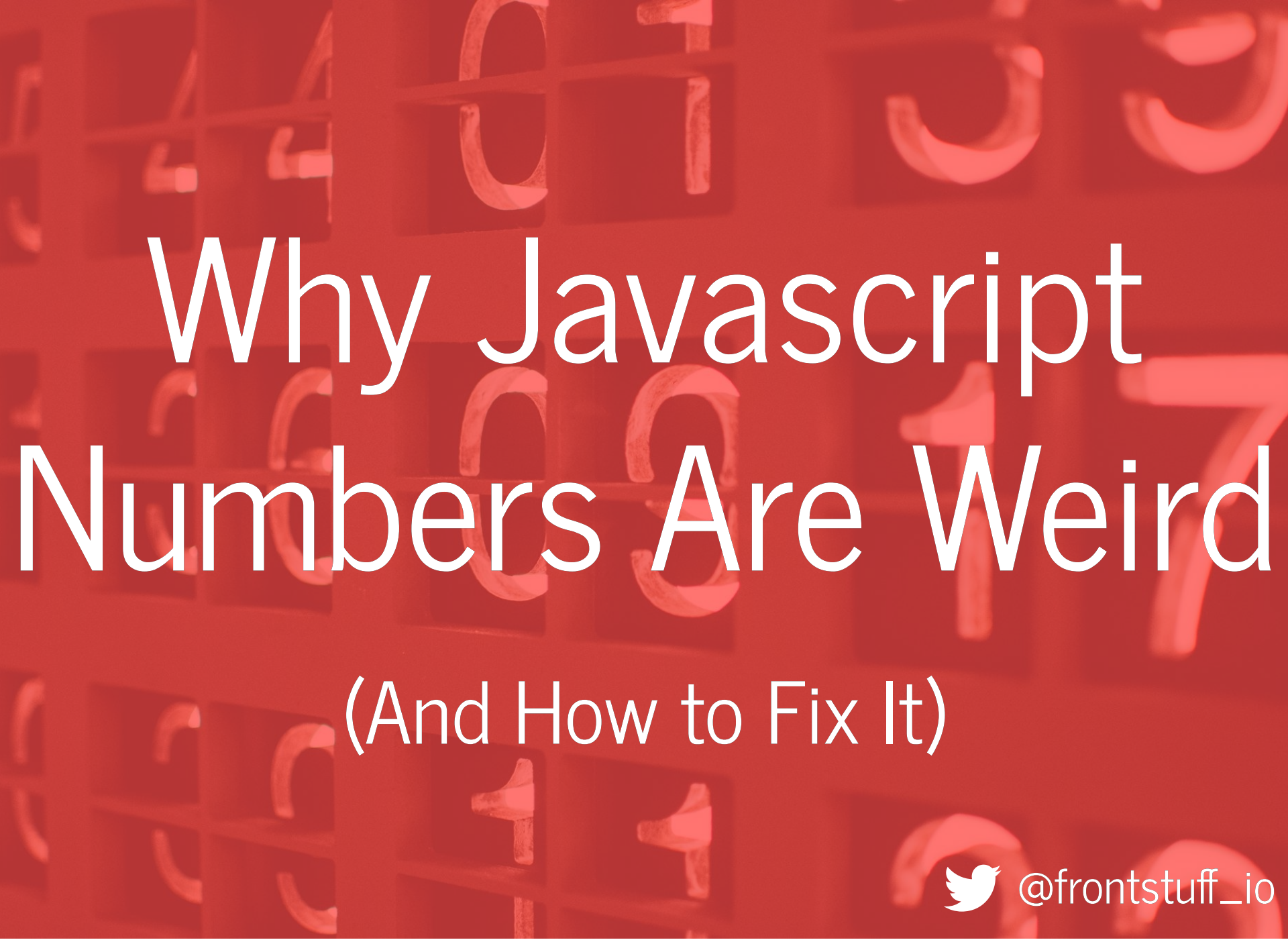
Why Javascript
Numbers Are Weird
(And How to Fix It)
@frontstuff_io

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Dinero.js

Dinero.js is a library for working with monetary values in JavaScript.

See full API docs

Features

- Immutable and chainable API.
- Global settings support.
- Extended formatting and rounding options.
- Native Intl support (no additional locale files).
- Currency conversion.

Download/install

Dinero.js provides builds for different environments. It also comes with polyfilled versions for older browsers.

The recommended way of install is via npm or Yarn:

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We use
a decimal system.

0

1 2

3 4 5

6 7 8 9

3 4 5

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3 4 5
300 + 40 + 5
3 x 100 4 x 10 5 x 1

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Computers use a binary system.

Canon EOS M50 Mirrorless Camera Kit w/EF-M15-45mm and 4K Video - Black

4.5 out of 5 stars 512

Black

$1001010111

Ships to France

Only 6 left in stock - order soon.

More Buying Choices

(25 used & new offers)

Also available in White

Fujifilm 16643000 X100V Digital Camera - Black

4.0 out of 5 stars 5

Black

$10101110111

Ships to France

In stock on March 28, 2020.

More Buying Choices

(3 new offers)

Also available in Silver

Kodak PIXPRO Friendly Zoom FZ53-BK 16MP Digital Camera with 5X Optical Zoom and 2.7" LCD Screen (Black)

4.0 out of 5 stars 592

Black

$1000101

Ships to France

More Buying Choices

(24 used & new offers)

Price may vary by color

Computers must convert decimal to binary.

5

5

1

1 x 2^2 (4)

5 - 4 = 1

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5

1 0

0 x 2^1 (2)

1 - 0 = 1

5

1 0 1

1 x 2^0 (1)

1 - 1 = 0

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Double-precision floating-point format

Java

```java
System.out.println(.1 + .2);

// 0.30000000000000004
```

Python

```python
print(.1 + .2)

# 0.30000000000000004
```

Ruby

```ruby
puts 0.1 + 0.2

# 0.30000000000000004
```

C#

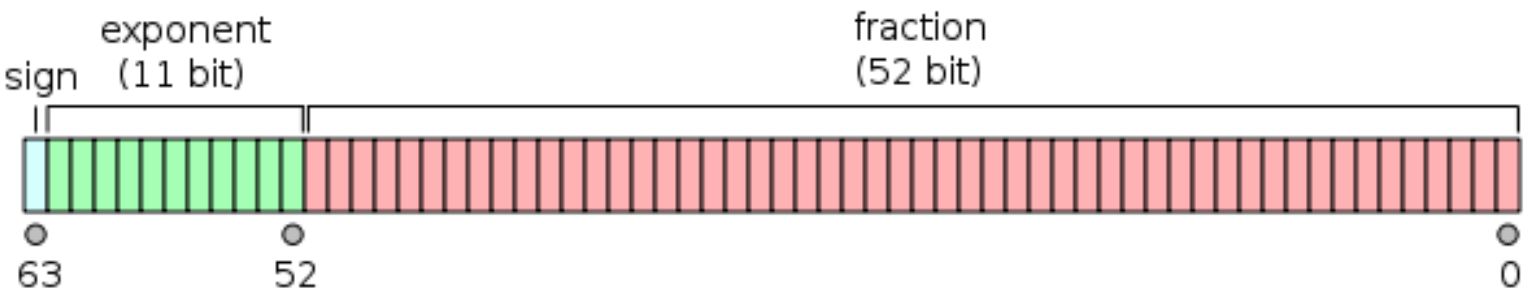
```csharp
Console.WriteLine("{0:R}", .1 + .2);

// 0.30000000000000004
```

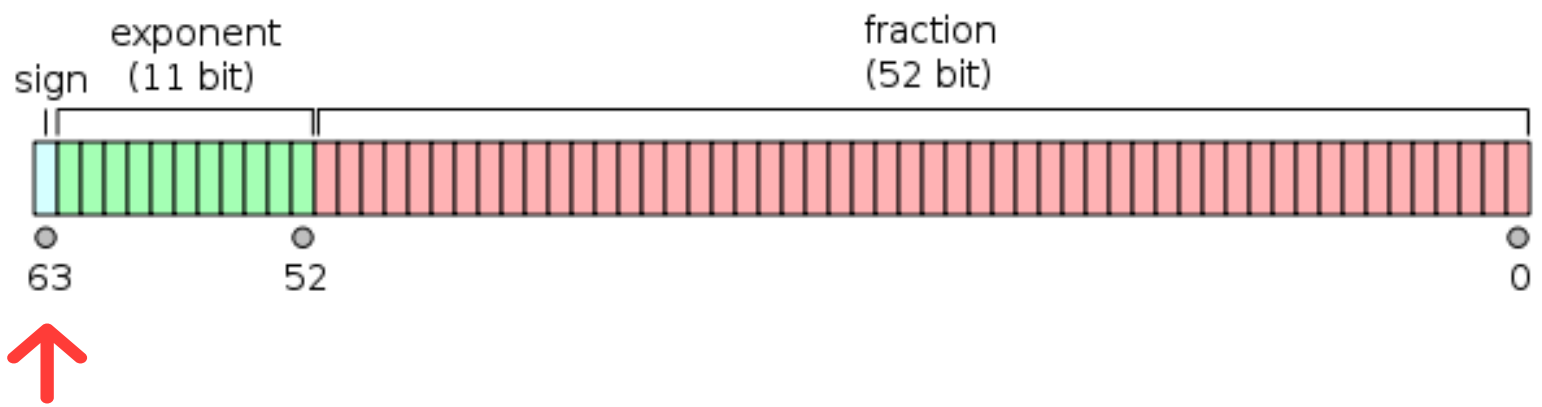
JavaScript

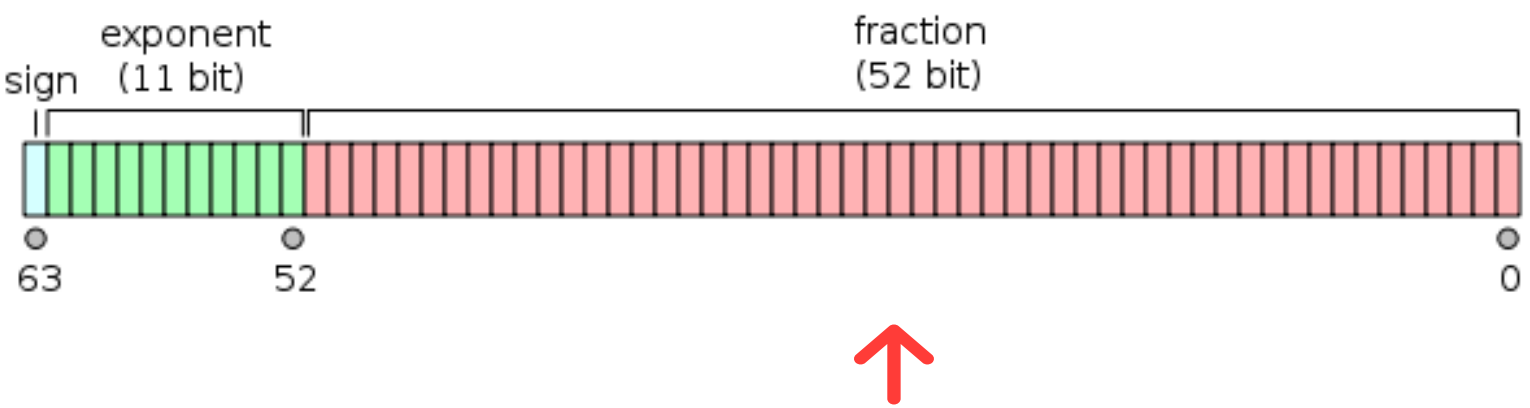
```javascript
console.log(.1 + .2);

// 0.30000000000000004
```

Before ES2020

JavaScript only had the number type


sign
exponent
(11 bit)
fraction
(52 bit)
63
52
0


sign
exponent
(11 bit)
fraction
(52 bit)
63
52
0


sign
exponent
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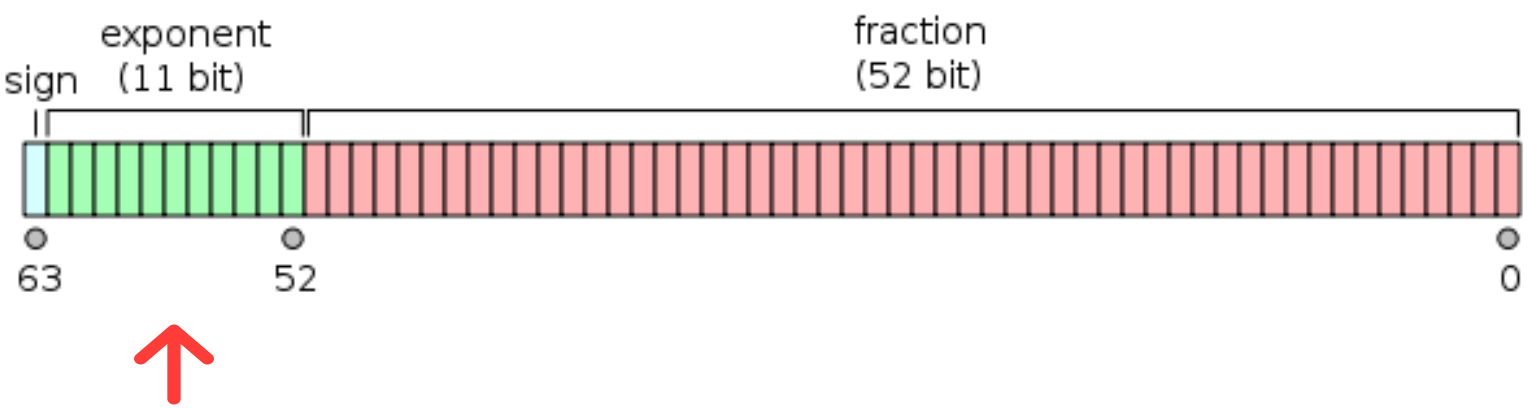
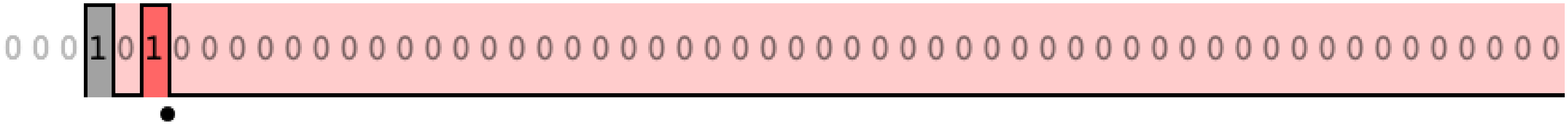
63
52
0


sign
exponent
(11 bit)
fraction
(52 bit)
63
52
0

5


0 0 0 1 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

0.75

0.75

1

0.75 x 2 = 1.5

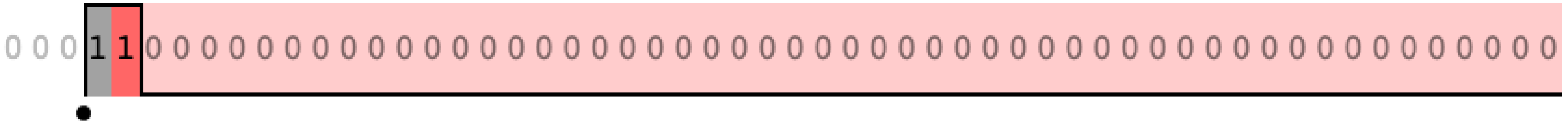
0.75

1 1

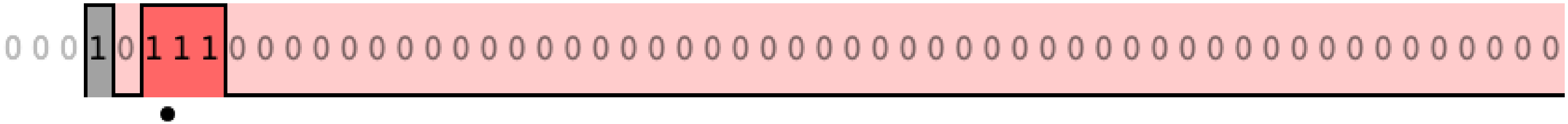
0.5 x 2 = 1

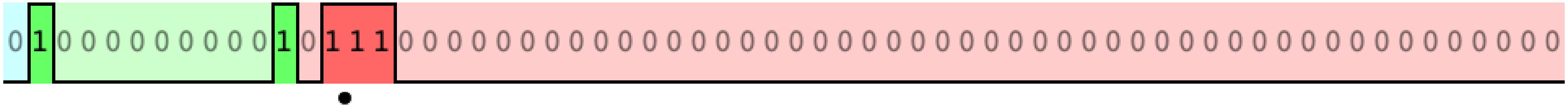
0.75

0.11


0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

5.75


0 0 0 1 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0


0 1 0 0 0 0 0 0 0 0 0 1 0 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

```
console.log(.1 + .2);

// 0.30000000000000004
```

0.1

0.1 + 0.2

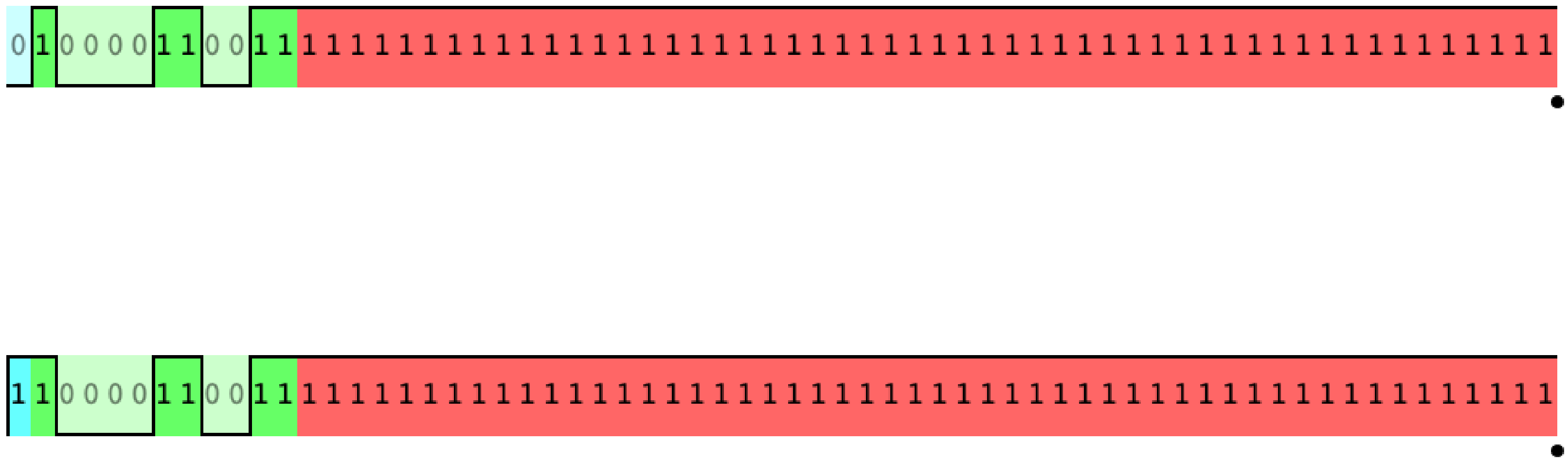
Same goes with

Large integers

```
Number.MAX_SAFE_INTEGER;

// 9007199254740991

Number.MAX_SAFE_INTEGER + 2;

// 9007199254740992
```

9007199254740991

-9007199254740991



0 1 0 0 0 0 1 1 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
1 1 0 0 0 0 1 1 0 0 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

What to do instead?

(1 + 2) / 10^1

```
Dinero({ amount: 500, currency: "USD" });

// represents $5
```

10n

```
9007199254740991n + 2n;

// 9007199254740993n
```

Arbitrary precision math is slower than floating point math.

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Arbitrary precision integers are still new.

bartaz.github.io/ieee754-visualization

0.30000000000000004.com

floating-point-gui.de

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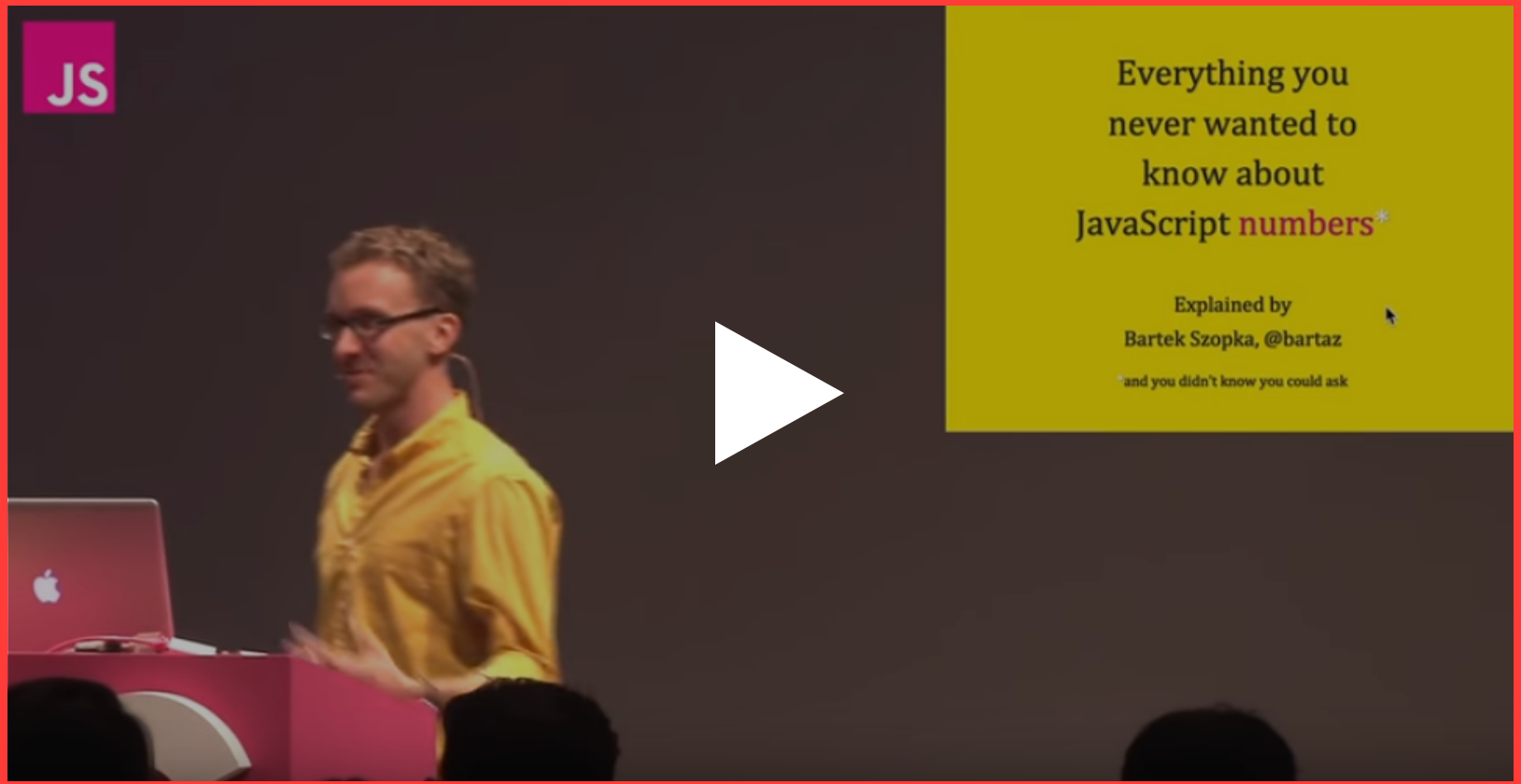

youtu.be/MqHDDtVYJRI

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Thank you!

sarahdayan.dev

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