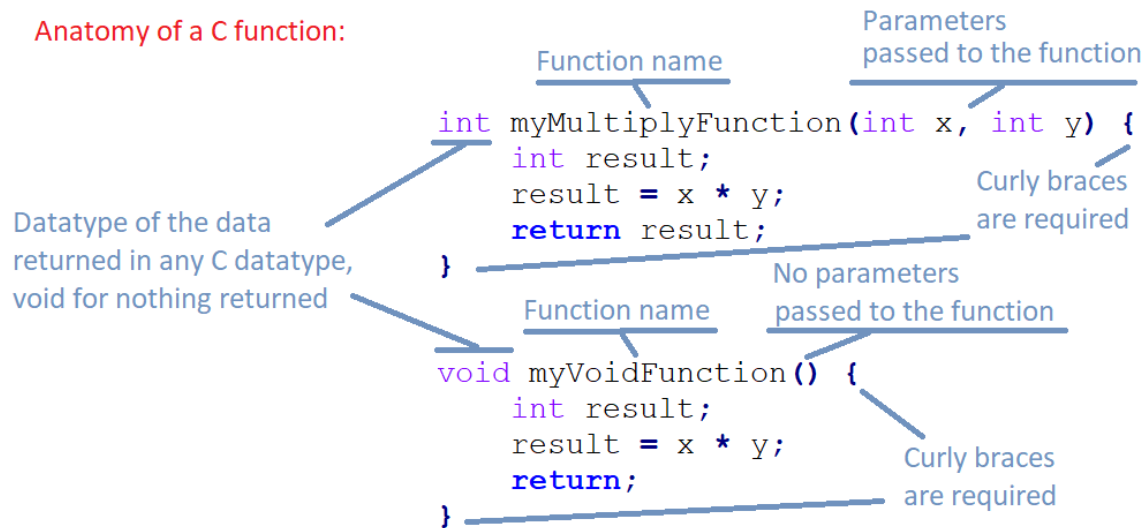# Microcontrollers & Applications

Lecture 3.2: User-Defined Functions & Variable Scope
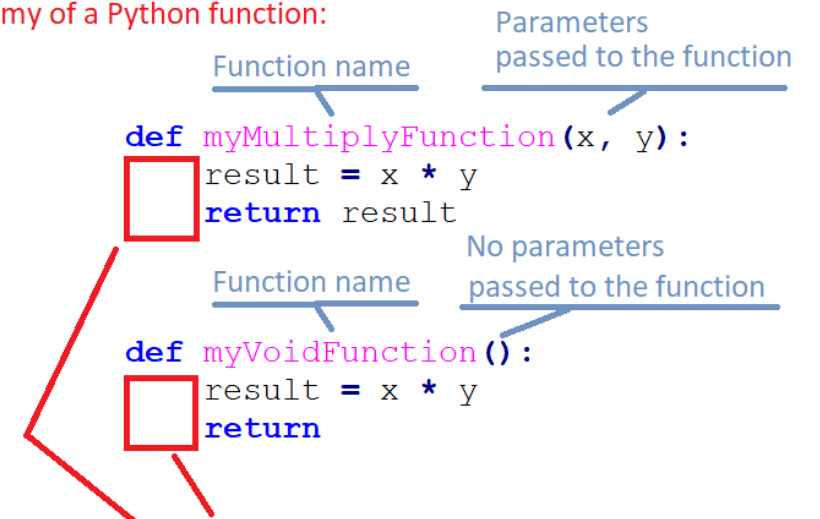
Function Definition

Anatomy of a C function:
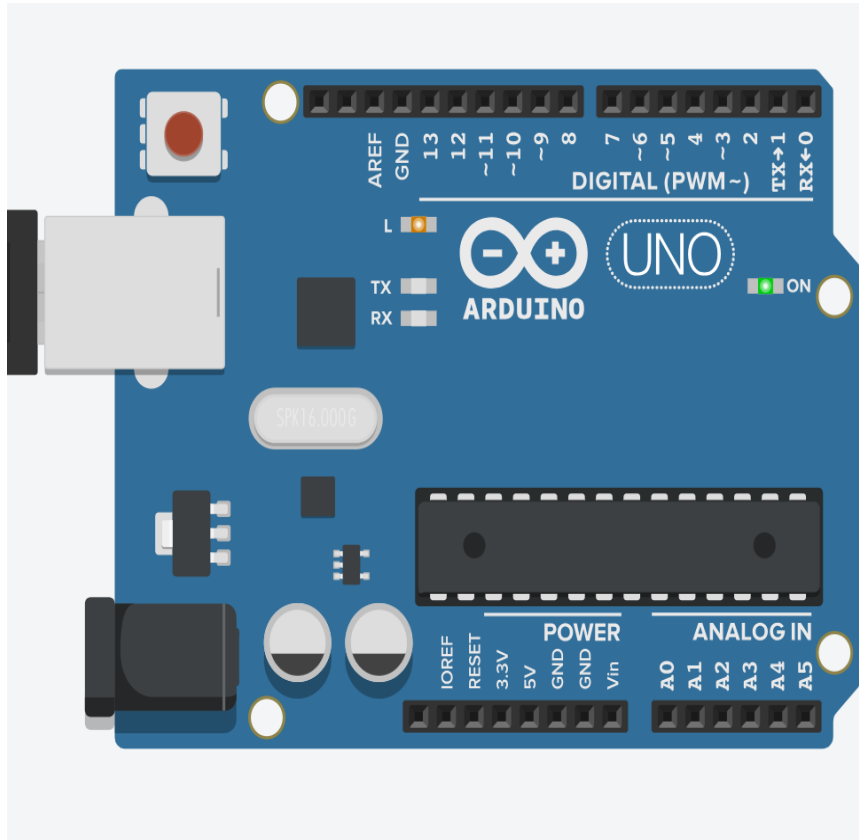
Function name

Parameters passed to the function

```c
int myMultiplyFunction(int x, int y) {
    int result;
    result = x * y;
    return result;
}
```

Datatype of the data returned in any C datatype, void for nothing returned

Curly braces are required

Function name

No parameters passed to the function

```c
void myVoidFunction() {
    int result;
    result = x * y;
    return;
}
```

Curly braces are required

return statements, datatype of returned value must match the datatype declaration of the function

Anatomy of a Python function:

Function name

Parameters passed to the function

```python
def myMultiplyFunction(x, y):
    result = x * y
    return result
```

Function name

No parameters passed to the function

```python
def myVoidFunction():
    result = x * y
    return
```

Giving the same number of extra spaces from the left is necessary to indicate which commands belong to the function

Function Definition in Arduino (1)


```
#define ONBOARD_LED 13

#define DELAY_TIME 1000


void setup()

{

  pinMode(ONBOARD_LED, OUTPUT);

  Serial.begin(9600);

  Serial.println("LED functions under testing");

}


void loop()

{

  led_on();

  led_off();

}
```

```
void led_on()

{

  digitalWrite(ONBOARD_LED, HIGH);

  Serial.println("LED is lightening");

  delay(DELAY_TIME);

}


void led_off()

{

  digitalWrite(ONBOARD_LED, LOW);

  Serial.println("LED is NOT lightening");

  delay(DELAY_TIME);

}
```
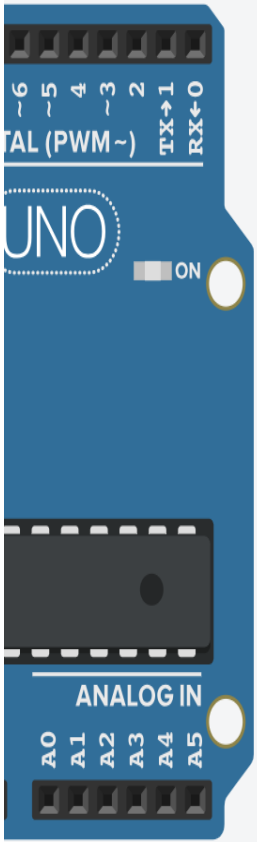
Function Definition in Arduino (2): variable scope

```
1   unsigned int ONBOARD_LED = 13;
2   unsigned long DELAY_TIME = 1000;
3
4   void setup()
5   {
6     unsigned long BPS = 9600;
7     pinMode(ONBOARD_LED, OUTPUT);
8     Serial.begin(BPS);
9     Serial.println("LED functions under testing");
10  }
11
12  void loop()
13  {
14    unsigned long MY_TIME = 1000;
15    led_on();
16    led_off();
17    led_toggle();
18  }
19
20  void led_on()
21  {
22    unsigned long DELAY_TIME = 500;
23    digitalWrite(ONBOARD_LED, HIGH);
24    Serial.println("LED is lightening");
25    delay(DELAY_TIME);
26  }
27
28  void led_off()
29  {
30    digitalWrite(ONBOARD_LED, LOW);
31    Serial.println("LED is NOT lightening");
32    delay(DELAY_TIME);
33  }
34
35  void led_toggle()
36  {
37    Serial.println("LED is TOGGLING");
38    delay(MY_TIME);
39  }
```

Sorry, it seems like your code has some errors.   Close ✕
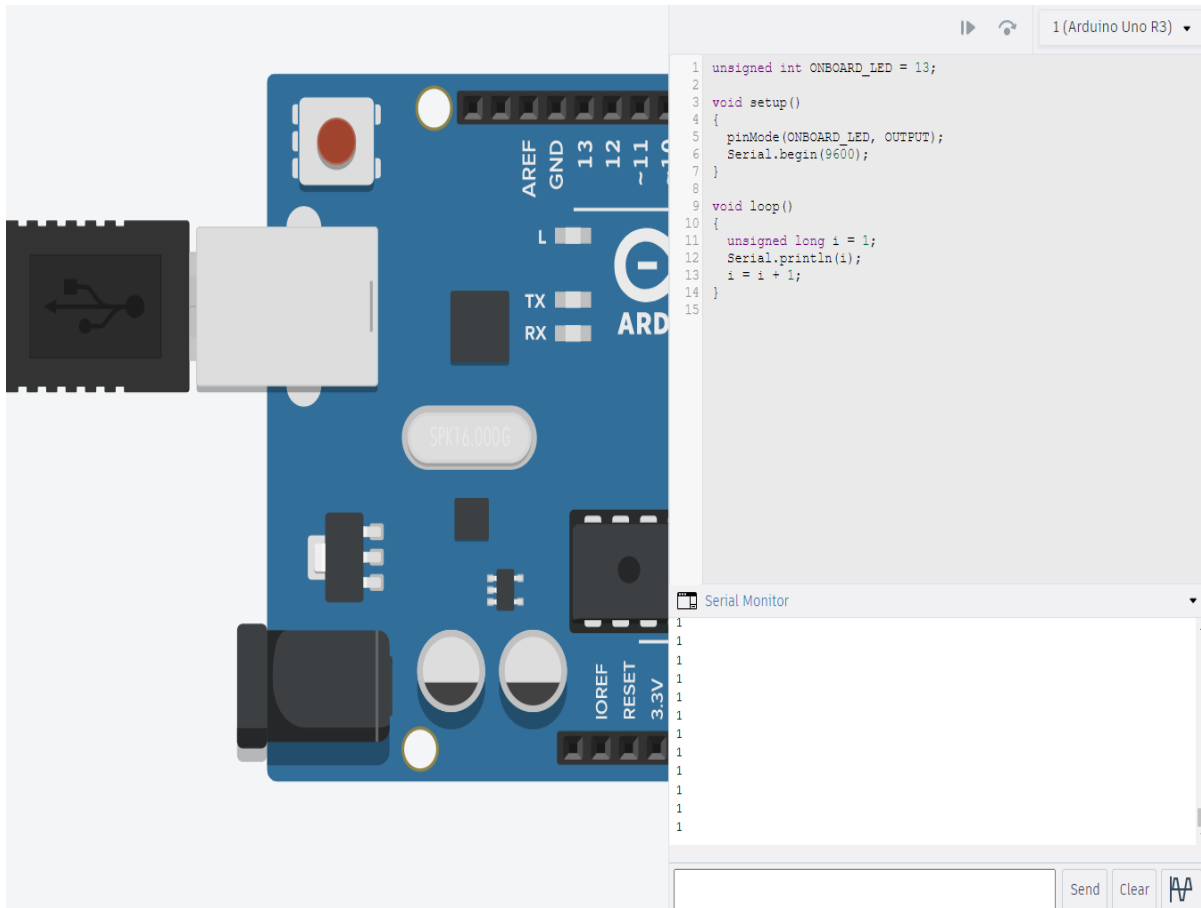
```
In function 'void led_toggle()':
38:9: error: 'MY_TIME' was not declared in this scope
38:9: note: suggested alternative: 'DELAY_TIME'
```

```
unsigned int ONBOARD_LED = 13;

unsigned long DELAY_TIME = 1000;


void setup()

{

  unsigned long BPS = 9600;

  pinMode(ONBOARD_LED, OUTPUT);

  Serial.begin(BPS);

  Serial.println("LED functions under testing");

}


void loop()

{

  unsigned long MY_TIME = 1000;
```

```
led_on();

led_off();

led_toggle();

}


void led_on()

{

  unsigned long DELAY_TIME = 500;

  digitalWrite(ONBOARD_LED, HIGH);

  Serial.println("LED is lightening");

  delay(DELAY_TIME);

}


void led_off()
```

```
{

  digitalWrite(ONBOARD_LED, LOW);

  Serial.println("LED is NOT lightening");

  delay(DELAY_TIME);

}


void led_toggle()

{

  DELAY_TIME = 2000;

  Serial.println("LED is TOGGLING");

  delay(MY_TIME);

}
```

```
In function 'void led_toggle()':
38:9: error: 'MY_TIME' was not declared
in this scope
38:9: note: suggested alternative:
'DELAY_TIME'
```

Function Definition in Arduino (3): global vs local variables

- A variable must defined before its first use.

- A variable must be defined in the same code block (limited by curly braces) or in the upper code block.

  - ONBOARD_LED is defined at the top of the program, so you can use it everywhere.

  - MY_TIME is defined under the loop() function. Since led_toggle() function is not a sub-block of the loop() function block, it generates an error message.

  - DELAY_TIME is defined both at the top of the program and the led_on() function block. The value of the DELAY_TIME is 500 in the led_on() code block, 1000 in other code blocks.

  - DELAY_TIME is changed in the led_toggle() function block, so that DELAY_TIME will be 2000 in all code blocks (other than led_on) after calling led_toggle() function.

- If a variable is defined in both in code block and its upper block, the definition of the code block itself will be used.
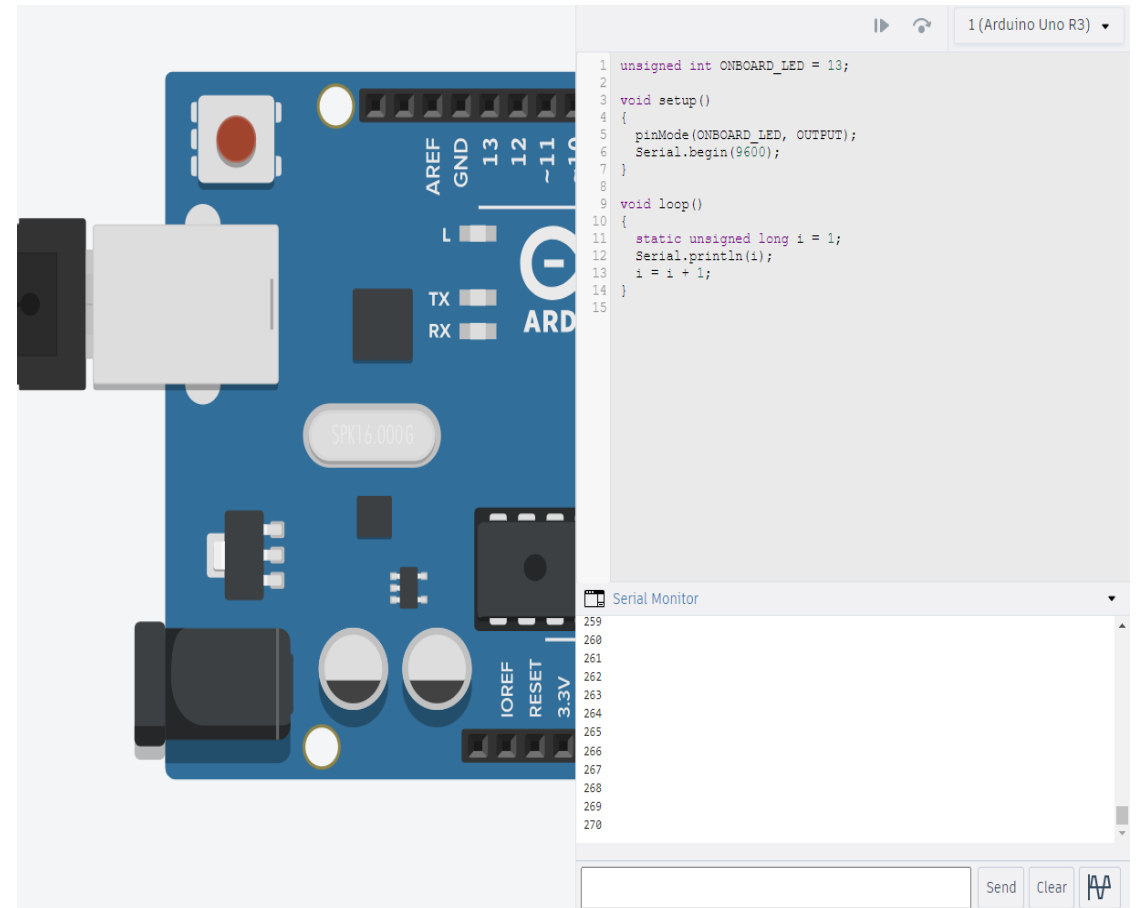
Function Definition in Arduino (4): static variables

Function Definition in Arduino (4): argument passing byval vs byref

Function Definition in Arduino (5): recursive functions
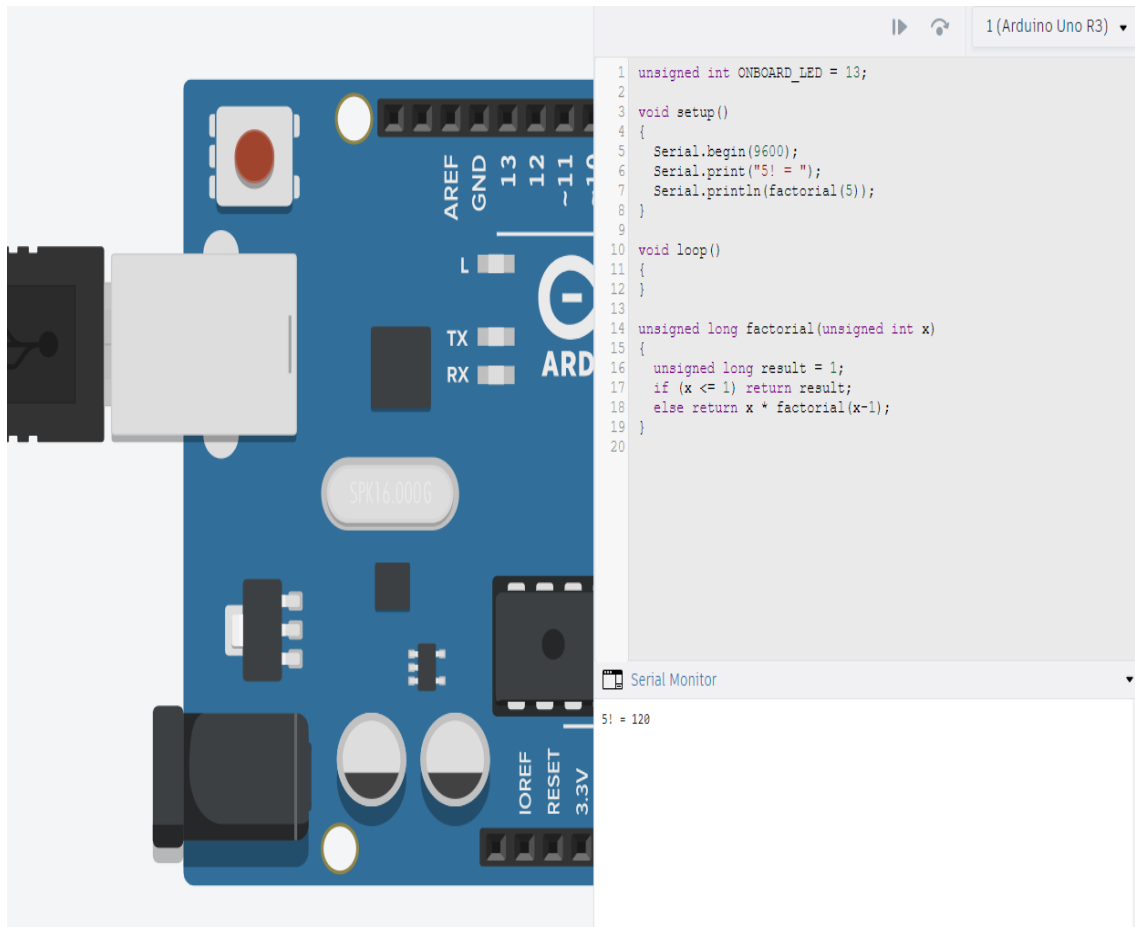

```
void setup() {

  Serial.begin(9600);

  Serial.print("5! = ");

  Serial.println(factorial(5));

  // Serial.println("5! = " + factorial(5));

}



void loop() {

}



unsigned long factorial(unsigned int x) {

  unsigned long result = 1;

  if (x <= 1) return result;

  else return x * factorial(x-1);

}
```

Function Definition in Python:

- A variable must have a value before its first read.

- All variables become global variable and are available to all code blocks.

Thanks for listening ☺

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