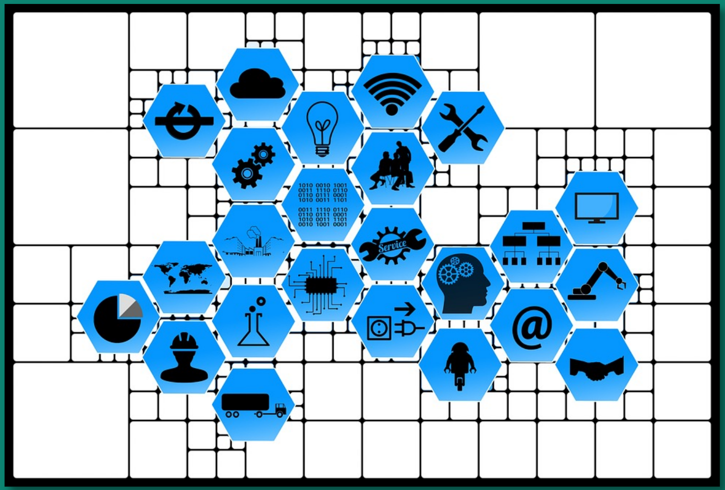
SIT123 Data Capture Technologies



Dr Imali Dias
imali.dias@deakin.edu.au

Lecture –Week 2 Trimester 2, 2022

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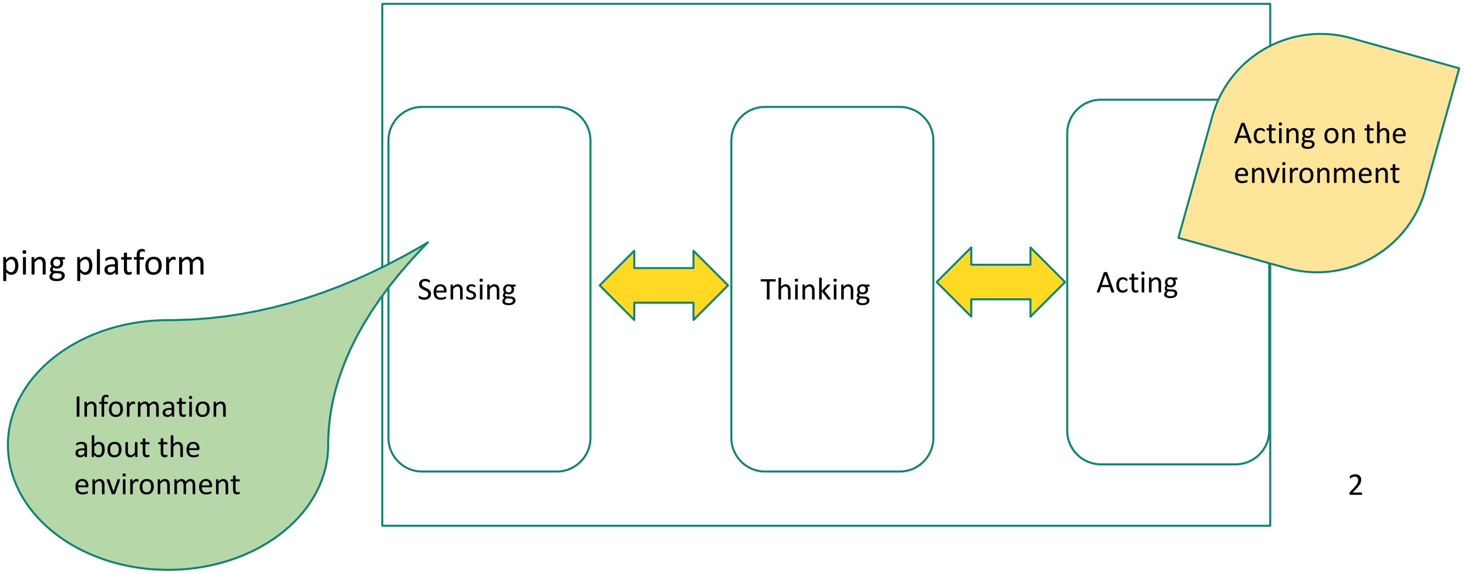
Recape: what we have done so far

Week 1

- Introduction to Data Capture Technologies
  - Sense-Think-Act
- Arduino
  - electronic prototyping platform
  - Setup() & loop()
  - pinMode
  - Input & output



Introduction to SIT123 Data Capture Technologies

- Sensor data
- Sensor characteristics
- Connecting sensors to Arduino
- Preparing sensor data

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Sensors

Sensors

RECAP from WEEK1: Sensing/Sensors

Collect information about the world

- Motion
- Velocity and acceleration
- Force
- Pressure
- Flow
- Sound
- Moisture

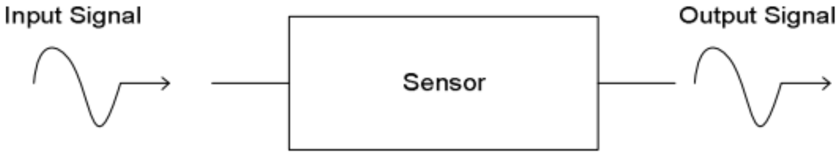
- Light
- Radiation
- Temperature
- Position
- Chemical presence
- …. Many more

Sensors

RECAP from WEEK1: Sensing/Sensors

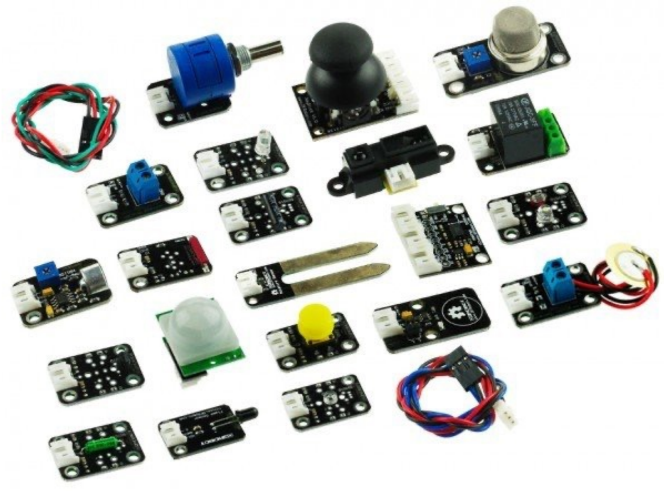
Sensor - an electrical/mechanical/chemical device that maps an environmental attribute to a quantitative measurement

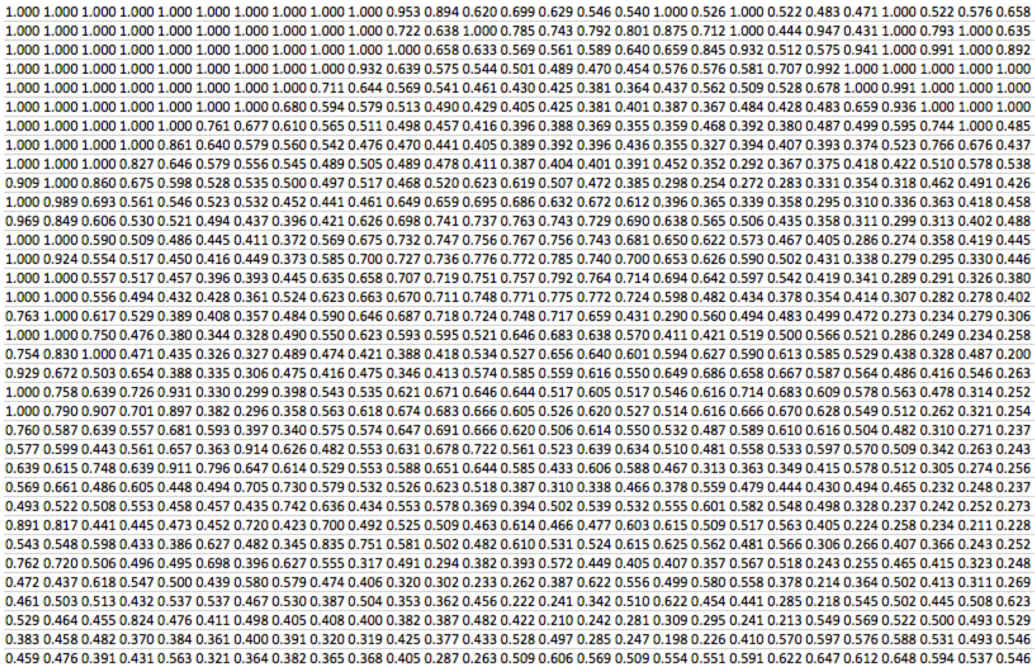
A device which provides a usable output in response to a specified measurand



Sensors

Sensor Data





1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.953	0.894	0.620	0.699	0.629	0.546	0.540	1.000	0.526	1.000	0.522	0.483	0.471	1.000	0.522	0.576	0.658
1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.722	0.638	1.000	0.785	0.743	0.792	0.801	0.875	0.712	1.000	0.444	0.947	0.431	1.000	0.793	1.000	0.635
1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.658	0.633	0.569	0.561	0.589	0.640	0.659	0.845	0.932	0.512	0.575	0.941	1.000	0.991	1.000	0.892
1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.932	0.639	0.575	0.544	0.501	0.489	0.470	0.454	0.576	0.576	0.581	0.707	0.992	1.000	1.000	1.000	1.000	1.000
1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.711	0.644	0.569	0.541	0.461	0.430	0.425	0.381	0.364	0.437	0.562	0.509	0.528	0.678	1.000	0.991	1.000	1.000	1.000
1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.680	0.594	0.579	0.513	0.490	0.429	0.405	0.425	0.381	0.401	0.387	0.367	0.484	0.428	0.483	0.659	0.936	1.000	1.000	1.000
1.000	1.000	1.000	1.000	1.000	0.761	0.677	0.610	0.565	0.511	0.498	0.457	0.416	0.396	0.388	0.369	0.355	0.359	0.468	0.392	0.380	0.487	0.499	0.595	0.744	1.000	0.485
1.000	1.000	1.000	1.000	0.861	0.640	0.579	0.560	0.542	0.476	0.470	0.441	0.405	0.389	0.392	0.396	0.436	0.355	0.327	0.394	0.407	0.393	0.374	0.523	0.766	0.676	0.437
1.000	1.000	1.000	0.827	0.646	0.579	0.556	0.545	0.489	0.505	0.489	0.478	0.411	0.387	0.404	0.401	0.391	0.452	0.352	0.292	0.367	0.375	0.418	0.422	0.510	0.578	0.538
0.909	1.000	0.860	0.675	0.598	0.528	0.535	0.500	0.497	0.517	0.468	0.520	0.623	0.619	0.507	0.472	0.385	0.298	0.254	0.272	0.283	0.331	0.354	0.318	0.462	0.491	0.426
1.000	0.989	0.693	0.561	0.546	0.523	0.532	0.452	0.441	0.461	0.649	0.659	0.695	0.686	0.632	0.672	0.612	0.396	0.365	0.339	0.358	0.295	0.310	0.336	0.363	0.418	0.458
0.969	0.849	0.606	0.530	0.521	0.494	0.437	0.396	0.421	0.626	0.698	0.741	0.737	0.763	0.743	0.729	0.690	0.638	0.565	0.506	0.435	0.358	0.311	0.299	0.313	0.402	0.488
1.000	1.000	0.590	0.509	0.486	0.445	0.411	0.372	0.569	0.675	0.732	0.747	0.756	0.767	0.756	0.743	0.681	0.650	0.622	0.573	0.467	0.405	0.286	0.274	0.358	0.419	0.445
1.000	0.924	0.554	0.517	0.450	0.416	0.449	0.373	0.585	0.700	0.727	0.736	0.776	0.772	0.785	0.740	0.700	0.653	0.626	0.590	0.502	0.431	0.338	0.279	0.295	0.330	0.446
1.000	1.000	0.557	0.517	0.457	0.396	0.393	0.445	0.635	0.658	0.707	0.719	0.751	0.757	0.792	0.764	0.714	0.694	0.642	0.597	0.542	0.419	0.341	0.289	0.291	0.326	0.380
1.000	1.000	0.556	0.494	0.432	0.428	0.361	0.524	0.623	0.663	0.670	0.711	0.748	0.771	0.775	0.772	0.724	0.598	0.482	0.434	0.378	0.354	0.414	0.307	0.282	0.278	0.402
0.763	1.000	0.617	0.529	0.389	0.408	0.357	0.484	0.590	0.646	0.687	0.718	0.724	0.748	0.717	0.659	0.431	0.290	0.560	0.494	0.483	0.499	0.472	0.273	0.234	0.279	0.306
1.000	1.000	0.750	0.476	0.380	0.344	0.328	0.490	0.550	0.623	0.593	0.595	0.521	0.646	0.683	0.638	0.570	0.411	0.421	0.519	0.500	0.566	0.521	0.286	0.249	0.234	0.258
0.754	0.830	1.000	0.471	0.435	0.326	0.327	0.489	0.474	0.421	0.388	0.418	0.534	0.527	0.656	0.640	0.601	0.594	0.627	0.590	0.613	0.585	0.529	0.438	0.328	0.487	0.200
0.929	0.672	0.503	0.654	0.388	0.335	0.306	0.475	0.416	0.475	0.346	0.413	0.574	0.585	0.559	0.616	0.550	0.649	0.686	0.658	0.667	0.587	0.564	0.486	0.416	0.546	0.263
1.000	0.758	0.639	0.726	0.931	0.330	0.299	0.398	0.543	0.535	0.621	0.671	0.646	0.644	0.517	0.605	0.517	0.546	0.616	0.714	0.683	0.609	0.578	0.563	0.478	0.314	0.252
1.000	0.790	0.907	0.701	0.897	0.382	0.296	0.358	0.563	0.618	0.674	0.683	0.666	0.605	0.526	0.620	0.527	0.514	0.616	0.666	0.670	0.628	0.549	0.512	0.262	0.321	0.254
0.760	0.587	0.639	0.557	0.681	0.593	0.397	0.340	0.575	0.574	0.647	0.691	0.666	0.620	0.506	0.614	0.550	0.532	0.487	0.589	0.610	0.616	0.504	0.482	0.310	0.271	0.237
0.577	0.599	0.443	0.561	0.657	0.363	0.914	0.626	0.482	0.553	0.631	0.678	0.722	0.561	0.523	0.639	0.634	0.510	0.481	0.558	0.533	0.597	0.570	0.509	0.342	0.263	0.243
0.639	0.615	0.748	0.639	0.911	0.796	0.647	0.614	0.529	0.553	0.588	0.651	0.644	0.585	0.433	0.606	0.588	0.467	0.313	0.363	0.349	0.415	0.578	0.512	0.305	0.274	0.256
0.569	0.661	0.486	0.605	0.448	0.494	0.705	0.730	0.579	0.532	0.526	0.623	0.518	0.387	0.310	0.338	0.466	0.378	0.559	0.479	0.444	0.430	0.494	0.465	0.232	0.248	0.237
0.493	0.522	0.508	0.553	0.458	0.457	0.435	0.742	0.636	0.434	0.553	0.578	0.369	0.394	0.502	0.539	0.532	0.555	0.601	0.582	0.548	0.498	0.328	0.237	0.242	0.252	0.273
0.891	0.817	0.441	0.445	0.473	0.452	0.720	0.423	0.700	0.492	0.525	0.509	0.463	0.614	0.466	0.477	0.603	0.615	0.509	0.517	0.563	0.405	0.224	0.258	0.234	0.211	0.228
0.543	0.548	0.598	0.433	0.386	0.627	0.482	0.345	0.835	0.751	0.581	0.502	0.482	0.610	0.531	0.524	0.615	0.625	0.562	0.481	0.566	0.306	0.266	0.407	0.366	0.243	0.252
0.762	0.720	0.506	0.496	0.495	0.698	0.396	0.627	0.555	0.317	0.491	0.294	0.382	0.393	0.572	0.449	0.405	0.407	0.357	0.567	0.518	0.243	0.255	0.465	0.415	0.323	0.248
0.472	0.437	0.618	0.547	0.500	0.439	0.580	0.579	0.474	0.406	0.320	0.302	0.233	0.262	0.387	0.622	0.556	0.499	0.580	0.558	0.378	0.214	0.364	0.502	0.413	0.311	0.269
0.461	0.503	0.513	0.432	0.537	0.537	0.467	0.530	0.387	0.504	0.353	0.362	0.456	0.222	0.241	0.342	0.510	0.622	0.454	0.441	0.285	0.218	0.545	0.502	0.445	0.508	0.623
0.529	0.464	0.455	0.824	0.476	0.411	0.498	0.405	0.408	0.400	0.382	0.387	0.482	0.422	0.210	0.242	0.281	0.309	0.295	0.241	0.213	0.549	0.569	0.522	0.500	0.493	0.529
0.383	0.458	0.482	0.370	0.384	0.361	0.400	0.391	0.320	0.319	0.425	0.377	0.433	0.528	0.497	0.285	0.247	0.198	0.226	0.410	0.570	0.597	0.576	0.588	0.531	0.493	0.546
0.459	0.476	0.391	0.431	0.563	0.321	0.364	0.382	0.365	0.368	0.405	0.287	0.263	0.509	0.606	0.569	0.509	0.554	0.551	0.591	0.622	0.647	0.612	0.648	0.594	0.537	0.546

Sensors

Example 1: Sensor data logs (relative humidity and air temp)

```
Humidity: 45.90 %, Temp: 23.90 Celsius
Humidity: 45.70 %, Temp: 23.90 Celsius
Humidity: 45.50 %, Temp: 23.90 Celsius
Humidity: 45.40 %, Temp: 23.90 Celsius
Humidity: 45.20 %, Temp: 23.90 Celsius
Humidity: 45.10 %, Temp: 23.90 Celsius
Humidity: 45.60 %, Temp: 23.90 Celsius
Humidity: 99.90 %, Temp: 25.20 Celsius
Humidity: 99.90 %, Temp: 25.10 Celsius
Humidity: 99.90 %, Temp: 24.80 Celsius
Humidity: 99.90 %, Temp: 26.30 Celsius
Humidity: 99.90 %, Temp: 26.80 Celsius
Humidity: 99.90 %, Temp: 26.80 Celsius
Humidity: 99.90 %, Temp: 27.60 Celsius
Humidity: 99.90 %, Temp: 27.30 Celsius
```

- 15 data points

- Format:

Relative Humidity: <data>, Temp: <data>

Sensors

Example 2: Sensor data logs (air temp)

```
01/01/2017 09:01:00, 22.2
01/01/2017 09:01:01, 22.2
01/01/2017 09:01:02, 22.2
01/01/2017 09:01:03, 22.2
01/01/2017 09:01:04, 22.3
01/01/2017 09:01:05, 22.3
01/01/2017 09:01:06, 22.2
01/01/2017 09:01:07, 22.3
01/01/2017 09:01:08, 22.3
01/01/2017 09:01:09, 22.4
01/01/2017 09:01:10, 22.3
01/01/2017 09:01:11, 22.3
01/01/2017 09:01:12, 22.4
01/01/2017 09:01:13, 22.3
01/01/2017 09:01:14, 22.4
```

- 15 data points

- Format: **<timestamp>, <data>**

- A reading every second

Sensors

Can you spot differences in the data logs given in Example 1 & Example 2?

- What is the format in each log file?

- What kind of data are in the logs?

- What is a shortcoming of the data recorded in Example 2?

- What is a shortcoming of the data recorded in Example 1?

Sensors

CSV

A **CSV** is a file containing **comma separated values**

CSV files have extension .csv

You can use excel or any text editor (Notepad) to create & open .csv files

```
Eg:
Data1,Data2,Data3
Example1,Example2,Example3
Example1,Example2,Example3
```

```
Eg:
DateTime, Temperature
01/01/2017 09:01:00, 22.2
01/01/2017 09:01:01, 22.2
01/01/2017 09:01:02, 22.2
```

CSV specification: see https://tools.ietf.org/html/rfc4180

Sensors

Why CSV?

- A common format for storing data
- Has a simple structure
- Human-readable

Sensor Characteristics

sampling rate, sensitivity, accuracy

Sensors

Characteristics: Sampling rate

- Also called ‘data delay’

- The rate at which measurements are taken

- Eg: once every ten milliseconds, once every second, once every two seconds etc

- Given in Hz: 10Hz, 1Hz, .5Hz

What is the sampling rate in this given block of data?

```
01/01/2017 09:01:00, 22.2
01/01/2017 09:01:01, 22.2
01/01/2017 09:01:02, 22.2
01/01/2017 09:01:03, 22.2
01/01/2017 09:01:04, 22.3
01/01/2017 09:01:05, 22.3
01/01/2017 09:01:06, 22.2
01/01/2017 09:01:07, 22.3
```

Sensors

Characteristics: Sampling rate

What is the sampling rate in the following?

- 200 Hz -> 200 readings per second
- 100 Hz?
- .5 Hz?
- .25 Hz?

Eg:
If the sensor is .5 Hz, that means it takes .5 readings per second.
So,
Every 1 sec -> .5 reading
When does it take 1 reading?

Sensors

Characteristics: Sampling rate

What is the sampling rate in the following?

- 200 Hz -> 200 readings per second

- 100 Hz?

- .5 Hz?

- .25 Hz?

Eg:
If the sensor is .5 Hz, that means it takes .5 readings per second.
So,
Every 1 sec -> .5 reading
When does it take 1 reading?
1/.5 = 2
That is, it takes a reading every 2 seconds.

Sensors

Characteristics: Sensitivity

Ratio of output change to input change

smallest amount of difference in quantity that will change an instrument's reading

Eg: DHT22 Temperature & Humidity

https://www.sparkfun.com/datasheets/Sensors/Temperature/DHT22.pdf

Sensitivity of DHT22: humidity 0.1%RH; temperature 0.1 Celsius

Sensors

Characteristics: Accuracy

Amount of uncertainty in a measurement with respect to an absolute standard

Eg: DHT22 Temperature & Humidity

https://www.sparkfun.com/datasheets/Sensors/Temperature/DHT22.pdf

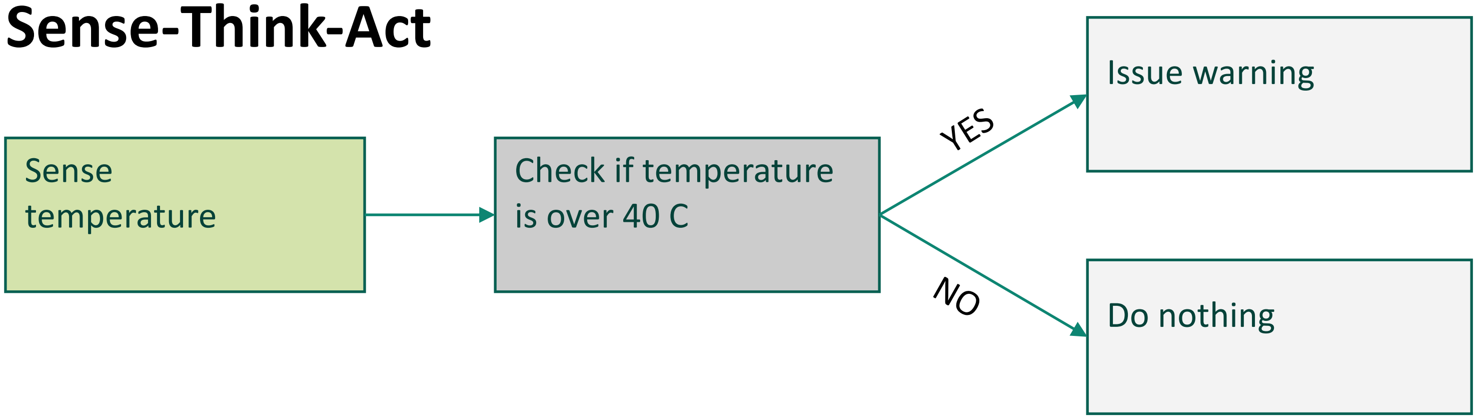
humidity +-2%RH(Max +-5%RH); temperature <+-0.5Celsius

Sensors

Connecting a Sensor to Arduino

Sensors

Sense-Think-Act



Sense temperature

Check if temperature is over 40 C

YES

Issue warning

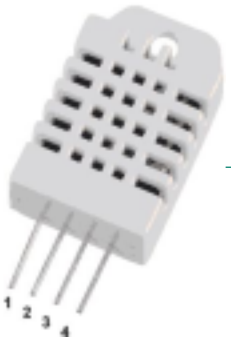
NO

Do nothing

<SENSE>

<THINK>

<ACT>



- Turn on LED
- Emit a sound via a Speaker
- Write to SD card

…

…

Sensors

What happens when you sense with Arduino?

Sensor senses the data -> data comes to the Arduino microcontroller

- We need to write code to:
  - Receive the data from the sensor
  - Do things with the data (display it, save it, act on it etc)

Sensors

How do you connect a Sensor to the Arduino board?

Three pins on a sensor:

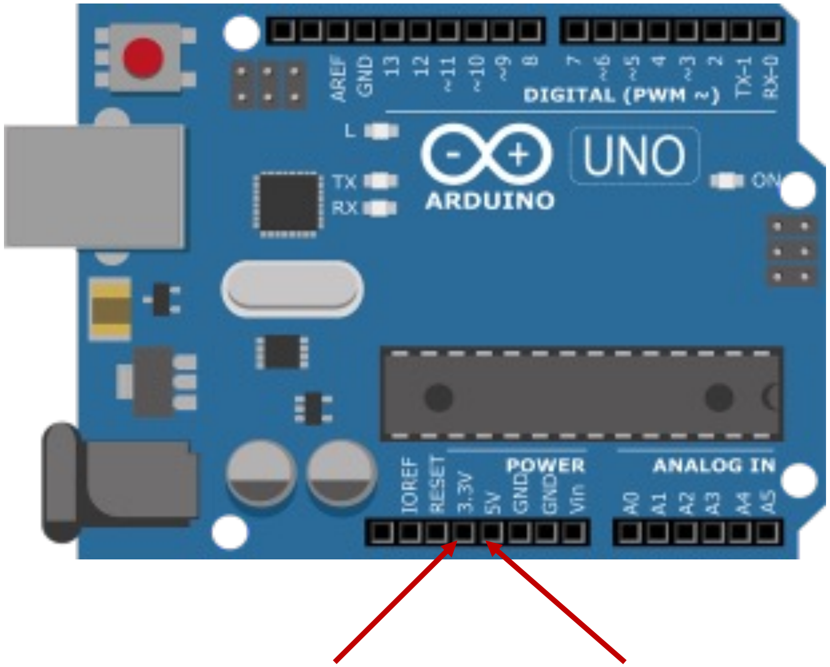
- Vcc (Power) - Stands for Voltage at the Common Collector (positive [+] electrical connection)
- Data- Connect to an input pin on the Arduino board. This transmits the data signal (sensor values)
- Ground (negative [-]) – Connect to the GND pin on the Arduino board

These three pins have to be connected to the relevant pins on the Arduino board.

Sensors

+VCC

Some sensors require 5V, some require 3.3V.



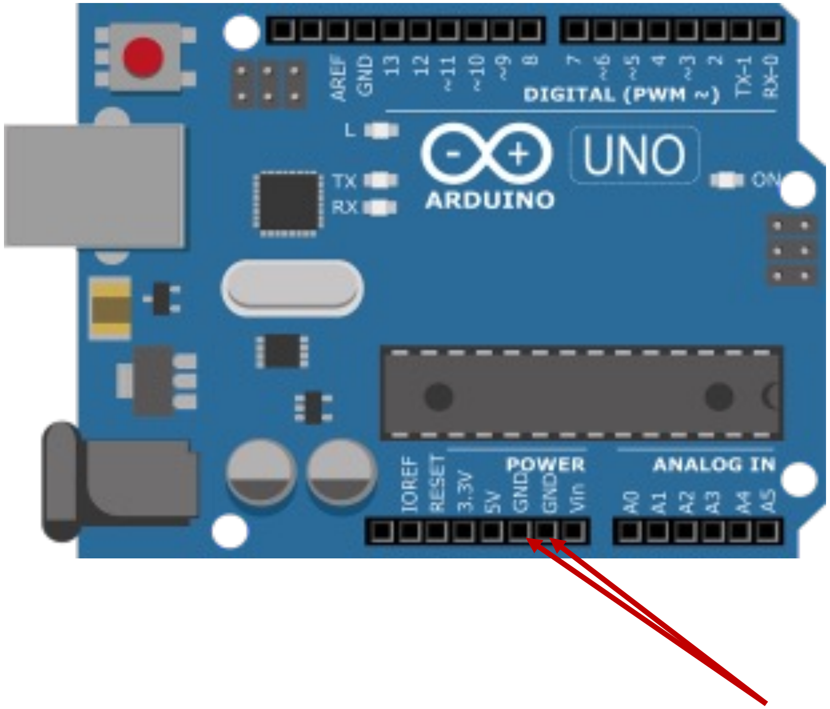
3.3V pin

5V pin

You must connect to the correct pin or else the sensor may get damaged!

Sensors

- Ground (GND)



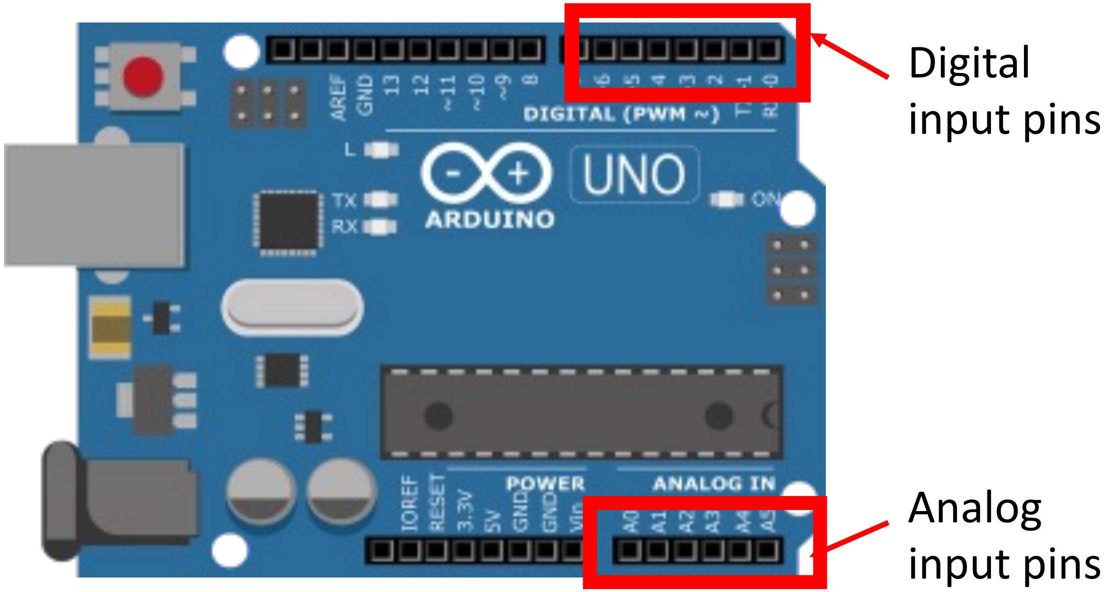
GND pins

Sensors

The sensor is connected to Arduino microcontroller's input pins.

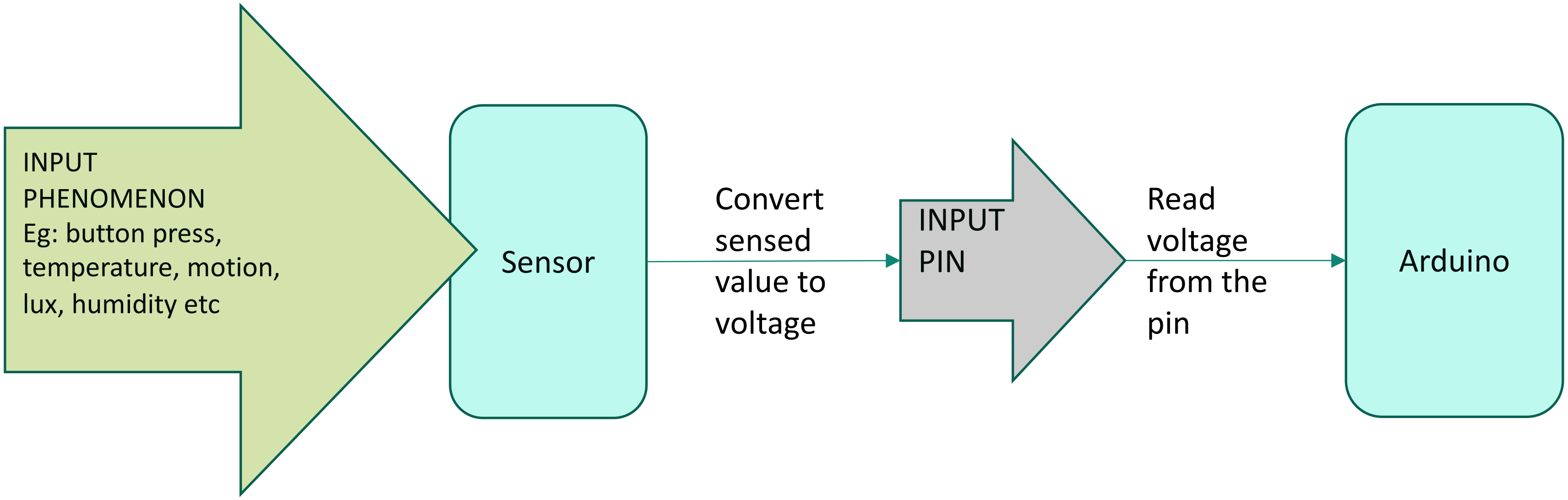
The voltage on the pins change from the data sensed.

The microcontroller receives the sensor data by 'Reading' the ***voltage*** on the input pins.



Sensors

What happens when you sense with Arduino?


INPUT PHENOMENON
Eg: button press, temperature, motion, lux, humidity etc
Sensor
Convert sensed value to voltage
INPUT PIN
Read voltage from the pin
Arduino

Sensors

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Input Phenomenon can be either Digital or Analog

Digital : Flips between two values

- Eg: True or False (1 or 0)

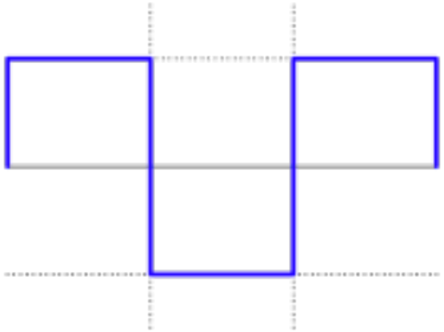
- 1,0,1,0,1 …

- 5,0,5,0

- 3.5,0,3.5,0

Analog: Continuous values

- Eg: 1,1.2, 1.74, 2, 2.3, 4.1...



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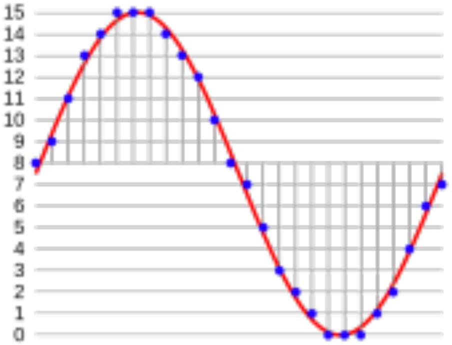

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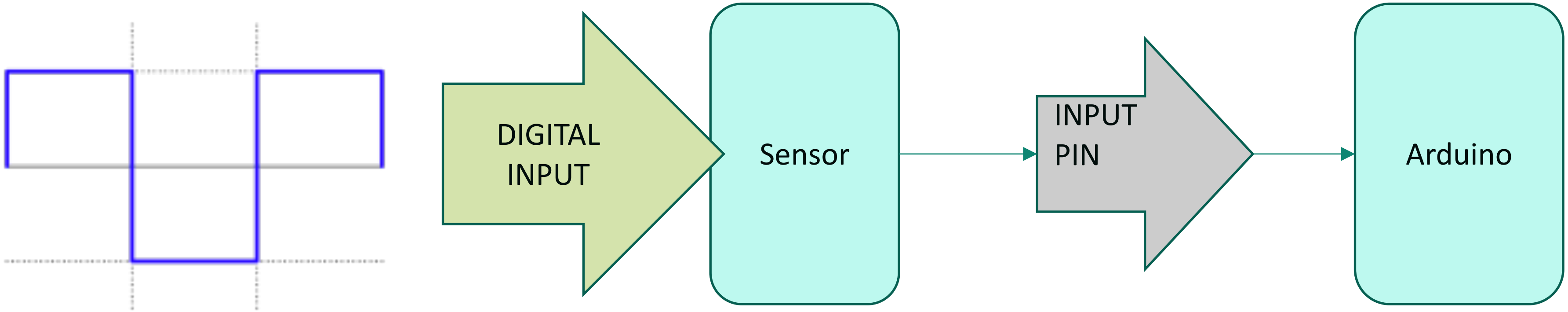
Sensors

Digital phenomenon measured by Sensor



DIGITAL INPUT

Sensor

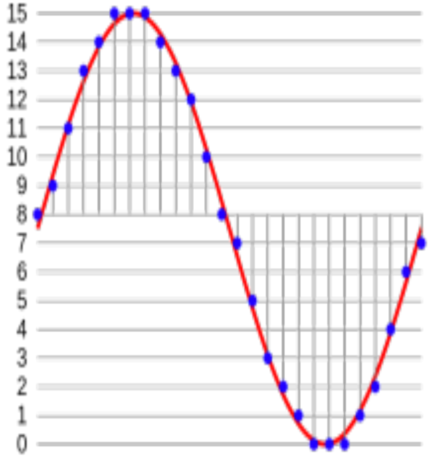
INPUT PIN

Arduino

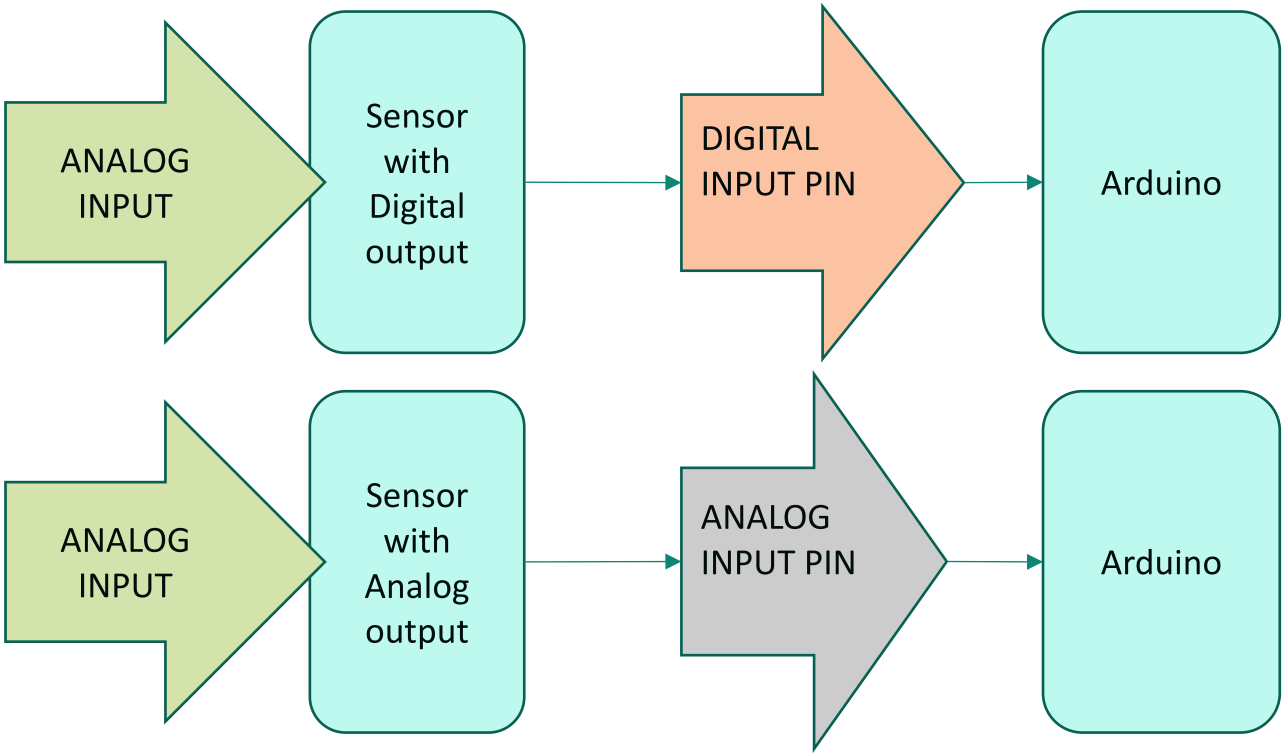
Eg: button press (on/off), contact (yes/no)

Sensors

Analog phenomenon measured by Sensors



Eg: temperature,
moisture,
light level (lux), motion



ANALOG INPUT → Sensor with Digital output → DIGITAL INPUT PIN → Arduino

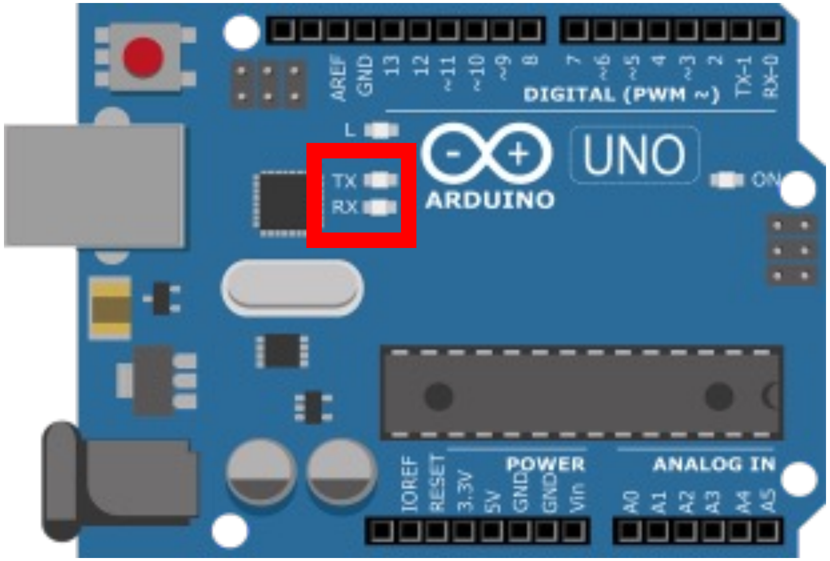
ANALOG INPUT → Sensor with Analog output → ANALOG INPUT PIN → Arduino

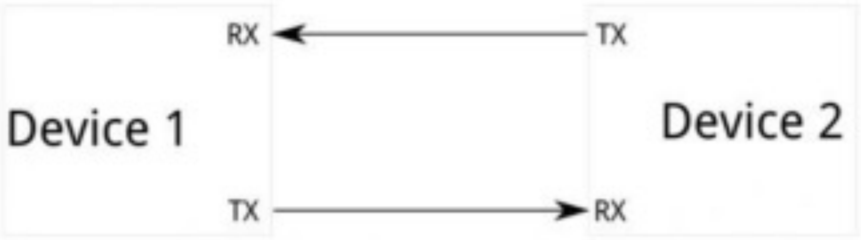
Sensors

Serial Communication

RX blinks when the Arduino is receiving data.

TX blinks when the Arduino is transmitting data.





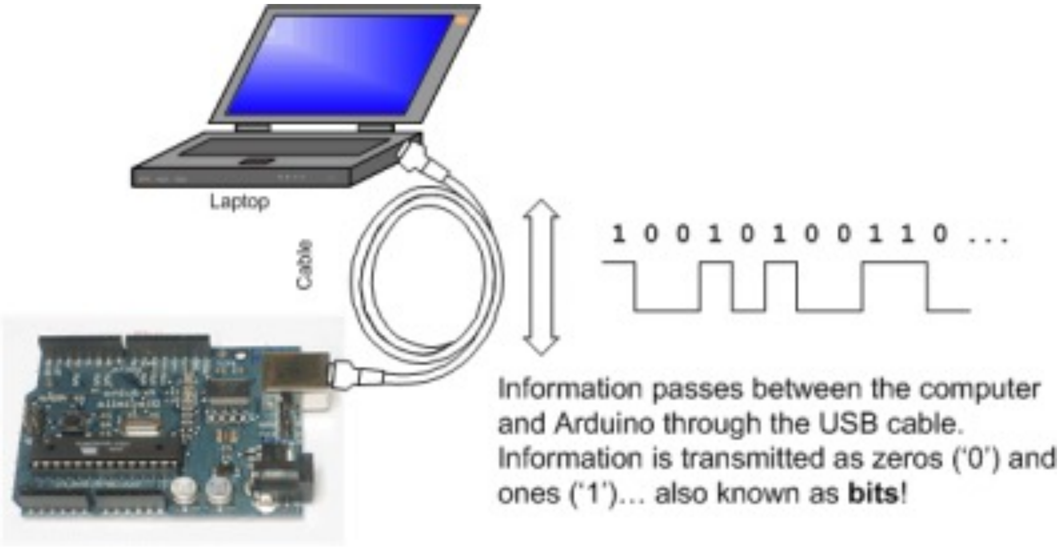
Sensors

Serial Communication

All Arduino boards have at least one serial port (also known as a UART).

It communicates on digital pins 0 (RX) and 1 (TX) as well as with the computer via USB

Used for communication between the Arduino board and a computer or other devices



Information passes between the computer and Arduino through the USB cable. Information is transmitted as zeros ('0') and ones ('1')... also known as **bits**!

Sensors

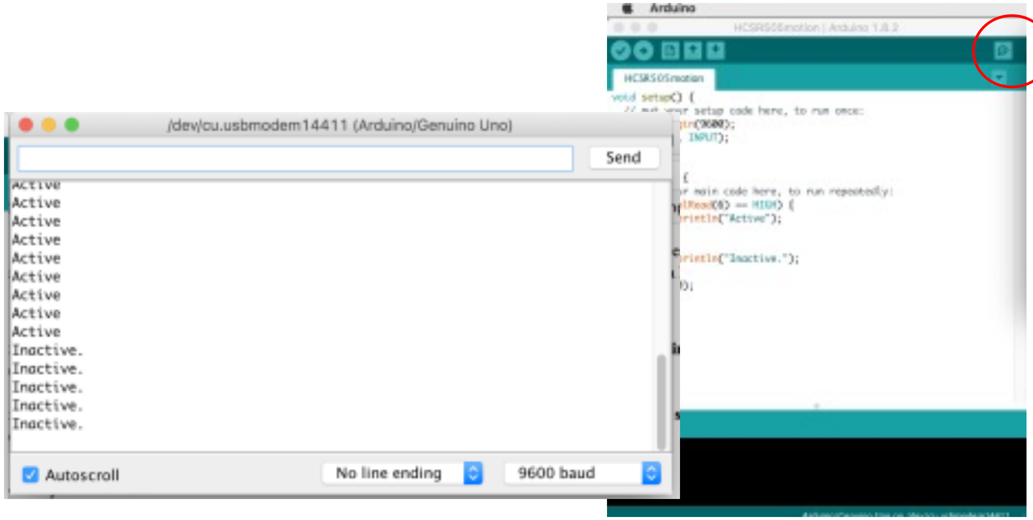
Arduino Serial Monitor

Serial data is sent from the Arduino microcontroller via the USB cable to your computer.

In the computer, the Arduino IDE has a ‘Serial Monitor’ that can show output from the Arduino.

You can also use it to controlling Arduino from your computer's keyboard.

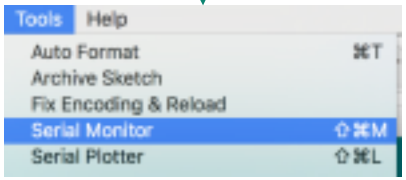
It is a separate pop-up window.


Arduino
HCSRS05motion | Arduino 1.8.2
HCSRS05motion
/dev/cu.usbmodem14411 (Arduino/Genuino Uno)
Send
☑ Autoscroll
No line ending
9600 baud

```
void setup() {
  // put your setup code here, to run once:
  ...gin(9600);
  ..., INPUT);
...
  ... {
  ...r main code here, to run repeatedly:
  ...lRead(8) == HIGH) {
  ...rintln("Active");
...
  ...rintln("Inactive.");
...
...);
```

```
Active
Active
Active
Active
Active
Active
Active
Active
Active
Inactive.
Inactive.
Inactive.
Inactive.
Inactive.
```

Two ways to open the Serial Monitor



Sensors

Arduino Serial Monitor

We use serial monitor to easily test the sensors and our code.

It allows us to see what is happening inside the microcontroller as we write and test our code.

It allows us to see what sensor values are being read.

Sensors

Receiving Data in the Arduino: Motion Sensor

```
void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600);
  pinMode(6, INPUT);
}

void loop() {
  // put your main code here, to run repeatedly:
  if (digitalRead(6) == HIGH) {
  Serial.println("Active");
  }
  else {
     Serial.println("Inactive.");
  }
  delay(1000);
}
```

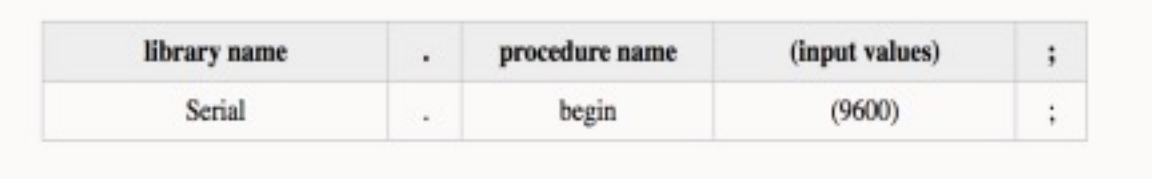
Sensors

Receiving Data in the Arduino: Motion Sensor

```
void setup() {
   // put your setup code here, to run once:
   Serial.begin(9600);
   pinMode(6, INPUT);
}

void loop() {
   // put your main code here, to run repeatedly:
   if (digitalRead(6) == HIGH) {
   Serial.println("Active");
   }
   else {
       Serial.println("Inactive.");
   }
   delay(1000);
}
```

set up Serial library at 9600 bps (bits per second)



library name	.	procedure name	(input values)	;
Serial	.	begin	(9600)	;

9600 bps -> also called the ‘baud rate’

Means how fast the connection can read and write bits.

Sensors

Bits-per-second (baud rate)

If the Arduino transfers data at 9600 bits per second and your program is sending 12 bytes of data, how long does it take to send over this information?

Sensors

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Bits-per-second (baud rate)

If the Arduino transfers data at 9600 bits per second and your program is sending 12 bytes of data, how long does it take to send over this information?

12 bytes = 12 * 8 bits = 96 bits.

To transfer 9600 bits, it takes 1 second.

So to transfer 96 bits, it takes 96/9600 seconds = 1/100 seconds (0.01 seconds)

Sensors

Receiving Data in the Arduino: Motion Sensor

```
void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600);
  pinMode(6, INPUT);
}

void loop() {
  // put your main code here, to run repeatedly:
  if (digitalRead(6) == HIGH) {
  Serial.println("Active");
  }
  else {
     Serial.println("Inactive.");
  }
  delay(1000);
}
```

sets pin 6 as input pin.

-> Read the value from pin 6.

Sensors

Receiving Data in the Arduino: Motion Sensor

```
void setup() {
   // put your setup code here, to run once:
   Serial.begin(9600);
   pinMode(6, INPUT);
}

void loop() {
   // put your main code here, to run repeatedly:
   if (digitalRead(6) == HIGH) {
   Serial.println("Active");
   }
   else {
       Serial.println("Inactive.");
   }
   delay(1000);
}
```

If the input value is high, then print ‘Active’ to the Serial monitor. Else print ‘Inactive’

- Motion sensor only gives active and inactive values.

- That is, a ‘high’ value if motion is detected, and a ‘low’ value if motion is not detected.

Sensors

Receiving Data in the Arduino: Motion Sensor

```
void setup() {
   // put your setup code here, to run once:
   Serial.begin(9600);
   pinMode(6, INPUT);
}

void loop() {
   // put your main code here, to run repeatedly:
   if (digitalRead(6) == HIGH) {
   Serial.println("Active");
   }
   else {
       Serial.println("Inactive.");
   }
   delay(1000);
}
```

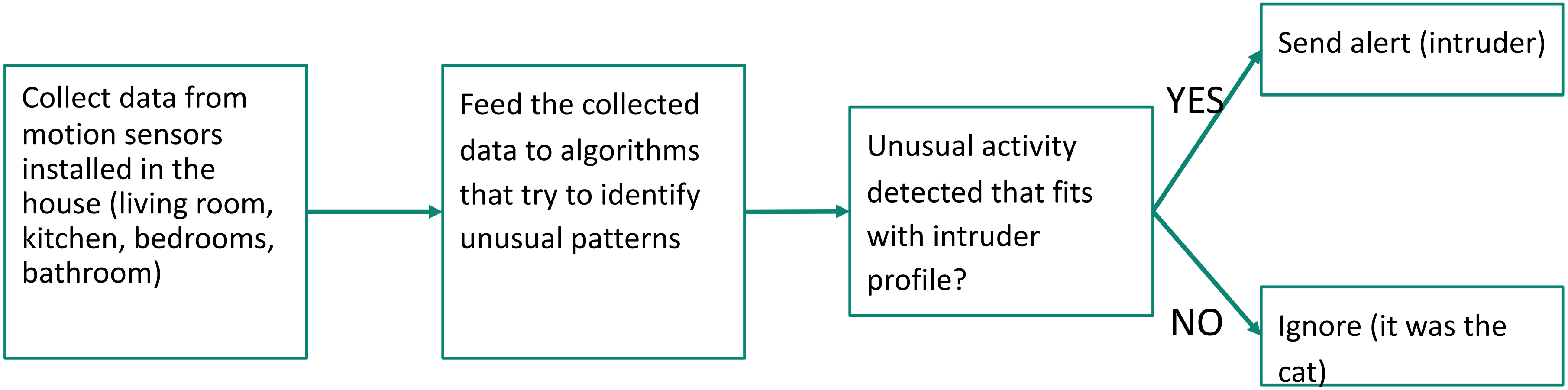
- Repeat the loop every second

Sensors

Preparing Sensor Data

Sensors

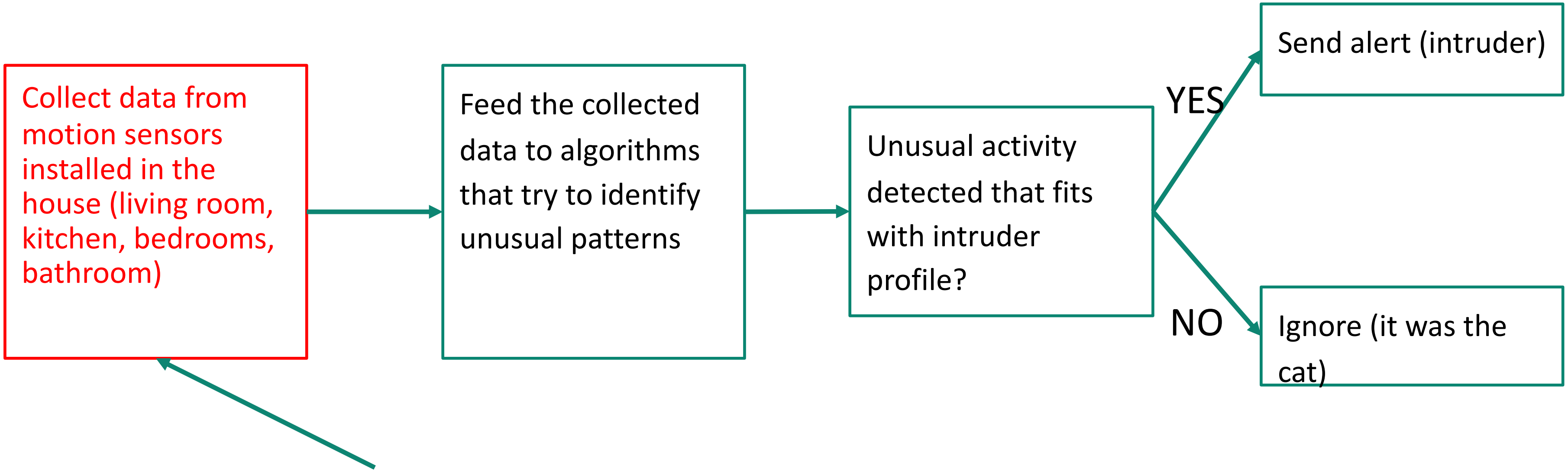
Example from Smart Home: Detect Intruders


Collect data from motion sensors installed in the house (living room, kitchen, bedrooms, bathroom)
Feed the collected data to algorithms that try to identify unusual patterns
Unusual activity detected that fits with intruder profile?
YES
Send alert (intruder)
NO
Ignore (it was the cat)

Sensors

Example from Smart Home: Detect Intruders

What can go wrong?



Collect data from motion sensors installed in the house (living room, kitchen, bedrooms, bathroom)

Feed the collected data to algorithms that try to identify unusual patterns

Unusual activity detected that fits with intruder profile?

YES

Send alert (intruder)

NO

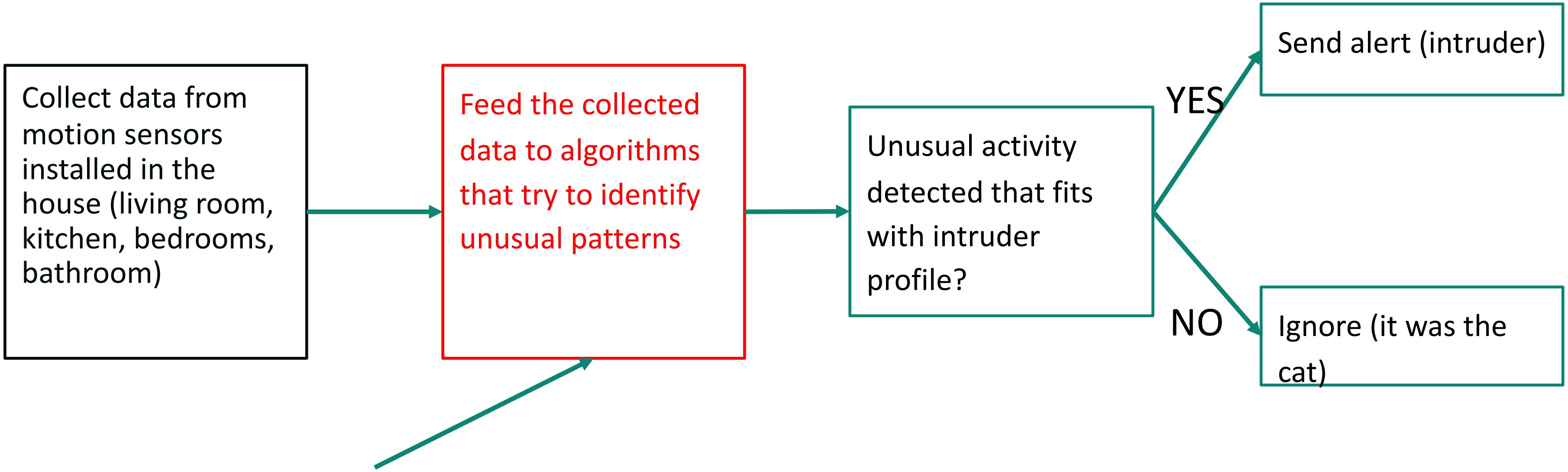
Ignore (it was the cat)

What if this data was incorrect?

Sensors

Example from Smart Home: Detect Intruders

What can go wrong?



Collect data from motion sensors installed in the house (living room, kitchen, bedrooms, bathroom)

Feed the collected data to algorithms that try to identify unusual patterns

Unusual activity detected that fits with intruder profile?

Send alert (intruder)

Ignore (it was the cat)

What if the algorithm couldn’t process the data properly?

Sensors

What is Data Preparation?

Organise/filter the **data** into a form suitable for further analysis and processing.

This is needed because of the following typical problems with data quality:

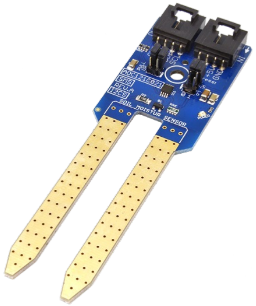
- Sometimes there can be missing data (due to network error, power failures, hardware error, file error etc)
- Sensor error
- Different formats (date formats): Eg: 01/01/2017 09:01:00 vs 01-01-2017 09:01:00 AM
- Different representations: Eg: 2 vs Two
- Licensing issues/Privacy/keep you from using the data as you would like
- …. Many more

Lab Work Week 2

PIR (Passive Infra Red) Motion Detector

DHT22

Temperature and Humidity Sensor

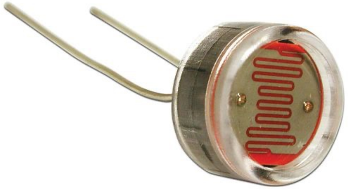


DFrobot

Soil Moisture Sensor

<u>Some more, not for Lab work but for your knowledge!</u>

ultrasonic sensor



light sensor

Line follower

Sensors

Today we talked about...

Sensors

- Sensor data
- Sensor characteristics
- Connecting sensors to Arduino
- Preparing sensor data

Any Questions!