NaN

"NaN" stands for:

Not a Number

What kinds of things give us NaN?

Fuzzy math

```
console.log(
  0 / 0,
  Infinity / Infinity,
  0 * Infinity,
  Infinity - Infinity,
  Math.pow(1, Infinity)
);
```

```
› NaN NaN NaN NaN NaN NaN
```

Complex Numbers

```
console.log(
  Math.sqrt(-1),
  Math.log(-1),
  Math.acos(2),
  Math.asin(2)
);
```

```
› NaN NaN NaN NaN
```

Turning things into Numbers

```
console.log(
  parseInt('hello'), parseFloat('world'),
  Number(undefined), Number({}),
  +{}, +undefined,
  +new Date('hello')
);
```

```
> NaN NaN NaN NaN NaN NaN NaN
```

What is NaN? (in JavaScript)

"Not a Number" is...

```
console.log(NaN);
```

```
> NaN
```

... a particular JavaScript value.

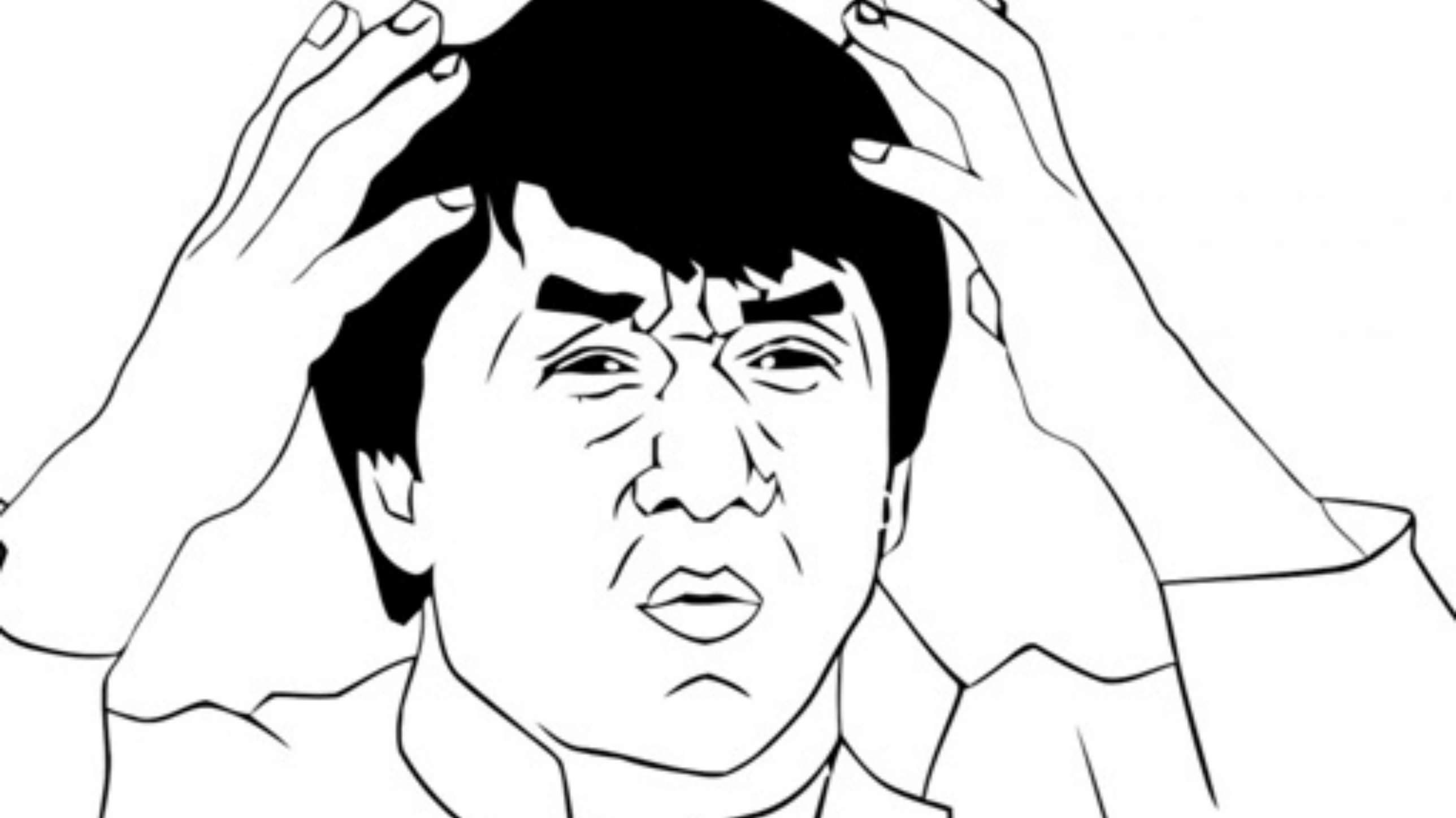
(*very* particular)

"Not a Number" is...

```
console.log(typeof NaN);
```

```
> number
```

...a Number.

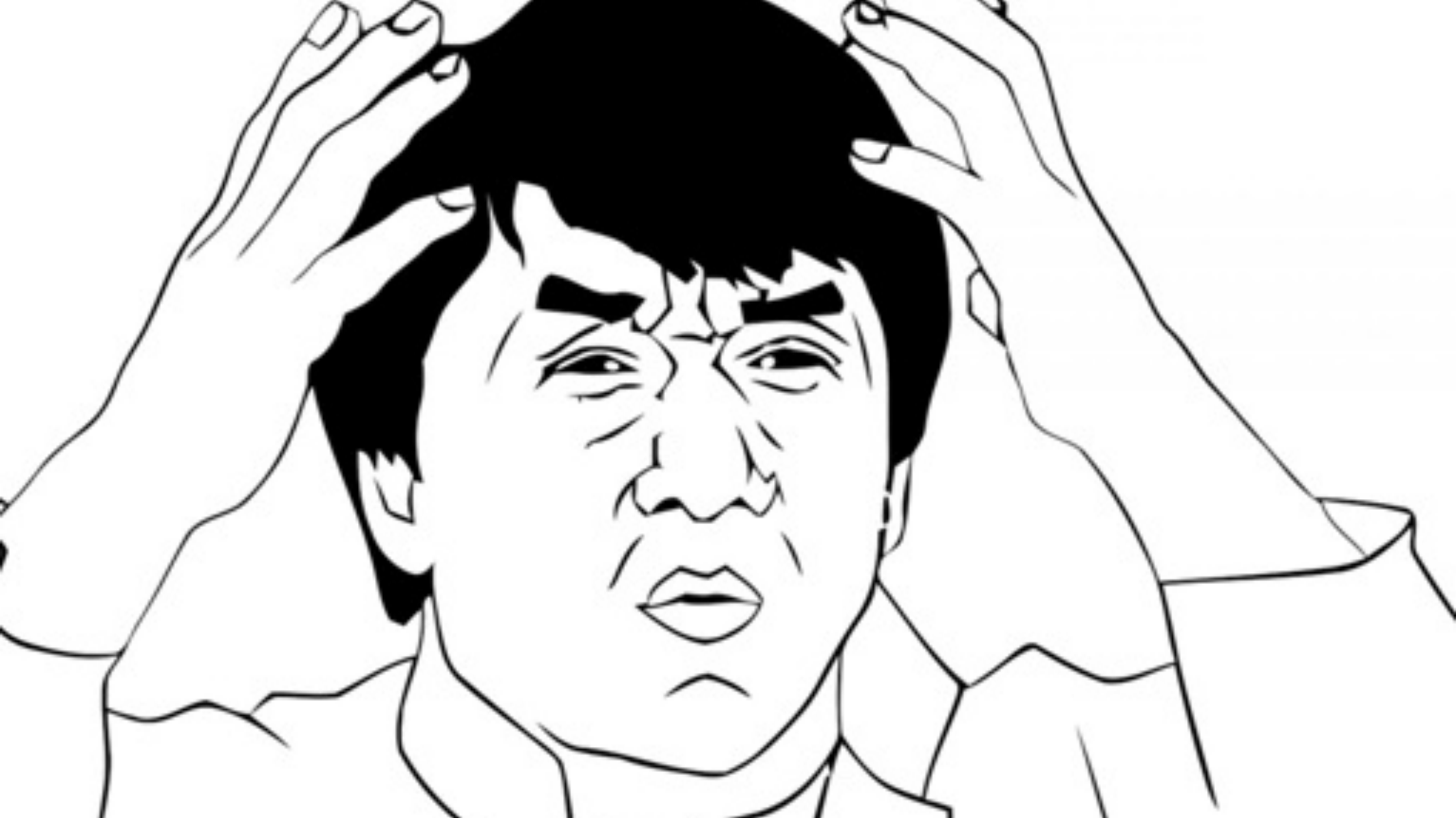


"Not a Number" is...

```
console.log(NaN === NaN);
```

```
› false
```

...not "Not a Number".



"Not a Number" is...

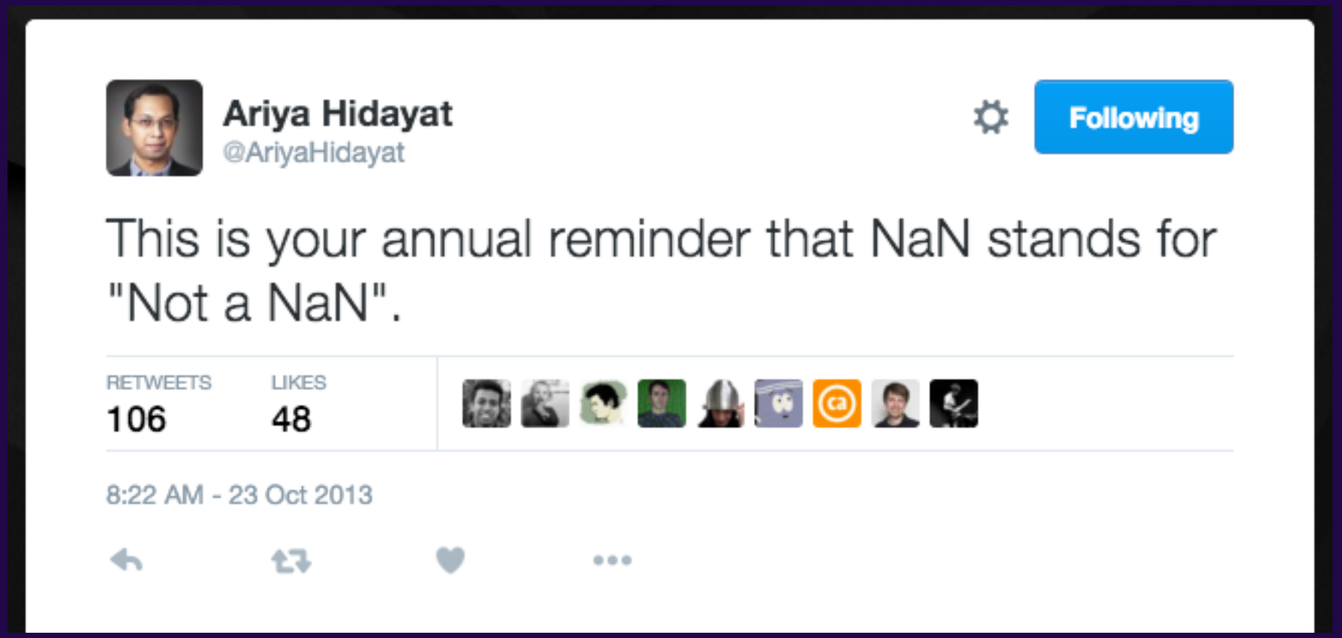
```
var assert = require('assert');
assert.equal(NaN, NaN);
```

```
› AssertionError: NaN == NaN
```

...tricky to test.

"NaN" actually stands for:

Not a NaN


Ariya Hidayat
@AriyaHidayat
Following
This is your annual reminder that NaN stands for "Not a NaN".
RETWEETS
106
LIKES
48
8:22 AM - 23 Oct 2013

So how do we tell if something is NaN?

Easy! Just use isNaN:

```
console.log(isNaN(NaN));
```

```
› true
```

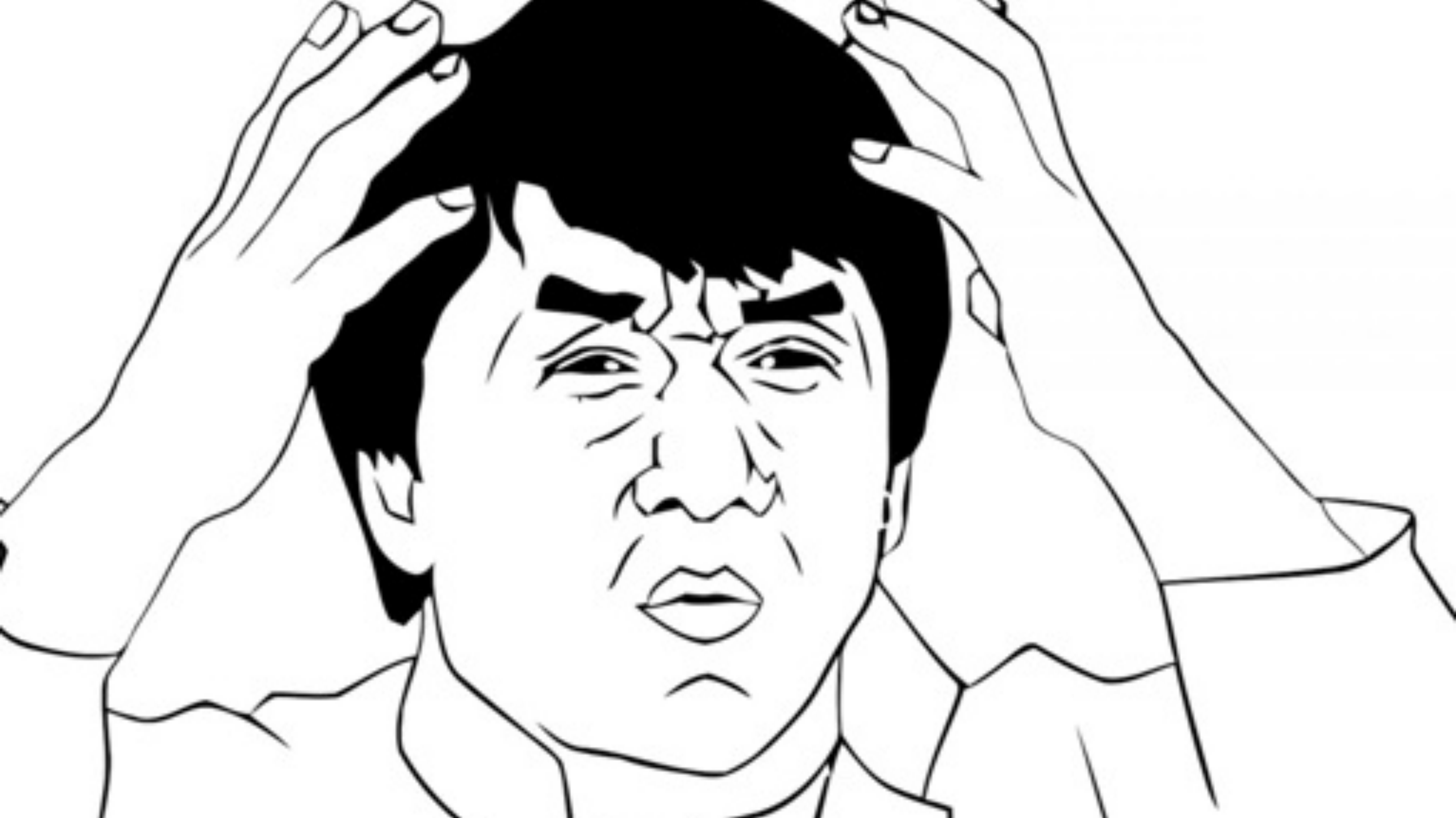
Or maybe not...

```
console.log(isNaN('hello'), isNaN(['hello']), isNaN({}));
```

```
> true true true
```

```
console.log(typeof 'hello', typeof ['hello'], typeof {});
```

```
> string object object
```



So let's just make our own:

```
function myIsNaN(x) {
  return typeof x === 'number' && isNaN(x);
}

console.log(myIsNaN(NaN), isNaN(NaN),
  myIsNaN('hello'), isNaN('hello'),
  myIsNaN(['hello']), isNaN(['hello']),
  myIsNaN({}), isNaN({})
);

> true true false true false true false true
```

Or we can recall "Not a NaN":

```
function myIsNaN(x) {
  return x !== x;
}

console.log(myIsNaN(NaN), isNaN(NaN),
  myIsNaN('hello'), isNaN('hello'),
  myIsNaN(['hello']), isNaN(['hello']),
  myIsNaN({}), isNaN({})
);
```

```
› true true false true false true false true
```

This works because NaN is the only non-reflexive value in JavaScript.

Number.isNaN was added recently:

```
console.log(Number.isNaN(NaN), isNaN(NaN),
  Number.isNaN('hello'), isNaN('hello'),
  Number.isNaN(['hello']), isNaN(['hello']),
  Number.isNaN({}), isNaN({})
);
```

...and it does what we want:

```
> true true false true false true false true
```

But NaN isn't just a JavaScript thing...

NaN is actually defined by the IEEE754 floating-point standard.

Bit representation of a float32 value:

- 1-bit sign
- 8-bit exponent
- 23-bit significand

```
0 10000000 01000000000000000000000 -> 2.5
```

Note: the significand is actually 24 bits, but only 23 are explicitly stored.

Bit representations of special values:

```
0 11111111 00000000000000000000000 -> Infinity
1 11111111 00000000000000000000000 -> -Infinity
0 11111111 10000000000000000000000 -> NaN
```

NaN values have a maximized exponent and a nonzero significand.

So these are also all NaN:

```
1 11111111 10000000000000000000000 -> NaN (quiet, negative)
0 11111111 10000000000000000000001 -> NaN (quiet, but different)
0 11111111 00000000000000000000001 -> NaN (signaling)
0 11111111 00000000000000000000010 -> NaN (signaling, but different)
0 11111111 00000000000000000000011 -> NaN (we can start counting!)
```

How many NaNs are there, really?

$2^{24} - 2 = 16777214$

And that's just with a float32!

What about a double64?

2^52 - 2 =

4503599627370494

That's 4.5 * 10^15, or 4.5 quadrillion.

4.5 petabytes is about 10,000 years worth of music.

If there are so many different possible NaNs, then it only seems reasonable...

...that one NaN is unlikely to be the same as another NaN!

Thus, NaN !== NaN.

Some Related Links

- http://ariya.ofilabs.com/2014/05/the-curious-case-of-javascript-nan.html
- http://www.2ality.com/2012/02/nan-infinity.html
- https://en.wikipedia.org/wiki/NaN

Who are you and where can I find the slides?

- I'm Lewis J Ellis: @lewisjellis on Twitter and GitHub
- My website is LewisJEllis.com.
- Slides available at GitHub.com/LewisJEllis/nantalk