Meet TI-Rover
Geometry Challenges Day
TI-84 Plus CE
Python

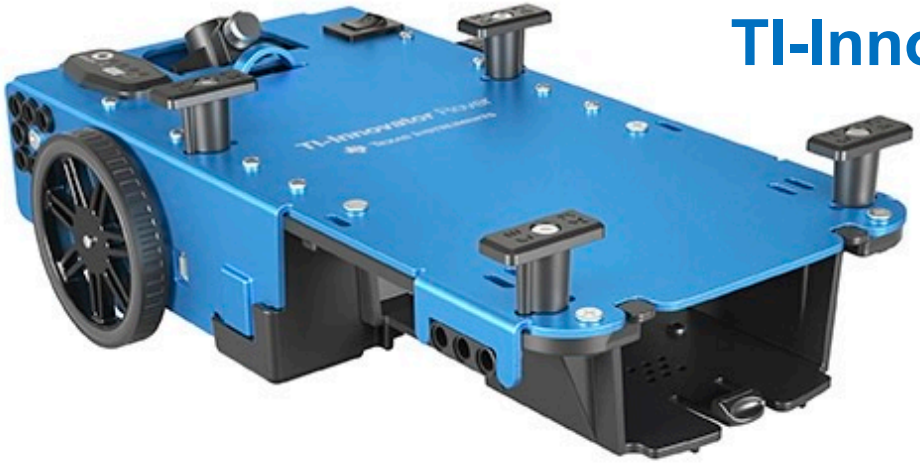
Texas Instruments

@ticalculators

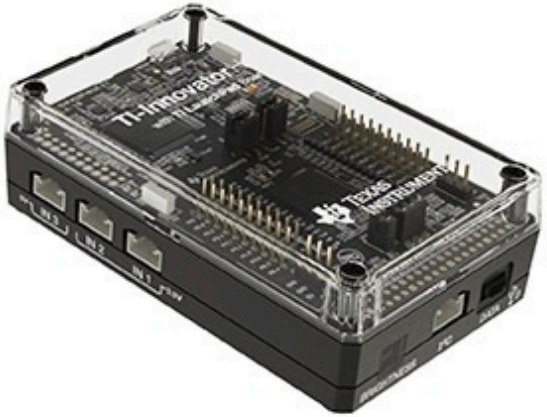
Meet the TI-Innovator™ Rover

TI Graphing Calculator

TI-Innovator™ Rover



TI-Innovator™ Hub



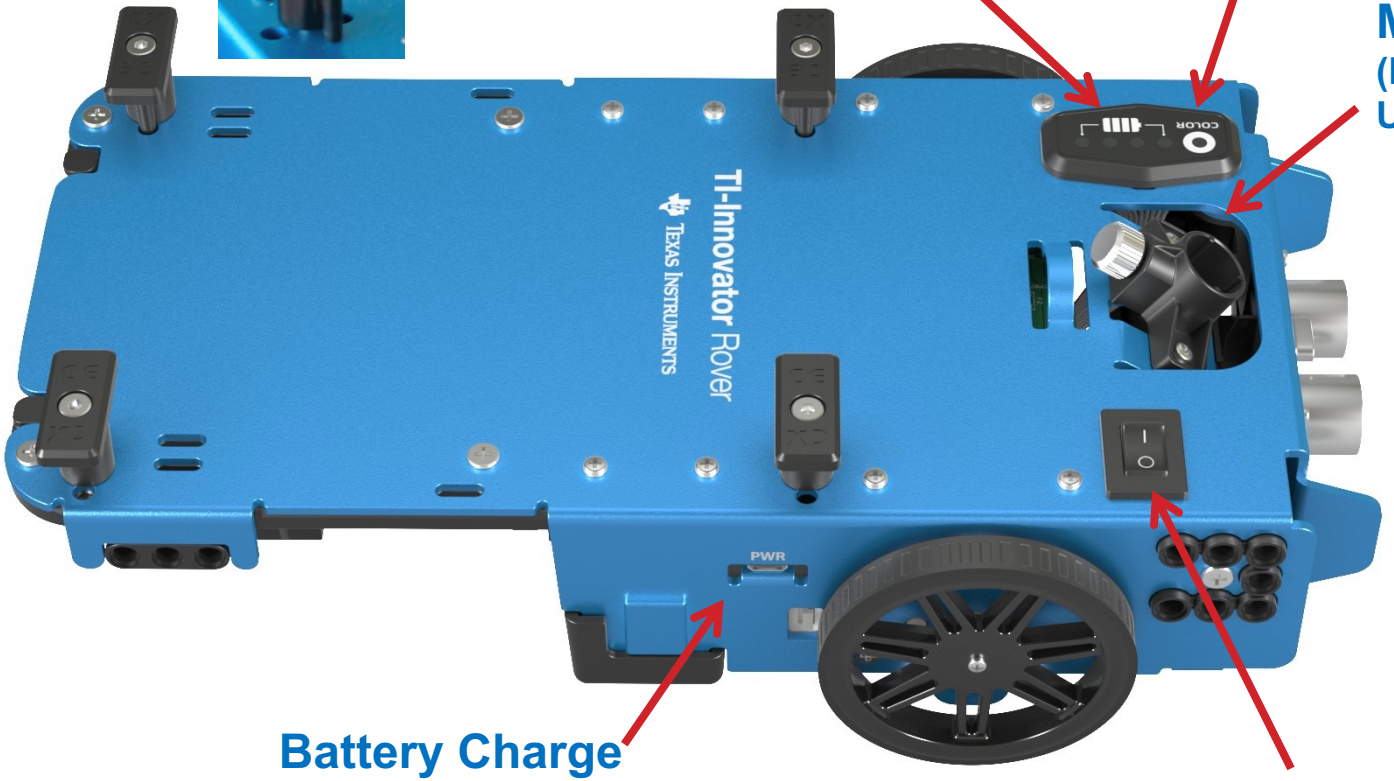
Rover from the top

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

Battery indicator

Red-Green-Blue (RGB) Color LED

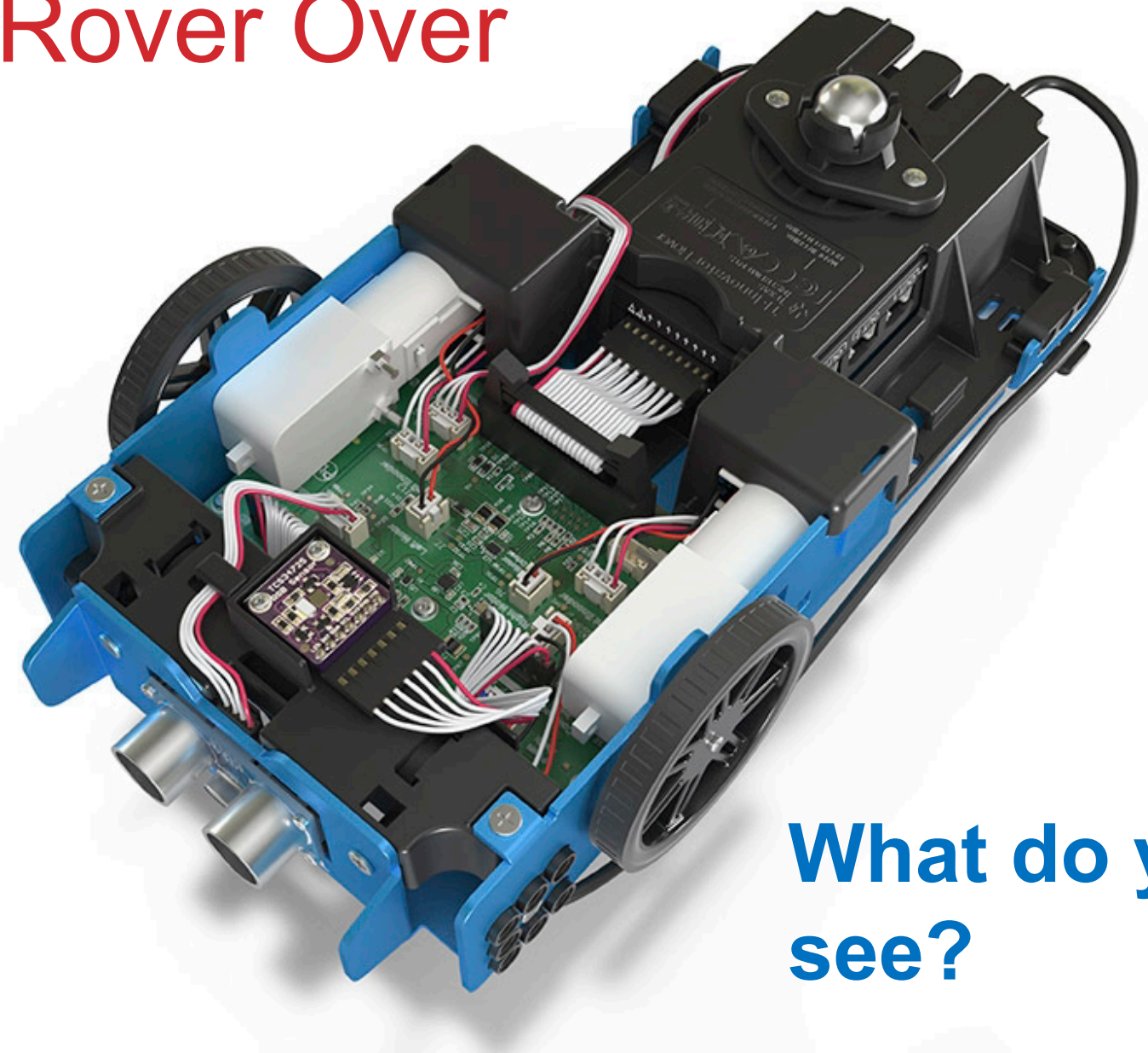
Marker holder
(Expo Fine and Ultra Fine sizes)



Battery Charge with USB micro to wall adapter.

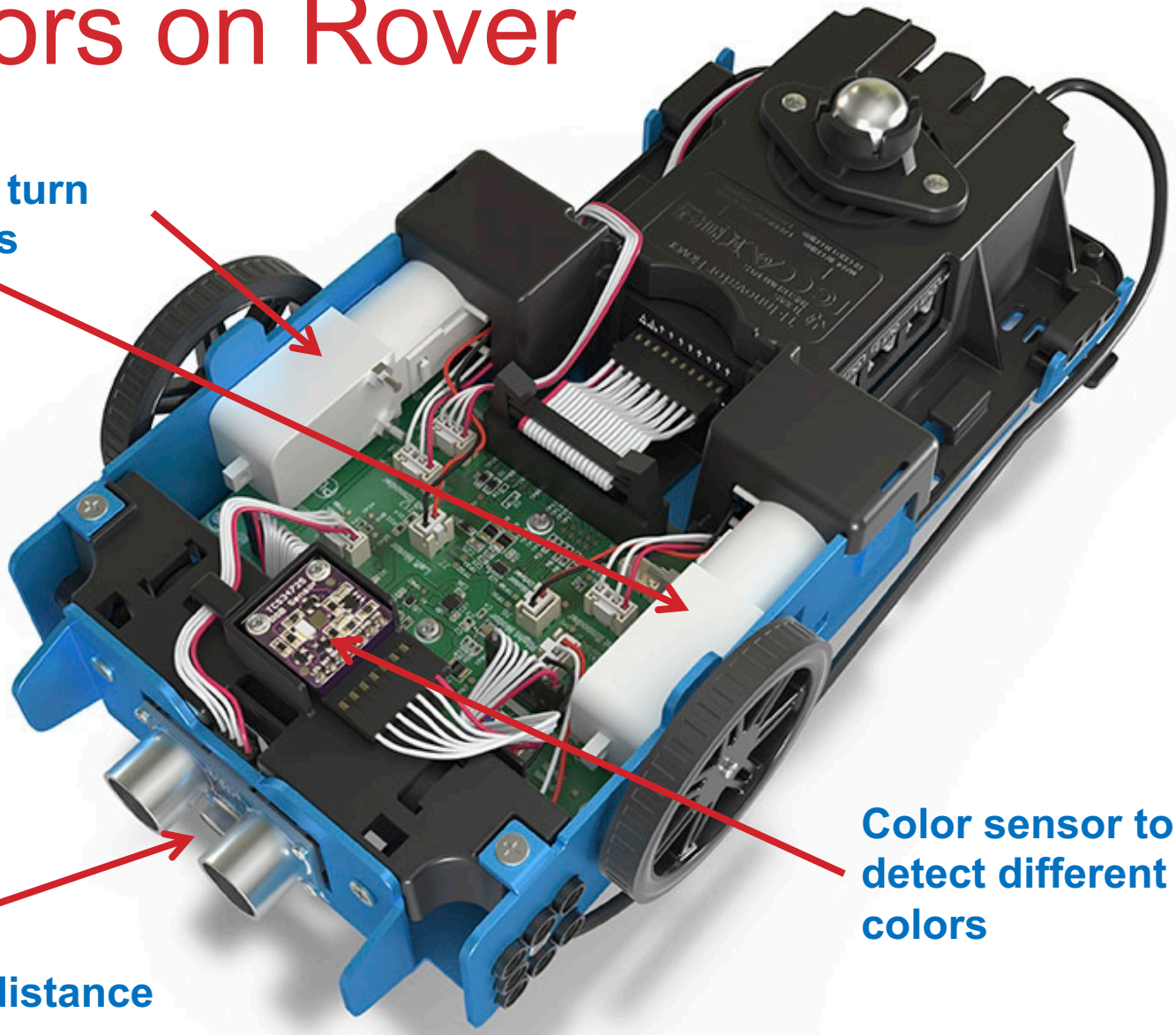
On/Off Switch

Turn Rover Over

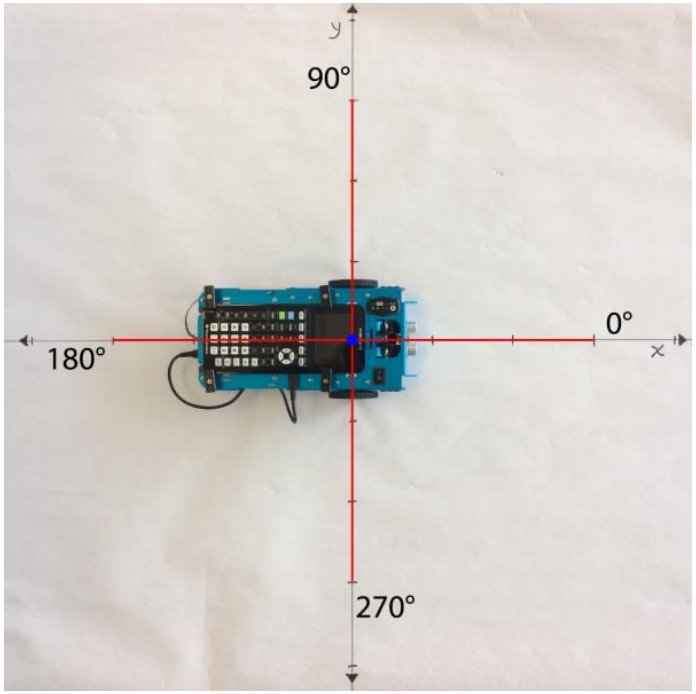


What do you see?

Sensors on Rover



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.

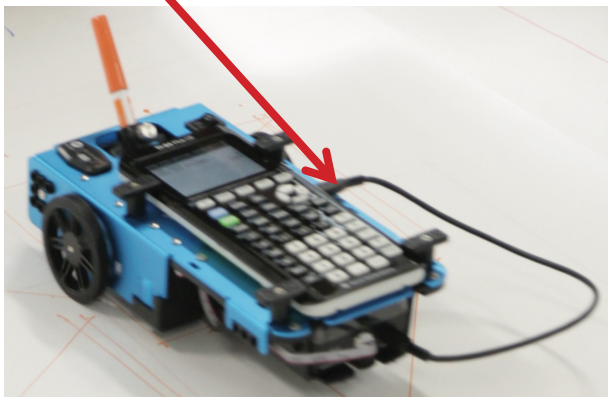
Connecting Rover to your calculator

1 **Make sure that your Rover is switched on.**

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

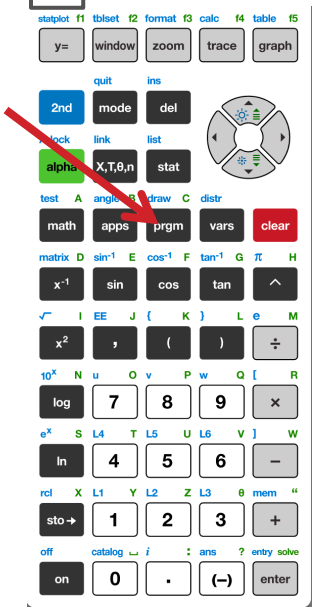
2 **Plug B side into USB B port of the Rover Hub.**

Unit-to-unit cable



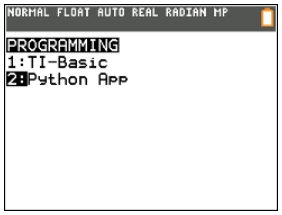
Creating a new Python Program

1



Press the **[prgm]** key to create, edit and execute TI-Python programs.

2

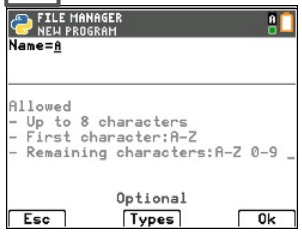


Press **down arrow [enter]** or Press **[2]** to select 2: Python App

3

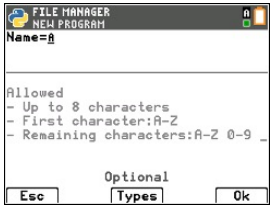
You have the option to run, edit, create or manage programs.

4



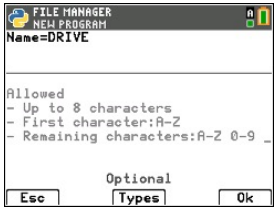
Press **[New]** softkey (zoom button)

5



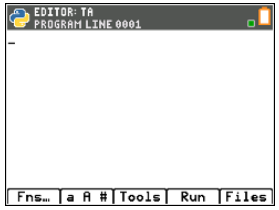
You are prompted to enter a program name. The blinking A cursor shows that you are in alpha entry mode. The green alpha labels on the keys are active.

6



Type your program name and press **[Ok].**

7



You are now in position to begin entering statements to your program.

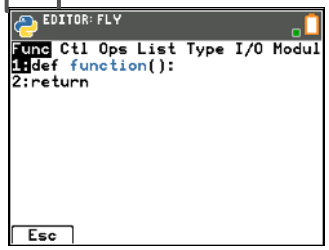
Entering a TI-Rover Program –

importing the TI-Rover module and connecting to a Rover

1

The Python program editor uses an insert cursor and a backspace delete.
Press **[Fns…]** softkey to see functions to use in your program.

2

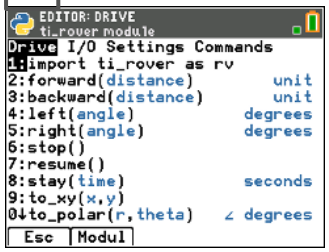


Press **right arrow** repeatedly or **left arrow** to move to the Modul menu.

3

You will see a menu of installed modules available to use functions from. Select **7:ti_rover**.

4



Select **1:import ti_rover as rv**.

5

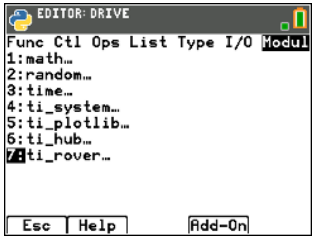
The ti_rover module import statement is pasted to your program. The ti_rover import statement is required at the beginning of every Rover program. This import statement brings in Rover functions to use in your program, sets Rover's initial position and sets up communication between the Rover and the Hub.

Entering a TI-Rover Program

1

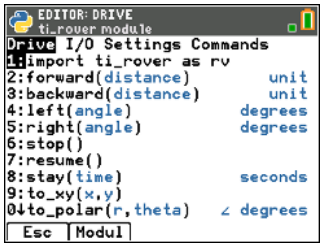
You are now ready to enter functions to control your Rover. Navigate to the Rover menus by pressing **[Fns…]** then **arrow** to the Modul menu.

2



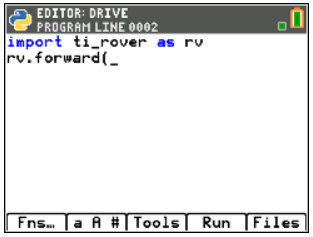
Then **select ti_rover...** to see options.

3



You begin on the Drive menu. **Select** the **2:forward()** function.

4

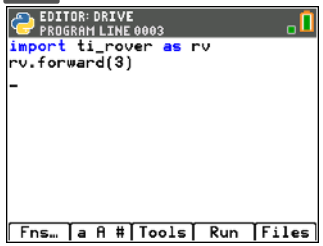


Enter a value for the number of Rover units to drive forward. **Arrow to the end of the statement** and press **[enter]** to move to the next statement.

A faster approach is to use **[2nd] [enter]** from any place on a line to complete the statement and move the cursor to the beginning of a blank line below.

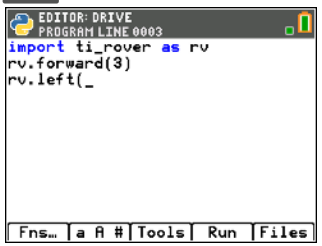
Note: It is important that each statement begin on a new line.

5



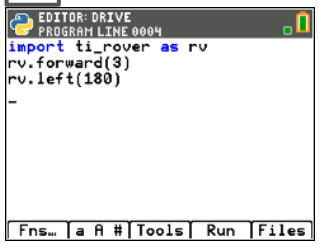
Navigate to the Drive menu again by press **[fns…]**, **left arrow**, **7:ti_rover...**,**4:left()** to select the **left turn function**.

6



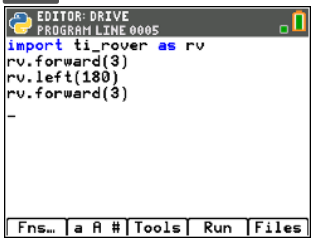
Enter a value for the angle to turn in degrees. Press **[2nd] [enter]** to move to the next statement.

7



Navigate to the Drive menu again, then select **2:forward()**. After the function is pasted **enter the Rover units** to drive. Press **[2nd] [enter]** to move to the next statement..

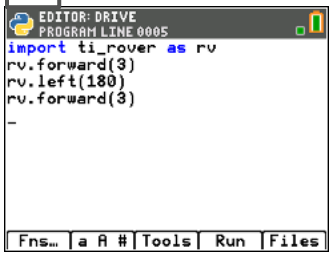
8



You are now ready to run your TI-Rover program.
.

Running a TI-Rover Program

1



You are now ready to run your program.

Before pressing **[Run]** go through the pre-drive checklist.

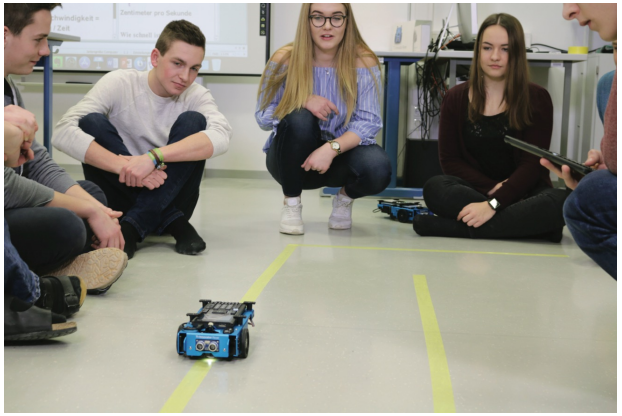
1. Make sure that TI-Rover is turned ON.
2. Make sure that the calculator unit-to-unit cable is connected to the Hub inside the Rover. Plug the B end of the cable into the Data USB B port of the Hub. Plug the A end of the cable into the calculator.
3. Press **[Run]**.

2

The program will run in the Python shell. You will receive messages on the status of the program.

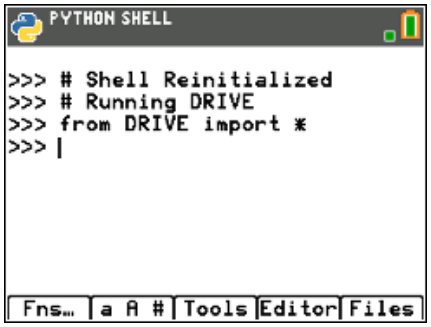
You can run the program again by pressing **[Tools]** and selecting **1:Rerun Last Program** from the menu.

You can return to the program editor by pressing **[Editor]**.



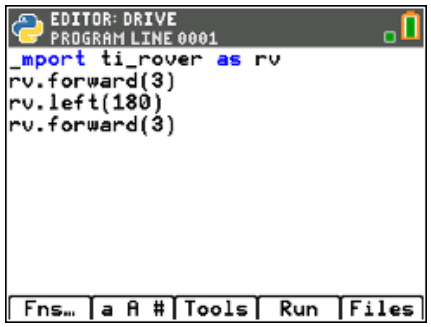
Editing a Rover Program

1



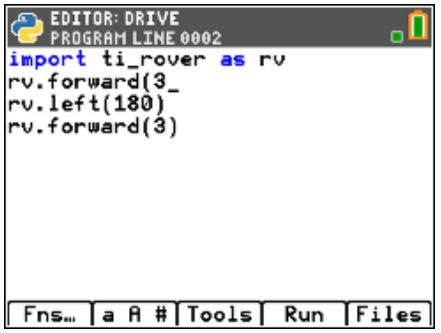
Press **[Editor]** to go back to your Python editor page.

2



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

3



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

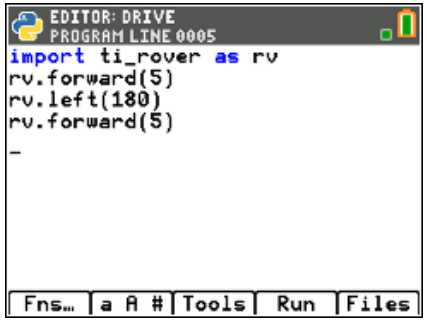
4

Type in a new value for distance, **right arrow** to the end of the line, then **down arrow** to position the cursor to change the value of the second forward() function.

5

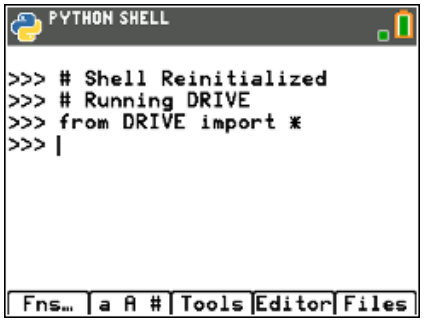
Press **[del]** to backspace over the current distance value. **Type in a new value** for distance, Press **[2nd] [enter]** to move to the next statement.

6



Press **[Run]** to run the program in the Python shell.

7



TI-Rover Module Menus

Drive

```
EDITOR: DRIVE
ti_rover module
Drive I/O Settings Commands
1:import ti_rover as rv
2:forward(distance)          unit
3:backward(distance)         unit
4:left(angle)              degrees
5:right(angle)             degrees
6:stop()
7:resume()
8:stay(time)               seconds
9:to_xy(x,y)
0↓to_polar(r,theta)    ∠ degrees
A:to_angle(angle)          degrees
B:forward_time(time)       seconds
C:backward_time(time)      seconds
D:forward(distance,"unit") ▸
E:backward(distance,"unit") ▸
F:left(angle,"unit") ▸
G:right(angle,"unit") ▸
H:forward_time(T,S,"unit") ▸
I↓backward_time(T,S,"unit") ▸
J:forward(D,"unit",S,"unit") ▸
K:backward(D,"unit",S,"unit") ▸
L:disconnect_rv()      Disconnect
```

Input/Output (I/O)

```
EDITOR: DRIVE
ti_rover module
Drive I/O Settings Commands
1:Inputs…
2:Outputs…
3:Path…
```

```
EDITOR: DRIVE
ti_rover module
Inputs
1:ranger_measurement()     meters
2:color_measurement()         1-9
3:red_measurement()         0-255
4:green_measurement()       0-255
5:blue_measurement()        0-255
6:gray_measurement()        0-255
7:encoders_gyro_measurement()
8:gyro_measurement()       degrees
9:ranger_time()            seconds
```

```
EDITOR: DRIVE
ti_rover module
Outputs
1:color_rgb(r,g,b)          0-255
2:color_blink(freq,time)
3:color_off()
4:motor_left(speed,time)     ±255
5:motor_right(speed,time)    ±255
6:motors("ldir",L,"rdir",R,T) ▸
```

```
EDITOR: DRIVE
ti_rover module
Path
1:waypoint_xythdrn()
2:waypoint_prev()
3:waypoint_eta()
4:path_done()
5:pathlist_x()
6:pathlist_y()
7:pathlist_time()
8:pathlist_heading()
9:pathlist_distance()
0↓pathlist_revs()
A:pathlist_cmdnum()
B:waypoint_x()
C:waypoint_y()
D:waypoint_time()
E:waypoint_heading()
F:waypoint_distance()
G:waypoint_revs()
```

Settings

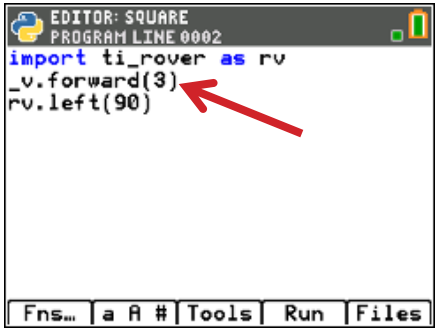
```
EDITOR: DRIVE
ti_rover module
Drive I/O Settings Commands
1:units/s
2:m/s
3:revs/s
4:units
5:m
6:revs
7:degrees
8:radians
9:grads
0:clockwise
A:counterclockwise
```

Commands

```
EDITOR: DRIVE
ti_system module
Drive I/O Settings Commands
1:from ti_system import *
2:sleep(seconds)
3:disp_at(row,"text","align") ▸
4:disp_clr()  clear text screen
5:disp_wait()              [clear]
6:disp_cursor()      0=off 1=on
7:while not escape():      [clear]
8:wait_until_done()
9:while not path_done():
0↓position(x,y)
A:position(x,y,heading,"unit") ▸
B:grid_origin()
C:grid_m_unit(scale_value)
D:path_clear()
E:zero_gyro()
```

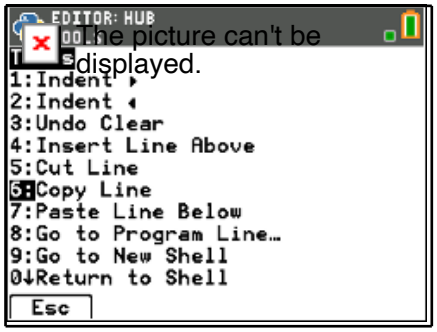
Copying and Pasting a Line of Code

1



Use **arrow keys** to move the cursor to a position anywhere on the line that you would like to copy.

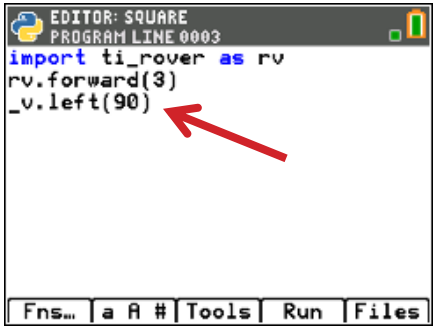
2



Press **[Tools]** then select **6:Copy Line** from the menu.

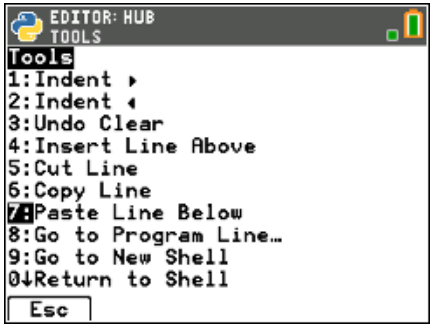
After you select you will be returned to the editor.

3



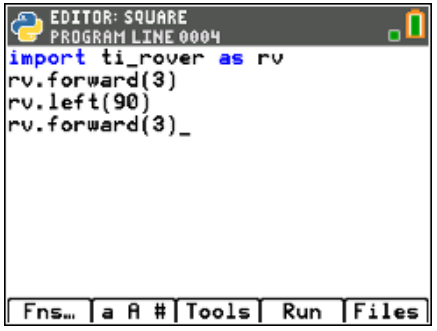
Use **arrow keys** to move the cursor to any location on the line above where you would like to insert the copied line.

4



Press **[Tools]** then select **7:Paste Line Below** from the menu. The copied line will be pasted.

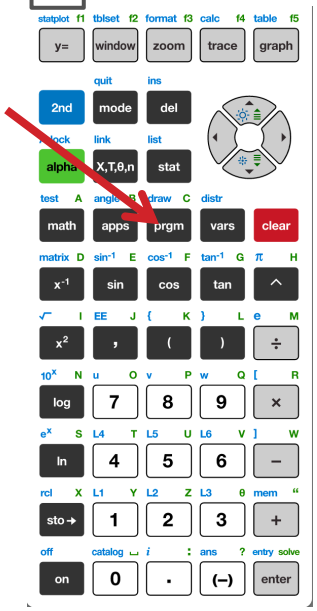
5



You can paste again by returning to the **[Tools]** menu and selecting **7:Paste Line Below.**

Opening an existing Python Program File

1



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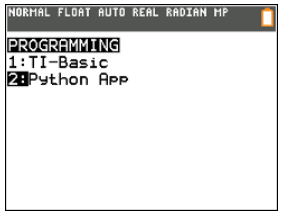
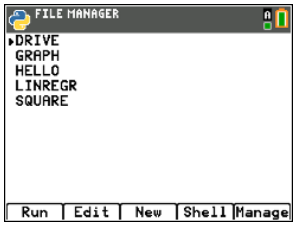
2



Press **[enter]** or Press **[2]** to select 2: Python App

3

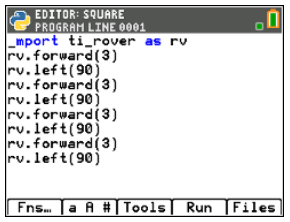


To edit an existing program, use the **Up and Down Arrow keys** to select a program.

4

Press **[Edit]** to open with Python Editor with the selected program.

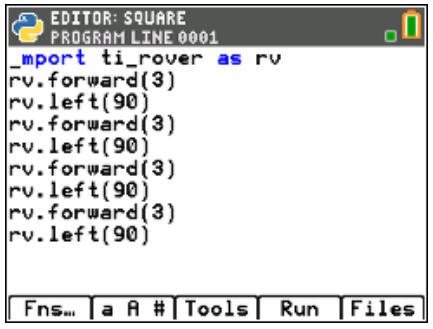
5



You can now make changes to the program or run the program.

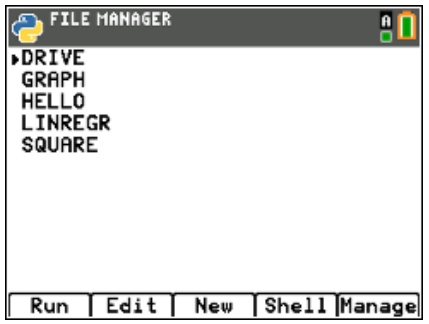
Copying/Replicating a Python Program File

1



Press **[Files]** to return to the file management screen.

2

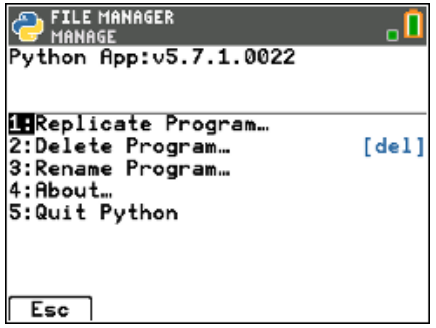


Use the **Up and Down Arrow keys** to select a program.

3

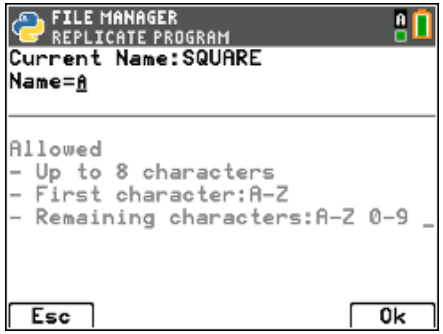
Press **[Manage]** to see file options.

4



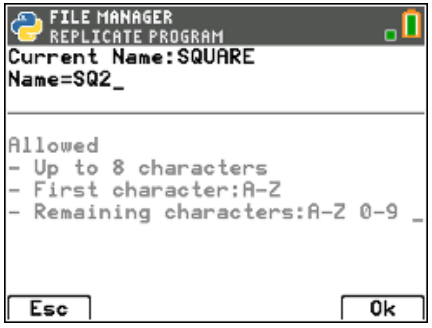
Select **1:Replicate Program** to receive a prompt.

5



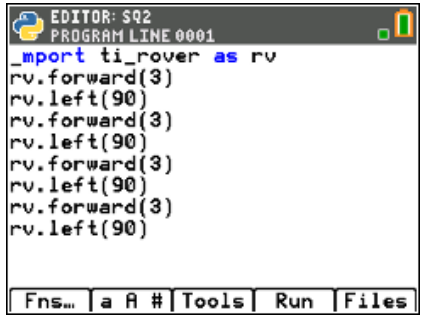
Type in the name of the new program using the green alpha key labels.

6



To use a number in the name, exit alpha mode by pressing **[2nd] [alpha]** then a **number key**.
Press **[Ok]** to finish the dialogue.

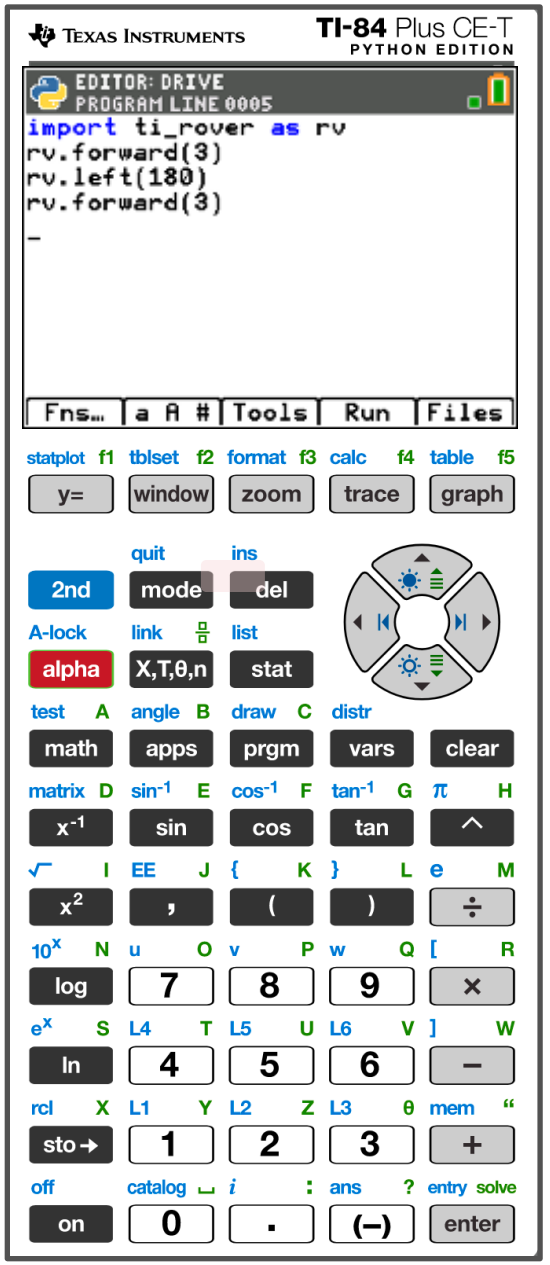
7



You are now in the editor ready to make changes or to run the new program.

Entry and Edit Tips

- Use **number key shortcuts** or **arrow keys** and **[enter]** to select from menus
- Use **arrow keys** to move the cursor around the screen.
- Use **[alpha] repeatedly** to cycle from numeric, to lower case alpha to upper case alpha entry mode. The cursor indicates the current mode.
- Use **[2nd] [A-lock]** to lock to alpha entry or to return to numeric entry.
- Use **[Fns…] softkey** to bring up Python function menus, including the **Modul (modules)** menu.
- Use **[clear]** or **[Esc] softkey** to back out of a menu.
- Use **[del]** as a destructive backspace
- Use **[2nd] [enter]** from any place on a line to complete the statement and move the cursor to the beginning of a blank line below.
- Use **[Tools] softkey** menu to undo a clear and to copy, cut, paste and more.
- Use **[Editor] softkey** to return to the editor from the Shell.
- Use **[2nd] [quit]** to leave the Python app and return to the calculator.



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MAKE IT MOVE!

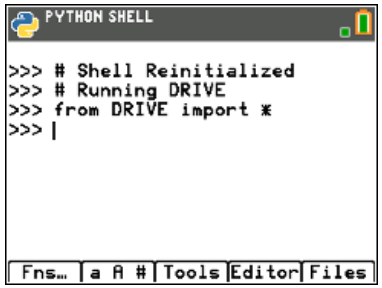
New Program:

Press **[Fns…], left arrow,** then **7:ti_rover…** for the Rover menus.

Press **[Run]** to run the program in the Python shell.

Task: Discover how far Rover drives per unit.

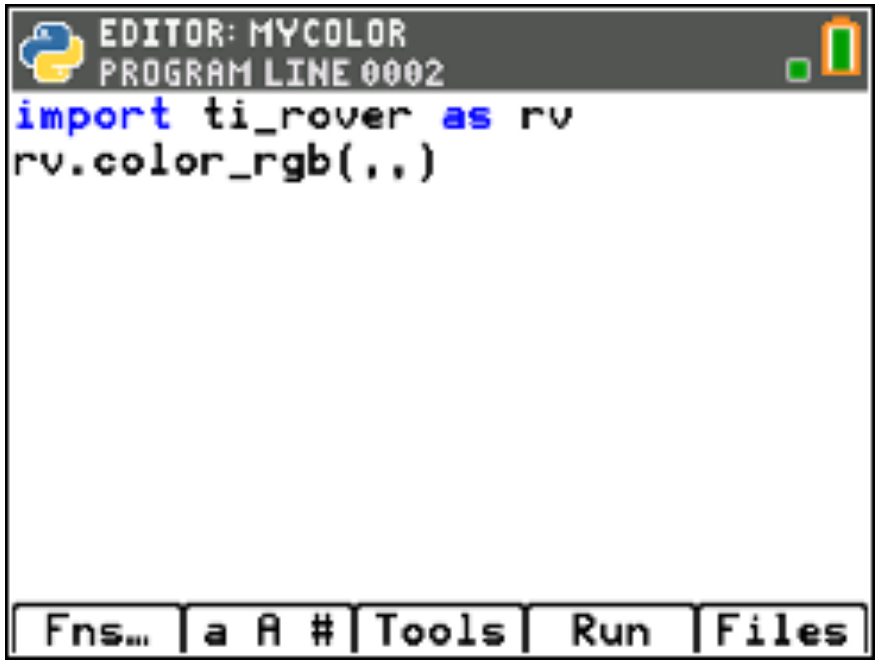
Use differing values (1-20) to determine what 1 Rover unit is.



From the Python shell, press **[Editor]** to move from the shell to the Python editor.

Set the color

New Program:



Press **[Fns…], left arrow,** then **7:ti_rover…** for the Rover menus.

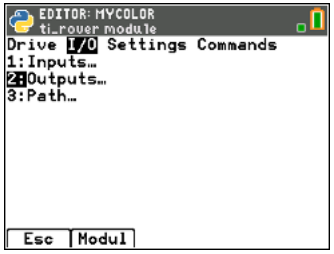
Press **[Run]** to run the program in the Python shell.

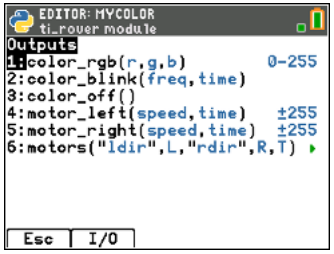
Task: Set the color output of the RGB LED.

Each color takes a value (0-255).

Challenge Task: Try to make Yellow

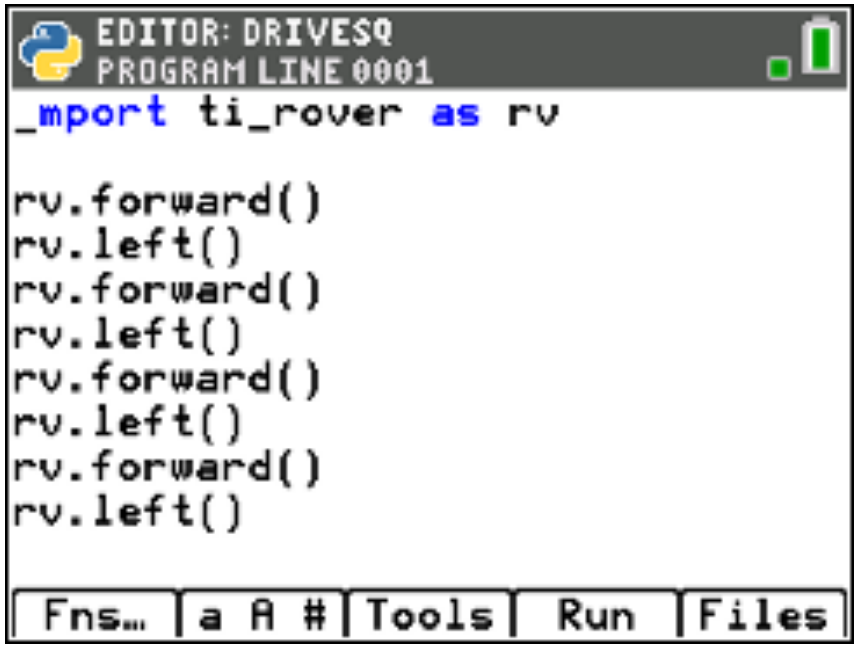
Find the color_rgb( ) function on the Rover Outputs menu. Enter values for the red, green and blue components of the color to display.





Explore angles

New Program:



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

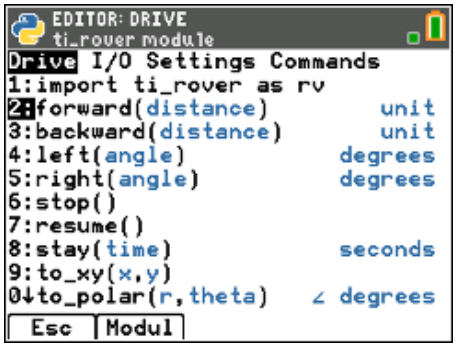
Press **[Fns…], left arrow,** then **7:ti_rover…** for the Rover menus.

Press **[Run]** to run the program in the Python shell.

Task: Drive a square.

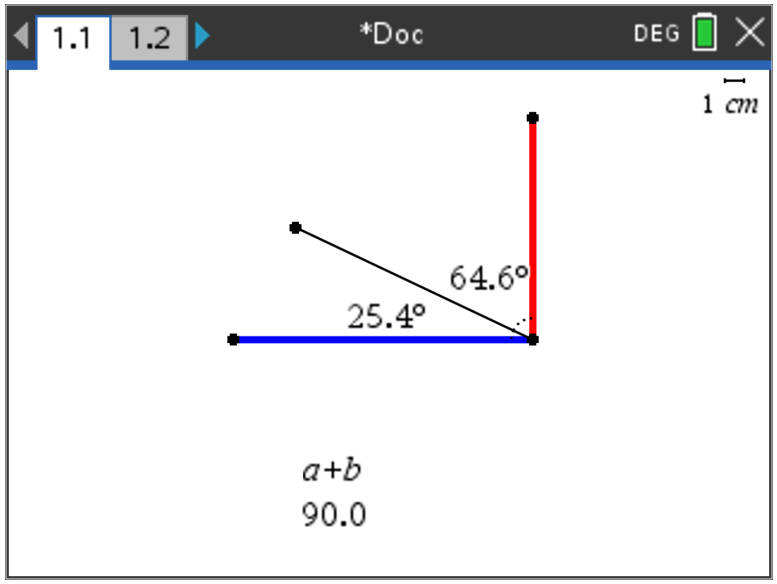
Challenge Task: Try to drive an equilateral triangle.

See the inputs for the most common drive functions below.

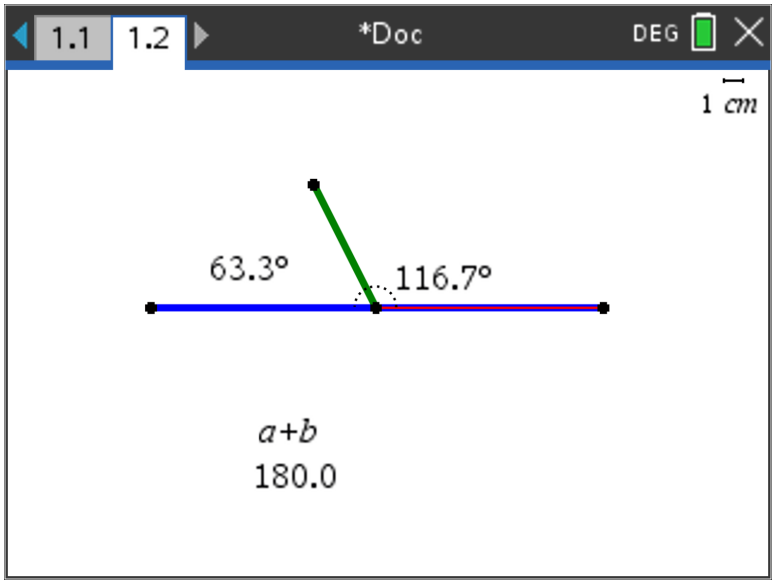


Quick Math Reminders

- Complementary Angles:
  - Sum to 90 degrees

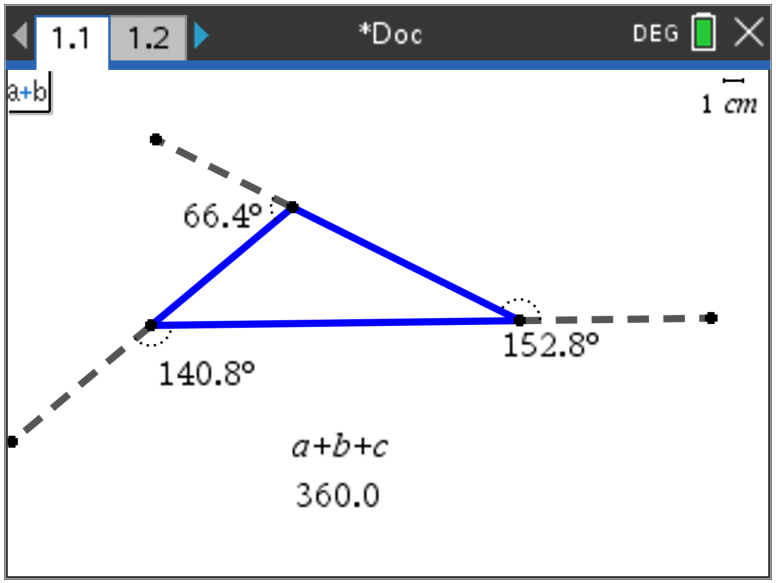


- Supplementary Angles:
  - Sum to 180 degrees

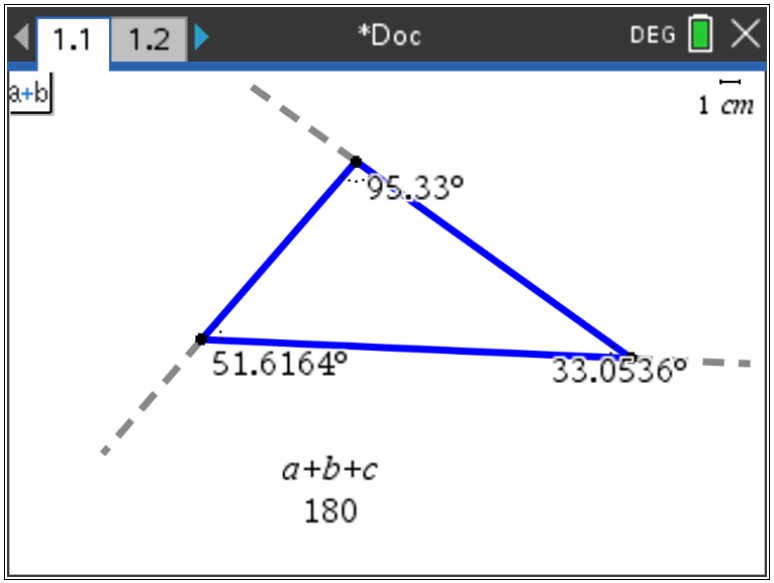


Quick Math Reminders

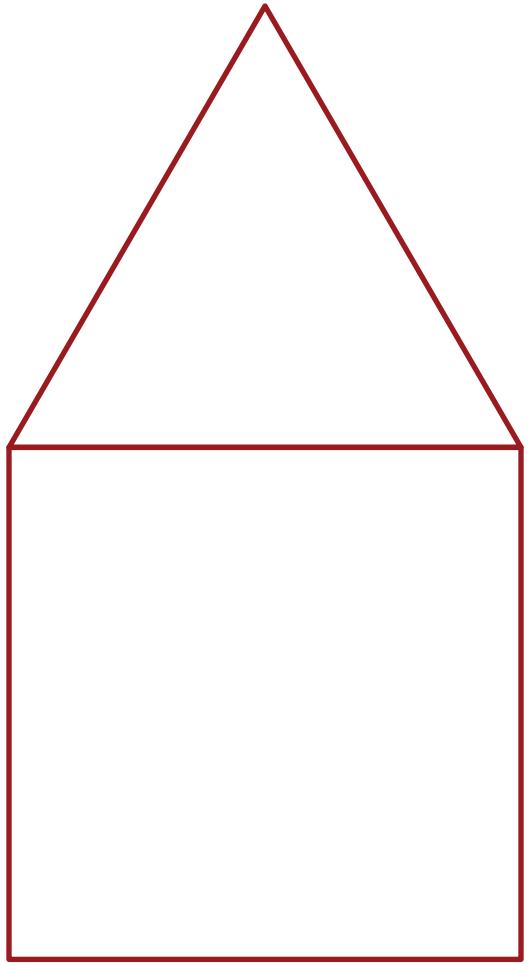
» Exterior angles:



» Interior Angles:

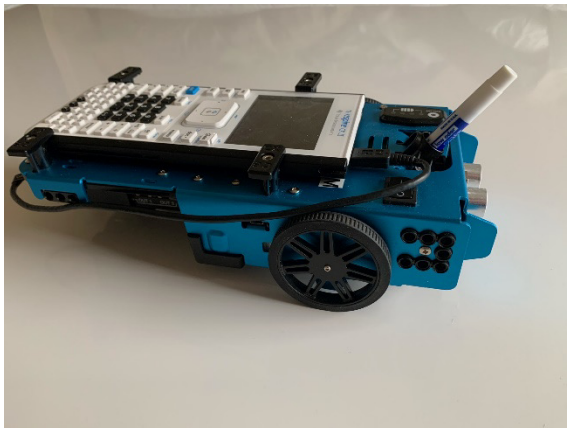


Logic Challenge

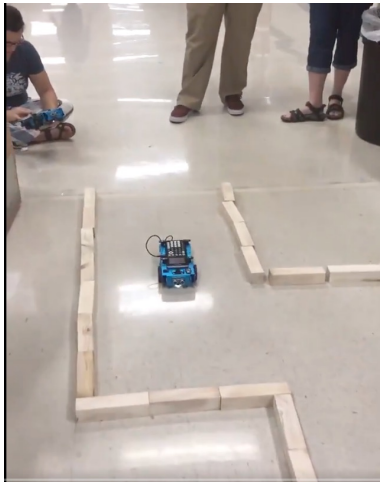


Task: Drive the figure shown without crossing any lines or going back over a line and without picking up the pen.

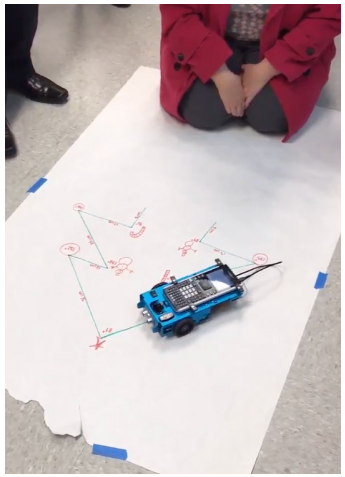
When you are ready put the pen in and trace your path



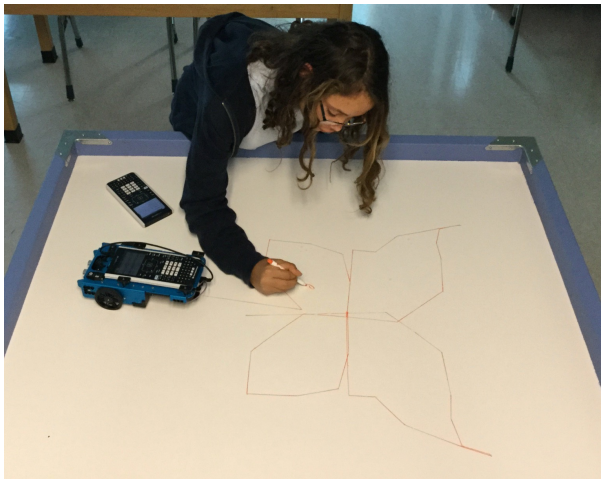
Where can you go next with TI-Rover?



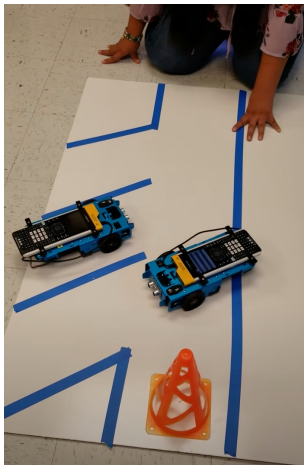
Drive an obstacle course



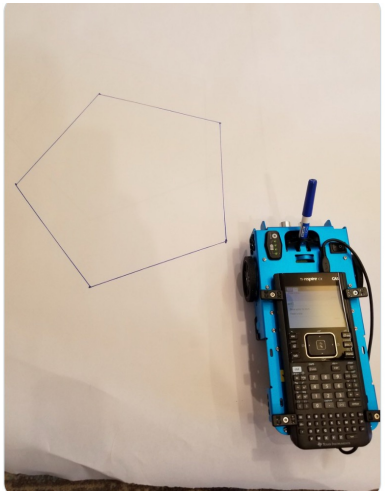
Drive a design



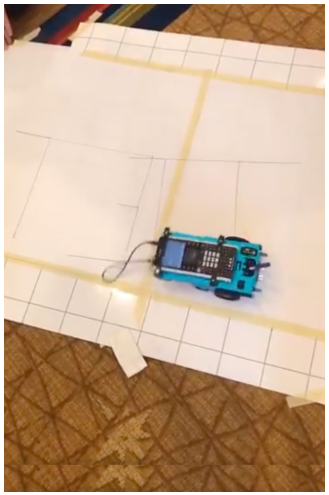
Draw artwork



Park your Rover



Use a For loop
to draw polygons



Write your name

Navigate a map

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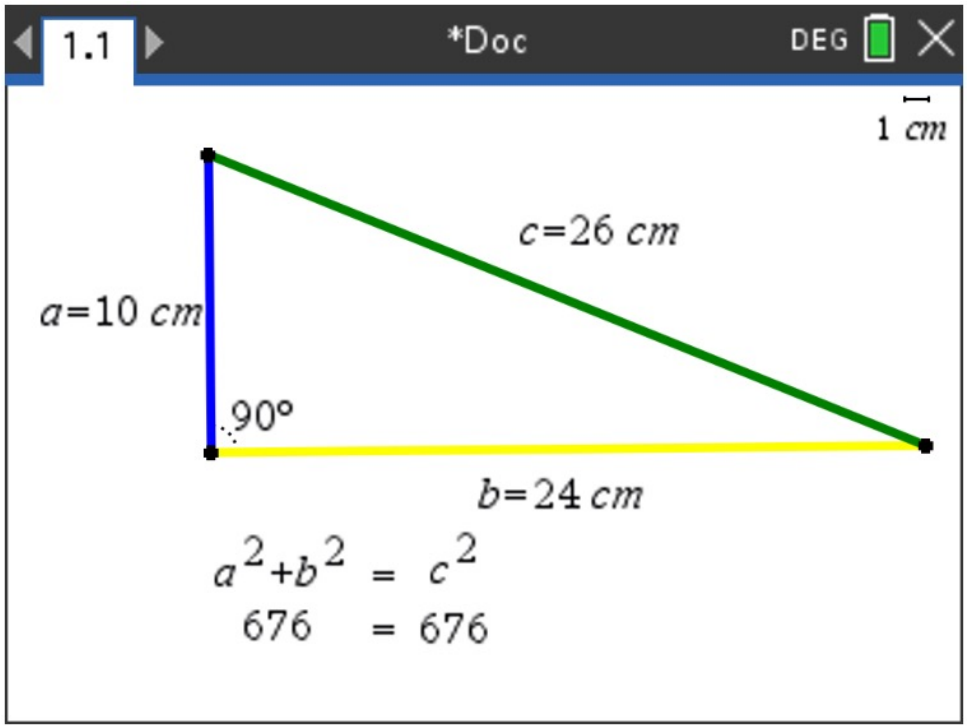
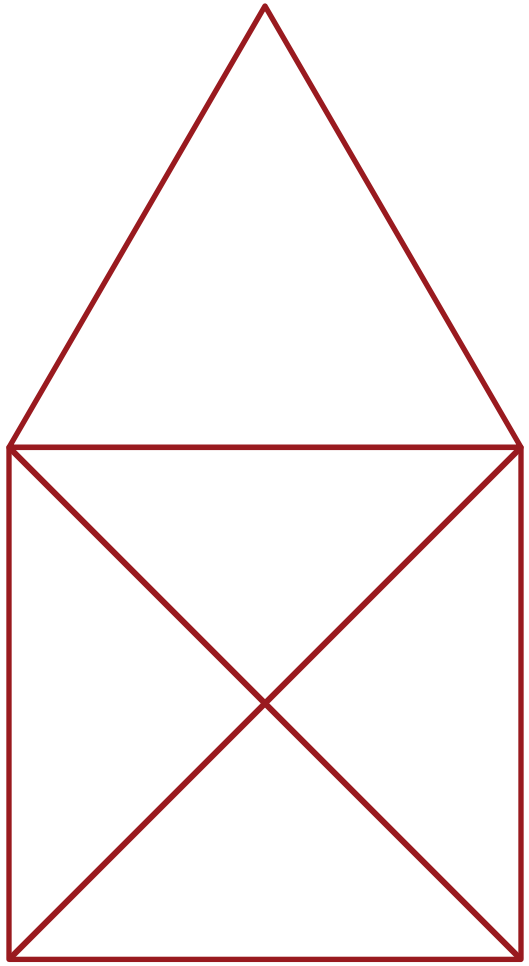
Quick Math Reminders

» Pythagorean Theorem



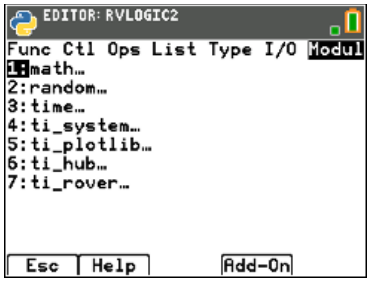
Logic Challenge 2

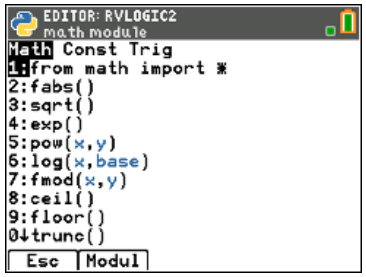


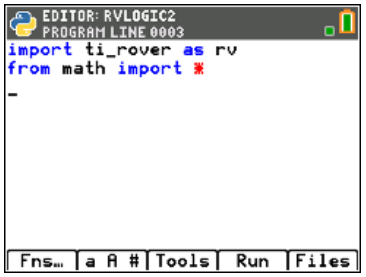
Task: Drive the figure shown without crossing any lines or going back over a line and without picking up the pen.

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

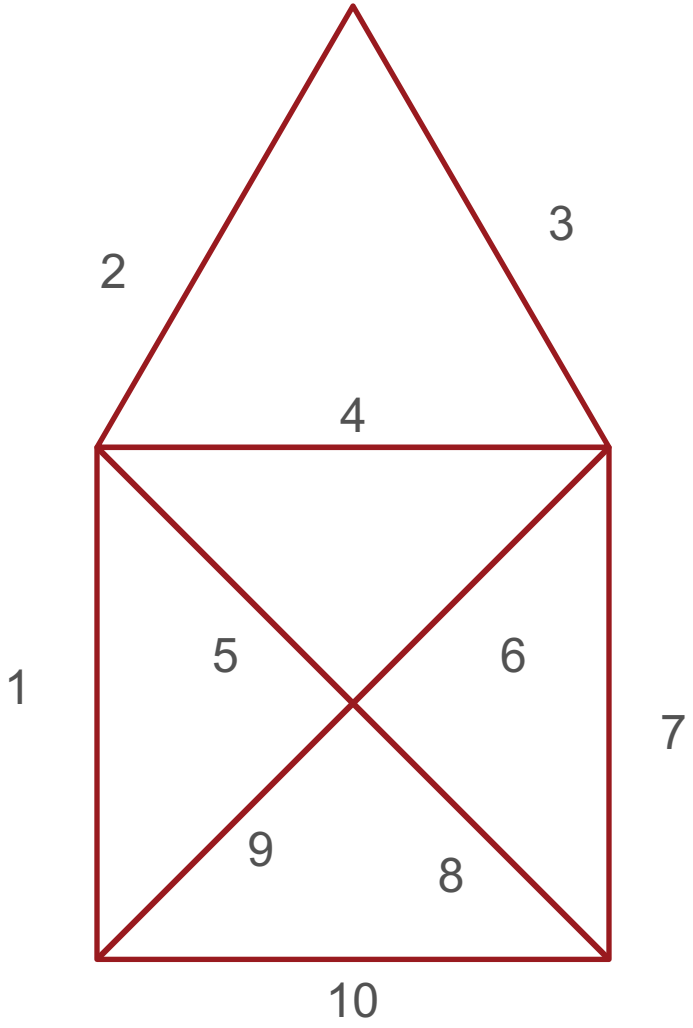
Import the Python Math module in addition to the Rover module for this challenge.

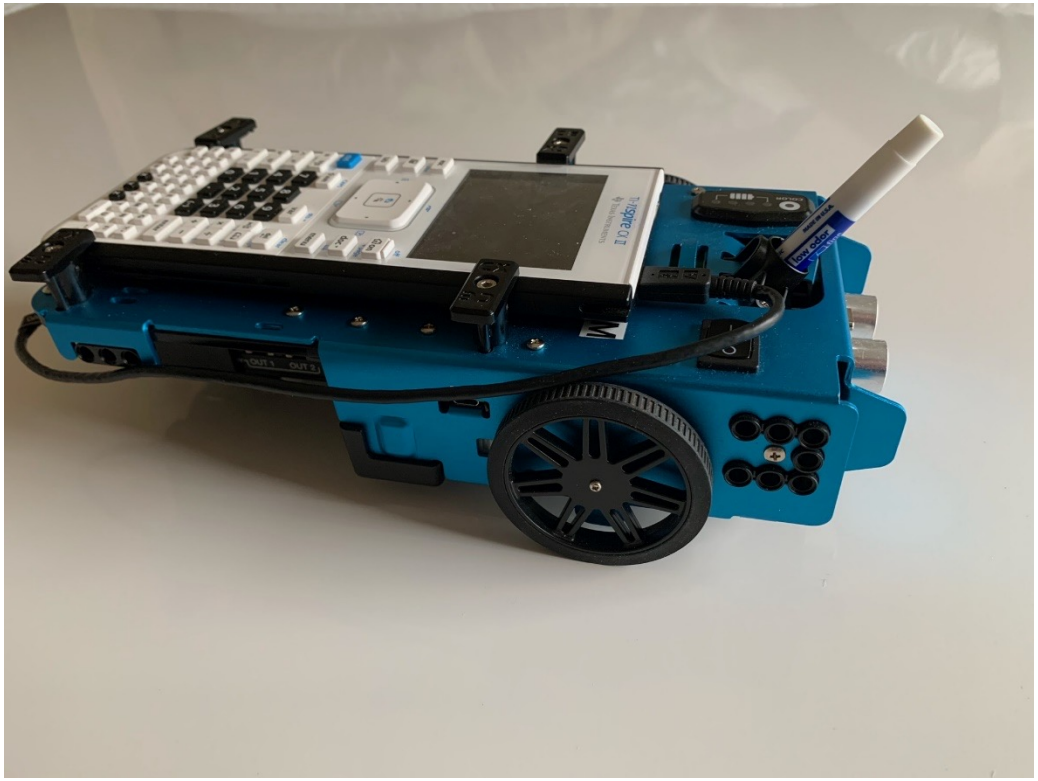




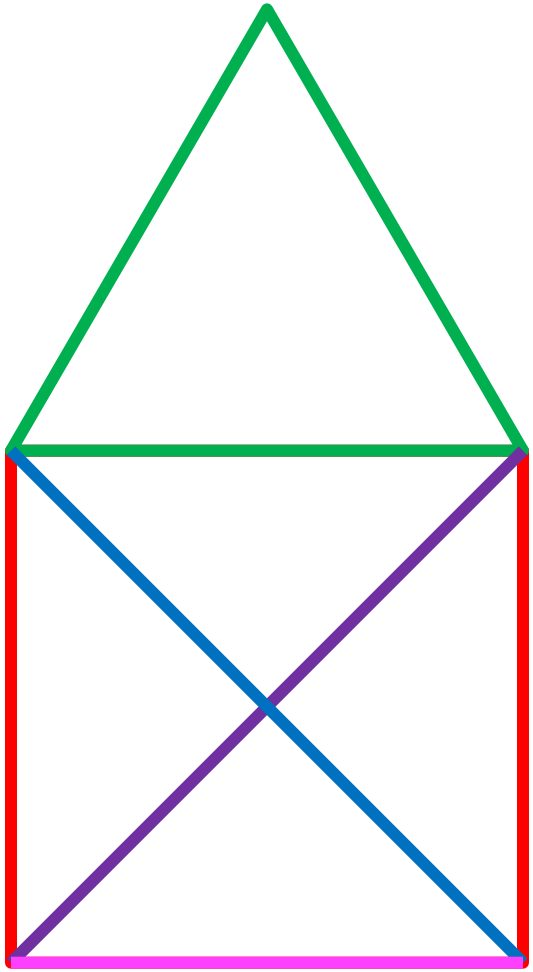


Logic Challenge 2





Logic Challenge 3

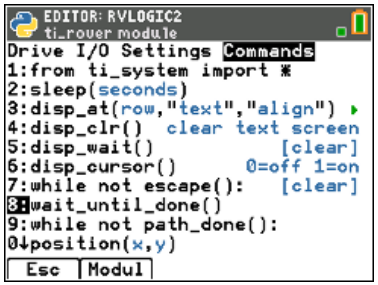


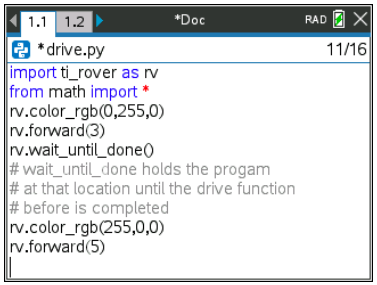
Task: Drive the figure shown without crossing any lines or going back over a line and without picking up the pen.

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!

See www.TIstemProjects.com for more TI STEM and coding activities and projects.