

# ES7 Typed Objects

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# Introduction of Typed Objects

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- A feature of ECMAScript 7
- Allows the use of defined types in objects
- Proposed to better the memory storage of objects
- More predictable performance

# Overview of Presentation

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- What is ECMAScript?
- Motivation
- History
- Typed Arrays and Typed Objects
- Supported Types
- Performance
- Pros
- Cons
- Examples
- Conclusion/References

# What is ECMAScript?

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- ECMAScript, simply put, is just the language specification of javascript
- It has gone through 6 revisions so far, the latest release being ECMAScript 2015, or ES6, released June of 2015.
- There is not a full implementation of all of ES6's features, though many applications such as Firefox and Chrome make use of features from it.

# Motivation

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- A data type in JavaScript which will behave like a statically typed language
- Avoid the pitfalls of Typed Arrays in ES6
- A smarter way to allocate memory

# History

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- JavaScript is a dynamically typed language
- Assigning different types to the same variable allowed
- ES6 introduced typed arrays, but they have their limitations

# Typed Arrays and Typed Objects

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- Typed Objects are generalizations of Typed Arrays
- Typed Arrays cannot use non scalar types
  - References to objects
  - Structs
- Typed objects overcome these limitations

# What types are supported?

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any	uint8	int8
float32	object	uint16
int16	float64	string
uint32	int32	

---



# Difference between traditional objects

- JavaScript can allocate any data type to any variable
  - Always allocates 64-bits in memory, regardless of the number
- Typed Objects require that objects are the correct type
  - Behaves like a statically typed language
  - Optimally allocates memory based on type
  - ex: int32 allocates 32 bits

# Memory Difference

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00	00	00	00	00	00	00	01
01							

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# Syntax Difference: Traditional Objects vs. Typed Objects

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ES5:

```
function Car(color){  
    this.color = color;  
}  
var myCar = new Car("blue");
```

ES7:

```
var Car = new StructType({color:string})  
var myCar = new Car();  
myCar.color = "blue"
```

# Runtime Comparison

- Not a ton of testing has been done, but there are some benchmarks that have been performed, but a few benchmarks show that, in general, typed objects are faster than vanilla javascript implementations.

Benchmark	1. Standard	2. Typed Objects	Ratio 1:2
Array of scalars	1040ms	837ms	1.243
Struct fields	936ms	1227ms	0.763
Array of structs	1970ms	1064ms	1.852

- Above: The Benchmarks, and their runtimes. Only the second benchmark is slower for Typed Objects, meaning more work needs to be done (hence why ES7 is still a work in progress.)

# Explanation of Benchmarks

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- The “array of scalars” benchmark consists of a loop reading and writing bytes from and to an array.
- The “struct fields” benchmark creates a struct with two fixed-length arrays as fields and repeatedly reads and writes those fields.
- The “array of structs” benchmark creates a 1024x768 image of Color structs. This test.
- **TL;DR: Typed Objects make cache misses less common**

# Pros

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- Can be used to store references to objects
- Can attach methods to the type defined structs
- Can limit the type of data in each field to prevent hard to find bugs
- Using structures allows the programmer to completely customize the type to meet the specifications of their application

# Cons

- No boolean types
  - No boolean types (unchecked)
  - Possibly covered in the “any” case
- Has not been released yet
  - ES6 still hasn't been supported in most browsers, so support may take a while for ES7
  - Introduced two years ago

# Example struct declaration

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Create a struct that will be our new type In this case, we are defining a “Point” type with two 8-bit integers

```
var Point = new StructType ({x:int8 , y:int8 });  
var point = new Point();  
point.x = 22;  
point.y = 257;
```



# Application Example

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```
const Point2D = new StructType({ x: uint32, y: uint32 });  
const Color = new StructType({ r: uint8, g: uint8, b: uint8 });  
const Pixel = new StructType({ point: Point2D, color: Color });
```

```
const Triangle = Pixel.Array(3);
```

```
let t = Triangle([  
  { point: { x: 0, y: 0 }, color: { r: 255, g: 255, b: 255 } },  
  { point: { x: 5, y: 5 }, color: { r: 128, g: 0, b: 0 } },  
  { point: { x: 10, y: 0 }, color: { r: 0, g: 0, b: 128 } }]);
```

Figure 1:

# Application Example (continued)

```
const Point2D = new StructType({ x: uint32, y: uint32 });  
const Color = new StructType({ r: uint8, g: uint8, b: uint8 });  
const Pixel = new StructType({ point: Point2D, color: Color });
```

```
const Triangle = Pixel.Array(3);
```

```
let t = Triangle([ { point: { x: 0, y: 0 }, color: { r: 255, g: 255, b: 255 } },  
                  { point: { x: 5, y: 5 }, color: { r: 128, g: 0, b: 0 } },  
                  { point: { x: 10, y: 0 }, color: { r: 0, g: 0, b: "128" } } ] );
```

\* "128" is a string, this would cause an error since, b is declared as a unsigned 8 bit integer

Figure 2:

# Conclusion

- Typed Objects are not yet supported
- But when and if they are. . .
  - They will provide **faster**, more **memory-efficient** object type declarations
- Typed Objects add functionality like static typing

# Resources

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- [https://developer.mozilla.org/en-US/docs/Web/JavaScript/Data\\_structures](https://developer.mozilla.org/en-US/docs/Web/JavaScript/Data_structures)
- <http://smallcultfollowing.com/babysteps/pubs/2014.04.01-TypedObjects.pdf>
- [https://developer.mozilla.org/en-US/docs/Web/JavaScript/New\\_in\\_JavaScript/ECMAScript\\_Next\\_support\\_in\\_Mozilla](https://developer.mozilla.org/en-US/docs/Web/JavaScript/New_in_JavaScript/ECMAScript_Next_support_in_Mozilla)