

Objects as Aggregates

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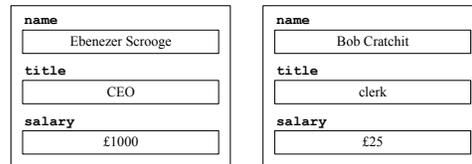
Objects in JavaScript

- JavaScript uses the word “object” in a frustratingly imprecise way.
- Unsurprisingly, the word “object” is used for the encapsulated data collections one finds in the object-oriented programming paradigm, as Eric will describe on Friday.
- Unfortunately, JavaScript uses the same word to refer to any collection of individual data items. In other programming languages, this idea is often called a “structure,” a “record,” or an “aggregate.” We will use “aggregate” when we want to restrict consideration to objects of this more primitive form.

Objects as Aggregates

- Even though modern programming practice tends to favor the object-oriented model, it is still important to understand the more traditional view of objects as data aggregates.
- Aggregates are used to represent situations in the real world in which several independent pieces of data are all part of a single unified structure. In contrast to an array, the data elements in an aggregate are often of different types and are identified by name rather than by a sequence number.
- The first example in the text imagines keeping track of the data for the employees of Scrooge and Marley, the company from Charles Dickens’s *A Christmas Carol*. Each employee is identified by a name, a job title, and a salary. A diagram of the two employees at the company appears on the next slide.

Employees at Scrooge and Marley



Using JSON to Create Objects

- The easiest way to create new aggregates in JavaScript is to use *JavaScript Object Notation* or *JSON*.
- In JSON, you specify an object simply by listing its contents as a sequence of name-value pairs. The name and the value are separated by a colon, the name-value pairs are separated by commas, and the entire list is enclosed in curly braces.
- The following declarations create variables named `ceo` and `clerk` for the employees diagrammed on the previous slide:

```
var ceo = {  
  name: "Ebenezer Scrooge",  
  title: "CEO",  
  salary: 1000  
};  
  
var clerk = {  
  name: "Bob Cratchit",  
  title: "clerk",  
  salary: 25  
};
```

Selecting Fields from an Object

- Given an object, you can select an individual field by writing an expression denoting the object and then following it by a dot and the name of the field. For example, the expression `ceo.name` returns the string "Ebenezer Scrooge"; similarly, `clerk.salary` returns the number 25.
- Fields are assignable. For example, the statement

```
clerk.salary *= 2;
```

doubles poor Mr. Cratchit’s salary.
- Fields selection can also be expressed using square brackets enclosing the name of the field expressed as a string, as in `ceo["name"]`. This style is necessary if the name of the field is not a simple identifier or if the name is computed by the program.

Arrays of Objects

- Since arrays can contain values of any type, the elements of an array can be JavaScript objects. For example, the employees at Scrooge and Marley can be initialized like this:

```
var employees = [
  { name: "Ebenezer Scrooge", title: "CEO", salary: 1000 },
  { name: "Bob Cratchit", title: "clerk", salary: 25 }
];
```

- The following function prints the payroll for the employee array supplied as an argument:

```
function printPayroll(employees) {
  for (var i = 0; i < employees.length; i++) {
    var emp = employees[i];
    console.log(emp.name + " (" + emp.title + ") £" +
      emp.salary);
  }
}
```

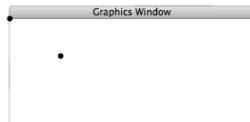
Exercise: Hogwarts Student Data

- How would you design an aggregate for keeping track of the following information about a student at Hogwarts:
 - The name of the student
 - The student's house
 - The student's year at Hogwarts
 - A flag indicating if the student has passed the O.W.L. exam
- How would you code this data for the following students:
 - Hermione Granger, Gryffindor, 5th year, passed O.W.L. exam
 - Luna Lovegood, Ravenclaw, 4th year, not yet passed O.W.L.
 - Vincent Crabbe, Slytherin, 5th year, failed O.W.L exam
- Just for fun, think about other data values that might be useful about a Hogwarts student and what types you would use to represent these values.

Representing Points as Aggregates

- One data aggregate that comes in handy in graphics captures the abstract notion of a *point* in two-dimensional space, which is composed of an *x* and a *y* component.
- Points can be created in JavaScript simply by writing their JSON notation, as in the following examples, which are shown along with their positions in the graphics window.

```
var p1 = { x: 0, y: 0 };
var p2 = { x: 90, y: 70 };
```



- The *x* and *y* components of **p1** can be selected as **p1.x** and **p1.y**, respectively.

Factory Functions

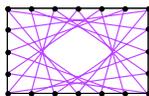
- Although JSON notation is compact and easy to read, it is often useful to define a function that creates a JavaScript object. Such functions are called *factories* and are written in the book using an uppercase initial letter.
- The following function creates a point-valued object for which the coordinate values default to the (0, 0) point at the origin:

```
function Point(x, y) {
  if (x === undefined) {
    x = 0;
    y = 0;
  }
  return { x: x, y: y };
}
```

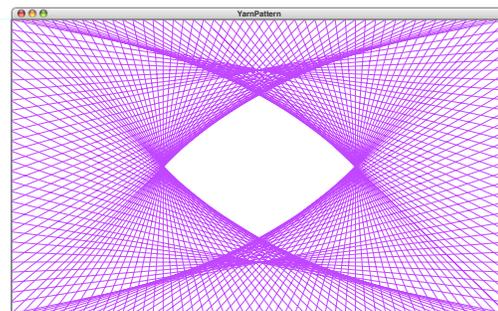
This *x* is a name. This *x* is a value.

Points and Graphics

- Points turn up often in graphical applications, particularly when you need to store the points in an array or an object.
- As a aesthetically pleasing illustration of the use of points and the possibility of creating dynamic pictures using nothing but straight lines, the text presents the program **YarnPattern.js**, which simulates the following process:
 - Place a set of pegs at regular intervals around a rectangular border.
 - Tie a piece of colored yarn around the peg in the upper left corner.
 - Loop that yarn around the peg a certain distance **DELTA** ahead.
 - Continue moving forward **DELTA** pegs until you close the loop.



A Larger Sample Run



The YarnPattern Program

```

/*
 * Creates a pattern that simulates winding a piece of yarn
 * around an array of pegs at the edges of the graphics window.
 */

function YarnPattern() {
  var gw = GWindow(GWINDOW_WIDTH, GWINDOW_HEIGHT);
  var pegs = createPegArray(GWINDOW_WIDTH, GWINDOW_HEIGHT,
                           N_ACROSS, N_DOWN);

  var thisPeg = 0;
  var nextPeg = -1;
  while (thisPeg !== 0 || nextPeg === -1) {
    nextPeg = (thisPeg + DELTA) % pegs.length;
    var p0 = pegs[thisPeg];
    var p1 = pegs[nextPeg];
    var line = GLine(p0.x, p0.y, p1.x, p1.y);
    line.setColor("Magenta");
    gw.add(line);
    thisPeg = nextPeg;
  }
}

```

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The YarnPattern Program

```

/*
 * Creates an array of pegs around the perimeter of a rectangle
 * with the specified width and height. The number of pegs in
 * each dimension is specified by nAcross and nDown.
 */

function createPegArray(width, height, nAcross, nDown) {
  var dx = width / nAcross;
  var dy = height / nDown;
  var pegs = [ ];
  for (var i = 0; i < nAcross; i++) {
    pegs.push(Point(i * dx, 0));
  }
  for (var i = 0; i < nDown; i++) {
    pegs.push(Point(nAcross * dx, i * dy));
  }
  for (var i = nAcross; i > 0; i--) {
    pegs.push(Point(i * dx, nDown * dy));
  }
  for (var i = nDown; i > 0; i--) {
    pegs.push(Point(0, i * dy));
  }
  return pegs;
}

```

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The YarnPattern Program

```

/*
 * Creates a new Point object. If this function is called with
 * no arguments, it creates a Point object at the origin.
 */

function Point(x, y) {
  if (x === undefined) {
    x = 0;
    y = 0;
  }
  return { x: x, y: y };
}

/* Constants */

const GWINDOW_WIDTH = 1000;
const GWINDOW_HEIGHT = 625;
const N_ACROSS = 80;
const N_DOWN = 50;
const DELTA = 113;

```

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