WEEK13 – JAVASCRIPT OBJECTS AND OOP

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OUTLINE

1. **Built-In Objects**
2. **Base Objects**
3. **Objects with Functions**
4. **Boolean, Number**
5. **The String Object**
6. **String Manipulation & Pattern Matching**
7. The Array Object
8. The Array Object for Queue and Stack
9. The Math Object
10. The Date Object
11. The RegExp Object

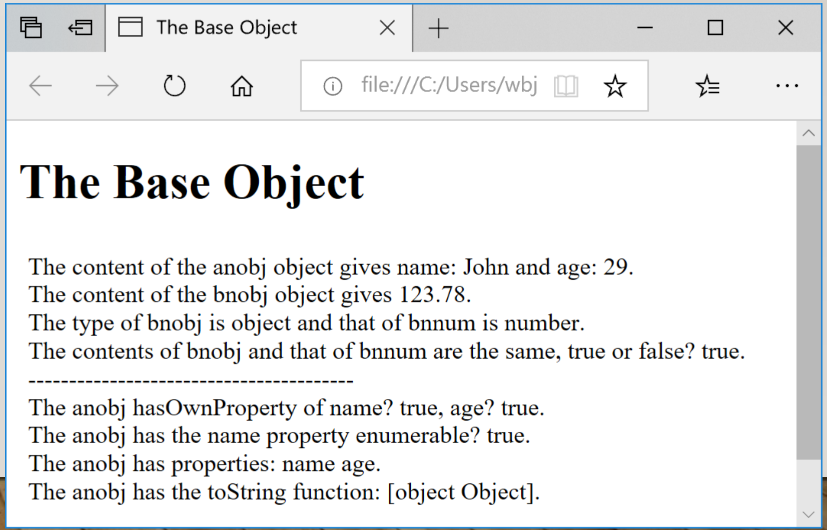
BUILT-IN OBJECTS IN JAVASCRIPT

- Object – basic object, it has properties (length, prototype), methods (create(), values(), get OwnPropertyNames(), …)
- Boolean, Number, Math – Math is an object providing functions for calculations
- String, Array – there are some methods helping you to process data in strings and arrays
- Function – this is particular in this language by defining a function and its arguments as objects
- Date – used for data of date and time
- RegExp – used for character pattern recognition
- Error – more particular, the error is packed to be an object for processing

THE BASE OBJECT

- The variable of the base object is used to combine multiple kinds of simple variables.
  - var aobj = new Object({name: "John", age: 29});
  - var bobj = new Object(123.78); // the same as var bnobj = 123.78;
  - var cobj = {x:10, y:10, dist:function(){return Math.sqrt(this.x*this.x+this.y*this.y);}};
- The object variable is similar to struct in c++.
  - struct mystruct = {char* name; int age;};
- The base object has many functions, for example:
  - hasOwnProperty("name"), propertyIsEnumerable("name"), toString(), …
  - for (var prop in anobj) outstring += " " + prop;

IC_W1301.html



The Base Object

```
The content of the anobj object gives name: John and age: 29.
The content of the bnobj object gives 123.78.
The type of bnobj is object and that of bnnum is number.
The contents of bnobj and that of bnnum are the same, true or false? true.
----------------------------------------
The anobj hasOwnProperty of name? true, age? true.
The anobj has the name property enumerable? true.
The anobj has properties: name age.
The anobj has the toString function: [object Object].
```

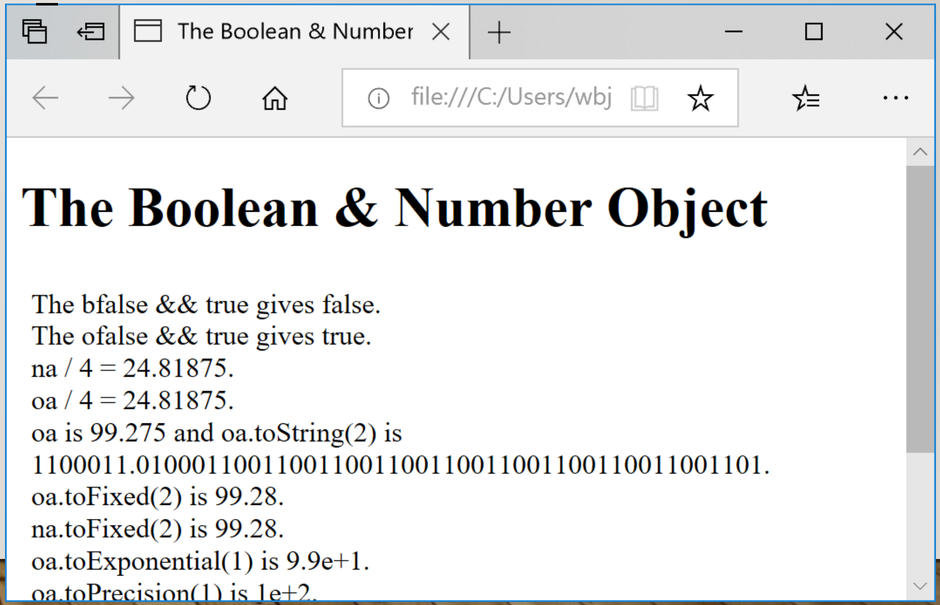
THE BASE OBJECT

- Declaration:
  - var oaddr = new Object({name: "John", age: 29});   var oaddr = {name: “John”, age: 29};
  - var o1 = {name: oaddr.name, age: oaddr.age};   var o2 = Object.create({name: “Marry”, age: 22});
  - var o1 = {x:10, y:10, dist:function(){return Math.sqrt(this.x*this.x+this.y*this.y);}};
- Querying & Setting Properties:
  - var name = o1.name; var age = o1.age; o1.age = 24; o1[“age”] = 24;
- Deleting Properties:
  - delete o1.age;
  - if (“name” in o1) window.alert(“true”); else window.alert(“false”);
- Reproducing Objects:
  - var o2 = Object.create(o1);

THE BOOLEAN AND NUMBER OBJECT

- The Boolean type:
  - var bfalse = false;   var objfalse = new Boolean(false);
  - bfalse && true -> false, but objfalse && true -> true, all objects are converted to true in the Boolean expression
- The Number type:
  - var na = 99.275; var oa = new Number(99.275);
  - toString(8), toFixed(2), toExponential(1), toPrecision(1)

IC_W1302.html



The Boolean & Number Object

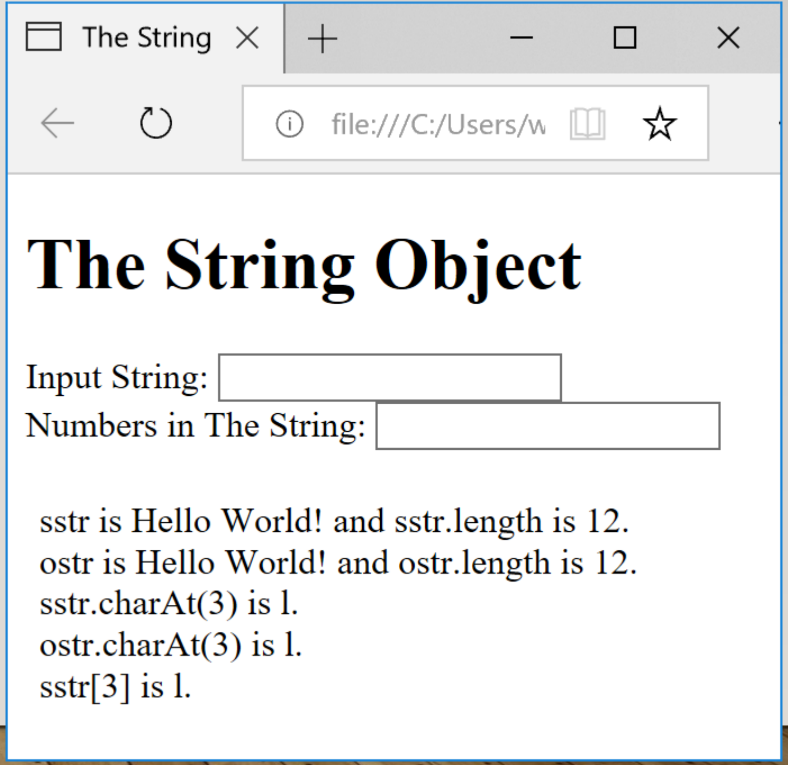
```
The bfalse && true gives false.
The ofalse && true gives true.
na / 4 = 24.81875.
oa / 4 = 24.81875.
oa is 99.275 and oa.toString(2) is
1100011.010001100110011001100110011001100110011001101.
oa.toFixed(2) is 99.28.
na.toFixed(2) is 99.28.
oa.toExponential(1) is 9.9e+1.
oa.toPrecision(1) is 1e+2.
```

THE STRING OBJECT

- The String type:
  - var sstr = "Hello World!";
  - var ostr = new String("Hello World!");
- Get length:
  - sstr.length
- Get character:
  - sstr.charAt(), sstr[]

```
for (let i=0; i<inp.length; i++){
        var ch = inp[i];
        switch(ch){
                case "0":
                case "1":
```

IC_W1303.html



The String Object

Input String:

Numbers in The String:

```
sstr is Hello World! and sstr.length is 12.
ostr is Hello World! and ostr.length is 12.
sstr.charAt(3) is l.
ostr.charAt(3) is l.
sstr[3] is l.
```

THE STRING OBJECT

- String manipulation methods:
  - var astr = “Hello World!”; astr += “ John”;
  - astr.concat(“Added String1”, “Added String 2”);
  - astr.slice(3, 7); // start from the 3rd char and take 7 chars
  - astr.substr(3, 7); astr.substring(3, 7);
  - astr.slice(-3); astr.substr(-3); // take 3 chars with an order back from the end
  - astr.substring(-3); // any negative value is changed to 0
  - astr.indexOf(“Wo”); // find the index number of the chars “Wo”
  - astr.lastIndexOf(“o”); // find the index number of the char with a reverse order
  - astr.indexOf(“o”, 5); find the char after the 5th char

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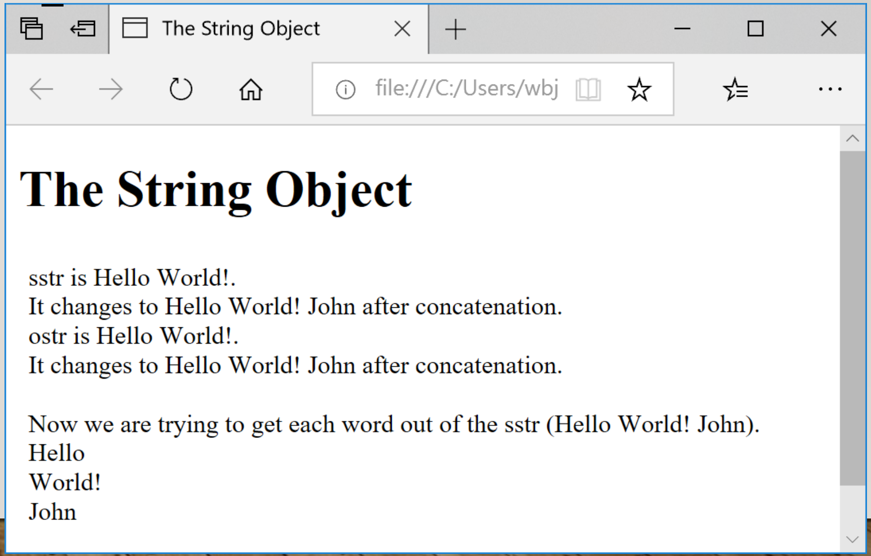


The String Object

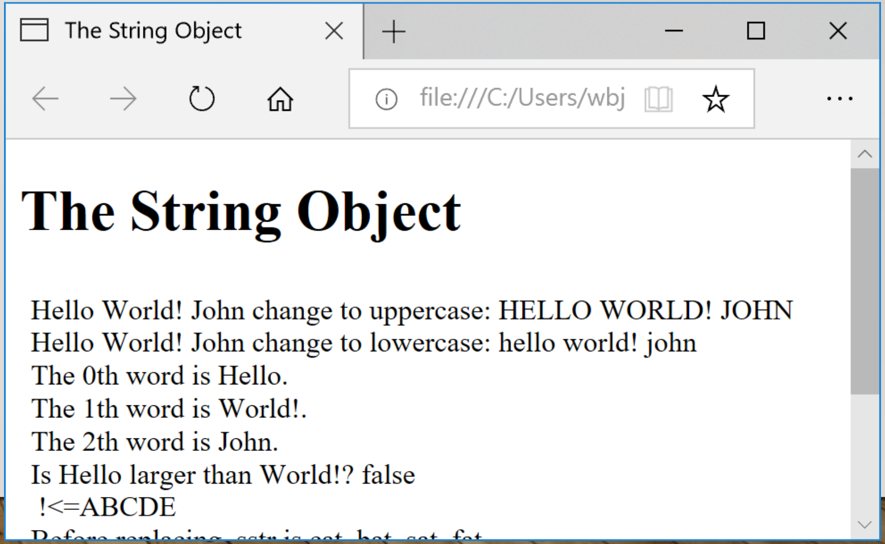
```
sstr is Hello World!.
It changes to Hello World! John after concatenation.
ostr is Hello World!.
It changes to Hello World! John after concatenation.

Now we are trying to get each word out of the sstr (Hello World! John).
Hello
World!
John
```

THE STRING OBJECT

- String manipulation and pattern-matching methods
  - var sstr = "   Hello! World!   "; sstr.trim(); // remove all blanks
  - sstr.toUpperCase(); sstr.toLowerCase();
  - var sstr = "red,blue,green,yello"; var colors = sstr.split(","); var colors = sstr.split(",", 2);
  - var sstr = "yellow"; sstr.localeCompare("brick"); sstr.localeCompare("yellow");
  - var sstr = String.fromCharCode(104, 101, 108, 108, 111); // ASCII codes
  - var sstr = "cat, bat, sat, fat"; var pattern = /.at/; sstr.match(pattern); // only find the 1st one – cat
  - sstr.replace("at", "ond"); // only change cat to cond
  - sstr.replace(/at/g, "ond"); // change all at to ond
  - sstr.replace(/(.at)/g, "word ($1)");

IC_W1305.html



The String Object

```
Hello World! John change to uppercase: HELLO WORLD! JOHN
Hello World! John change to lowercase: hello world! john
The 0th word is Hello.
The 1th word is World!.
The 2th word is John.
Is Hello larger than World!? false
 !<=ABCDE
Before replacing, sstr is cat, bat, sat, fat
```

OUTLINE

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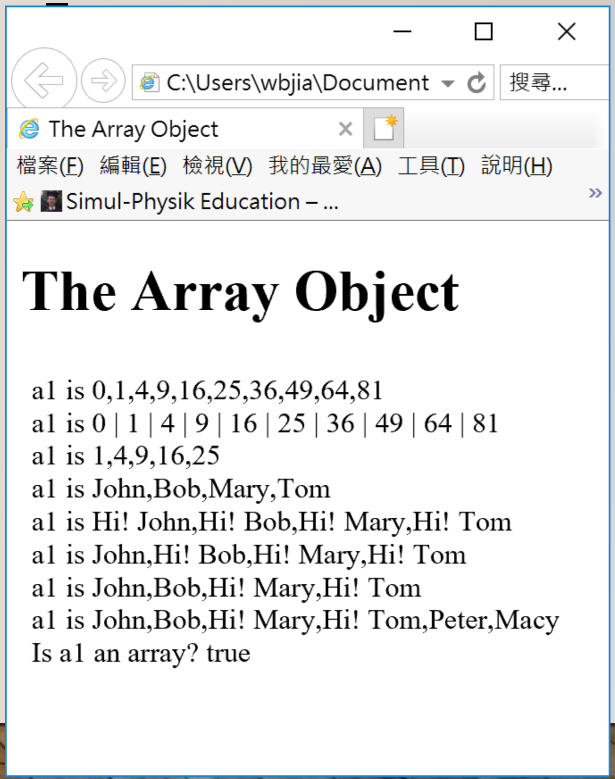
THE ARRAY OBJECT

- Declaring an Array
  - var a1 = new Array(10);   for(let i=0;i<a1.length;i++) a1[i]=i*i;
  - var a1 = new Array(1, 10, 20, 1);   var a1 = new Array(“John”,“Marry”,“Joe”);
  - var a1 = [1, 10, 20, 1];   var a1 = [“John”,“Marry”,“Joe”];
- The Array Usages:
  - The number of items in the Array: a1.length
  - The item value: a1[0], a1[1], a1[a1.length - 1]
  - Change the item value: a1[0] = “Joe”;
  - Add one more item: a1[a1.length] = “Bob”;
- Detecting Array
  - a1 instanceof Array

IC_W1306.html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The Array Object
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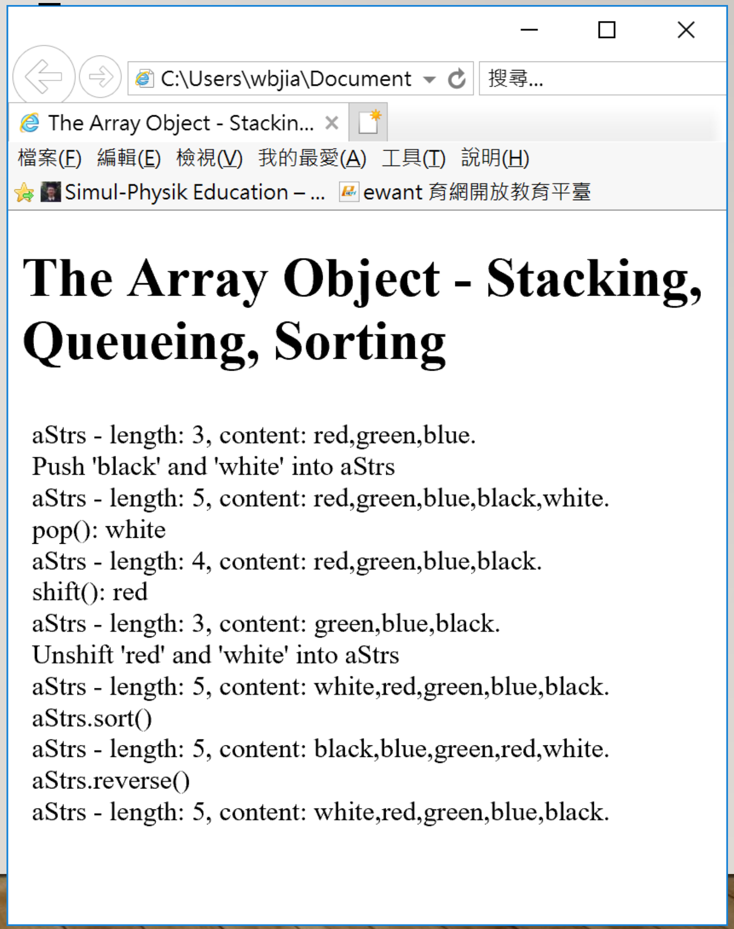
The Array Object

```
a1 is 0,1,4,9,16,25,36,49,64,81
a1 is 0 | 1 | 4 | 9 | 16 | 25 | 36 | 49 | 64 | 81
a1 is 1,4,9,16,25
a1 is John,Bob,Mary,Tom
a1 is Hi! John,Hi! Bob,Hi! Mary,Hi! Tom
a1 is John,Hi! Bob,Hi! Mary,Hi! Tom
a1 is John,Bob,Hi! Mary,Hi! Tom
a1 is John,Bob,Hi! Mary,Hi! Tom,Peter,Macy
Is a1 an array? true
```

THE ARRAY OBJECT

- Stack methods (first in last out):
  - var aData = []; aData.push(“red”,“green”); aData.push(“blue”); var data = aData.pop();
- Queue methods (first in first out):
  - Var aData = []; aData.unshift(“red”,“green”,“blue”); var data = aData.shift();
- Reordering:
  - Var aNum = [0, 3, 2, 1, 7, 5, 8]; aNum.reverse(); aNum.sort();
  - function compare(v1, v2){
  -     if (v1<v2) return -1; else if (v1>v2) return 1; else return 0;
  - }
  - aNum.sort(compare);

IC_W1307.html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The Array Object - Stacking, Queueing, Sorting

```
aStrs - length: 3, content: red,green,blue.
Push 'black' and 'white' into aStrs
aStrs - length: 5, content: red,green,blue,black,white.
pop(): white
aStrs - length: 4, content: red,green,blue,black.
shift(): red
aStrs - length: 3, content: green,blue,black.
Unshift 'red' and 'white' into aStrs
aStrs - length: 5, content: white,red,green,blue,black.
aStrs.sort()
aStrs - length: 5, content: black,blue,green,red,white.
aStrs.reverse()
aStrs - length: 5, content: white,red,green,blue,black.
```

THE ARRAY OBJECT

- Manipulating methods:
  - var aNum1 = [3, 2, 1, 5, 6, 7]; var aNum2 = aNum1.slice(2); var aNum3 = aNum1.slice(1,3);
  - var aNum4 = aNum1.splice(0,2); // aNum1 is changed to be [1, 5, 6, 7]
  - var removed = aNum1.splice(1, 1, 9, 10);
- Location methods:
  - aNum4.indexOf(2), aNum4.indexOf(2, 4), aNum4.lastIndexOf(2), aNum4.lastIndexOf(2,4)

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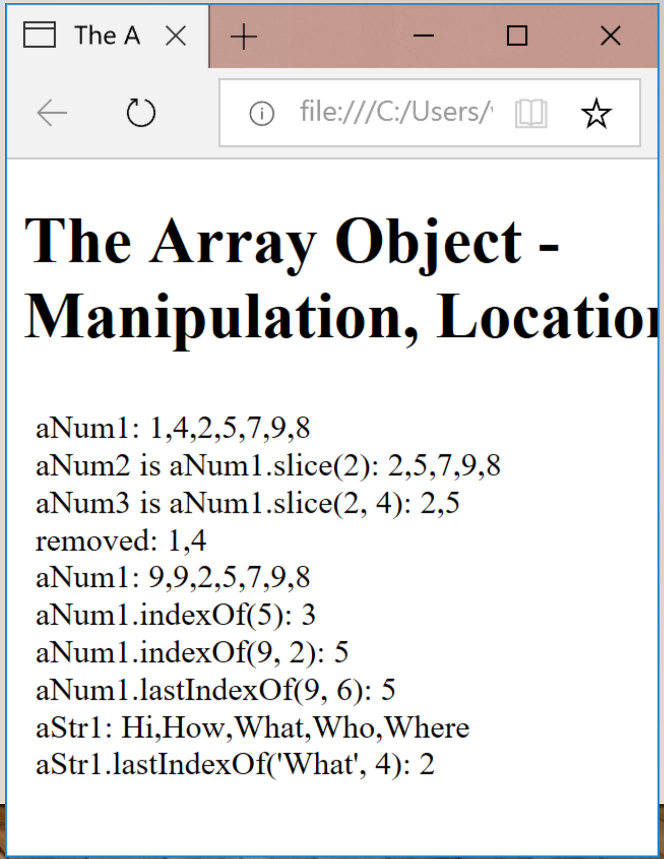


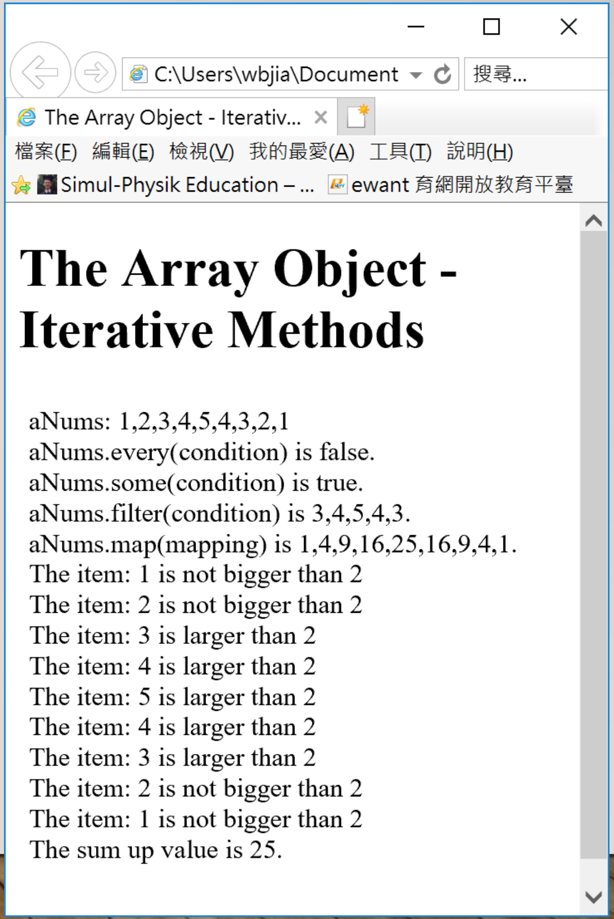
The Array Object - Manipulation, Locatio

```
aNum1: 1,4,2,5,7,9,8
aNum2 is aNum1.slice(2): 2,5,7,9,8
aNum3 is aNum1.slice(2, 4): 2,5
removed: 1,4
aNum1: 9,9,2,5,7,9,8
aNum1.indexOf(5): 3
aNum1.indexOf(9, 2): 5
aNum1.lastIndexOf(9, 6): 5
aStr1: Hi,How,What,Who,Where
aStr1.lastIndexOf('What', 4): 2
```

THE ARRAY OBJECT

- Iterative methods:
  - var aNums = [1, 2, 3, 4, 5, 4, 3, 2, 1];
  - function condition(item, index, array){ return (item > 2);}, aNums.every(condition), aNums.some(condition)
  - aNums.filter(condition)
  - function proc(item, index, array){ return item * item;}, aNums.map(proc)
- Reduction methods:
  - Function add(prev, curr, index, array){ return prev + curr; }
  - aNums.reduce(add)

IC_W1309.html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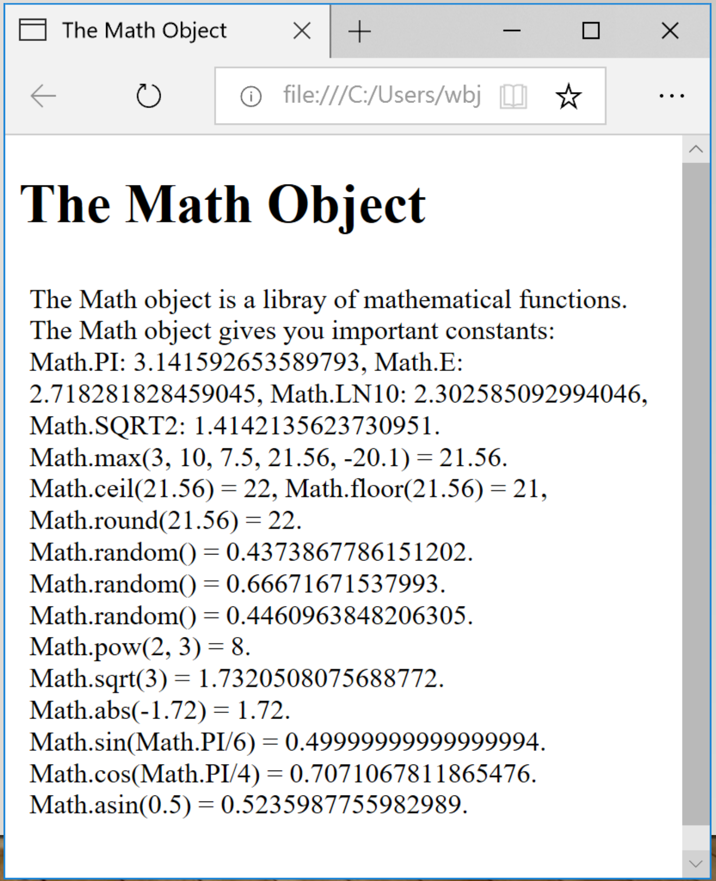
The Array Object - Iterative Methods

```
aNums: 1,2,3,4,5,4,3,2,1
aNums.every(condition) is false.
aNums.some(condition) is true.
aNums.filter(condition) is 3,4,5,4,3.
aNums.map(mapping) is 1,4,9,16,25,16,9,4,1.
The item: 1 is not bigger than 2
The item: 2 is not bigger than 2
The item: 3 is larger than 2
The item: 4 is larger than 2
The item: 5 is larger than 2
The item: 4 is larger than 2
The item: 3 is larger than 2
The item: 2 is not bigger than 2
The item: 1 is not bigger than 2
The sum up value is 25.
```

THE MATH OBJECT (LIBRARY)

- The Math object is a library consisting all needed mathematical functions.
  - Constants: Math.E, Math.LN10, Math.PI, …
  - Minimum or Maximum Methods: Math.min(), Math.max()
  - Rounding Methods: Math.ceil(), Math.floor(), Math.round()
  - Random Number Generating Method: Math.random()
  - Other Math Functions: Math.abs(), Math.exp(), Math.log()
  - Other Math Functions: Math.pow(base, power), Math.sqrt()
  - Other Math Functions: Math.acos(), Math.asin(), Math.atan()
  - Other Math Functions: Math.cos(), Math.sin(), Math.tan()

IC_W1310.html



The Math Object

```
The Math object is a libray of mathematical functions.
The Math object gives you important constants:
Math.PI: 3.141592653589793, Math.E:
2.718281828459045, Math.LN10: 2.302585092994046,
Math.SQRT2: 1.4142135623730951.
Math.max(3, 10, 7.5, 21.56, -20.1) = 21.56.
Math.ceil(21.56) = 22, Math.floor(21.56) = 21,
Math.round(21.56) = 22.
Math.random() = 0.4373867786151202.
Math.random() = 0.66671671537993.
Math.random() = 0.4460963848206305.
Math.pow(2, 3) = 8.
Math.sqrt(3) = 1.7320508075688772.
Math.abs(-1.72) = 1.72.
Math.sin(Math.PI/6) = 0.49999999999999994.
Math.cos(Math.PI/4) = 0.7071067811865476.
Math.asin(0.5) = 0.5235987755982989.
```

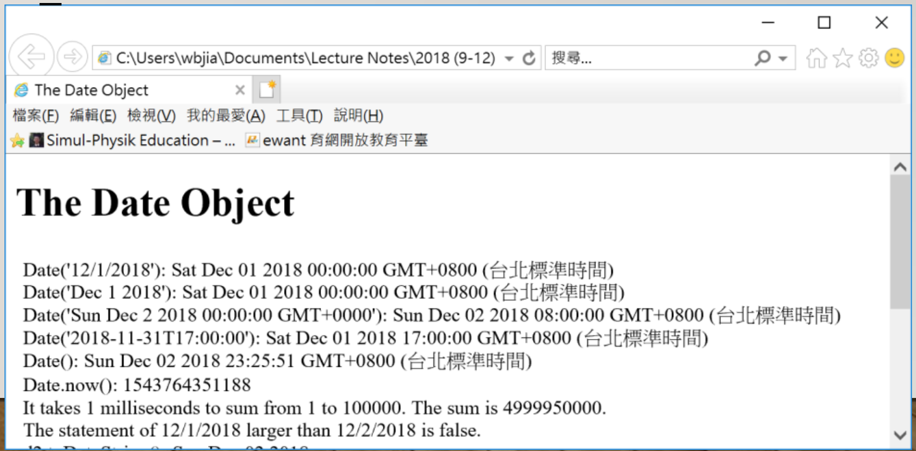
THE DATE OBJECT

- Formats:
  - 12/1/2018,   December 1, 2018,   Sat Dec 1 2018 00:00:00 GMT+0800
  - 2018-12-01T00:00:00
- It is a variable used to save the date&time information.
- Three kinds of usages:
  - var d1 = new Date();   var d1 = new Date("Dec 1, 2018");   var d1 = new Date(2018, 11, 1);
- The applications:
  - Date.now() – return the number of milliseconds since 1970/01/01 00:00:00 UTC
  - var start = Date.now();   doSomething();   var stop = Date.now();   var period = stop - start;
- The comparison:
  - var d1 = new Date(2007, 0, 1), d2 = new Date(2007, 1, 1);   alert(d1 < d2);

THE DATE OBJECT

- Output Formats:
  - toDateString(), toTimeString(), toLocaleDateString(), toLocaleTimeString()
  - toUTCString()
- Functions of the Date object:
  - getTime(), setTime(milliseconds), getFullYear(), setFullYear(year)
  - getMonth(), setMonth(month), getDate(), setDate(date), getDay()
  - getHours(), setHours(hours), getMinutes(), setMinutes(minutes)
  - getMilliseconds(), setMilliseconds(milliseconds), getTimezoneOffset()

IC_W1311.html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The Date Object

```
Date('12/1/2018'): Sat Dec 01 2018 00:00:00 GMT+0800 (台北標準時間)
Date('Dec 1 2018'): Sat Dec 01 2018 00:00:00 GMT+0800 (台北標準時間)
Date('Sun Dec 2 2018 00:00:00 GMT+0000'): Sun Dec 02 2018 08:00:00 GMT+0800 (台北標準時間)
Date('2018-11-31T17:00:00'): Sat Dec 01 2018 17:00:00 GMT+0800 (台北標準時間)
Date(): Sun Dec 02 2018 23:25:51 GMT+0800 (台北標準時間)
Date.now(): 1543764351188
It takes 1 milliseconds to sum from 1 to 100000. The sum is 4999950000.
The statement of 12/1/2018 larger than 12/2/2018 is false.
```

THE REGEXP OBJECT

- The RegExp is used to find the position of matched word in a sentence or a paragraph.
- The RegExp is declared: var var_name = /pattern/flags;
- The supporting flags:
  - g: global mode, the patterned will be applied to all of the strings instead of stopping after 1st matching
  - i: case-insensitive mode
  - m: multiline mode, continue looking for matches after the end of line
- The RegExp pattern
  - /at/gi – match all instances of 'at', ignore case-sensitive
  - /[bc]at/g – match all instances of bat or cat
  - /\[bc]at/g – match all instances of [bc]at
  - /.at/g – match all instances of three character combinations with "at"

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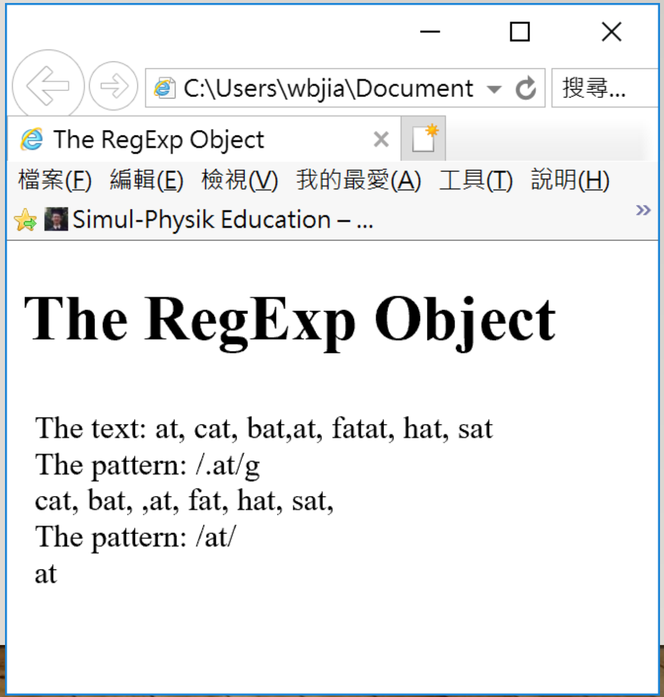
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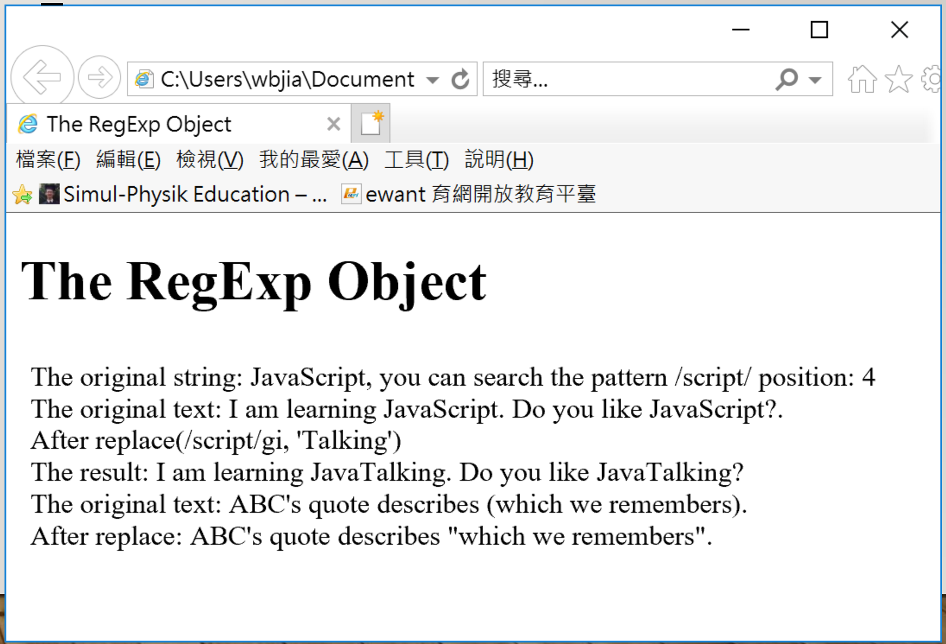
The RegExp Object

```
The text: at, cat, bat,at, fatat, hat, sat
The pattern: /.at/g
cat, bat, ,at, fat, hat, sat,
The pattern: /at/
at
```

THE REGEXP PATTERN

- The RegExp pattern
  - var pattern = /s$/; // matches any string ended with the letter "s"
  - [….]: any one character between the brackets
  - [^….]: any one character not between the brackets
  - . – any character except newline
  - \w – an ASCII character, \W – any character that is not an ASCII word character
  - \d – any ASCII digit, \D – any character other than an ASCII digit
  - \d{3} – three ASCII digital characters, \d{2,4} – two to four digital characters
  - ? – match zero or one occurrence of the previous term
  - + - match one or more occurrences
  - * - match zero or more occurrences

IC_W1313.html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The RegExp Object

```
The original string: JavaScript, you can search the pattern /script/ position: 4
The original text: I am learning JavaScript. Do you like JavaScript?.
After replace(/script/gi, 'Talking')
The result: I am learning JavaTalking. Do you like JavaTalking?
The original text: ABC's quote describes (which we remembers).
After replace: ABC's quote describes "which we remembers".
```

APPENDIX – OBJECT CONSTRUCTOR

- In C++, you write class and use new to create objects. When you create an object, you can initialize some values of the objects.
- In Javascript, the way can be followed by using function declaration with the this variable and the new operation.
- function class_name(par1, par2, …){

```
  this.var1 = par1; // initialize values of variables in the object
  this.func_name = function(pars…){……};
  ……}
```

EXERCISE

1. Give an input field to collect ten float numbers from the users. Give an option to select how many digital numbers do they wish for the output of the average and the standard deviation values. After the users confirm, show the average and the standard deviation of the ten float numbers.

2. Give a field for users to input a string. Please show the numbers of characters and numerical digits in the string.

EXERCISE

1. Use an object for an image of a ball contained in a rectangle on the html page. The object shall contain at least the position of the ball and the img object of the ball. Write a method for the object to move the ball. Give users a button to start the motion of the ball to the positive x direction in a constant speed mode. Give additional four buttons for users to change the moving direction of the ball. When the ball hit on the walls of the rectangular container, you show game over and stop the game.
2. Use a constructor function to create objects. Create two objects of balls with positions and moving methods. Let users start the balls in constant speed motion by pressing a button. Let the balls start to move in a random direction and let them bounce back when they hit against on the wall. Please exchange the two balls’ speed after they collide with each other.