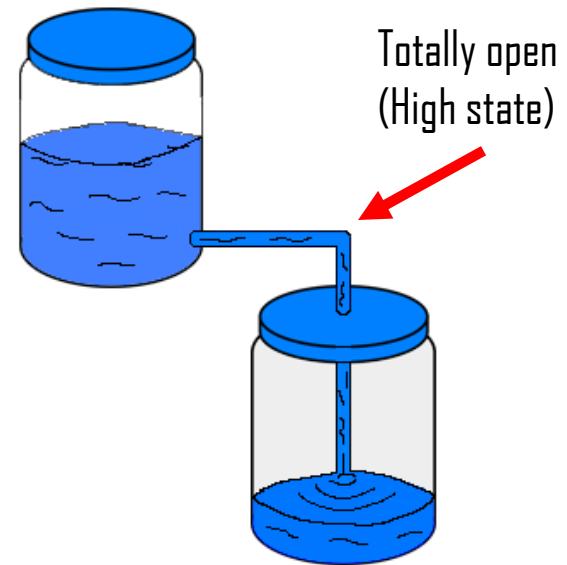
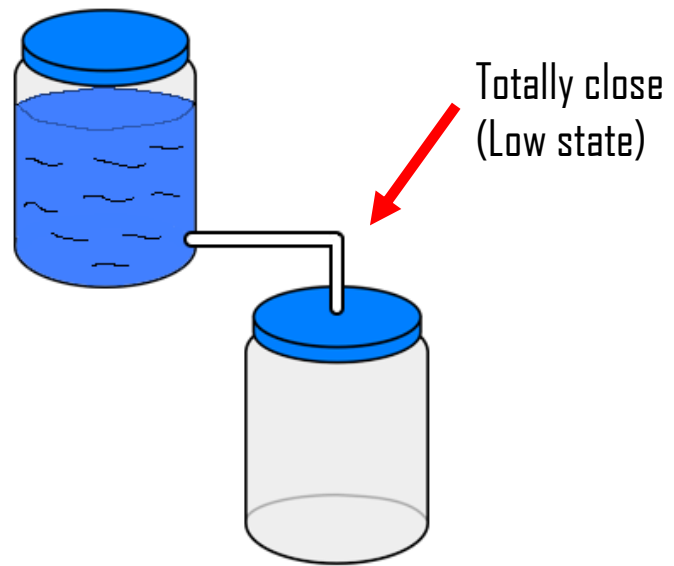




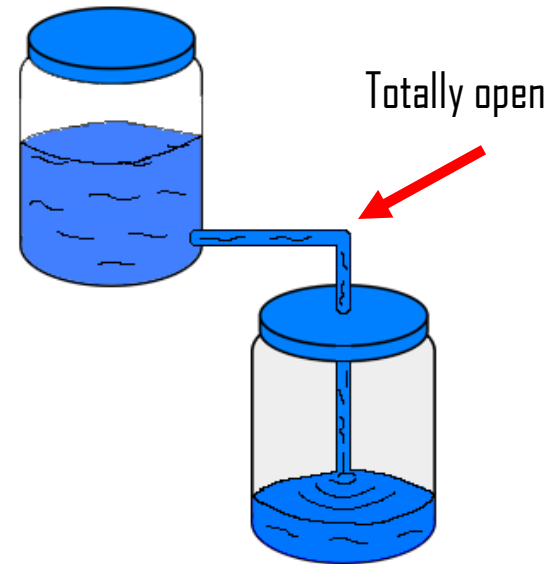
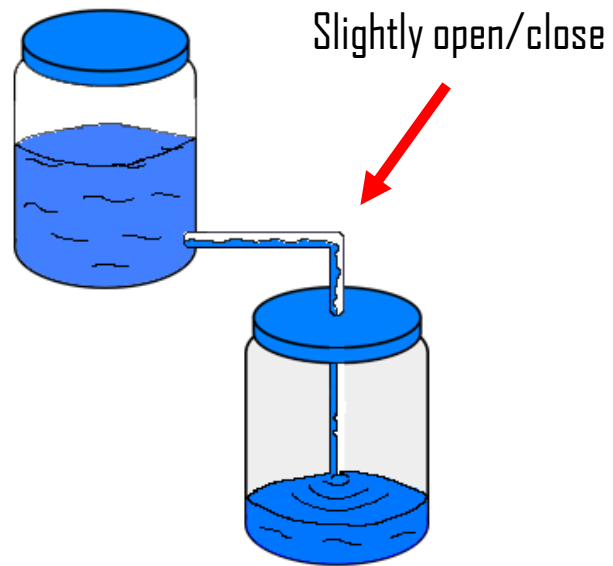
**PORTO
DESIGN
FACTORY**

öBot CERN
2018

Digital Pins



Analog Pins

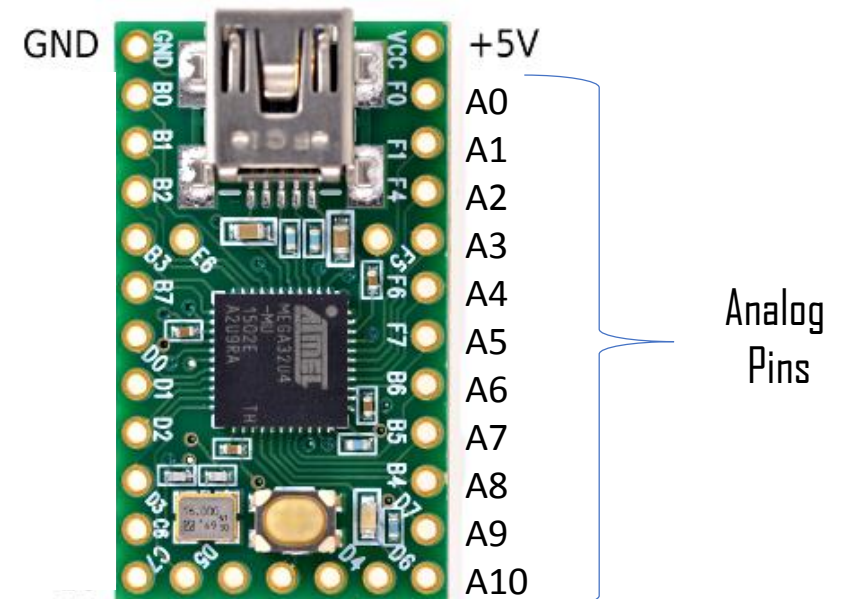


Analog Pins

The digital pins they are black and white, it's only high or low state

The analog pins have 1023 levels between the high and low state

The teensy 2.0 has 11 analog pins, where we can read values



Read analog values

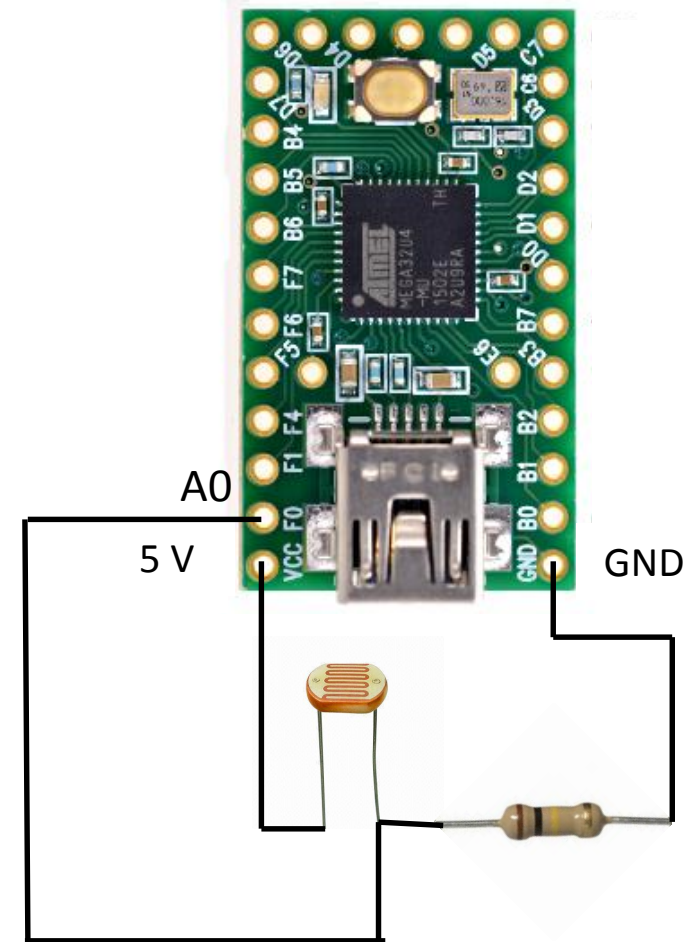
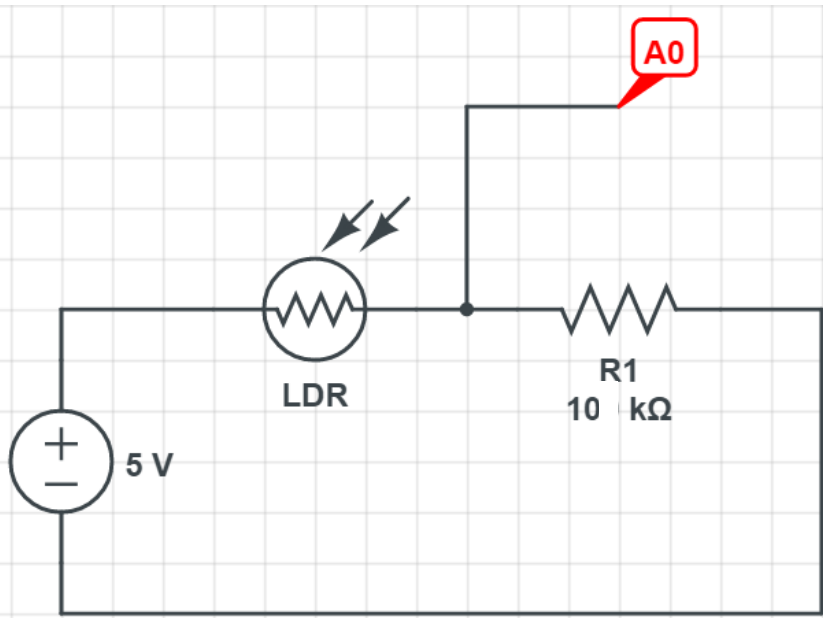
To read an analog values we will be using a sensor called LDR

A LDR is a light sensor that sends different results depending on the light that he is receiving

LDR



Assemble the LDR circuit



You have 5 minutes!!

Code for the LDR circuit

When we want to read an analog pin:

```
analogRead (A0) ;
```

Code for the LDR circuit

When we want to read an analog pin:

 `analogRead (A0) ;`

This function that return a value between 0 and 1023

Code for the LDR circuit

When we want to read an analog pin:

```
→ analogRead (A0) ;
```

This function that return a value between 0 and 1023

← Number of the pin

Code for the LDR circuit

When we want to read an analog pin:

```
→ analogRead (A0) ;
```

This function that return a value between 0 and 1023

Number of the pin

```
int sensorValue = 0;
```

Code for the LDR circuit

When we want to read an analog pin:

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analogRead(A0);
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This function that return a value between 0 and 1023

Number of the pin

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```

Type of the variable

Code for the LDR circuit

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int sensorValue = 0;
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Type of the variable

Name of the variable

Code for the LDR circuit

When we want to read an analog pin:

```
analogRead(A0);
```

This function that return a value between 0 and 1023

Number of the pin

```
int sensorValue = 0;
```

Type of the variable

Name of the variable

The start value of the variable

Code for the LDR circuit

```
int sensorValue = 0;

void setup()
{

}

void loop()
{
    sensorValue = analogRead(A0);
}
```

Code for the LDR circuit

```
int sensorValue = 0;

void setup()
{

}

void loop()
{
    sensorValue = analogRead(A0);
}
```

But how can we
see the result?



Serial communication

This technology is used to establish some type of communication between the microcontroller and a computer or a different device

To use this feature we need to:

```
Serial.begin(9600);
```



Serial communication

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This function establish a
communication to other device




Serial communication

This technology is used to establish some type of communication between the microcontroller and a computer or a different device


To use this feature we need to:

```
Serial.begin(9600);
```

This function establish a
communication to other device



The frequency that the
data is being sent



Serial communication

When we want to send data to serial port:

```
Serial.println(sensorValue);
```

Serial communication

When we want to send data to serial port:

```
Serial.println(sensorValue);
```




This function prints data to
the other device

Serial communication

When we want to send data to serial port:

```
Serial.println(sensorValue);
```

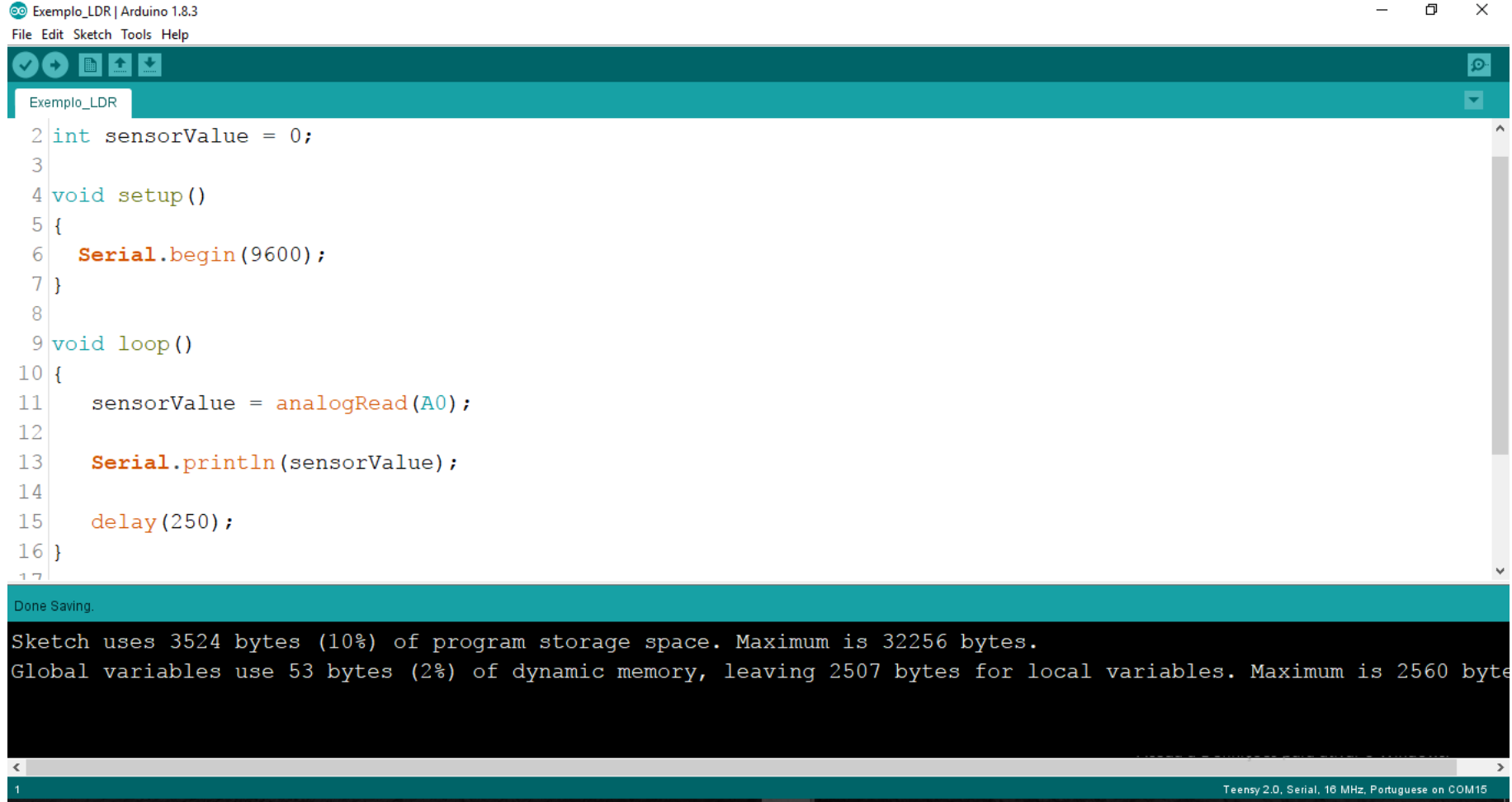
This function prints data to
the other device



Data to be sent



Code for the LDR circuit



```
Exemplo_LDR | Arduino 1.8.3
File Edit Sketch Tools Help

Exemplo_LDR
2 int sensorValue = 0;
3
4 void setup()
5 {
6   Serial.begin(9600);
7 }
8
9 void loop()
10 {
11   sensorValue = analogRead(A0);
12
13   Serial.println(sensorValue);
14
15   delay(250);
16 }
17
```

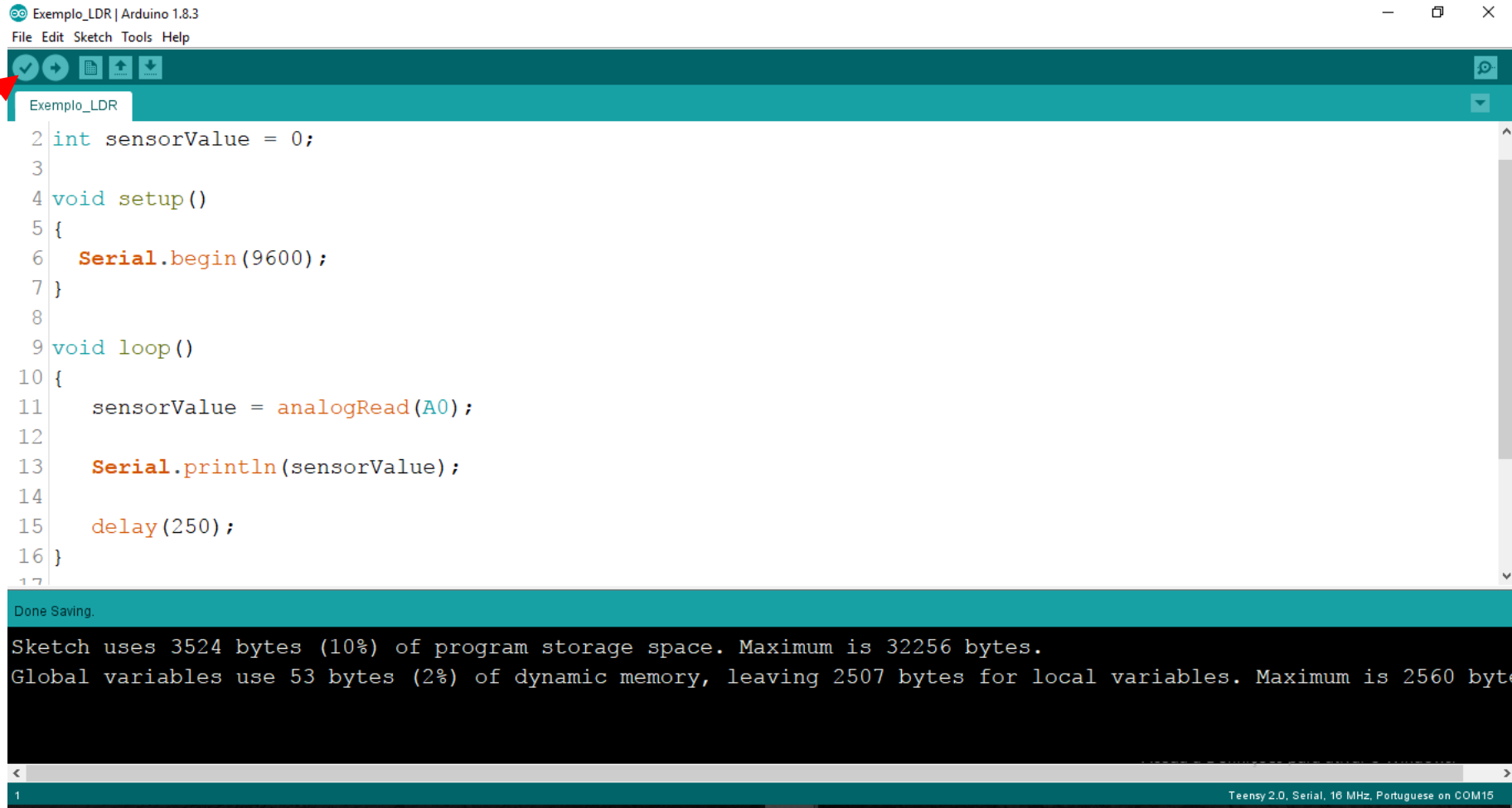
Done Saving.

Sketch uses 3524 bytes (10%) of program storage space. Maximum is 32256 bytes.
Global variables use 53 bytes (2%) of dynamic memory, leaving 2507 bytes for local variables. Maximum is 2560 bytes.

Teensy 2.0, Serial, 16 MHz, Portuguese on COM15

Code for the LDR circuit

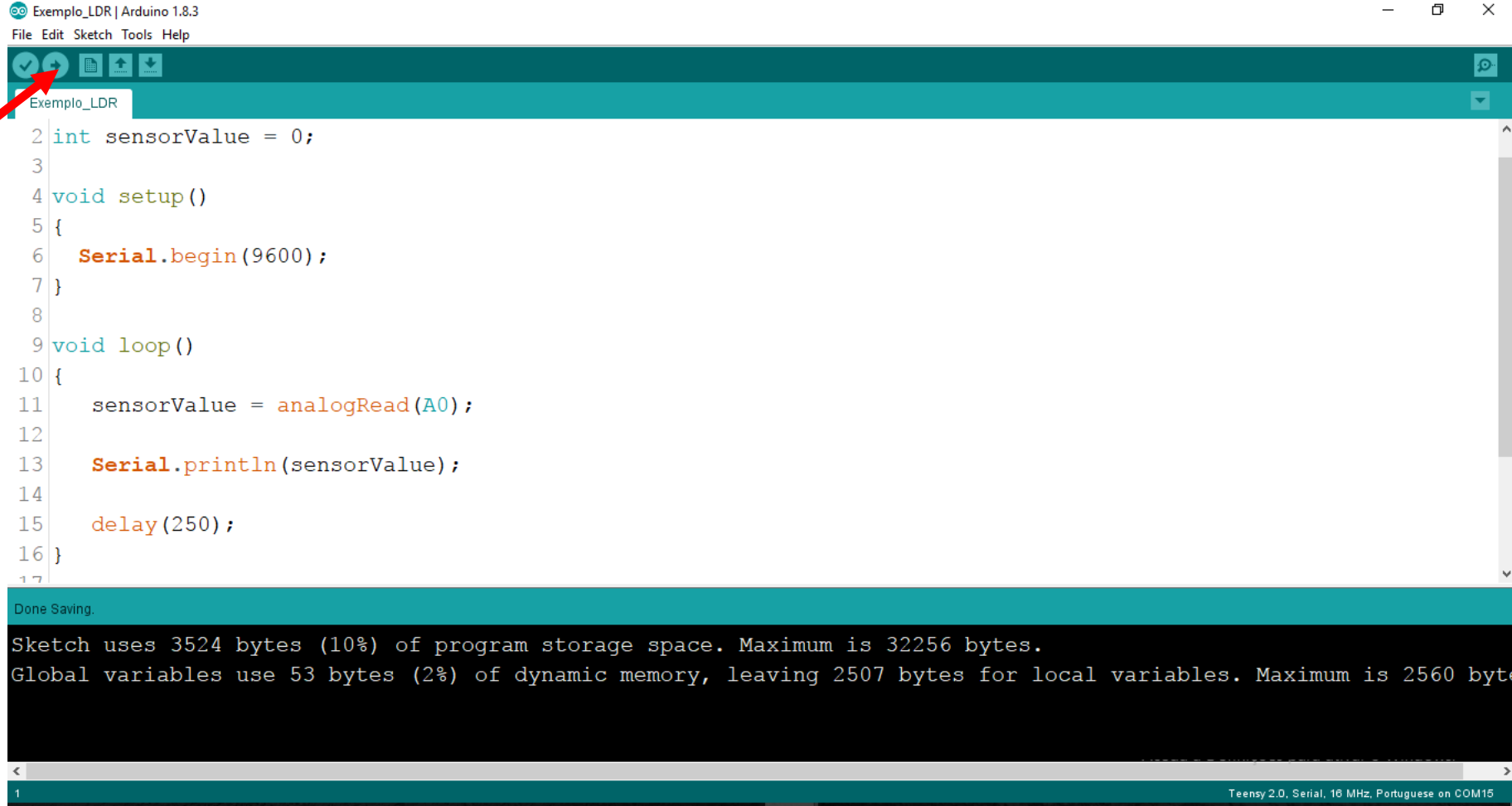
Click on
verify



```
Exemplo_LDR | Arduino 1.8.3
File Edit Sketch Tools Help
Exemplo_LDR
2 int sensorValue = 0;
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Done Saving.
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Teensy 2.0, Serial, 16 MHz, Portuguese on COM15
```

Code for the LDR circuit

Click on
upload



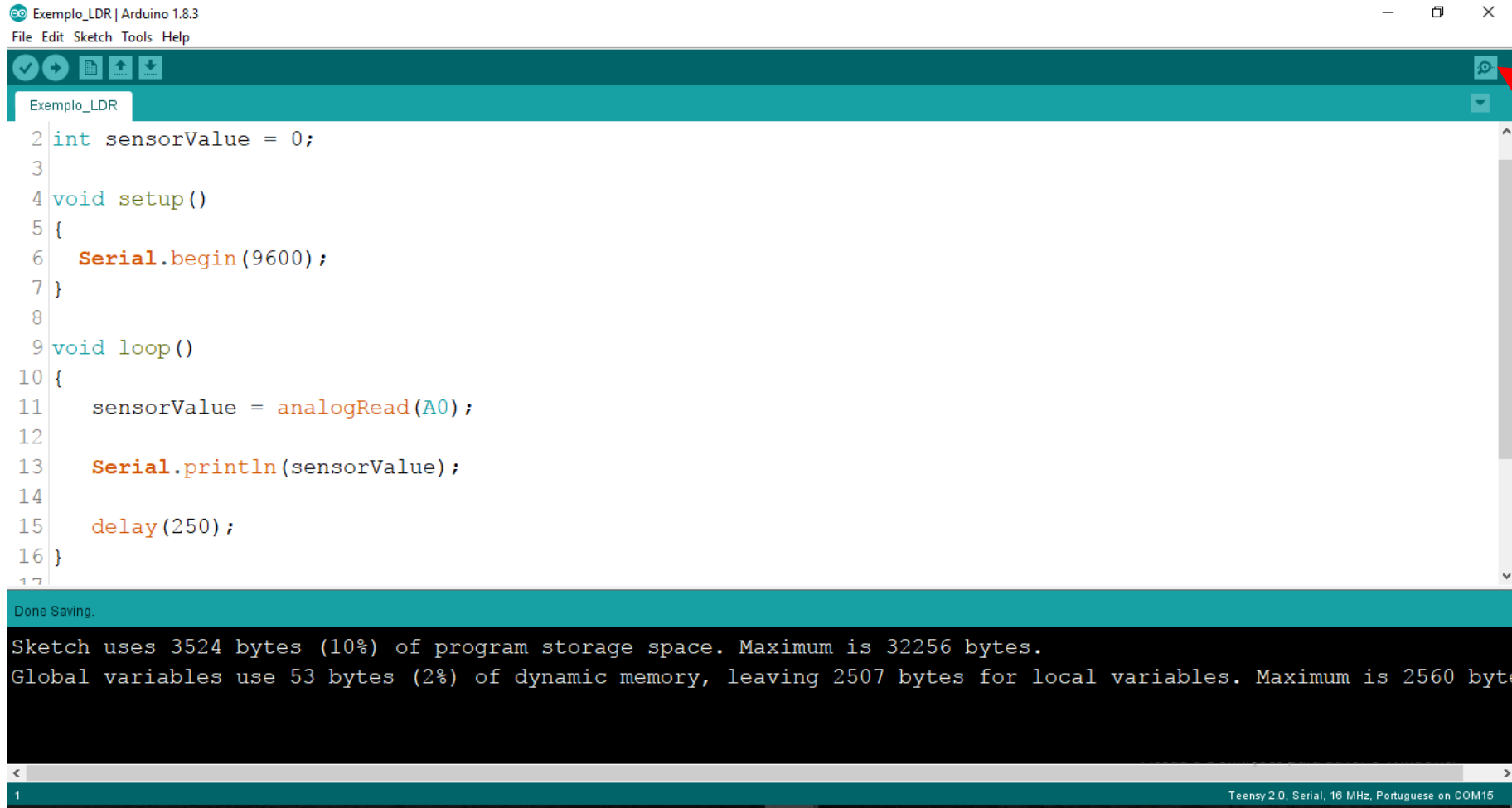
```
Exemplo_LDR | Arduino 1.8.3
File Edit Sketch Tools Help
Exemplo_LDR
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Code for the LDR circuit



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Teensy 2.0, Serial, 16 MHz, Portuguese on COM15

Click on
Serial Monitor

Code for the LDR circuit

The screenshot shows the Arduino IDE interface. On the left, the code editor displays the following code:

```
1  
2 int sensorValue = 0;  
3  
4 void setup()  
5 {  
6   Serial.begin(9600);  
7 }  
8  
9 void loop()  
10 {  
11   sensorValue = analogRead(A0);  
12  
13   Serial.println(sensorValue);  
14  
15   delay(250);  
16 }  
17  
18  
19  
20
```

On the right, the Serial Monitor window is open, showing the following data:

```
879  
876  
875  
875  
875  
875  
876  
876  
876  
875  
875  
875  
876
```

At the bottom of the IDE, a status bar indicates: "Sketch uses 3524 bytes (10%) of program storage space. Maximum is 32256 bytes. Global variables use 53 bytes (2%) of dynamic memory, leaving 2507 bytes for local variables." The baud rate is set to 9600.

Two callout boxes provide additional information:

- A box on the right states: "This is our terminal where we can see all the data that is sent".
- A box at the bottom right states: "Make sure that this value is 9600".

Code for the LDR circuit

```
Serial.println(sensorValue);
```

Code for the LDR circuit

```
Serial.println(sensorValue);
```



```
Serial.println("sensorValue");
```

Code for the LDR circuit

```
Serial.println(sensorValue);
```



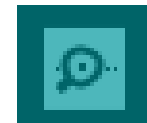
```
Serial.println("sensorValue");
```



Verify



Upload



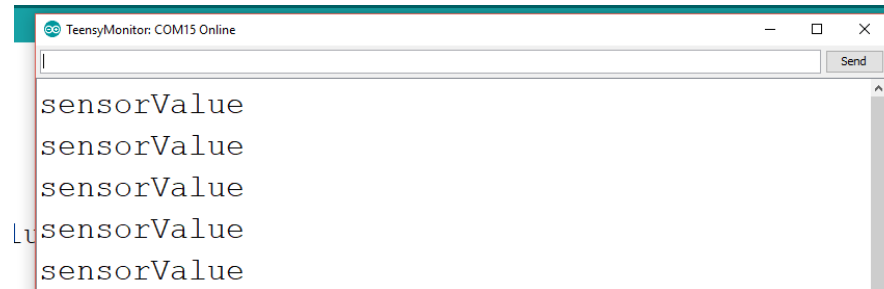
Serial Monitor

Code for the LDR circuit

```
Serial.println(sensorValue);
```



```
Serial.println("sensorValue");
```



Code for the LDR circuit

```
Serial.println(sensorValue);
```



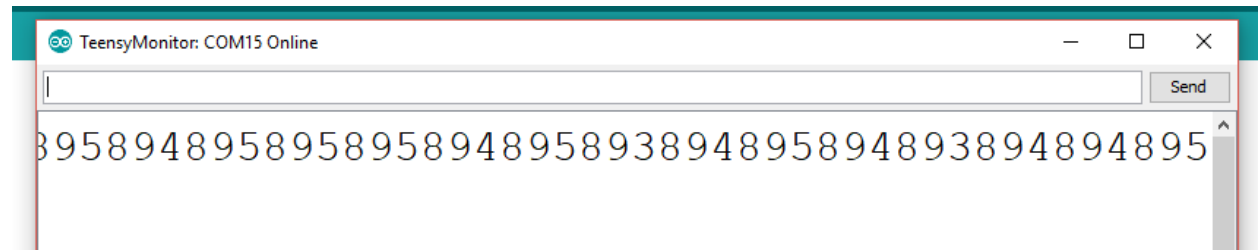
```
Serial.print(sensorValue);
```

Code for the LDR circuit

```
Serial.println(sensorValue);
```



```
Serial.print(sensorValue);
```

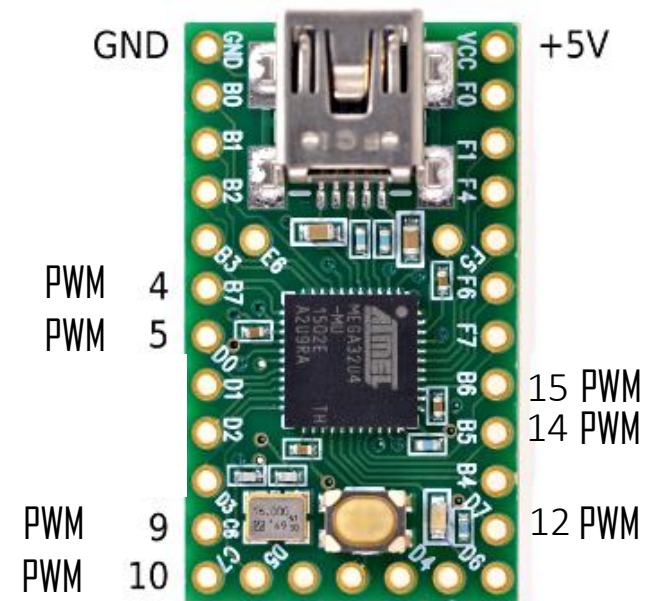


Analog output

The "analog output" is called PWM, and it works the same way as the input

The output is divided in 255 levels, starting with the zero

The teensy 2.0 has 7 PWM pins



Analog output

When we want to send a PWM:

Analog output

When we want to send a PWM:

```
analogWrite (4, 125) ;
```

Function that
sends the PWM




Analog output

When we want to send a PWM:

```
analogWrite (4, 125) ;
```

Function that
sends the PWM



Number of the pin




Analog output

When we want to send a PWM:

```
analogWrite (4, 125) ;
```

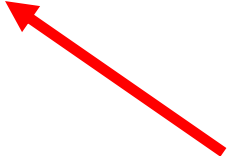
Function that
sends the PWM



Number of the pin



Value of the PWM
(0-255)



For loop

The for loop is used to repeat a action for a certain amount of times

```
for (int i=0; i<=255; i++)  
{  
  
}  
}
```

The FOR condition

The loop begins with open brackets

The loop ends with close brackets

For loop

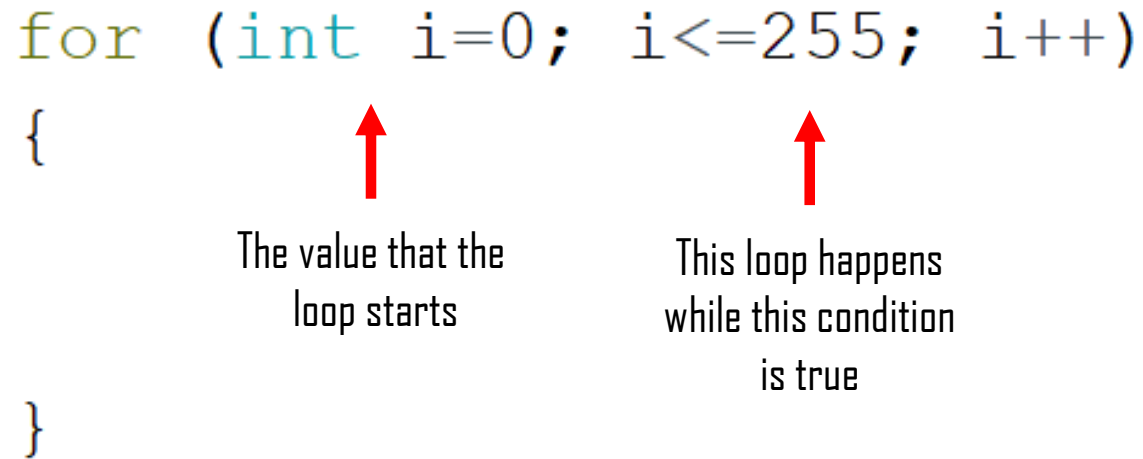
The for loop is used to repeat a action for a certain amount of times

```
for (int i=0; i<=255; i++)  
{  
    ↑  
    The value that the  
    loop starts  
}
```

For loop

The for loop is used to repeat a action for a certain amount of times

```
for (int i=0; i<=255; i++)  
{  
  
  
  
}
```



The value that the loop starts

This loop happens while this condition is true

For loop

The for loop is used to repeat a action for a certain amount of times

```
for (int i=0; i<=255; i++)  
{  
  
  
}
```

↑
The value that the
loop starts

↑
This loop happens
while this condition
is true

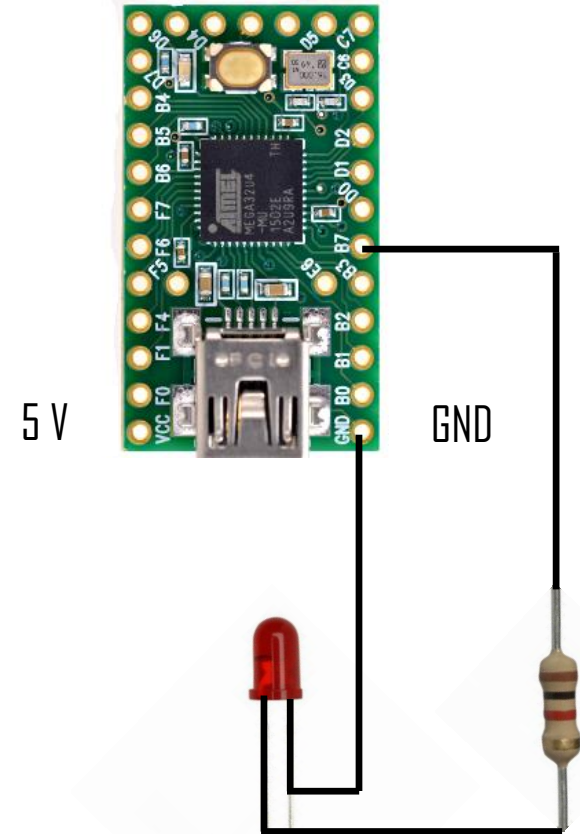
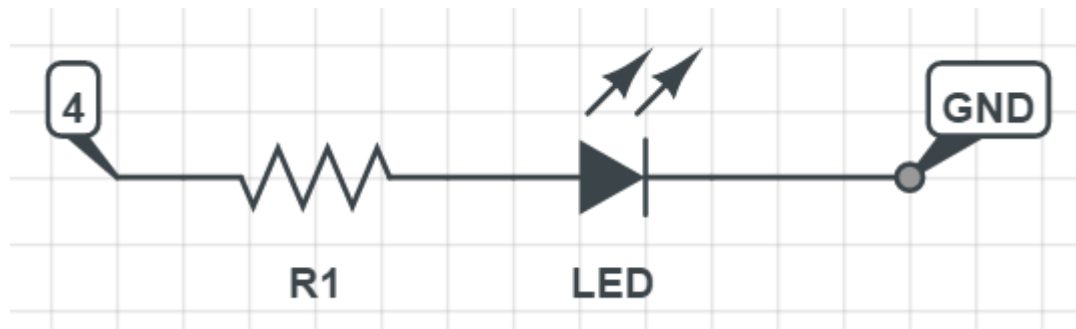
←
Everytime that the condition
is true the starting value
increases 1 unity

For loop

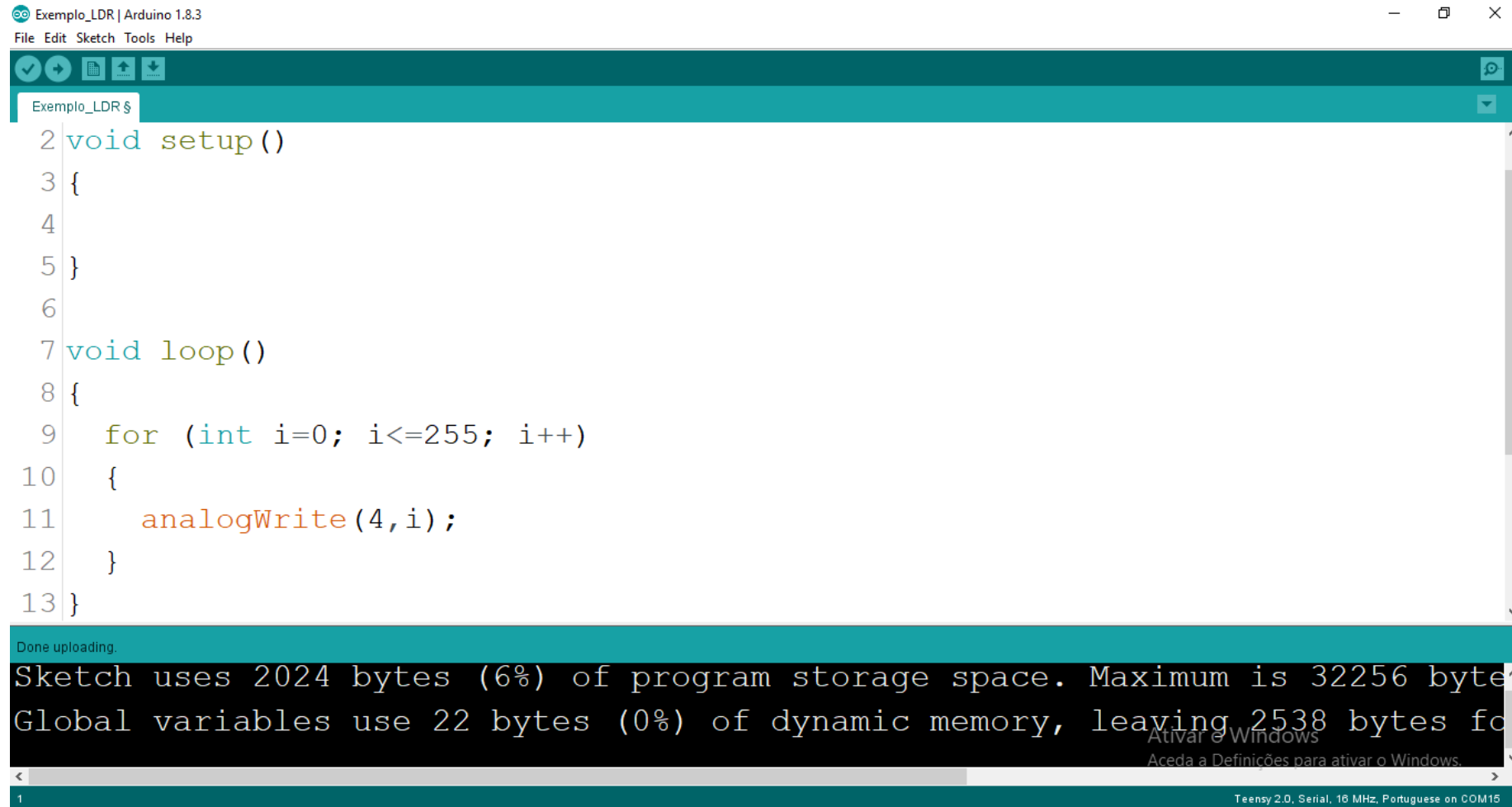
The for loop is used to repeat a action for a certain amount of times

```
for (int i=0; i<=255; i++)  
{  
    analogWrite(4,i);  
}
```

Code Analog Output



Code Analog Output



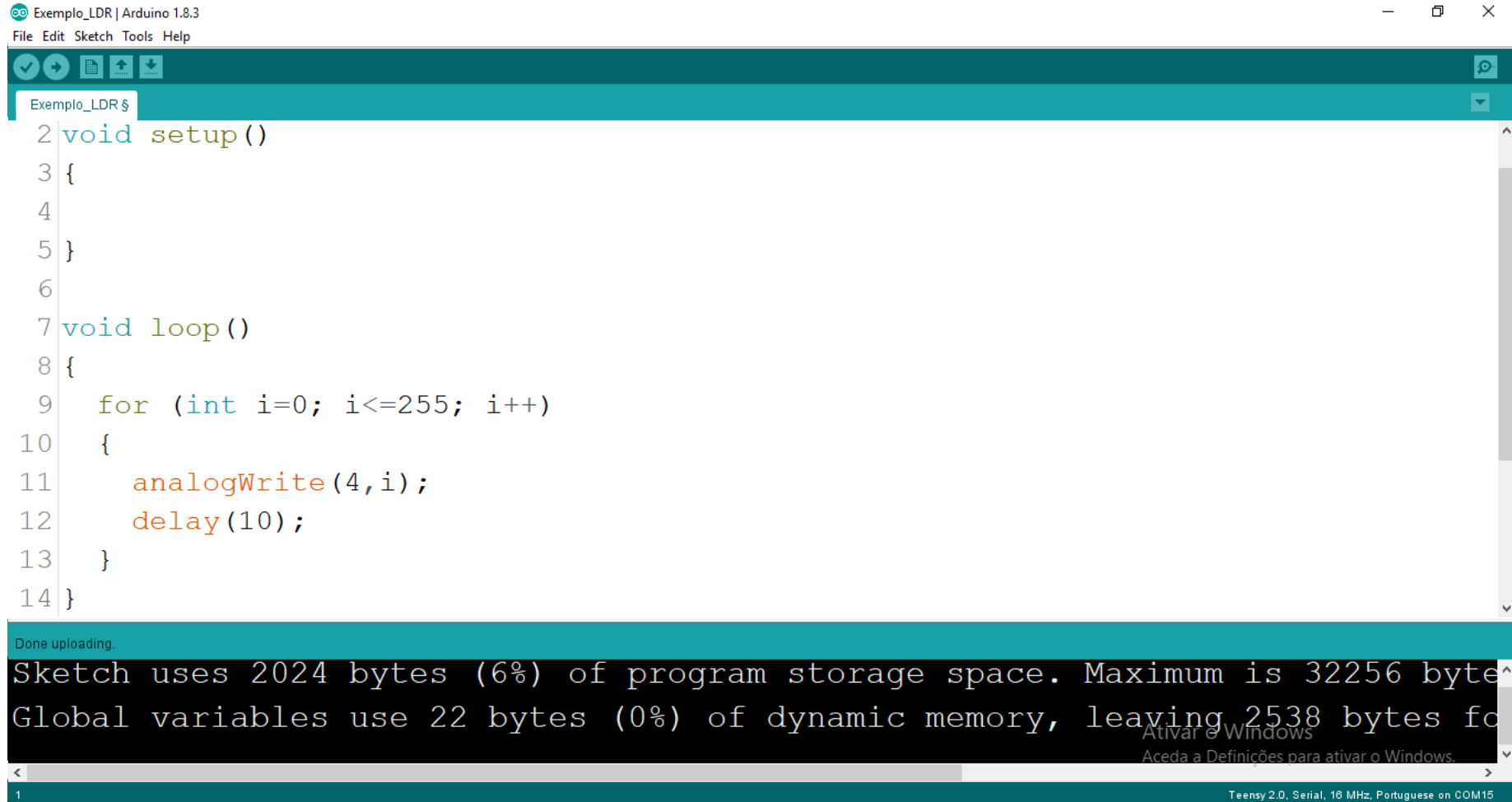
```
Exemplo_LDR | Arduino 1.8.3
File Edit Sketch Tools Help
Exemplo_LDR $
2 void setup()
3 {
4
5 }
6
7 void loop()
8 {
9   for (int i=0; i<=255; i++)
10  {
11    analogWrite(4,i);
12  }
13 }
```

Done uploading.

Sketch uses 2024 bytes (6%) of program storage space. Maximum is 32256 bytes.
Global variables use 22 bytes (0%) of dynamic memory, leaving 2538 bytes for local variables.

Teensy 2.0, Serial, 16 MHz, Portuguese on COM15

Code Analog Output



```
Exemplo_LDR | Arduino 1.8.3
File Edit Sketch Tools Help
Exemplo_LDR $
2 void setup()
3 {
4
5 }
6
7 void loop()
8 {
9   for (int i=0; i<=255; i++)
10  {
11    analogWrite(4,i);
12    delay(10);
13  }
14 }
```

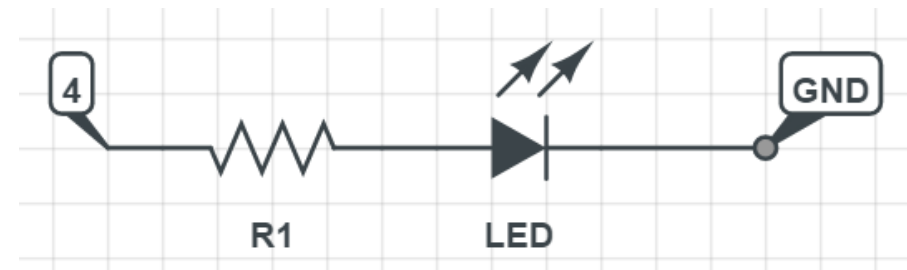
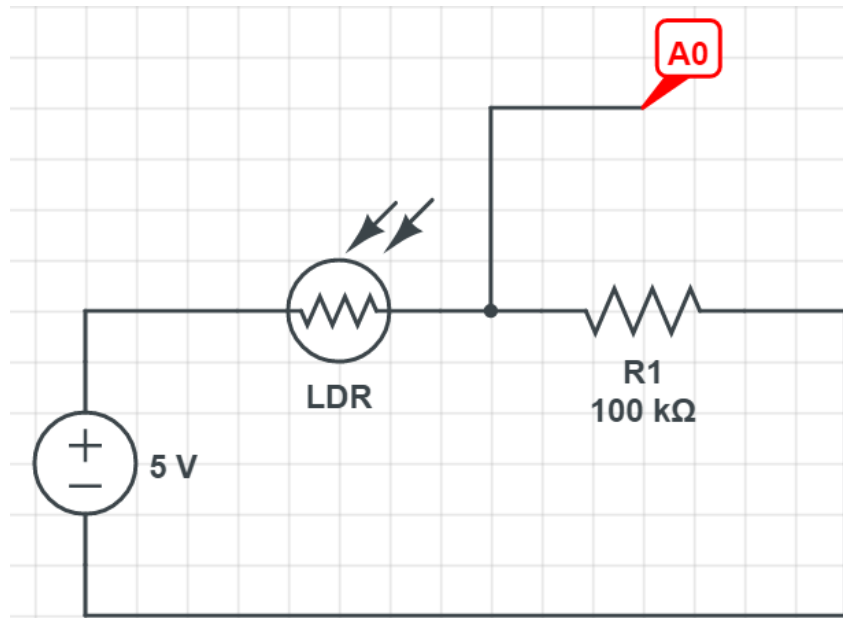
Done uploading.

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Teensy 2.0, Serial, 16 MHz, Portuguese on COM15

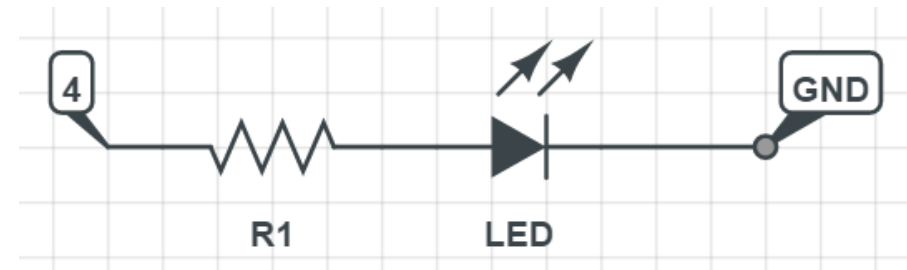
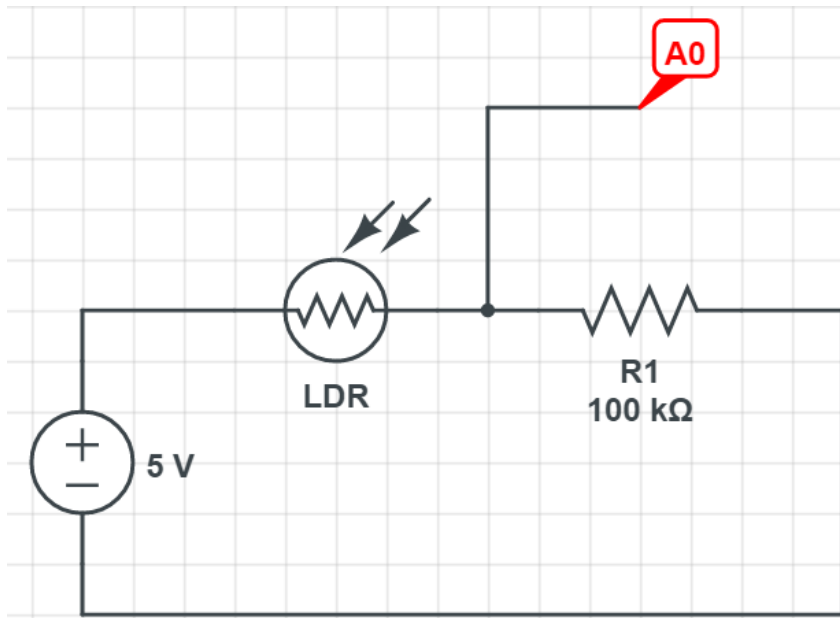
Challenge nº6

Now you must read the value from the sensor and send the value to the LED



Challenge nº6

Now you must read the value from the sensor and send the value to the LED



**Remember that you read
in 1023 and write in 255**

Components

Components that you can use:



Servo motor

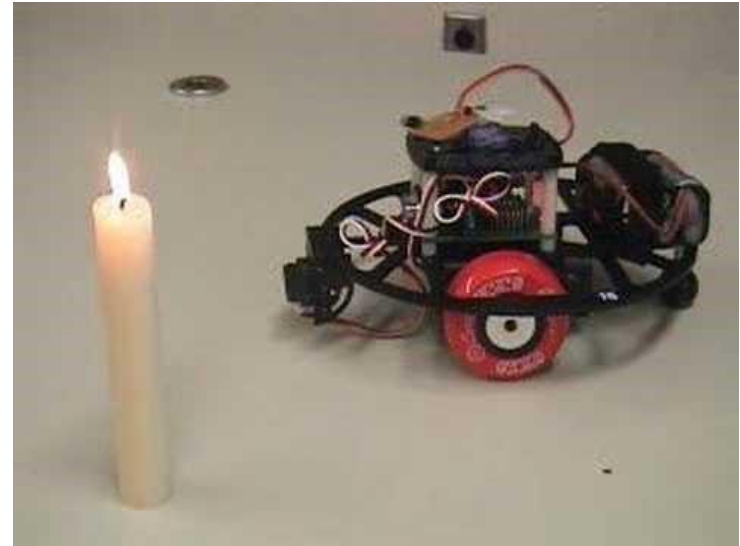


Components

Components that you can use:



Flame sensor

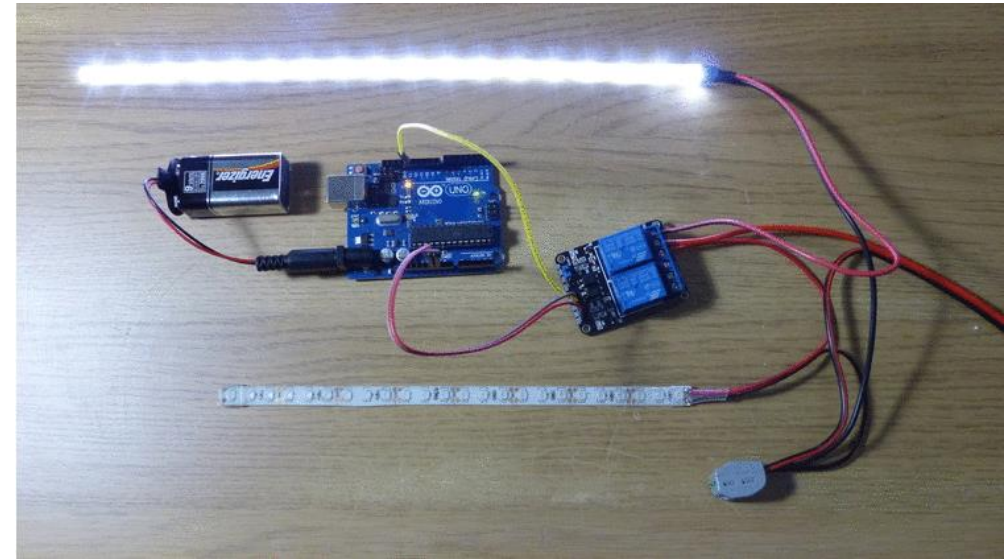


Components

Components that you can use:



Relay



Components

Components that you can use:



PIR

