CIS 371 Web Application Programming

TypeScript IV

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Based on the original version by Professor Hans Dulimarta.

Recall

- Optional Chaining (?) operator & Function Optional Parameters
- Coalesce operator (??) & non-null assertion operator (!)
- Logical OR (||) operator
- Enum vs. Literal Types
- String Interpolation
- ES6 key/value Shortcut
- TypeScript Functions (& Lambdas)
- Fat Arrow Function, Single-line return contraction
- Type Alias vs. Interface

Type Alias vs. Interface

- A type cannot be re-opened to add new properties
- An interface which is always extendable.

Online Doc

Inheritance

```ts
// Base interface for common properties
interface Book {
  title: string;
  author: string;
  pages: number;
  price: number;
}

// Extending Book for Physical Book
interface PhysicalBook extends Book {
  coverType: "Hardcover" | "Paperback";
}

// Extending Book for Digital Book
interface DigitalBook extends Book {
  format: "PDF" | "EPUB" | "MOBI";
}
```

```ts
const novel: Book = {
  title: "To Kill a Mockingbird",
  author: "Harper Lee",
  pages: 281,
  price: 56,
};

const hardcoverBook: PhysicalBook = {
  title: "1984",
  author: "George Orwell",
  pages: 328,
  coverType: "Hardcover",
  price: 56,
};

const eBook: DigitalBook = {
  title: "Sapiens",
  author: "Yuval Noah Harari",
  pages: 498,
  format: "EPUB",
  price: 35,
};
```

```ts
function purchase(book: Book) {
  console.log(book.price);
}

purchase(novel);
purchase(hardcoverBook);
purchase(eBook);
```

Class

```
enum coverType {
  "Hardcover",
  "Paperback",
}

class Book {
  title: string;
  author: string;
  pages: number;
  price: number;
  coverType: coverType;
  purchase() {
    console.log(this.price);
  }
}

const novel = new Book();
novel.purchase();
```

```
class Book {
  title: string;
  author: string;
  pages: number;
  price: number;
  coverType: coverType | undefined;
  constructor(title: string, author: string, pages: number, price: number) {
    this.title = title;
    this.author = author;
    this.pages = pages;
    this.price = price;
  }
```

Error: Property '...' has no initializer and is not definitely assigned in the constructor..

```
const novel = new Book("To Kill a Mockingbird", "Harper Lee", 281, 56);
novel.coverType = coverType.Hardcover;
novel.purchase();
```

Inheritance

```
class Book {
  title: string;
  author: string;
  pages: number;
  price: number;

  constructor(title: string, author
    this.title = title;
    this.author = author;
    this.pages = pages;
    this.price = price;
  }
}
```

```
class DigitalBook extends Book {
  fileSize: number; // File size in MB
  format: string; // Format like PDF, EPUB, etc.

  constructor(
    title: string,
    author: string,
    pages: number,
    price: number,
    fileSize: number,
    format: string
  ) {
    // Call the parent class constructor with the common properties
    super(title, author, pages, price);
    this.fileSize = fileSize;
    this.format = format;
  }
}
```

Functions as Arguments (to another Fn)

Array.sort()

```
const atoms = ["Neon", "Iron", "Calcium", "Hydrogen"]
console.log(atoms.sort())
// ["Calcium", "Hydrogen", "Iron", "Neon"]
```

```
const primes = [23, 17, 5, 101, 19]
const sorted_nums = primes.sort()
console.log(sorted_nums)
```

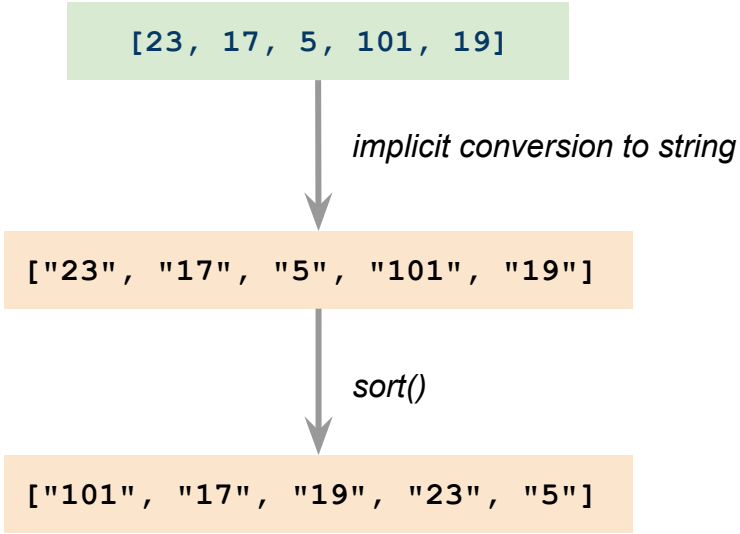
[101, 17, 19, 23, 5]

Array.prototype.sort()

The `sort()` method of `Array` instances sorts the elements of an array *in place* and returns the reference to the same array, now sorted. The default sort order is ascending, built upon converting the elements into strings, then comparing their sequences of UTF-16 code units values.

Online Doc

Array.sort() builtin behavior



To fix this ***"bug"***, we have to tell sort() the **collating order between two data items**

Array.sort() with collating order

```
function numericOrder(a:number, b:number): number {
    if (a < b) return -1;              // any negative number
    else if (a > b) return +1;         // any positive number
    else return 0;
}
```

```
const primes = [23, 17, 5, 101, 19]
const sorted_nums = primes.sort(numericOrder)
console.log(sorted_nums) // [5, 17, 19, 23, 101] Ok
```

*The collating function must return a **number***

- *Negative when the "first" item should be placed BEFORE the "second" item*
- *Positive when the "first" item should be placed AFTER the "second" item*
- *Zero when the order of the two items is irrelevant*

Array.sort() on objects

```
type Language = {
    name: string;  yearCreated: number
}
const langs: Language[] = [
    { name: "C", yearCreated: 1970},
    { name: "JavaScript", yearCreated: 1995},
    { name: "Fortran", yearCreated: 1954}
]
function orderByName(a:Language, b:Language): number {
    return a.name.localeCompare(b.name)
}
function orderByYear(a:Language, b:Language): number {
    return a.yearCreated - b.yearCreated
}
langs.sort(orderByYear)
```

ascending or descending?

- *Negative when the referenceStr occurs before compareString*
- *Positive when the referenceStr occurs after compareString*
- *Returns 0 if they are equivalent*

*The collating function takes two parameters of **type Language** but must **return a number***

Array.sort() on objects

```
type Language = {
    name: string;  yearCreated: number
}
const langs: Language[] = [
    { name: "C", yearCreated: 1970},
    { name: "JavaScript", yearCreated: 1995},
    { name: "Fortran", yearCreated: 1954}
]
```

```
function orderByName(a:Language, b:Language): number {
    return a.name.localeCompare(b.name)
}
langs.sort(orderByName)
```

Option 1: named function

```
langs.sort(
    function (a:Language, b:Language): number {
        return a.name.localeCompare(b.name)
    }
)
```

Option 2: unnamed function

```
langs.sort(
    (a:Language, b:Language): number => {
        return a.name.localeCompare(b.name)
    }
)
```

Option 3: lambda function

```
langs.sort(
    (a, b) => a.name.localeCompare(b.name)
)
```

Opt 4: typeless lambda & 1-line return contraction

Function Parameter Default Value

```
const whoAmI = (name: string, age: number, occupation: string = "Student", spouse?: string):
void => {
    console.log("Work as", occupation);
    console.log("Spouse name:", spouse ?? "N/A")
}
```

```
whoAmI("Andy", 22);                          // Work as undefined
                                             // Spouse name: N/A
whoAmI("Bob", 43, "banker");                 // Work as banker
                                             // Spouse name: N/A
whoAmI("Chuck", 31, undefined, "Cindy");     // Work as Student
                                             // Spouse name Cindy
whoAmI("Chuck", 31, null, "Cindy");          // Work as null
                                             // Spouse name Cindy
```

Array Operations

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 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?

shapes.some (?????) → Yes

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

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

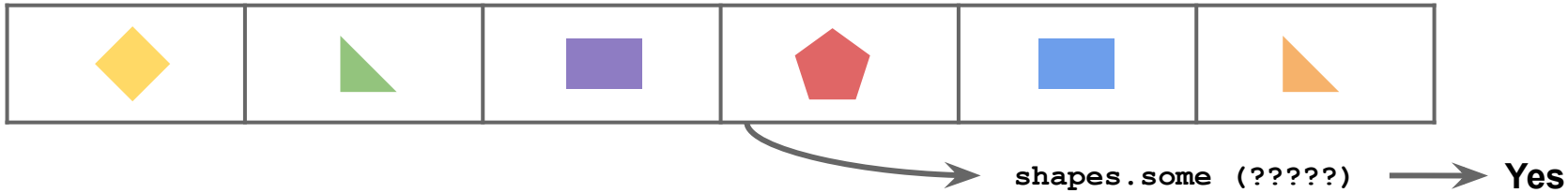
- *Purpose: Test if at least one element in the array passes the test implemented by the provided function.*
- *Return value: **A Boolean** (true if at least one passes the test, otherwise false).*

```
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
```

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



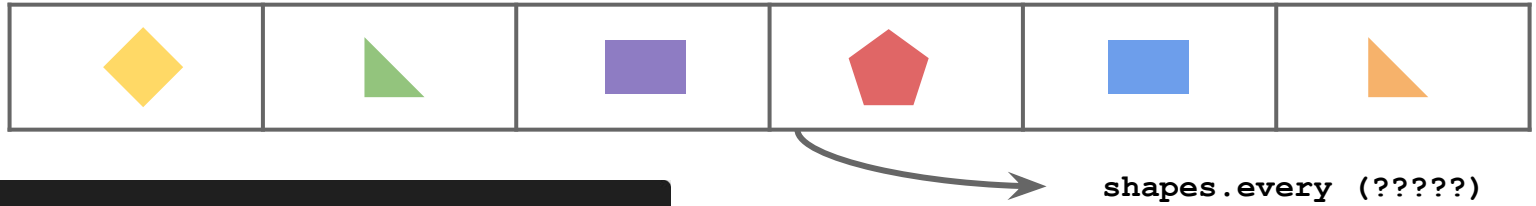
Incorrect!!!

```
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
```

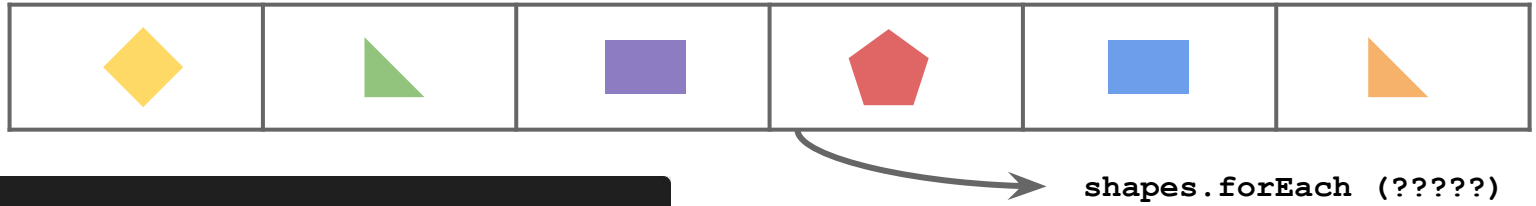
- *Purpose: Tests whether all elements in the array pass the test implemented by the provided function.*
- *Return value: **A Boolean** (true if every element passes the test, otherwise false).*

```
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
```

Array.forEach(): inspect all shapes




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

shapes.forEach(printShape);
```

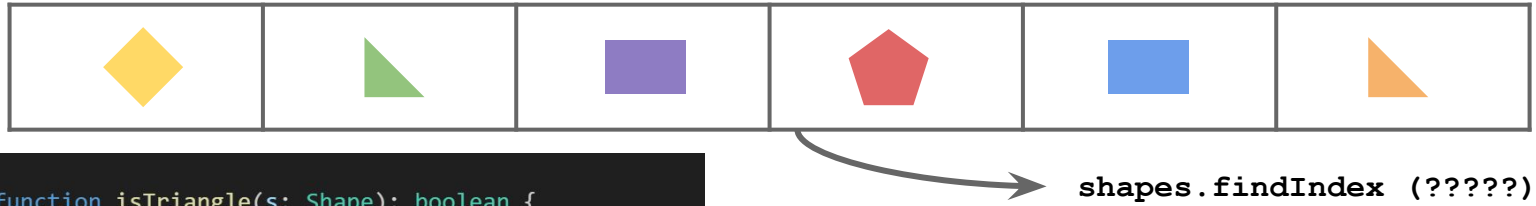
- *Purpose: Executes a provided function once for each array element.*
- *Return value:* ***undefined.***

```
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()**.