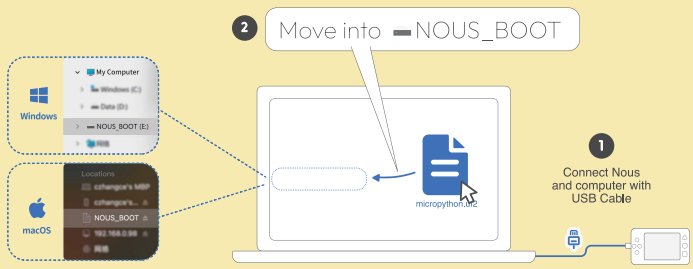
Log in to nous.matatastudio.com and connect Nous Hub to MatataCode. Select Toolbox-Firmware Upgrade to check if Nous Hub has latest version firmware. If not, download latest version firmware.
connection between Nous Hub and computer device. If fails, log in to Help Center at nous.matatastudio.com for detailed guidance.



Enter the Nous Hub system operation interface, select Settings,Click on the blank area 3 times to call up firmware upgrades and professional development tools.



After connecting Nous Hub to my computer via USB-C cable, 'NOUS_BOOT' disk appears. Drag the latest version downloaded firmware into disk, and Nous Hub will automatically update firmware and restart.



During upgrade process, don't interrupt connection between Nous Hub and computer device. If fails, log in to Help Center at nous.matata-studio.com for detailed guidance.

3. Learn how to connect Nous to MatataCode, and how to run the program.

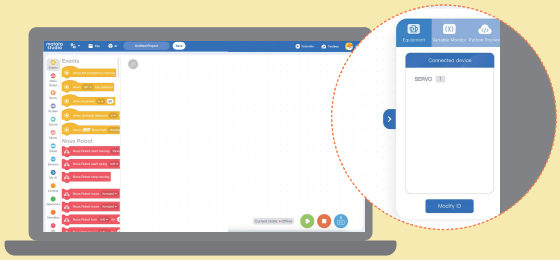
Log in to the web programming platform:
https://nous.matatastudio.com

Select the USB data cable (USB-C) or Bluetooth connection method to connect the Nous Hub to your device.

It is recommended to use USB data cable connection to ensure efficient and stable data transmission

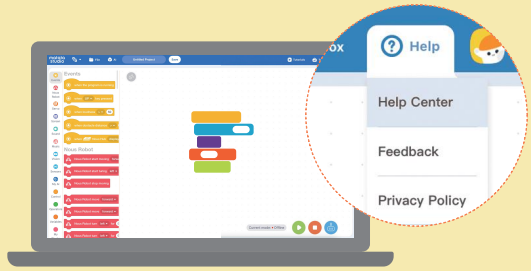
③ After the connection is success-ful, your device will automatically pop up a prompt.

When the USB-C expansion interface of the Nous Hub is connected to the servo module, you can view and modify the servo's ID address in the device management.



*Note: The factory default ID addresses of the two servos configured by Nous have been set to 1&2.

Create your own program.Use building blocks to create your own program code.



*Note: For more instructions on how to use Nous,please click the Help Center in the navigation bar.

Quickly switch program & delete program

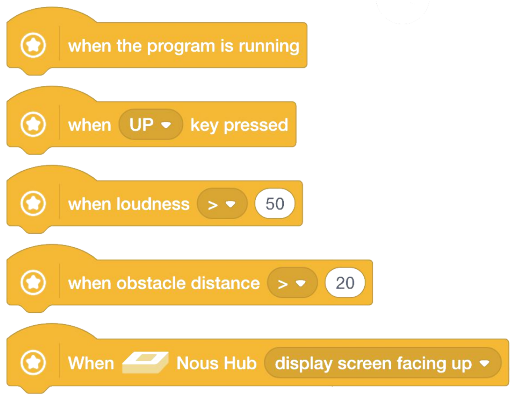
●Nous supports storing multiple programs. When you want to switch from the currently running program to another program, you can long press the Home button to exit and select the corresponding program;

●When you want to delete a personally created program, you can long press the corresponding program icon, and the system will prompt you to confirm whether you want to delete it. Just select to confirm the deletion.

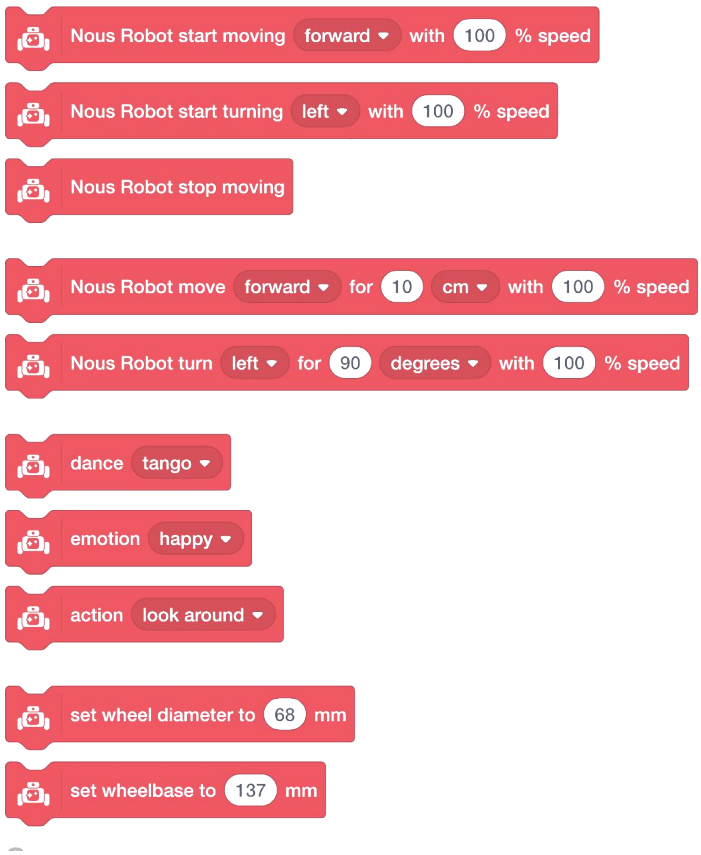
Download the program to your Nous Hub. Click the download program icon to download the created program to the Nous Hub. At this time, you can see the program you just created in the Nous Hub operation interface. Click to run.

4. Get familiar with the graphical programming coding blocks, especially visual and screen coding blocks.

Events

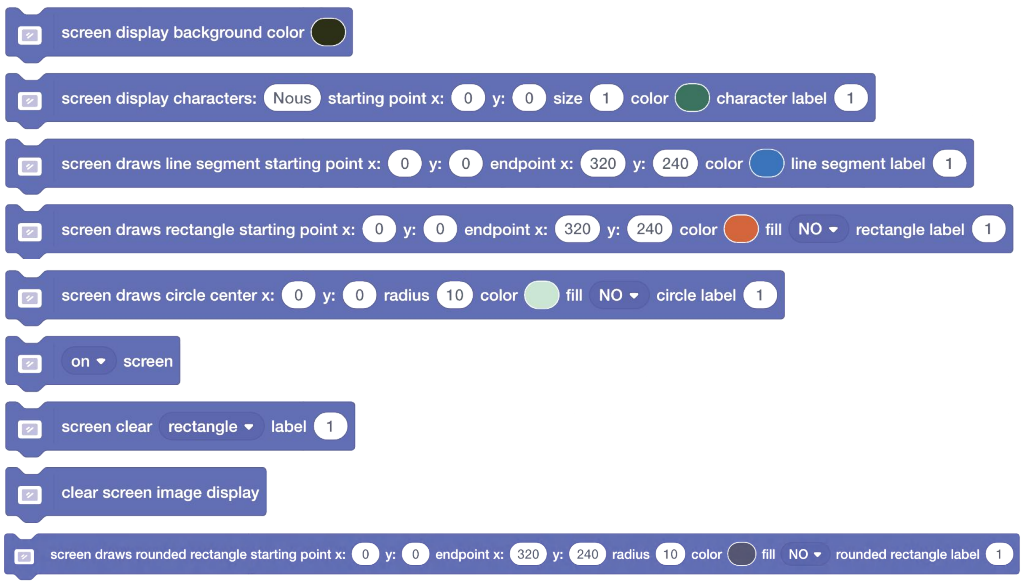


Nous Robot

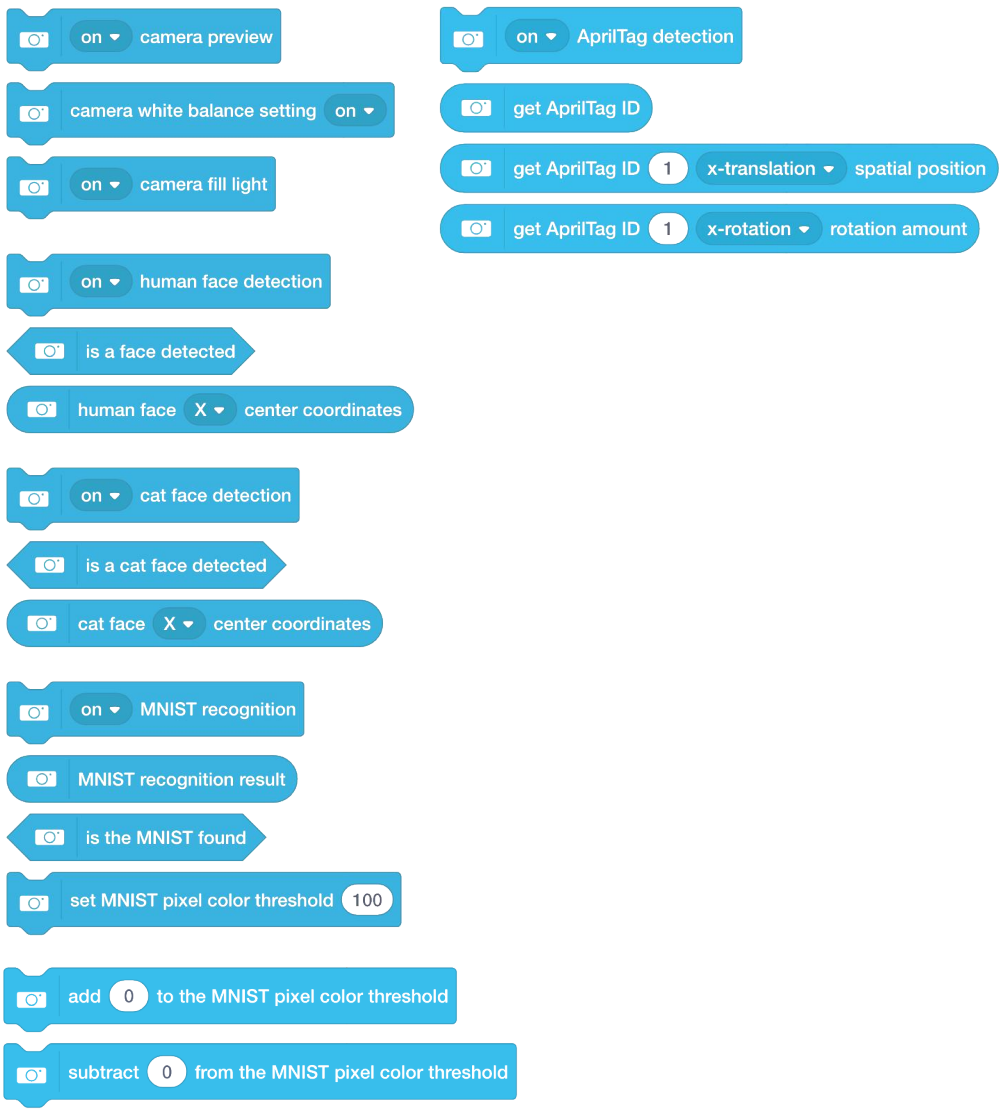


Servo

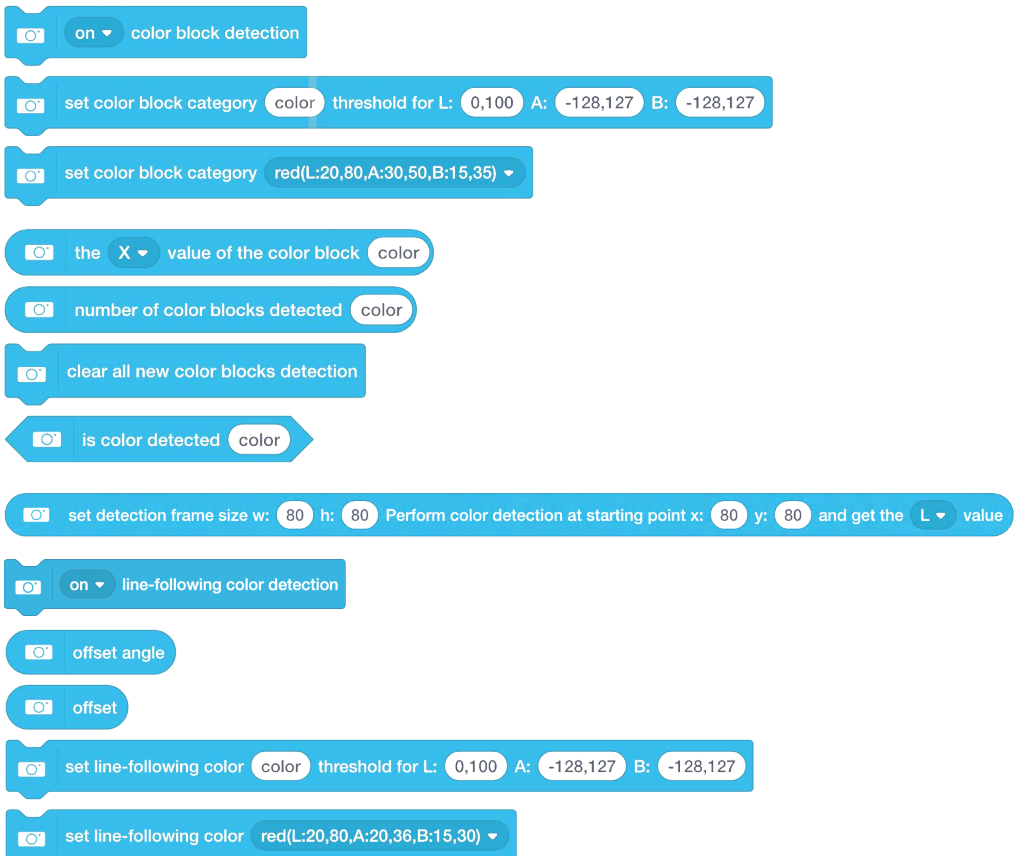
Screen



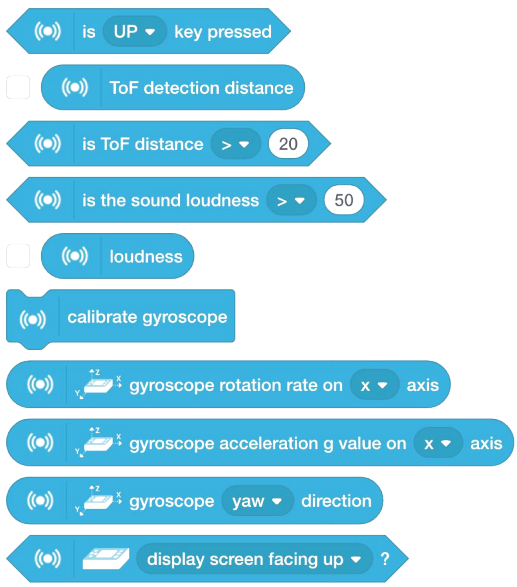
Vision



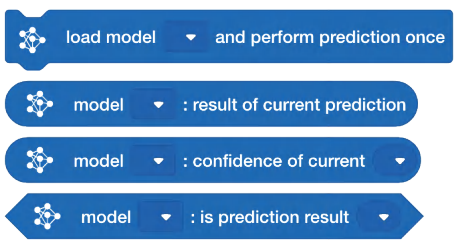
Vision



Sensors



My AI



Independent Practice

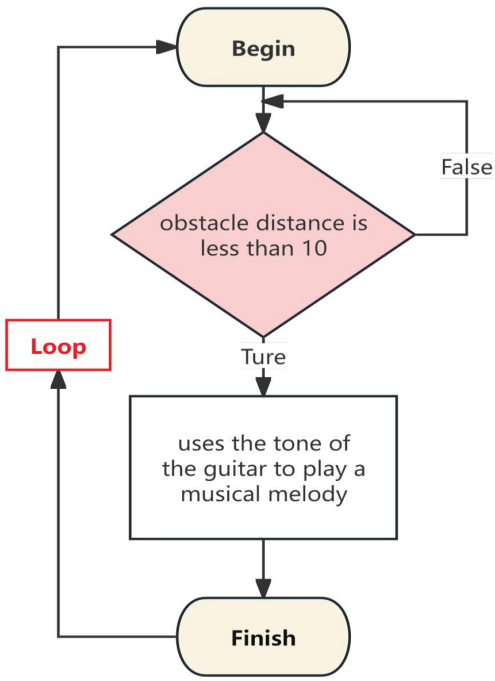
50 min

Now that we are familiar with the Nous programming platform, let's program the Nous Robot.

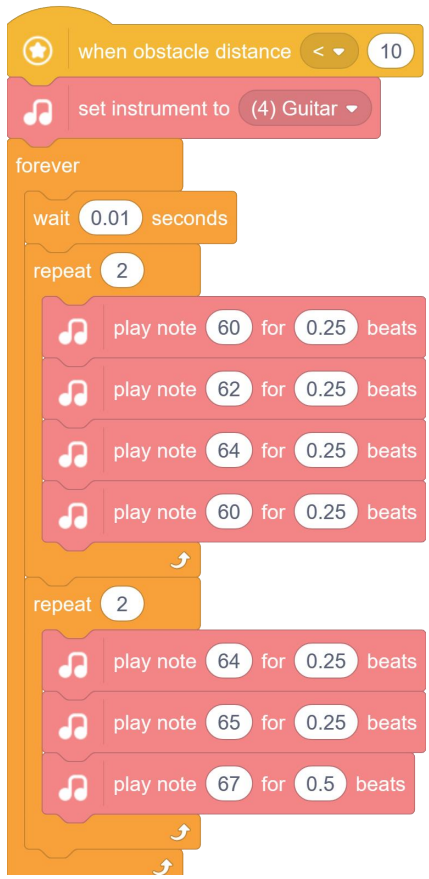
There are 6 programming tasks lised on the worksheet. Students write programs for Nous and run these programs according to the task requirements.

Task 1 Nous is a musician

When the obstacle distance is less than 10, Nous uses the tone of the guitar to play a musical melody, such as "Are You Sleeping?".

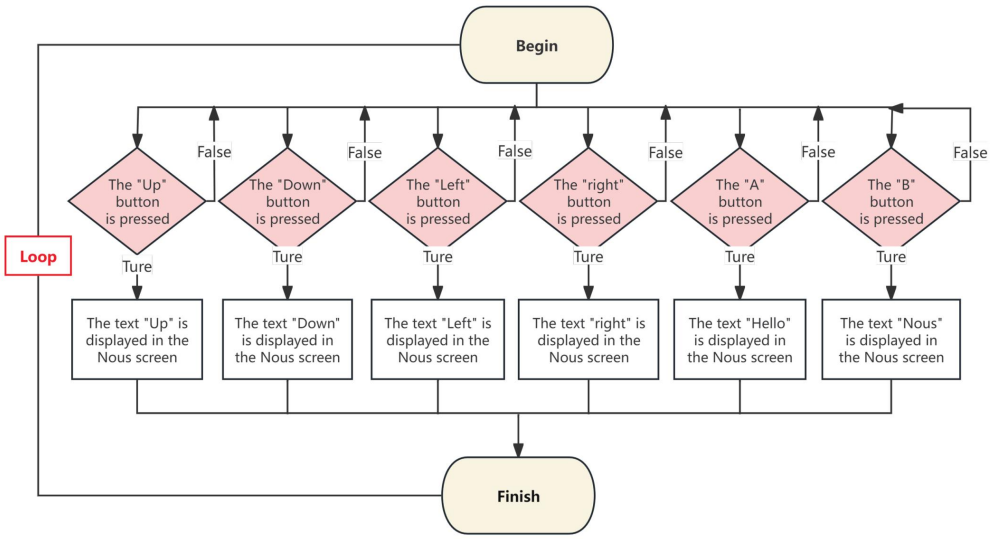


Demo Program

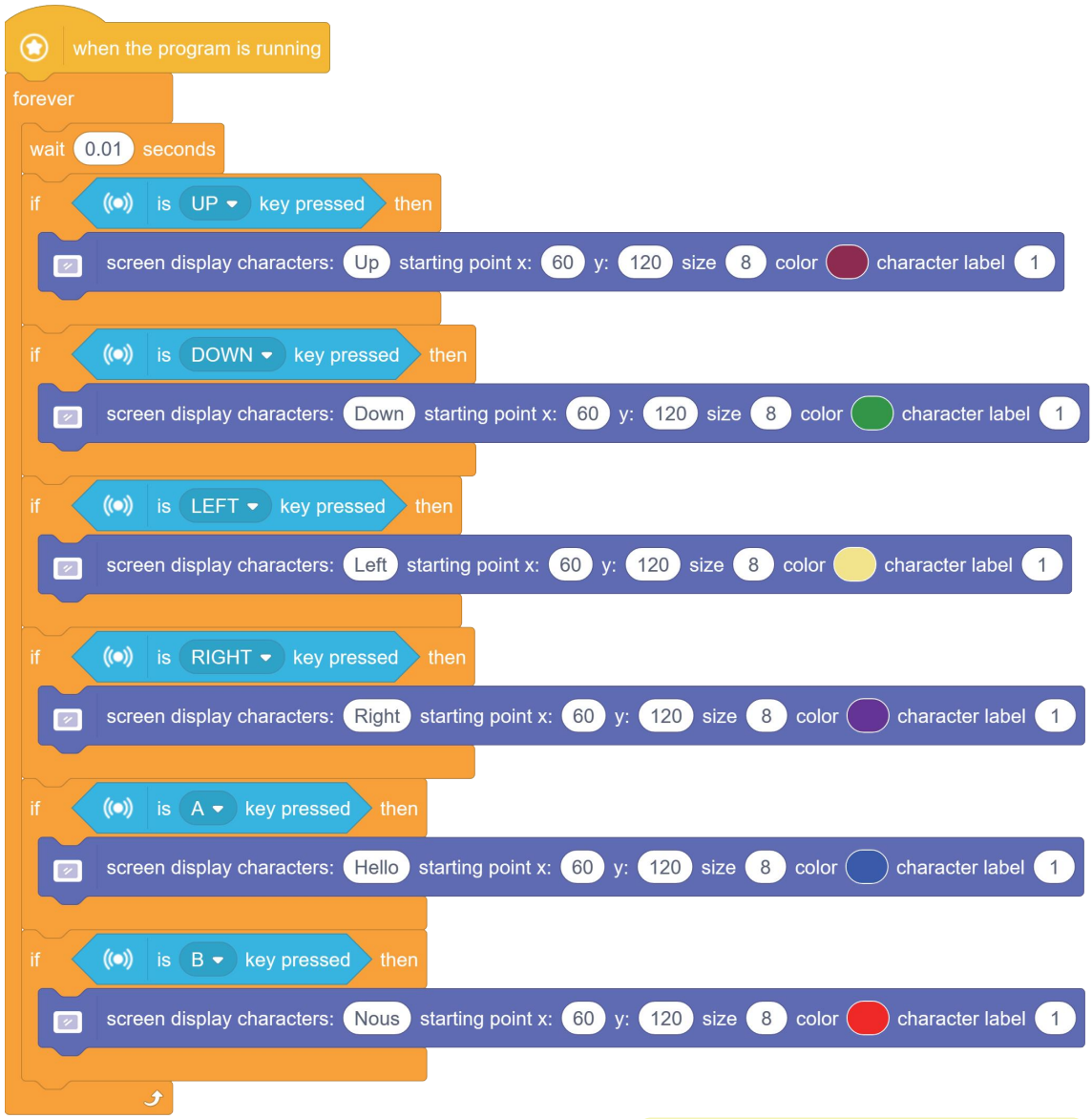


Task 2 Nous can show text

When the "Up" button is pressed, the text "Up" is displayed on the Nous' screen.
When the "Down" button is pressed, the text "Down" is displayed on the Nous' screen.
When the "Left" button is pressed, the text "Left" is displayed on the Nous' screen.
When the "Right" button is pressed, the text "Right" is displayed on the Nous' screen.
When button A is pressed, the text "Hello" is displayed on the Nous' screen.
When button B is pressed, the text "Nous" is displayed on the Nous' screen.



Demo Program

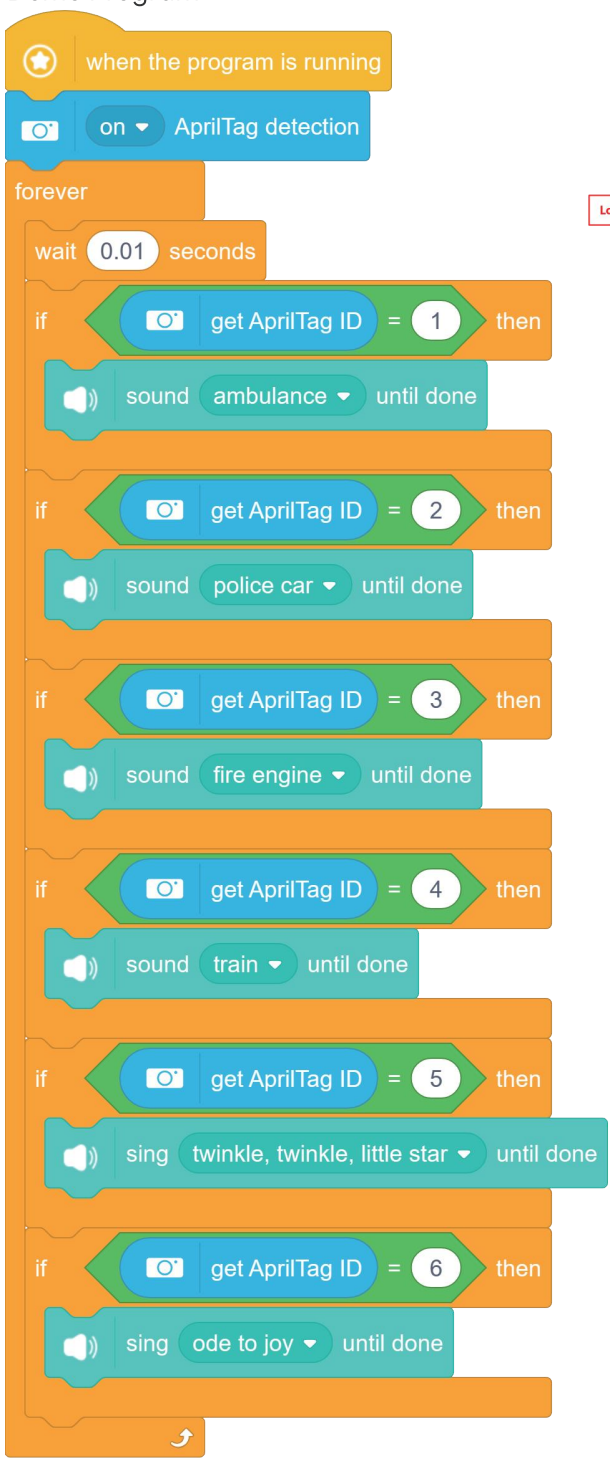


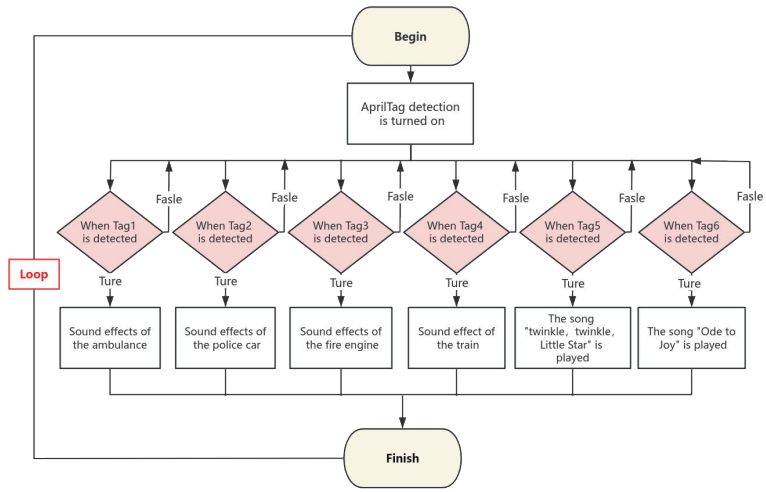
Note: When we need to display multiple graphics or characters of the same type on the screen, such as two circles, we need to add labels for each graphic or character.

Task 3 Nous detects AprilTags

When the program is running, AprilTag detection is turned on. When Tag1 is detected, Nous plays the sound effects of an ambulance until done; when Tag2 is detected, Nous plays the sound effects of a police car until done; when Tag3 is detected, Nous plays the sound effects of a fire engine until done; When Tag4 is detected, Nous plays the sound effect of a train until done; when Tag5 is detected, the song "twinkle,twinkle,little star" is played until done; when Tag6 is detected, the song "Ode to Joy" is played until done.

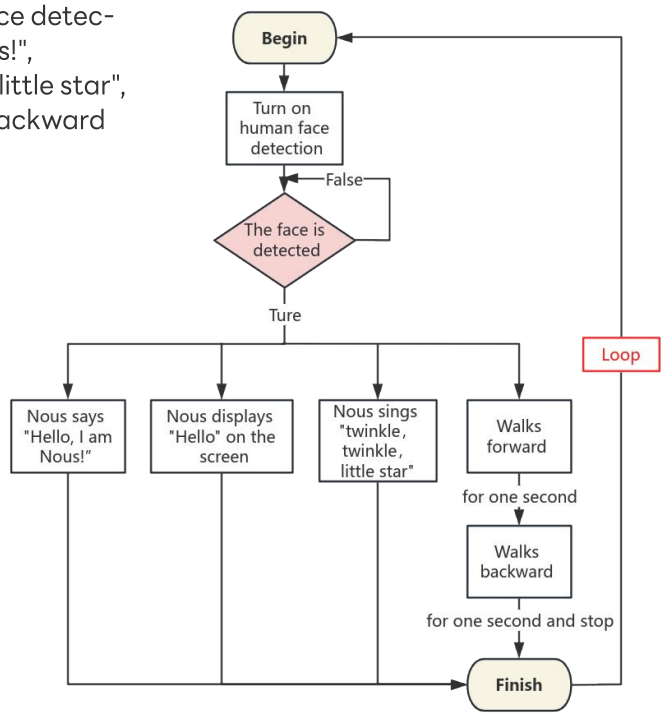
Demo Program



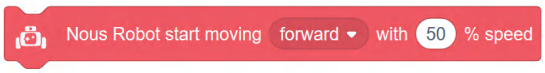


Task 4 Hello, I am Nous!

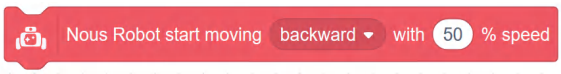
When the program is running, turn on human face detection. If a face is detected, Nous says "Hello, I am Nous!", displays "Hello" on the screen, sings "twinkle,twinkle,little star", and Nous walks forward for one second and walks backward for one second at 50% speed.



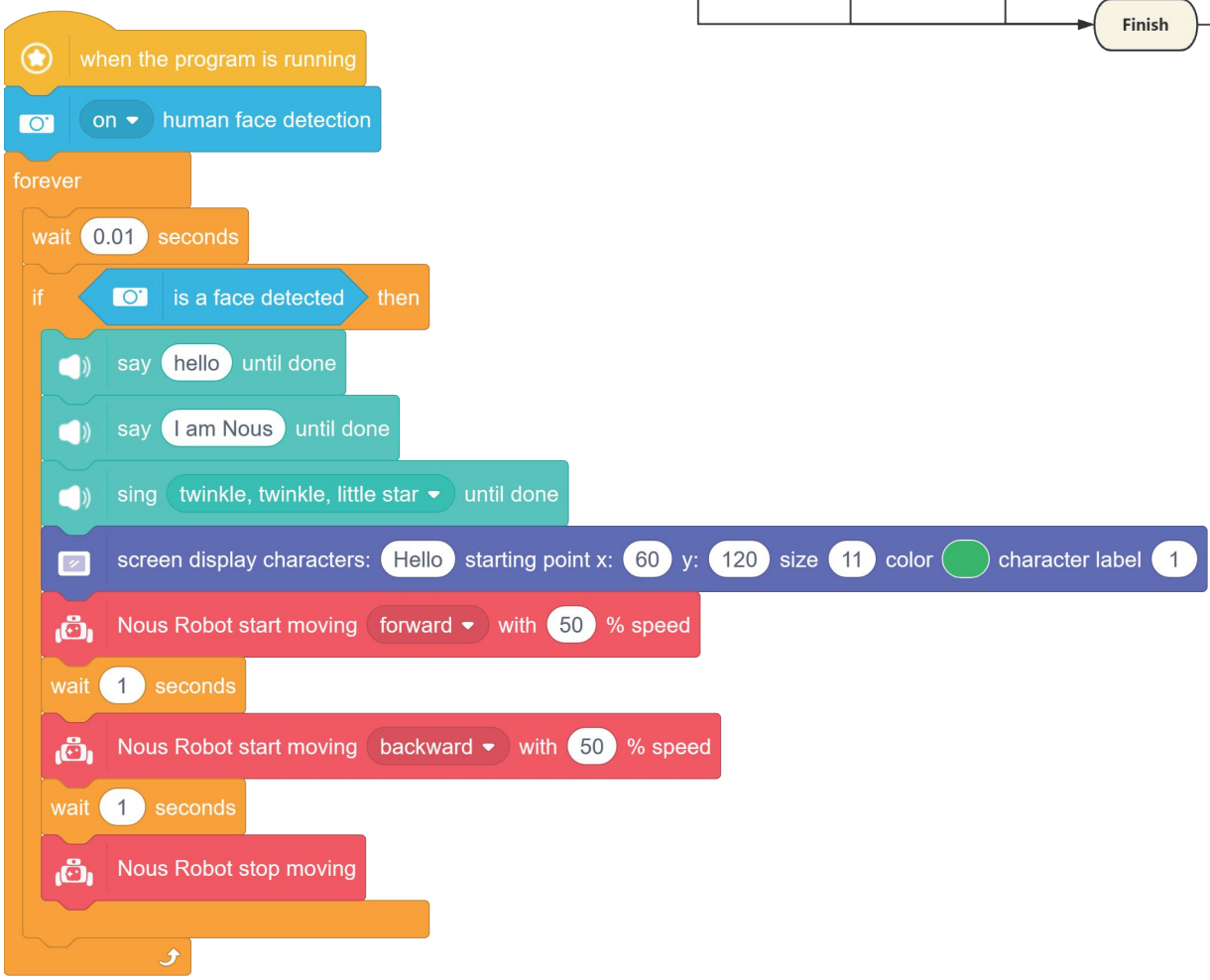
Move Forward



Move backwrd



Demo Program

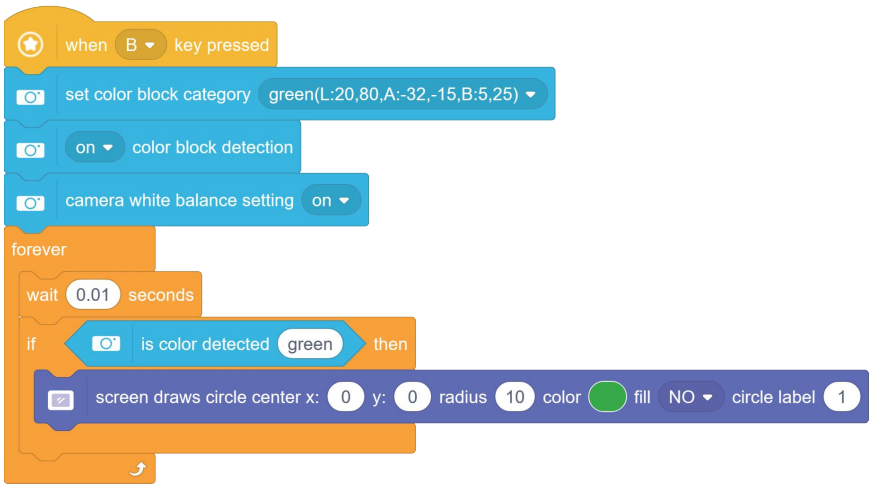


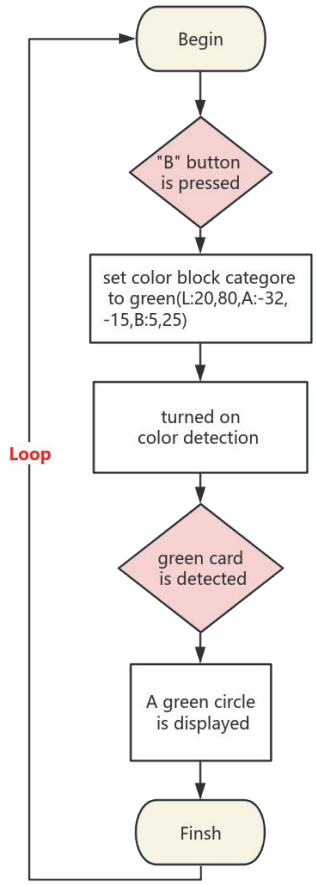
Task 5 Nous recognizes colors

When the "A" button is pressed,set color block categore to red(L:20,80,A:30,50,B:15,35), and color detection is turned on. When a red card is detected, a red circle is displayed in the center of the screen.

When the "B" button is pressed, set color block categore to green(L:20,80,A:-32,-15,B:5,25), and color detection is turned on. When a green card is detected, a green circle is displayed in the center of the screen.

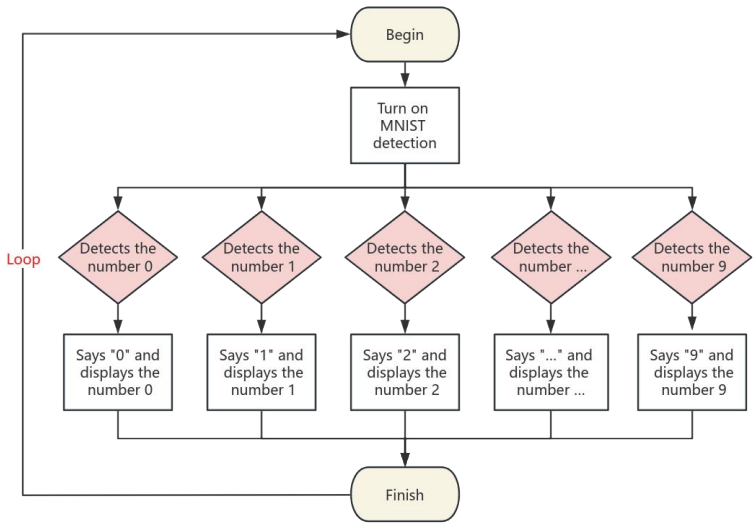
When the "Up" button is pressed, set color block categore to yellow(L:40,95,A:-15,-5,B:17,38), and color detection is turned on. When a yellow card is detected, a yellow circle is displayed in the center of the screen.



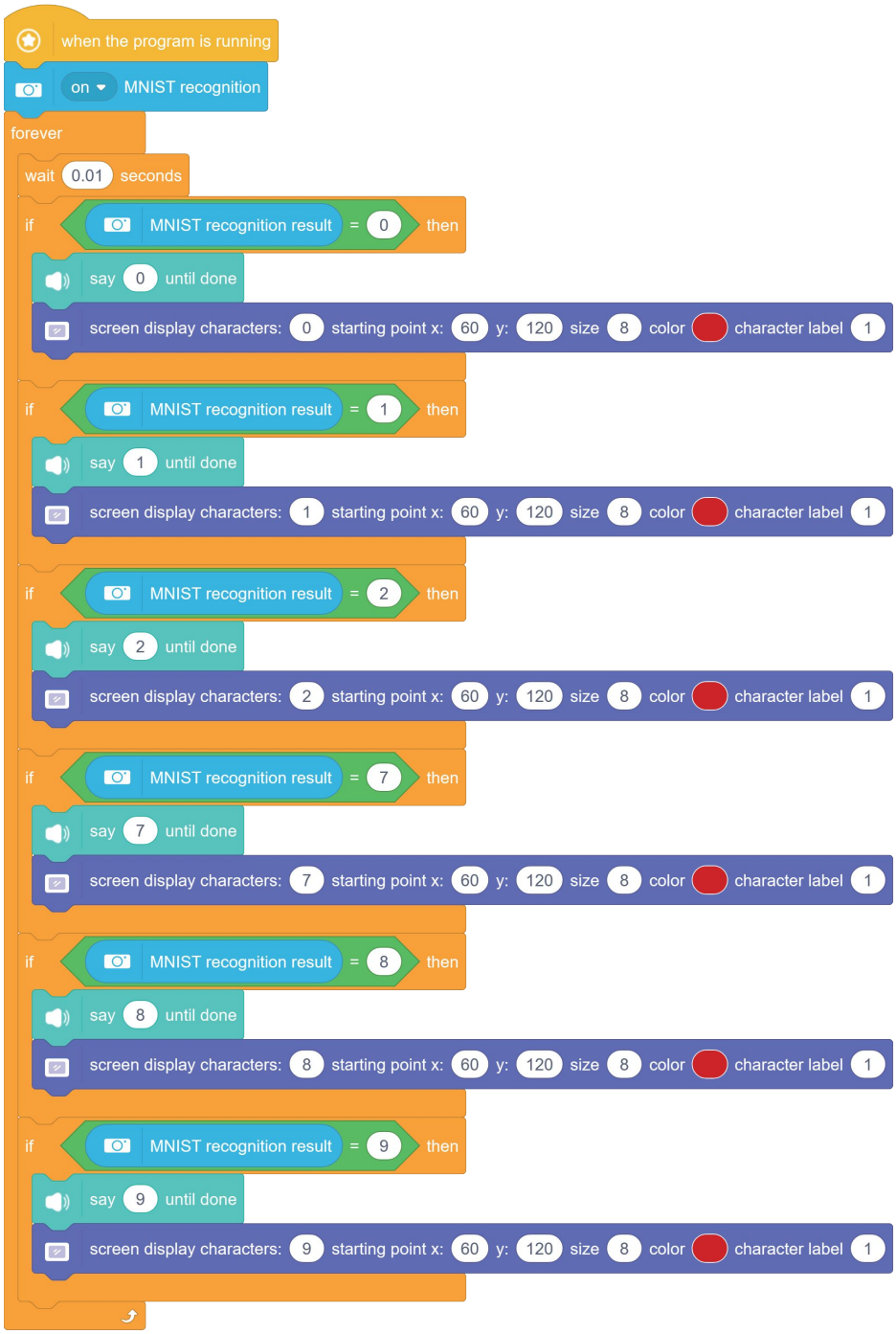


Task 6 Nous recognizes numbers

When the program is running, turn on the MNIST (handwritten digital 0-9) detection. When Nous detects the number 0, it says "0" and displays the number 0 on the screen; when Nous detects the number 1, it says "1" and displays the number 1 on the screen...



Demo Program



Wrap-up

5 min

Students show and run the programs they wrote for Nous, and briefly describe which functions of Nous are used in each program.