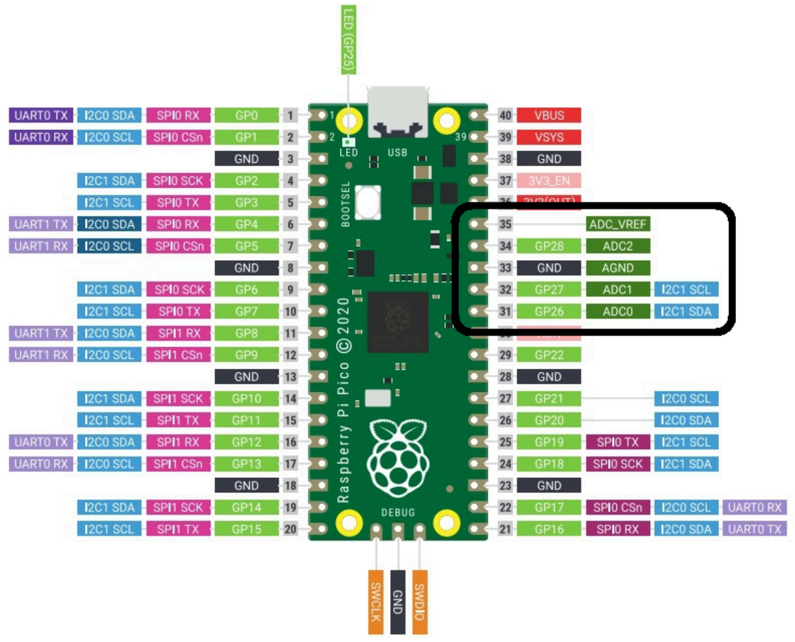
The ADC on RP2040 has a resolution of 12 bits, meaning that it can transform an analog signal into a number ranging from 0 to 4095 – though this is handled in MicroPython transformed to a 16-bit number ranging from 0 to 65535. RP2040 has five ADC channels total, four of which are brought out to chip GPIOs: GP26, GP27, GP28, and GP29. On Raspberry Pi Pico, the first three of these are brought out to GPIO pins, and the fourth can be used to measure the VSYS voltage on the board. The ADC's fifth input channel is connected to a temperature sensor built into RP2040.



It is possible to read any ADC channel either by using the pin number or by channel:

```
adc = machine.ADC(26)     # pin number
adc = machine.ADC(0)      # channel
```

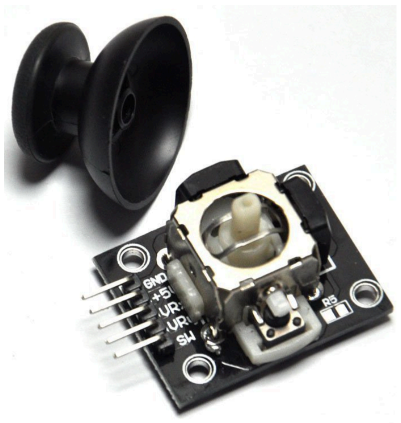
Task 1. Create a MicroPython script to read the internal temperature sensor and send this value to a computer.

```
from machine import ADC

from utime import sleep
```

```
#use channel instead number of a pin
temp_sensor = ADC(4)

while True:
    result = temp_sensor.read_u16()
     temperature = 27 - (result*3.3/65535 -
                         0.706)/0.001721
    print("Temperature: {:.2f}°C".format(temperature))
    sleep(2)
```

Typically, 0.706V means 27 degrees Celsius, with a slope of -1.721mV (0.001721) per degree.

Task 2. Connect a joystick to the Raspberry Pi Pico board.



Pico board	Joystick board
Gnd	Gnd
+3V3	+5V
GP26	VRx
GP27	VRy
GP15	SW

Create a MicroPython script to send to the computer, values proportional to the stick position.

```
from machine import ADC
from utime import sleep

joy_X = ADC(26)
joy_Y = ADC(27)

while True:
    t_string = "X position = " + str(joy_X.read_u16())
    print(t_string)
    t_string = "Y position = " + str(joy_Y.read_u16())
    print(t_string)
    sleep(0.5)
```

Task 3. Create a MicroPython script to send to the computer, values from 0 to 10, proportional to the current stick position.

```
from machine import ADC
from utime import sleep

def analog_map(x, in_min, in_max, out_min, out_max):
     return int((x-in_min)*(out_max-out_min)/
               (in_max-in_min)+ out_min)

joy_X = ADC(26)

while True:
     result = analog_map(joy_X.read_u16(),0,65535,0,10)
     t_string = "X postion = " + str(result)
     print(t_string)
     sleep(1)
```

Task 4. Connect the SSD1306 OLED display to the Raspberry Pi Pico board.

Pico board	**OLED display**	**Pico board**	**OLED display**
Gnd	Gnd	GP0	SDA
+3V3	Vcc	GP1	SCL

Scan the I2C bus to check it the display is available.

```
from machine import Pin, I2C
import utime

i2c = I2C(0, scl=Pin(1), sda=Pin(0), freq=400000)

while True:
    devices = i2c.scan()
    if devices:
        print('I2C device found:', [hex(device) for
               device in devices])
    else:
        print('No I2C devices found')
    utime.sleep(5)
```

Display test.

```
from machine import Pin,I2C
from ssd1306 import SSD1306_I2C
from utime import sleep

WIDTH = 128
HEIGHT = 64

i2c = I2C(0, scl = Pin(1), sda = Pin(0), freq = 400000)
print("I2C adr :" + hex(i2c.scan()[0]).upper())
print("I2C config :" + str(i2c))
oled = SSD1306_I2C(WIDTH,HEIGHT,i2c)

oled.fill(0)
oled.text("RPi Pico",5,10)
oled.show()
```

Task.5. (*own work - 0.5 of a point*) Create a MicroPython script that displays ambient temperature in Celsius degrees, Kelvins and Farenheit degrees value using an OLED display.

Task.6. (*own work - 1 of a point*) Use a joystick to control the position of a bargraph LED segment. Use the joystick switch button to switch on and off this segment.

Task 7. (*own work - 1 of a point*) Use a joystick to control the position of the displayed character on the OLED display.

Task.8. (*own work - 1.5 of a point*) Display temperature vs time graph on the Node-RED-based interface.

To pass the Exercise no 1 You have to solve either Task 5 or Task 6 or Task 7 or Task 8. Presentation and sending solution afterwards is mandatory.

For those interested:

1. MicroPython web page:

   micropython.org/download/rp2-pico/

   https://randomnerdtutorials.com/raspberry-pi-pico-analog-inputs-micropython/

2. SSD1306 display programming tutorial:

   microcontrollerslab.com/oled-display-raspberry-pi-pico-micropython-tutorial/

3. Using a SSD1306 OLED display:

   docs.micropython.org/en/latest/esp8266/tutorial/ssd1306.html