

# Meet the TI-Rover with Geometry Challenges

TI-Nspire CXII

Python

Texas Instruments

@ticalculators



[www.TIstemProjects.com](http://www.TIstemProjects.com)

Contact [stem-team@ti.com](mailto:stem-team@ti.com) with questions

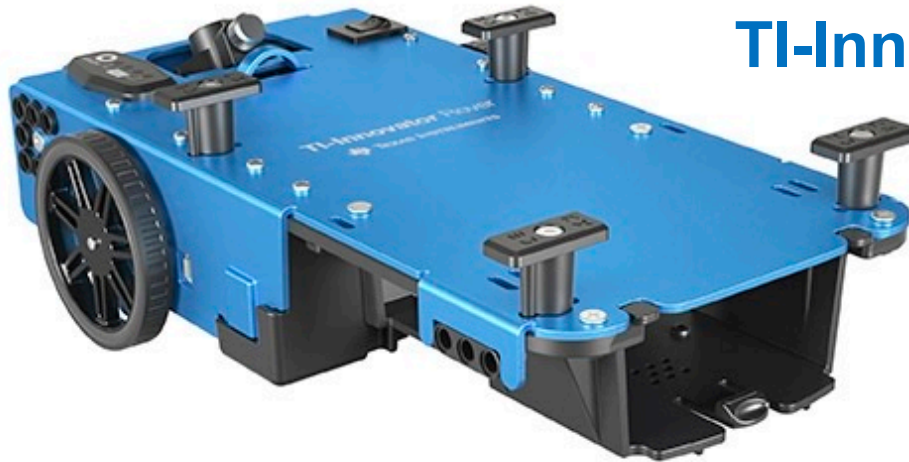
# Meet the TI-Innovator Rover



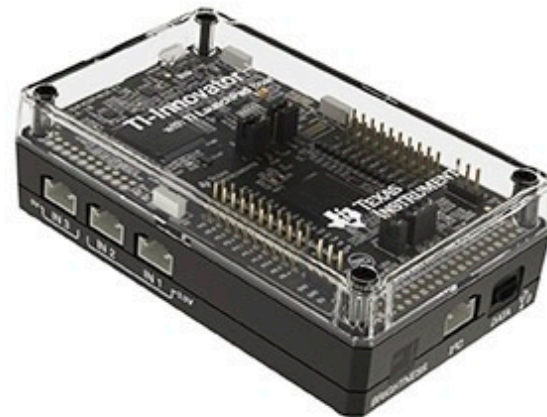
## TI Graphing Calculator



## TI-Innovator™ Rover



## TI-Innovator™ Hub



# Rover from the top

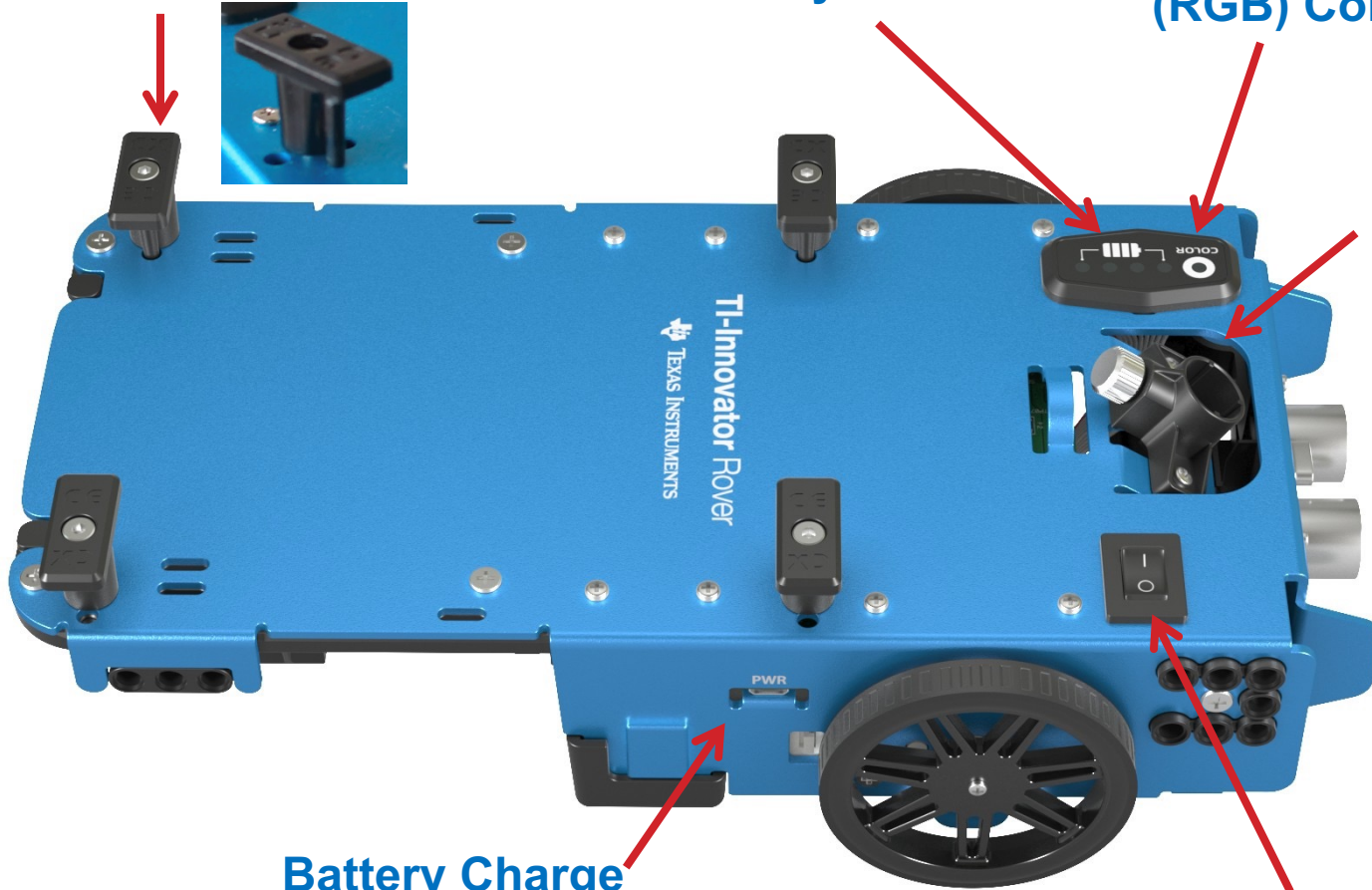
Calculator holder posts.  
Lift and twist to CE or CX side.



Battery indicator

Red-Green-Blue  
(RGB) Color LED

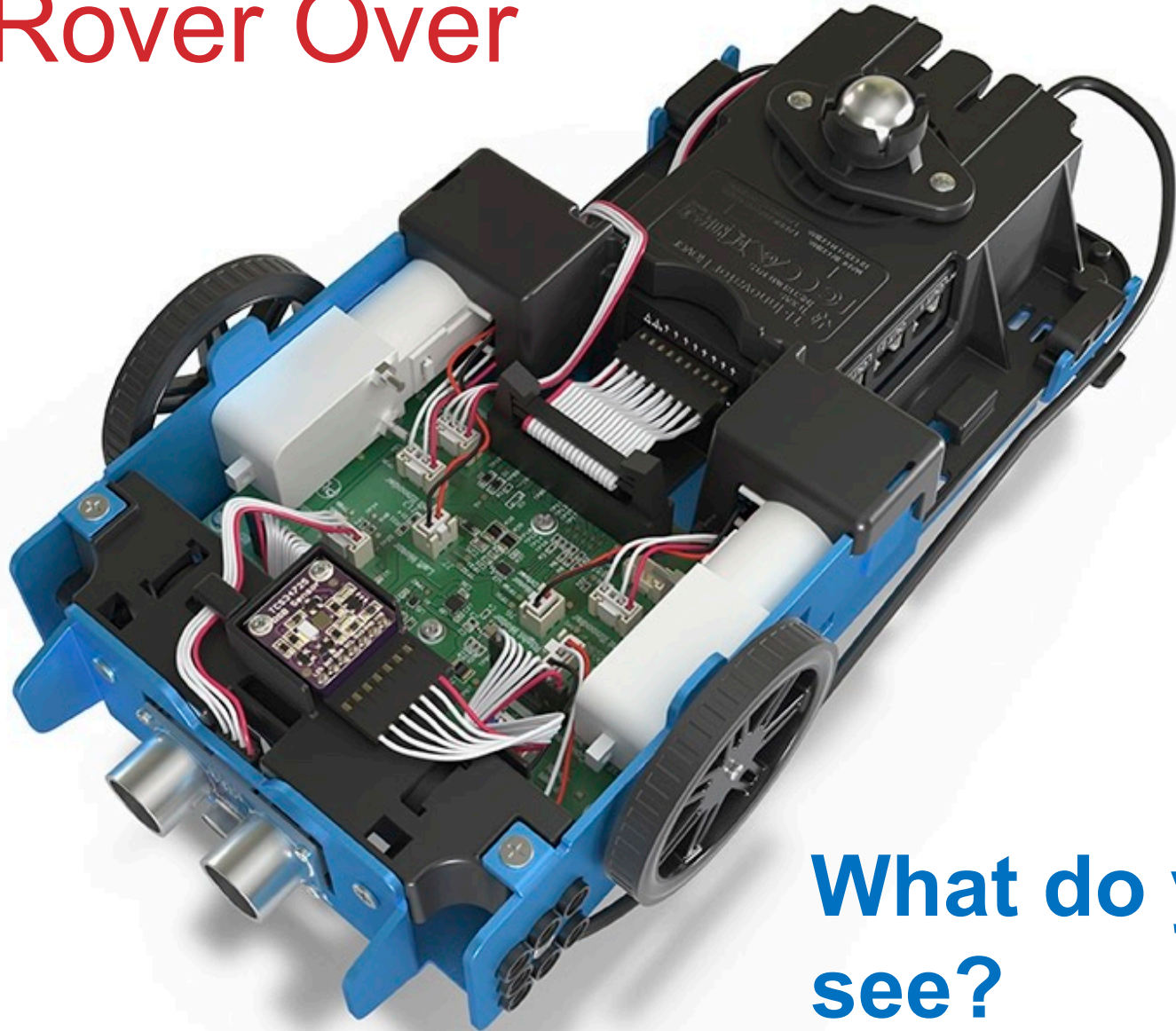
Marker holder  
(Expo Fine and  
Ultra Fine sizes)



Battery Charge  
with USB micro  
to wall adapter.

On/Off Switch

# Turn Rover Over



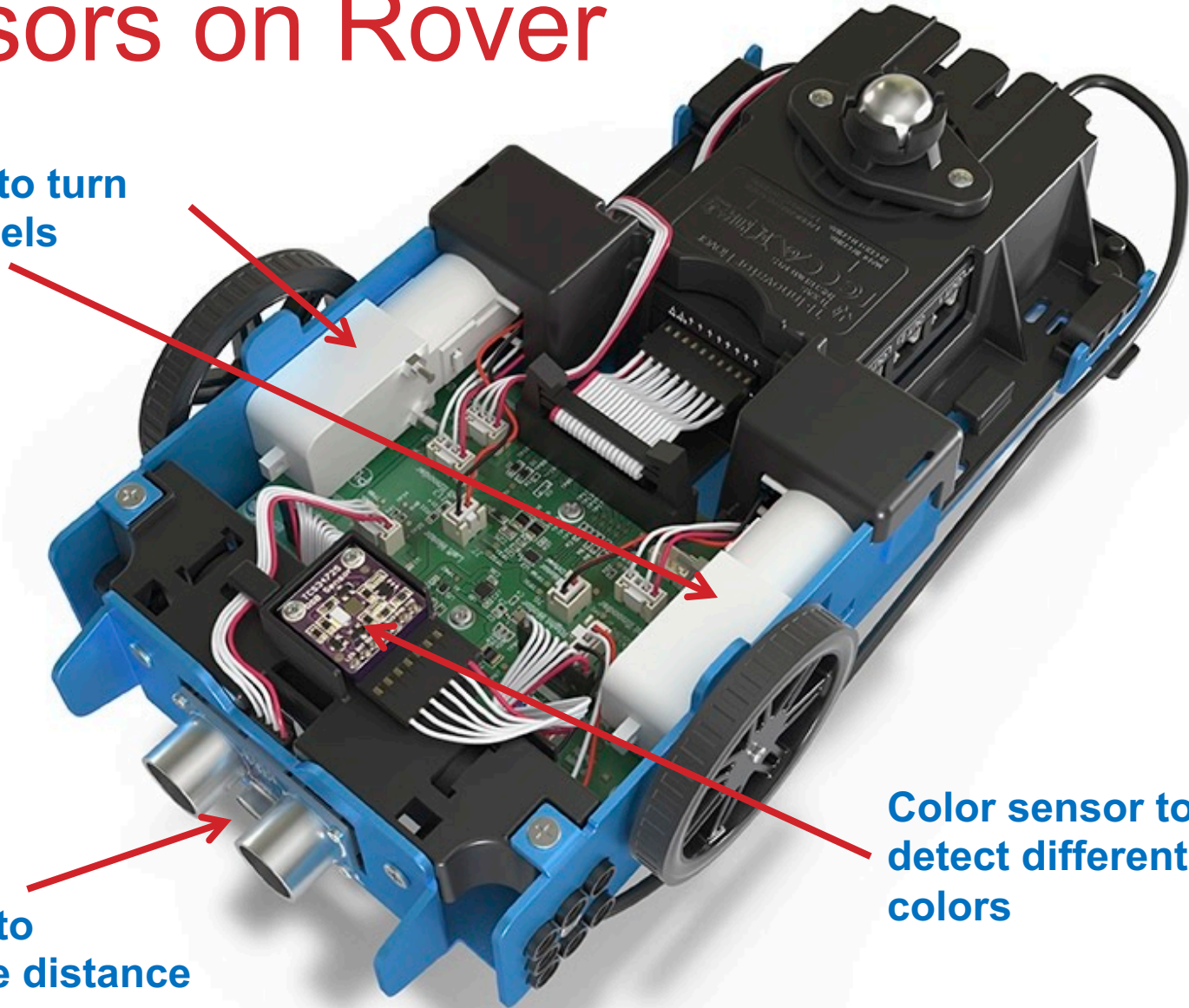
What do you  
see?

# Sensors on Rover

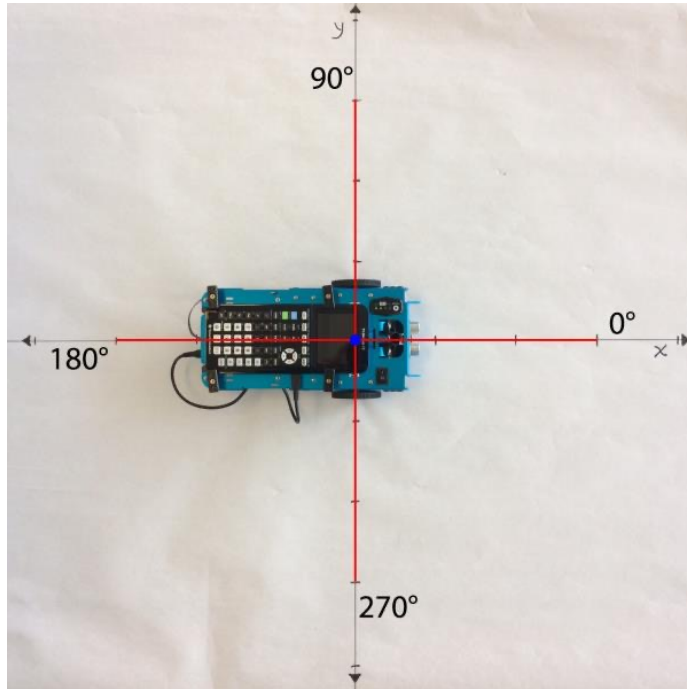
Motors to turn the wheels

Ranger to measure distance

Color sensor to detect different colors



# TI-Rover orientation and virtual grid



Rover programs set the initial position as the origin and the heading as 0 degrees measured from the x-axis.

**Note:** The Rover tracks its position on a virtual coordinate grid with a unit value of 10 cm. The coordinate grid position applies to the `to_xy(x,y)`, `to_polar(r,theta_degrees)` and `to_angle(angle, "unit")` functions on the Rover Drive menu. The virtual grid also applies to Path menu functions.

# Connecting Rover to your calculator



- 1 Make sure that your Rover is switched ON and on floor ready to roll before running the program.

- 2 Plug B side into USB B port of the Rover Hub.

- 3 Plug A side into port on calculator the Rover Hub.



Unit-to-unit cable



# Connecting your calculator to the Rover

## Initial Connection

- » Step 1: Make sure that Rover is switched ON
- » Step 2: plug unit-to-unit cable into Hub
  - » (Use end of cable labeled B)
- » Step 3: plug unit-to-unit cable into the calculator
  - » (Use end of cable labeled A)

## Troubleshooting

### Try the following as a fast fix:

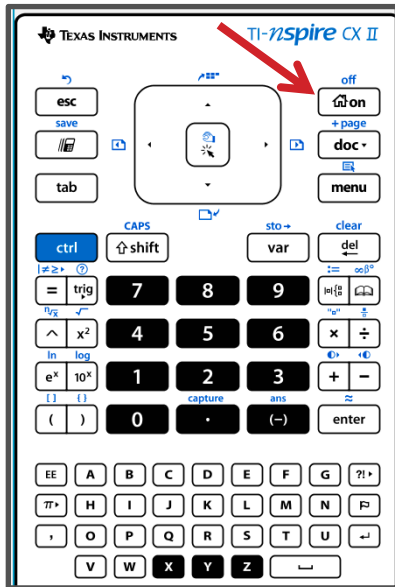
- » Step 1: unplug the unit-to-unit cable from the hub and the calculator.
- » Step 2: re-connect in the order of first Hub then calculator second.

### If the fast fix does not work, try these steps:

- » Step 1: unplug unit-to-unit cable from both the hub and the calculator
- » Step 2: Switch Rover OFF
- » Wait a second
- » Step 3: Switch Rover ON
- » Step 4: plug unit-to-unit cable into Hub
- » Step 5: plug unit-to-unit cable into the calculator

# Creating a new TI-Nspire document

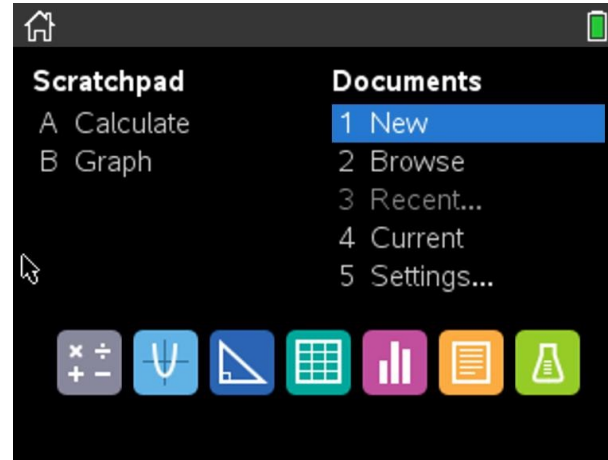
1



Press the **[home/on]** key to display the home screen.

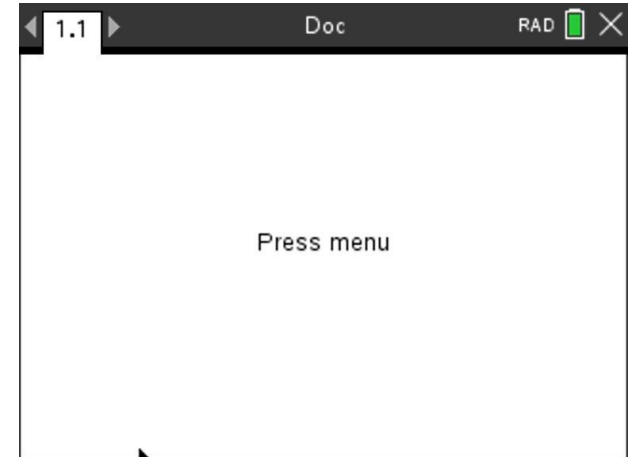
**Note:** If you have a document open, pressing the **[home/on]** key repeatedly toggles between the home screen and the document.

2



Use **arrow keys** and **[enter]** or Press **[1]** to select 1 New document.

3



See next slide for steps to add a program.

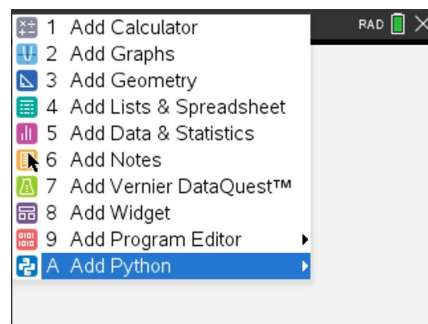
# Creating a Rover Program

1



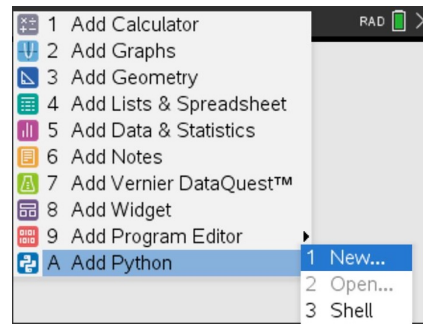
Press **[menu]** to bring up a menu of applications to add to the page.

2



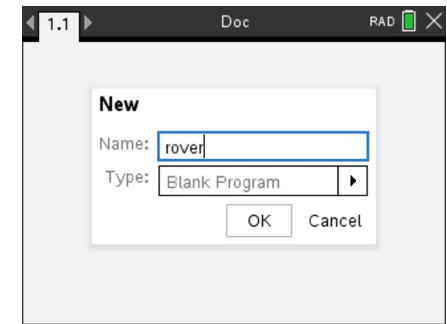
Press **down arrow** repeatedly then press **[enter]** or press **[A]** to select Add Python.

3



Select 1: New by pressing **[enter]** or **[1]**

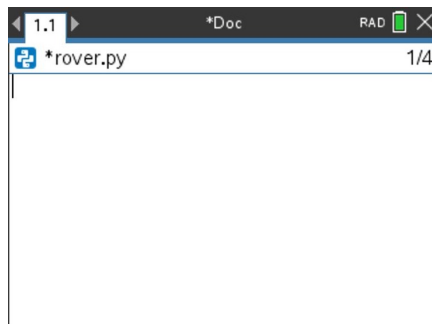
4



Enter your program name and press **[enter]**.

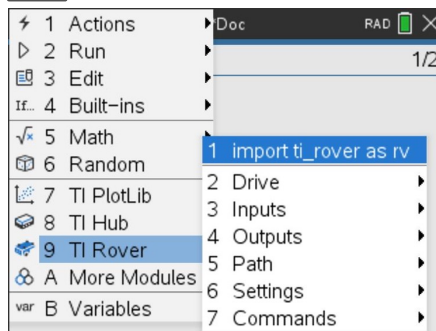
Note: You can also add a new page to the document by pressing **[ctrl] [doc] +page**.

5



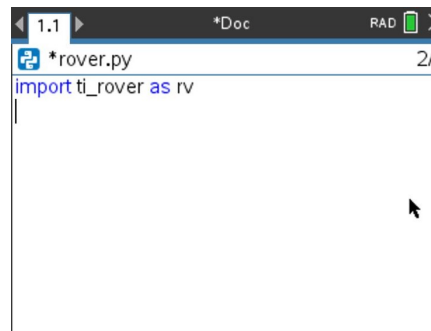
You begin at a blank edit screen.

6



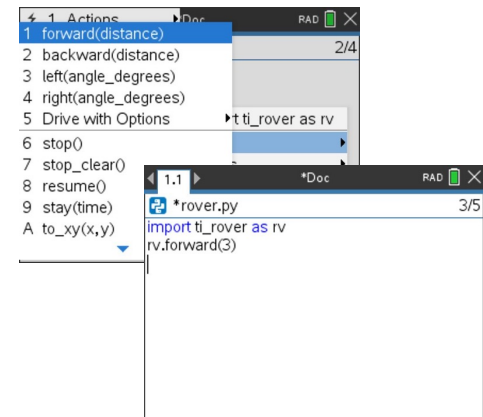
Press **[menu]** then **[9]** TI Rover **[1]** Import ti\_rover.

7



Importing the ti\_rover module is required at the beginning of every Rover program.

8

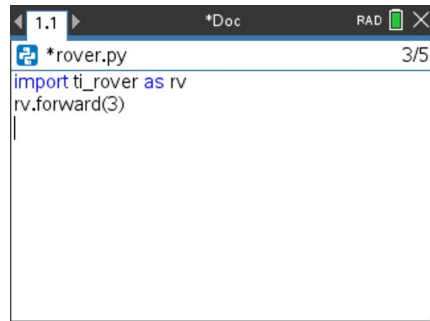


Press **[menu]** then **[9]** TI Rover **[2]** Drive **[1]** forward() to paste to the edit line. Type a value for units to drive. **Right arrow** to the end of the line and press **[enter]** to complete the statement.

Press **[ctrl] [R]** to run the program from a Python shell on the next page.

# Running a Rover Program

1



```
*Doc RAD 1.1
*rover.py 3/5
import ti_rover as rv
rv.forward(3)
```

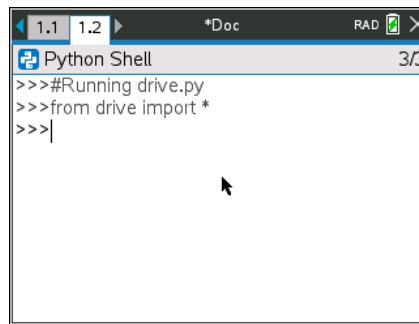
Press **[ctrl] [R]** to run the program from a Python shell on the next page.

Note: **[ctrl] [R]** also checks syntax and stores program changes. **[ctrl] [B]** is another option for checking syntax and storing. \* before the program name indicates that changes have not been stored.

Before running the program make sure that

- Rover is connected to the calculator
- Rover is switched on
- Rover is on a flat surface ready to roll

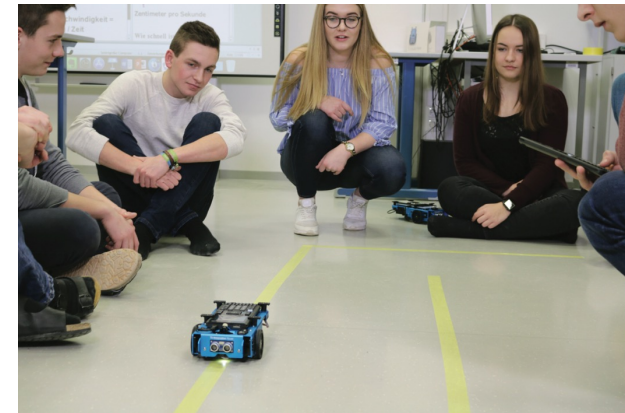
2



```
*Doc RAD 1.1 1.2
Python Shell 3/3
>>>#Running drive.py
>>>from drive import *
>>>|
```

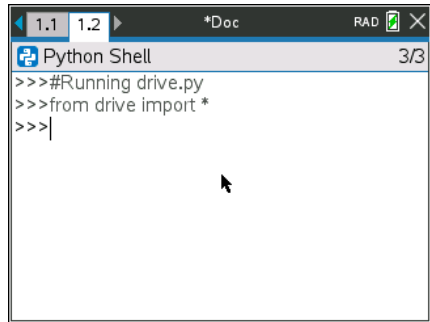
Your program runs in a Python shell.

You can re-run the program from the shell by pressing **[ctrl] [R]** again.



# Editing a Rover Program

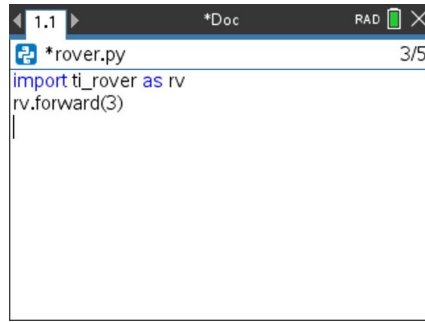
1



```
Python Shell 3/3
>>>#Running drive.py
>>>from drive import *
>>>|
```

Press **[ctrl] left** to go back to your Python editor page.

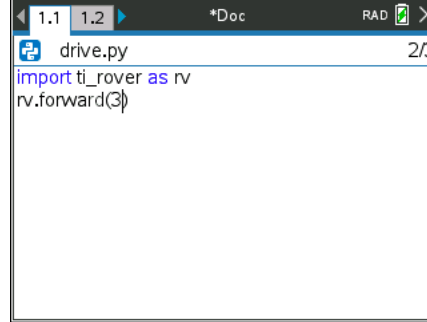
2



```
*rover.py 3/5
import ti_rover as rv
rv.forward(3)
|
```

Use the arrow keys to position the cursor to change the value of the forward distance.

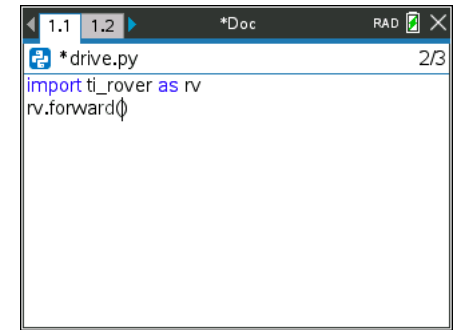
3



```
drive.py 2/3
import ti_rover as rv
rv.forward(3)
|
```

Press **[del]** to backspace over the 3.

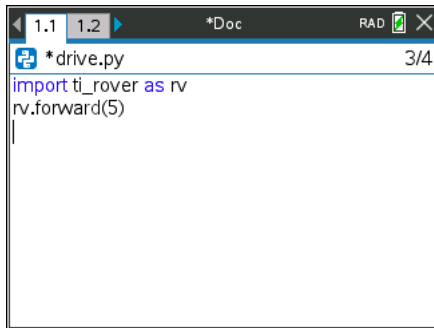
4



```
*drive.py 2/3
import ti_rover as rv
rv.forward(|
```

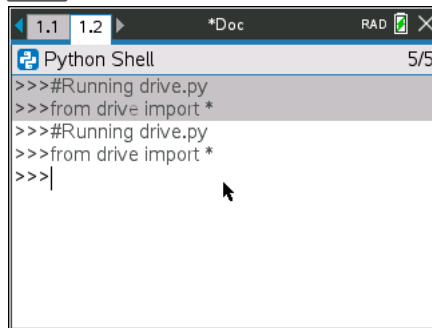
Type in a new value for distance, **right arrow** to the end of the line, then **[enter]** to move to the next line.

5



```
*drive.py 3/4
import ti_rover as rv
rv.forward(5)
|
```

6

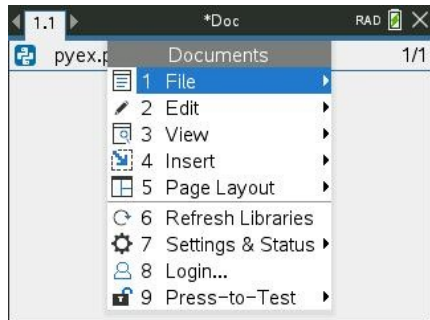


```
Python Shell 5/5
>>>#Running drive.py
>>>from drive import *
>>>#Running drive.py
>>>from drive import *
>>>|
```

Press **[ctrl] [R]** to run the program again from a Python shell on the next page.

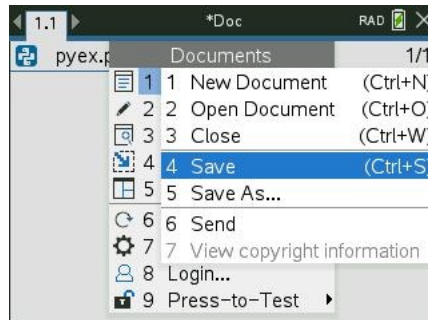
# Saving a TI-Nspire document file

1



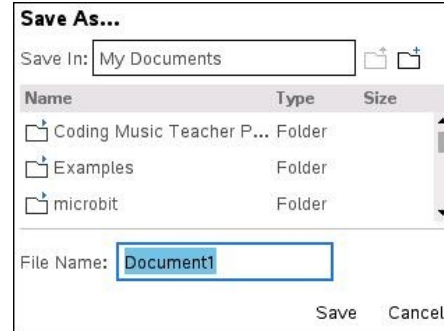
Press **[doc]** then select 1 File from the menu by pressing **[enter]** or **[1]**.

2



Select 4 Save or 5 Save As... from the menu.

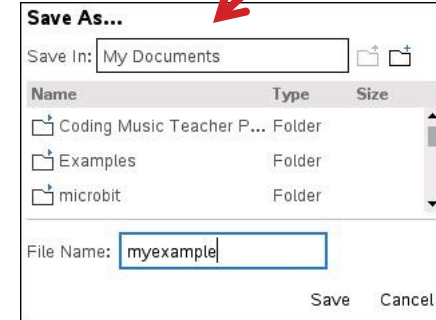
3



Type in your file name using alpha and numeric characters.

**Note:** The name must begin with an alpha character.

4



Folder where file will be saved.

Press **[enter]** to save the file to the folder indicated above.

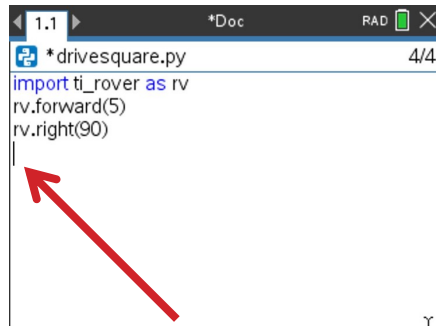
To change the folder press the **[UP]** arrow key and then use **arrows** and **[enter]** to select a folder before pressing **[enter]** to save the file.

Press **[esc]** to cancel the save dialogue.

You can use **[ctrl] [S]** as a shortcut to save the TI-Nspire document file.

# Copying and Pasting a Block of Code

1

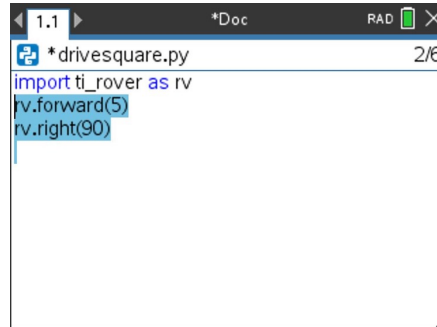


```
*drivesquare.py 4/4
import ti_rover as rv
rv.forward(5)
rv.right(90)
|
```

A red arrow points to the cursor at the start of the first line of code.

Use **arrow keys** to move the cursor to the beginning of row below the section of code that you want to copy.

2

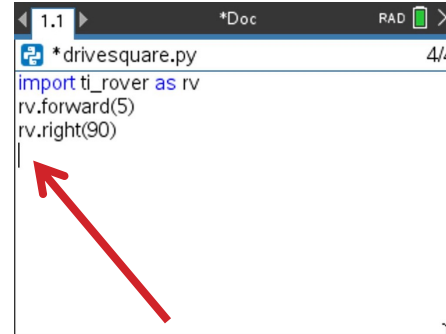


```
*drivesquare.py 2/6
import ti_rover as rv
rv.forward(5)
rv.right(90)
|
```

The first two lines of code are highlighted in blue.

Press and hold **[shift]** then press **UP arrow** repeatedly to highlight the rows to be copied. Press **[ctrl] [C]** to copy the highlighted code.

3

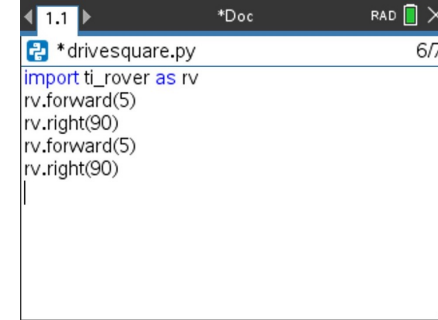


```
*drivesquare.py 4/4
import ti_rover as rv
rv.forward(5)
rv.right(90)
|
```

A red arrow points to the cursor at the start of the first line of code in a new location.

Use **arrow keys** to move the cursor to the location that you want to paste from.

4



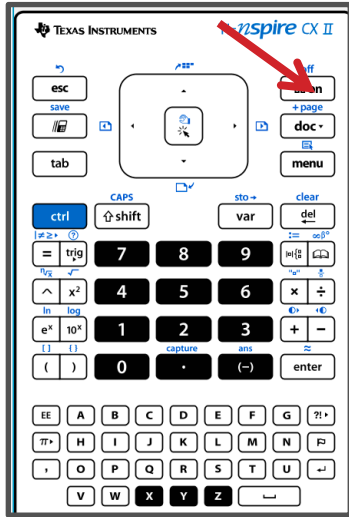
```
*drivesquare.py 6/7
import ti_rover as rv
rv.forward(5)
rv.right(90)
rv.forward(5)
rv.right(90)
|
```

Press **[ctrl] [V]** to paste.

You can paste repeatedly.

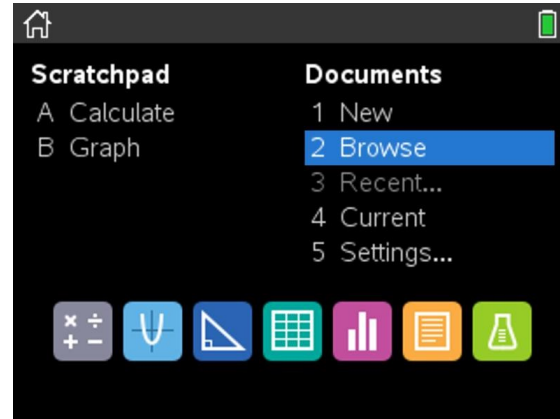
# Opening an existing TI-Nspire document file

1



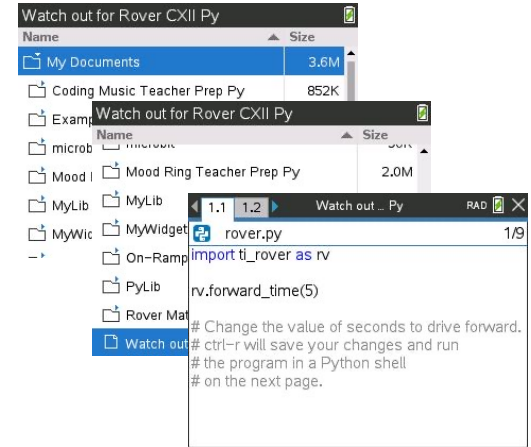
Press the **[home/on]** key to display the home screen.

2



Use **arrow keys** and **[enter]** or Press **[2]** to select 2 Browse files.

3



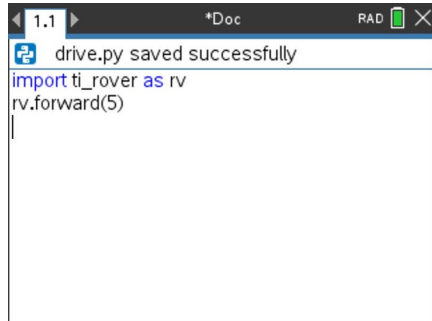
Use **arrow keys** and **[enter]** to select a folder and a file.

**Note:** Pressing the **[home/on]** key repeatedly toggles between the home screen and the current document.



# Copying a Python Program

1

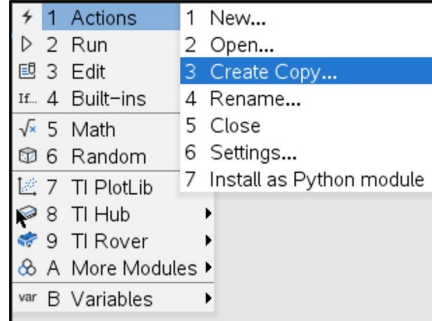


```
drive.py saved successfully
import ti_rover as rv
rv.forward(5)
```

Press **[ctrl] [B]** to compile and save your program.

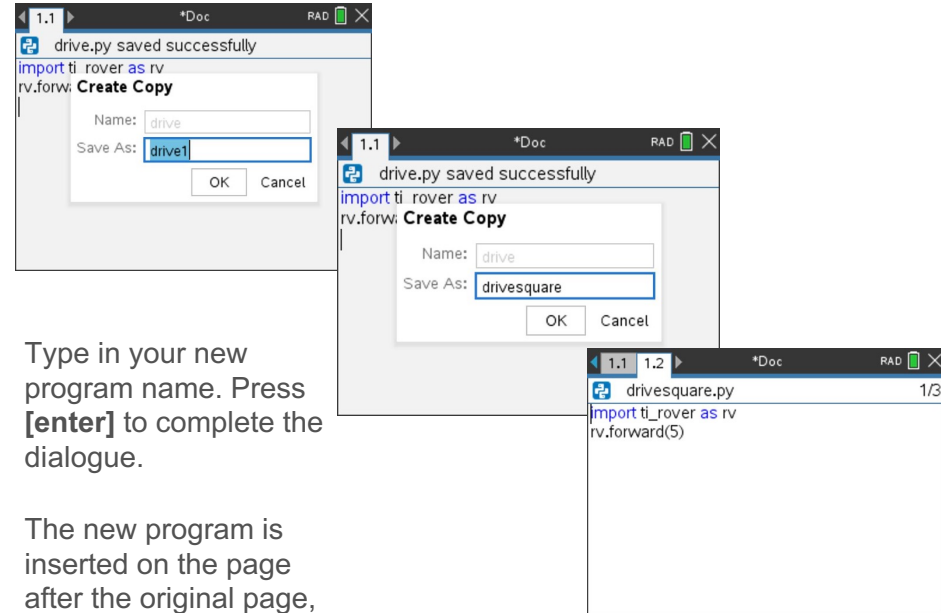
Note: You will not be able to copy the program if you have made changes since using **[ctrl] [R]** or **[ctrl] [B]**.

2



Press **[menu] [1]** Actions  
**[3]** Create Copy...

3

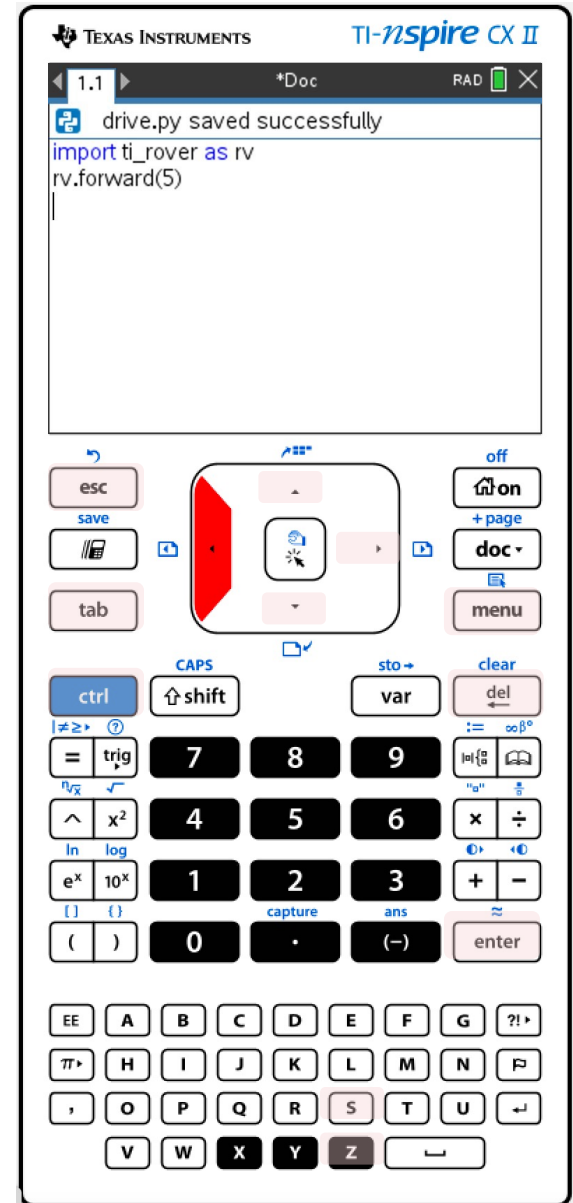


Type in your new program name. Press **[enter]** to complete the dialogue.

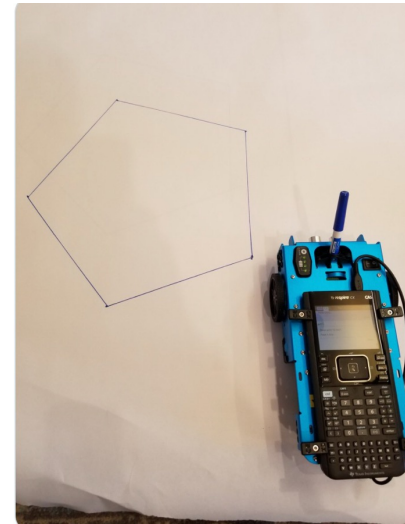
The new program is inserted on the page after the original page, in this case page 1.2.

# Entry and Edit Tips

- » Use **number key shortcuts** or **arrow keys** and **[enter]** to select from menus
- » Use **[esc]** to back out of a menu or a dialogue.
- » Use **[enter]** to complete a dialogue.
- » Use **[tab]** to move to the next input when entering a function
- » Use **arrow keys** to move the cursor around the screen
- » Use **[del]** as a destructive backspace
- » Use **[ctrl] [enter]** to complete a statement and move to the next line
- » Use **[ctrl] [Z]** to undo an action
- » Use **[ctrl] [S]** to save your file
- » Use **[ctrl] [left arrow]** and **[ctrl] [right arrow]** to move from page to page
- » Use **[menu]** to see options for the current application.



# Drawing with the TI-Rover



Use Expo Fine or Extra Fine dry erase markers.

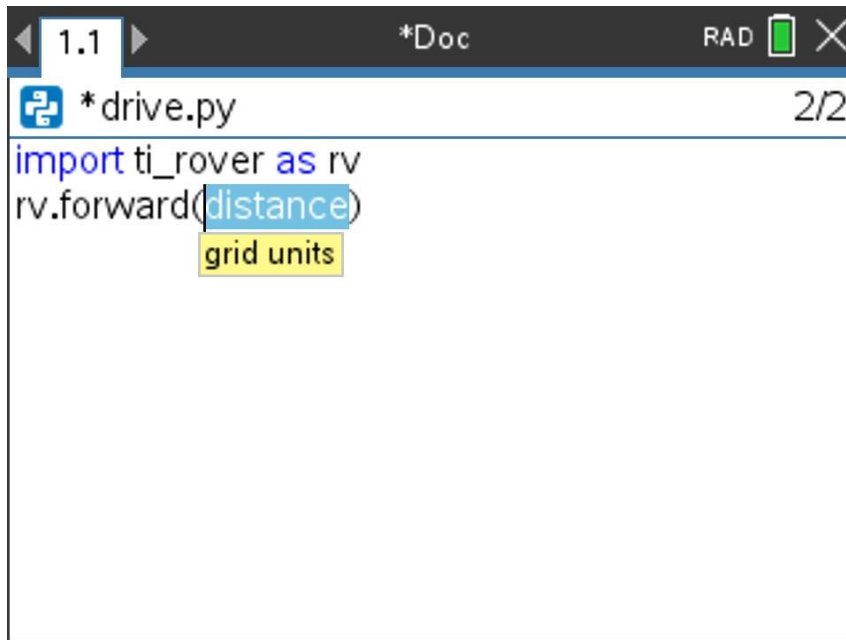
The markers drop into a slot on the front of the Rover.

Note: The Texas Instruments Workshop Loan Rover cases include markers.

Drawing surface: We recommend butcher paper held in place with painters tape on a hard surface.

# MAKE IT MOVE!

## New Program:



```
1.1 *Doc RAD X
*drive.py 2/2
import ti_rover as rv
rv.forward(distance)
    grid units
```

Press **[menu]** key to see Python Program Editor options.

Press **[ctrl] [R]** to run the program from a Python shell on the next page.

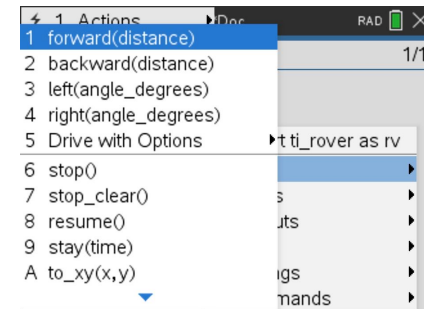
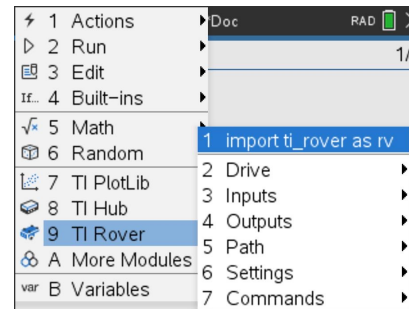
Use **[ctrl] left** to move from the shell page back to the Python editor page.

**Task: Discover how far Rover drives per unit.**

Use differing values (1-20) to determine what 1 Rover unit is.

Find `import ti_rover` on the TI Rover menu.

Find `forward()` and other drive functions on the Rover 2:Drive menu.



# Set the color

## New Program:



```
1.1 *Doc RAD X
*color.py 2/2
import ti_rover as rv
rv.color_rgb(red, green, blue)
0-255
```

Press **[menu]** key to see Python Program Editor options.

Press **[ctrl] [R]** to run the program from a Python shell on the next page.

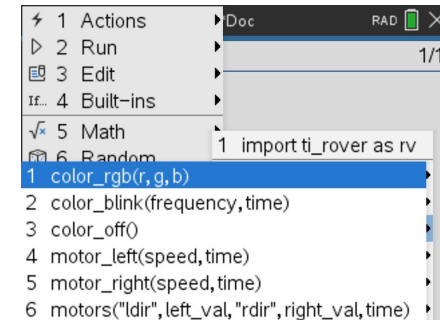
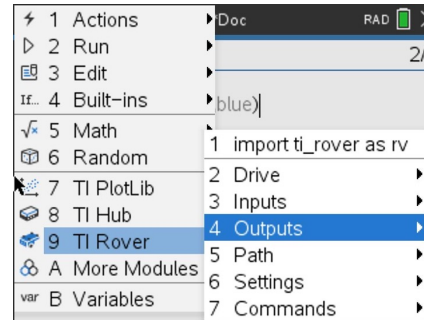
Use **[ctrl] left** to move from the shell page back to the Python editor page.

**Task: Set the color output of the RGB LED.**

Each color takes a value (0-255).

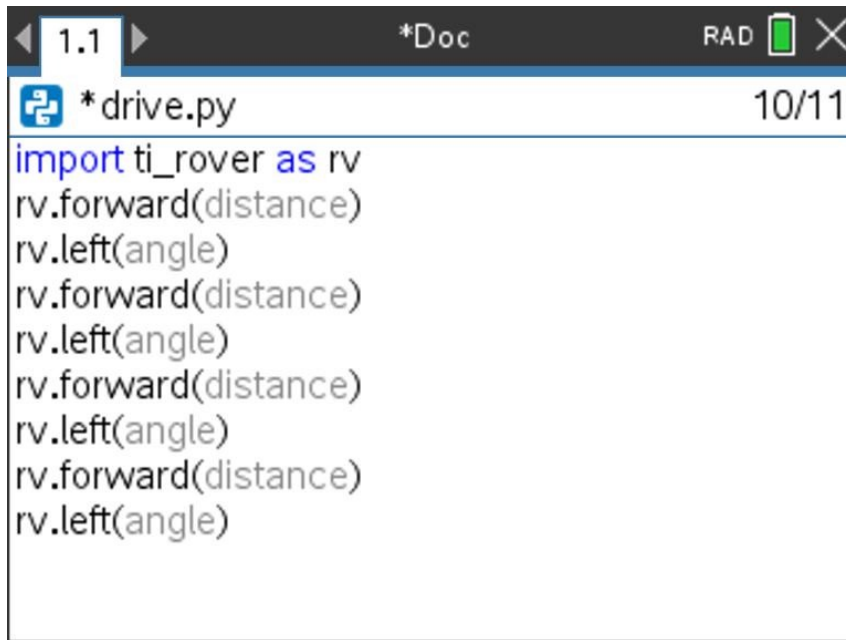
**Challenge Task: Try to make Yellow**

Find the `color_rgb()` function on the Rover Outputs menu.



# Explore angles

## New Program:



```
1.1 *Doc RAD 10/11
* drive.py
import ti_rover as rv
rv.forward(distance)
rv.left(angle)
rv.forward(distance)
rv.left(angle)
rv.forward(distance)
rv.left(angle)
rv.forward(distance)
rv.left(angle)
```

## Task: Drive a square.

**Challenge Task:** Try to drive an equilateral triangle.

The program above is a framework for driving a square. Enter values for distance and turn angle.

Press **[menu]** key to see Python Program Editor options.

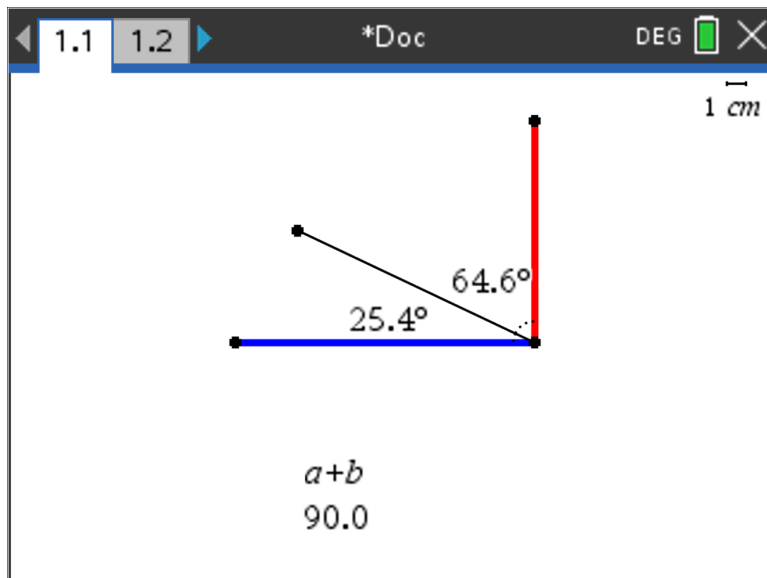
Press **[ctrl] [R]** to run the program from a Python shell on the next page.

Use **[ctrl] left** to move from the shell page back to the Python editor page.

# Quick Math Reminders

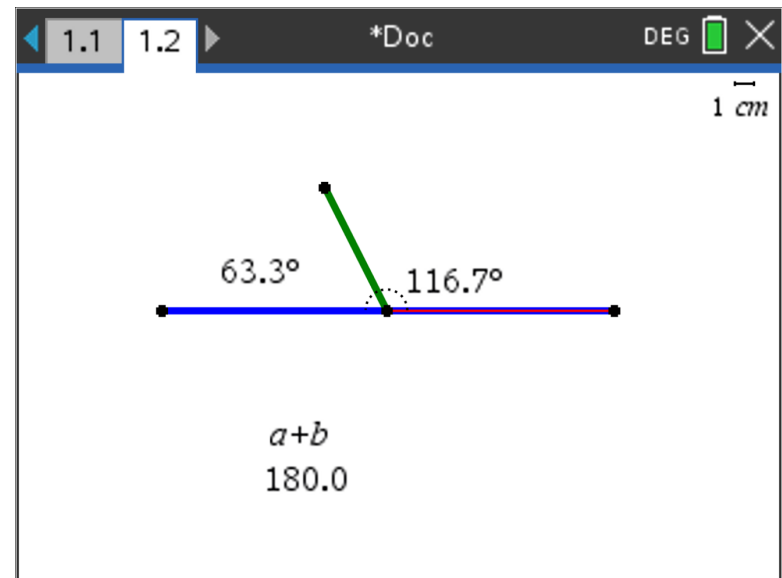
» Complementary Angles:

» Sum to 90 degrees



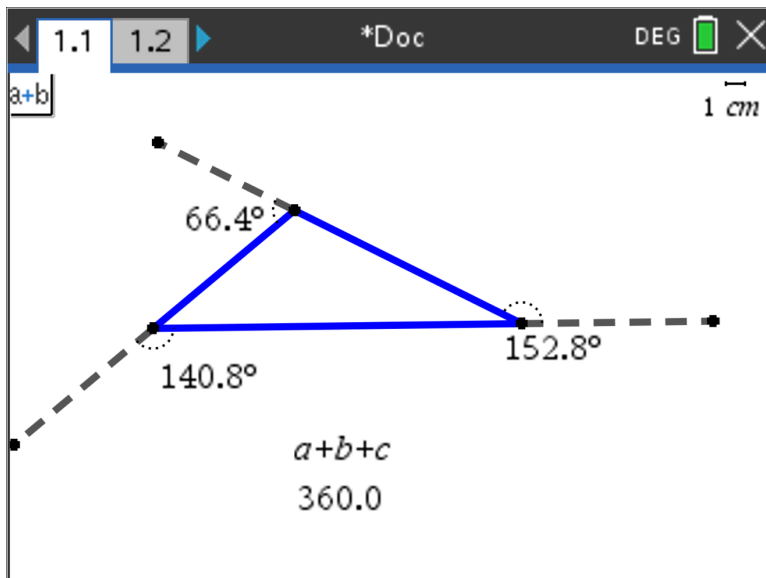
» Supplementary Angles:

» Sum to 180 degrees

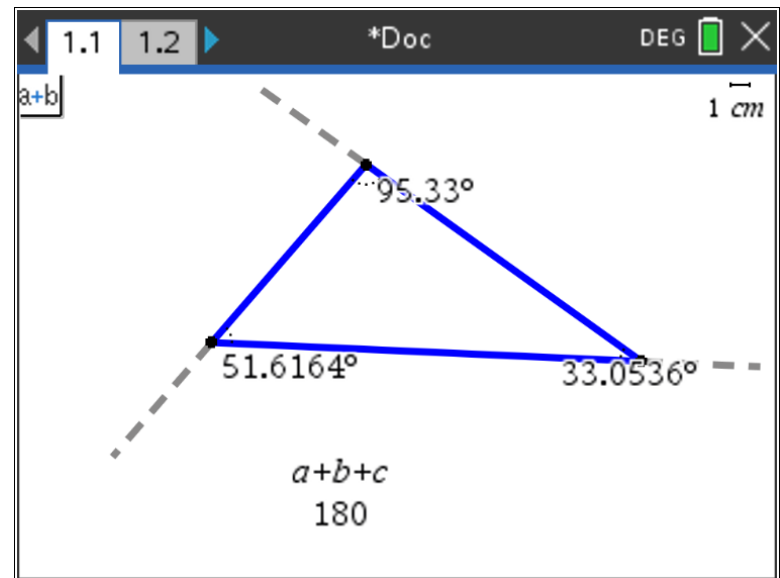


# Quick Math Reminders

» Exterior angles:

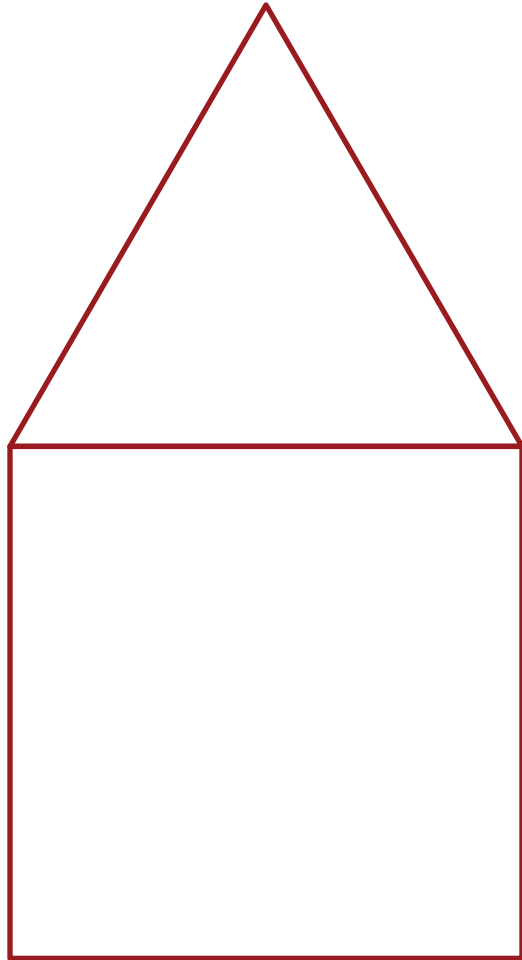


» Interior Angles:





# Logic Challenge

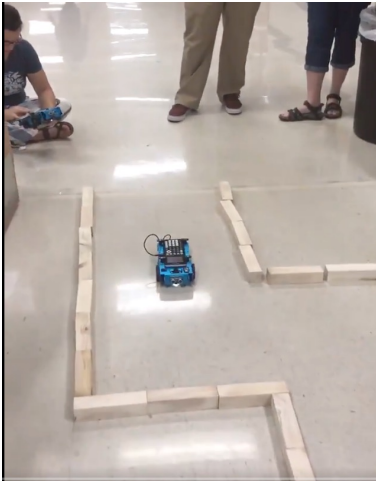


**Task: Drive the figure shown without crossing any lines or going back over a line and without picking up the pen.**

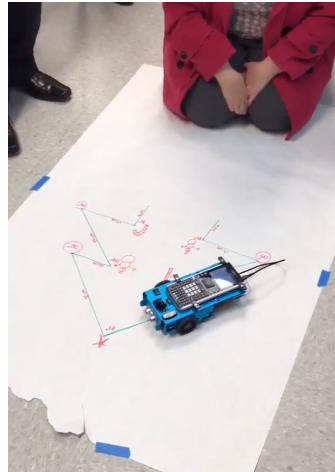
When you are ready put the pen in and trace your path



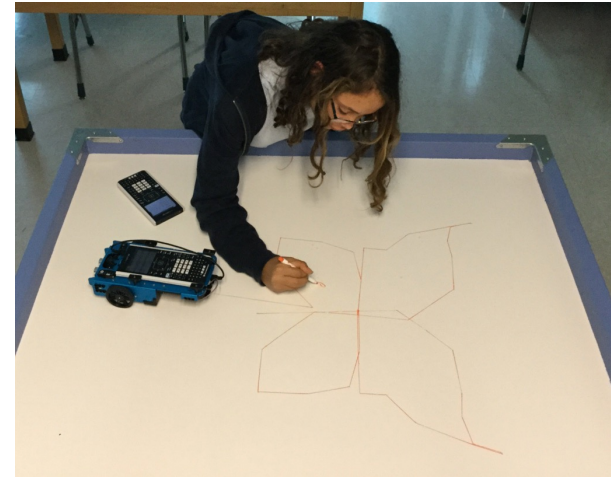
# Where can you go next with TI-Rover?



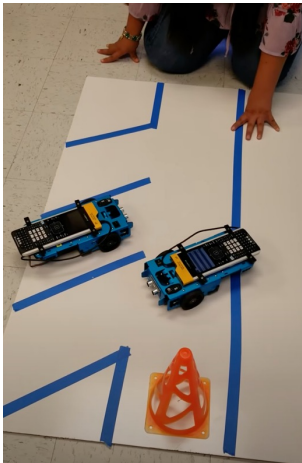
Drive an obstacle course



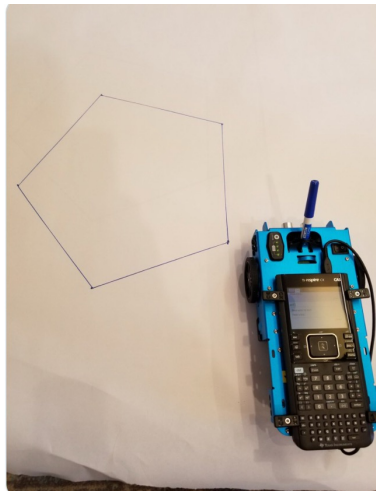
Drive a design



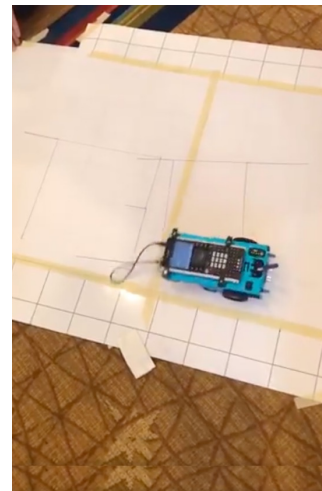
Draw artwork



Park your Rover



Use a For loop to draw polygons



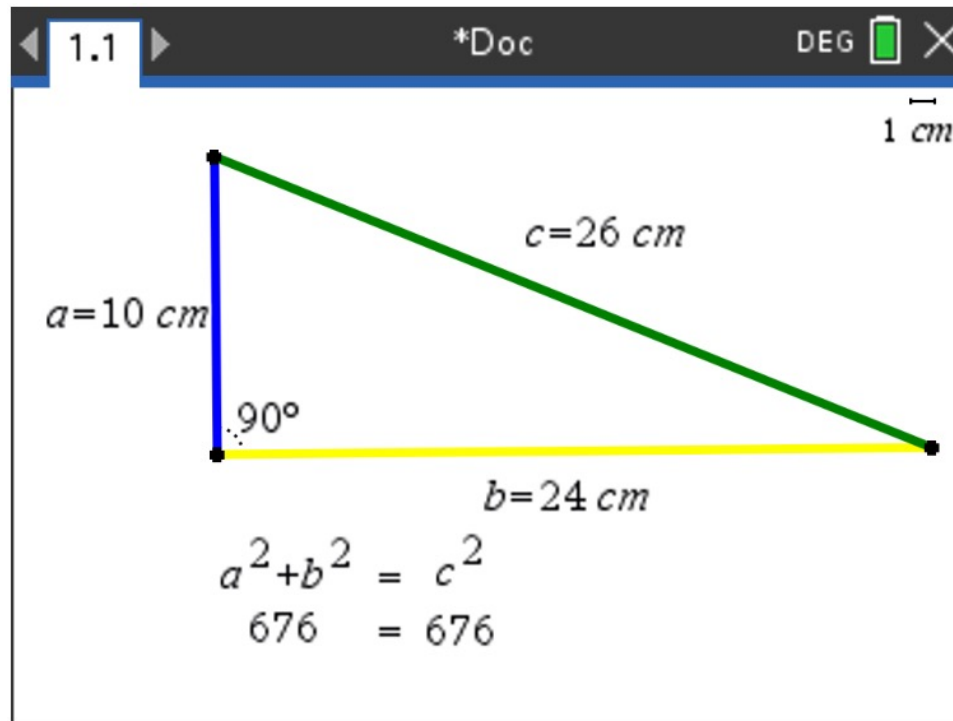
Write your name



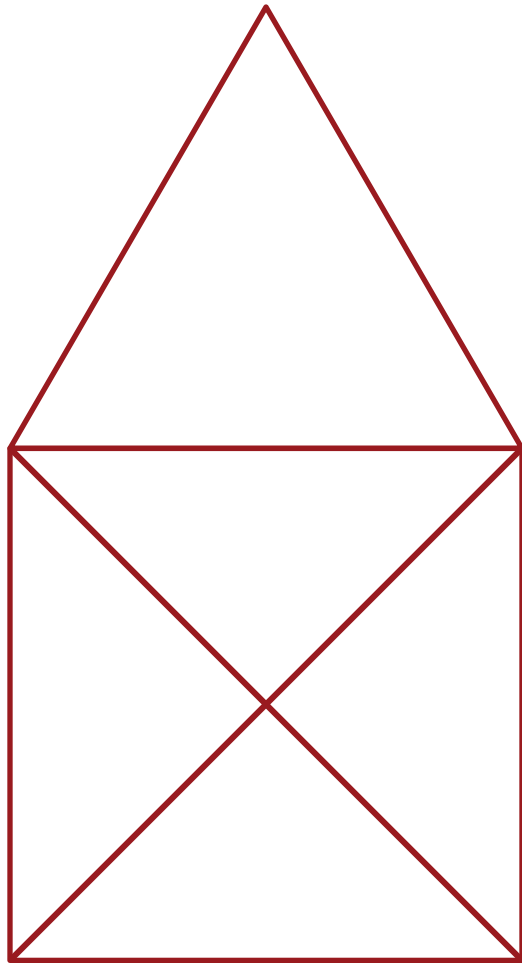
Navigate a map

# Quick Math Reminders

## » Pythagorean Theorem



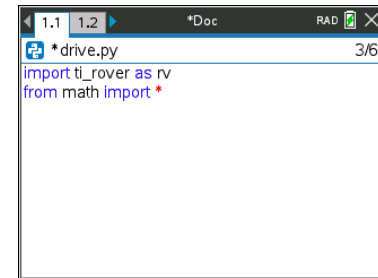
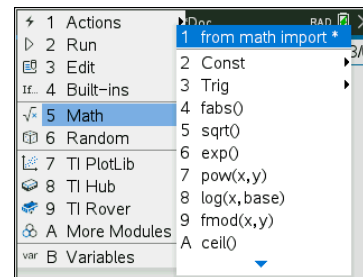
# Logic Challenge 2



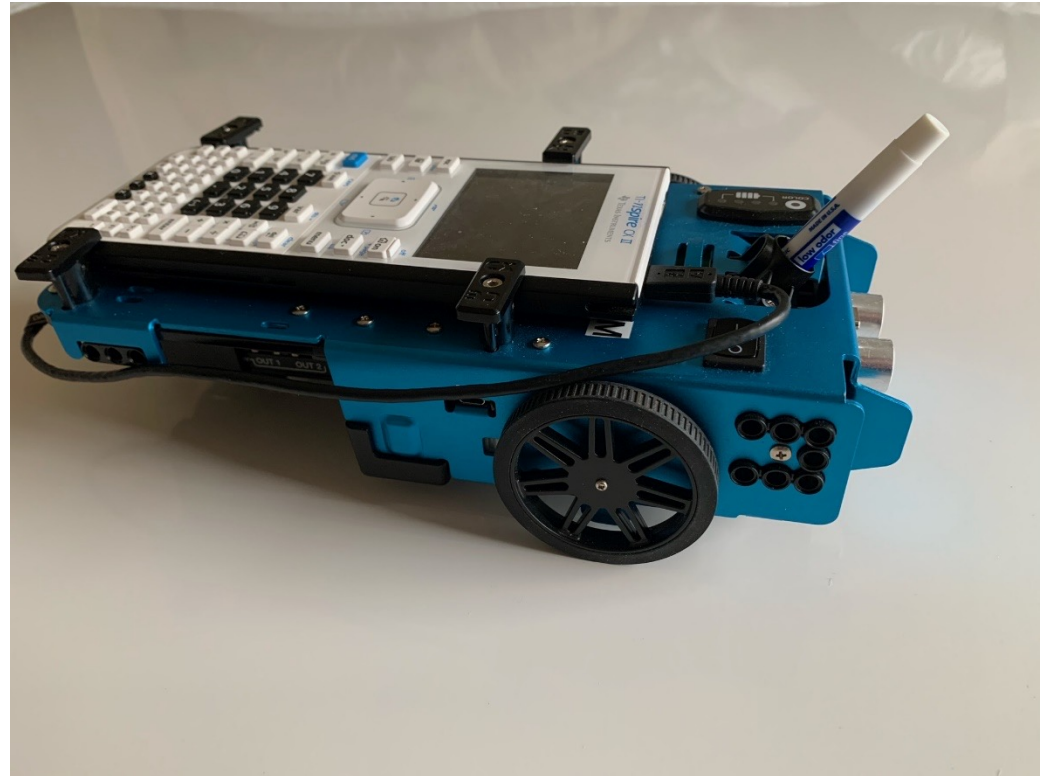
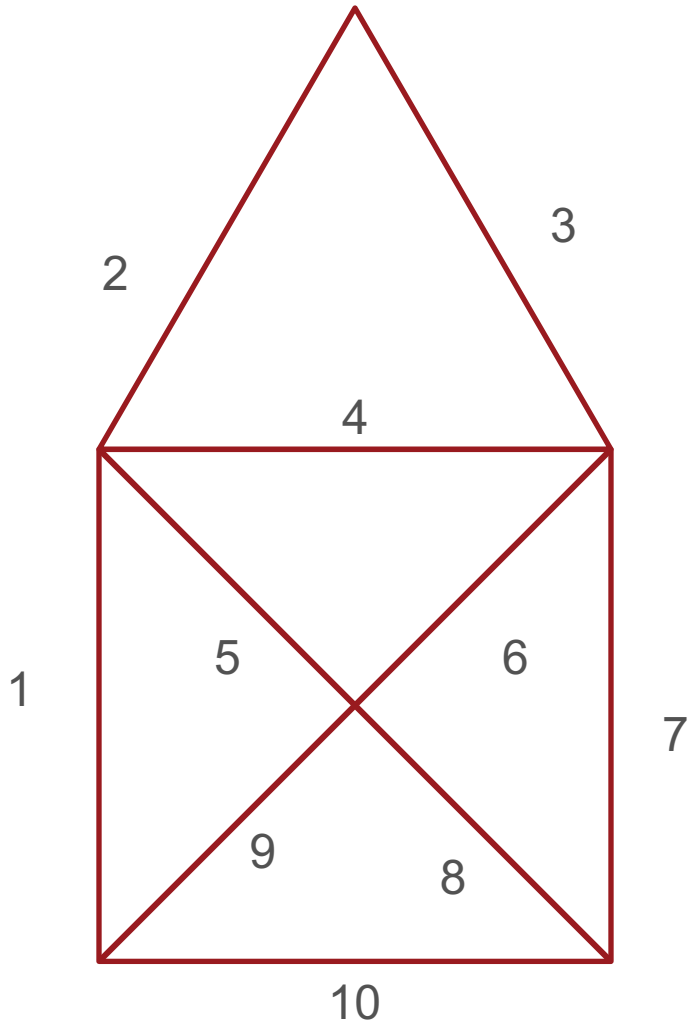
**Task: Drive the figure shown without crossing any lines or going back over a line and without picking up the pen.**

**When you are ready put the pen in and trace your path**

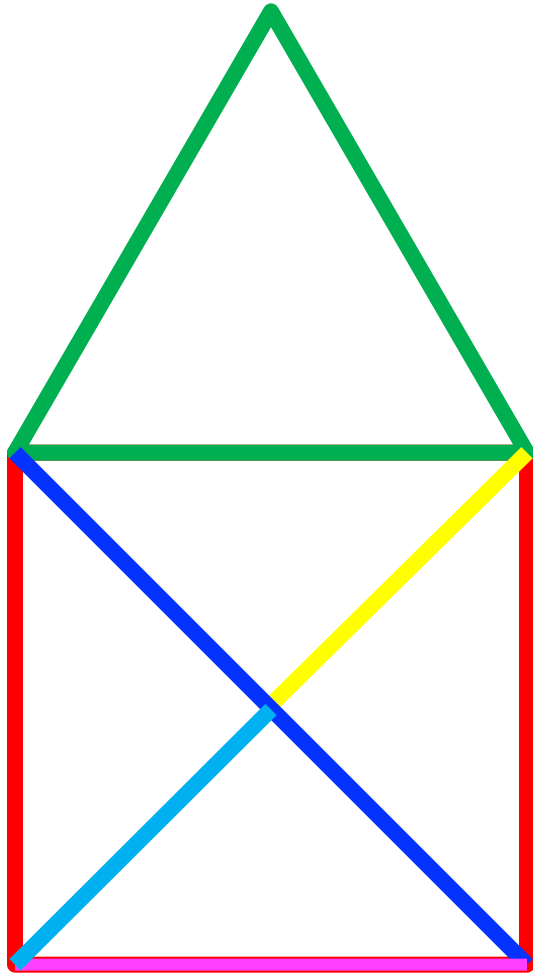
Import the Python Math module in addition to the Rover module for this challenge. The Math Module is needed for Square Root and other advanced functions.



# Logic Challenge 2



# Logic Challenge 3

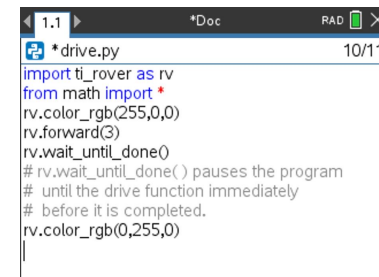
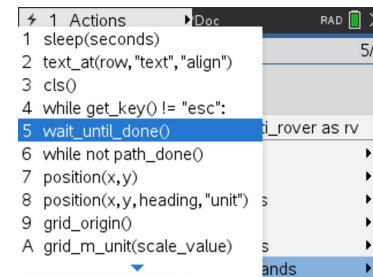
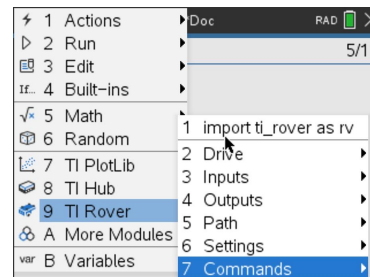


**Task: Drive the figure shown without crossing any lines or going back over a line and without picking up the pen.**

**Now match the colors using the RGB LED. Don't worry about using the pen.**

Import the Python Math module in addition to the Rover module for this challenge.

Use `wait_until_done()` from the Rover Commands menu to synchronize Rover drive functions with the RGB LED.



# Thank You



[www.TIstemProjects.com](http://www.TIstemProjects.com)

Contact [stem-team@ti.com](mailto:stem-team@ti.com) with questions