한국외국어대학교
HANKUK UNIVERSITY OF FOREIGN STUDIES

Web programming

Web 프로그래밍

Lecture 09

JavaScript (JS) (Part 4)

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Today's schedule

- JS Sets
  - JS Sets Methods
  - JS Task 1

- JS Maps
  - JS Maps Methods
  - JS Task 2

- JS Errors
  - JS Errors - The Error Object

JavaScript Sets

- A JavaScript Set is a collection of unique values.
- Each value can only occur once in a Set.
- The values can be of any type, values, or objects.

How to Create a Set

You can create a JavaScript Set by:

1. Passing an array to new Set()
2. Create an empty set and use add() to add values

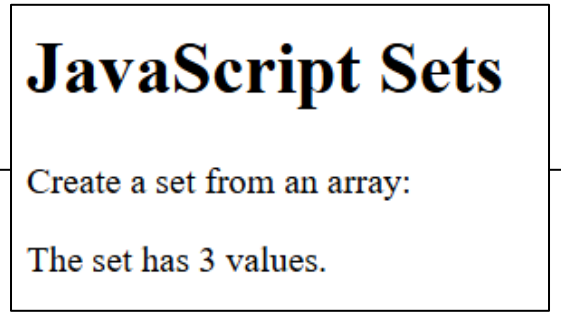
```
// Create a Set
const letters = new Set(["a","b","c"]);
```

```
// Create a Set
const letters = new Set();

// Add Values to the Set
letters.add("a");
letters.add("b");
letters.add("c");
```

JavaScript Sets

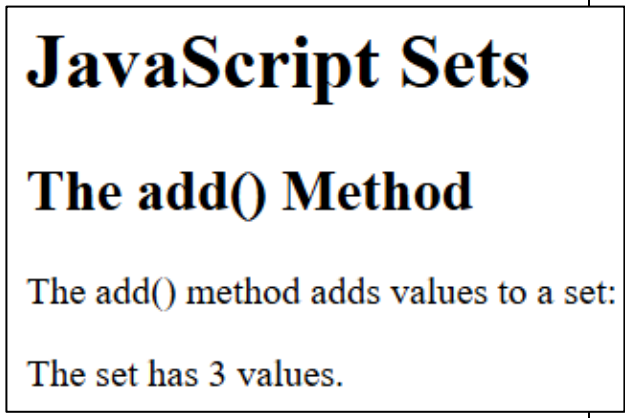
Example 1:

```
<h1>JavaScript Sets</h1>
<p>Create a set from an array:</p>
<p id="demo"></p>

<script>
// Create a Set
const letters = new Set(["a","b","c"]);

// Display set.size
document.getElementById("demo").innerHTML =
"The set has " + letters.size + " values.";
</script>
```



Example 2:

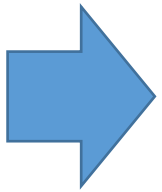
```
<h1>JavaScript Sets</h1>
<h2>The add() Method</h2>
<p>The add() method adds values to a set:</p>
<p id="demo"></p>

<script>
// Create a Set
const letters = new Set();

// Add Values to the Set
letters.add("a");
letters.add("b");
letters.add("c");

// Display the Size
document.getElementById("demo").innerHTML =
"The set has " + letters.size + " values.";
</script>
```

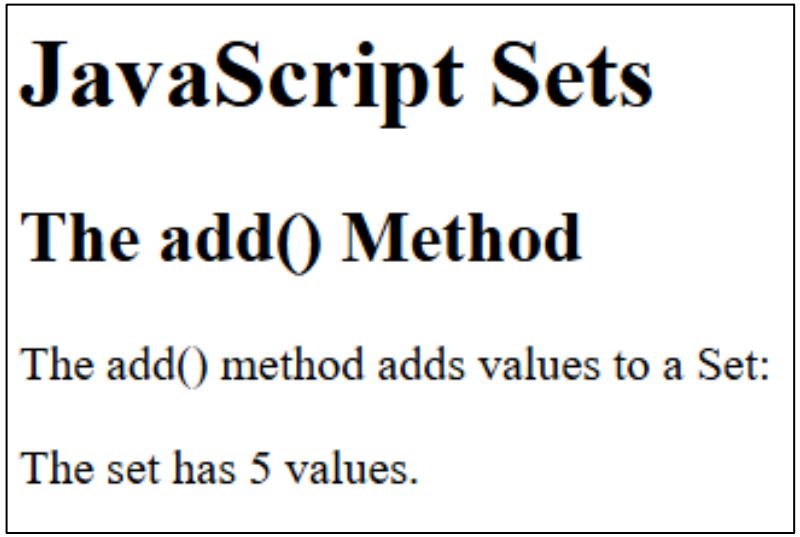


JavaScript Sets

Example 3: Add new elements

```
<h1>JavaScript Sets</h1>
<h2>The add() Method</h2>
<p>The add() method adds values to a Set:</p>
<p id="demo"></p>

<script>
// Create a new Set
const letters = new Set(["a","b","c"]);

// Add a new Element
letters.add("d");
letters.add("e");

// Display set.size
document.getElementById("demo").innerHTML =
"The set has " + letters.size + " values.";

</script>
```





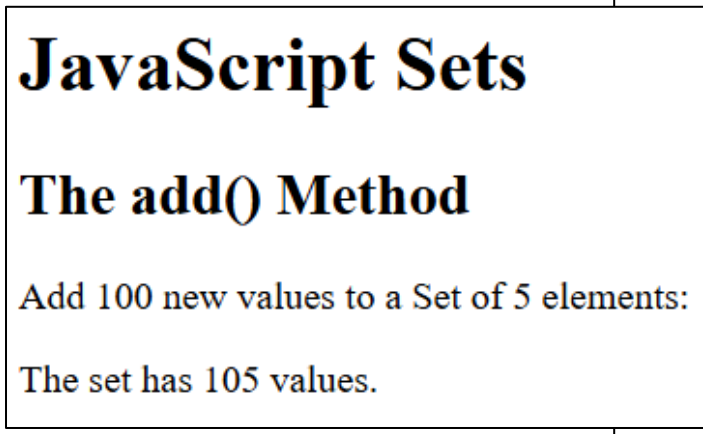
JavaScript Sets

Example 4: Add new elements using for loop

1) add x numbers (x = 100, 500, …)

```
<h1>JavaScript Sets</h1>
<h2>The add() Method</h2>
<p>Add 100 new values to a Set of 5 elements:</p>
<p id="demo"></p>
<script>
// Create a new Set
const letters = new Set(["a","b","c"]);
// Add a new Element
letters.add("d");
letters.add("e");
```

```
// Display set.size
document.getElementById("demo").innerHTML = "The set has " + letters.size + " values.";
</script>
```



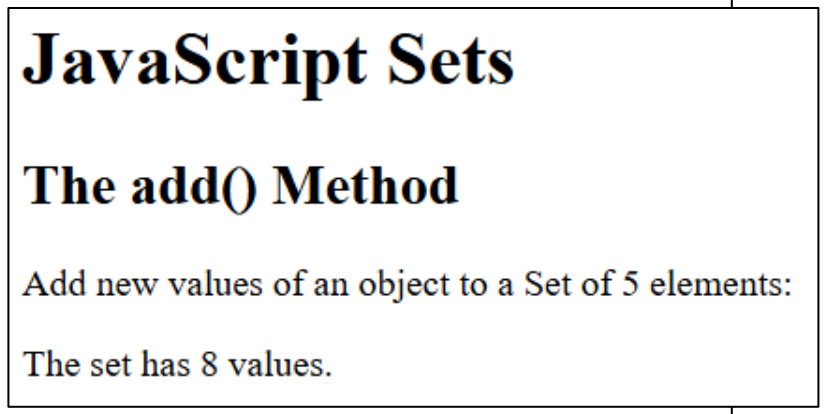
JavaScript Sets

Example 5: Add new elements from an object using for loop

2) Add elements of an Object to a Set. → `const person = {fname:"John", lname:"Doe", age:25};`

```
<h1>JavaScript Sets</h1>
<h2>The add() Method</h2>
<p>Add new values of an object to a Set of 5 elements:</p>
<p id="demo"></p>
<script>
// Create a new Set
const letters = new Set(["a","b","c"]);
// Add a new Element
letters.add("d");
letters.add("e");
// Add object to Set Elements
```

```
// Display set.size
document.getElementById("demo").innerHTML = "The set has " + letters.size + " values.";
</script>
```



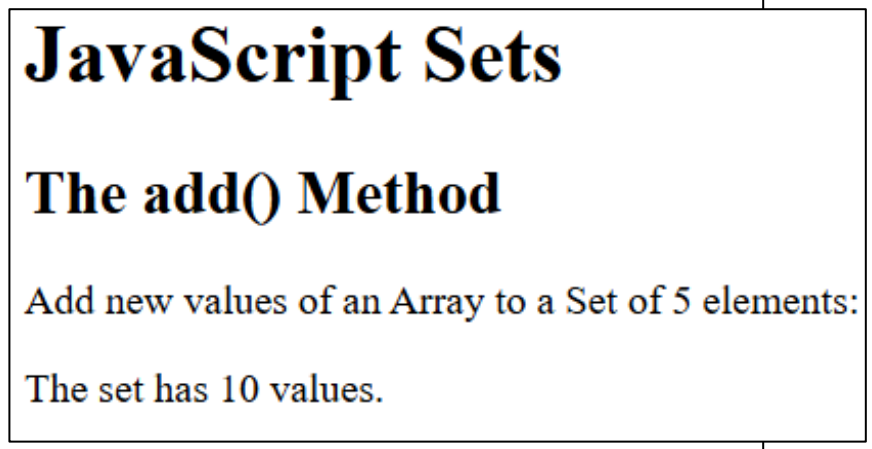
JavaScript Sets

Example 6: Add new elements from an array using for loop

3) Add elements of an Array to a Set. → `const cars = ["BMW", "Volvo", "Kia", "Toyota", "Hyundai"];`

```
<h1>JavaScript Sets</h1>
<h2>The add() Method</h2>
<p>Add new values of an Array to a Set of 5 elements:</p>
<p id="demo"></p>
<script>
// Create a new Set
const letters = new Set(["a","b","c"]);
// Add a new Element
letters.add("d");
letters.add("e");
// Add Array to Set Elements
```

```
// Display set.size
document.getElementById("demo").innerHTML = "The set has " + letters.size + " values.";
</script>
```

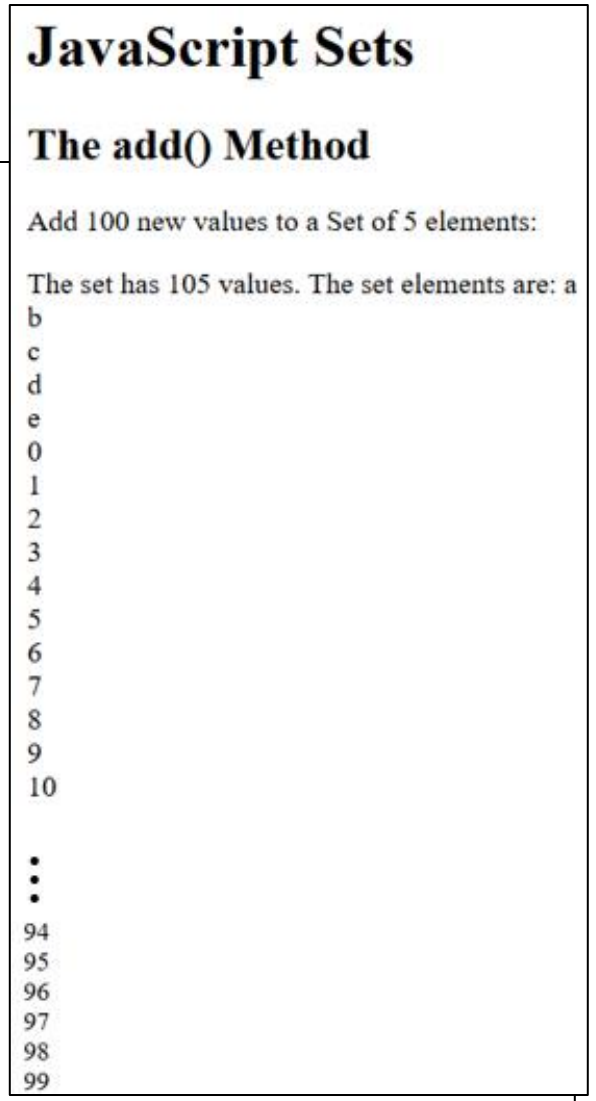


JavaScript Sets – Display the Set elements

Example 7: Display [a,b,c,d,e] and x numbers (x = 100)

```
<h1>JavaScript Sets</h1>
<h2>The add() Method</h2>
<p>Add 100 new values to a Set of 5 elements:</p>
<p id="demo"></p>
<script>
// Create a new Set
const letters = new Set(["a","b","c"]);
// Add a new Element
letters.add("d");
letters.add("e");

// Add 100 numbers to Set Elements
for (let i = 0; i< 100; i++){
letters.add(i);
}
// Display all 105 Elements
```

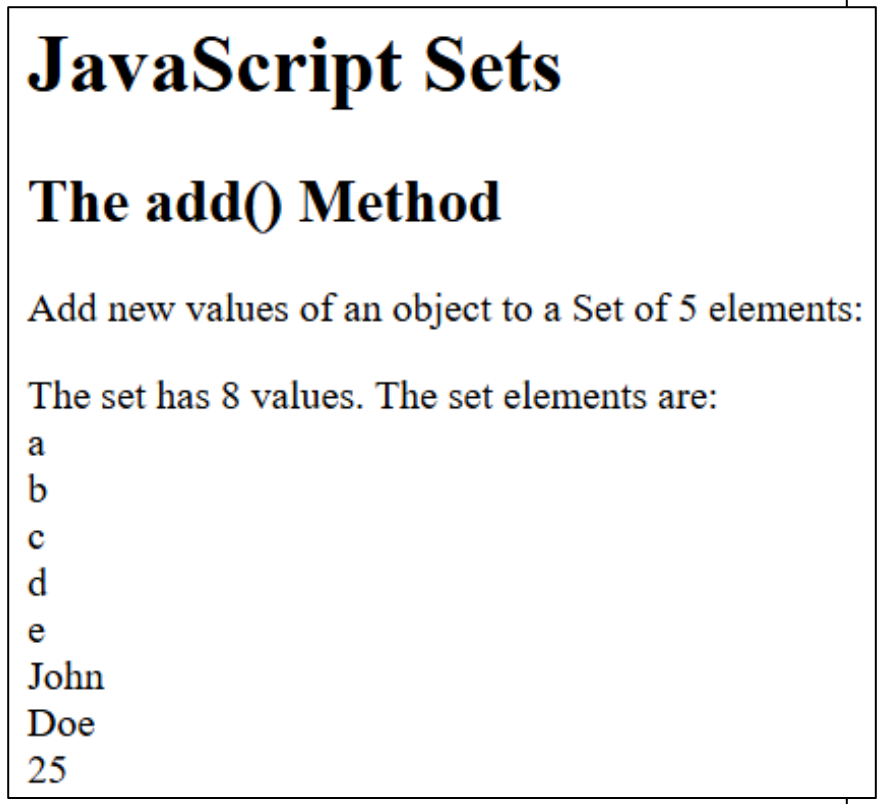
```
document.getElementById("demo").innerHTML = "The set has " + letters.size + " values.  " + "The set elements are: "
+  text;
</script>
```



JavaScript Sets – Display the Set elements

Example 8: Display [a,b,c,d,e] and 3 object elements (John, Doe, 25)

```
<h1>JavaScript Sets</h1>
<h2>The add() Method</h2>
<p>Add new values of an object to a Set of 5 elements:</p>
<p id="demo"></p>
<script>
// Create a new Set
const letters = new Set(["a","b","c"]);
// Add a new Element
letters.add("d");
letters.add("e");

const person = {fname:"John", lname:"Doe", age:25};
// Add all object's Elements
for (let x in person) {
    letters.add(person[x]);
}

// Display all the 8 Elements
[redacted]
document.getElementById("demo").innerHTML = "The set has " + letters.size + " values.  " + "The set elements are: " +
"<br>" +  text;
</script>
```

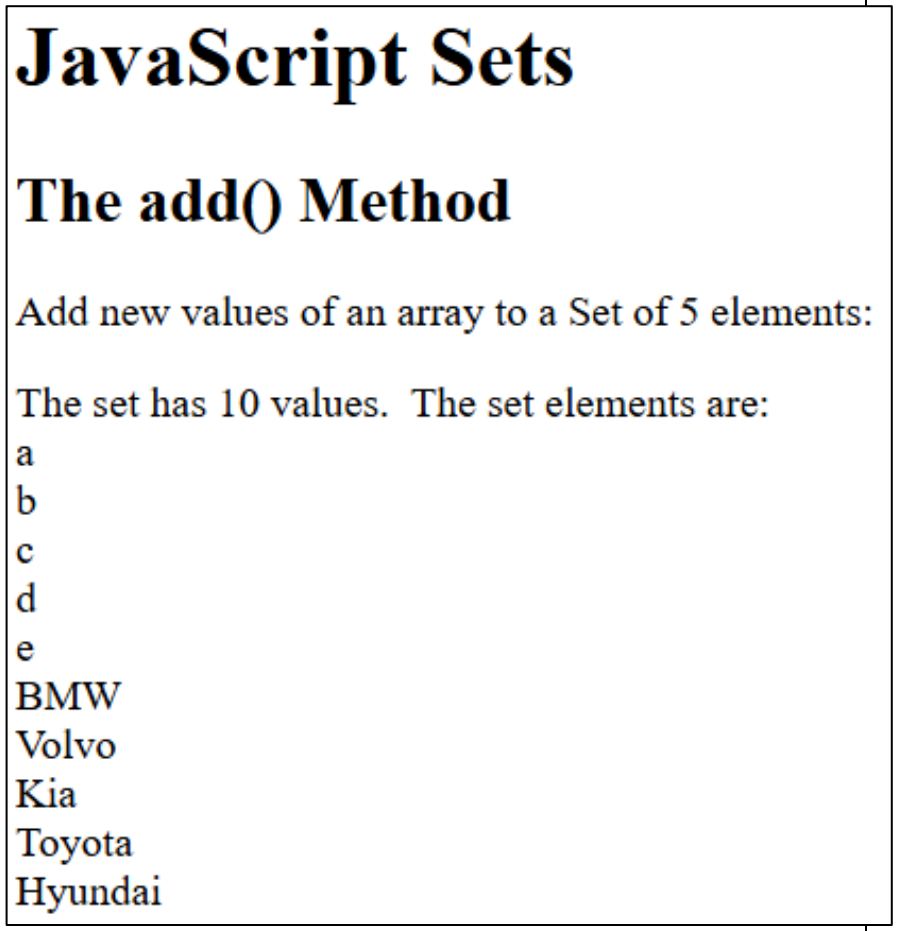


JavaScript Sets – Display the Set elements

Example 9: Display [a,b,c,d,e] and 5 array elements `["BMW", "Volvo", "Kia", "Toyota", "Hyundai"];`

```
<h1>JavaScript Sets</h1>
<h2>The add() Method</h2>
<p>Add new values of an array to a Set of 5 elements:</p>
<p id="demo"></p>
<script>
// Create a new Set
const letters = new Set(["a","b","c"]);
// Add a new Element
letters.add("d");
letters.add("e");
// Add Array to Set Elements
const cars = ["BMW", "Volvo", "Kia", "Toyota", "Hyundai"];
for (let x of cars) {
letters.add(x);
}
// Display all the 10 Elements
```

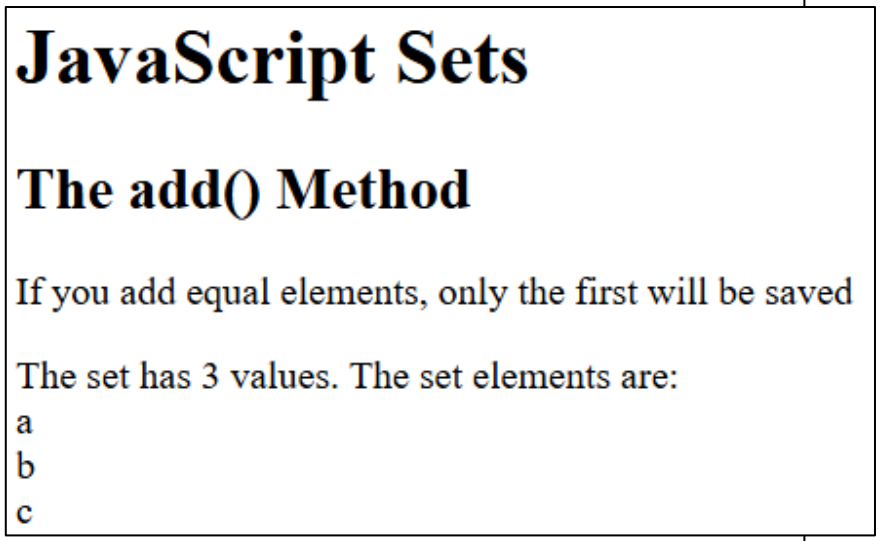
```
document.getElementById("demo").innerHTML = "The set has " + letters.size + " values.  " + "The set elements are: " +
"<br>" +  text;
</script>
```



JavaScript Sets – Adding equal elements

Example 10: If you add equal elements, only one of them will be saved

```
<h1>JavaScript Sets</h1>
<h2>The add() Method</h2>
<p id="demo"></p>
<script>
// Create a Set
const letters = new Set();
// Add Values to the Set
letters.add("a");
letters.add("b");
letters.add("b");
letters.add("c");
letters.add("c");
letters.add("c");
letters.add("c");
letters.add("c");
letters.add("c");
// Display all Elements
let text = "";
for (const x of letters) {
text += x + "<br>";
}
document.getElementById("demo").innerHTML = "The set has " + letters.size + " values. " + "The set elements are: "
+ "<br>" + text;;
</script>
```



JavaScript Sets – The values() and Keys() methods

The values() method returns an Iterator object with the values in a Set

The keys() method returns an Iterator object with the values in a Set

Note

A Set has no keys, so `keys()` returns the same as `values()`.

Change in the previous examples and check the output

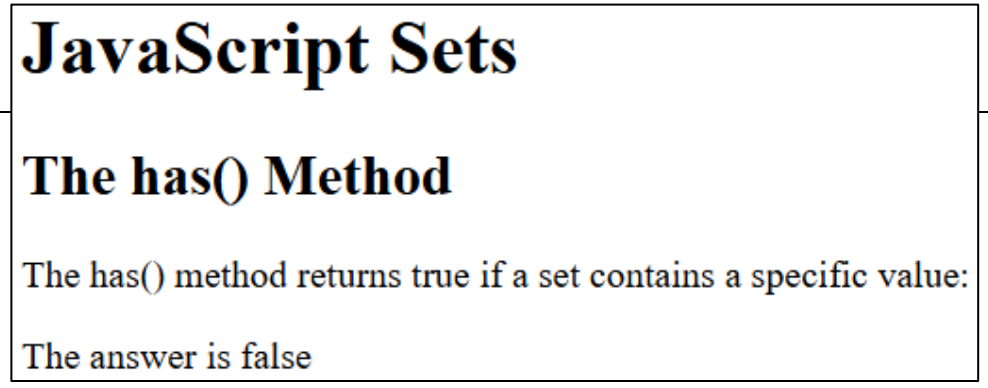
```
// List all Elements
let text = "";
for (const x of letters.values()) {
  text += x + "<br>";
}
```

```
// List all Elements
let text = "";
for (const x of letters.keys()) {
  text += x + "<br>";
}
```

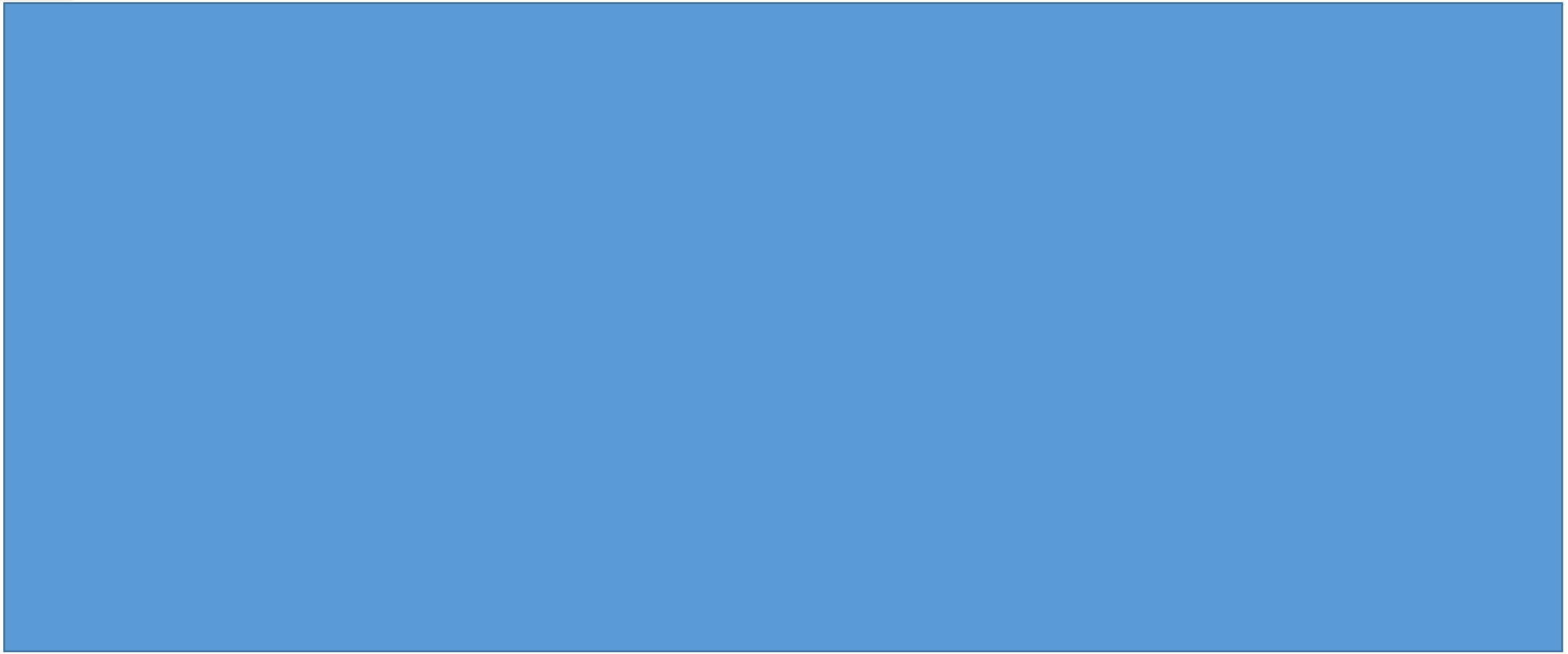
JavaScript Sets – The has() method

Example 11: The has() method returns true if a specified value exists in a set.

```
<h1>JavaScript Sets</h1>
<h2>The has() Method</h2>
<p>The has() method returns true if a set contains a specific value: </p>
<p id="demo"></p>
<script>
// Create a new Set
const letters = new Set(["BMW", "Volvo", "Kia", "Toyota", "Hyundai"]);

// Does the Set contain "Jeep"?
answer = letters.has("Jeep");
document.getElementById("demo").innerHTML = "The answer is " + answer;

</script>
```



JavaScript Sets – Task 1



JavaScript Sets – Task 1 (code)

Today's schedule

- ~~JS Sets~~
  - ~~JS Sets Methods~~
  - ~~JS Task 1~~

- JS Maps
  - JS Maps Methods
  - JS Task 2

- JS Errors
  - JS Errors - The Error Object

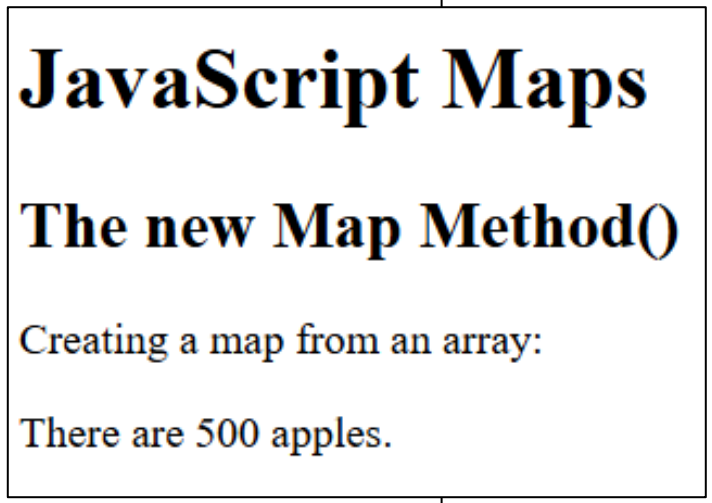
JavaScript Maps

A Map holds key-value pairs where the keys can be any datatype.

- You can create a JavaScript Map by:

  (1) Passing an Array to new Map()

```
<h1>JavaScript Maps</h1>
<h2>The new Map Method()</h2>
<p>Creating a map from an array:</p>
<p id="demo"></p>

<script>
// Create a Map
const fruits = new Map([
  ["apples", 500],
  ["bananas", 300],
  ["oranges", 200]
]);

let numb = fruits.get("apples");
document.getElementById("demo").innerHTML = "There are " + numb + " apples.";
</script>
```



I need "" !!

```
// In this example, the key should be a string
 → try call fruits.get(apples);
```

JavaScript Maps

- You can create a JavaScript Map by:
  (2) Create a Map and use Map.set()

```
<h1>JavaScript Maps</h1>
<h2>The set() Method</h2>
<p id="demo"></p>

<script>
// Create a Map
const fruits = new Map();

// Set Map Values
fruits.set("apples", 500);
fruits.set("bananas", 300);
fruits.set("oranges", 200);

let numb = fruits.get("apples");
document.getElementById("demo").innerHTML = "There are " + numb + " apples.";

</script>
```

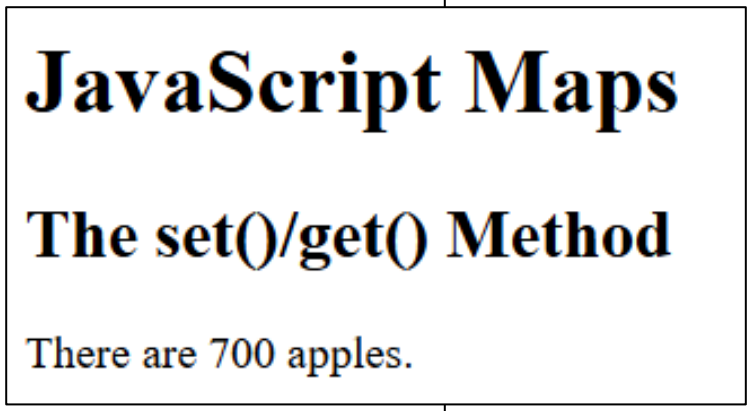

```
// In this example, the key should be a string
 → try call fruits.get(apples);
```

JavaScript Maps – set()/get() Map values

The set() method can also be used to change existing Map values

The get() method gets the value of a key in a Map

```
<h1>JavaScript Maps</h1>
<h2>The set()/get() Method</h2>
<p id="demo"></p>

<script>
// Create a Map
const fruits = new Map([
  ["apples", 500],
  ["bananas", 300],
  ["oranges", 200]
]);

fruits.set("apples", 700);// change apples value to 700
let numb = fruits.get("apples");
document.getElementById("demo").innerHTML = "There are " + numb + " apples.";
</script>
```



JavaScript Maps – Maps are objects

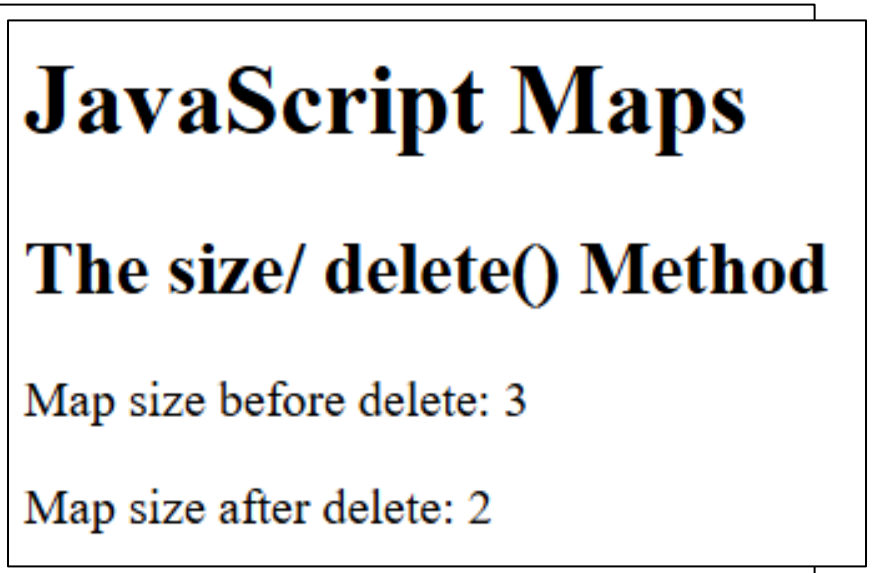
1) typeof returns object

2) instanceof Map returns true

```
<h1>JavaScript Maps</h1>
<h2>typeof Map</h2>
<p id="demo"></p>
<p id="demo1"></p>

<script>
// Create a Map
const fruits = new Map([
  ["apples", 500],
  ["bananas", 300],
  ["oranges", 200]
]);

document.getElementById("demo").innerHTML = "Maps is : " + typeof fruits;
document.getElementById("demo1").innerHTML = fruits instanceof Map;
</script>
```

JavaScript Maps – size/ delete() methods

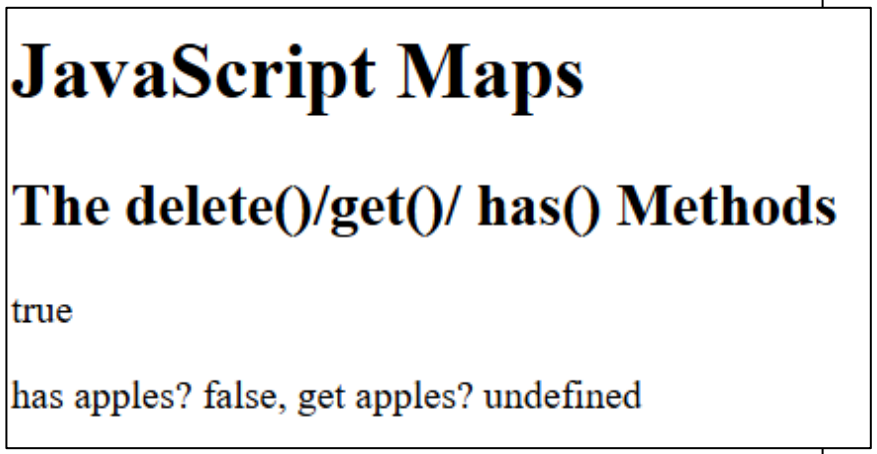
```
<h1>JavaScript Maps</h1>
<h2>The size/ delete() Method</h2>
<p id="demo1"></p>
<p id="demo2"></p>
<script>
// Create a Map
const fruits = new Map([
  ["apples", 500],
  ["bananas", 300],
  ["oranges", 200]
]);

// size of map before delete
fruits.size
document.getElementById("demo1").innerHTML =  " Map size before delete:  " + fruits.size;

// Delete an Element
fruits.delete("apples");
document.getElementById("demo2").innerHTML = " Map size after delete:  " + fruits.size;
</script>
```




```
// size() gives an error
```

JavaScript Maps – delete()/ has() / get() methods

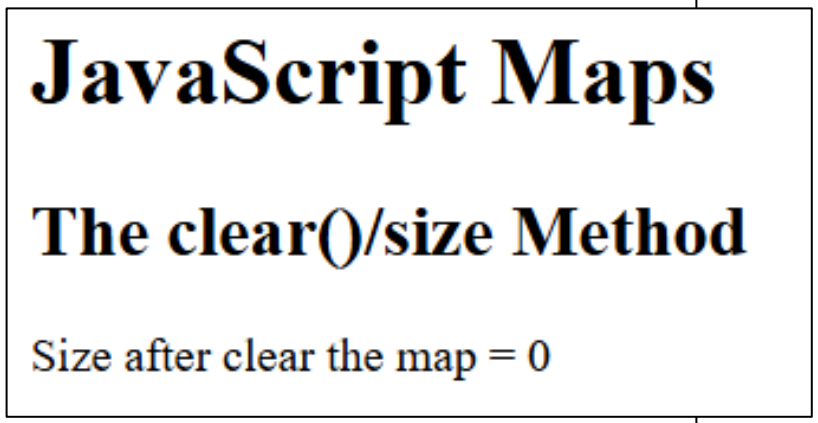
```
<h1>JavaScript Maps</h1>
<h2>The delete()/get()/ has() Methods</h2>
<p id="demo1"></p>
<p id="demo2"></p>
<script>
// Create a Map
const fruits = new Map([
  ["apples", 500],
  ["bananas", 300],
  ["oranges", 200]
]);

document.getElementById("demo1").innerHTML = fruits.has("apples");

// Delete an Element
fruits.delete("apples");

document.getElementById("demo2").innerHTML = "has apples?  " + fruits.has("apples") +
",  get apples?  "   + fruits.get("apples");
</script>
```



JavaScript Maps – clear()/size methods

The clear() method removes all the elements from a map

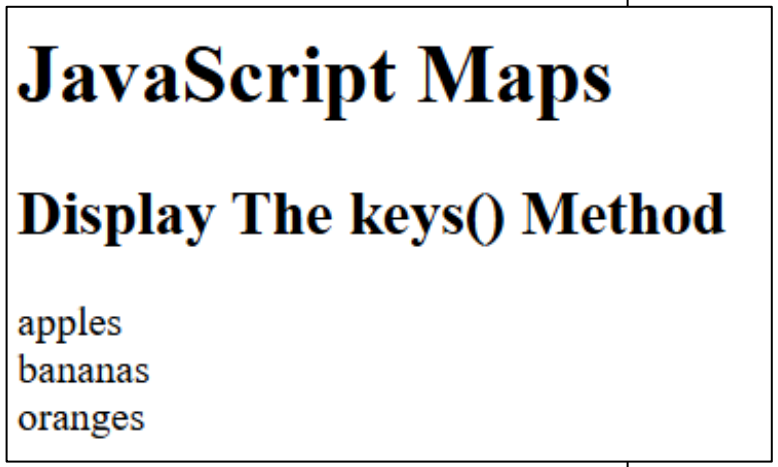
```
<h1>JavaScript Maps</h1>
<h2>The clear()/size Method</h2>
<p id="demo"></p>

<script>
// Create a Map
const fruits = new Map([
  ["apples", 500],
  ["bananas", 300],
  ["oranges", 200]
]);

// Clear the Map
fruits.clear();
document.getElementById("demo").innerHTML = " Size after clear the map = " + fruits.size;
</script>
```



JavaScript Maps – Display the keys using keys() method

The keys() method returns an iterator object with the keys in a map

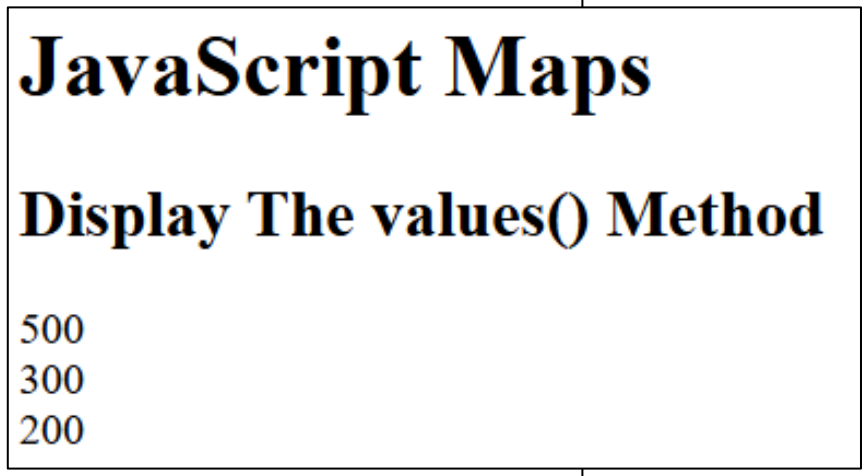
```
<h1>JavaScript Maps</h1>
<h2>Display The keys() Method</h2>
<p id="demo"></p>

<script>
// Create a Map
const fruits = new Map([
  ["apples", 500],
  ["bananas", 300],
  ["oranges", 200]
]);

let text = "";
for (const x of fruits.keys()) {
  text += x + "<br>";
}

document.getElementById("demo").innerHTML = text;
</script>
```



JavaScript Maps – Display the values using values() method

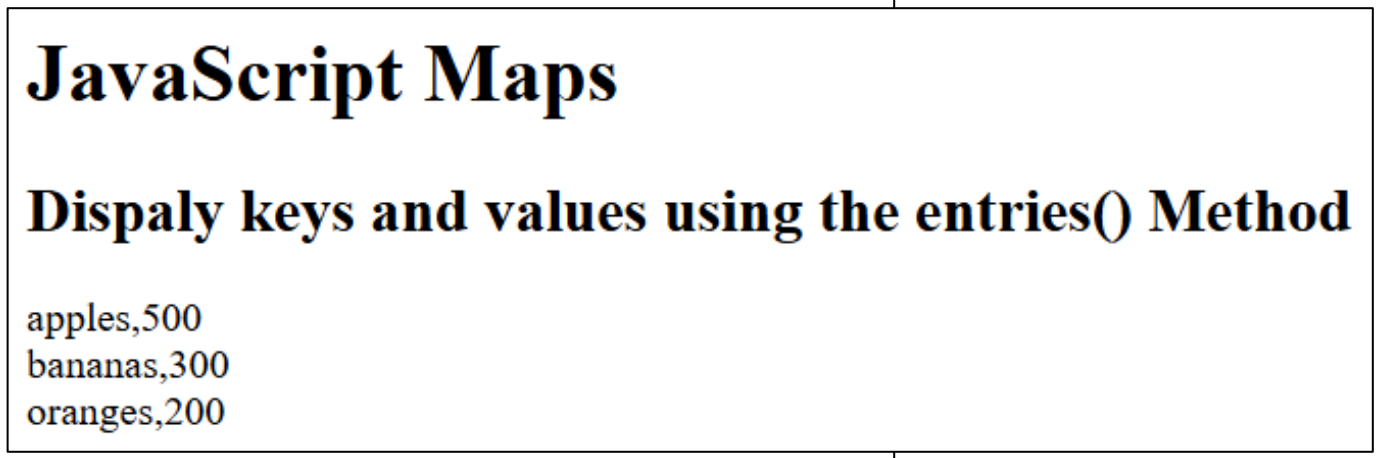
The values() method returns an iterator object with the values in a map

```
<h1>JavaScript Maps</h1>
<h2>Display The values() Method</h2>
<p id="demo"></p>

<script>
// Create a Map
const fruits = new Map([
  ["apples", 500],
  ["bananas", 300],
  ["oranges", 200]
]);

let text = "";
for (const x of fruits.values()) {
  text += x + "<br>";
}

document.getElementById("demo").innerHTML = text;
</script>
```



JavaScript Maps – Display keys/values using entries() method

```
<h1>JavaScript Maps</h1>
<h2>Display keys and values using the entries() Method</h2>
<p id="demo"></p>

<script>
// Create a Map
const fruits = new Map([
  ["apples", 500],
  ["bananas", 300],
  ["oranges", 200]
]);

let text = "";
for (const x of fruits.entries()) {
  text += x + "<br>";
}

document.getElementById("demo").innerHTML = text;
</script>
```



JavaScript Maps – Display keys/values using forEach() method

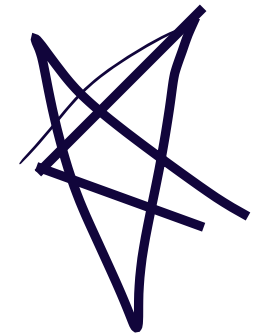
The forEach() method invokes a callback for each key/value pair in a map

```
<h1>JavaScript Maps</h1>
<h2>The forEach() Method</h2>
<p id="demo"></p>

<script>
// Create a Map
const fruits = new Map([
  ["apples", 500],
  ["bananas", 300],
  ["oranges", 3200]
]);

let text = "";
fruits.forEach (function(value, key) {
  text += key + ' = ' + value + "<br>"
})

document.getElementById("demo").innerHTML = text;
</script>
```

JavaScript Maps

The forEach() Method

apples = 500
bananas = 300
oranges = 3200



You can get key or value separately.

Try to replace the locations of key and value

```
fruits.forEach (function(key, value) {
  text += key + ' = ' + value + "<br>"
})
```

Is it the same output?

JavaScript Maps – Display total sum using values() method

```
<h1>JavaScript Maps</h1>
<h2>The values() Method</h2>
<p id="demo"></p>

<script>
// Create a Map
const fruits = new Map([
  ["apples", 500],
  ["bananas", 300],
  ["oranges", 200]
]);

let total = 0;
for (const x of fruits.values()) {
  total += x;
}
document.getElementById("demo").innerHTML = "Total sum of
values = " + total;

</script>
```

JavaScript Maps

The values() Method

Total sum of values = 1000

Try the below cases

```
let total = "    " ;
total += x;
```

```
let total =  0 ;
total += x + "<br>" ;
```

```
// Create a Map
const fruits = new Map([
  ["apples", 500],
  ["bananas", 300],
  ["oranges", 200],
  ["oranges", 100],
  ["oranges", 400],
  ["oranges", 200]
]);
```

Total = 1000 or 1700? Why?

JavaScript Maps – Task 2

JavaScript Maps – Task 2 (code)

Today's schedule

- ~~JS Sets~~
  - ~~JS Sets Methods~~
  - ~~JS Task 1~~

- ~~JS Maps~~
  - ~~JS Maps Methods~~
  - ~~JS Task 2~~

- JS Errors
  - JS Errors - The Error Object

JavaScript Errors

Errors Will Happen!

- When executing JavaScript code, different errors can occur.
- Errors can be coding errors made by the programmer (typos or wrong rules)
- Errors due to wrong input
- Errors due to other unexpected things

Statement to handle errors: Throw, and Try...Catch...Finally

- The try statement defines a code block to run (to try).
- The catch statement defines a code block to handle any error.
- The finally statement defines a code block to run regardless of the result.
- The throw statement defines a custom error.

JavaScript Errors - try and catch

The try statement defines a block of code to be tested for errors while it is being executed.

The catch statement defines a block of code to be executed if an error occurs in the try block.

```
try {
  Block of code to try
}
catch(err) {
  Block of code to handle errors
}
```

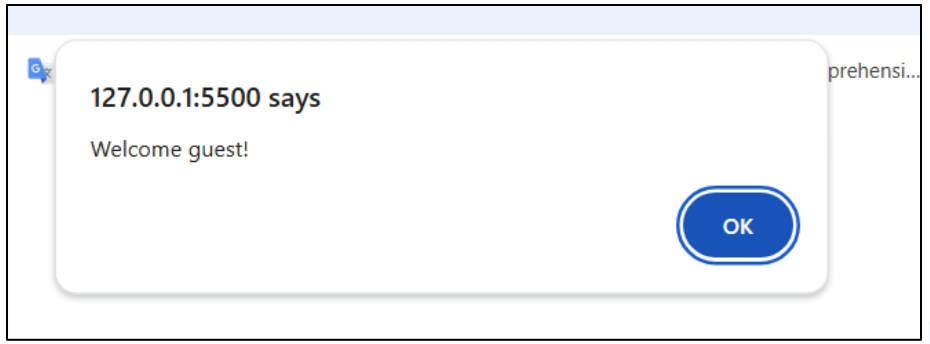
Example 1: When typo (adlert instead of alert)

```
<h2>JavaScript Error Handling</h2>
<p>How to use <b>try-catch</b> to display an error.</p>
<p id="demo"></p>

<script>
try {
  adlert("Welcome guest!"); // typo error (adlert)
}
catch(err) {
  document.getElementById("demo").innerHTML = err.message;
}
</script>
```

JavaScript Error Handling

How to use **try-catch** to display an error.

adlert is not defined



If no error, alert works

JavaScript Errors – try/catch and throw

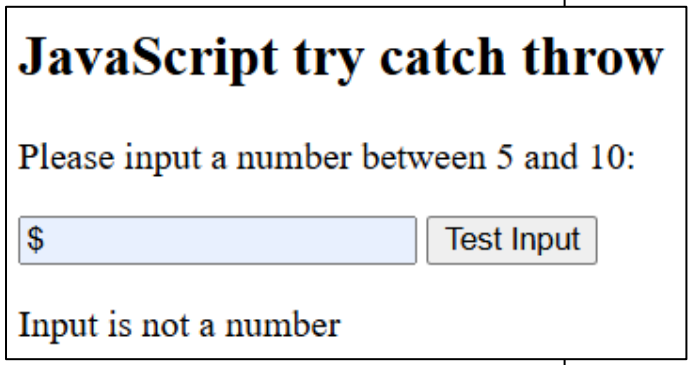
- When an error occurs, JavaScript will normally stop and generate an error message (e.g., adlert is not defined).
- However, the throw statement allows you to create a custom error.
- If you use throw together with try and catch, you can control program flow and generate custom error messages.
- Technically you can throw an exception (throw an error).
- The exception can be a JavaScript String, a Number, or an Object.

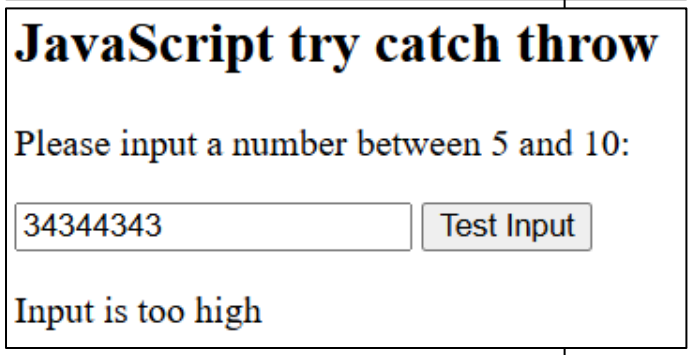
```
throw "Too big";    // throw a text
throw 500;          // throw a number
```

JavaScript Errors – try/catch and throw

User should input a number between 5 and 10, otherwise show the error messages

```
<h2>JavaScript try catch</h2>
<p>Please input a number between 5 and 10:</p>
<input id="demo" type="text">
<button type="button" onclick="myFunction()" >Test Input</button>
<p id="p1"></p>
<script>
function myFunction() {
  const message = document.getElementById("p1");
  message.innerHTML = ""; // At beginning it is empty message
  let x = document.getElementById("demo").value; // Take input from a user
  try {
    if(x.trim() == "")  throw "empty";
    if(isNaN(x)) throw "not a number";
    x = Number(x);
    if(x < 5)  throw "too low";
    if(x > 10)   throw "too high";
  }
  catch(err) {
    message.innerHTML = "Input is " + err; // At the end it is error message
  }
}
</script>
```





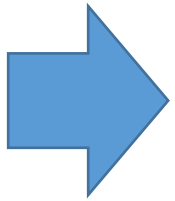
JavaScript Errors – try/catch and finally

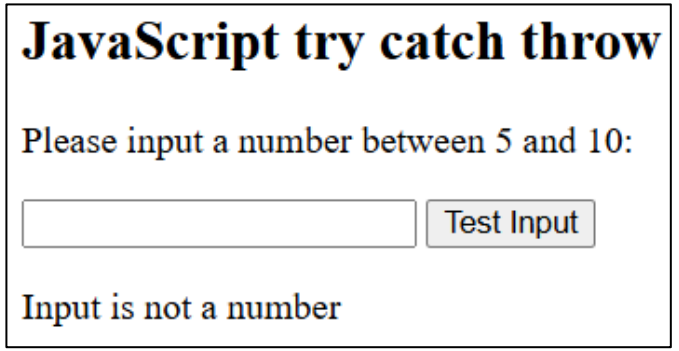
The finally statement lets you execute code, after try and catch, regardless of the result

Syntax

```
try {
  Block of code to try
}
catch(err) {
  Block of code to handle errors
}
finally {
  Block of code to be executed regardless of the try / catch result
}
```

```
catch(err) {
  message.innerHTML = "Input is " + err;
}

finally {
  document.getElementById("demo").value = "";
}
```





JavaScript Errors – The Error Object

- JavaScript has a built in error object that provides error information when an error occurs.

Four different errors can be returned by the error object

Error Name	Description
RangeError	A number "out of range" has occurred
ReferenceError	An illegal reference has occurred
SyntaxError	A syntax error has occurred
TypeError	A type error has occurred

JavaScript Errors – (1) Range Error

A RangeError is thrown if you use a number that is outside the range of legal values.

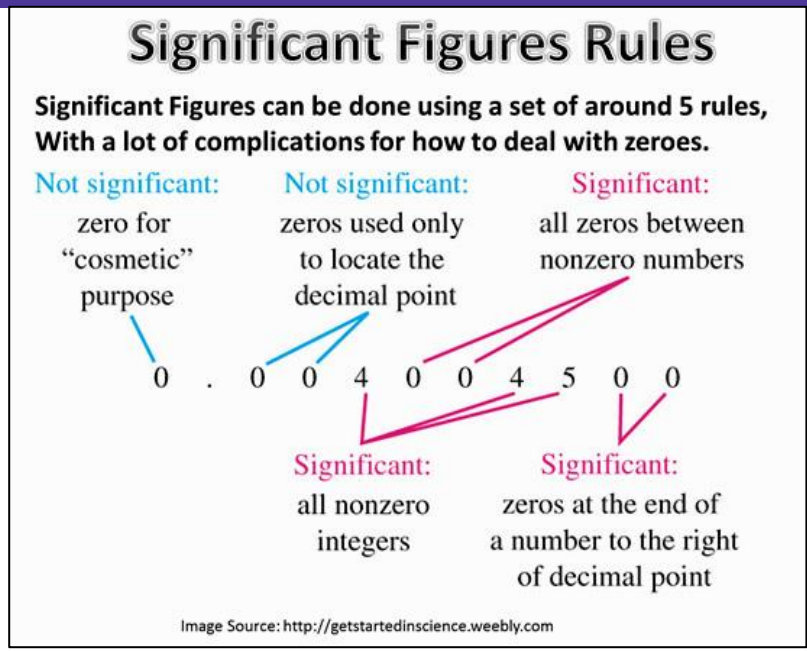
```
<h1>JavaScript Errors</h1>
<h2>The RangeError</h2>
<p>You cannot set the number of significant digits too high:</p>
<p id="demo">

<script>
let num = 5;
try {
  let x = num.toPrecision(500); // 500 is to high
  document.getElementById("demo").innerHTML = x;
}
catch(err) {
  document.getElementById("demo").innerHTML = "Error messgage
=  " + err.name;
}
</script>
```

JavaScript Errors

The RangeError

You cannot set the number of significant digits too high:

Error messgage = RangeError



Number	Number of Significant digits/figures
50000	One
0.008	One
89	Two
340	Two
6700	Two
0.012	Two
1002	Four
4.9210	Five

JavaScript Errors – (2) Reference Error

A ReferenceError is thrown if you use (reference) a variable that has not been declared

```
<h1>JavaScript Errors</h1>
<h2>The ReferenceError</h2>
<p>You cannot use the value of a non-existing variable:</p>
<p id="demo"></p>

<script>
let x = 5;
try {
  x = y + 1; // y has not been declared!
}
catch(err) {
  document.getElementById("demo").innerHTML = "Error messgage =  " + err.name;
}
</script>
```

How to fix this error?

JavaScript Errors – (3) Syntax Error

A SyntaxError is thrown if you try to evaluate code with a syntax error.

```
<h1>JavaScript Errors</h1>
<h2>The SyntaxError</h2>
<p>You cannot evaluate code that contains a syntax error: </p>
<p id="demo"></p>

<script>
try {
  eval("alert('Hello)"); // Missing ' will produce an error

}
catch(err) {
  document.getElementById("demo").innerHTML = "Error messgage =  " + err.name;
}
</script>
```

JavaScript Errors – (4) Type Error

A TypeError is thrown if an operand or argument is incompatible with the type expected by an operator or function.

```
<h1>JavaScript Errors</h1>
<h2>The TypeError</h2>
<p> You cannot convert a number to upper case </p>
<p id="demo"></p>

<script>
let num = 1;
try {
  num.toUpperCase(); //toUpperCase function is expected to convert a string not number

}
catch(err) {
  document.getElementById("demo").innerHTML = "Error messgage =  " + err.name;
}
</script>
```

How to fix this error?

Today's schedule

- ~~JS Sets~~
  - ~~JS Sets Methods~~
  - ~~JS Task 1~~

- ~~JS Maps~~
  - ~~JS Maps Methods~~
  - ~~JS Task 2~~

- ~~JS Errors~~
  - ~~JS Errors – The Error Object~~

Thank You !!

Any Questions!