

T.R.E. Meeting #2**Reading & Writing (Nightlight)**

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Contact Info for Today's Lesson:

President Ryan Muller

mullerr@vt.edu | 610-573-1890**Learning Objectives:**

- Review Lesson #1 (Not included in notes)
- Learn differences between digital and analog signals
- Learn how to write to device
- Learn how to read from device
- Put together for nightlight

Agenda:

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Analog vs Digital Signals:

- Digital Signals
 - Known by computers as either HIGH or LOW (On or Off)
 - We refer to this as either a 1 or a 0.
 - In voltages, this is either 5V (HIGH) or 0V (LOW) for Arduino
- Analog Signals
 - Variable
 - Can be any value between Max and Min
 - We refer to analog values in percentages or similar formats.
 - Max value is 5V (100%) and the min value is 0V (0%)
- Examples (While these signals are not necessarily in these applications, they are still representative of how those functions occur)
 - Digital Signals
 - Light switch (On or Off)
 - Car (On or Off)
 - Very Old Thermostat (On or Off)
 - Analog Signals
 - Dimmer Switch (0% to 100%)
 - Car Speed (0mph to Max)
 - Modern Thermostat (50 degrees to 90 degrees)
 - These should be good examples of when students will need one type of signal vs another

Writing to a device

- At the top of the code in the “Setup” loop, students need to make sure they set the pinMode in order to properly communicate with external devices. To write to a device the pinMode should be OUTPUT.
 - Ex: `pinMode(pin, OUTPUT);`
- Digital signals can be written by using `digitalWrite(pin, HIGH)` and `digitalWrite(pin, LOW)` where pin is the name or number of the pin being controlled. As a reminder, HIGH will be 5V and LOW will be 0V.
- Analog signals can be written with a new function: `analogWrite(pin, value)` where pin is the name or number of the pin being controlled and value is a number from 0 to 255 (To be explained later).
 - To calculate the voltage of the device, use $((\text{value}/255)*5\text{V})$ where value is the value in the code.

Example: Writing a digital signal

(Left) Turn on LED

(Right) Blink LED

In order to use this circuit, the positive lead of an LED must be plugged into 3.3V and the negative lead will be controlled by the pin (in this case pin 8).

```
Nightlight $
1 int LED = 8;
2
3 void setup() {
4   pinMode(LED, OUTPUT);
5 }
6
7 void loop() {
8   digitalWrite(LED, LOW);
9 }
10
11
12
13
```

```
Nightlight $
1 int LED = 8;
2
3 void setup() {
4   pinMode(LED, OUTPUT);
5 }
6
7 void loop() {
8   digitalWrite(LED, LOW);
9   delay(100);
10  digitalWrite(LED, HIGH);
11  delay(100);
12 }
13
..
```

Example: Writing to an analog signal

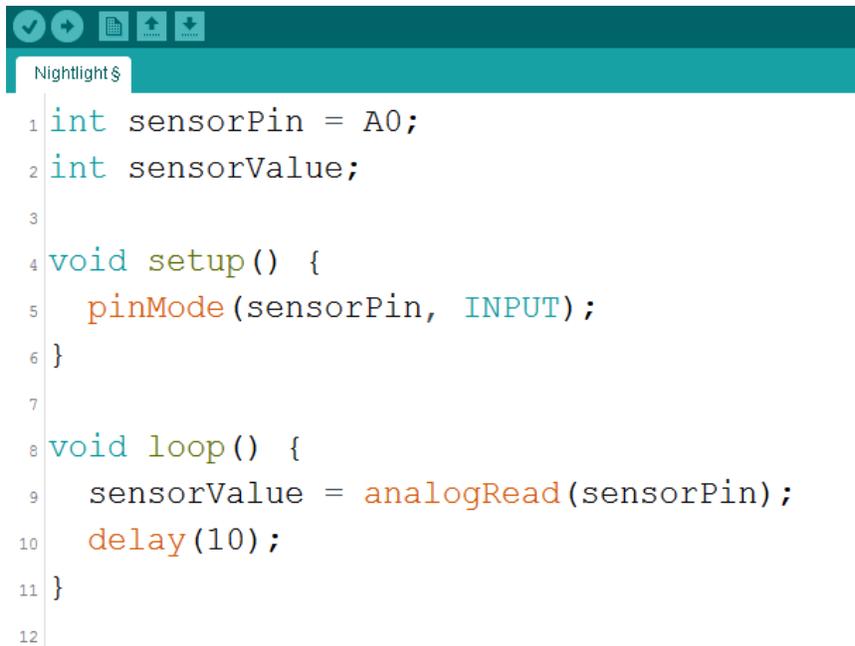
To write to an analog device, it can only be plugged into very specific ports on the arduino. Only ports with a ~ next to it can give analog signals. In the code on the right, the LED is turned on (255), then half way (127), then off (0).

```
Nightlight
1 int LED = 8;
2
3 void setup() {
4   pinMode(LED, OUTPUT);
5 }
6
7 void loop() {
8   analogWrite(LED, 255);
9   delay(100);
10  analogWrite(LED, 127);
11  delay(100);
12  analogWrite(LED, 0);
13  delay(100);
14 }
15
```

Reading a device - Analog

- At the top of the code in the “Setup” loop, students need to make sure they set the pinMode in order to properly communicate with external devices. To write to a device the pinMode should be INPUT.
 - Ex: `pinMode(pin, INPUT);`
- Analog signals can only be read from Analog Input signals found on the opposite side of the board labelled A0 to A5.
- Reading a device requires `analogRead(pin)`.
- To calculate the voltage of the device, use $((\text{value}/255)*5V)$ where value is the value in the code.

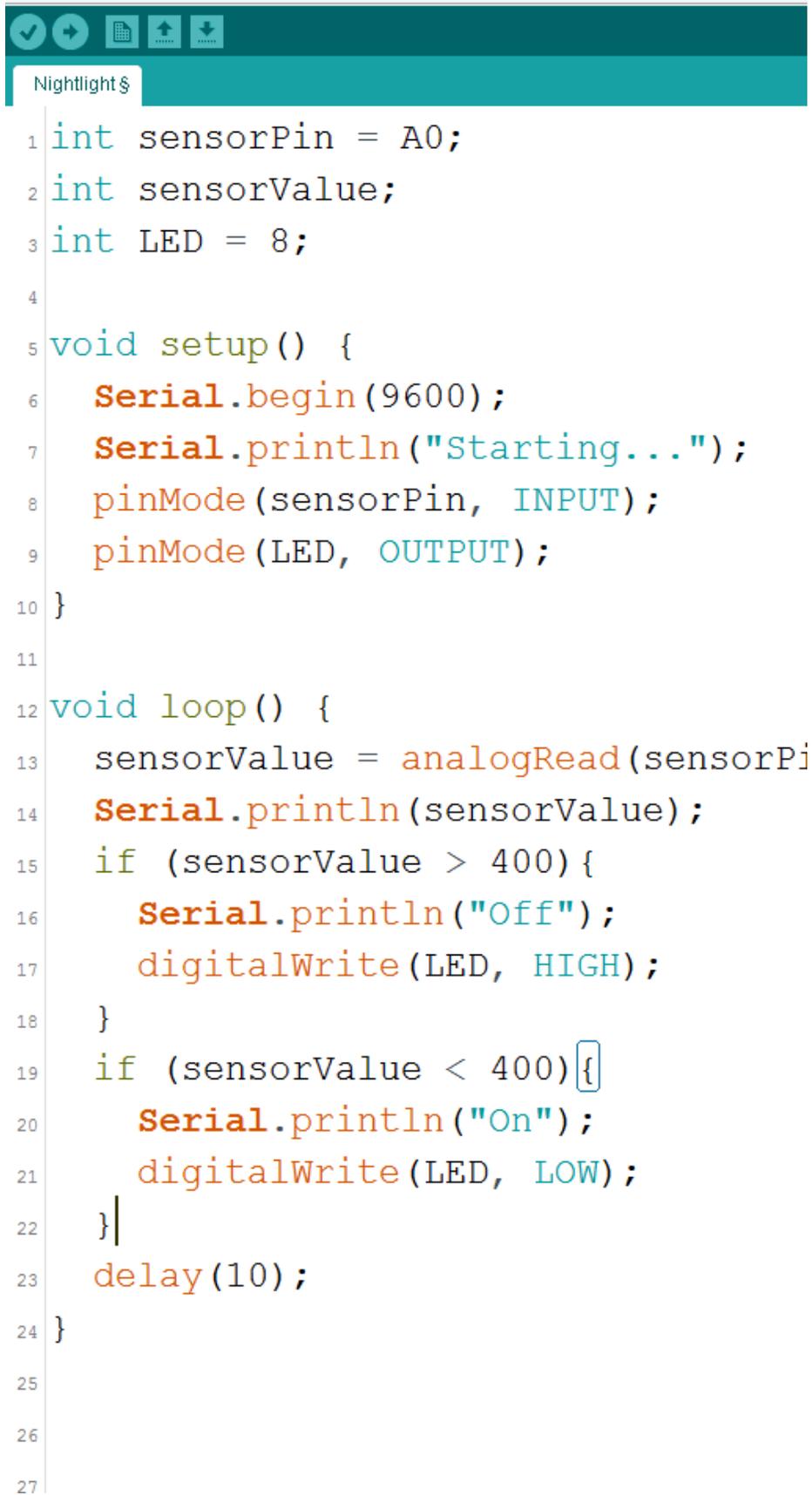
The following code reads a value from a sensor:



```
1 int sensorPin = A0;
2 int sensorValue;
3
4 void setup() {
5   pinMode(sensorPin, INPUT);
6 }
7
8 void loop() {
9   sensorValue = analogRead(sensorPin);
10  delay(10);
11 }
12
```

Full Code

Attached is the full code for the nightlight. (Missing from this document is the schematic to wire the peripherals.) Notice that we write as a value between 0 and 255 but we read a value between 0 and 1024 (to be explained later). Hence, 2.5V is read as 512.



```
1 int sensorPin = A0;
2 int sensorValue;
3 int LED = 8;
4
5 void setup() {
6     Serial.begin(9600);
7     Serial.println("Starting...");
8     pinMode(sensorPin, INPUT);
9     pinMode(LED, OUTPUT);
10 }
11
12 void loop() {
13     sensorValue = analogRead(sensorPin);
14     Serial.println(sensorValue);
15     if (sensorValue > 400) {
16         Serial.println("Off");
17         digitalWrite(LED, HIGH);
18     }
19     if (sensorValue < 400) {
20         Serial.println("On");
21         digitalWrite(LED, LOW);
22     }
23     delay(10);
24 }
25
26
27
```