Non-Primitive Data Type

- These are Mutable types.
- The variable and its state can be changed after defining.
- The memory allocated for a variable can change dynamically.
- Non-Primitive types are allocated with memory heap.
- The range of value varies according to the memory available.
- They don’t have any fixed range for storing value.
- TypeScript non-primitive types are
    - Array
    - Object
    - Regular Expression

Array Type

- Arrays in computer programming are used to **reduce overhead** and **complexity**.
- Arrays can reduce overhead by storing values in sequential order.
- Array can reduce complexity by storing multiple values under one name.
- Array is a type of arrangement that stores in sequential order, but can be accessed random.

- Array is a collection of various types of values. Some technologies have issues with allocating different types of memory in sequential order. Hence, they restrict array to store same type values.
- Array size can be changed dynamically, which is not supported in various technologies.
- TypeScript Array can be used for both similar type of values and for various types of values.
- It can restrict array to handle similar type to satisfy certain situations.
- It can allow array to handle different types of values to satisfy other situations.
- TypeScript Array have the behaviour of Array as well as Collection [Stack, Queue, HashTable etc.]
- Array is a data structure.
- **John von Neumann – 1945**
- **1957 FORTRAN**
- **1960 COBOL, ALGOL 60**
- **1972 C**
- **1983 C++**
- Array is used to implement data structures such as
    - Lists
    - Heaps
    - Hash tables
    - Queues

- Deques
- Stacks
- Strings
- Vlists

Declaring Array in TypeScript

let variableName:string[];

Meta Characters

? zero or one occurance

+ one or more occurances

* zero or more occurances

[] multiple , random, range

- After declaring Array, you have to **initialize or render** memory for array.
- Values can't be stored into Array if memory is not **Initialized** or **Rendered**.

  Ex:

```
let products:string[];
products[0] = "TV";                    // invalid – [0] – is not defined
products[1] = "Mobile";
console.log(products.toString());
```

Initialize memory for Array

- You can render or initialize memory for Array by using
    - Meta Character “[ ]”
    - Array Constructor “Array()”

Using Meta Character:

Ex:

```
let products:string[] = [];   // Initialization
products[0] = "TV";
products[1] = "Mobile";
console.log(products.toString());
```

Ex:

```
let products:string[];
products = [];      //rendering
products[0] = "TV";
products[1] = "Mobile";
console.log(products.toString());
```

Using Array Constructor:

Ex:

```
let products:string[] = new Array();
```

```
products[0] = "TV";
products[1] = "Mobile";
console.log(products.toString());
```

Ex:

```
let products:string[];
products = Array();
products[0] = "Samsung TV";
products[1] = "Mobile";
console.log(products.toString());
```

- **new is** dynamic memory allocating operator.

FAQ: What is difference between [ ] and Array()?

A. Array() will not allow to **initialize** different types of values even when the data type is “any”. It can handle only the type of value which is first loaded into memory.
Array [ ] will allow to initialize or render.

FAQ: How typescript array can store different types of values?

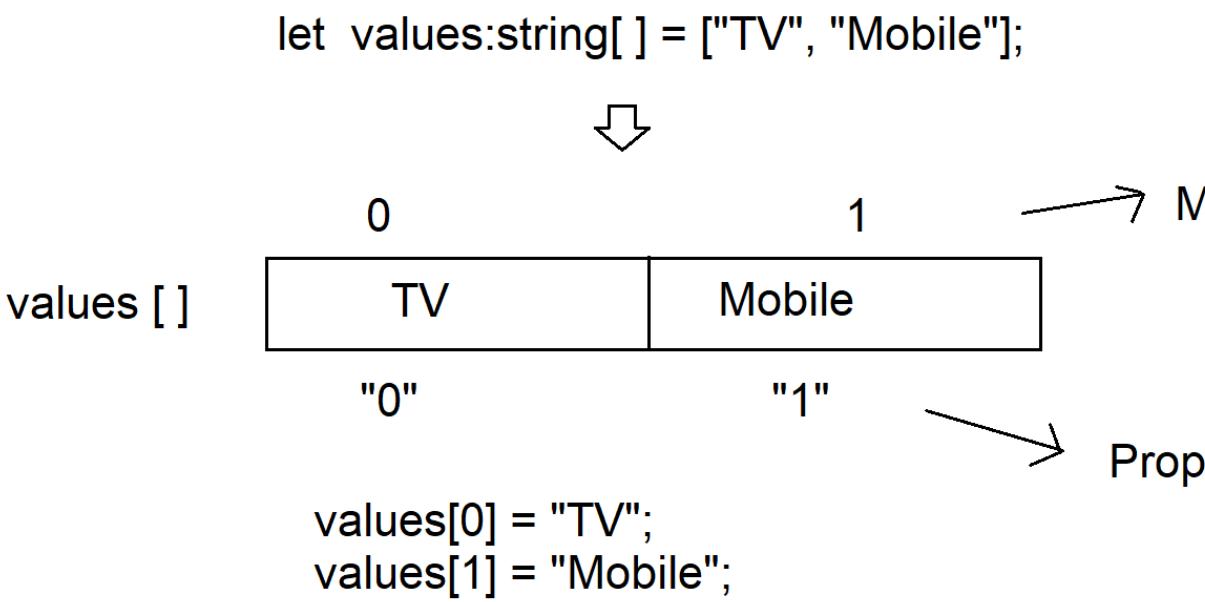
A. By using “any” as data type.
Ex:

```
let products:any[] = [10, "A", true];
```

Note: If array is allowing different types of values then it is called as “Tuple”.

Storing Values into Array

- You can initialize values or render values into memory allocated for Array.
- The memory allocated for array comprises of multiple blocks, which are accessed by using a **property name**.



- The property of array is “**string**” type which maps to same name **index**.

  values[0] **0** is property and maps to **0** index.

Ex:

```
let values:string[] = ["TV", "Mobile"];
for(var property in values)
{
   console.log(`${property} : [${typeof property}] - ${values[property]}`);
}
```

O/P:

0 : [string] - TV

1 : [string] - Mobile

Ex:

```
let values:string[] = [];
values["0"] = "Samsung TV";
values["1"] = "Nike Casuals";
console.log(values.toString());
```

Manipulating Array Elements

- Array object is derived from “Array” interface that provides a set of properties and methods which are used to manipulate Array.

Reading Array Elements:

Member / Technique	Description
toString()	It reads all elements from an array and returns a string that concat elements with [,] delimiter.

join()	It reads all element from an array and returns a string that concat elements with custom delimiter.
	
	Ex:
	let products:string[] = ["TV", "Mobile", "Shoe"];
	console.log(products.toString());
	console.log(products.join("-->"));

Loop	- TypeScript can use “for, while, do while” loops for reading array elements.
	- Looping control defines initializer, condition and counter.
	Ex:
	let products:string[] = ["TV", "Mobile", "Shoe"];
	for(var i=0; i<products.length; i++)
	{
	console.log(products[i]);

	}

Iterator	- TypeScript can use “for-in, for-of” iterators
	- Iterator is a design pattern used to access elements from a collection in sequential order without condition, initializer and counter.
	Ex: Iterate over values “**for-of”**
	
	let products:string[] = ["TV", "Mobile", "Shoe"];
	for(var item of products)
	{
	console.log(item);
	}
	
	Ex: Iterate over properties “**for-in”**
	
	let products:string[] = ["TV", "Mobile", "Shoe"];
	for(var property in products)
	{
	console.log(property);
	}
	
	Ex: Iterate over properties and values “**for-in”**

	let products:string[] = ["TV", "Mobile", "Shoe"];
	for(var property in products)
	{
	  console.log(`${property} : ${products[property]}`);
	}

find()	It can search for elements based on any specific condition and return only the first occurrence element that matches the condition.
	
	Syntax:
	arrayName.find(function(param){ return condition; });
	
	Ex:
	let sales:number[] = [20000, 42000, 13000, 45000, 52000, 12000];
	let result:number = sales.find(function(val){
	  return val>40000;
	  });
	console.log(result);
	
	Ex:
	let sales:number[] = [20000, 42000, 13000, 45000, 52000, 12000];

	function getvalue(val){
	  return val>40000;
	}
	let result:number =
	sales.find(getvalue);
	console.log(result);

filter()	It is similar to “find()” but can return all values that match the give condition.
	
	Ex:
	let sales:number[] = [20000, 42000, 13000, 45000, 52000, 12000];
	function getvalue(sale){
	  return sale>40000;
	}
	let result:number[] =
	sales.filter(getvalue);
	for(var item of result)
	{
	  console.log(item);
	}

slice()	It can return only the elements between specified index.
	Ex:
	let sales:number[] = [20000, 42000, 13000, 45000, 52000, 12000];
	console.log(sales.slice(1,3));

	console.log(slaes.slice(1)); 1 to end

Adding values into an Array

push()	It adds a value(s) into array as the last element.
	Ex:
	let products:string[] = ["TV","Mobile"];
	function PrintValues()
	{
	  for(var property in products) {
	  console.log(`[${property}] : ${products[property]} `);
	  }
	}
	products.push("Shoe","Watch");
	PrintValues();

unshift()	It adds a value(s) into array as first element.
	Ex:
	let products:string[] = ["TV","Mobile"];
	function PrintValues()
	{
	  for(var property in products) {
	  console.log(`[${property}] : ${products[property]} `);

	}
	}
	products.unshift("Shoe","Watch");
	PrintValues();

splice()	It adds a value(s) into array at specified index location.
	
	Syntax:
	arrayName.splice(startIndex, deleteCount, “items..”)
	
	Ex:
	let products:string[] = ["TV","Mobile"];
	function PrintValues()
	{
	for(var property in products) {
	console.log(`[${property}] : ${products[property]} `);
	}
	}
	products.splice(1,0,"Watch","Shoe");
	PrintValues();

Removing Array Elements

Method	Description
pop()	It removes and returns the last element.

	Ex: let products:string[] = ["TV","Mobile","Watch"]; function PrintValues() { for(var property in products) { console.log(`[${property}] : ${products[property]} `); } } PrintValues(); let removedElement:string = products.pop(); console.log(`${removedElement} Removed.`); PrintValues();
shift()	It removes and returns the first element. Ex: let products:string[] = ["TV","Mobile","Watch"]; function PrintValues() { for(var property in products) { console.log(`[${property}] : ${products[property]} `); } }

	PrintValues();
	let removedElement:string = products.shift();
	console.log(`${removedElement} Removed.`);
	PrintValues();

splice()	It removes specified element(s) based on index number and returns an array of removed elements.
	
	Ex:
	let products:string[] = ["TV","Mobile","Watch","Shoe"];
	function PrintValues()
	{
	for(var property in products) {
	console.log(`[${property}] : ${products[property]} `);
	}
	}
	PrintValues();
	let removedElement:string[] = products.splice(1,2);
	console.log(`${removedElement} Removed.`);
	PrintValues();

Searching for Element in Array

Method	Description
find()	It can search for elements based on any specific condition and return only the first occurrence element that matches the condition.
filter()	It is similar to “find()” but can return all values that match the give condition.

indexOf()	It can search for your value in array and return its index number. It finds the first occurrence.
	Ex:
	
	let products:string[] =
	["TV","Watch","Shoe"];
	let searchString:string = "Mobile";
	if(products.indexOf(searchString)==-1) {
	console.log(`${searchString} Not Found`);
	} else {
	console.log(`${searchString} found at ${products.indexOf(searchString)}`);
	}

lastIndex(	It finds and returns the last occurrence

)	index number. The index functions return “-1” if not found.

includes()	It is a boolean method that determines whether an array contains a specified element.
	New in ES7.
	
	Syntax:
	arrayName.includes(“searchValue”, startAtIndex)
	
	Ex:
	let products:string[] = ["TV","Watch","Mobile", "Shoe"];
	let searchString:string = "Mobile";
	if(products.includes(searchString)==true) {
	console.log(`${searchString} found at ${products.indexOf(searchString)}`);
	} else {
	console.log(`${searchString} Not Found`);
	}

New into Array

keys()	- It can iterate over keys in array and return all keys in the forms

	of iterator.
	- It returns an iterator object that contains collection of all keys.
	- TypeScript requires “Array.from()” method to read values from an iterator.
	Ex:
	let products:string[] = ["TV","Watch","Mobile", "Shoe"];
	
	let result:any = products.keys();
	
	for(var item of Array.from(result))
	{
	console.log(item);
	}

entries()	It can iterate over key and value pair. Ex: