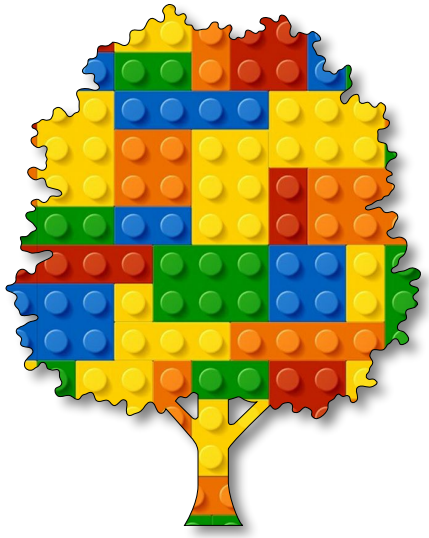
Algorithmic Art

Module E

Unit #4

smoke and fire



Content

Section E Unit #4 smoke and fire

Introduction to smoke and fire

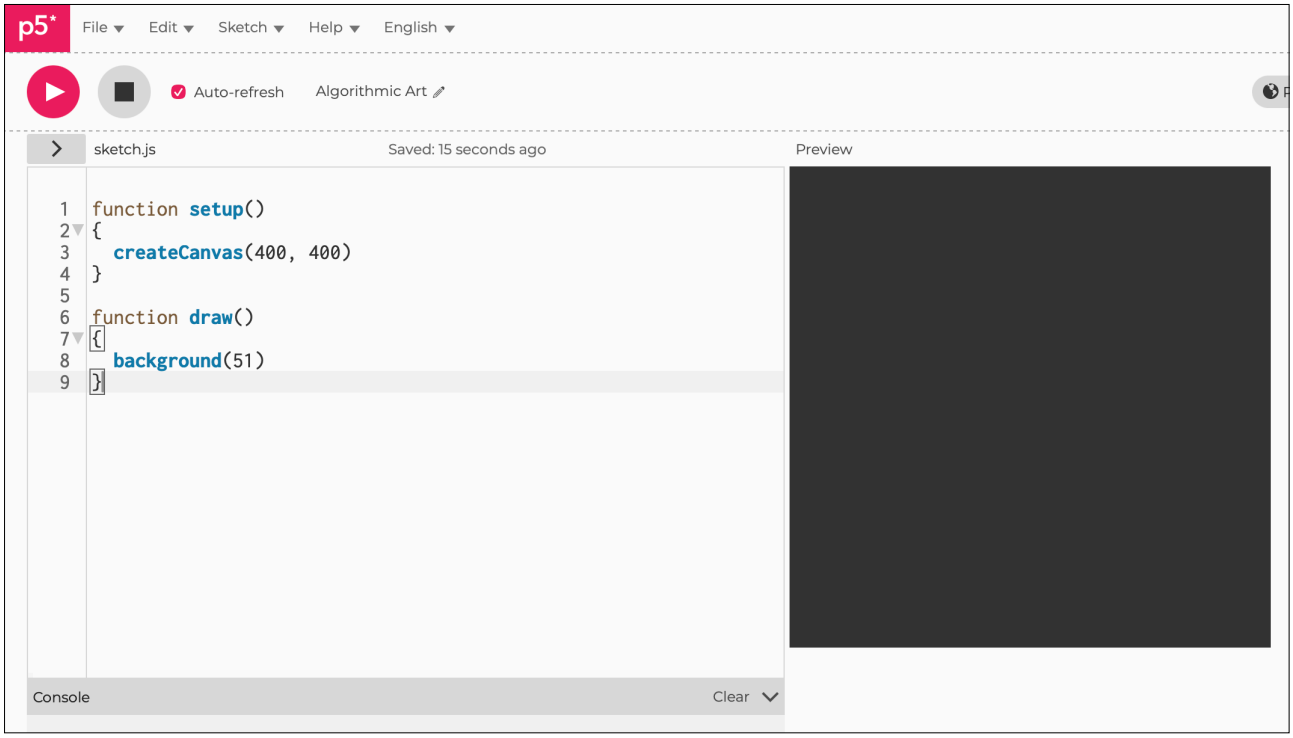
Creating a simple smoke or fire effect using a simple particle system with p5.js.

Sketch E4.1 starting sketch

This is our basic sketch; this gives us a nice dark background for a change.

```
function setup()
{
  createCanvas(400, 400)
}

function draw()
{
  background(51)
}
```

Figure E4.1



Sketch E4.2 adding a particle class

We are going to add a particle class with a constructor function. We want the particles to start near the bottom and in the middle, then travel up and fade.

```
function setup()
{
  createCanvas(400, 400)
}

function draw()
{
  background(51)
}
```

```
class Particle
{
  constructor()
  {
    this.x = 200
    this.y = 380
  }
}
```

Notes

Nothing has changed.

Sketch E4.3 adding move and show

We want a `show()` function and a `move()` function.

```
function setup()
{
  createCanvas(400, 400)
}

function draw()
{
  background(51)
}

class Particle
{
  constructor()
  {
    this.x = 200
    this.y = 380
  }

  show()
  {

  }

  move()
  {

  }
}
```

Sketch E4.4 draw a circle

We draw a circle at these x and y co-ordinates filling it with white (255).

```
function setup()
{
  createCanvas(400, 400)
}

function draw()
{
  background(51)
}

class Particle
{
  constructor()
  {
    this.x = 200
    this.y = 380
  }

  show()
  {
    stroke(255)
    fill(255, 10)
    circle(this.x, this.y, 16)
  }

  move()
  {

  }
}
```

Sketch E4.5 particle p

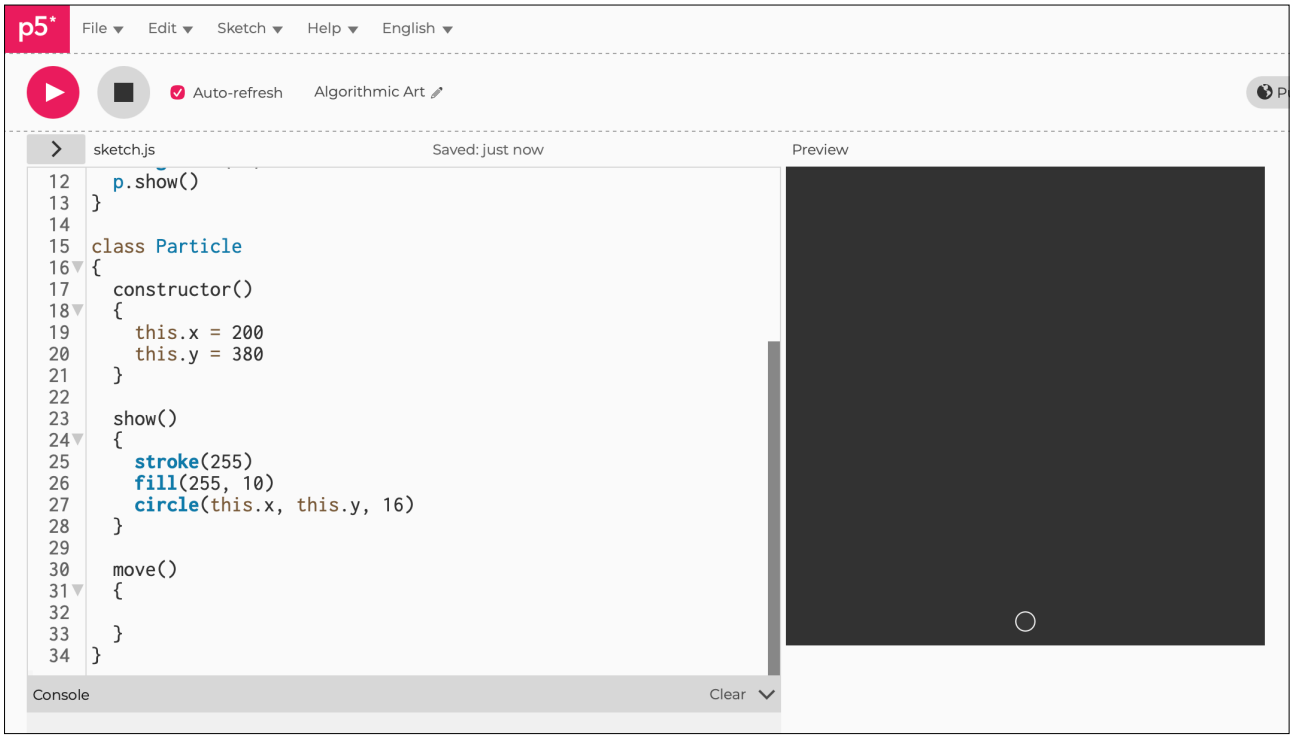
Let's create one particle called p so we can see it.

```
let p

function setup()
{
  createCanvas(400, 400)
  p = new Particle()
}

function draw()
{
  background(51)
  p.show()
}

class Particle
{
  constructor()
  {
    this.x = 200
    this.y = 380
  }

  show()
  {
    stroke(255)
    fill(255, 10)
    circle(this.x, this.y, 16)
  }

  move()
  {

  }
}
```

🗒️ Notes

At last, we have something to see!

Figure E4.5



Sketch E4.6 an array of particles

We want to create many particles, so we create an array and `push()` them into the array using a `for()` loop. We will start with just one particle.

```
let p
let particles = []

function setup()
{
  createCanvas(400, 400)
  p = new Particle()
  particles.push(p)
}

function draw()
{
  background(51)
  for (let i = 0; i < particles.length; i++)
  {
    particles[i].show()
  }
}

class Particle
{
  constructor()
  {
    this.x = 200
    this.y = 380
  }

  show()
  {
    stroke(255)
    fill(255, 10)
    circle(this.x, this.y, 16)
  }
```

```
  move()
  {

  }
}
```

🗒️ Notes

You should have exactly the same as before.

Sketch E4.7 move the particle

Let's give it some movement, velocity. We create two variables called velX and velY.

```
let p
let particles = []

function setup()
{
  createCanvas(400, 400)
  p = new Particle()
  particles.push(p)
}

function draw()
{
  background(51)
  for (let i = 0; i < particles.length; i++)
  {
    particles[i].move()
    particles[i].show()
  }
}

class Particle
{
  constructor()
  {
    this.x = 200
    this.y = 380
    this.velX = random(-1, 1)
    this.velY = random(-5, -1)
  }

  show()
  {
    stroke(255)
    fill(255, 10)
```

```
    circle(this.x, this.y, 16)
  }

  move()
  {
    this.x += this.velX
    this.y += this.velY
  }
}
```

🗒️ Notes

The particle (circle) will drift upwards. Every time you replay the sketch, the particle will have a different (random) velocity.

The += symbol is shorthand for:

```
this.x = this.x + this.velX
this.y = this.y + this.velY
```

Sketch E4.8 many particles

We want more than one particle. To do this quickly, we cut and paste the following code from `setup()` into `draw()`.

! you delete those lines of code in `setup()`.

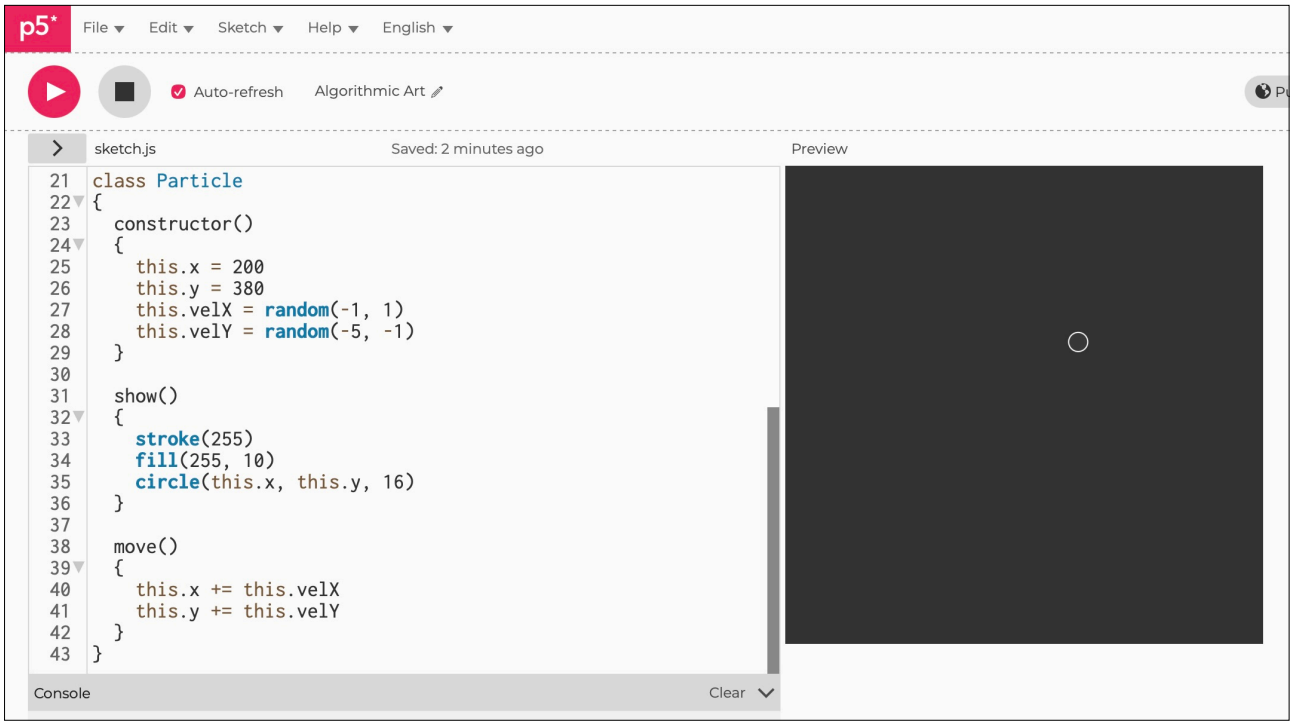
```
let p
let particles = []

function setup()
{
  createCanvas(400, 400)
  // p = new Particle()
  // particles.push(p)
}

function draw()
{
  background(51)
  p = new Particle()
  particles.push(p)
  for (let i = 0; i < particles.length; i++)
  {
    particles[i].movement()
    particles[i].show()
  }
}

class Particle
{
  constructor()
  {
    this.x = 200
    this.y = 380
    this.velX = random(-1, 1)
    this.velY = random(-5, -1)
  }
```

```
  show()
  {
    stroke(255)
    fill(255, 10)
    circle(this.x, this.y, 16)
  }

  move()
  {
    this.x += this.velX
    this.y += this.velY
  }
}
```

🗒️ Notes

You get a stream of particles.

Figure E4.8



Sketch E4.9 no smoke without fire

This is a pleasing effect but still not like smoke or fire. So we will introduce some alpha. This is so we can fade it and remove it altogether when it has disappeared; otherwise, the programme will run slower and slower as we create more and more articles.

❗ We replace `stroke(255)` with `noStroke()`.

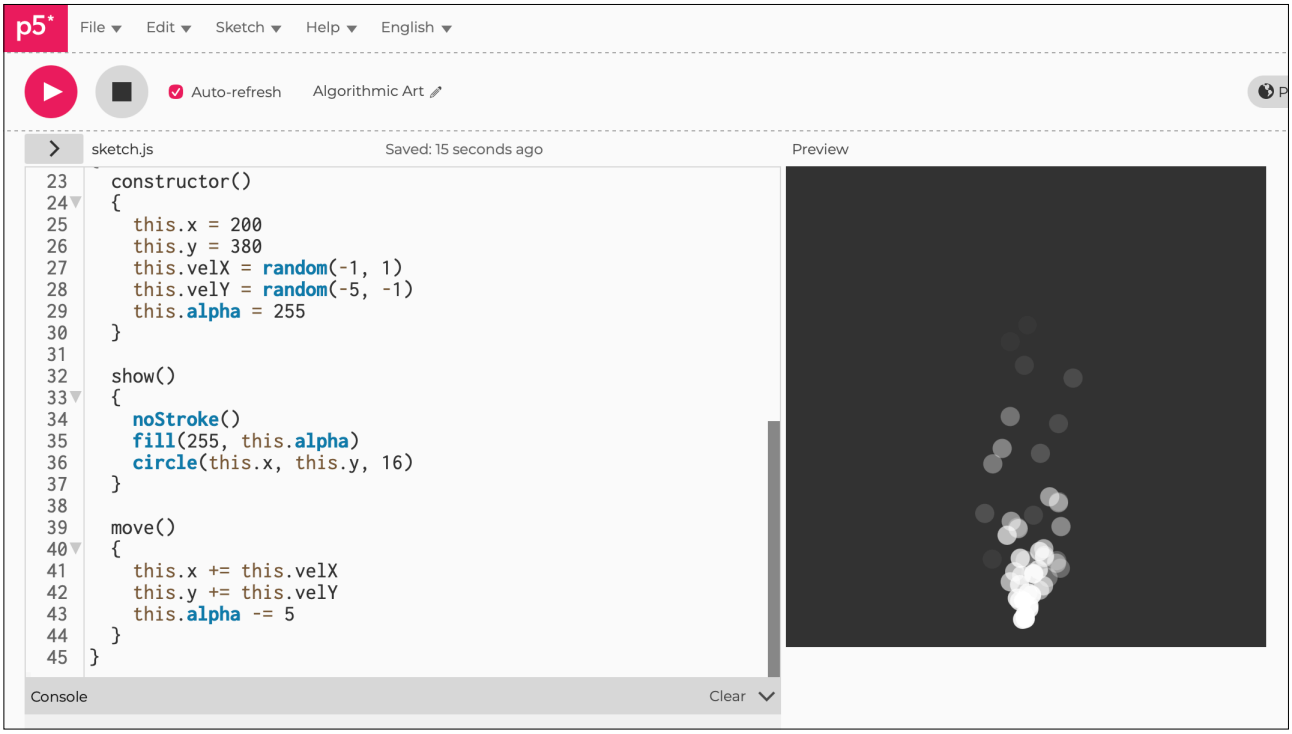
```
let p
let particles = []

function setup()
{
  createCanvas(400, 400)
}

function draw()
{
  background(51)
  p = new Particle()
  particles.push(p)
  for (let i = 0; i < particles.length; i++)
  {
    particles[i].movement()
    particles[i].show()
  }
}

class Particle
{
  constructor()
  {
    this.x = 200
    this.y = 380
    this.velX = random(-1, 1)
    this.velY = random(-5, -1)
    this.alpha = 255
  }
```

```
  show()
  {
    noStroke()
    fill(255, this.alpha)
    circle(this.x, this.y, 16)
  }

  move()
  {
    this.x += this.velX
    this.y += this.velY
    this.alpha -= 5
  }
}
```

Notes

The line of code: `this.alpha -= 5` means `this.alpha = this.alpha - 5`

Figure E4.9



Sketch E4.10 too many particles

We need to address the issue. If we include a line to see how many particles we have created and still exist, we can use `console.log()` in `draw()`. We can give it the parameter of `particles.length`, and as you let it run for a short while, the number just keeps on going up.

```
let p
let particles = []

function setup()
{
  createCanvas(400, 400)
}

function draw()
{
  background(51)
  p = new Particle()
  particles.push(p)
  for (let i = 0; i < particles.length; i++)
  {
    particles[i].move()
    particles[i].show()
  }
  console.log(particles.length)
}

class Particle
{
  constructor()
  {
    this.x = 200
    this.y = 380
    this.velX = random(-1, 1)
    this.velY = random(-5, -1)
    this.alpha = 255
  }
```

```
  show()
  {
    noStroke()
    fill(255, this.alpha)
    circle(this.x, this.y, 16)
  }

  move()
  {
    this.x += this.velX
    this.y += this.velY
    this.alpha -= 5
  }
}
```

🗒️ Notes

After running this for a few minutes, you will get the idea. We will keep it there for the moment and delete it later after we have removed the particles that have faded to zero. You will notice that it is fine for a few minutes and then starts to run very slowly.

Figure E4.10

Sketch E4.11 remove dead particles

To remove the particles that are less than zero (fade), we use the splice() function in a new function that checks to see if it is zero or less. We will call this function finished().

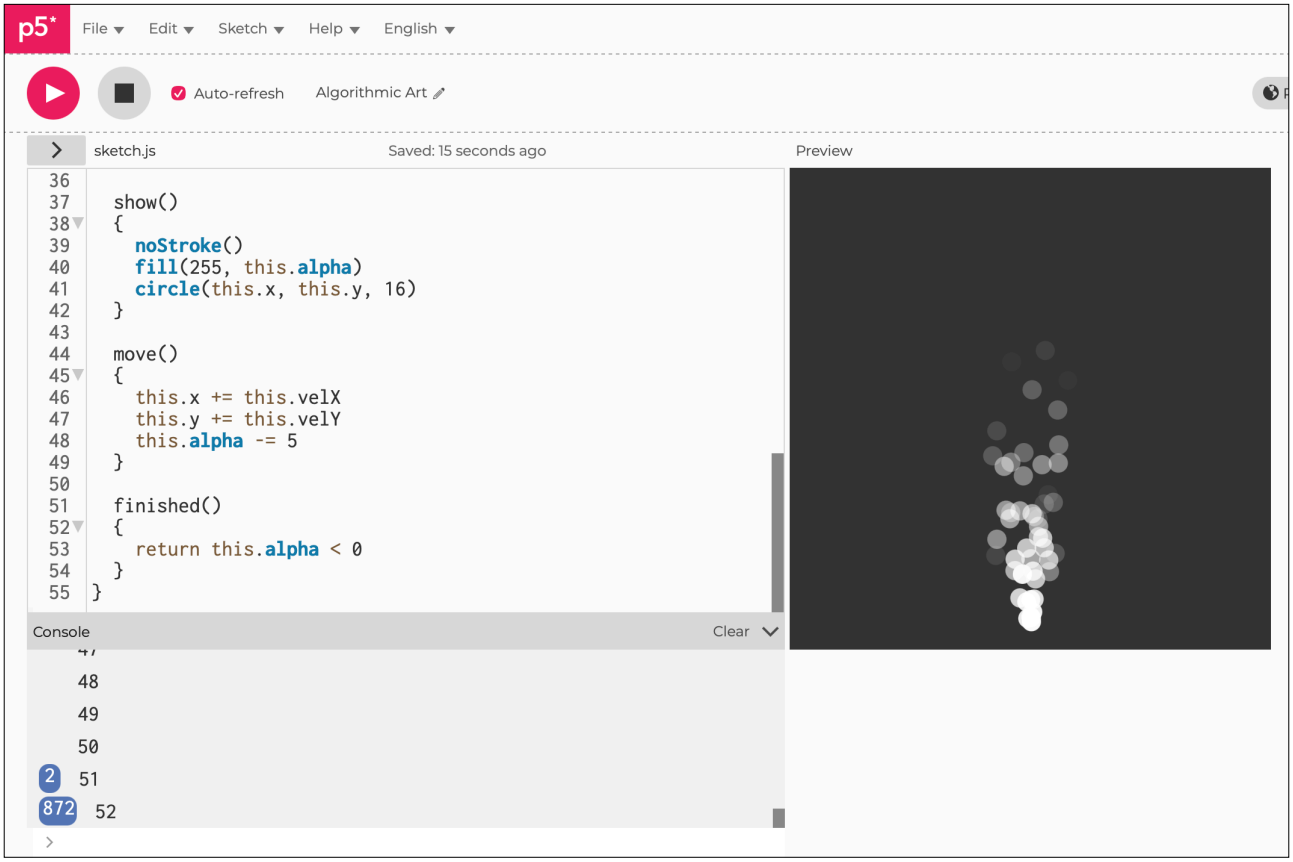
```
let p
let particles = []

function setup()
{
  createCanvas(400, 400)
}

function draw()
{
  background(51)
  p = new Particle()
  particles.push(p)
  for (let i = 0; i < particles.length; i++)
  {
    particles[i].move()
    particles[i].show()
    if (particles[i].finished())
    {
      particles.splice(i, 1)
    }
  }
  console.log(particles.length)
}

class Particle
{
  constructor()
  {
    this.x = 200
    this.y = 380
    this.velX = random(-1, 1)
```

```
    this.velY = random(-5, -1)
    this.alpha = 255
  }

  show()
  {
    noStroke()
    fill(255, this.alpha)
    circle(this.x, this.y, 16)
  }

  move()
  {
    this.x += this.velX
    this.y += this.velY
    this.alpha -= 5
  }

  finished()
  {
    return this.alpha < 0
  }
}
```

🗒️ Notes

The code: `return this.alpha < 0` means the function `finished()` will return `true` when the alpha is less than zero. Think boolean (true/false). In my case, the counter stops at 52.

Figure E4.11


p5*
File
Edit
Sketch
Help
English
Auto-refresh
Algorithmic Art
sketch.js
Saved: 15 seconds ago
Preview
36
37 show()
38 {
39 noStroke()
40 fill(255, this.alpha)
41 circle(this.x, this.y, 16)
42 }
43
44 move()
45 {
46 this.x += this.velX
47 this.y += this.velY
48 this.alpha -= 5
49 }
50
51 finished()
52 {
53 return this.alpha < 0
54 }
55 }
Console
Clear
48
49
50
2 51
872 52

Sketch E4.12 backwards array

Although this looks fine, there is a problem. When you are using `splice()`, we are doing something a bit odd when we delete something from an array counting from the front. This can mean that you jump past the next one after you have deleted a particle.

The way around it is to start from the end and check through the array backwards. We start with the last element in the array, which is at `particles.length - 1` because the numbering system starts from `0` (not 1), count backwards (`i--`) while `i` is greater than zero (`> 0`). It may take a bit of thinking through, but the logic is very sound. It is a good idea to explore the nature of arrays and how they are spliced.

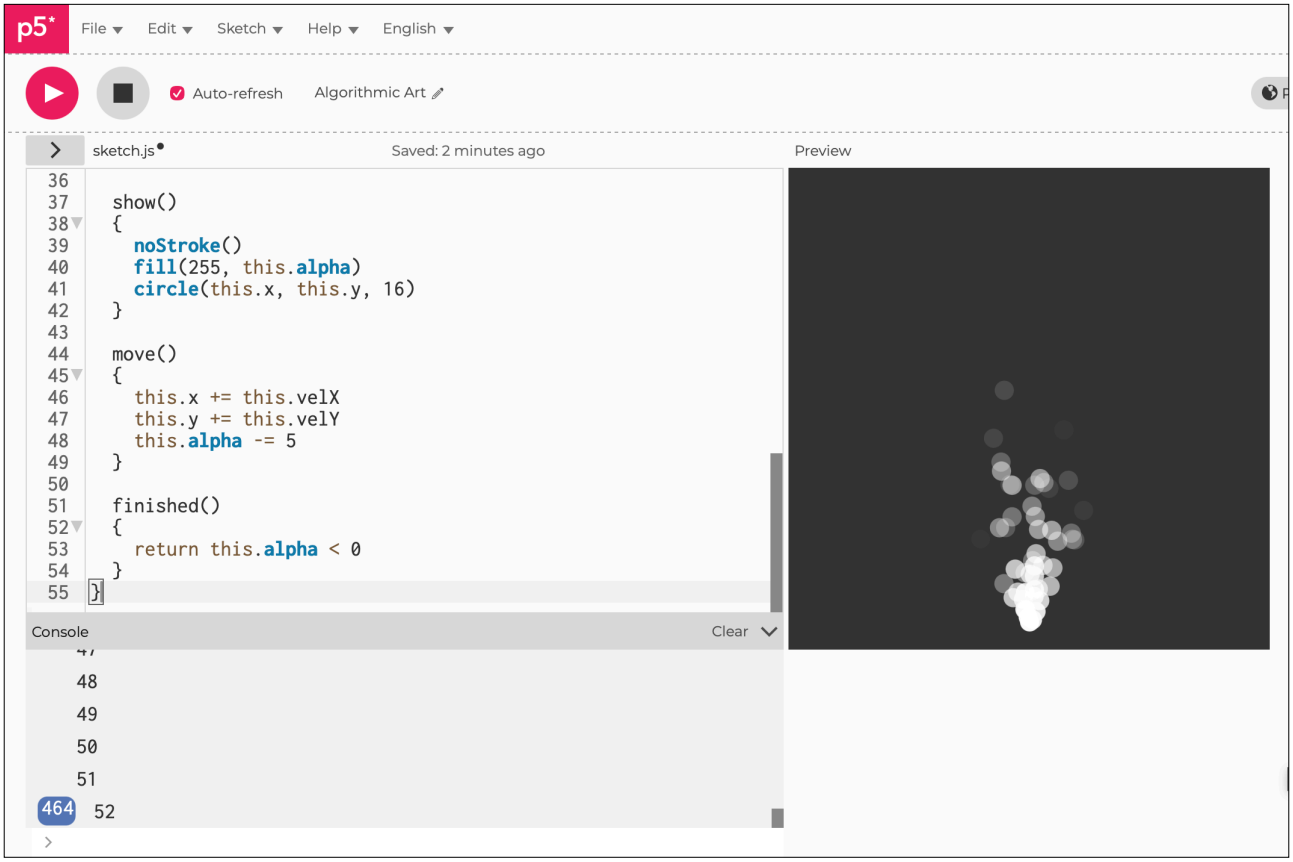
```
let p
let particles = []

function setup()
{
  createCanvas(400, 400)
}

function draw()
{
  background(51)
  p = new Particle()
  particles.push(p)
  for (let i = particles.length - 1; i > 0; i--)
  {
    particles[i].move()
    particles[i].show()
    if (particles[i].finished())
    {
      particles.splice(i, 1)
    }
  }
  console.log(particles.length)
}

class Particle
{
```

```
  constructor()
  {
    this.x = 200
    this.y = 380
    this.velX = random(-1, 1)
    this.velY = random(-5, -1)
    this.alpha = 255
  }

  show()
  {
    noStroke()
    fill(255, this.alpha)
    circle(this.x, this.y, 16)
  }

  move()
  {
    this.x += this.velX
    this.y += this.velY
    this.alpha -= 5
  }

  finished()
  {
    return this.alpha < 0
  }
}
```

🗒️ Notes

When you run this with the `console.log()`, you will see that it has the same effect; you may see a slight improvement. It didn't stick at 51, much cleaner and better coding.

Figure E4.12


p5*
File
Edit
Sketch
Help
English
Auto-refresh
Algorithmic Art
sketch.js
Saved: 2 minutes ago
Preview
show()
{
noStroke()
fill(255, this.alpha)
circle(this.x, this.y, 16)
}
move()
{
this.x += this.velX
this.y += this.velY
this.alpha -= 5
}
finished()
{
return this.alpha < 0
}
}
Console
Clear
48
49
50
51
464 52

Sketch E4.13 adding more particles

We only added one particle per frame in draw(), now let's add, say, five particles per frame.

! remove console.log().

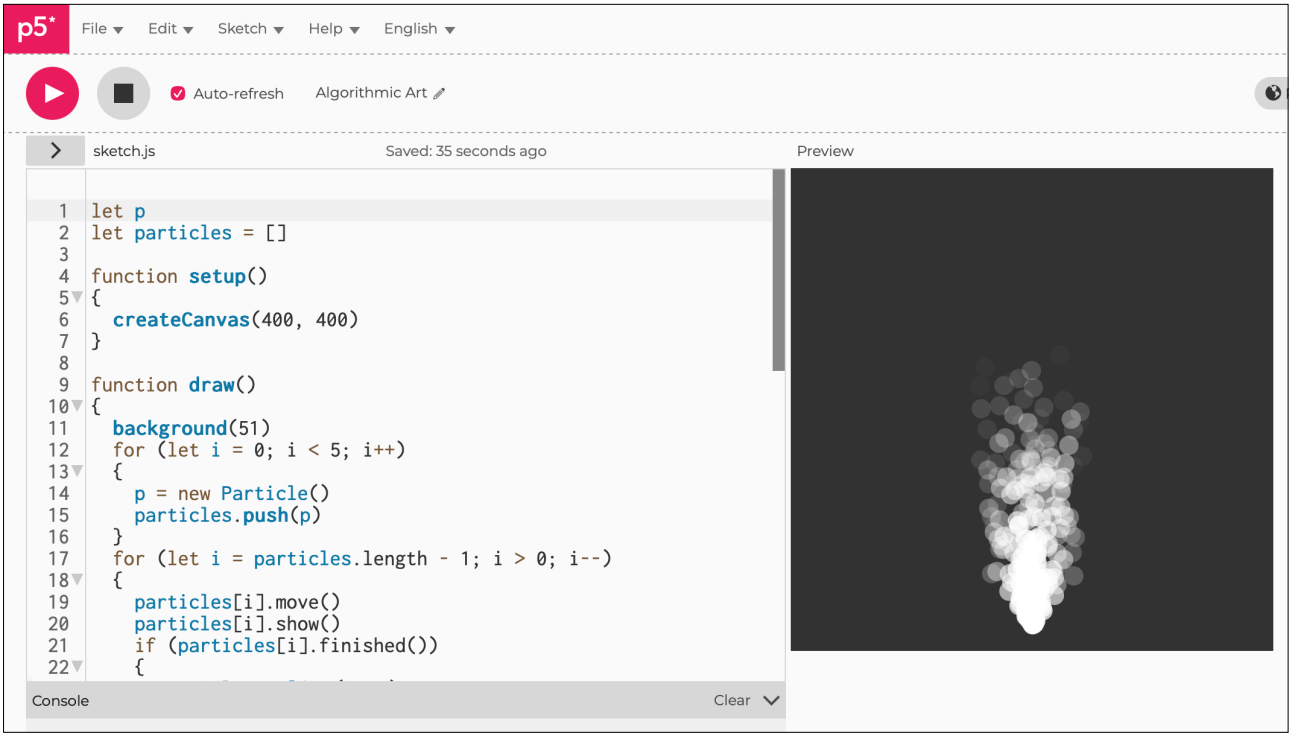
```
let p
let particles = []

function setup()
{
  createCanvas(400, 400)
}

function draw()
{
  background(51)
  for (let i = 0; i < 5; i++)
  {
    p = new Particle()
    particles.push(p)
  }
  for (let i = particles.length - 1; i > 0; i--)
  {
    particles[i].move()
    particles[i].show()
    if (particles[i].finished())
    {
      particles.splice(i, 1)
    }
  }
  // console.log(particles.length)
}

class Particle
{
  constructor()
```

```
  {
    this.x = 200
    this.y = 380
    this.velX = random(-1, 1)
    this.velY = random(-5, -1)
    this.alpha = 255
  }

  show()
  {
    noStroke()
    fill(255, this.alpha)
    circle(this.x, this.y, 16)
  }

  move()
  {
    this.x += this.velX
    this.y += this.velY
    this.alpha -= 5
  }

  finished()
  {
    return this.alpha < 0
  }
}
```

🗒️ Notes

It looks so much better.

Figure E4.13


p5*
File
Edit
Sketch
Help
English
Auto-refresh
Algorithmic Art
sketch.js
Saved: 35 seconds ago
Preview
let p
let particles = []
function setup()
{
createCanvas(400, 400)
}
function draw()
{
background(51)
for (let i = 0; i < 5; i++)
{
p = new Particle()
particles.push(p)
}
for (let i = particles.length - 1; i > 0; i--)
{
particles[i].move()
particles[i].show()
if (particles[i].finished())
{
Console
Clear

Sketch E4.14 some adaptations

Just some little adjustments.

```
let p
let particles = []

function setup()
{
  createCanvas(400, 400)
}

function draw()
{
  background(51)
  for (let i = 0; i < 5; i++)
  {
    p = new Particle()
    particles.push(p)
  }
  for (let i = particles.length - 1; i > 0; i--)
  {
    particles[i].move()
    particles[i].show()
    if (particles[i].finished())
    {
      particles.splice(i, 1)
    }
  }
}

class Particle
{
  constructor()
  {
    this.x = 200
    this.y = 380
    this.velX = random(-1, 1)
```

```
    this.velY = random(-6, -2)
    this.alpha = 255
    this.radius = 20
  }

  show()
  {
    noStroke()
    fill(255, this.alpha)
    circle(this.x, this.y, this.radius)
  }

  move()
  {
    this.x += this.velX
    this.y += this.velY
    this.alpha -= 5
    this.radius -= 0.001
  }

  finished()
  {
    return this.alpha < 0
  }
}
```

🗒️ Notes

Even better.

🌻 Challenges

1. Change the diameter randomly.
2. Add some colour and then fade.

Figure E4.14


p5*
File
Edit
Sketch
Help
English
Auto-refresh
Algorithmic Art
sketch.js
Saved: just now
Preview
this.radius = 20
}
show()
{
noStroke()
fill(255, this.alpha)
circle(this.x, this.y, this.radius)
}
move()
{
this.x += this.velX
this.y += this.velY
this.alpha -= 5
this.radius -= 0.001
}
finished()
{
return this.alpha < 0
}
}
Console
Clear