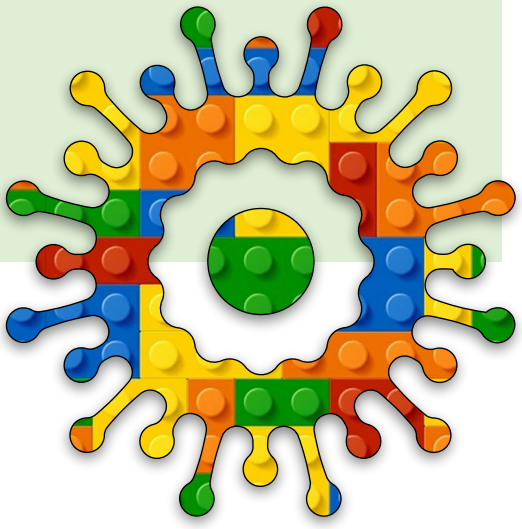
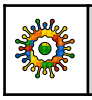
Introducing Robotics

Module A

Unit #4

Arrays





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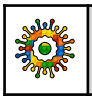


Introduction to random & arrays

Arrays are a very powerful tool for collecting, storing, and manipulating data. This is a simple introduction to their use and purpose.

The `random()` function gives you a random number. Although not completely random, it is random enough for most purposes. There are ways to improve the randomness using `randomSeed()`.

Sketch A4.1 a blinking array

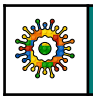
We will start with a basic sketch that you are familiar with. This will blink reasonably fast.

```
void setup()
{
  pinMode(11, OUTPUT);
}

void loop()
{
  blink(250);
}

void blink(int delayPeriod)
{
  digitalWrite(11, HIGH);
  delay(delayPeriod);
  digitalWrite(11, LOW);
  delay(delayPeriod);
}
```

Sketch A4.2 hardcode blink

We will hard-code the `delayPeriod` for when the LED is off. Now it is on for `250` milliseconds and off for `100` milliseconds.

```
void setup()
{
  pinMode(11, OUTPUT);
}

void loop()
{
  blink(250);
}

void blink(int delayPeriod)
{
  digitalWrite(11, HIGH);
  delay(delayPeriod);
  digitalWrite(11, LOW);
  delay(100);
}
```



Sketch A4.3 an array called durations

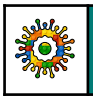
We are going to add an array for how long the LED is on for. The name of the array is durations. The data is stored in square brackets [], separated by commas. We are going to have the LED on for three different periods of time.

❗ Nothing happens just yet, we have to cycle through the array.

```
int durations[] = {100, 100, 2000};

void setup()
{
  pinMode(11, OUTPUT);
}

void loop()
{
  blink(250);
}

void blink(int delayPeriod)
{
  digitalWrite(11, HIGH);
  delay(delayPeriod);
  digitalWrite(11, LOW);
  delay(100);
}
```

🛠 Code Explanation

durations[]	An empty array called durations. The [] brackets denote an array, this is then filled with the elements in the {} braces.



Sketch A4.4 elements of the array

Now we need to call each element of the array in turn. The counting in arrays is different to the way we count. The counting starts with `0`, then `1`, then `2` rather than `1, 2, 3, 4, 5...` so the first element in the array is position `0` (not `1`).

Now we need to loop through each one in turn and we can do this with a `for()` loop. Each `i` is an index. So...
`index [0]` is `100`,
`index [1]` is `100` and
`index [2]` is `2000`.

This translates to...
`durations[0]` is `100`,
`durations[1]` is `100` and
`durations[2]` is `2000`, looping through one at a time till it gets to the last one and starts all over again.

Each value is passed onto the `delayPeriod` for the blink function. What you should see is 2 short blinks followed by two longer blinks and then two short blinks etc.

```
int durations[] = {100, 100, 2000};


void setup()
{
  pinMode(11, OUTPUT);
}


void loop()
{
  for (int i = 0; i < 3; i++)
  {
    blink(durations[i]);
  }
```

```
}

void blink(int delayPeriod)
{
  digitalWrite(11, HIGH);
  delay(delayPeriod);
  digitalWrite(11, LOW);
  delay(100);
}
```

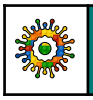
🗒️ Notes

You should get two short blinks followed by one long blink, and then repeat. You have used your first array with the Uno.

Sketch A4.5 random delay

Starting with our very basic blink sketch.

```
void setup()
{
  pinMode(11, OUTPUT);
}

void loop()
{
  digitalWrite(11, HIGH);
  delay(1000);
  digitalWrite(11, LOW);
  delay(1000);
}
```



Sketch A4.6 a variable called delayRandom

Introduce a variable we will call `delayRandom` (made-up word) and give it an initial value of `1000`. It is always a good idea to give a variable an initial value.

❗ nothing will happen yet.

```
int delayRandom = 1000;

void setup()
{
  pinMode(11, OUTPUT);
}

void loop()
{
  digitalWrite(11, HIGH);
  delay(delayRandom);
  digitalWrite(11, LOW);
  delay(delayRandom);
}
```

Notes

There is no randomness yet; we have simply called it a variable name.

Sketch A4.7 random number

Now we change the 1000 milliseconds to a random number between 0 and 1000. It will change every time it loops through.

```
int delayRandom = 1000;

void setup()
{
  pinMode(11, OUTPUT);
}

void loop()
{
  delayRandom = random(1000);
  digitalWrite(11, HIGH);
  delay(delayRandom);
  digitalWrite(11, LOW);
  delay(delayRandom);
}
```

🗒️ Notes

The LED will blink random lengths and pause for random lengths up to 1,000 milliseconds (1 second).

🛠️ Code Explanation

`random(1000);`	Gives you a random number between 0 and 1000

Sketch A4.8 random limits

We can create upper and lower limits, so now it has a random number between 500 and 2000 milliseconds.

```
int delayRandom = 1000;

void setup()
{
  pinMode(11, OUTPUT);
}

void loop()
{
  delayRandom = random(500, 2000);
  digitalWrite(11, HIGH);
  delay(delayRandom);
  digitalWrite(11, LOW);
  delay(delayRandom);
}
```

🛠️ Code Explanation

`random(500, 2000);`	Returns a random number between 500 and 2000

Sketch A4.9 random array

Starting with our basic sketch with the `delay()` set to `1000`.

❗ Delete the bits and pieces not needed.

```
void setup()
{
  pinMode(11, OUTPUT);
}

void loop()
{
  digitalWrite(11, HIGH);
  delay(1000);
  digitalWrite(11, LOW);
  delay(1000);
}
```

Sketch A4.10 an empty array

We add an array of ten elements. This is a blank or empty array, effectively ten zeros.

```
int durations[10];


void setup()
{
  pinMode(11, OUTPUT);
}


void loop()
{
  digitalWrite(11, HIGH);
  delay(1000);
  digitalWrite(11, LOW);
  delay(1000);
}
```

🛠️ Code Explanation

`int durations[10];`	This array is effectively empty but it has been given the dimensions of 10 elements.

Sketch A4.11 filling an empty array

In `setup()`, we fill each element with a random number between `0` and `1000`. We do this by looping through `10` times, each time selecting a random number.

❗ Nothing to see just yet.

```
int durations[10];

void setup()
{
  pinMode(11, OUTPUT);
  for (int i = 0; i < 10; i++)
  {
    durations[i] = random(1000);
  }
}

void loop()
{
  digitalWrite(11, HIGH);
  delay(1000);
  digitalWrite(11, LOW);
  delay(1000);
}
```

Notes

This is storing the random elements in the array; it still isn't going to give a random blink, not yet…

🛠️ Code Explanation

`durations[i] = random(1000);`	As it cycles through the loop, `i` starts at zero and increments by 1 each loop. So for each position in the array it puts a random number from 0 to 1000 into that array. The `i` value is the index reference for the array, counting starts at zero not 1

Sketch A4.12 reading the array

Now we need to read from each element in a similar loop inside the `void loop()` function. You should see the same pattern of blinks every `10` blinks.

```
int durations[10];

void setup()
{
  pinMode(11, OUTPUT);
  for (int i = 0; i < 10; i++)
  {
    durations[i] = random(1000);
  }
}

void loop()
{
  for (int i = 0; i < 10; i++)
  {
    digitalWrite(11, HIGH);
    delay(durations[i]);
    digitalWrite(11, LOW);
    delay(durations[i]);
  }
}
```

Notes

At this point, we cannot see inside the array; for that, we would need to be introduced to serial communication. We will do that later, and you could come back to this and see what values it generates for each element in the array.

🛠️ Code Explanation

`delay(durations[i]);`	This is the reverse of the previous operation. It goes through the array one element at a time starting at index 0 through to index 9, it reads its value and that is the length of the delay.