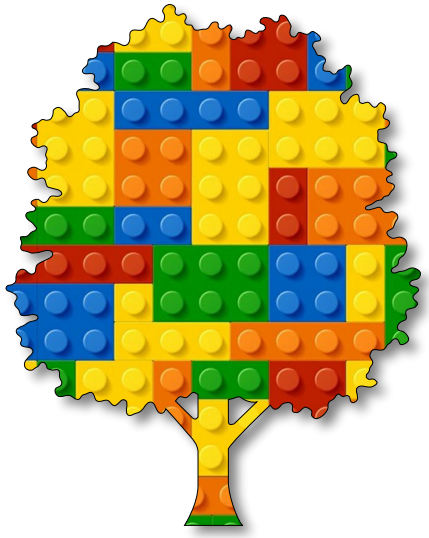
Algorithmic Art

Module D

Unit #8

3D arrays part 2



Content

Module D Unit #8 3D arrays part 2

Introduction to 3D arrays part 2

We are going to develop further the concept of a 3D array and create some interesting shapes and patterns. First off is a cube of cubes, and then we will have a spiral of bubbles!

Sketch D8.1 an array of cubes

! Using much of the previous sketch.

Starting a new sketch with many of the previous elements. Making an array of cubes where we have 0 to 100 in steps of 20 for a cube size of 20, giving us five cubes. We do this with a simple for() loop.

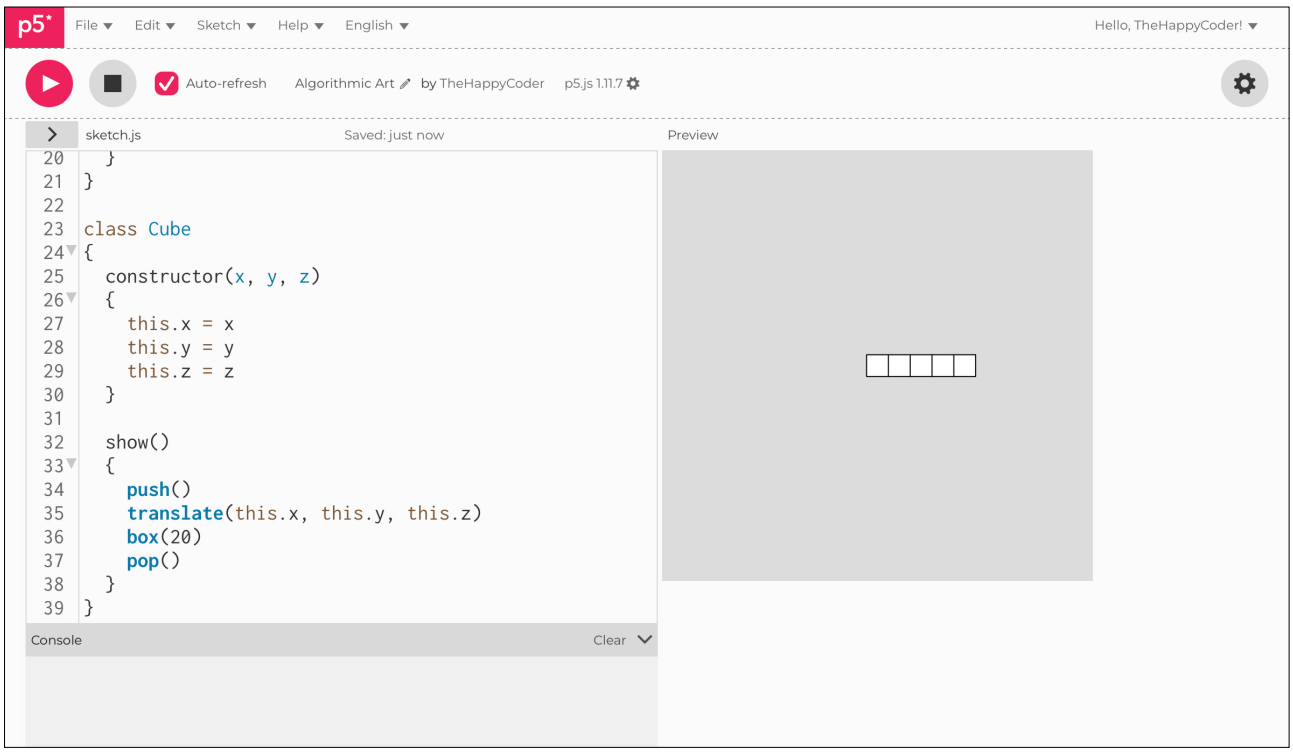
```
let cubes = []
let cube

function setup()
{
  createCanvas(400, 400, WEBGL)
  for (let i = 0; i < 100; i += 20)
  {
    cube = new Cube(i, 0, 0)
    cubes.push(cube)
  }
}

function draw()
{
  background(220)
  for (let i = 0; i < cubes.length; i++)
  {
    cubes[i].show()
  }
}

class Cube
{
  constructor(x, y, z)
  {
    this.x = x
    this.y = y
    this.z = z
  }
```

```
  show()
  {
    push()
    translate(this.x, this.y, this.z)
    box(20)
    pop()
  }
}
```

🗒️ Notes

As you can see, we have a problem. We have drawn the cubes from `(0, 0)`, which is the centre of the canvas. We need to start at `-100` rather than `0`. Also, we can only see from the front; it would be nice to rotate the array of cubes to see them properly.

Figure D8.1



Sketch D8.2 rotating the array

Now we rotate the array about the centre of the canvas. Also, we have now got ten cubes.

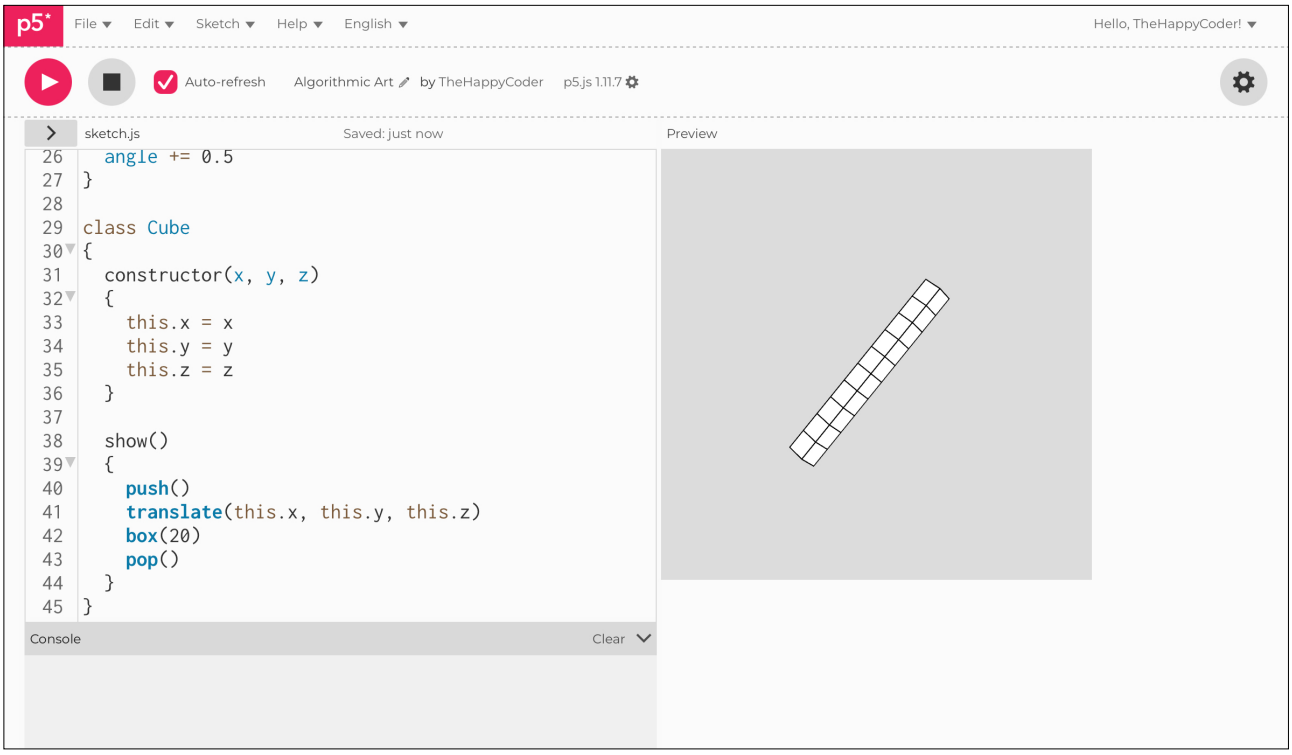
```
let cubes = []
let cube
let angle = 0

function setup()
{
  createCanvas(400, 400, WEBGL)
  angleMode(DEGREES)
  for (let i = -100; i < 100; i += 20)
  {
    cube = new Cube(i, 0, 0)
    cubes.push(cube)
  }
}

function draw()
{
  background(220)
  rotateX(angle)
  rotateY(angle)
  rotateZ(angle)
  for (let i = 0; i < cubes.length; i++)
  {
    cubes[i].show()
  }
  angle += 0.5
}

class Cube
{
  constructor(x, y, z)
  {
    this.x = x
```

```
    this.y = y
    this.z = z
  }

  show()
  {
    push()
    translate(this.x, this.y, this.z)
    box(20)
    pop()
  }
}
```

Notes

A long stick of cubes or a long cuboid, rotating.

Figure D8.2



Sketch D8.3 spaced out

If we space them out a little bit more by increasing the steps from 20 to 25, this will also mean that we have only eight cubes.

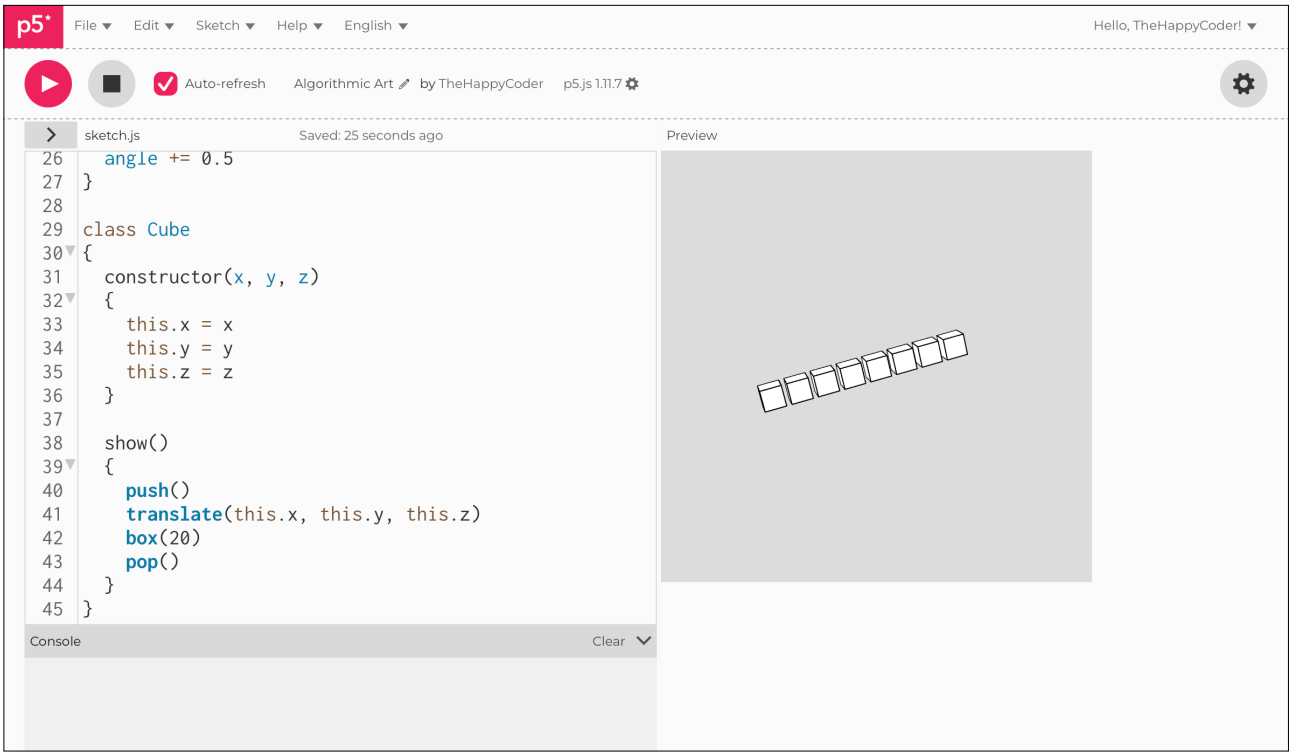
```
let cubes = []
let cube
let angle = 0

function setup()
{
  createCanvas(400, 400, WEBGL)
  angleMode(DEGREES)
  for (let i = -100; i < 100; i += 25)
  {
    cube = new Cube(i, 0, 0)
    cubes.push(cube)
  }
}

function draw()
{
  background(220)
  rotateX(angle)
  rotateY(angle)
  rotateZ(angle)
  for (let i = 0; i < cubes.length; i++)
  {
    cubes[i].show()
  }
  angle += 0.5
}

class Cube
{
  constructor(x, y, z)
  {
    this.x = x
```

```
    this.y = y
    this.z = z
  }

  show()
  {
    push()
    translate(this.x, this.y, this.z)
    box(20)
    pop()
  }
}
```

Notes

A bit more spaced out.

Figure D8.3



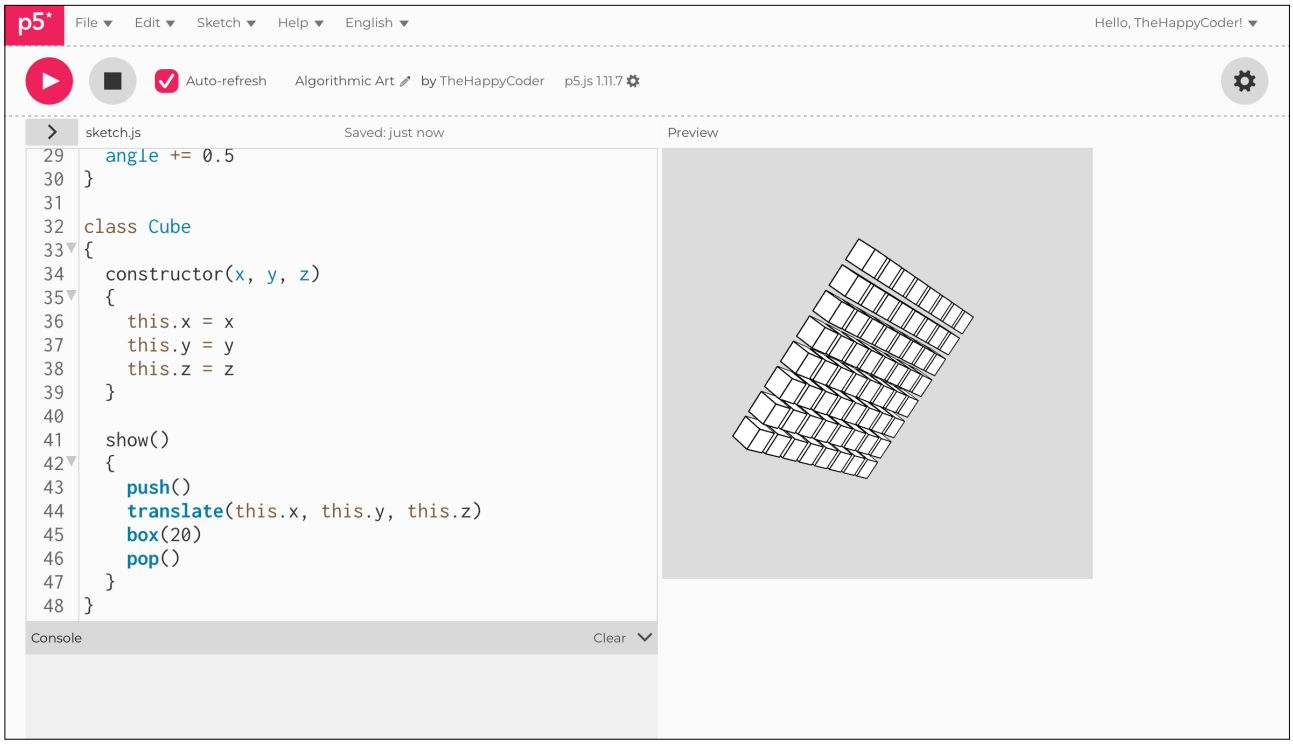
Sketch D8.4 an array in the y direction

Yet we can do even better because we can create an array in the y direction also. For that, we need a nested loop.

```
let cubes = []
let cube
let angle = 0

function setup()
{
  createCanvas(400, 400, WEBGL)
  angleMode(DEGREES)
  for (let i = -100; i < 100; i += 25)
  {
    for (let j = -100; j < 100; j += 25)
    {
      cube = new Cube(i, j, 0)
      cubes.push(cube)
    }
  }
}

function draw()
{
  background(220)
  rotateX(angle)
  rotateY(angle)
  rotateZ(angle)
  for (let i = 0; i < cubes.length; i++)
  {
    cubes[i].show()
  }
  angle += 0.5
}

class Cube
{
```

```
  constructor(x, y, z)
  {
    this.x = x
    this.y = y
    this.z = z
  }

  show()
  {
    push()
    translate(this.x, this.y, this.z)
    box(20)
    pop()
  }
}
```

Figure D8.4



Sketch D8.5 a cube of cubes

But why stop there? Let's add the third dimension, the z direction; we just add another nested loop.

```
let cubes = []
let cube
let angle = 0

function setup()
{
  createCanvas(400, 400, WEBGL)
  angleMode(DEGREES)
  for (let i = -100; i < 100; i += 25)
  {
    for (let j = -100; j < 100; j += 25)
    {
      for (let k = -100; k < 100; k += 25)
      {
        cube = new Cube(i, j, k)
        cubes.push(cube)
      }
    }
  }
}

function draw()
{
  background(220)
  rotateX(angle)
  rotateY(angle)
  rotateZ(angle)
  for (let i = 0; i < cubes.length; i++)
  {
    cubes[i].show()
  }
  angle += 0.5
}
```

```
class Cube
{
  constructor(x, y, z)
  {
    this.x = x
    this.y = y
    this.z = z
  }

  show()
  {
    push()
    translate(this.x, this.y, this.z)
    box(20)
    pop()
  }
}
```

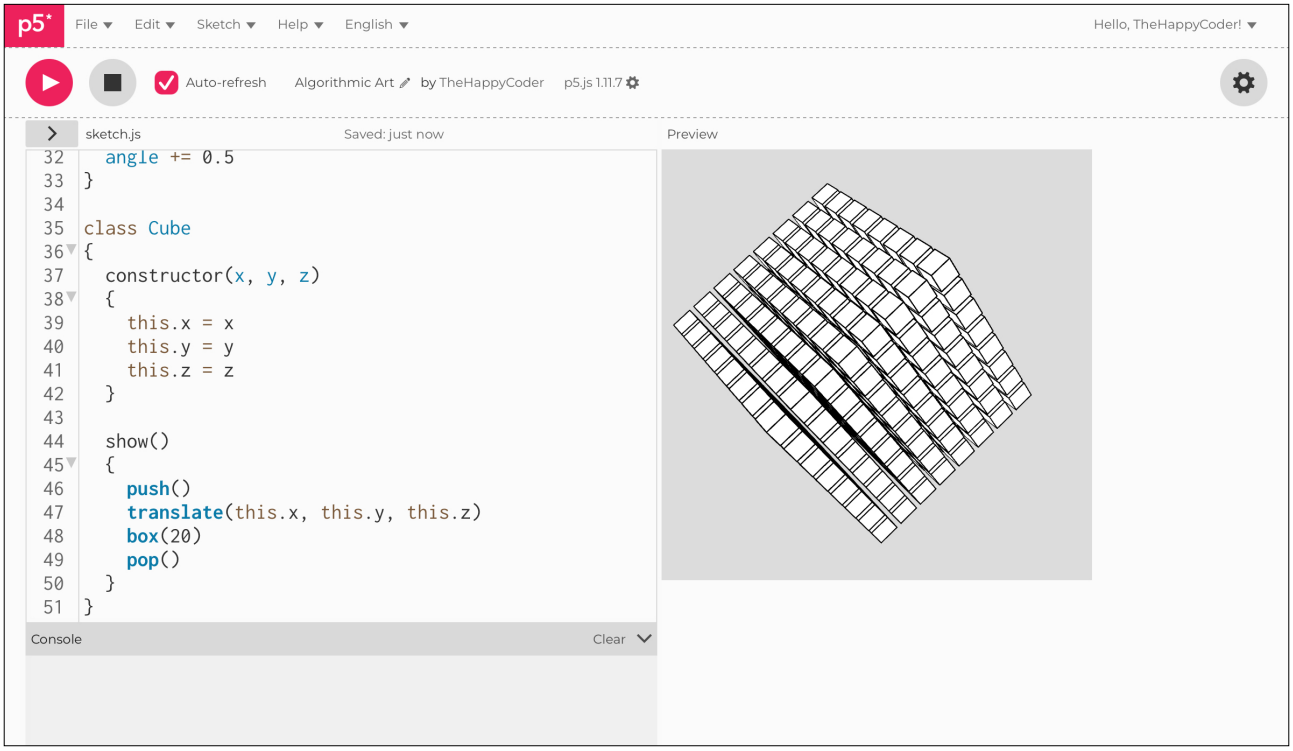
🗒️ Notes

Inside the `cubes[]` array, we have a 3D array.

🌻 Challenge

Have a look inside the `cubes[]` array with `console.log()`.

Figure D8.5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Sketch
Help
English
Hello, TheHappyCoder!
Auto-refresh
Algorithmic Art
by TheHappyCoder
p5.js 1.11.7
sketch.js
Saved: just now
Preview
angle += 0.5
}
class Cube
{
constructor(x, y, z)
{
this.x = x
this.y = y
this.z = z
}
show()
{
push()
translate(this.x, this.y, this.z)
box(20)
pop()
}
}
Console
Clear

Sketch D8.6 adding a splash of colour

We can add individual colours (random) to each cube. We use a function called `color(a, b, c)` with three arguments for the red, green, and blue. We add a variable (`c`) to carry this information to the new cube being created.

```
let cubes = []
let cube
let angle = 0

function setup()
{
  createCanvas(400, 400, WEBGL)
  angleMode(DEGREES)
  for (let i = -100; i < 100; i += 25)
  {
    for (let j = -100; j < 100; j += 25)
    {
      for (let k = -100; k < 100; k += 25)
      {
        let c = color(random(255), random(255), random(255))
        cube = new Cube(i, j, k, c)
        cubes.push(cube)
      }
    }
  }
}

function draw()
{
  background(220)
  rotateX(angle)
  rotateY(angle)
  rotateZ(angle)
  for (let i = 0; i < cubes.length; i++)
  {
    cubes[i].show()
  }
```

```
  angle += 0.5
}

class Cube
{
  constructor(x, y, z, c)
  {
    this.x = x
    this.y = y
    this.z = z
    this.c = c
  }

  show()
  {
    push()
    fill(this.c)
    translate(this.x, this.y, this.z)
    box(20)
    pop()
  }
}
```

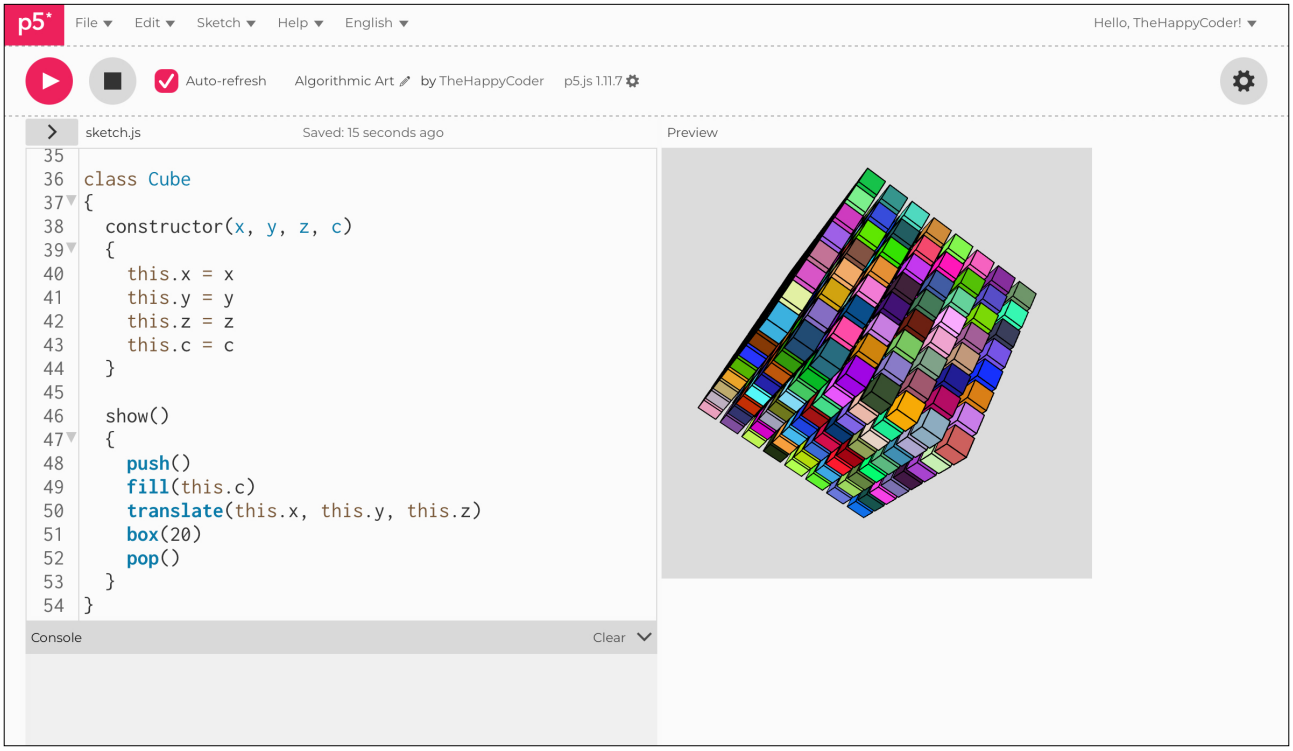
🗒️ Notes

We give each individual cube its own colour.

🌻 Challenges

1. Add some `alpha` (fourth argument) to the colour to make it transparent and remove the `stroke()`.
2. Change the shape to a sphere or cylinder.

Figure D8.6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sketch.js
Saved: 15 seconds ago
Preview
35
36 class Cube
37 {
38 constructor(x, y, z, c)
39 {
40 this.x = x
41 this.y = y
42 this.z = z
43 this.c = c
44 }
45
46 show()
47 {
48 push()
49 fill(this.c)
50 translate(this.x, this.y, this.z)
51 box(20)
52 pop()
53 }
54 }
Console
Clear

Sketch D8.7 a bubble factory

A bit of refactoring. We are going to use a sphere, so we will change the name of the class, variable, and array to something more appropriate and familiar: `bubble`. Also added `sphere(10)`, `lights()`, and `noStroke()`.

```
let bubbles = []
let bubble
let angle = 0

function setup()
{
  createCanvas(400, 400, WEBGL)
  angleMode(DEGREES)
  for (let i = -100; i < 100; i += 25)
  {
    for (let j = -100; j < 100; j += 25)
    {
      for (let k = -100; k < 100; k += 25)
      {
        let c = color(random(255), random(255), random(255))
        bubble = new Bubble(i, j, k, c)
        bubbles.push(bubble)
      }
    }
  }
}

function draw()
{
  background(220)
  rotateX(angle)
  rotateY(angle)
  rotateZ(angle)
  for (let i = 0; i < bubbles.length; i++)
  {
    bubbles[i].show()
  }
```

```
  angle += 0.5
}


class Bubble
{
  constructor(x, y, z, c)
  {
    this.x = x
    this.y = y
    this.z = z
    this.c = c
  }

  show()
  {
    push()
    fill(this.c)
    translate(this.x, this.y, this.z)
    lights()
    noStroke()
    sphere(10)
    pop()
  }
}
```

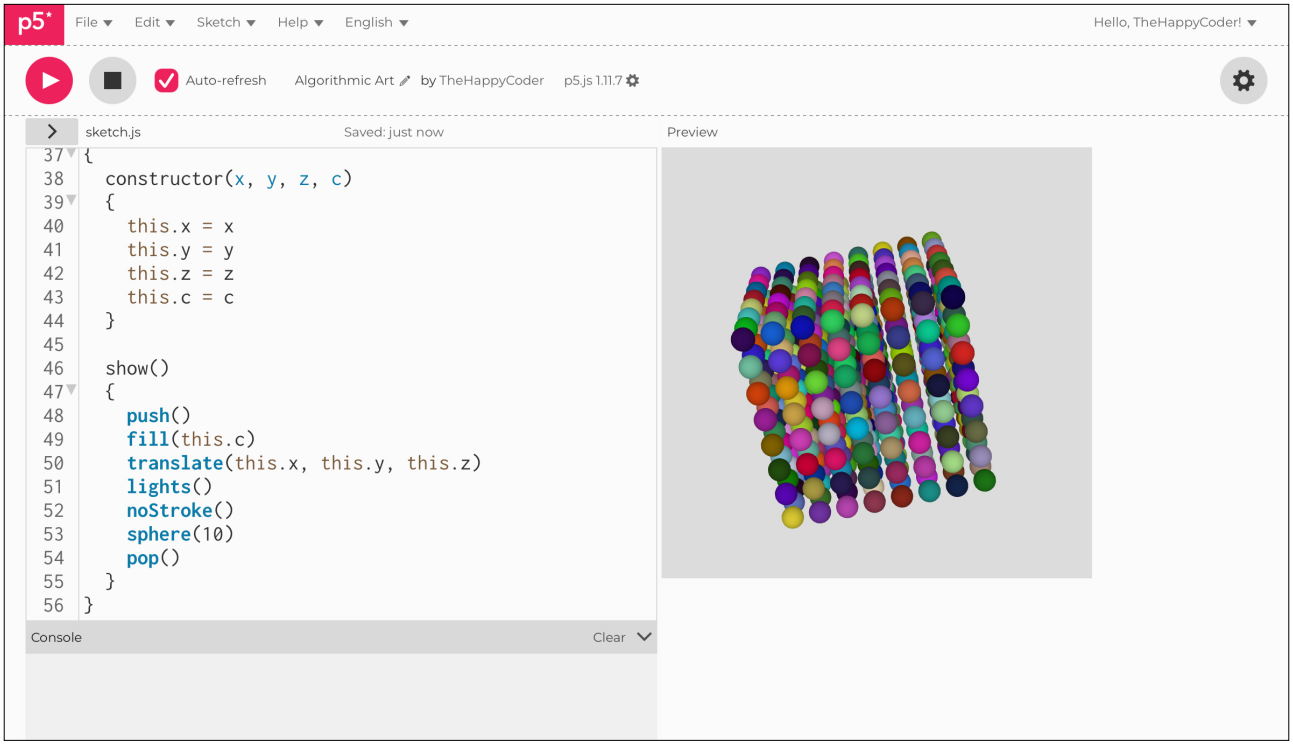
🗒️ Notes

The `noStroke()` is just so that you can see the colours.

🌻 Challenge

Call the variable, class, and array anything you want.

Figure D8.7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sketch.js
Saved: just now
Preview
{
constructor(x, y, z, c)
{
this.x = x
this.y = y
this.z = z
this.c = c
}
show()
{
push()
fill(this.c)
translate(this.x, this.y, this.z)
lights()
noStroke()
sphere(10)
pop()
}
}
Console
Clear

Sketch D8.8 not a cube

Our next step is putting all those bubbles in a circle rather than a cube, but first remove all the code highlighted and commented, then change the `constructor()` function.

```
let bubbles = []
let bubble
let angle = 0

function setup()
{
  createCanvas(400, 400, WEBGL)
  angleMode(DEGREES)
  // for (let i = -100; i < 100; i += 25)
  // {
  //   for (let j = -100; j < 100; j += 25)
  //   {
  //     for (let k = -100; k < 100; k += 25)
  //     {
  //       let c = color(random(255), random(255), random(255))
  //       bubble = new Bubble(i, j, k, c)
  //       bubbles.push(bubble)
  //     }
  //   }
  // }
}

function draw()
{
  background(220)
  rotateX(angle)
  rotateY(angle)
  rotateZ(angle)
  for (let i = 0; i < bubbles.length; i++)
  {
    bubbles[i].show()
  }
```

```
  angle += 0.5
}

class Bubble
{
  constructor(x, y, z)
  {
    this.x = x
    this.y = y
    this.z = z
    // this.c = c
  }

  show()
  {
    push()
   // fill(this.c)
    translate(this.x, this.y, this.z)
    lights()
    noStroke()
    sphere(10)
    pop()
  }
}
```

🗒️ Notes

Don't try running this just yet!

Sketch D8.9 now a circle

Creating a circle of bubbles.

```
let bubbles = []
let bubble
let angle = 0

function setup()
{
  createCanvas(400, 400, WEBGL)
  angleMode(DEGREES)
  for (let i = 0; i < 360; i += 30)
  {
    let x = 100 * sin(i)
    let y = 100 * cos(i)
    bubble = new Bubble(x, y, 0)
    bubbles.push(bubble)
  }
}

function draw()
{
  background(220)
  rotateX(angle)
  rotateY(angle)
  rotateZ(angle)
  for (let i = 0; i < bubbles.length; i++)
  {
    bubbles[i].show()
  }
  angle += 0.5
}

class Bubble
{
  constructor(x, y, z)
  {
```

```
    this.x = x
    this.y = y
    this.z = z
  }

  show()
  {
    push()
    translate(this.x, this.y, this.z)
    lights()
    fill('yellow')
    noStroke()
    sphere(10)
    pop()
  }
}
```

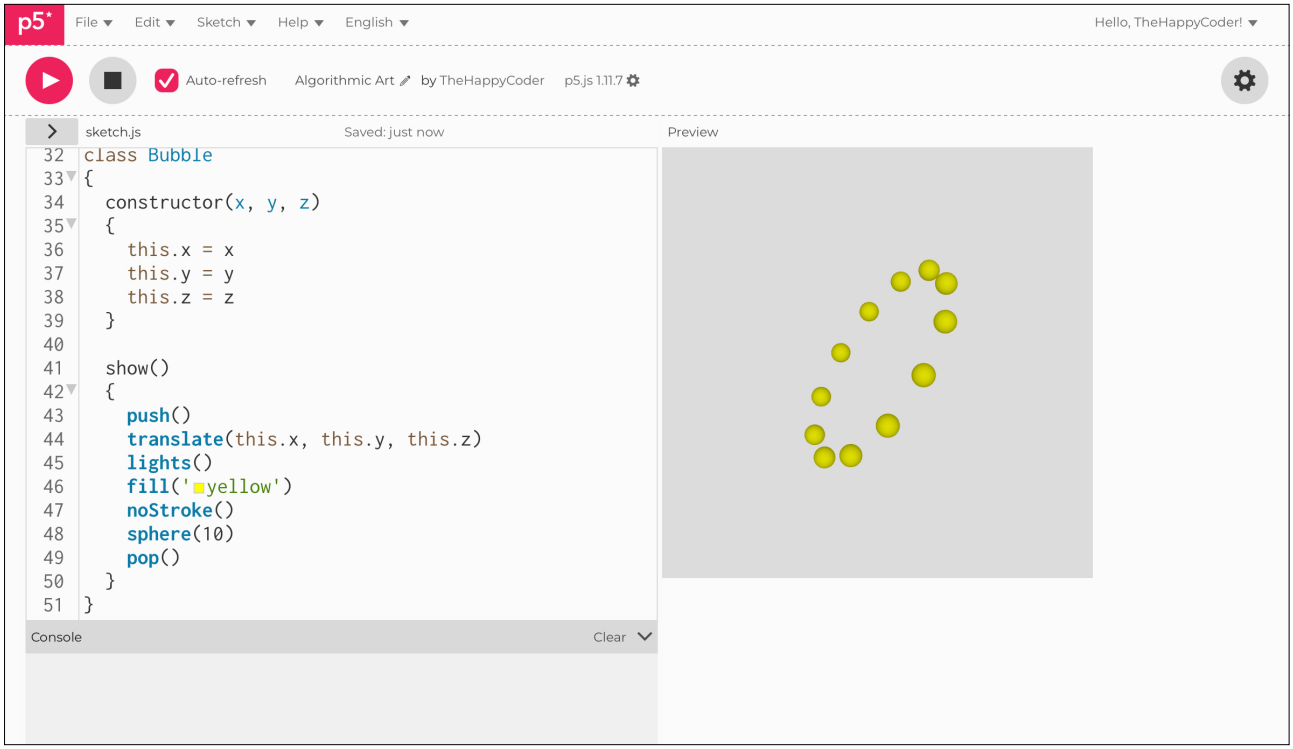
🗒️ Notes

We have a nice ring of spheres.

🌻 Challenge

Add other lights or materials.

Figure D8.9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by TheHappyCoder
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sketch.js
Saved: just now
Preview
32 class Bubble
33 {
34 constructor(x, y, z)
35 {
36 this.x = x
37 this.y = y
38 this.z = z
39 }
40
41 show()
42 {
43 push()
44 translate(this.x, this.y, this.z)
45 lights()
46 fill('yellow')
47 noStroke()
48 sphere(10)
49 pop()
50 }
51 }
Console
Clear

Sketch D8.10 creating a spiral

Next, let's try to make a spiral so that the array of bubbles also has a z component.

```
let bubbles = []
let bubble
let angle = 0

function setup()
{
  createCanvas(400, 400, WEBGL)
  angleMode(DEGREES)
  for (let i = 0; i < 360; i += 30)
  {
    let x = 100 * sin(i)
    let y = 100 * cos(i)
    bubble = new Bubble(x, y, i)
    bubbles.push(bubble)
  }
}

function draw()
{
  background(220)
  rotateX(angle)
  rotateY(angle)
  rotateZ(angle)
  for (let i = 0; i < bubbles.length; i++)
  {
    bubbles[i].show()
  }
  angle += 0.5
}

class Bubble
{
  constructor(x, y, z)
  {
```

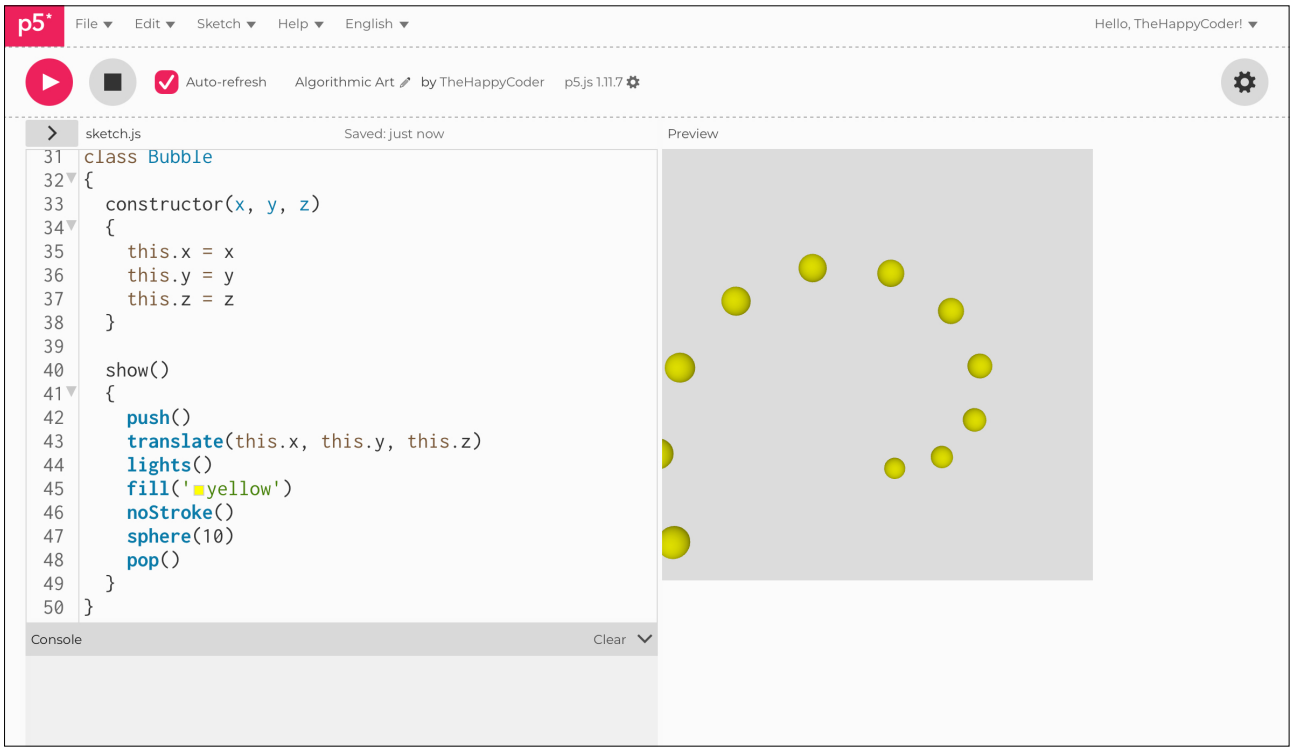
```
    this.x = x
    this.y = y
    this.z = z
  }

  show()
  {
    push()
    translate(this.x, this.y, this.z)
    lights()
    fill('yellow')
    noStroke()
    sphere(10)
    pop()
  }
}
```

Notes

It's a spiral Jim, but not as we know it. Let's see if we can improve.

Figure D8.10



Sketch D8.11 more spirally

We can make some improvements to this to make it more of a spiral.

```
let bubbles = []
let bubble
let angle = 0

function setup()
{
  createCanvas(400, 400, WEBGL)
  angleMode(DEGREES)
  for (let i = -360; i < 360; i += 10)
  {
    let x = 100 * sin(i)
    let y = 100 * cos(i)
    bubble = new Bubble(x, y, i/4)
    bubbles.push(bubble)
  }
}

function draw()
{
  background(220)
  rotateX(angle)
  rotateY(angle)
  rotateZ(angle)
  for (let i = 0; i < bubbles.length; i++)
  {
    bubbles[i].show()
  }
  angle += 0.5
}

class Bubble
{
  constructor(x, y, z)
  {
```

```
    this.x = x
    this.y = y
    this.z = z
  }

  show()
  {
    push()
    translate(this.x, this.y, this.z)
    lights()
    fill('yellow')
    noStroke()
    sphere(10)
    pop()
  }
}
```

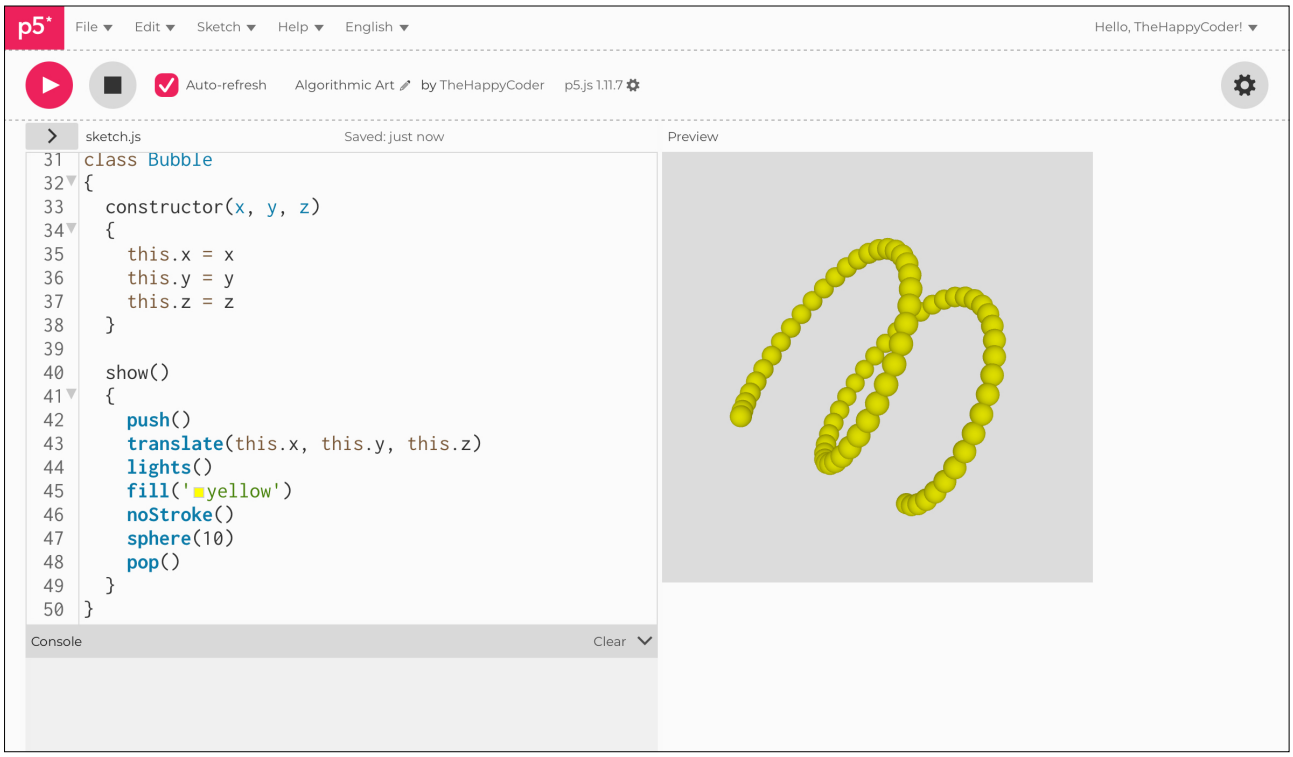
🗒️ Notes

Much better.

🌻 Challenges

1. Can you randomise the diameter of the sphere?
2. Add random colours to the spheres.
3. Change the radius of the spiral so that it starts small and increases.
4. How would you extend it?
5. How would you rotate it about an axis?

Figure D8.11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by TheHappyCoder
p5.js 1.11.7
sketch.js
Saved: just now
Preview
class Bubble
{
constructor(x, y, z)
{
this.x = x
this.y = y
this.z = z
}
show()
{
push()
translate(this.x, this.y, this.z)
lights()
fill('yellow')
noStroke()
sphere(10)
pop()
}
}
Console
Clear