python-ev3dev Documentation

Release 0.8.0.post3

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November 07, 2016

Contents

A Python3 library implementing an interface for ev3dev devices, letting you control motors, sensors, hardware buttons, LCD displays and more from Python code.

If you haven't written code in Python before, you'll need to learn the language before you can use this library.

CHAPTER 1

Getting Started

This library runs on ev3dev. Before continuing, make sure that you have set up your EV3 or other ev3dev device as explained in the ev3dev Getting Started guide. Make sure that you have a kernel version that includes `-10-ev3dev` or higher (a larger number). You can check the kernel version by selecting "About" in Brickman and scrolling down to the "kernel version". If you don't have a compatible version, upgrade the kernel before continuing. Also note that if the ev3dev image you downloaded was created before September 2016, you probably don't have the most recent version of this library installed: see *Upgrading this Library* to upgrade it.

Once you have booted ev3dev and connected to your EV3 (or Raspberry Pi / BeagleBone) via SSH, you should be ready to start using ev3dev with Python: this library is included out-of-the-box. If you want to go through some basic usage examples, check out the *Usage Examples* section to try out motors, sensors and LEDs. Then look at *Writing Python Programs for Ev3dev* to see how you can save your Python code to a file.

Make sure that you look at the *User Resources* section as well for links to documentation and larger examples.

CHAPTER 2

Usage Examples

To run these minimal examples, run the Python3 interpreter from the terminal using the `python3` command:

```
$ python3
Python 3.4.2 (default, Oct  8 2014, 14:47:30)
[GCC 4.9.1] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>>
```

The >>> characters are the default prompt for Python. In the examples below, we have removed these characters so it's easier to cut and paste the code into your session.

2.1 Required: Import the library

```
import ev3dev.ev3 as ev3
```

2.2 Controlling the LEDs with a touch sensor

This code will turn the left LED red whenever the touch sensor is pressed, and back to green when it's released. Plug a touch sensor into any sensor port and then paste in this code - you'll need to hit `Enter` after pasting to complete the loop and start the program. Hit `Ctrl-C` to exit the loop.

```
ts = ev3.TouchSensor()
while True:
    ev3.Leds.set_color(ev3.Leds.LEFT, (ev3.Leds.GREEN, ev3.Leds.RED)[ts.value()])
```

2.3 Running a motor

Now plug a motor into the `A` port and paste this code into the Python prompt. This little program will run the motor at 500 ticks per second, which on the EV3 "large" motors equates to around 1.4 rotations per second, for three seconds (3000 milliseconds).

```
m = ev3.LargeMotor('outA')
m.run_timed(time_sp=3000, speed_sp=500)
```

The units for `speed_sp` that you see above are in "tacho ticks" per second. On the large EV3 motor, these equate to one tick per degree, so this is 500 degress per second.

2.4 Using text-to-speech

If you want to make your robot speak, you can use the *Sound.speak* method:

```
ev3.Sound.speak('Welcome to the E V 3 dev project!').wait()
```

To quit the Python REPL, just type `exit()` **or press** `Ctrl-D`**.**

Make sure to check out the *User Resources* section for more detailed information on these features and many others.

CHAPTER 3

Writing Python Programs for Ev3dev

Every Python program should have a few basic parts. Use this template to get started:

```
#!/usr/bin/env python3
from ev3dev.ev3 import *

# TODO: Add code here
```

The first two lines should be included in every Python program you write for ev3dev. The first allows you to run this program from Brickman, while the second imports this library.

When saving Python files, it is best to use the `.py` extension, e.g. `my-file.py`.

CHAPTER 4

User Resources

Library Documentation **Class documentation for this library can be found on** our Read the Docs page **.** You can always go there to get information on how you can use this library's functionality.

ev3python.com One of our community members, @ndward, has put together a great website with detailed guides on using this library which are targeted at beginners. If you are just getting started with programming, we highly recommend that you check it out at *ev3python.com*!

Frequently-Asked Questions Experiencing an odd error or unsure of how to do something that seems simple? Check our our FAQ to see if there's an existing answer.

ev3dev.org ev3dev.org is a great resource for finding guides and tutorials on using ev3dev, straight from the maintainers.

Support If you are having trouble using this library, please open an issue at our Issues tracker so that we can help you. When opening an issue, make sure to include as much information as possible about what you are trying to do and what you have tried. The issue template is in place to guide you through this process.

Demo Robot Laurens Valk of robot-square has been kind enough to allow us to reference his excellent EXPLOR3R robot. Consider building the EXPLOR3R and running the demo programs referenced below to get familiar with what Python programs using this binding look like.

Demo Code There are demo programs that you can run to get acquainted with this language binding. The programs are designed to work with the EXPLOR3R robot.

CHAPTER 5

Upgrading this Library

You can upgrade this library from the command line as follows. Make sure to type the password (the default is `maker`) when prompted.

```
sudo apt-get update
sudo apt-get install --only-upgrade python3-ev3dev
```

CHAPTER 6

Developer Resources

Python Package Index The Python language has a package repository where you can find libraries that others have written, including the latest version of this package.

The ev3dev Binding Specification Like all of the language bindings for ev3dev supported hardware, the Python binding follows the minimal API that must be provided per this document.

The ev3dev-lang Project on GitHub The source repository for the generic API and the scripts to automatically generate the binding. Only developers of the ev3dev-lang-python binding would normally need to access this information.

CHAPTER 7

Python 2.x and Python 3.x Compatibility

Some versions of the ev3dev distribution come with both Python 2.x and Python 3.x installed but this library is compatible only with Python 3.

As of the 2016-10-17 ev3dev image, the version of this library which is included runs on Python 3 and this is the only version that will be supported from here forward.

Contents

7.1 API reference

Each class in ev3dev module inherits from the base `Device` class.

class `ev3dev.core.`**`Device`**(*class_name*, *name_pattern='*'*, *name_exact=False*, ***kwargs*)
The ev3dev device base class

Contents:

7.1.1 Motor classes

Tacho motor

class `ev3dev.core.`**`Motor`**(*address=None*, *name_pattern='*'*, *name_exact=False*, ***kwargs*)
The motor class provides a uniform interface for using motors with positional and directional feedback such as the EV3 and NXT motors. This feedback allows for precise control of the motors. This is the most common type of motor, so we just call it *motor*.

The way to configure a motor is to set the '_sp' attributes when calling a command or before. Only in 'run_direct' mode attribute changes are processed immediately, in the other modes they only take place when a new command is issued.

`address`
Returns the name of the port that this motor is connected to.

`command`
Sends a command to the motor controller. See *commands* for a list of possible values.

`commands`
Returns a list of commands that are supported by the motor controller. Possible values are *run-forever*, *run-to-abs-pos*, *run-to-rel-pos*, *run-timed*, *run-direct*, *stop* and *reset*. Not all commands may be supported.

- *run-forever* will cause the motor to run until another command is sent.
- *run-to-abs-pos* will run to an absolute position specified by *position_sp* and then stop using the action specified in *stop_action*.
- *run-to-rel-pos* will run to a position relative to the current *position* value. The new position will be current *position* + *position_sp*. When the new position is reached, the motor will stop using the action specified by *stop_action*.
- *run-timed* will run the motor for the amount of time specified in *time_sp* and then stop the motor using the action specified by *stop_action*.
- *run-direct* will run the motor at the duty cycle specified by *duty_cycle_sp*. Unlike other run commands, changing *duty_cycle_sp* while running *will* take effect immediately.
- *stop* will stop any of the run commands before they are complete using the action specified by *stop_action*.
- *reset* will reset all of the motor parameter attributes to their default value. This will also have the effect of stopping the motor.

count_per_m
Returns the number of tacho counts in one meter of travel of the motor. Tacho counts are used by the position and speed attributes, so you can use this value to convert from distance to tacho counts. (linear motors only)

count_per_rot
Returns the number of tacho counts in one rotation of the motor. Tacho counts are used by the position and speed attributes, so you can use this value to convert rotations or degrees to tacho counts. (rotation motors only)

driver_name
Returns the name of the driver that provides this tacho motor device.

duty_cycle
Returns the current duty cycle of the motor. Units are percent. Values are -100 to 100.

duty_cycle_sp
Writing sets the duty cycle setpoint. Reading returns the current value. Units are in percent. Valid values are -100 to 100. A negative value causes the motor to rotate in reverse.

full_travel_count
Returns the number of tacho counts in the full travel of the motor. When combined with the *count_per_m* atribute, you can use this value to calculate the maximum travel distance of the motor. (linear motors only)

max_speed
Returns the maximum value that is accepted by the *speed_sp* attribute. This may be slightly different than the maximum speed that a particular motor can reach - it's the maximum theoretical speed.

polarity
Sets the polarity of the motor. With *normal* polarity, a positive duty cycle will cause the motor to rotate clockwise. With *inversed* polarity, a positive duty cycle will cause the motor to rotate counter-clockwise. Valid values are *normal* and *inversed*.

position
Returns the current position of the motor in pulses of the rotary encoder. When the motor rotates clockwise, the position will increase. Likewise, rotating counter-clockwise causes the position to decrease. Writing will set the position to that value.

position_d
The derivative constant for the position PID.

position_i
The integral constant for the position PID.

position_p
The proportional constant for the position PID.

position_sp
Writing specifies the target position for the *run-to-abs-pos* and *run-to-rel-pos* commands. Reading returns the current value. Units are in tacho counts. You can use the value returned by *counts_per_rot* to convert tacho counts to/from rotations or degrees.

ramp_down_sp
Writing sets the ramp down setpoint. Reading returns the current value. Units are in milliseconds and must be positive. When set to a non-zero value, the motor speed will decrease from 0 to 100% of *max_speed* over the span of this setpoint. The actual ramp time is the ratio of the difference between the *speed_sp* and the current *speed* and max_speed multiplied by *ramp_down_sp*.

ramp_up_sp
Writing sets the ramp up setpoint. Reading returns the current value. Units are in milliseconds and must be positive. When set to a non-zero value, the motor speed will increase from 0 to 100% of *max_speed* over the span of this setpoint. The actual ramp time is the ratio of the difference between the *speed_sp* and the current *speed* and max_speed multiplied by *ramp_up_sp*.

reset(***kwargs*)
Reset all of the motor parameter attributes to their default value. This will also have the effect of stopping the motor.

run_direct(***kwargs*)
Run the motor at the duty cycle specified by *duty_cycle_sp*. Unlike other run commands, changing *duty_cycle_sp* while running *will* take effect immediately.

run_forever(***kwargs*)
Run the motor until another command is sent.

run_timed(***kwargs*)
Run the motor for the amount of time specified in *time_sp* and then stop the motor using the action specified by *stop_action*.

run_to_abs_pos(***kwargs*)
Run to an absolute position specified by *position_sp* and then stop using the action specified in *stop_action*.

run_to_rel_pos(***kwargs*)
Run to a position relative to the current *position* value. The new position will be current *position* + *position_sp*. When the new position is reached, the motor will stop using the action specified by *stop_action*.

speed
Returns the current motor speed in tacho counts per second. Note, this is not necessarily degrees (although it is for LEGO motors). Use the *count_per_rot* attribute to convert this value to RPM or deg/sec.

speed_d
The derivative constant for the speed regulation PID.

speed_i
The integral constant for the speed regulation PID.

speed_p
The proportional constant for the speed regulation PID.

speed_sp
Writing sets the target speed in tacho counts per second used for all *run-** commands except *run-direct*. Reading returns the current value. A negative value causes the motor to rotate in reverse with the exception

of *run-to-*-pos* commands where the sign is ignored. Use the *count_per_rot* attribute to convert RPM or deg/sec to tacho counts per second. Use the *count_per_m* attribute to convert m/s to tacho counts per second.

state
Reading returns a list of state flags. Possible flags are *running*, *ramping*, *holding*, *overloaded* and *stalled*.

stop(***kwargs*)
Stop any of the run commands before they are complete using the action specified by *stop_action*.

stop_action
Reading returns the current stop action. Writing sets the stop action. The value determines the motors behavior when *command* is set to *stop*. Also, it determines the motors behavior when a run command completes. See *stop_actions* for a list of possible values.

stop_actions
Returns a list of stop actions supported by the motor controller. Possible values are *coast*, *brake* and *hold*. *coast* means that power will be removed from the motor and it will freely coast to a stop. *brake* means that power will be removed from the motor and a passive electrical load will be placed on the motor. This is usually done by shorting the motor terminals together. This load will absorb the energy from the rotation of the motors and cause the motor to stop more quickly than coasting. *hold* does not remove power from the motor. Instead it actively tries to hold the motor at the current position. If an external force tries to turn the motor, the motor will 'push back' to maintain its position.

time_sp
Writing specifies the amount of time the motor will run when using the *run-timed* command. Reading returns the current value. Units are in milliseconds.

wait(*cond*, *timeout=None*)
Blocks until `cond(self.state)` is `True`. The condition is checked when there is an I/O event related to the `state` attribute. Exits early when `timeout` (in milliseconds) is reached.

Returns `True` if the condition is met, and `False` if the timeout is reached.

wait_until(*s*, *timeout=None*)
Blocks until `s` is in `self.state`. The condition is checked when there is an I/O event related to the `state` attribute. Exits early when `timeout` (in milliseconds) is reached.

> **Warning:** In ev3dev kernel release cycles 16 and earlier, there is a bug which causes the `state` attribute to include `stalled` immediately after starting the motor even if it is not actually being prevented from rotating. As a workaround, we recommend sleeping your code for around 100ms after starting a motor if you are going to use this method to wait for it to be `stalled`. A fix for this has not yet been released.

Returns `True` if the condition is met, and `False` if the timeout is reached.

Example:

```
m.wait_until('stalled')
```

wait_while(*s*, *timeout=None*)
Blocks until `s` is not in `self.state`. The condition is checked when there is an I/O event related to the `state` attribute. Exits early when `timeout` (in milliseconds) is reached.

> **Warning:** In ev3dev kernel release cycles 16 and earlier, there is a bug which causes the `state` attribute to include `stalled` immediately after starting the motor even if it is not actually being prevented from rotating. As a workaround, we recommend sleeping your code for around 100ms after starting a motor if you are going to use this method to wait for it to be `stalled`. A fix for this has not yet been released.

Returns `True` if the condition is met, and `False` if the timeout is reached.

Example:

```
m.wait_while('running')
```

Large EV3 Motor

class ev3dev.core.**LargeMotor**(*address=None*, *name_pattern='*'*, *name_exact=False*, ***kwargs*)
Bases: *ev3dev.core.Motor*

EV3/NXT large servo motor

Medium EV3 Motor

class ev3dev.core.**MediumMotor**(*address=None*, *name_pattern='*'*, *name_exact=False*, ***kwargs*)
Bases: *ev3dev.core.Motor*

EV3 medium servo motor

DC Motor

class ev3dev.core.**DcMotor**(*address=None*, *name_pattern='motor*'*, *name_exact=False*, ***kwargs*)
The DC motor class provides a uniform interface for using regular DC motors with no fancy controls or feedback. This includes LEGO MINDSTORMS RCX motors and LEGO Power Functions motors.

address
Returns the name of the port that this motor is connected to.

command
Sets the command for the motor. Possible values are *run-forever*, *run-timed* and *stop*. Not all commands may be supported, so be sure to check the contents of the *commands* attribute.

commands
Returns a list of commands supported by the motor controller.

driver_name
Returns the name of the motor driver that loaded this device. See the list of [supported devices] for a list of drivers.

duty_cycle
Shows the current duty cycle of the PWM signal sent to the motor. Values are -100 to 100 (-100% to 100%).

duty_cycle_sp
Writing sets the duty cycle setpoint of the PWM signal sent to the motor. Valid values are -100 to 100 (-100% to 100%). Reading returns the current setpoint.

polarity
Sets the polarity of the motor. Valid values are *normal* and *inversed*.

ramp_down_sp
Sets the time in milliseconds that it take the motor to ramp down from 100% to 0%. Valid values are 0 to 10000 (10 seconds). Default is 0.

ramp_up_sp
Sets the time in milliseconds that it take the motor to up ramp from 0% to 100%. Valid values are 0 to 10000 (10 seconds). Default is 0.

run_direct(***kwargs*)
Run the motor at the duty cycle specified by *duty_cycle_sp*. Unlike other run commands, changing *duty_cycle_sp* while running *will* take effect immediately.

run_forever(***kwargs*)
Run the motor until another command is sent.

run_timed(***kwargs*)
Run the motor for the amount of time specified in *time_sp* and then stop the motor using the action specified by *stop_action*.

state
Gets a list of flags indicating the motor status. Possible flags are *running* and *ramping*. *running* indicates that the motor is powered. *ramping* indicates that the motor has not yet reached the *duty_cycle_sp*.

stop(***kwargs*)
Stop any of the run commands before they are complete using the action specified by *stop_action*.

stop_action
Sets the stop action that will be used when the motor stops. Read *stop_actions* to get the list of valid values.

stop_actions
Gets a list of stop actions. Valid values are *coast* and *brake*.

time_sp
Writing specifies the amount of time the motor will run when using the *run-timed* command. Reading returns the current value. Units are in milliseconds.

Servo Motor

class ev3dev.core.**ServoMotor**(*address=None*, *name_pattern='motor*'*, *name_exact=False*, ***kwargs*)
The servo motor class provides a uniform interface for using hobby type servo motors.

address
Returns the name of the port that this motor is connected to.

command
Sets the command for the servo. Valid values are *run* and *float*. Setting to *run* will cause the servo to be driven to the position_sp set in the *position_sp* attribute. Setting to *float* will remove power from the motor.

driver_name
Returns the name of the motor driver that loaded this device. See the list of [supported devices] for a list of drivers.

float(***kwargs*)
Remove power from the motor.

max_pulse_sp
Used to set the pulse size in milliseconds for the signal that tells the servo to drive to the maximum (clockwise) position_sp. Default value is 2400. Valid values are 2300 to 2700. You must write to the position_sp attribute for changes to this attribute to take effect.

mid_pulse_sp
Used to set the pulse size in milliseconds for the signal that tells the servo to drive to the mid position_sp.

Default value is 1500. Valid values are 1300 to 1700. For example, on a 180 degree servo, this would be 90 degrees. On continuous rotation servo, this is the 'neutral' position_sp where the motor does not turn. You must write to the position_sp attribute for changes to this attribute to take effect.

min_pulse_sp
Used to set the pulse size in milliseconds for the signal that tells the servo to drive to the miniumum (counter-clockwise) position_sp. Default value is 600. Valid values are 300 to 700. You must write to the position_sp attribute for changes to this attribute to take effect.

polarity
Sets the polarity of the servo. Valid values are *normal* and *inversed*. Setting the value to *inversed* will cause the position_sp value to be inversed. i.e *-100* will correspond to *max_pulse_sp*, and *100* will correspond to *min_pulse_sp*.

position_sp
Reading returns the current position_sp of the servo. Writing instructs the servo to move to the specified position_sp. Units are percent. Valid values are -100 to 100 (-100% to 100%) where *-100* corresponds to *min_pulse_sp*, *0* corresponds to *mid_pulse_sp* and *100* corresponds to *max_pulse_sp*.

rate_sp
Sets the rate_sp at which the servo travels from 0 to 100.0% (half of the full range of the servo). Units are in milliseconds. Example: Setting the rate_sp to 1000 means that it will take a 180 degree servo 2 second to move from 0 to 180 degrees. Note: Some servo controllers may not support this in which case reading and writing will fail with *-EOPNOTSUPP*. In continuous rotation servos, this value will affect the rate_sp at which the speed ramps up or down.

run(***kwargs*)
Drive servo to the position set in the *position_sp* attribute.

state
Returns a list of flags indicating the state of the servo. Possible values are: * *running*: Indicates that the motor is powered.

7.1.2 Sensor classes

Sensor

This is the base class all the other sensor classes are derived from.

class ev3dev.core.**Sensor**(*address=None*, *name_pattern='sensor*'*, *name_exact=False*, ***kwargs*)
The sensor class provides a uniform interface for using most of the sensors available for the EV3. The various underlying device drivers will create a *lego-sensor* device for interacting with the sensors.

Sensors are primarily controlled by setting the *mode* and monitored by reading the *value<N>* attributes. Values can be converted to floating point if needed by *value<N>* / 10.0 ^ *decimals*.

Since the name of the *sensor<N>* device node does not correspond to the port that a sensor is plugged in to, you must look at the *address* attribute if you need to know which port a sensor is plugged in to. However, if you don't have more than one sensor of each type, you can just look for a matching *driver_name*. Then it will not matter which port a sensor is plugged in to - your program will still work.

address
Returns the name of the port that the sensor is connected to, e.g. *ev3:in1*. I2C sensors also include the I2C address (decimal), e.g. *ev3:in1:i2c8*.

bin_data(*fmt=None*)
Returns the unscaled raw values in the *value<N>* attributes as raw byte array. Use *bin_data_format*, *num_values* and the individual sensor documentation to determine how to interpret the data.

Use *fmt* to unpack the raw bytes into a struct.

Example:

```
>>> from ev3dev import *
>>> ir = InfraredSensor()
>>> ir.value()
28
>>> ir.bin_data('<b')
(28,)
```

bin_data_format
Returns the format of the values in *bin_data* for the current mode. Possible values are:

- *u8*: Unsigned 8-bit integer (byte)
- *s8*: Signed 8-bit integer (sbyte)
- *u16*: Unsigned 16-bit integer (ushort)
- *s16*: Signed 16-bit integer (short)
- *s16_be*: Signed 16-bit integer, big endian
- *s32*: Signed 32-bit integer (int)
- *float*: IEEE 754 32-bit floating point (float)

command
Sends a command to the sensor.

commands
Returns a list of the valid commands for the sensor. Returns -EOPNOTSUPP if no commands are supported.

decimals
Returns the number of decimal places for the values in the *value<N>* attributes of the current mode.

driver_name
Returns the name of the sensor device/driver. See the list of [supported sensors] for a complete list of drivers.

mode
Returns the current mode. Writing one of the values returned by *modes* sets the sensor to that mode.

modes
Returns a list of the valid modes for the sensor.

num_values
Returns the number of *value<N>* attributes that will return a valid value for the current mode.

units
Returns the units of the measured value for the current mode. May return empty string

value (*n=0*)
Returns the value or values measured by the sensor. Check num_values to see how many values there are. Values with N >= num_values will return an error. The values are fixed point numbers, so check decimals to see if you need to divide to get the actual value.

Special sensor classes

The classes derive from *Sensor* and provide helper functions specific to the corresponding sensor type. Each of the functions makes sure the sensor is in the required mode and then returns the specified value.

Touch Sensor

class ev3dev.core.**TouchSensor**(*address=None*, *name_pattern='sensor*'*, *name_exact=False*, ***kwargs*)

Bases: *ev3dev.core.Sensor*

Touch Sensor

is_pressed
A boolean indicating whether the current touch sensor is being pressed.

Color Sensor

class ev3dev.core.**ColorSensor**(*address=None*, *name_pattern='sensor*'*, *name_exact=False*, ***kwargs*)

Bases: *ev3dev.core.Sensor*

LEGO EV3 color sensor.

ambient_light_intensity
Ambient light intensity. Light on sensor is dimly lit blue.

blue
Blue component of the detected color, in the range 0-1020.

color

Color detected by the sensor, categorized by overall value.

- 0: No color
- 1: Black
- 2: Blue
- 3: Green
- 4: Yellow
- 5: Red
- 6: White
- 7: Brown

green
Green component of the detected color, in the range 0-1020.

raw
Red, green, and blue components of the detected color, in the range 0-1020.

red
Red component of the detected color, in the range 0-1020.

reflected_light_intensity
Reflected light intensity as a percentage. Light on sensor is red.

Ultrasonic Sensor

class ev3dev.core.**UltrasonicSensor**(*address=None*, *name_pattern='sensor*'*, *name_exact=False*, ***kwargs*)

Bases: *ev3dev.core.Sensor*

LEGO EV3 ultrasonic sensor.

distance_centimeters
Measurement of the distance detected by the sensor, in centimeters.

distance_inches
Measurement of the distance detected by the sensor, in inches.

other_sensor_present
Value indicating whether another ultrasonic sensor could be heard nearby.

Gyro Sensor

class ev3dev.core.**GyroSensor**(*address=None*, *name_pattern='sensor*'*, *name_exact=False*, ***kwargs*)

Bases: *ev3dev.core.Sensor*

LEGO EV3 gyro sensor.

angle
The number of degrees that the sensor has been rotated since it was put into this mode.

rate
The rate at which the sensor is rotating, in degrees/second.

rate_and_angle
Angle (degrees) and Rotational Speed (degrees/second).

Infrared Sensor

class ev3dev.core.**InfraredSensor**(*address=None*, *name_pattern='sensor*'*, *name_exact=False*, ***kwargs*)

Bases: *ev3dev.core.Sensor*

LEGO EV3 infrared sensor.

proximity
A measurement of the distance between the sensor and the remote, as a percentage. 100% is approximately 70cm/27in.

Sound Sensor

class ev3dev.core.**SoundSensor**(*address=None*, *name_pattern='sensor*'*, *name_exact=False*, ***kwargs*)

Bases: *ev3dev.core.Sensor*

LEGO NXT Sound Sensor

sound_pressure
A measurement of the measured sound pressure level, as a percent. Uses a flat weighting.

sound_pressure_low
A measurement of the measured sound pressure level, as a percent. Uses A-weighting, which focuses on levels up to 55 dB.

Light Sensor

class ev3dev.core.**LightSensor**(*address=None*, *name_pattern='sensor*'*, *name_exact=False*, ***kwargs*)

Bases: *ev3dev.core.Sensor*

LEGO NXT Light Sensor

ambient_light_intensity
A measurement of the ambient light intensity, as a percentage.

reflected_light_intensity
A measurement of the reflected light intensity, as a percentage.

7.1.3 Other classes

Remote Control

class ev3dev.core.**RemoteControl**(*sensor=None*, *channel=1*)
EV3 Remote Controller

Event handlers

These will be called when state of the corresponding button is changed:

on_red_up

on_red_down

on_blue_up

on_blue_down

on_beacon

Member functions and properties

any()
Checks if any button is pressed.

beacon
Checks if *beacon* button is pressed.

blue_down
Checks if *blue_down* button is pressed.

blue_up
Checks if *blue_up* button is pressed.

buttons_pressed
Returns list of currently pressed buttons.

check_buttons(*buttons=[]*)
Check if currently pressed buttons exactly match the given list.

on_change(*changed_buttons*)
This handler is called by *process()* whenever state of any button has changed since last *process()* call. *changed_buttons* is a list of tuples of changed button names and their states.

process()
Check for currenly pressed buttons. If the new state differs from the old state, call the appropriate button event handlers.

red_down
Checks if *red_down* button is pressed.

red_up
Checks if *red_up* button is pressed.

Button

class ev3dev.ev3.**Button**
EV3 Buttons

Event handlers

These will be called when state of the corresponding button is changed:

on_up

on_down

on_left

on_right

on_enter

on_backspace

Member functions and properties

any()
Checks if any button is pressed.

backspace
Check if 'backspace' button is pressed.

buttons_pressed
Returns list of names of pressed buttons.

check_buttons(*buttons=[]*)
Check if currently pressed buttons exactly match the given list.

down
Check if 'down' button is pressed.

enter
Check if 'enter' button is pressed.

left
Check if 'left' button is pressed.

static on_backspace(*state*)
This handler is called by *process()* whenever state of 'backspace' button has changed since last *process()* call. *state* parameter is the new state of the button.

on_change(*changed_buttons*)
This handler is called by *process()* whenever state of any button has changed since last *process()* call. *changed_buttons* is a list of tuples of changed button names and their states.

static on_down(*state*)
This handler is called by *process()* whenever state of 'down' button has changed since last *process()* call. *state* parameter is the new state of the button.

static on_enter(*state*)
This handler is called by *process()* whenever state of 'enter' button has changed since last *process()* call. *state* parameter is the new state of the button.

static on_left(*state*)
This handler is called by *process()* whenever state of 'left' button has changed since last *process()* call. *state* parameter is the new state of the button.

static on_right(*state*)
This handler is called by *process()* whenever state of 'right' button has changed since last *process()* call. *state* parameter is the new state of the button.

static on_up(*state*)
This handler is called by *process()* whenever state of 'up' button has changed since last *process()* call. *state* parameter is the new state of the button.

process()
Check for currenly pressed buttons. If the new state differs from the old state, call the appropriate button event handlers.

right
Check if 'right' button is pressed.

up
Check if 'up' button is pressed.

Leds

class ev3dev.core.**Led**(*address=None*, *name_pattern='*'*, *name_exact=False*, ***kwargs*)
Any device controlled by the generic LED driver. See https://www.kernel.org/doc/Documentation/leds/leds-class.txt for more details.

brightness
Sets the brightness level. Possible values are from 0 to *max_brightness*.

brightness_pct
Returns led brightness as a fraction of max_brightness

delay_off
The *timer* trigger will periodically change the LED brightness between 0 and the current brightness setting. The *off* time can be specified via *delay_off* attribute in milliseconds.

delay_on
The *timer* trigger will periodically change the LED brightness between 0 and the current brightness setting. The *on* time can be specified via *delay_on* attribute in milliseconds.

max_brightness
Returns the maximum allowable brightness value.

trigger
Sets the led trigger. A trigger is a kernel based source of led events. Triggers can either be simple or

complex. A simple trigger isn't configurable and is designed to slot into existing subsystems with minimal additional code. Examples are the *ide-disk* and *nand-disk* triggers.

Complex triggers whilst available to all LEDs have LED specific parameters and work on a per LED basis. The *timer* trigger is an example. The *timer* trigger will periodically change the LED brightness between 0 and the current brightness setting. The *on* and *off* time can be specified via *delay_{on,off}* attributes in milliseconds. You can change the brightness value of a LED independently of the timer trigger. However, if you set the brightness value to 0 it will also disable the *timer* trigger.

triggers
Returns a list of available triggers.

class ev3dev.ev3.**Leds**
The EV3 LEDs.

EV3 platform

Led groups:

LEFT

RIGHT

Colors:

RED

GREEN

AMBER

ORANGE

YELLOW

BrickPI platform

Led groups:

LED1

LED2

Colors:

BLUE

static all_off()
Turn all leds off

static set(*group*, ***kwargs*)
Set attributes for each led in group.

Example:

```
Leds.set(LEFT, brightness_pct=0.5, trigger='timer')
```

static set_color(*group*, *color*, *pct=1*)
Sets brigthness of leds in the given group to the values specified in color tuple. When percentage is specified, brightness of each led is reduced proportionally.

Example:

```
        Leds.set_color(LEFT, AMBER)
```

Power Supply

class ev3dev.core.**PowerSupply**(*address=None*, *name_pattern='*'*, *name_exact=False*, ***kwargs*)
A generic interface to read data from the system's power_supply class. Uses the built-in legoev3-battery if none is specified.

max_voltage

measured_amps
The measured current that the battery is supplying (in amps)

measured_current
The measured current that the battery is supplying (in microamps)

measured_voltage
The measured voltage that the battery is supplying (in microvolts)

measured_volts
The measured voltage that the battery is supplying (in volts)

min_voltage

technology

type

Sound

class ev3dev.core.**Sound**
Sound-related functions. The class has only static methods and is not intended for instantiation. It can beep, play wav files, or convert text to speech.

Note that all methods of the class spawn system processes and return subprocess.Popen objects. The methods are asynchronous (they return immediately after child process was spawned, without waiting for its completion), but you can call wait() on the returned result.

Examples:

Play 'bark.wav', return immediately: Sound.play('bark.wav')

Introduce yourself, wait for completion: Sound.speak('Hello, I am Robot').wait()

static beep(*args=''*)
Call beep command with the provided arguments (if any). See beep man page and google 'linux beep music' for inspiration.

static play(*wav_file*)
Play wav file.

static speak(*text*, *espeak_opts='-a 200 -s 130'*)
Speak the given text aloud.

static tone(**args*)
tone(tone_sequence):

Play tone sequence. The tone_sequence parameter is a list of tuples, where each tuple contains up to three numbers. The first number is frequency in Hz, the second is duration in milliseconds, and the third is delay in milliseconds between this and the next tone in the sequence.

Here is a cheerful example:

```
Sound.tone([
    (392, 350, 100), (392, 350, 100), (392, 350, 100), (311.1, 250, 100),
    (466.2, 25, 100), (392, 350, 100), (311.1, 250, 100), (466.2, 25, 100),
    (392, 700, 100), (587.32, 350, 100), (587.32, 350, 100),
    (587.32, 350, 100), (622.26, 250, 100), (466.2, 25, 100),
    (369.99, 350, 100), (311.1, 250, 100), (466.2, 25, 100), (392, 700, 100),
    (784, 350, 100), (392, 250, 100), (392, 25, 100), (784, 350, 100),
    (739.98, 250, 100), (698.46, 25, 100), (659.26, 25, 100),
    (622.26, 25, 100), (659.26, 50, 400), (415.3, 25, 200), (554.36, 350, 100),
    (523.25, 250, 100), (493.88, 25, 100), (466.16, 25, 100), (440, 25, 100),
    (466.16, 50, 400), (311.13, 25, 200), (369.99, 350, 100),
    (311.13, 250, 100), (392, 25, 100), (466.16, 350, 100), (392, 250, 100),
    (466.16, 25, 100), (587.32, 700, 100), (784, 350, 100), (392, 250, 100),
    (392, 25, 100), (784, 350, 100), (739.98, 250, 100), (698.46, 25, 100),
    (659.26, 25, 100), (622.26, 25, 100), (659.26, 50, 400), (415.3, 25, 200),
    (554.36, 350, 100), (523.25, 250, 100), (493.88, 25, 100),
    (466.16, 25, 100), (440, 25, 100), (466.16, 50, 400), (311.13, 25, 200),
    (392, 350, 100), (311.13, 250, 100), (466.16, 25, 100),
    (392.00, 300, 150), (311.13, 250, 100), (466.16, 25, 100), (392, 700)
    ]).wait()
```

tone(frequency, duration):

Play single tone of given frequency (Hz) and duration (milliseconds).

Screen

class ev3dev.core.**Screen**

Bases: ev3dev.core.FbMem

A convenience wrapper for the FbMem class. Provides drawing functions from the python imaging library (PIL).

clear()

Clears the screen

draw

Returns a handle to PIL.ImageDraw.Draw class associated with the screen.

Example:

```
screen.draw.rectangle((10,10,60,20), fill='black')
```

image

Returns a handle to PIL.Image class that is backing the screen. This can be accessed for blitting images to the screen.

Example:

```
screen.image.paste(picture, (0, 0))
```

shape

Dimensions of the screen.

update()

Applies pending changes to the screen. Nothing will be drawn on the screen until this function is called.

xres

Horizontal screen resolution

yres
Vertical screen resolution

Bitmap fonts

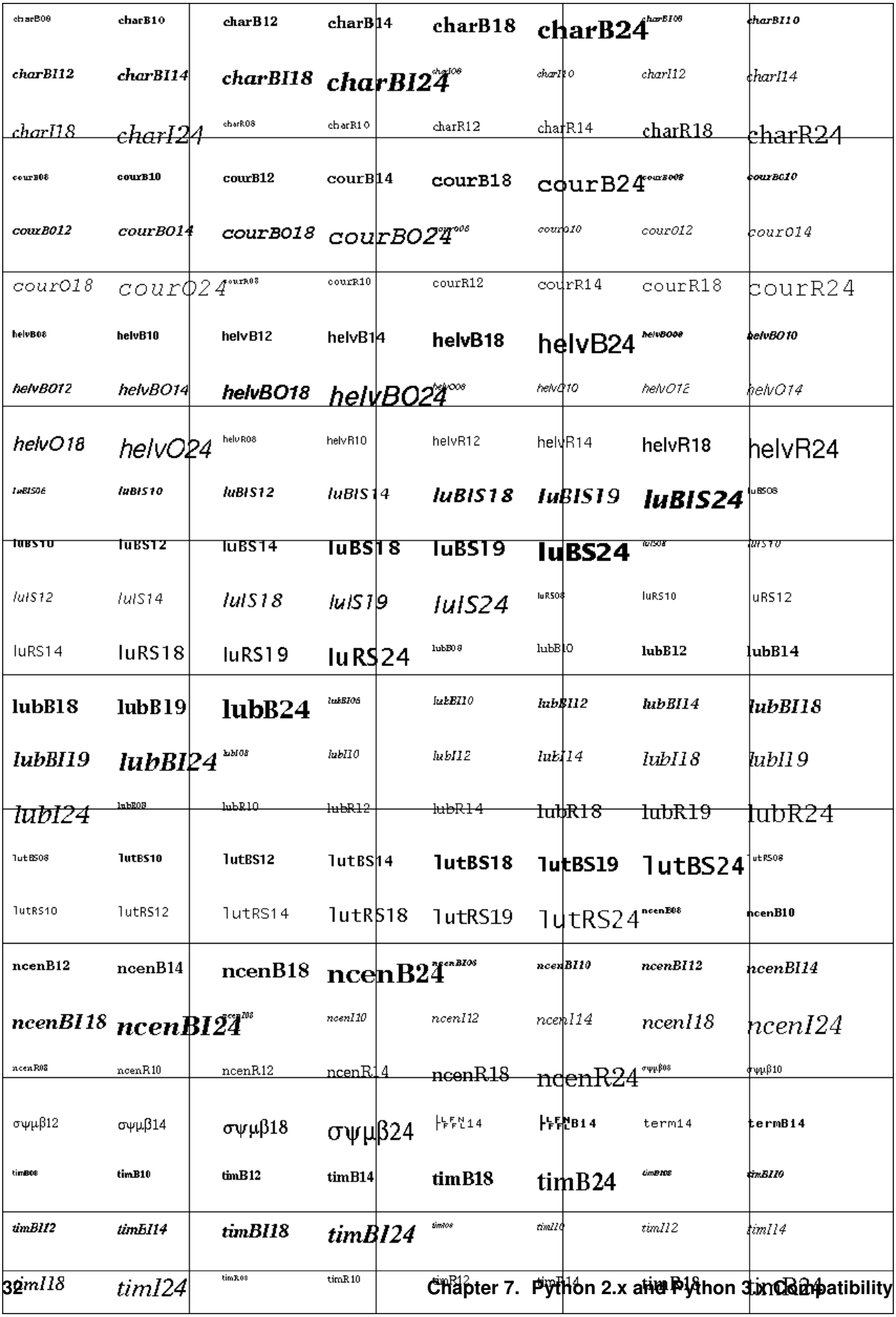
The *Screen* class allows to write text on the LCD using python imaging library (PIL) interface (see description of the `text()` method here). The `ev3dev.fonts` module contains bitmap fonts in PIL format that should look good on a tiny EV3 screen:

```
import ev3dev.fonts as fonts
screen.draw.text((10,10), 'Hello World!', font=fonts.load('luBS14'))
```

`ev3dev.fonts.`**`available`**`()`
Returns list of available font names.

`ev3dev.fonts.`**`load`**`(`*`name`*`)`
Loads the font specified by name and returns it as an instance of PIL.ImageFont class.

The following image lists all available fonts. The grid lines correspond to EV3 screen size:


charB08
charB10
charB12
charB14
charB18
charB24
charBI08
charBI10
charBI12
charBI14
charBI18
charBI24
charI08
charI10
charI12
charI14
charI18
charI24
charR08
charR10
charR12
charR14
charR18
charR24
courB08
courB10
courB12
courB14
courB18
courB24
courBO08
courBO10
courBO12
courBO14
courBO18
courBO24
courO08
courO10
courO12
courO14
courO18
courO24
courR08
courR10
courR12
courR14
courR18
courR24
helvB08
helvB10
helvB12
helvB14
helvB18
helvB24
helvBO08
helvBO10
helvBO12
helvBO14
helvBO18
helvBO24
helvO08
helvO10
helvO12
helvO14
helvO18
helvO24
helvR08
helvR10
helvR12
helvR14
helvR18
helvR24
luBIS08
luBIS10
luBIS12
luBIS14
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luBIS24
luBS08
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luIS24
luRS08
luRS10
uRS12
luRS14
luRS18
luRS19
luRS24
lubB08
lubB10
lubB12
lubB14
lubB18
lubB19
lubB24
lubBI06
lubBI10
lubBI12
lubBI14
lubBI18
lubBI19
lubBI24
lubI08
lubI10
lubI12
lubI14
lubI18
lubI19
lubI24
lubR08
lubR10
lubR12
lubR14
lubR18
lubR19
lubR24
lutBS08
lutBS10
lutBS12
lutBS14
lutBS18
lutBS19
lutBS24
lutRS08
lutRS10
lutRS12
lutRS14
lutRS18
lutRS19
lutRS24
ncenB08
ncenB10
ncenB12
ncenB14
ncenB18
ncenB24
ncenBI08
ncenBI10
ncenBI12
ncenBI14
ncenBI18
ncenBI24
ncenI08
ncenI10
ncenI12
ncenI14
ncenI18
ncenI24
ncenR08
ncenR10
ncenR12
ncenR14
ncenR18
ncenR24
σψμβ08
σψμβ10
σψμβ12
σψμβ14
σψμβ18
σψμβ24
term14
termB14
timB08
timB10
timB12
timB14
timB18
timB24
timBI08
timBI10
timBI12
timBI14
timBI18
timBI24
timI08
timI10
timI12
timI14
timI18
timI24
timR08
timR10
timR12
timR14
timR18
timR24

Lego Port

class ev3dev.core.**LegoPort**(*address=None*, *name_pattern='*'*, *name_exact=False*, ***kwargs*)

The *lego-port* class provides an interface for working with input and output ports that are compatible with LEGO MINDSTORMS RCX/NXT/EV3, LEGO WeDo and LEGO Power Functions sensors and motors. Supported devices include the LEGO MINDSTORMS EV3 Intelligent Brick, the LEGO WeDo USB hub and various sensor multiplexers from 3rd party manufacturers.

Some types of ports may have multiple modes of operation. For example, the input ports on the EV3 brick can communicate with sensors using UART, I2C or analog validate signals - but not all at the same time. Therefore there are multiple modes available to connect to the different types of sensors.

In most cases, ports are able to automatically detect what type of sensor or motor is connected. In some cases though, this must be manually specified using the *mode* and *set_device* attributes. The *mode* attribute affects how the port communicates with the connected device. For example the input ports on the EV3 brick can communicate using UART, I2C or analog voltages, but not all at the same time, so the mode must be set to the one that is appropriate for the connected sensor. The *set_device* attribute is used to specify the exact type of sensor that is connected. Note: the mode must be correctly set before setting the sensor type.

Ports can be found at */sys/class/lego-port/port<N>* where *<N>* is incremented each time a new port is registered. Note: The number is not related to the actual port at all - use the *address* attribute to find a specific port.

address
Returns the name of the port. See individual driver documentation for the name that will be returned.

driver_name
Returns the name of the driver that loaded this device. You can find the complete list of drivers in the [list of port drivers].

mode
Reading returns the currently selected mode. Writing sets the mode. Generally speaking when the mode changes any sensor or motor devices associated with the port will be removed new ones loaded, however this this will depend on the individual driver implementing this class.

modes
Returns a list of the available modes of the port.

set_device
For modes that support it, writing the name of a driver will cause a new device to be registered for that driver and attached to this port. For example, since NXT/Analog sensors cannot be auto-detected, you must use this attribute to load the correct driver. Returns -EOPNOTSUPP if setting a device is not supported.

status
In most cases, reading status will return the same value as *mode*. In cases where there is an *auto* mode additional values may be returned, such as *no-device* or *error*. See individual port driver documentation for the full list of possible values.

7.2 Working with ev3dev remotely using RPyC

RPyC (pronounced as are-pie-see), or Remote Python Call, is a transparent python library for symmetrical remote procedure calls, clustering and distributed-computing. RPyC makes use of object-proxying, a technique that employs python's dynamic nature, to overcome the physical boundaries between processes and computers, so that remote objects can be manipulated as if they were local. Here are simple steps you need to follow in order to install and use RPyC with ev3dev:

1. Install RPyC both on the EV3 and on your desktop PC with the following command (depending on your operating system, you may need to use `pip3` or `pip` on the PC instead of `easy_install3`):

```
sudo easy_install3 rpyc
```

2. Create file `rpyc_server.sh` with the following contents on the EV3:

```
#!/bin/bash
python3 `which rpyc_classic.py`
```

and make the file executable:

```
chmod +x rpyc_classic.py
```

Launch the created file either from ssh session, or from brickman.

3. Now you are ready to connect to the RPyC server from your desktop PC:

```
import rpyc
conn = rpyc.classic.connect('ev3dev') # host name or IP address of the EV3
ev3 = conn.modules['ev3dev.ev3']      # import ev3dev.ev3 remotely
m = ev3.LargeMotor('outA')
m.run_timed(time_sp=1000, speed_sp=600)
```

You can run scripts like this from any interactive python environment, like ipython shell/notebook, spyder, pycharm, etc.

Some *advantages* of using RPyC with ev3dev are:

- It uses much less resources than running ipython notebook on EV3; RPyC server is lightweight, and only requires an IP connection to the EV3 once set up (no ssh required).
- The scripts you are working with are actually stored and edited on your desktop PC, with your favorite editor/IDE.
- Some robots may need much more computational power than what EV3 can give you. A notable example is the Rubics cube solver: there is an algorithm that provides almost optimal solution (in terms of number of cube rotations), but it takes more RAM than is available on EV3. With RPYC, you could run the heavy-duty computations on your desktop.

The most obvious *disadvantage* is latency introduced by network connection. This may be a show stopper for robots where reaction speed is essential.

7.3 Frequently-Asked Questions

7.3.1 My script works when launched as `python3 script.py` but exits immediately or throws an error when launched from Brickman or as `./script.py`

This may occur if your file includes Windows-style line endings, which are often inserted by editors on Windows. To resolve this issue, open an SSH session and run the following command, replacing `<file>` with the name of the Python file you're using:

```
sed -i 's/\r//g' <file>
```

This will fix it for the copy of the file on the brick, but if you plan to edit it again from Windows you should configure your editor to use Unix-style endings. For PyCharm, you can find a guide on doing this here. Most other editors have similar options; there may be an option for it in the status bar at the bottom of the window or in the menu bar at the top.

CHAPTER 8

Indices and tables

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