CIS 371 Web Application Programming

TypeScript II

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Based on the original version by Professor Hans Dulimarta.

Recall

- JavaScript and TypeScript,
- Initial Setup For Node JS,
- Function vs. Method,
- Data Types,
- multiple types,
- == vs ===,
- Arrays,
    - for-in vs. for-of,
    - push() and .pop(),
    - creates a copy using slice(),
    - delete/replaces elements splice(),

Objects

Java Classes and Objects vs. **TS Objects**

```
// Java objects must be instantiated from a class
// In Sub.java
class Sub() {
  public String name;
  public int calorie;
}

// In AnotherFile.java
Sub my_order = new Sub();
my_order.name = "Spicy Turkey";
my_order.calorie = 182;

my_order.price = 3.17;  // ERROR!
```

```
// TypeScript (no class needed)
const my_order = {
  name: "Spicy Turkey",
  calorie: 182
}
```

Objects can be created without a class definition

Objects in TypeScript

```
// Typeless objects
const in_a_month = {
  name: "September",
  days: 30
}

const employee_vacation = {
  name: "Bob",  days: 11
}
```

```
// Typed objects
type Monthly = {
  name: string,
  days: number
}
const in_a_month:Monthly {
  name: "September",
  days: 30
}
```

```
type VacationDays = {
  name: string,
  days: number
}
const employee_vacation:VacationDays = {
  name: "Bob",
  days: 11
}
```

Objects with Sub-Objects & Array property

```
type City = {
  name: string,
  population: number,
  geopos: {
    lat: number,
    lon: number
  },
  univs: Array<string>
}
```

```
const ours:City = {
  name: "Grand Rapids",
  population: 198400,
  geopos: {
    lat: 42.9633599,
    lon: -85.6680863
  },
  univs:  [
    "Calvin", "Cornerstone",
    "GVSU"
  ]
}
```

```
const theirs:City = {
  name: "East Lansing",
  population: 48729,
  geopos: {
    lat: 42.737652,
    lon: -84.483788
  },
  univs:  [
    "MSU",
  ]
}
```

```
console.log(ours.name);
for (let u of ours.univs) console.log(u);

console.log(theirs.geopos.lat);
```

```
Grand Rapids
Calvin
Cornerstone
GVSU
42.737652
```

for-in to enumerate object properties

```
const theirs:City = {
  name: "East Lansing",
  population: 48729,
  geopos: {
    lat: 42.737652,
    lon: -84.483788
  },
  univs:  [
    "MSU",
  ]
}
```

```
for (let z in theirs) {
  console.debug(z)
}
```

```
name
population
geopos
univs
```

```
for (let z in theirs) {
  console.debug(z, theirs[z]);
 }                 ^--------^ ERROR
```

```
const eLan = theirs as any;
for (let z in theirs) {
  console.debug(z, "==>", eLan[z])
}
```

```
name ==> East Lansing
population ==> 48729
geopos ==> {lat: 42..., lon: -84..}
univs == > ["MSU"]
```

Array of Objects

```
// In Atom.java
class Atom {
  public String name;
  public weight double;
}

// In AnotherFile.java
ArrayList<Atom> atoms = new ArrayList<>();
Atom a = new Atom("Carbon", 12);
atoms.add(a);
Atom b = new Atom("Oxygen", 16);
atoms.add(b);
atoms.add(new Atom("Natrium", 23);
```

TS: option 1

```
// TypeScript (no class required)
 const atoms = [];
 atoms.push({ name: "Carbon", weight: 12});
 atoms.push({ name: "Oxygen", weight: 16});
 atoms.push({ name: "Natrium", weight: 23});
```

TS: option 2

```
// Or initialize the array
const atoms = [
  { name: "Carbon", weight: 12},
  { name: "Oxygen", weight: 16},
  { name: "Natrium", weight: 23}
];
```

Array of Typed Objects

Typeless array

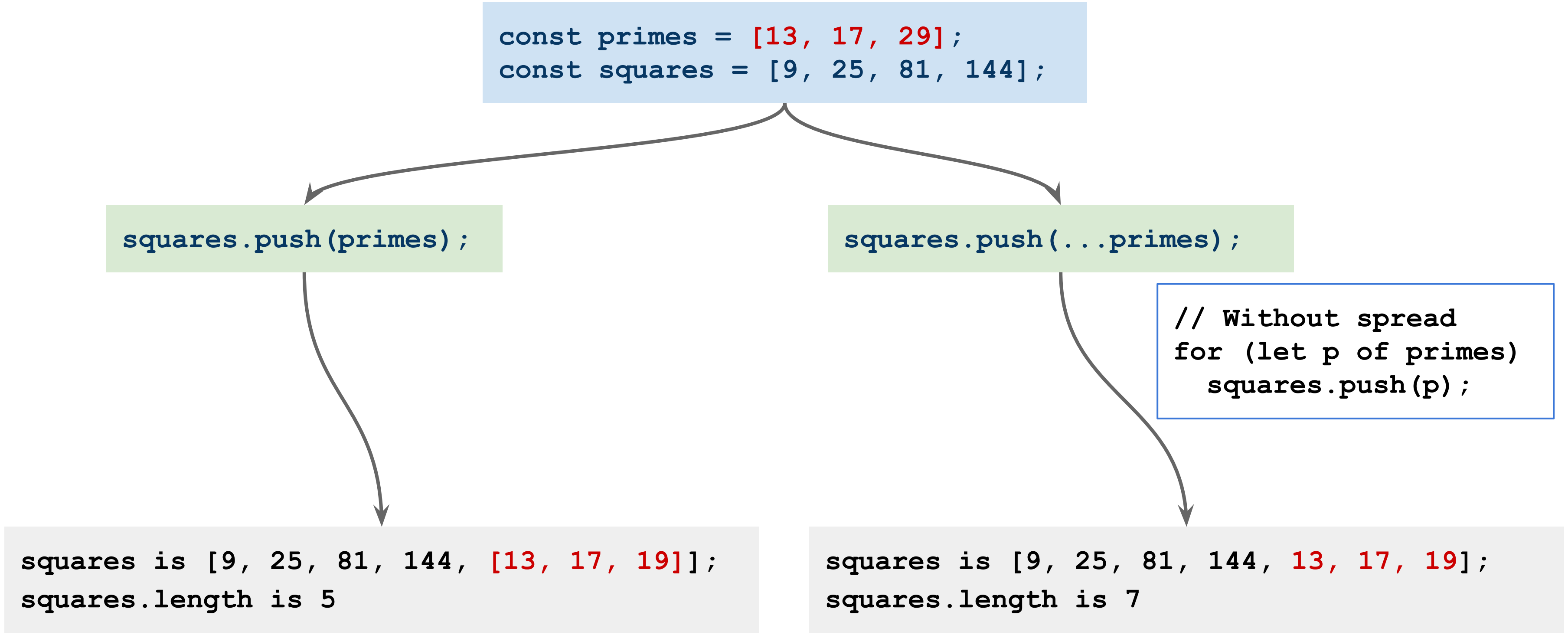
```
const atoms = [];
atoms.push({ name: "Carbon", weight: 12});
atoms.push({ namme: "Fluor", weight: 12}); // OK
atoms.push({ name: "Oxygen"}); // OK
atoms.push({ name: "Natrium", weight: 23, isMetal: false}); // OK
```

```
// Declare a type
type Atom = {
  name: string,
  weight: number
}
```

Typed array

```
const atoms:Array<Atom> = [];
 atoms.push({ name: "Carbon", weight: 12});
 atoms.push({ namme: "Fluor", weight: 12});          // ERROR: "namme" does not exist
 atoms.push({ name: "Oxygen"});                      // ERROR: property "weight" is missing
 atoms.push({
   name: "Natrium",
   weight: 23,
   isMetal: false});                                 // ERROR: "isMetal" does not exist
```

Spreading an Array



```
const primes = [13, 17, 29];
const squares = [9, 25, 81, 144];
```

```
squares.push(primes);
```

```
squares.push(...primes);
```

```
// Without spread
for (let p of primes)
  squares.push(p);
```

```
squares is [9, 25, 81, 144, [13, 17, 19]];
squares.length is 5
```

```
squares is [9, 25, 81, 144, 13, 17, 19];
squares.length is 7
```

Spreading an Object

```
const name = { first: “Bob”, last: “Dylan”};
const job = { position: “Web Developer”, salary: 75000};
```

```
const one = {name, job};
```

```
{
  name: {
    first: “Bob”,
    last: “Dylan”
  },
  job: {
    position: “Web Developer”,
    salary: 75000
  }
}
```

```
const two = {name, ... job}
```

```
{
  name: {
    first: “Bob”,
    last: “Dylan”
  },
  position: “Web Developer”,
  salary: 75000
}
```

```
const three = {
   ... name,
    ... job
}
```

```
{
  first: “Bob”,
  last: “Dylan”,
  position: “Web Developer”,
  salary: 75000
}
```

Spread on Objects (with duplicate props)

If objects have duplicate properties...

Spread on Objects (with duplicate props)

```
const prop1 = {name: "Carbon", abbrev: "Cb"}
const prop2 = {weight: 12, abbrev: "C"}
// without spread on prop1
const element = {prop1, ... prop2};
```

```
{
  prop1: {
    name: "Carbon", abbrev: "Cb"
  },
  weight: 12, abbrev: "C"
}
```

```
{
  isMetal: false,
  name: "Clue",
  abbrev: "C",
  weight: 12,
}
```

With spread

```
const prop1 = {name: "Carbon", abbrev: "Ca"}
const prop2 = {weight: 12, abbrev: "C", name: "Clue"}
// with spread
const element = {...prop1, ...prop2, isMetal: false};
const el2     = {...prop2, ...prop1, isMetal: false};
```

```
{
  isMetal: false,
  name: "Carbon",
  abbrev: "Ca",
  weight: 12,
}
```

Later values overwrite previous values of the same key

Object spread: copy and modify

```
const bob = {
  first: “Bob”,
  last: “Dylan”,
  position: “Web Developer”,
  salary: 75000
}
```

```
const bob_now = {
  ...bob,
  workFromHome: true,
  position: “Cloud Data Egr.”,
  salary: 78000
}
```

bob_now

```
{
  first: “Bob”,
  last: “Dylan”,
  workFromHome: true,
  position: “Cloud Data Egr.”,
  salary: 78000
}
```

This won’t work (no copy created).

```
const bob_now = bob;
bob_now.position = “Cloud Data Egr.”;
bob_now.salary = 78000;
```

Array Destructuring

```
const nums:number[] = [1,2,3,4,5];
const [first,rest] = nums;
```

Without spread

```
// first is 1   (number)
// rest is 2    (number)
```

```
const nums:number[] = [1,2,3,4,5];
const [first, ...rest] = nums;
```

With spread

```
// first is 1 (number)
// rest is [2,3,4,5] (number[])
```

```
function splitIt([f, ...r]: number[]): void {
  console.log(f);
  console.log(r);
}

splitIt([5, 20, 31, 19]);
```

With spread on func args

```
// 5    a number
// [20, 31, 19]  an ARRAY of numbers
```

Array Destructuring

```
const nums:number[] = [1,2,3,4,5];
const [first, ...rest] = nums;
```

With spread

```
// first is 1 (number)
// rest is [2,3,4,5] (number[])
```

```
const nums:number[] = [1,2,3,4,5];
const [...rest, last] = nums;
```

Syntax Error

The operator (...) can only be used to gather the remaining elements in an array. It must be the last element in the destructuring assignment.

Optional Chaining (?) operator

```
type City = {
  name: string,
  population: number,
  geopos: {
    lat: number,
    lon: number
  } | null,
  univs: Array<string>
}
```

```
  let newCity: City = {
  name: “East Lansing”,
  population: 48729,
  geopos: null,
  univs:  [
    “MSU”,
  ]
}
```

```
if (newCity.geopos){
    const lat = newCity.geopos.lat
    console.log(lat)
}
else{
    console.log("No Geo Info")
}
```

```
const lat = newCity.geopos.lat
```

null?

```
const lat = newCity.geopos? newCity.geopos.lat: "No geo info"
console.log(lat)
```

ternary operator

Optional Chaining (?) operator

```
type City = {
  name: string,
  population: number,
  geopos: {
    lat: number,
    lon: number
  } | null,
  univs: Array<string>
}
```

```
 let newCity: City = {
 name: "East Lansing",
 population: 48729,
 geopos: null,
 univs:  [
   "MSU",
 ]
}
```

```
const lat = newCity.geopos.lat
```

null?

```
const lat = newCity.geopos?.lat
```

Chaining

undefined

Coalesce operator (??) & non-null assertion operator (!)

```
let aName: string | null;
```

```
const theName:string = aName? aName : "No name"
console.log(theName)
```

ternary operator

```
if (aName){
    const theName:string = aName
    console.log(theName)
}
else{
    console.log("No name")
}
```

```
const theName:string = aName
```

null?

if **aName** is **null**, **theName** will be **null** even it should not have that type.

```
const theName:string = aName ?? "no name"
```

Coalesce

```
const theName:string = aName!
```

non-null assertion

Logical OR (||) operator

```
const aString = '';
console.log(aString ?? 'Empty Value');

const aNumber = 0;
console.log(aNumber ?? 'Zero Value');

const aBool = false;
console.log(aBool ?? 'False Value');
```

```

0
false
```

```
const aString = '';
console.log(aString || 'Empty Value');

const aNumber = 0;
console.log(aNumber || 'Zero Value');

const aBool = false;
console.log(aBool || 'False Value');
```

```
Empty Value
Zero Value
False Value
```

Enum vs. Literal Types

```
enum CollegeYear {
  Freshman,
  Sophomore,
  Junior,
  Senior
}
```

Sort order (enum order): Freshman < Sophomore < Junior < Senior

```
let yr: CollegeYear;
yr = CollegeYear.Junior;
console.debug(yr);
console.debug(CollegeYear[yr]);
```

```
2
Junior
```

```
type CollegeLiteral =
    "Freshman" |
    "Sophomore" |
    "Junior" |
    "Senior";
```

Sort order (alphabetical): "Freshman" < "Junior" < "Senior" < "Sophomore"

```
let yr: CollegeLiteral;
yr = "junior";                       // Compile error
yr = "Junior"
console.debug(yr);                   // Output "Junior"
```

Literal Types: Narrowing

```
// TypeScript
let dayOfWeek: string;
dayOfWeek = "Monday";   // No error

let strictDOW: "Mon" | "Tue" | "Wed" | "Thu";
strictDOW = undefined; // Error
strictDOW = "Fri"; // Error

let dieValue: 1 | 2 | 3 | 4 | 5 | 6;
dieValue = undefined; // Error
dieValue = 0; // Error
```

- Use this for data with one a small number of valid values.
- Invalid values are detected at compile time (not at runtime)

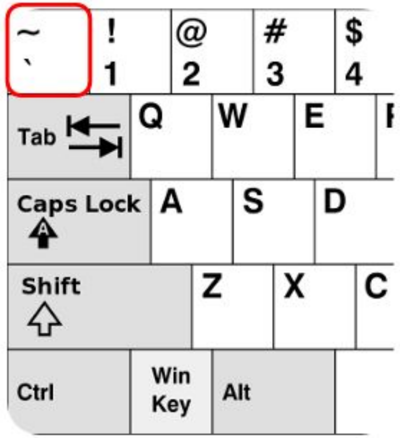
String Interpolation (backquotes)

```
`Some text here ${var} and here`
`More text ${expression} also here`
```

```
const x = "Eleven";
const arr = [3, 5, 13];

// Java-like string concatenation
let oldStore = (4 + arr[0]) + "-" + x;     // 7-Eleven

// Use backquotes string interpolation
let store = `${4 + arr[0]}-${x}`;          // 7-Eleven
```



ES6 key/value Shortcut

```
let cityName = "Allendale";
let zipCode = "49401";

let location = {
  city: cityName,
  zip: zipCode;
};
```

```
let city = "Allendale";
let zip = "49401";
let location = {
  city: city,
  zip: zip;
};
```

equivalent

When both key and value refer to the same name, you don't have to write them both. Only one is required

```
let city = "Allendale";
let zip = "49401";
let location = {
  city,
  zip;
};
```