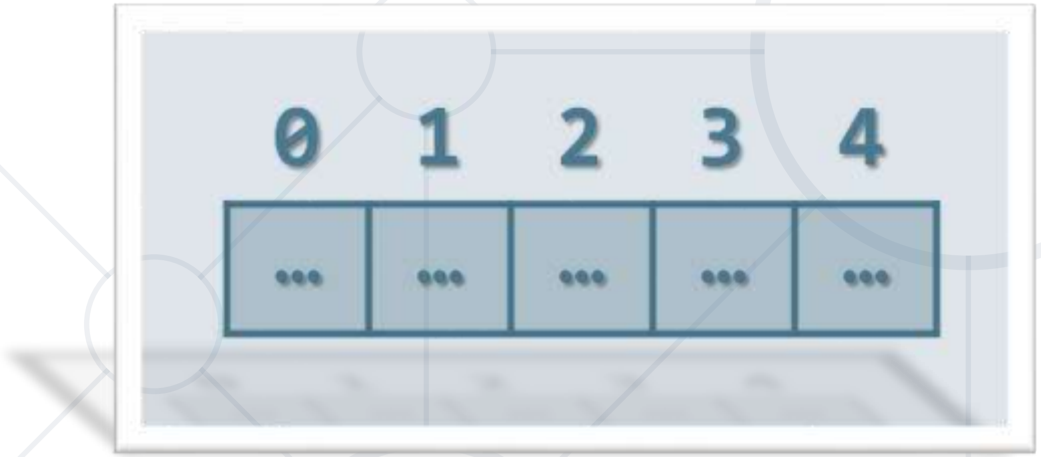
Arrays and Matrices

Arrays, Array Operations, Matrices, Multi-Dimensional Arrays



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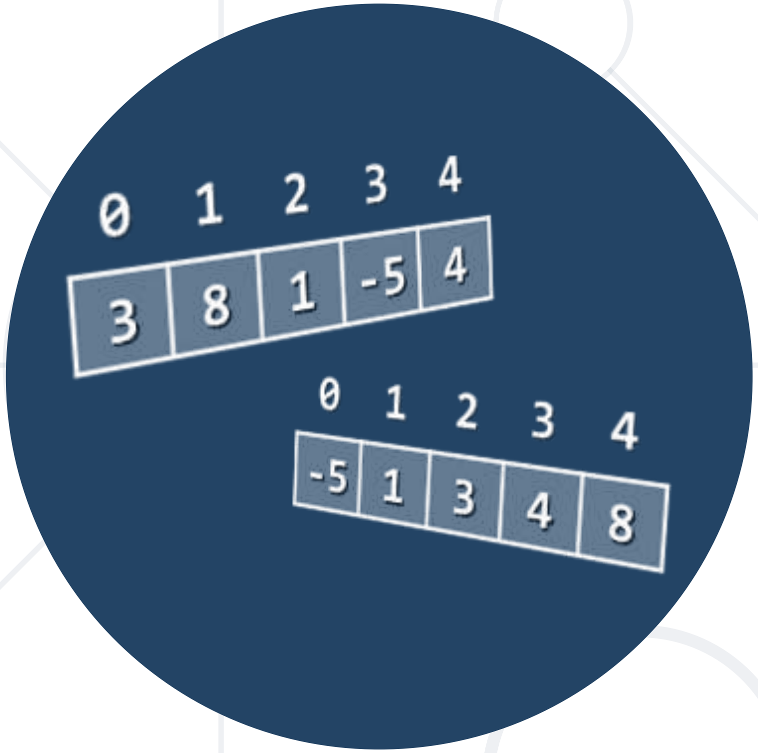
#JS-CORE

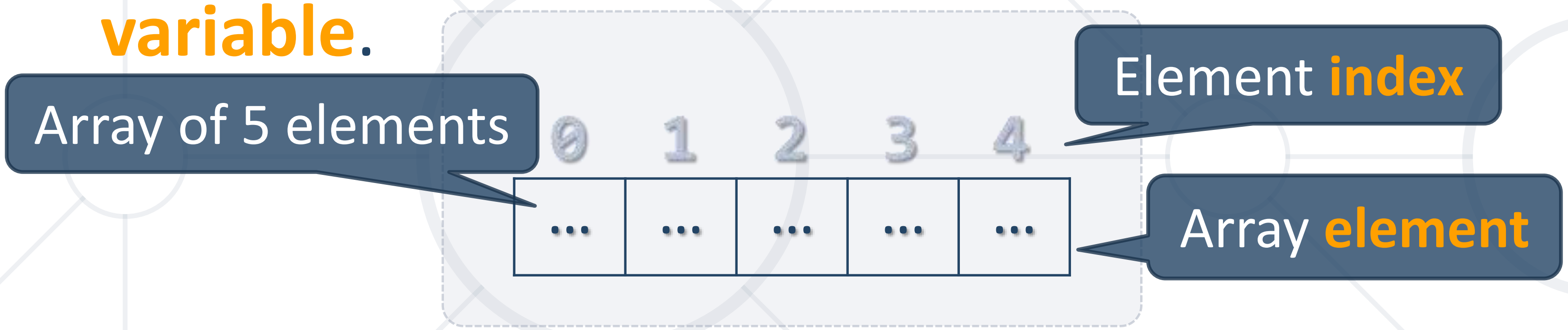


Arrays in JS

Working with Arrays of Elements

What is an Array?

- JS arrays are used to store **multiple values** in a **single variable**.



- Elements are **numbered** from **0** to **length-1**.
- Creating an array using **an array literal**.

The better way.

```
let numbers = [10, 20, 30, 40, 50];
```

- Creating an array using the keyword **new**.

May create some unexpected results.

```
let numbers = new Array(10, 20, 30, 40, 50);
```

Arrays of Different Types

```
// Array holding numbers
let numbers = [10, 20, 30, 40, 50];
```

```
// Array holding strings
let weekDays = ['Monday', 'Tuesday', 'Wednesday',
  'Thursday', 'Friday', 'Saturday', 'Sunday'];
```

```
// Array holding mixed data
var mixedArr =
  [20, new Date(), 'hello', {x:5, y:8}];
```

Accessing Elements

- Array elements are accessed using their **index number**.

```
let cars = ['BMW', 'Audi', 'Opel'];
let firstCar = cars[0];    // BMW
let lastCar = cars[arr.length - 1];  // Opel
```

- Accessing indexes that do not exist in the array returns **undefined**.

```
console.log(cars[3]);   // undefined
console.log(cars[-1]);  // undefined
```

Problem: Sum First Last

- You are given an array of string elements.
  - Multiplicate each element with the length of the array and print each index with its value.

```
function sumFirstLast(numArr) {
        let listInput = JSON.parse(document.getElementById("arr").value);
            let divResult = document.getElementById('result');
            function calculate(list) {
                for (let i = 0; i < list.length; i++) {
                    let p = document.createElement('p');
                     p.textContent = `${i} -> ${list[i]*list.length}`
                    divResult.appendChild(p) }
            }
            calculate(listInput);
}
```

Check your solution here: https://judge.softuni.bg/Contests/Practice/Index/1464#0

Changing elements

- Elements can be modified.

```
let fruits = ['Apple', 'Kiwi'];
fruits[0] = 'Peach';
console.log(fruits); // ['Peach', 'Kiwi']
```

- JS arrays are **resizable**.

```
fruits.push('Banana');
fruits[fruits.length] = 'Mango';
// both examples add a new element to the array
```

- Note that adding elements with **high indexes** can create **undefined "holes"** in an array!

Problem: Even Position Element

- You are given an array of numbers.
  - Find the elements at even position and print them.

```
function solve(numArr) {
  let listInput = JSON.parse(document.getElementById("arr").value);
  let result = [];
  function calculate(numArr) {
    numArr.forEach((element, index) => {
      if (index % 2 === 0) {
        result.push(element);
      }
    });
  }
  calculate(listInput);
  document.getElementById("result").innerHTML = result.join(' x ');
}
```

Check your solution here: https://judge.softuni.bg/Contests/Practice/Index/1464#1

Properties and Methods

- The **length property** returns the **number of elements**.

```
let fruits = ['Mango', ‘Kiwi', 'Orange'];
console.log(fruits.length); // returns 3
```

- The **sort()** method sorts the item of an array. By default, it sorts the values as **strings** in **alphabetical** and **ascending** order.

```
console.log(fruits.sort());
// ['Kiwi', 'Mango', 'Orange']
```

- However, if numbers are sorted as strings, **"25"** is **bigger than "100"**, because **"2"** is bigger than **"1"**.

Sorting an array of numbers

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```
let nums = [20, 40, 10, 30, 100, 5];
console.log(nums.join(' ')); // 20 40 10 30 100 5
```

```
nums.sort(); // Works incorrectly on arrays of numbers
console.log(nums.join('|')); // 10 100 20 30 40 5
```

- Sorting numbers in **ascending order**

```
nums.sort((a, b) => a - b); // Compare elements as numbers
console.log(nums.join(' ')); // 5 10 20 30 40 100
```

- Sorting numbers **in descending order**

```
nums.sort((a, b) => b - a); // Compare elements as numbers
console.log(nums.join(' ')); // 100 40 30 20 10 5
```

Add / Remove Elements at Both Ends

```
let nums = [10, 20, 30];
console.log(nums.join('|')); // 10|20|30
```

```
nums.push(40);
console.log(nums.join('|')); // 10|20|30|40
```

```
let tail = nums.pop();       // tail = 40
console.log(nums.join('|')); // 10|20|30
```

```
nums.unshift(0);
console.log(nums.join('|')); // 0|10|20|30
```

```
let head = nums.shift();     // head = 0
console.log(nums.join('|')); // 10|20|30
```

Problem: Replace and Reverse

- You are given **an array of strings**.
- Make the **first letter** of each element **upper** and **reverse** the array.

```
function solve(numArr) {
  let listInput = JSON.parse(document.getElementById("arr").value);
  function calculate(numArr) {
    numArr.forEach((element, index) => {
      numArr[index] = element.split('').reverse().join('');
    });
    numArr.forEach((element, index) => {
      numArr[index] = element.charAt(0).toUpperCase().concat(element.slice(1));
    });
    return numArr.join(' ');
  }
  let result = calculate(listInput);
  document.getElementById("result").innerHTML = result;
}
```

Check your solution here: https://judge.softuni.bg/Contests/Practice/Index/1464#2

Slicing Arrays

```
let nums = ['one', 'two', 'three', 'four'];
console.log(nums.join('|')); // one|two|three|four
```

```
let firstNums = nums.slice(0, 2); // start, end+1
console.log(firstNums.join('|')); // one|two
```

```
let lastNums = nums.slice(2, 4); // start, end+1
console.log(lastNums.join('|')); // three|four
```

```
let midNums = nums.slice(1, 3); // start, end+1
console.log(midNums.join('|')); // two|three
```

Splice: Cut and Insert Array Elements

```
let nums = [5, 10, 15, 20, 25, 30];
console.log(nums.join('|')); // 5|10|15|20|25|30
```

```
let mid = nums.splice(2, 3); // start, delete-count
console.log(mid.join('|')); // 15|20|25
console.log(nums.join('|')); // 5|10|30
```

```
nums = [5, 10, 15, 20, 25, 30];
nums.splice(3, 2, "twenty", "twenty-five");
console.log(nums.join('|'));
// 5|10|15|twenty|twenty-five|30
```

Looping through an array

```
let nums = [5, 10, 15, 20, 25, 30];
```

- **for** … **of** works like **foreach**

```
for (let num of nums)
  console.log(num);
```

- **for** … **in** goes through array indices

```
for (let i in nums)
  console.log(i + " " + nums[i]);
```

- Traditional **for**-loop

```
for (let i = 0; i < nums.length; i++)
  console.log(nums[i]);
```

Problem: Find Element

- You are given a string and **an array of strings**.
  - Search if the string is **present** in **each element** of the array.

```
function solve() {
  let number = parseInt(document.getElementById("num").value);
  let listInput = JSON.parse(document.getElementById("arr").value);
  let answer = [];
  function calc(searched, input) {
    for (let element of input) {
      let result = element.includes(searched);
      let index = element.indexOf(searched);
      answer.push(result + ' -> ' + index);
    }
    return answer;
  }
  let result = calc(number, listInput);
  document.getElementById("result").innerHTML = result;
}
```

Check your solution here: https://judge.softuni.bg/Contests/Practice/Index/1464#3

More Array Methods

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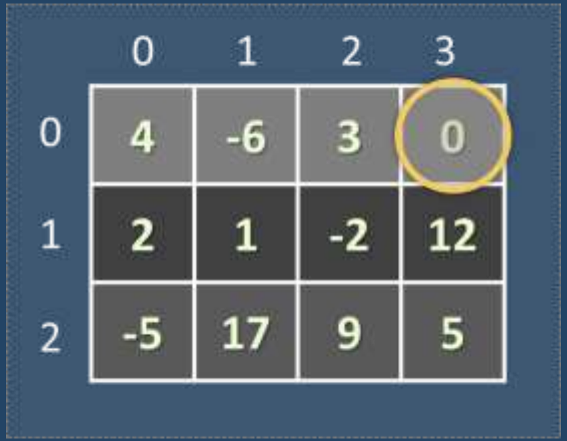
- **includes()** – check if an array contains a specific element
- **indexOf()** - returns the position of an element in an array
- **isArray()** – checks if an object is an array
- **reverse()** – reverses the order of elements in an array
- **toString()** – converts an array to string
- **reduce()** – reduces the values of an array (from left to right)
- Note that you **CANNOT reduce** an **empty array**!

Problem: Multiple Sort

- You are given **an array of strings**. Sort the elements by **ascending** order and then **alphabetically**.

```
function solve() {
  let listInput = JSON.parse(document.getElementById("arr").value);
  let sortAscending = [];
  let sortAlphabetically = [];
  function calc(input) {
    let resultContainer = document.getElementById("result");
    let div1 = document.createElement('div');
    let div2 = document.createElement('div');
    sortAscending = input.sort((a, b) => a - b);
    div1.textContent = sortAscending.join(', ')
    resultContainer.appendChild(div1);
    sortAlphabetically = input.sort((a, b) => a.localeCompare(b));
    div2.textContent = sortAscending.join(', ')
    resultContainer.appendChild(div2);
  }
  calc(listInput);
}
```

Check your solution here: https://judge.softuni.bg/Contests/Practice/Index/1464#4



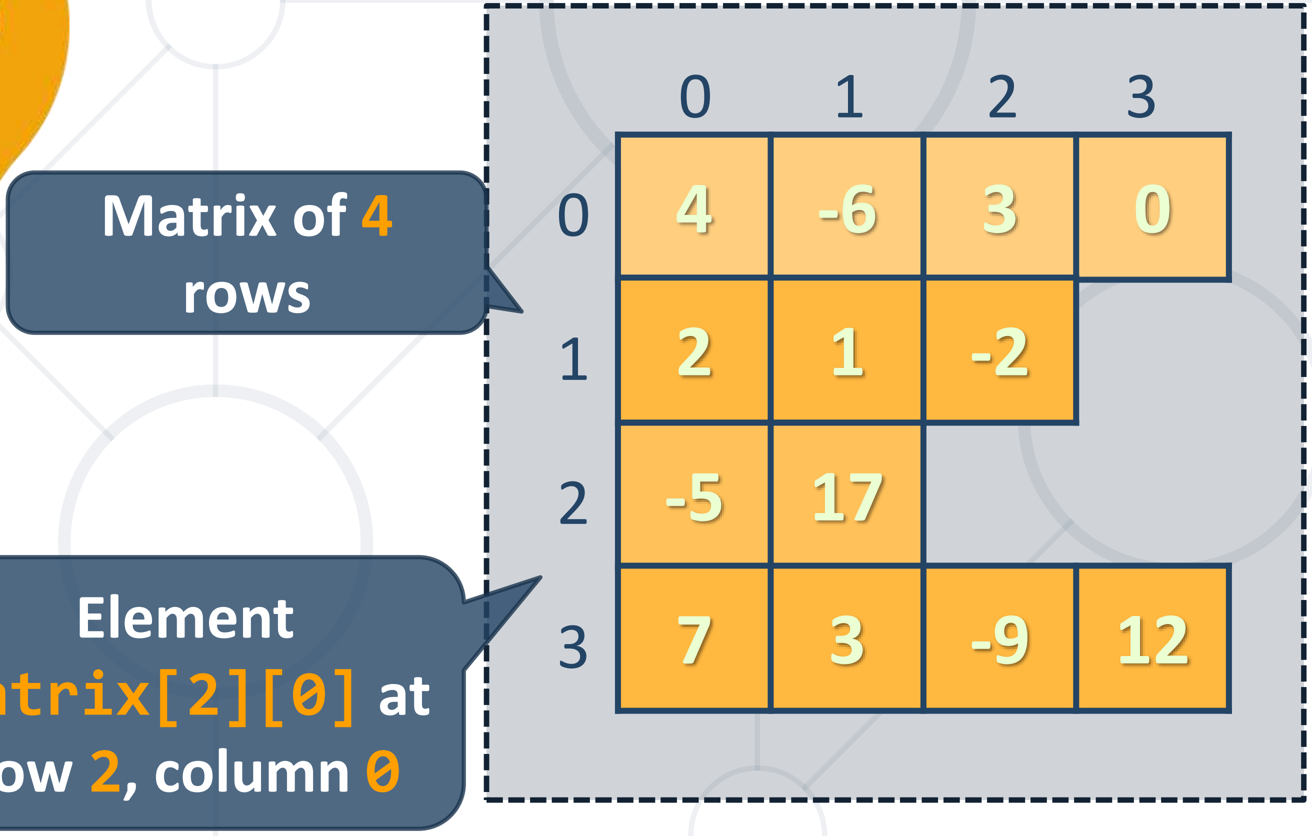
	0	1	2	3
0	4	-6	3	0
1	2	1	-2	12
2	-5	17	9	5

Matrices

Array of Arrays

Matrices in JS

- A **matrix** is a **table of values**.
- Matrices are represented as **nested arrays** in JavaScript.



$$\begin{array}{c|cccc} & 0 & 1 & 2 & 3 \\ \hline 0 & 4 & -6 & 3 & 0 \\ 1 & 2 & 1 & -2 & \\ 2 & -5 & 17 & & \\ 3 & 7 & 3 & -9 & 12 \end{array}$$

```
let matrix = [
   [4, -6, 3, 0],
   [2, 1, -2],
   [-5, 17],
   [7, 3, -9, 12]
];
```

Looping through a matrix

```
let matrix = [[4, 5, 6],
              [6, 5, 4],
              [5, 5, 5]];
```

```
for (let row = 0; row < matrix.length; row++) {
     console.log(matrix[row]);  // [4, 5, 6]
                                // [6, 5, 4]
                                // [5, 5, 5]
       for (let col = 0; col < matrix[row].length; col++) {
     console.log(matrix[row][col]);
    // prints each element of the matrix on a separate line
    }
}
```

Live Exercises

Summary

- Arrays are used to store **multiple values** in a **single variable**.
- Elements are **accessed** using their **index number**.
- **Sorting** and **modifying** elements using methods.
- Looping through arrays with **for … of**, **for … in** and traditional **for-loop**.
- A matrix is a **table of values**.

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