CIS 371 Web Application Programming

TypeScript IV

GRAND VALLEY STATE UNIVERSITY®

Lecturer: Dr. Yong Zhuang

Based on the original version by Professor Hans Dulimarta.

Recall

- Type Alias vs. Interface vs. Class, Inheritance
- TypeScript Functions (& Lambdas):
    - Named, Anonymous, Lambda(Fat Arrow) Function
    - Single-line return contraction
- Functions as Arguments
    - Array.sort()

Array high-order functions

- Array.every(), Array.some()
- Array.find(), findIndex()
- Array.filter(), Array.map(), Array.flatmap()
- Array.forEach()
- Array.reduce()
- … and many others
- flatMap() is available in ES2019

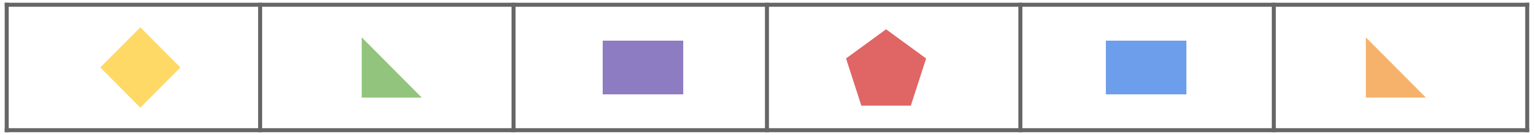
```
// tsconfig.json {
  "compilerOptions": {
    "target": "ES2019",
    // other options go here
  }
  ...
}
```

Array Operations

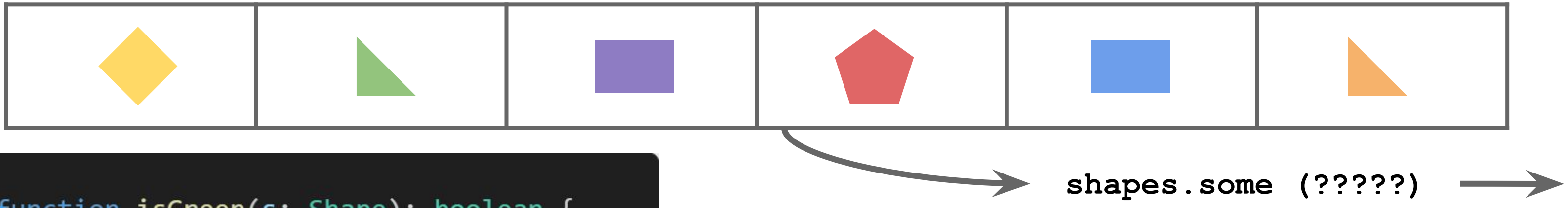
Array high-order functions

```
type Shape = {
  color: string;
  numSides: number;
  sideDims: Array<number>; // the length of each side
};
```

```
let shapes: Array<Shape> = [_____]
```



Array.some(): do we have any green shape?

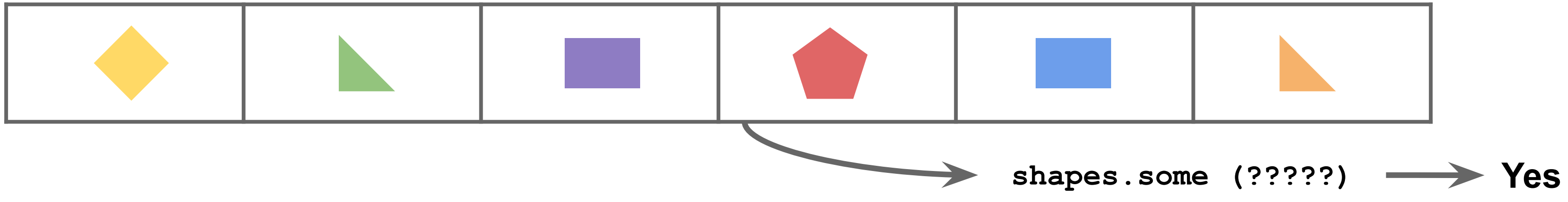


```
function isGreen(s: Shape): boolean {
    return s.color === "green"
}

const someGreen = shapes.some(isGreen);
console.log(someGreen);   // true
```

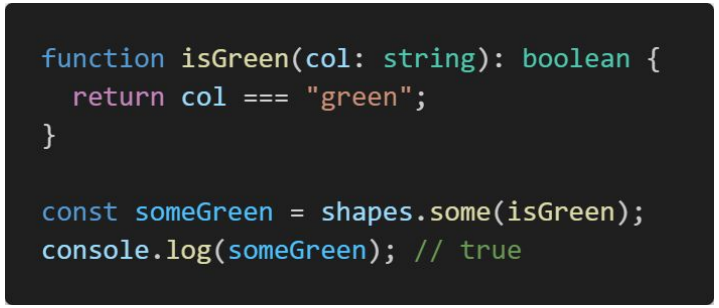
```
const someGreen = shapes.some(function (s: Shape): boolean {
  return s.color === "green";                              // Anonymous function
});

const someGreen = shapes.some((s: Shape): boolean => {
  return s.color === "green";                              // Anonymous fat arrow
});

const someGreen = shapes.some((s: Shape): boolean => s.color === "green");
                                                           // 1 line return elimination
const someGreen = shapes.some((s) => s.color === "green");
                                                           // No explicit type
```

- *Purpose: Test if at least one element in the array passes the test implemented by the provided function.*
- *Return value: **A Boolean** (true if at least one passes the test, otherwise false).*

Array.some(): do we have any green shape?



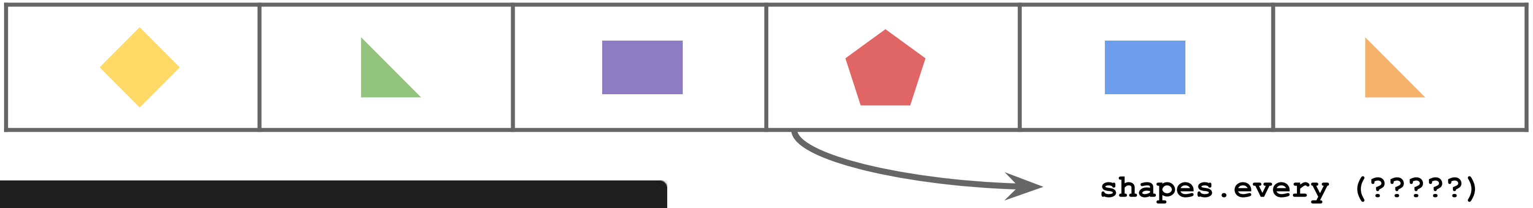
Incorrect!!!



```
function isGreen(col: string): boolean {
  return col === "green";
}

const someGreen = shapes.some(isGreen);
console.log(someGreen); // true
```

// isGreen must take a Shape as its input parameter
// NOT a string!!!

Array.every(): are all shapes triangle?

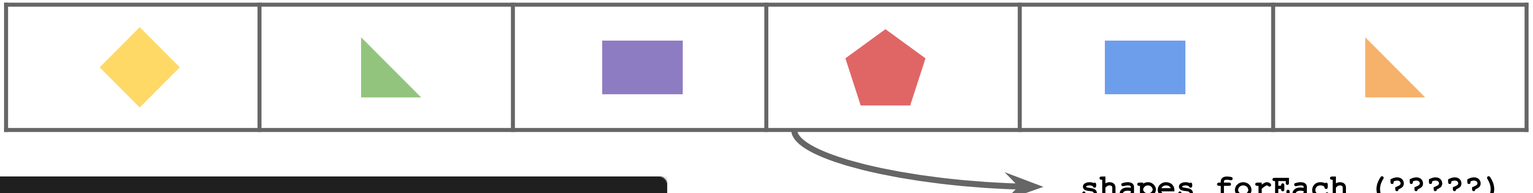


```
function isTriangle(s: Shape): boolean {
  return s.numSides === 3;
}

const allTriangle = shapes.every(isTriangle);
console.log(allTriangle); // false
```

```
const allTriangle = shapes.every(function (s: Shape): boolean {
  return s.numSides === 3;                                  // Anonymous function
});

const allTriangle = shapes.every((s: Shape): boolean => {
  return s.numSides === 3;                                  // Anonymous fat arrow
});

const allTriangle = shapes.every((s: Shape): boolean => s.numSides === 3);
                                                            // 1 line return elimination

const allTriangle = shapes.every((s) => s.numSides === 3);
                                                            // No explicit type
```

- *Purpose: Tests whether all elements in the array pass the test implemented by the provided function.*
- *Return value:* ***A Boolean*** *(true if every element passes the test, otherwise false).*

Array.forEach(): inspect all shapes



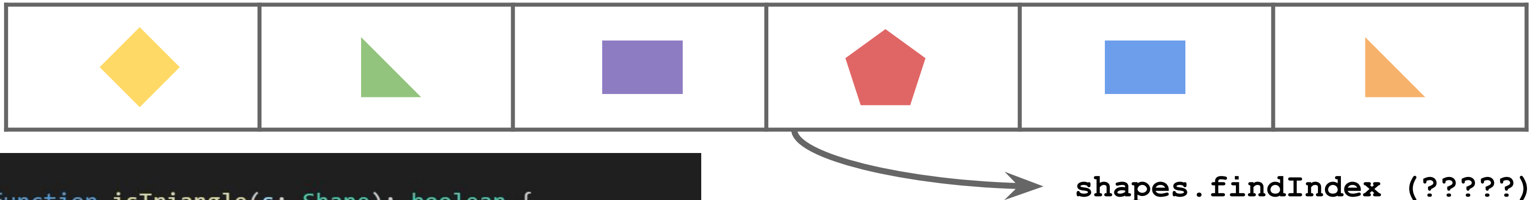
`shapes.forEach (?????)`

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

shapes.forEach(printShape);
```

```
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
```

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

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



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

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

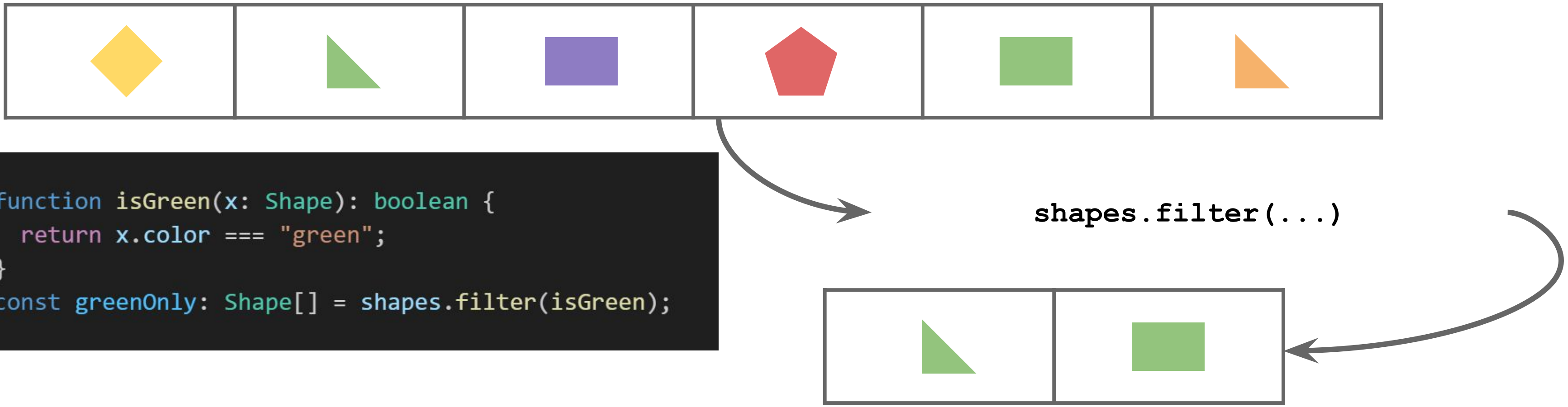
- *Purpose: To find the index of the* ***first element*** *in the array that satisfies a provided testing function.*
- *Return value: the index of the* ***first element*** *in the array that passes the test. If* ***no elements*** *pass the test, it returns* ***-1****.*

```
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

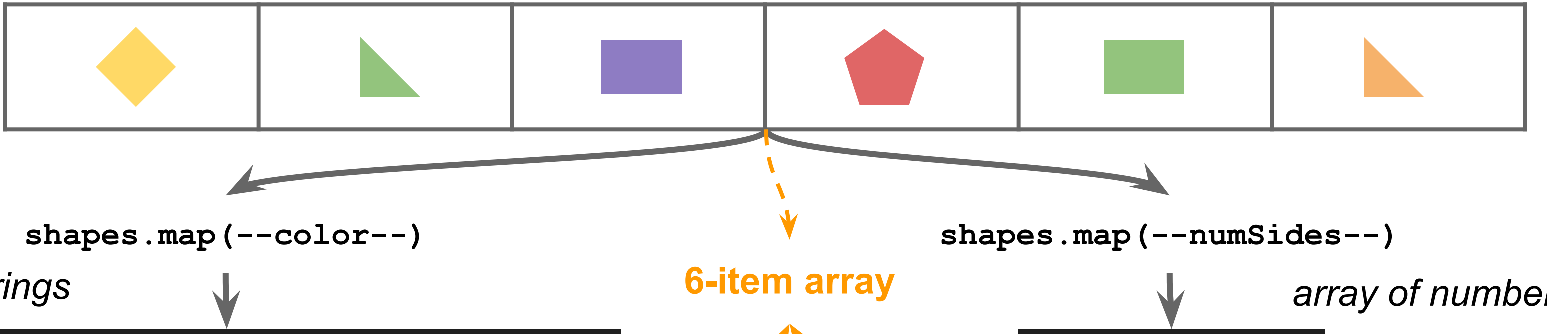


```
function isGreen(x: Shape): boolean {
  return x.color === "green";
}
const greenOnly: Shape[] = shapes.filter(isGreen);
```

- *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



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

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

```
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.

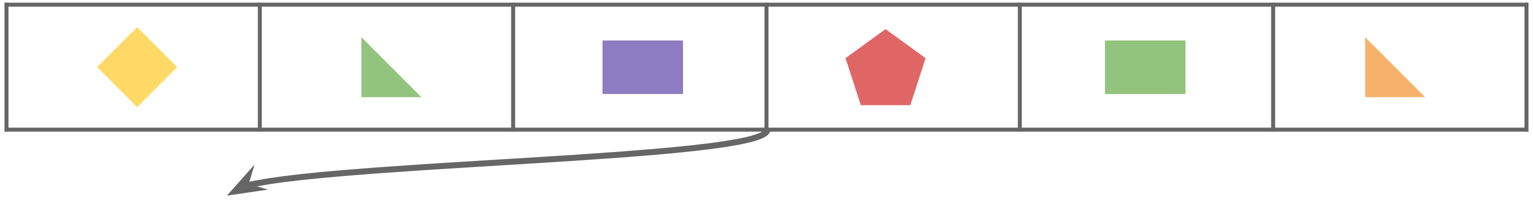
.map()

```
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--)
```

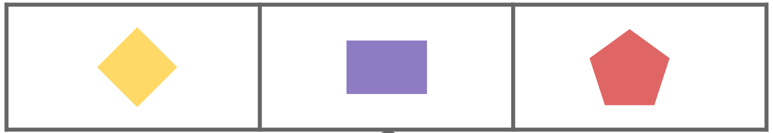
```
["yellow", "green", "purple", "red", "green", "orange"]
```

```
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]
```

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

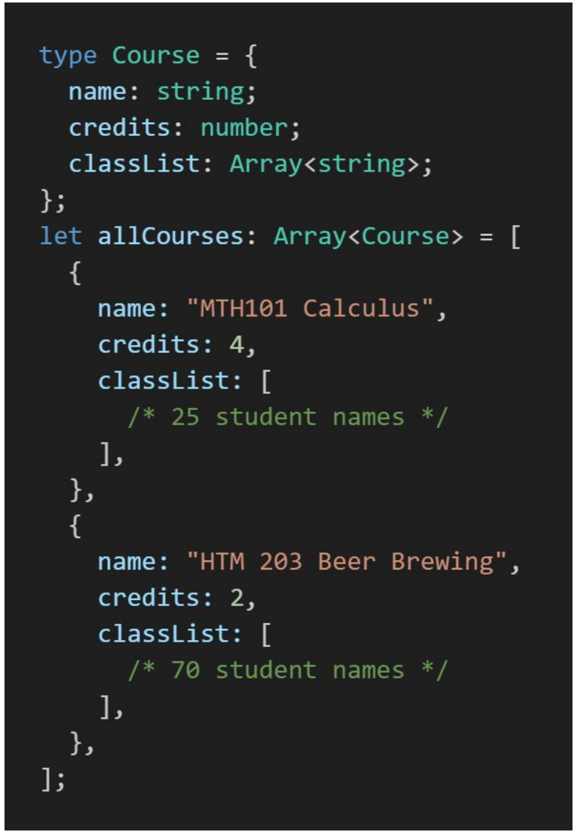
`shapes.map(--sideDims--)`

length = 3

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

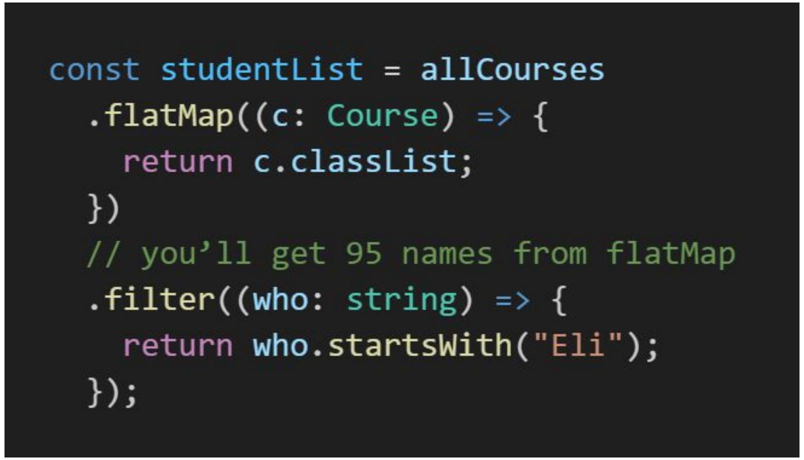
```
let stats: number[][];
stats = shapes.map((s: Shape): number[] => {
  return s.sideDims;
});
stats = shapes.map((s: Shape): number[] => s.sideDims);
```

Practical Use Case of flatmap()

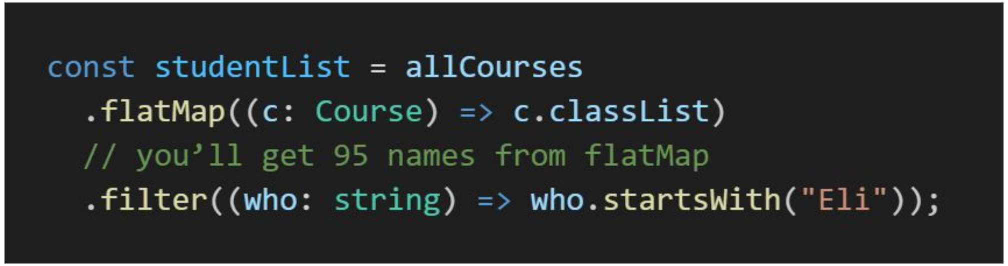


```
type Course = {
  name: string;
  credits: number;
  classList: Array<string>;
};
let allCourses: Array<Course> = [
  {
    name: "MTH101 Calculus",
    credits: 4,
    classList: [
      /* 25 student names */
    ],
  },
  {
    name: "HTM 203 Beer Brewing",
    credits: 2,
    classList: [
  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

Practice

Answer