IF...ELSE STATEMENTS

The **if...else** statement checks a condition.
If it resolves to **true** the first code block is executed.
If the condition resolves to **false** the second code block is run instead.

```
if (score >= 50) {
   congratulate();
}
else {
   encourage();
}
```

CODE TO EXECUTE IF VALUE IS TRUE

CODE TO EXECUTE IF VALUE IS FALSE

● CONDITIONAL STATEMENT ● CONDITION ● IF CODE BLOCK ● ELSE CODE BLOCK

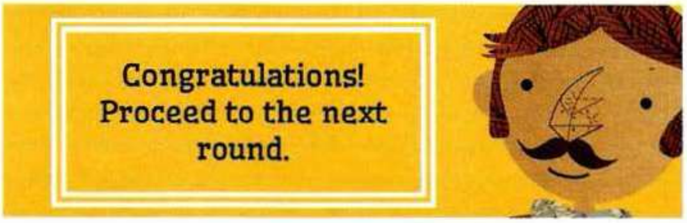
USING IF...ELSE STATEMENTS

JAVASCRIPT

c04/js/if-else-statement.js

```
var pass = 50;          // Pass mark
var score = 75;         // Current score
var msg;                // Message

// Select message to write based on score
if (score >= pass) {
  msg = 'Congratulations, you passed!';
} else {
  msg = 'Have another go!';
}

var el = document.getElementById('answer');
el.textContent = msg;
```

RESULT



Congratulations! Proceed to the next round.

Here you can see that an `if...else` statement allows you to provide two sets of code:

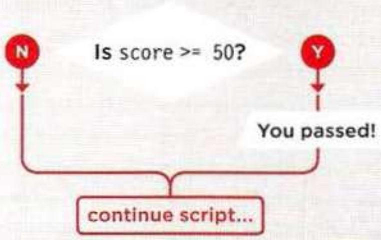
1. one set if the condition evaluates to `true`

2. another set if the condition is `false`

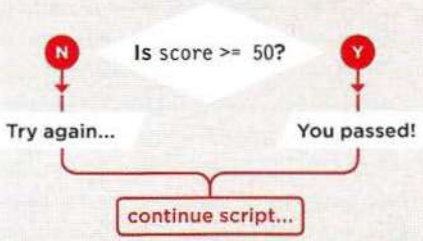
In this test, there are two possible outcomes: a user can either get a score equal to or greater than the pass mark (which means they pass), or they can score less than the pass mark (which means they fail). One response is required for each eventuality. The response is then written to the page.

Note that the statements inside an `if` statement should be followed by a semicolon, but there is no need to place one after the closing curly brace of the code blocks.

An `if` statement only runs a set of statements if the condition is `true`:



An `if...else` statement runs one set of code if the condition is `true` or a different set if it is `false`:



SWITCH STATEMENTS

A **switch** statement starts with a variable called the **switch value.** Each case indicates a possible value for this variable and the code that should run if the variable matches that value.

Here, the variable named **level** is the switch value. If the value of the **level** variable is the string **One**, then the code for the first case is executed. If it is **Two**, the second case is executed. If it is **Three**, the third case is executed. If it is none of these, the code for the **default** case is executed.

The entire statement lives in one code block (set of curly braces), and a colon separates the option from the statements that are to be run if the case matches the switch value.

At the end of each case is the **break** keyword. It tells the JavaScript interpreter that it has finished with this **switch** statement and to proceed to run any subsequent code that appears after it.

```
switch (level) {

  case 'One':
    title = 'Level 1';
    break;

  case 'Two':
    title = 'Level 2';
    break;

  case 'Three':
    title = 'Level 3';
    break;

  default:
    title = 'Test';
    break;

}
```

IF... ELSE

- There is no need to provide an **else** option. (You can just use an **if** statement.)
- With a series of **if** statements, they are all checked *even if* a match has been found (so it performs more slowly than **switch**).

VS.

SWITCH

- You have a **default** option that is run if none of the cases match.
- If a match is found, that code is run; then the **break** statement stops the rest of the **switch** statement running (providing better performance than multiple **if** statements).

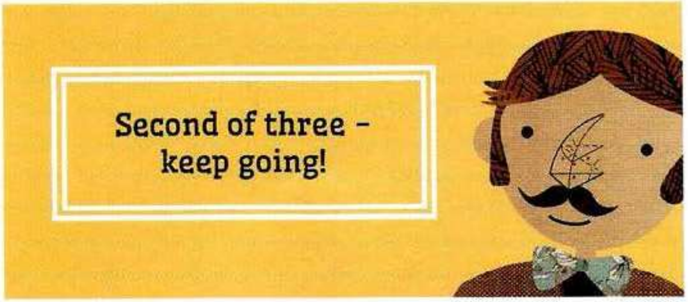
USING SWITCH STATEMENTS

JAVASCRIPT

c04/js/switch-statement.js

```
var msg;          // Message
var level = 2;  // Level

// Determine message based on level
switch (level) {
case 1:
    msg = 'Good luck on the first test';
    break;

case 2:
    msg = 'Second of three - keep going!';
    break;

case 3:
    msg = 'Final round, almost there!';
    break;

default:
    msg = 'Good luck!';
    break;
}

var el = document.getElementById('answer');
el.textContent = msg;
```

RESULT



Second of three - keep going!

In this example, the purpose of the `switch` statement is to present the user with a different message depending on which level they are at. The message is stored in a variable called `msg`.

The variable called `level` contains a number indicating which level the user is on. This is then used as the switch value. (The switch value could also be an expression.)

In the following code block (inside the curly braces), there are three options for what the value of the `level` variable might be: the numbers 1, 2, or 3.

If the value of the `level` variable is the number 1, the value of the `msg` variable is set to '`Good luck on the first test`'.

If the value is 2, it will read: '`Second of three - keep going!`'

If the value is 3, the message will read: '`Final round, almost there!`'

If no match is found, then the value of the `msg` variable is set to '`Good luck!`'

Each case ends with the break keyword which will tell the JavaScript interpreter to skip the rest of this code block and continue onto the next.

TYPE COERCION & WEAK TYPING

If you use a data type JavaScript did not expect, it tries to make sense of the operation rather than report an error.

JavaScript can convert data types behind the scenes to complete an operation. This is known as **type coercion**. For example, a string '1' could be converted to a number 1 in the following expression: ('1' > 0). As a result, the above expression would evaluate to true.

JavaScript is said to use **weak typing** because the data type for a value can change. Some other languages require that you specify what data type each variable will be. They are said to use **strong typing**.

Type coercion can lead to unexpected values in your code (and also cause errors). Therefore, when checking if two values are equal, it is considered better to use strict equals operators === and !== rather than == and != as these strict operators check that the value and data types match.

DATA TYPE	PURPOSE
string	Text
number	Number
Boolean	true or false
null	Empty value
undefined	Variable has been declared but not yet assigned a value

NaN is a value that is counted as a number. You may see it when a number is expected, but is not returned, e.g., ('ten'/2) results in NaN.

TRUTHY & FALSY VALUES

Due to type coercion, every value in JavaScript can be treated as if it were true or false; and this has some interesting side effects.

FALSY VALUES

VALUE	DESCRIPTION
`var highScore = false;`	The traditional Boolean `false`
`var highScore = 0;`	The number zero
`var highScore = '';`	`NaN` (Not a Number)
`var highScore = 10/'score';`	Empty value switch
`var highScore;`	A variable with no value assigned to it

Almost everything else evaluates to truthy...

TRUTHY VALUES

VALUE	DESCRIPTION
`var highScore = true;`	The traditional Boolean `true`
`var highScore = 1;`	Numbers other than zero
`var highScore = 'carrot';`	Strings with content
`var highScore = 10/5;`	Number calculations
`var highScore = 'true';`	`true` written as a string
`var highScore = '0';`	Zero written as a string
`var highScore = 'false';`	`false` written as a string

Falsy values are treated *as if* they are `false`. The table to the left shows a `highScore` variable with a series of values, all of which are falsy.

Falsy values can also be treated as the number 0.

Truthy values are treated *as if* they are `true`. Almost everything that is not in the falsy table can be treated as if it were true.

Truthy values can also be treated as the number 1.

In addition, the presence of an object or an array is usually considered truthy, too. This is commonly used when checking for the presence of an element in a page.

The next page will explain more about why these concepts are important.

CHECKING EQUALITY & EXISTENCE

Because the presence of an object or array can be considered truthy, it is often used to check for the existence of an element within a page.

A **unary operator** returns a result with just one operand. Here you can see an `if` statement checking for the presence of an element. If the element is found, the result is truthy, so the first set of code is run. If it is not found, the second set is run instead.

```
if (document.getElementById('header')) {
  // Found: do something
} else {
  // Not found: do something else
}
```

Those new to JavaScript often think the following would do the same:
`if (document.getElementById('header') == true)`
but `document.getElementById('header')` would return an object which is a truthy value but it is *not* equal to a Boolean value of `true`.

Because of type coercion, the strict equality operators === and !== result in fewer unexpected values than == and != do.

If you use == the following values can be considered equal: `false`, `0`, and `''` (empty string). However, they are not equivalent when using the strict operators.

EXPRESSION	RESULT
`(false == 0)`	`true`
`(false === 0)`	`false`
`(false == '')`	`true`
`(false === '')`	`false`
`(0 == '')`	`true`
`(0 === '')`	`false`

Although `null` and `undefined` are both falsy, they are not equal to anything other than themselves. Again, they are not equivalent when using strict operators.

EXPRESSION	RESULT
`(undefined == null)`	`true`
`(null == false)`	`false`
`(undefined == false)`	`false`
`(null == 0)`	`false`
`(undefined == 0)`	`false`
`(undefined === null)`	`false`

Although `NaN` is considered falsy, it is not equivalent to anything; it is not even equivalent to itself (since `NaN` is an undefinable number, two cannot be equal).

EXPRESSION	RESULT
`(Nan == null)`	`false`
`(NaN == NaN)`	`false`

SHORT CIRCUIT VALUES

Logical operators are processed left to right. They short-circuit (stop) as soon as they have a result - but they return the value that stopped the processing (not necessarily `true` or `false`).

On line 1, the variable `artist` is given a value of `Rembrandt`.
On line 2, if the variable `artist` has a value, then `artistA` will be given the same value as `artist` (because a non-empty string is truthy).

```
var artist = 'Rembrandt';
var artistA = (artist || 'Unknown');
```

If the string is empty (see below), `artistA` becomes a string `'Unknown'`.

```
var artist = '';
var artistA = (artist || 'Unknown');
```

You could even create an empty object if artist does not have a value:

```
var artist = '';
var artistA = (artist || {});
```

Logical operators will not always return `true` or `false`, because:

- They return the value that stopped processing.
- That value might have been treated as truthy or falsy although it was not a Boolean.

Programmers use this creatively (for example, to set values for variables or even create objects).

Here are three values. If any one of them is considered truthy, the code inside the `if` statement will execute. When the script encounters `valueB` in the logical operator, it will short circuit because the number 1 is considered truthy and the subsequent code block is executed.

```
valueA = 0;
valueB = 1;
valueC = 2;

if (valueA || valueB || valueC) {
  // Do something here
}
```

This technique could also be used to check for the existence of elements within a page, as shown on p168.

As soon as a truthy value is found, the remaining options are not checked. Therefore, experienced programmers often:

- Put the code most likely to return true *first* in OR operations, and false answers first in AND operations.
- Place the options requiring the most processing power last, just in case another value returns `true` and they do not need to be run.

LOOPS

Loops check a condition. If it returns **true**, a code block will run. Then the condition will be checked again and if it still returns **true**, the code block will run again. It repeats until the condition returns **false**. There are three common types of loops:

FOR

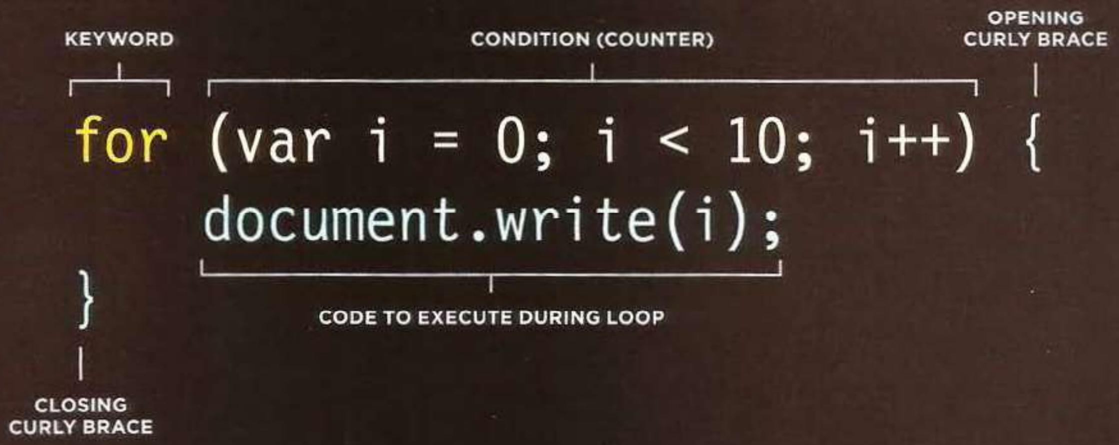
If you need to run code a specific number of times, use a **for** loop. (It is the most common loop.) In a **for** loop, the condition is usually a counter which is used to tell how many times the loop should run.

WHILE

If you do not know how many times the code should run, you can use a **while** loop. Here the condition can be something other than a counter, and the code will continue to loop for as long as the condition is **true**.

DO WHILE

The **do...while** loop is very similar to the **while** loop, but has one key difference: it will always run the statements inside the curly braces at least once, even if the condition evaluates to **false**.



```
for (var i = 0; i < 10; i++) {
    document.write(i);
}
```

This is a **for** loop. The condition is a counter that counts to ten. The result would write "0123456789" to the page.

If the variable **i** is less than ten, the code inside the curly braces is executed. Then the counter is incremented.

The condition is checked again, if **i** is less than ten it runs again. The next three pages show how this loop works in greater detail.

LOOP COUNTERS

A **for** loop uses a counter as a condition.
This instructs the code to run a specified number of times.
Here you can see the condition is made up of three statements:

INITIALIZATION

Create a variable and set it to **0**. This variable is commonly called **i**, and it acts as the counter.

```
var i = 0;
```

The variable is only created the first time the loop is run. (You may also see the variable called **index**, rather than just **i**.)

You will sometimes see this variable declared before the condition. The following is the same and it is mainly a preference of the coder.

```
var i;
for (i = 0; i < 10; i++) {
  // Code goes here
}
```

CONDITION

The loop should continue to run until the counter reaches a specified number.

```
i < 10;
```

The value of **i** was initially set to **0**, so in this case the loop will run 10 times before stopping.

The condition may also use a variable that holds a number. If a variable called **rounds** held the number of rounds in a test and the loop ran once for each round, the condition would be:

```
var rounds = 3;
i < (rounds);
```

UPDATE

Every time the loop has run the statements in the curly braces, it adds one to the counter.

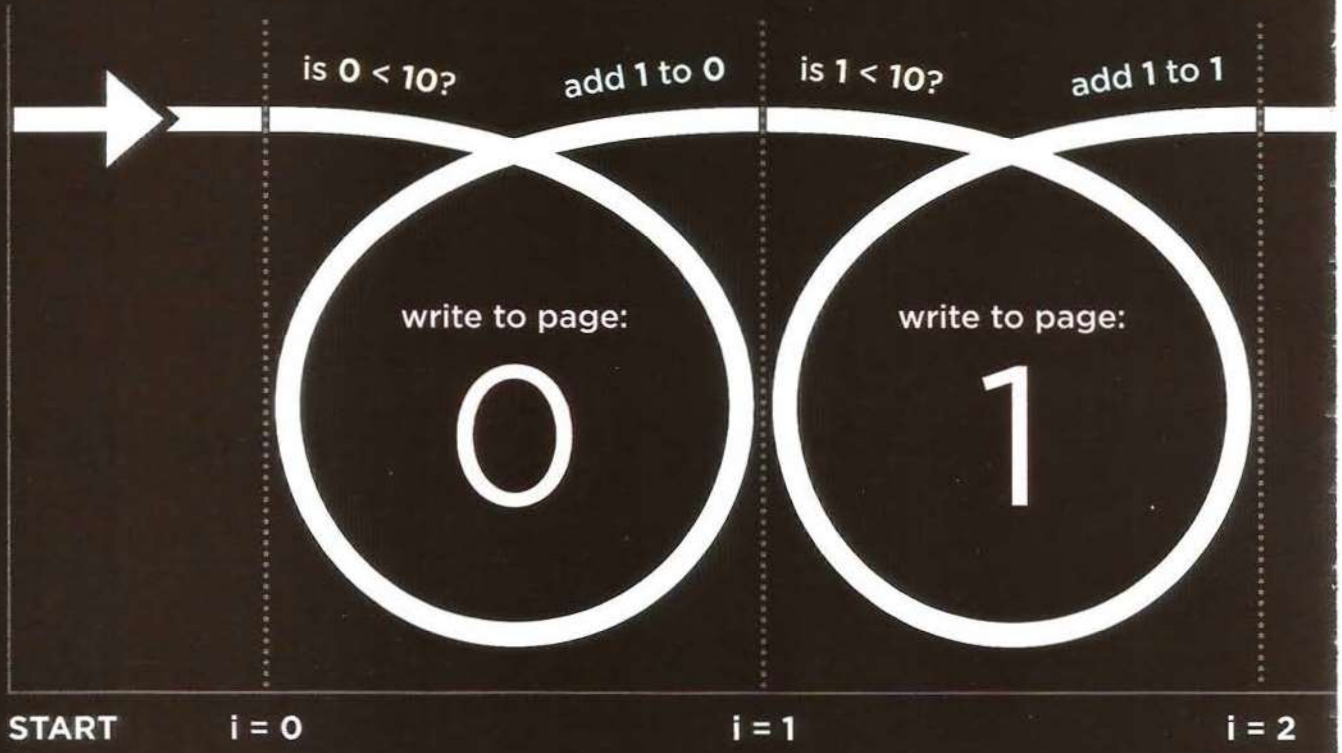
```
i++
```

One is added to the counter using the increment (++) operator.

Another way of reading this is that it says, "Take the variable **i**, and add one using the **++** operator."

It is also possible for loops to count downwards using the decrement operator (--).

LOOPING

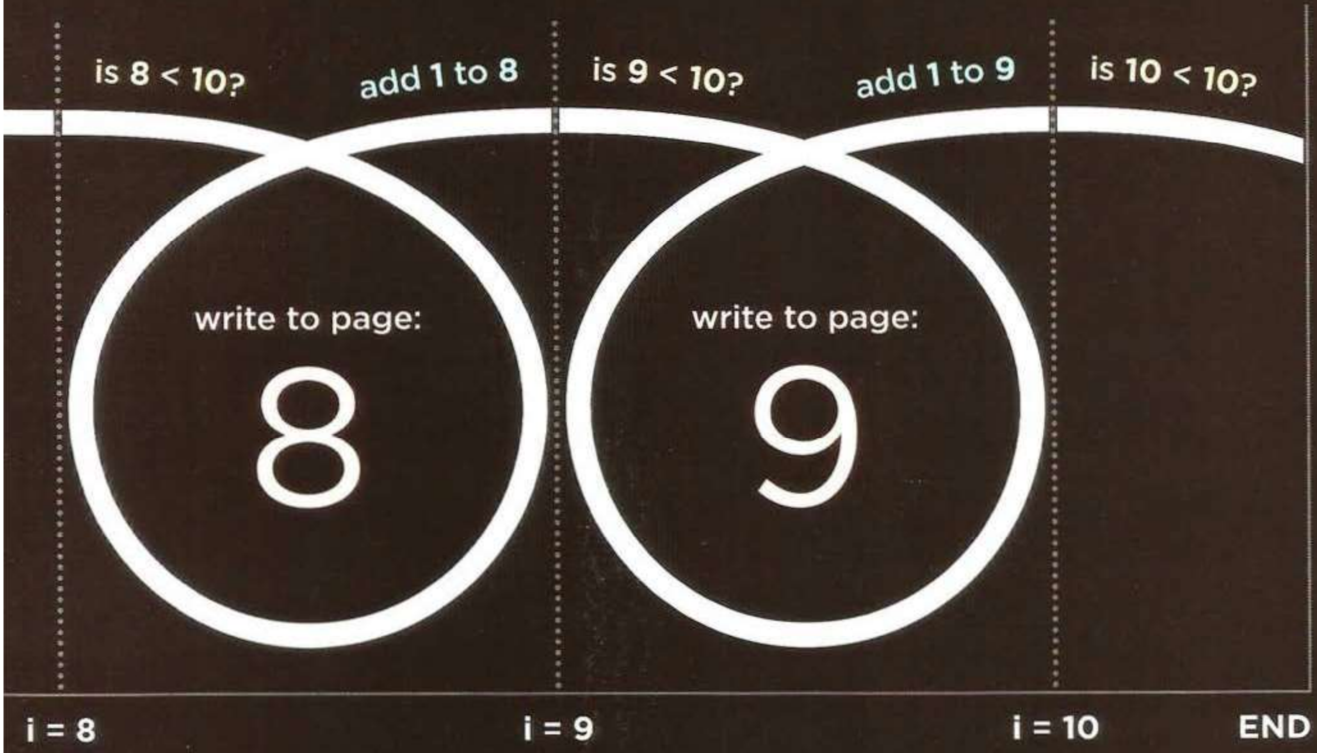


The first time the loop is run, the variable `i` (the counter) is assigned a value of zero.

Every time the loop is run, the condition is checked. Is the variable `i` less than 10?

Then the code inside the loop (the statements between the curly brackets) is run.

```
for (var i = 0; i < 10; i++) {
    document.write(i);
}
```



The variable **i** can be used inside the loop. Here it is used to write a number to the page.

When the statements have finished, the variable **i** is incremented by 1.

When the condition is no longer true, the loop ends. The script moves to the next line of code.

KEY LOOP CONCEPTS

Here are three points to consider when you are working with loops. Each is illustrated in examples on the following three pages.

KEYWORDS

You will commonly see these two keywords used with loops:

`break`

This keyword causes the termination of the loop and tells the interpreter to go onto the next statement of code outside of the loop. (You may also see it used in functions.)

`continue`

This keyword tells the interpreter to continue with the current iteration, and then check the condition again. (If it is `true`, the code runs again.)

LOOPS & ARRAYS

Loops are very helpful when dealing with arrays if you want to run the same code for each item in the array.

For example, you might want to write the value of each item stored in an array into the page.

You may not know how many items will be in an array when writing a script, but, when the code runs, it can check the total number of items in a loop. That figure can then be used in the counter to control how many times a set of statements is run.

Once the loop has run the right number of times, the loop stops.

PERFORMANCE ISSUES

It is important to remember that when a browser comes across JavaScript, it will stop doing anything else until it has processed that script.

If your loop is dealing with only a small number of items, this will not be an issue. If, however, your loop contains a lot of items, it can make the page slower to load.

If the condition never returns `false`, you get what is commonly referred to as an **infinite loop**. The code will not stop running until your browser runs out of memory (breaking your script).

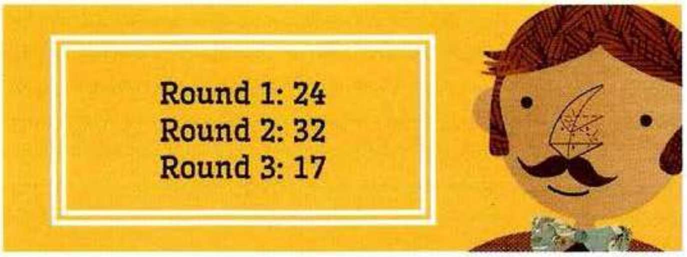
Any variable you can define outside of the loop and that does not change *within* the loop should be defined outside of it. If it were declared inside the loop, it would be recalculated every time the loop ran, needlessly using resources.

USING FOR LOOPS

JAVASCRIPT c04/js/for-loop.js

```
var scores = [24, 32, 17];       // Array of scores
var arrayLength = scores.length;// Items in array
var roundNumber = 0;             // Current round
var msg = '';                    // Message
var i;                           // Counter

// Loop through the items in the array
for (i = 0; i < arrayLength; i++) {

  // Arrays are zero based (so 0 is round 1)
  // Add 1 to the current round
  roundNumber = (i + 1);

  // Write the current round to message
  msg += 'Round ' + roundNumber + ': ';

  // Get the score from the scores array
  msg += scores[i] + '<br />';
}

document.getElementById('answer').innerHTML = msg;
```

RESULT



Round 1: 24
Round 2: 32
Round 3: 17

The counter and array both start from 0 (rather than 1). So, within the loop, to select the current item from the array, you use the counter variable i to specify the item from the array, e.g., scores[i]. But remember that it is a number lower then you might expect (e.g., first iteration is 0, second is 1).

A for loop is often used to loop through the items in an array.

In this example, the scores for each round of a test are stored in an array called scores.

The total number of items in the array is stored in a variable called arrayLength. This number is obtained using the length property of the array.

There are three more variables: roundNumber holds the round of the test; msg holds the message to display; i is the counter (declared outside the loop).

The loop starts with the for keyword, then contains the condition inside the parentheses. As long as the counter is less than the total number of items in the array, the contents of the curly braces will continue to run. Each time the loop runs, the round number is increased by 1.

Inside the curly braces are rules that write the round number and the score to the msg variable. The variables declared outside of the loop are used within the loop.

The msg variable is then written into the page. It contains HTML so the innerHTML property is used to do this. Remember, p228 will talk about security issues relating to this property.

USING WHILE LOOPS

Here is an example of a `while` loop. It writes out the 5 times table. Each time the loop is run, another calculation is written into the variable called `msg`.

This loop will continue to run for as long as the condition in the parentheses is true. That condition is a counter indicating that, as long as the variable `i` remains less than 10, the statements in the subsequent code block should run.

Inside the code block there are two statements:

The first statement uses the += operator, which is used to add new content to the `msg` variable. Each time the loop runs, a new calculation and line break is added to the end of the message being stored in it. So += works as a shorthand for writing:
`msg = msg + 'new msg'`
(See bottom of the next page for a breakdown of this statement.)

The second statement increments the counter variable by one. (This is done inside the loop rather than with the condition.)

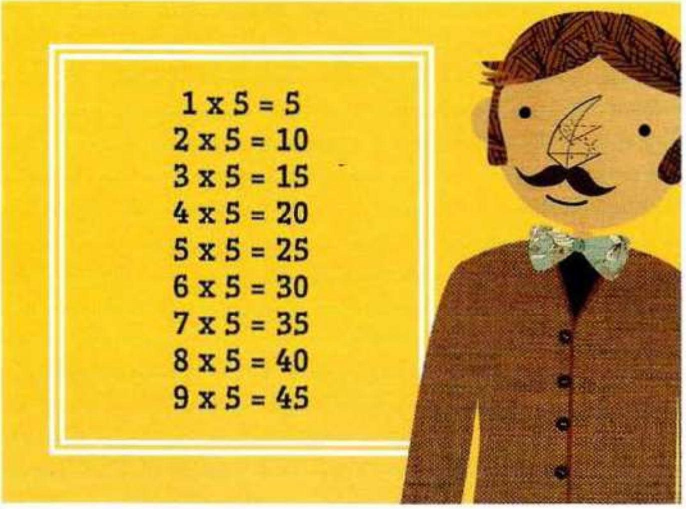
When the loop has finished, the interpreter goes to the next line of code, which writes the `msg` variable to the page.

c04/js/while-loop.js

JAVASCRIPT

```
var i = 1;         // Set counter to 1
var msg = '';      // Message

// Store 5 times table in a variable
while (i < 10) {
  msg += i + ' x 5 = ' + (i * 5) + '<br />';
  i++;
}

document.getElementById('answer').innerHTML = msg;
```

RESULT



```
1 x 5 = 5
2 x 5 = 10
3 x 5 = 15
4 x 5 = 20
5 x 5 = 25
6 x 5 = 30
7 x 5 = 35
8 x 5 = 40
9 x 5 = 45
```

In this example, the condition specifies that the code should run nine times. A more typical use of a `while` loop would be when you *do not know* how many times you want the code to run. It should continue to run as long as a condition is met.

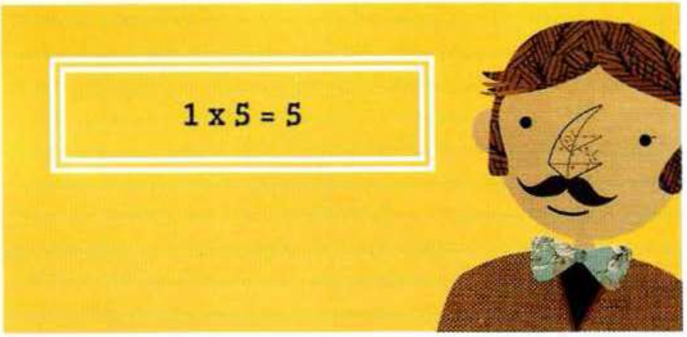
USING DO WHILE LOOPS

JAVASCRIPT

c04/js/do-while-loop.js

```
var i = 1;         // Set counter to 1
var msg = '';      // Message

// Store 5 times table in a variable
do {
  msg += i + ' x 5 = ' + (i * 5) + '<br />';s
  i++;
} while (i < 1);
// Note how this is already 1 and it still runs

document.getElementById('answer').innerHTML = msg;
```

RESULT



1 x 5 = 5

The key difference between a `while` loop and a `do while` loop is that the statements in the code block come *before* the condition. This means that those statements are run once whether or not the condition is met.

If you take a look at the condition, it is checking that the value of the variable called `i` is less than 1, but that variable has already been set to a value of 1.

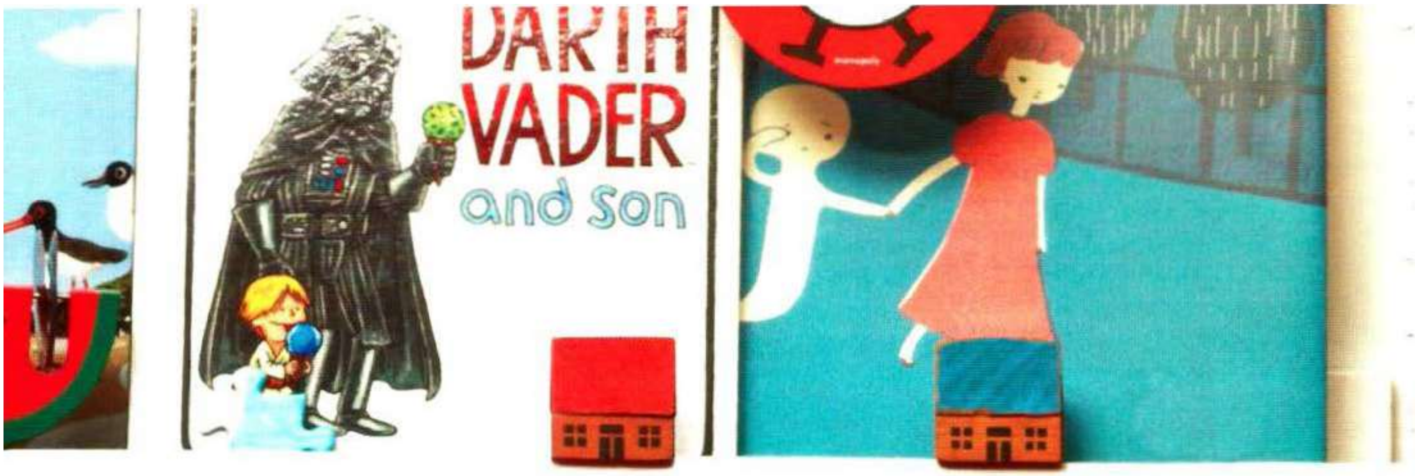
Therefore, in this example the result is that the 5 times table is written out once, even though the counter is not less than 1.

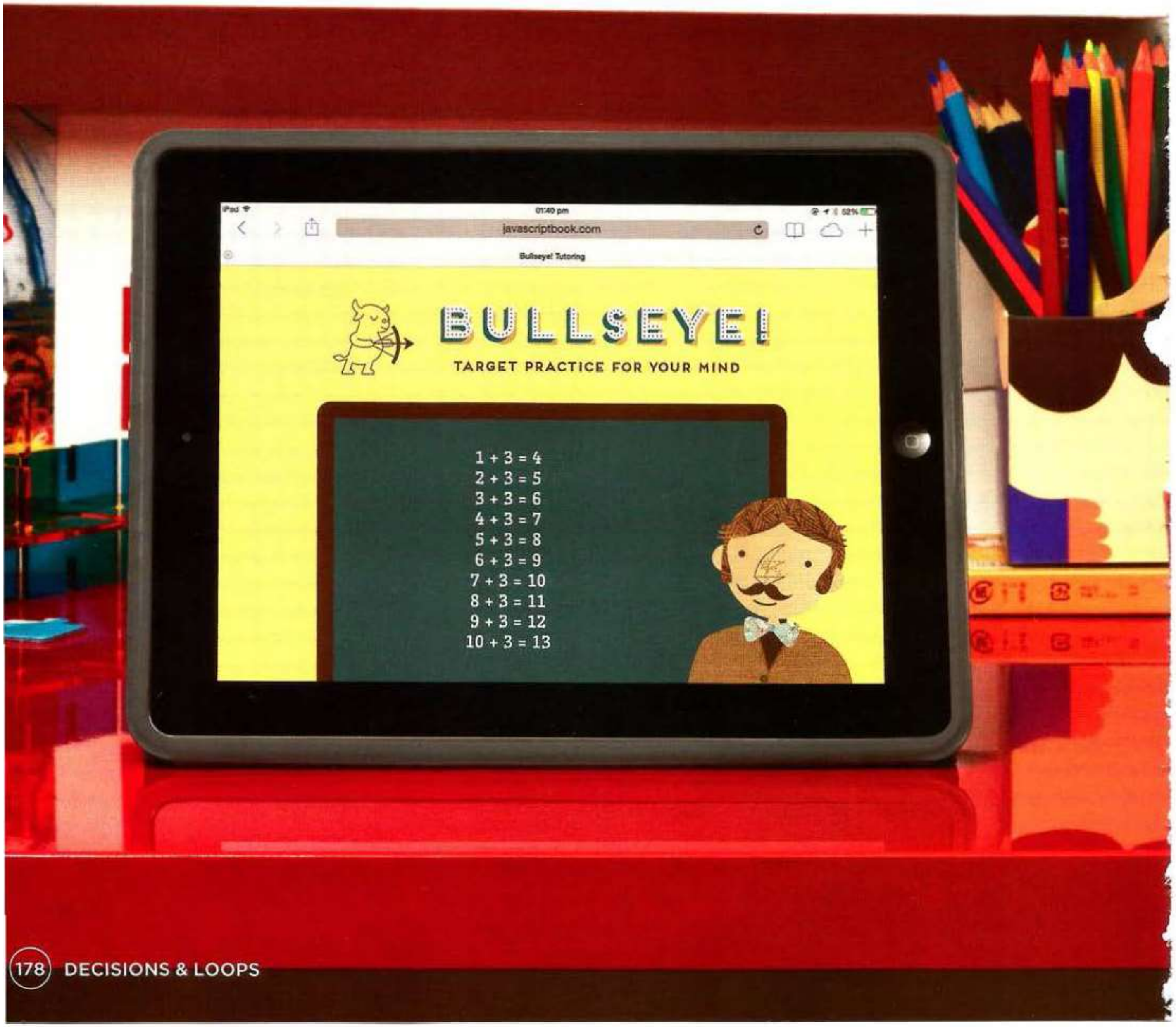
Some people like to write `while` on a separate line from the closing curly brace before it.

Breaking down the first statement in these examples:

```
 1   2  3      4          5          6
msg += i + ' x 5 = ' + (i * 5) + '<br />';
```

1. Take variable called `msg`
2. Add to the following to its value
3. The number in the counter
4. Write out the string **x 5 =**
5. The counter multiplied by **5**
6. Add a line break





```
1 + 3 = 4
2 + 3 = 5
3 + 3 = 6
4 + 3 = 7
5 + 3 = 8
6 + 3 = 9
7 + 3 = 10
8 + 3 = 11
9 + 3 = 12
10 + 3 = 13
```

EXAMPLE
DECISIONS & LOOPS

In this example, the user can either be shown addition or multiplication of a given number. The script demonstrates the use of both conditional logic and loops.

The example starts with two variables:

1. `number` holds the number that the calculations will be performed with (in this case it is the number 3)
2. `operator` indicates whether it should be addition or multiplication (in this case it is performing addition)

An `if...else` statement is used to decide whether to perform addition or multiplication with the number. If the variable called `operator` has the value `addition`, the numbers will be added together; otherwise they will be multiplied.

Inside the conditional statement, a `while` loop is used to calculate the results. It will run 10 times because the condition is checking whether the value of the counter is less than 11.

EXAMPLE
DECISIONS & LOOPS

c04/example.html

HTML

```
<!DOCTYPE html>
<html>
  <head>
    <title>Bullseye! Tutoring</title>
    <link rel="stylesheet" href="css/c04.css" />
  </head>
  <body>
    <section id="page2">
      <h1>Bullseye</h1>
      <img src="images/teacher.png" id="teacher2" alt="" />
      <section id="blackboard"></section>
    </section>
    <script src="js/example.js"></script>
  </body>
</html>
```

The HTML for this example is very slightly different than the other examples in this chapter because there is a blackboard which the table is written onto.

You can see the script is added to the page just before the closing </body> tag.

EXAMPLE
DECISIONS & LOOPS

JAVASCRIPT

c04/js/example.js

```
var table = 3;                     // Unit of table
var operator = 'addition';         // Type of calculation (defaults to addition)
var i = 1;                         // Set counter to 1
var msg = '';                      // Message

if (operator === 'addition') {     // If the operator variable says addition
  while (i < 11) {                 // While counter is less than 11
    msg += i + ' + ' + table + ' = ' + (i + table) + '<br />'; // Calculation
    i++;                           // Add 1 to the counter
  }
} else {                           // Otherwise
  while (i < 11) {                 // While counter is less than 11
    msg += i + ' x ' + table + ' = ' + (i * table) + '<br />'; // Calculation
    i++;                           // Add 1 to the counter
  }
}

// Write the message into the page
var el = document.getElementById('blackboard');
el.innerHTML = msg;
```

If you read the comments in the code, you can see how this example works. The script starts by declaring four variables and setting values for them.

Then, an if statement checks whether the value of the variable called operator is addition. If it is, it uses a while loop to perform the calculations and store the results in a variable called msg.

If you change the value of the operator variable to anything other than addition, the conditional statement will select the second set of statements. These also contain a while loop, but this time it will perform multiplication (rather than addition).

When one of the loops has finished running, the last two lines of the script select the element whose id attribute has a value of blackboard, and updates the the page with the content of the msg variable.

SUMMARY

DECISIONS & LOOPS

- Conditional statements allow your code to make decisions about what to do next.
- Comparison operators (===, !==, ==, !=, <, >, <=, =>) are used to compare two operands.
- Logical operators allow you to combine more than one set of comparison operators.
- `if...else` statements allow you to run one set of code if a condition is true, and another if it is false.
- `switch` statements allow you to compare a value against possible outcomes (and also provides a default option if none match).
- Data types can be coerced from one type to another.
- All values evaluate to either truthy or falsy.
- There are three types of loop: `for`, `while`, and `do...while`. Each repeats a set of statements.