Animating multiple objects

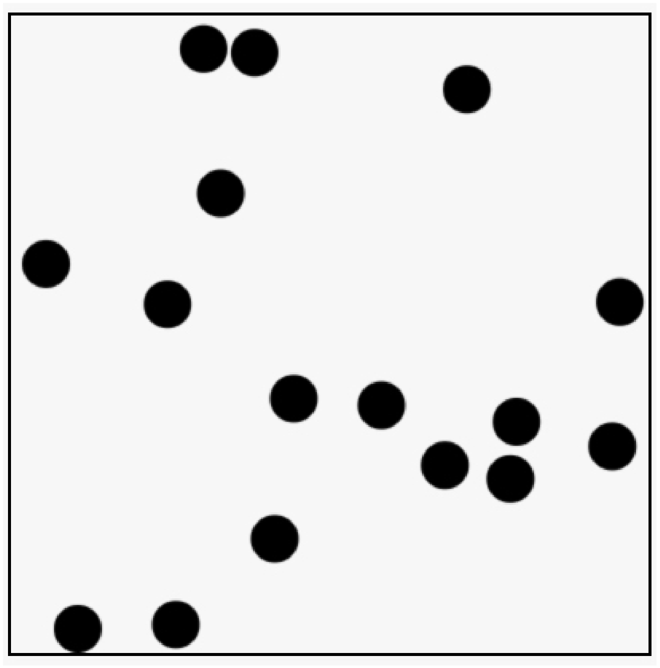
INTRODUCTION

In this section we will see how we can animate and control the player, but also animate other objects on the screen.

Let's study a simple example: animating a few balls and detecting collisions with surrounding walls. For the sake of simplicity, we will not use time-based animation in the first examples.

FIRST EXAMPLE: ANIMATE MULTIPLE BALLS THAT BOUNCE AGAINST HORIZONTAL AND VERTICAL WALLS

Online example at JSBin:



In this example, we defined *a constructor function* for creating balls. This is a way to design JavaScript "pseudo classes" we find in other object oriented languages like Java, C# etc. It's useful when you plan to create many objects of the same class. Here, we are going to animate maybe hundreds of balls on the screen.

Each ball has an `x` and `y` position, and in this example, instead of working with angles, we defined two "speeds" - horizontal and vertical speeds - in the form of increments we will add to the `x` and `y`positions at each frame of animation. We also added a variable for adjusting the size of the balls: the `radius`.

Here is the constructor function for building balls:

```
// Constructor function for balls
function Ball(x, y, vx, vy, diameter) {
  // property of each ball: a x and y position, speeds,
radius
  this.x = x;
  this.y = y;
  this.vx = vx;
  this.vy = vy;
  this.radius = diameter/2;
  // methods
  this.draw = function() {
    ctx.beginPath();
    ctx.arc(this.x, this.y, this.radius, 0,2*Math.PI);
    ctx.fill();
  };
  this.move = function() {
    // add horizontal increment to the x pos
    // add vertical increment to the y pos
    this.x += this.vx;
    this.y += this.vy;
 };
}
```

Using a constructor function makes it easy to build new balls as follows:

```
var b1 = new Ball(10, 10, 2, 2, 5); // x, y, vx, vy, radius
var b1 = new Ball(100, 130, 4, 5, 5);
etc...
```

We defined two methods in the constructor function for moving the ball and for drawing the ball as a black filled circle. Here is the syntax for moving and drawing a ball:

```
b1.draw();
b1.move();
```

We will call these methods from inside the mainLoop, and as you'll see, we will create many balls. This object oriented design makes it easier to deal with multiple objects.

Here is the rest of the code from this example:

```
var canvas, ctx, width, height;
// array of balls to animate
var ballArray = [];
function init() {
  canvas =document.querySelector("#myCanvas");
  ctx = canvas.getContext('2d');
  width = canvas.width;
  height = canvas.height;
  // try to change this number
  createBalls(16);
  requestAnimationFrame(mainLoop);
}
function createBalls(numberOfBalls) {
  for(var i=0; i < numberOfBalls; i++) {

    // Create a ball with random position and speed.
    // You can change the radius
    var ball = new Ball(width*Math.random(),
                        height*Math.random(),
                        (10*Math.random())-5,
                        (10*Math.random())-5,
                        30);
    // add the ball to the array
    ballArray[i] = ball;
   }
}
```

```
function mainLoop() {
  // clear the canvas
  ctx.clearRect(0, 0, width, height);
  // for each ball in the array
  for(var i=0; i < ballArray.length; i++) {
    var ball = ballArray[i];
    // 1) move the ball
    ball.move();
    // 2) test if the ball collides with a wall
    testCollisionWithWalls(ball);
    // 3) draw the ball
    ball.draw();
  }
  // ask for a new frame of animation at 60f/s
  window.requestAnimationFrame(mainLoop);
}
function testCollisionWithWalls(ball) {
  // left
  if (ball.x < ball.radius) { // x and y of the ball are at
the center of the circle
    ball.x = ball.radius;     // if collision, we replace the
ball at a position
    ball.vx *= -1;            // where it's exactly in
contact with the left border
  }                           // and we reverse the
horizontal speed
  // right
  if (ball.x > width - (ball.radius)) {
    ball.x = width - (ball.radius);
    ball.vx *= -1;
  }
  // up
  if (ball.y < ball.radius) {
    ball.y = ball.radius;
    ball.vy *= -1;
  }
  // down
  if (ball.y > height - (ball.radius)) {
    ball.y = height - (ball.radius);
    ball.vy *= -1;
  }
}
```

Notice that:

- All the balls are stored in an array (*line 4*),
- We wrote a `createBalls(nb)` function that creates a given number of balls (and stores them in the array) with random values for position and speed (*lines 18-32*)
- In the mainLoop, we iterate on the array of balls and for each ball we: 1) move it, 2) test if it collides with the boundaries of the canvas (in the function `testCollisionWithWalls`), and 3) we draw the balls (*lines 38-50*). The order of these steps is not critical and may be changed.
- The function that tests collisions is straightforward (*lines 55-76*). We did not use "if... else if" since a ball may sometimes touch two walls at once (in the corners). In that rare case, we need to invert both the horizontal and vertical speeds. When a ball collides with a wall, we need to replace it in a position where it is no longer in collision (otherwise it will collide again during the next animation loop execution).

SAME EXAMPLE BUT WITH THE BALL DIRECTION AS AN ANGLE, AND A SINGLE SPEED VARIABLE

Try this example at JSBin: it behaves in the same way as the previous example.

Note that we just changed the way we designed the balls and computed the angles after rebound against the walls. The changes are highlighted in bold:

```
var canvas, ctx, width, height;
// Array of balls to animate
var ballArray = [];
function init() {
  ...
}
function createBalls(numberOfBalls) {
  for(var i=0; i < numberOfBalls; i++) {
    // Create a ball with random position and speed.
    // You can change the radius
    var ball = new Ball(width*Math.random(),
                         height*Math.random(),
              (2*Math.PI)*Math.random(), // angle
              (10*Math.random())-5,      // speed
                         30);
   // We add it in an array
   ballArray[i] = ball;
  }
}
function mainLoop() {
  ...
}
function testCollisionWithWalls(ball) {
  // left
  if (ball.x < ball.radius) {
     ball.x = ball.radius;
     ball.angle = -ball.angle + Math.PI;
  }
  // right
  if (ball.x > width - (ball.radius)) {
    ball.x = width - (ball.radius);
    ball.angle = -ball.angle + Math.PI;
  }
  // up
  if (ball.y < ball.radius) {
    ball.y = ball.radius;
    ball.angle = -ball.angle;
  }
  // down
  if (ball.y > height - (ball.radius)) {
    ball.y = height - (ball.radius);
    ball.angle =-ball.angle;
  }
}
// constructor function for balls
function Ball(x, y, angle, v, diameter) {
  this.x = x;
  this.y = y;
  this.angle = angle;
  this.v = v;
  this.radius = diameter/2;
  this.draw = function() {
   ...
  };
  this.move = function() {
   // add horizontal increment to the x pos
   // add vertical increment to the y pos
   this.x += this.v * Math.cos(this.angle);
   this.y += this.v * Math.sin(this.angle);
  };
}
```

Using angles or horizontal and vertical increments is equivalent. However, one method might be preferable to the other: for example, to control an object that follows the mouse, or that tracks another object in order to attack it, angles will be more practical in terms of maths.