JavaScript: Coercion and Functions

Lecture 23

Conversion of Primitive Values

		string	number	boolean
numbers	`0`	`"0"`		`false`
	`-0`	`"0"`		`false`
	`1`	`"1"`		`true`
	`NaN`	`"NaN"`		`false`
	`Infinity`	`"Infinity"`		`true`
	`-Infinity`	`"-Infinity"`		`true`
	`6.022e23`	`"6.022e+24"`		`true`

Conversion of Primitive Values

		string	number	boolean
boolean	true	"true"	1	
	false	"false"	0	
strings	""		0	false
	" "		0	true
	"1.2"		1.2	true
	"0"		0	true
	"one"		NaN	true

Conversion of Primitive Values

		string	number	boolean
undefined	`undefined`	`"undefined"`	`NaN`	`false`
null	`null`	`"null"`	`0`	`false`

Summary of (Simple?) Rules

- How do numbers convert to things?
  - Boolean: 0 is false, non-0 is true (exception: NaN)
- How do strings convert to things?
  - Numbers: non-valid syntax give NaN (exception: empty/blank give 0)
  - Boolean: true, only empty string is false
- How does undefined convert to things?
  - Number: NaN
- How does null convert to things?
  - Number: 0

Easier? Column-Major View

- How do things convert to boolean?
  - Empty string is `false`
  - Numbers `(+/-)0` and `NaN` are `false`
  - `undefined` and `null` are `false`
- Aka “falsy” (vs. “truthy”)
- Importance: Boolean contexts

```
if (pet)… // evaluate pet as a boolean
```

- Pitfall: &&, || may not result in a boolean
  - `x || y` means `x ? x : y` (first `x` converted)

```
p = "cat" || "dog"    //=> p == "cat"
```

  - Old idiom: `!!x` forces conversion to boolean

```
p = !!("cat" || "dog") //=> p == true
```

Easier? Column-Major View

- How do things convert to Numbers?
  - Empty (and whitespace) string is `0`
  - Non-numeric strings are **`NaN`**
  - **`undefined`** is **`NaN`**
  - **`null`** is 0
- Importance: Used in == evaluation

== Evaluation is… Different

- When types do not match, coerce:
  - **`null`** & **`undefined`** (only) equal each other
  - Strings & booleans converted to *numbers*

    `"1.0" == true && "" == false`
  - Pitfall: **`NaN`** is *not equal* to **`NaN`**
- When *one* operand is an object:
  - Convert via **`valueOf`** (fall back **`toString`**)
  - Result then compared with usual == rules
  - Note: no coercion when *both* operands are references (== means reference equality)
- Sanity:
  - Use === since it never coerces

Your Turn

Evaluate: True or false?

```
true == '1'

'false' == false

0 == '0'

0 == ''

NaN == NaN
```

Surprising Consequences

```
false == 'false'    //=>
false == '0'        //=>
!!'0'               //=>
('0' == 0) && (0 == '') &&
              ('0' != '') //=>
(NaN == true) || (NaN == false)
                    //=>
!!NaN               //=>
(NaN != 0) && (!!NaN == !!0)
                    //=>
```

- dorey.github.io/JavaScript-Equality-Table

Functions are People too

- Named functions: declaration & use

```
function foo(a, b) { … }
foo("hi", 3);
```

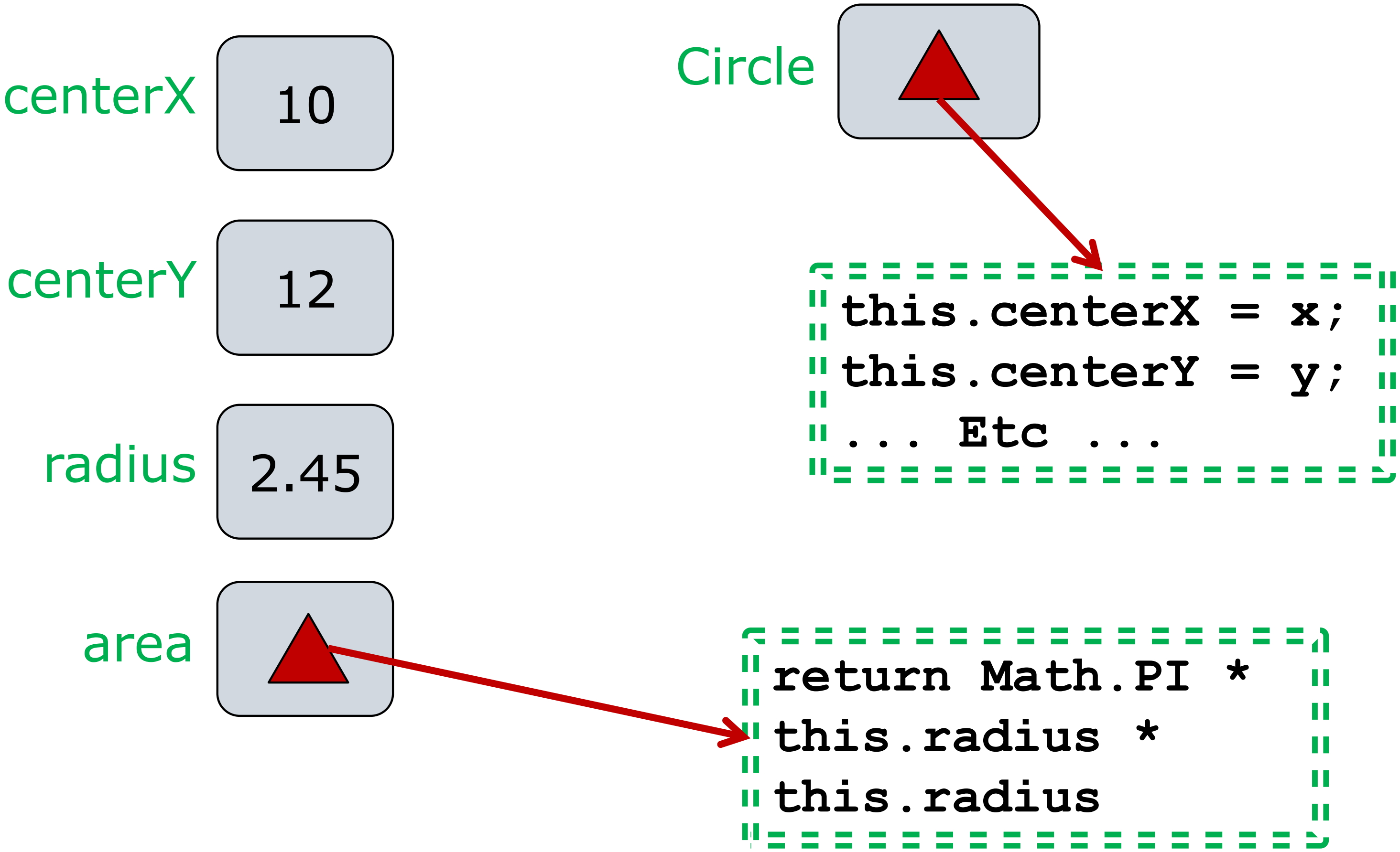
- Anonymous functions

```
function(a, b) { … }
// how is such a thing invoked?
```

- Functions are objects (first-class citizens)
- They can be assigned to variables!

```
let foo = function(a, b) {…};
foo("hi", 3);
let bar = foo;  // cf. let bar = foo();
bar("world", 17);
```

Functions are Objects



```
this.centerX = x;
this.centerY = y;
... Etc ...
```

```
return Math.PI *
this.radius *
this.radius
```

Functions Can Be Arguments

```
function apply(f, a) {
  return f(a); // f is a function!
}

function square(i) {
  return i * i;
}

apply(square, 5) //=> 25
```

Functions Can Be Return Values

```
function grantDegree() {
  function addTitle(name) {
    return `Dr. ${name}`;
  }
  return addTitle; // a function!
}

let phd = grantDegree();
phd("Turing"); // phd is a function
phd(3/2);      //=> "Dr. 1.5"
```

Closures

```
function greaterThan(bound) {
  function compare(value) {
    return value > bound;
  }
  return compare; // 1-arg function
}

let testPos = greaterThan(0);
testPos(4)  //=> true
testPos(-3) //=> false
```

Closures + Anonymity

```
function greaterThan(bound) {
  function compare(value) {
    return value > bound;
  }
  return compare; // 1-arg function
}

let testPos = greaterThan(0);
testPos(4)  //=> true
testPos(-3) //=> false
```

Closures + Anonymity

```
function greaterThan(bound) {
  let compare = function(value) {
    return value > bound;
  }
  return compare; // 1-arg function
}

let testPos = greaterThan(0);
testPos(4)  //=> true
testPos(-3) //=> false
```

Closures + Anonymity

```
function greaterThan(bound) {
  return function(value) {
    return value > bound;
  }
}


let testPos = greaterThan(0);
testPos(4)  //=> true
testPos(-3) //=> false
```

Arrow Function Expressions

- Concise notation for anon. functions
- Syntax:
  - Omit **`function`** keyword
  - Place arrow **=>** between params and body
  - `(a, b = 10) => { ... }`

```
(r) => { return Math.PI * r**2 }
```

- For one-liner, can omit **`return`** and **`{}`** ’s

```
(r) => Math.PI * r**2
```

- For one parameter, can omit () ’s

```
r => Math.PI * r**2
```

- Use where function expressions needed

```
let area = r => Math.PI * r**2
```

Closures + Anonymity Revisited

```
function greaterThan(bound) {
  return value => value > bound;
}
```

```
let testPos = greaterThan(0);
testPos(4)  //=> true
testPos(-3) //=> false
```

Summary

- Truthy, falsey, and friends
  - Type coercion is everywhere
  - Coerce to boolean in conditionals
  - Coerce to number for ==
- Functions as first-class citizens
  - Can be passed as arguments
  - Can be returned as return values!
  - Closure: carry their context

IIFE

- Immediately Invoked Function Expression
  - Define *and* invoke function at the same time
- Basic forms:
  - `(function(){ /* code here */ })();`
  - `let n = function(){ /* code here*/ }();`
- Work-around for weird JavaScript scoping
  - **`var`** scopes variables to the enclosing *function*
  - IIFE creates a lexical scope (with closures)
- Modern JavaScript has **`let`** (and **`const`**)
  - These scope variables to the enclosing *block*
  - General advice: prefer **`let`** to **`var`**
  - But IIFEs are still encountered in the wild