Micro Parabolas

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Professional Development from Texas Instruments

Student Activity

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BBC Micro:bit | TI-Nspire™ | Investigation | Student | 50 min

Introduction

The BBC Micro:bit™ has a built in accelerometer. In this activity you will learn how to capture data from the accelerometer and use it to manipulate a graph.

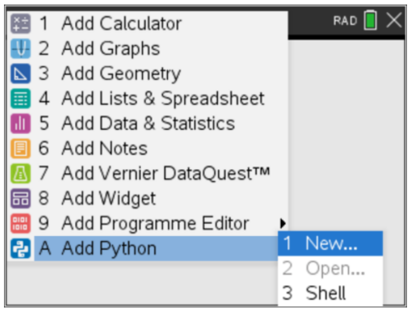
Let's Get Moving

Equipment and set-up checklist:

- ✓ TI-Nspire CX II with Micro:bit Python module
- ✓ Micro:bit & Calculator to Micro:bit cable

1 Start a new document and insert a Python program.

Name: Micro



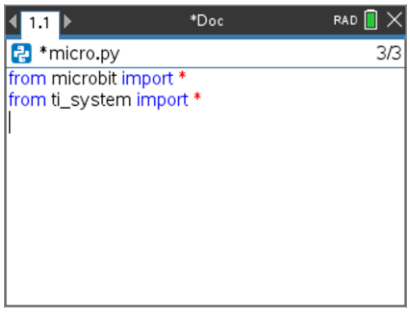
2 Import the Micro:bit and TI System modules.

Menu > **More Modules** > **BBC micro:bit** > **from microbit import***

This instruction means that the micro:bit commands will be accessible from your Python program.

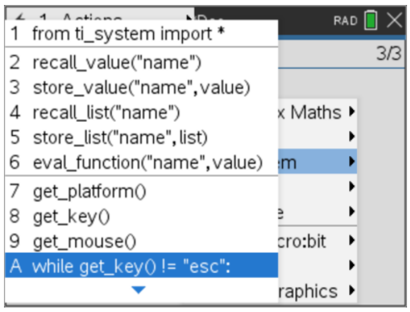
Menu > **More Modules** > **TI System** > **from ti_system import***

Some of the variables collected in the Python program need to be made accessible to the calculator's environment.



3 A while loop that can be halted by the "esc" (escape) key is useful when exploring and the loop conditions are yet to be determined. A pre-prepared instruction exists:

Menu > **More Modules** > **TI System** > **while get_key()!="esc"**



The Python programming tool on the calculator includes some handy navigation tools. The TAB key can be used to jump from one user input component to another within commands. If there are no more user input components, the TAB key will jump to the end of the line.

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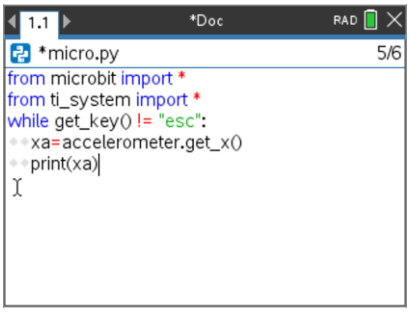
4 We're ready to start capturing data from the accelerometer and displaying the results on screen.

Menu > **More Modules** > **BBC micro:bit** > **Sensors** > **Accelerometer**

Select the x axis option: x=get_x() and store as: xa
To see the values, use the print() command:

Menu > **Built-ins** > **I/O** > **print()**

Put xa in the print command and run the program.



Question: 1.

Run the program and explore what happens when you tilt the micro:bit in different directions.

a) What range of values can you obtain for xa?

b) Which axis on the micro:bit is responsible for changing the xa values?
Note: The accelerometer is very sensitive, any movement will likely cause change, focus on the most significant changes.

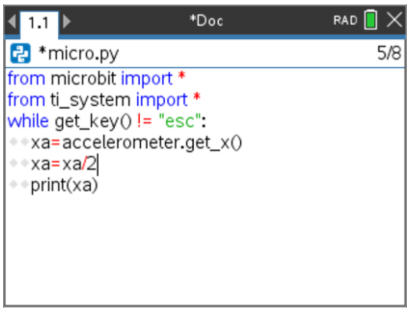
c) Suppose you want the values of xa to vary between -10 and 10, suggest ways this could be achieved whilst maintaining the full range of movements for the micro:bit.

Acting on Data

1 The adjustment to the range of values for the variable 'xa' need to be made within the loop. Put the conversion immediately prior to the print(xa) statement and run the program to check the output.

xa = xa/*** [Replace the *** with your conversion factor.]

Note: The conversion shown opposite will NOT achieve the desired outcome. Use your conversion value!



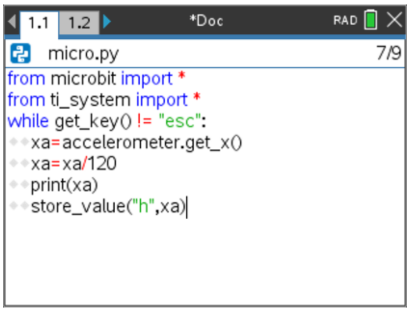
2 The 'xa' variable collected in Python needs to be transferred to the other applications in the calculator. This needs to occur within the "While" loop:

Menu > **More Modules** > **TI System** > **store_value("name",value)**

Name = Variable name in the calculator environments.

Value = Python variable name.

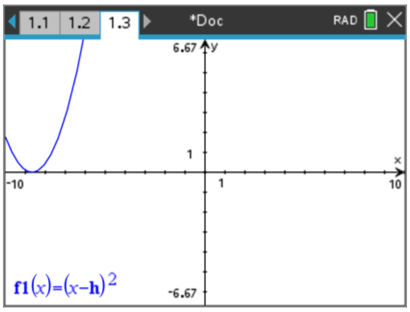
In this example, 'xa' will be stored to 'h' and accessible from the calculator environments. **Run your program**. You won't notice any difference; however, 'h' will now have a value which is critical for the next step!



3 You should now be in the Python Shell (Page 1.2). Insert a Graphs Application, (Page 1.3) and graph the following function:

$$y = (x - h)^2$$

When you enter the function, you should notice that the 'h' is bold, signifying it has already been defined, courtesy of your "micro" program.



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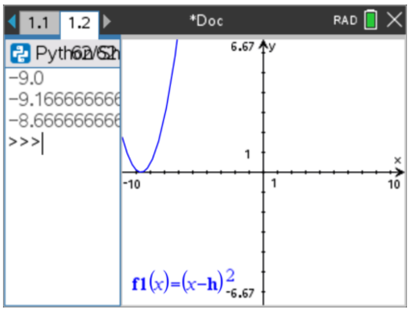
4 Navigate back to the Python Shell (Page 1.2) and press:

Ctrl + 4

This is a short-cut to combine or group pages 1.2 and 1.3 onto one page. The two applications: Python Shell and Graphs should now be visible. We want to focus on the Graph application, press:

doc > **Page Layout** > **Custom Split**

Move the divider to the left to make more of the Graph application visible.

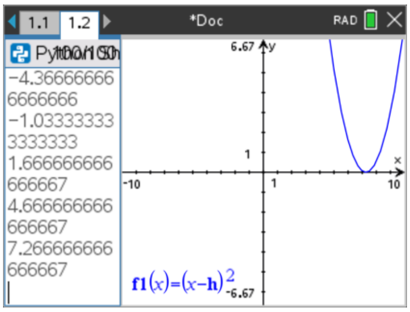


5 We are now ready to run the Python program again. The calculator focus may be on the Graphs application, to shift focus press: Ctrl + Tab, this is similar to Alt + Tab in the Microsoft Windows™ environment.

To run the program press:

Menu > Tools > Run

Select the micro program and start moving the micro:bit! When you're done exploring, press "esc" to exit the loop and therefore end the program.



Question: 2.

What happens to the graph when the micro:bit is tilted?

Question: 3.

Edit the conversion line in your program: xa = xa / … so that it reads: xa = int(xa/ …) including your conversion factors and run the program again. What does the "int( )" command do to the numbers?

> The equation label can be moved away from the equation (or hidden) so that it is not moving with the graph.
>
> To display the value of 'h', select the graph and press Ctrl + Menu, select Attributes, navigate down to "Label Parameters" and select the option to "Show Values".

Challenge 1:

Edit your Python program, using the same loop, capture data for the acceleration in the Y direction. Apply a suitable scale factor and transfer this measurement to a calculator variable: 'k'. Run your program to ensure k has a stored value, then change your graph to:

$$y = (x - h)^2 + k$$

Run your program and answer the following question:

Question: 4.

What happens to the graph when the micro:bit is tilted now?

Challenge 2:

Another transformation needs to be created, however the 'z' axis accelerometer is a little harder to control. The other transformation is referred to as a dilation, typically referenced as "a". Edit your Python program, and create a new loop so that the accelerometer can control the value of 'a' where 'a' is able to vary between -3 and +3 in increments of 0.25. Redefine your equation as follows:

$$y = a(x - h)^2 + k$$

Run your program and answer the following question:

Question: 5.

What affect does 'a' have on the parabola?

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