

CIS 371 Web Application Programming

TypeScript V



GRAND VALLEY
STATE UNIVERSITY®

Lecturer: **Dr. Yong Zhuang**

Recall

- Type Alias vs. Interface
- Class
- Functions as Arguments (to another Fn) : High-order functions
 - `Array.sort()`
 - `Array.some()`
 - `Array.every()`

Array.forEach(): inspect all shapes



shapes.forEach (?????)

```
function printShape(s: Shape): void {  
  console.log("# of sides", s.numSides);  
}
```

```
shapes.forEach(printShape);
```

- Purpose: Executes a provided function once for each array element.
- Return value: **undefined**.

```
shapes.forEach(function (s: Shape): void {  
  console.log("# of sides", s.numSides);  
}); // Anonymous function
```

```
shapes.forEach((s: Shape): void => {  
  console.log("# of sides", s.numSides);  
}); // Anonymous fat arrow
```

```
shapes.forEach((s) => {  
  console.log("# of sides", s.numSides);  
}); // No explicit type
```

Array.findIndex(): where is ...?



```
function isTriangle(s: Shape): boolean {  
  return s.numSides === 3;  
}
```

```
const idxTriangle = shapes.findIndex(isTriangle);  
console.log(idxTriangle); // 1
```

- Purpose: To find the index of the **first element** in the array that satisfies a provided testing function.
- Return value: the index of the **first element** in the array that passes the test. If **no elements** pass the test, it returns **-1**.

```
const idxTriangle = shapes.findIndex(function (s: Shape): boolean {  
  return s.numSides === 3;  
});  
  
const idxTriangle = shapes.findIndex((s: Shape): boolean => {  
  return s.numSides === 3;  
});  
  
const idxTriangle = shapes.findIndex((s: Shape): boolean => s.numSides === 3);  
  
const idxTriangle = shapes.findIndex((s) => s.numSides === 3);
```

Array find() functions

- If you need the actual element that satisfies a condition in the array, use [find\(\)](#).
- If you need the index of the found element in the array that satisfies a condition, use [findIndex\(\)](#).
- If you need to find the index of a specific value in the array, use [indexOf\(\)](#). (It's similar to `findIndex()`, but checks each element for equality with the value instead of using a testing function.)
- If you need to determine whether an array includes a specific value, use [includes\(\)](#). Again, it checks each element for equality with the value instead of using a testing function.
- If you need to find if any element satisfies the provided testing function, use [some\(\)](#).

Array.filter(): give me only green shapes



```
function isGreen(x: Shape): boolean {  
  return x.color === "green";  
}  
const greenOnly: Shape[] = shapes.filter(isGreen);
```

shapes.filter(...)



- *Purpose:* creates a new array with all elements that pass the test implemented by the provided function.
- *Return value:* a new array with the elements that pass the test. If no elements pass the test, an empty array will be returned.

```
const greenOnly = shapes.filter((shp: Shape): boolean => {  
  return shp.color === "green";  
});  
  
const greenOnly = shapes.filter((x) => x.color === "green");
```

Array.map(): extract all colors/num sides



`shapes.map(--color--)`

array of strings



```
["yellow", "green", "purple", "red", "green", "orange"]
```

`shapes.map(--numSides--)`

array of numbers



```
[4, 3, 4, 5, 4, 3]
```

6-item array



```
let colors: string[];

colors = shapes.map((x: Shape) => {
  return x.color;
});

//or
colors = shapes.map((x) => x.color);
```

```
let sides: number[];

sides = shapes.map((x: Shape) => {
  return x.numSides;
});

//or
sides = shapes.map((x) => x.numSides);
```

Array.filter() & Array.map()

.filter()

```
// Named Function
const numbers = [2, -30, 0, 17, 9, -11];
function isPos(x: number): boolean {
  return x > 0;
}
const out = numbers.filter(isPos);
console.log(out); // [2, 17, 19]
```

```
// Fat arrow
const numbers = [2, -30, 0, 17, 9, -11];
const out = numbers.filter((x: number) => {
  return x > 0;
});
console.log(out); // [2, 17, 19]
```

To create a new array with elements that pass a condition (or test) from the original array.

.map()

```
const numbers = [2, -30, 0, 17, 9, -11];
function plus10(x: number): number {
  return x + 10;
}
const out = numbers.map(plus10);
console.log(out); // [12, -20, 10, 27, 19, -1]
```

```
const numbers = [2, -30, 0, 17, 9, -11];
const out = numbers.map((x: number) => {
  return x + 10;
});
console.log(out); // [12, -20, 10, 27, 19, -1]
```

To create a new array by transforming each element in the original array.

Chaining multiple Array functions



`map(--color--)`



```
["yellow", "green", "purple", "red", "green", "orange"]
```



`filter(c === "green")`



```
["green", "green"]
```

```
const someBlue = shapes.map((x) => x.color).filter((c) => c === "green");
```

Array.flatMap(): from one to many



`shapes.flatMap(--sideDims--)`

length = 13

```
[7, 7, 7, 7, 8, 11, 8, 11, 6.1, 6.1, 6.1, 6.1, 6.1]
```

`shapes.map(--sideDims--)`

length = 3

```
[  
  [7, 7, 7, 7],  
  [8, 11, 8, 11],  
  [6.1, 6.1, 6.1, 6.1, 6.1],  
]
```

```
let stats: number[];  
stats = shapes.flatMap((s: Shape): number[] => {  
  return s.sideDims;  
});  
stats = shapes.flatMap((s: Shape): number[] => s.sideDims);
```

```
let stats: number[][];  
stats = shapes.map((s: Shape): number[] => {  
  return s.sideDims;  
});  
stats = shapes.map((s: Shape): number[] => s.sideDims);
```

Practical Use Case of flatmap()

```
type Course = {  
  name: string;  
  credits: number;  
  classList: Array<string>;  
};  
let allCourses: Array<Course> = [  
  {  
    name: "MTH101 Calculus",  
    credits: 4,  
    classList: [  
      /* 25 student names */  
    ],  
  },  
  {  
    name: "HTM 203 Beer Brewing",  
    credits: 2,  
    classList: [  
      /* 70 student names */  
    ],  
  },  
];
```

Find all students whose name begins with "Eli"



```
const studentList = allCourses  
  .flatMap((c: Course) => {  
    return c.classList;  
  })  
  // you'll get 95 names from flatMap  
  .filter((who: string) => {  
    return who.startsWith("Eli");  
  });
```

```
const studentList = allCourses  
  .flatMap((c: Course) => c.classList)  
  // you'll get 95 names from flatMap  
  .filter((who: string) => who.startsWith("Eli"));
```

Introducing: Array.reduce()



`some | every`

boolean



`reduce (redFunc, initVal)`

single result of your preferred type (total,
max, min, ...)

Not limited to only boolean output!!!

Array.reduce(): sum of values

```
const scores = [23, -31, 17, 31, 19];
const computeSum = (accumulator: number, currentValue: number): number => {
  return accumulator + currentValue;
};

const totalScore = scores.reduce(computeSum);
console.log("Total ", totalScore); // Total 59
```

pos	accumulator	currentValue	return
1	23	-31	-8
2	-8	17	9
3	9	31	40
4	40	19	59

- *Acc is initialized from the first array item*
- *Work begins at position 1*

Array.reduce(): sum of values (with initial value)

```
const scores = [23, -31, 17, 31, 19];
const computeSum = (accumulator: number, currentValue: number): number => {
  return accumulator + currentValue;
};

const totalScore = scores.reduce(computeSum, 2000);
console.log("Total ", totalScore); // Total 2059
```

pos	accumulator	currentValue	return
0	2000	23	2023
1	2023	-31	1992
2	1992	17	2009
3	2009	31	2040
4	2040	19	2059

- *Acc is initialized from the initial value*
- *Work begins at position 0*

Array.reduce(): shortest river name(with initial value)

```
const rivers = ["Amazon", "Mississippi", "Nile", "YangTze", "Yenisei"];
const shorterOf = (accumulator: string, currentValue: string): string => {
  if (currentValue.length < accumulator.length) return currentValue;
  else return accumulator;
};

const riverName = rivers.reduce(shorterOf, "Yellow");
console.log("Shortest ", riverName); // Nile
```

pos	accumulator	currentValue	return
0	Yellow	Amazon	Yellow
1	Yellow	Mississippi	Yellow
2	Yellow	Nile	Nile
3	Nile	YangTze	Nile
4	Nile	Yenisei	Nile

- Acc is initialized from the provided value
- Work begins at position 0

Array.reduce(): shortest river name(with initial value)

```
const rivers = ["Amazon", "Mississippi", "Nile", "YangTze", "Yenisei"];
const shorterOf = (accumulator: string, currentValue: string): string => {
  if (currentValue.length < accumulator.length) return currentValue;
  else return accumulator;
};

const riverName = rivers.reduce(shorterOf, "Roe");
console.log("Shortest ", riverName); // ?
```

pos	accumulator	currentValue	return
0	Roe	Amazon	Roe
1	Roe	Mississippi	Roe
2	Roe	Nile	Roe
3	Roe	YangTze	Roe
4	Roe	Yenisei	Roe



Array.reduce() with initial value

```
const rivers = ["Amazon", "Mississippi", "Nile", "YangTze", "Yenisei"];
const shorterLen = (accumulator: number, currentValue: string): number => {
  if (currentValue.length < accumulator) return currentValue.length;
  else return accumulator;
};
// Use 37 to initialize riverLen
const riverLen = rivers.reduce(shorterLen, 37);
console.log("Shortest ", riverLen); // 4
```

pos	accumulator(num)	currentValue(str)	return(num)
0	37	Amazon	6
1	6	Mississippi	6
2	6	Nile	4
3	4	YangTze	4
4	4	Yenisei	4

- *Type of acc and curr may be different*
- *Type of acc and type of initial value must match*
- *Type of acc determines the type of return*

Array.reduce()

```
let myArray: Array<XYZ>;
```

```
function myFunction(prev: XYZ, curr: XYZ): XYZ {  
    // More code here  
    return _____;  
}  
const result: XYZ = myArray.reduce(myFunction);
```



without initial value?

```
function myFunction(prev: resultType, curr: XYZ): resultType {  
    // More code here  
    return _____;  
}  
const initValue: resultType = _____;  
const result: resultType = myArray.reduce(myFunction, initValue);
```

Reduce: Array of objects

```
type River = {  
  name: string;  
  countries: Array<string>; // the river passes thru these countries  
  lenInMiles: number; // river length in miles  
};
```

```
const waters: Array<River> = [  
  {  
    name: "Amazon",  
    countries: ["Brazil", "Columbia", "Peru"],  
    lenInMiles: 4132,  
  },  
  { name: "Nile", countries: ["Egypt"], lenInMiles: 4388 },  
  { name: "Mississippi", countries: ["US"], lenInMiles: 2340 },  
  {  
    name: "Mekong",  
    countries: ["China", "Myanmar", "Laos", "Thailand", "Vietnam"],  
    lenInMiles: 2703,  
  },  
  { name: "Ganges", countries: ["India", "Bangladesh"], lenInMiles: 1560 },  
];
```

The name of the longest river?

```
type River = {  
  name: string;  
  countries: Array<string>;  
  lenInMiles: number;  
};
```

```
function lengthCompare(prev: River, curr: River): River {  
  if (prev.lenInMiles > curr.lenInMiles) return prev;  
  else return curr;  
}  
  
let winner: River;  
winner = waters.reduce(lengthCompare);  
console.log(winner.name);
```

```
let winner: River;  
winner = waters.reduce((prev: River, curr: River): River => {  
  if (prev.lenInMiles > curr.lenInMiles) return prev;  
  else return curr;  
});  
console.log(winner.name);
```

Practice

The longest mile?

```
type River = {  
  name: string;  
  countries: Array<string>;  
  lenInMiles: number;  
};
```

```
function compLength(prev: River, curr: River): River {  
  if (prev.lenInMiles > curr.lenInMiles) return prev;  
  else return curr;  
}  
let winner: River;  
winner = waters.reduce(compLength);  
console.log("Longest mile is", winner.lenInMiles);
```

```
function compRivLen(prev: number, curr: River): number {  
  if (prev > curr.lenInMiles) return prev;  
  else return curr.lenInMiles;  
}  
let winner: number;  
winner = waters.reduce(compRivLen, Number.MIN_VALUE);  
console.log("Longest mile is", winner);
```

Practice

Goes through most countries?

```
type River = {  
  name: string;  
  countries: Array<string>;  
  lenInMiles: number;  
};
```

```
function countryCompare(prev: River, curr: River): River {  
  if (prev.countries.length > curr.countries.length) return prev;  
  else return curr;  
}  
  
let winner: River;  
winner = waters.reduce(countryCompare);  
console.log(winner.name);
```

```
let winner: River;  
winner = waters.reduce((prev: River, curr: River): River => {  
  if (prev.countries.length > curr.countries.length) return prev;  
  else return curr;  
});  
console.log(winner.name);
```

Practice

Some examples

How many green shapes?

```
shapes.filter((s) => s.color === "green").length;
```

How many equilateral triangles?

```
shapes.filter(  
  (s) =>  
    s.numSides === 3 &&  
    s.sideDims[0] === s.sideDims[1] &&  
    s.sideDims[1] === s.sideDims[2]  
).length;
```

```
shapes  
  .filter((s) => s.numSides === 3)  
  .filter(  
    (s) => s.sideDims[0] === s.sideDims[1] && s.sideDims[1] === s.sideDims[2]  
  ).length;
```

Largest perimeter?

```
shapes  
  .map((shp) => {  
    let perimeter = 0;  
    // Compute perimeter  
    return perimeter;  
  })  
  .reduce((acc: number, curr: number) => {  
    if (acc > curr) return acc;  
    else return curr;  
  });
```