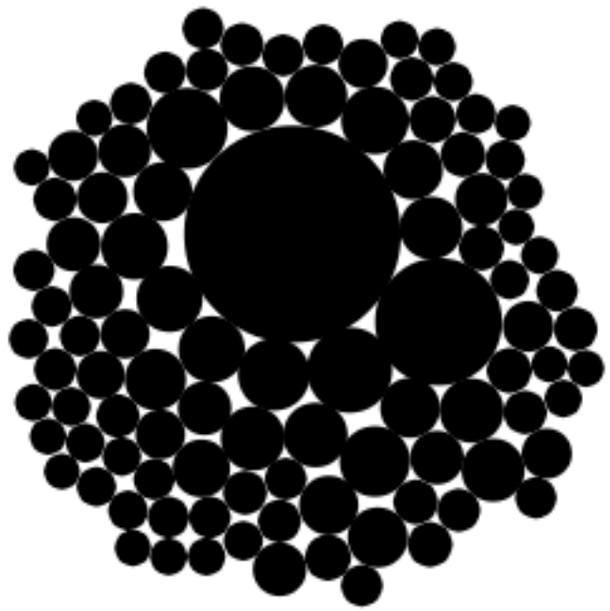
Packed circles

1. Bubbles collide with each other
2. Initial conditions are paramount



Creating particles

The area of the particle should signify the country's growth.

```
/* in the constructor */
 this.radius = sqrt(sum)/4000;

/* in the draw function */
 ellipse(this.pos.x,
         this.pos.y,
         this.radius*2,
         this.radius*2);
```

Making collisions

It is a constraint based problem, where the constraint is that no circle can be juxtaposed to any other.

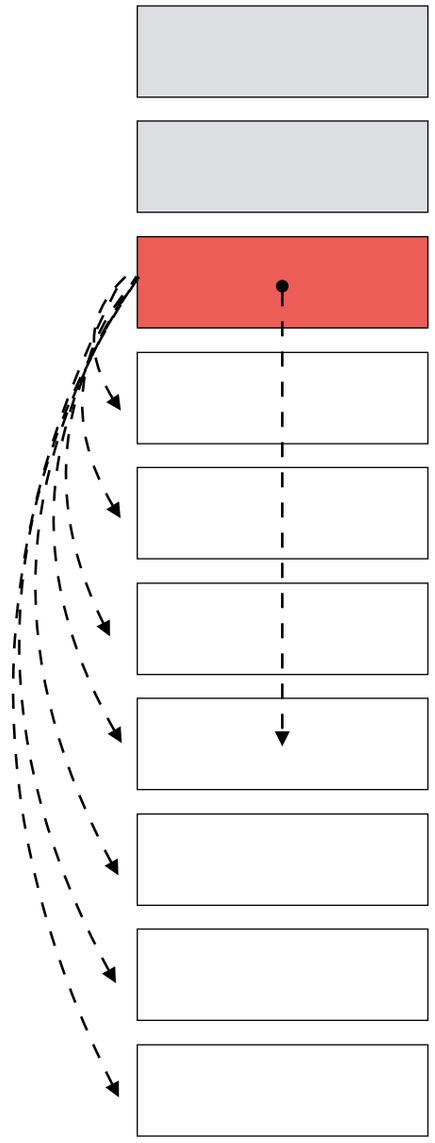
Making collisions

Circles will be compared in pairs, and if the constraints are not met, the system is modified in order to attain some of these constraints.

Making collisions

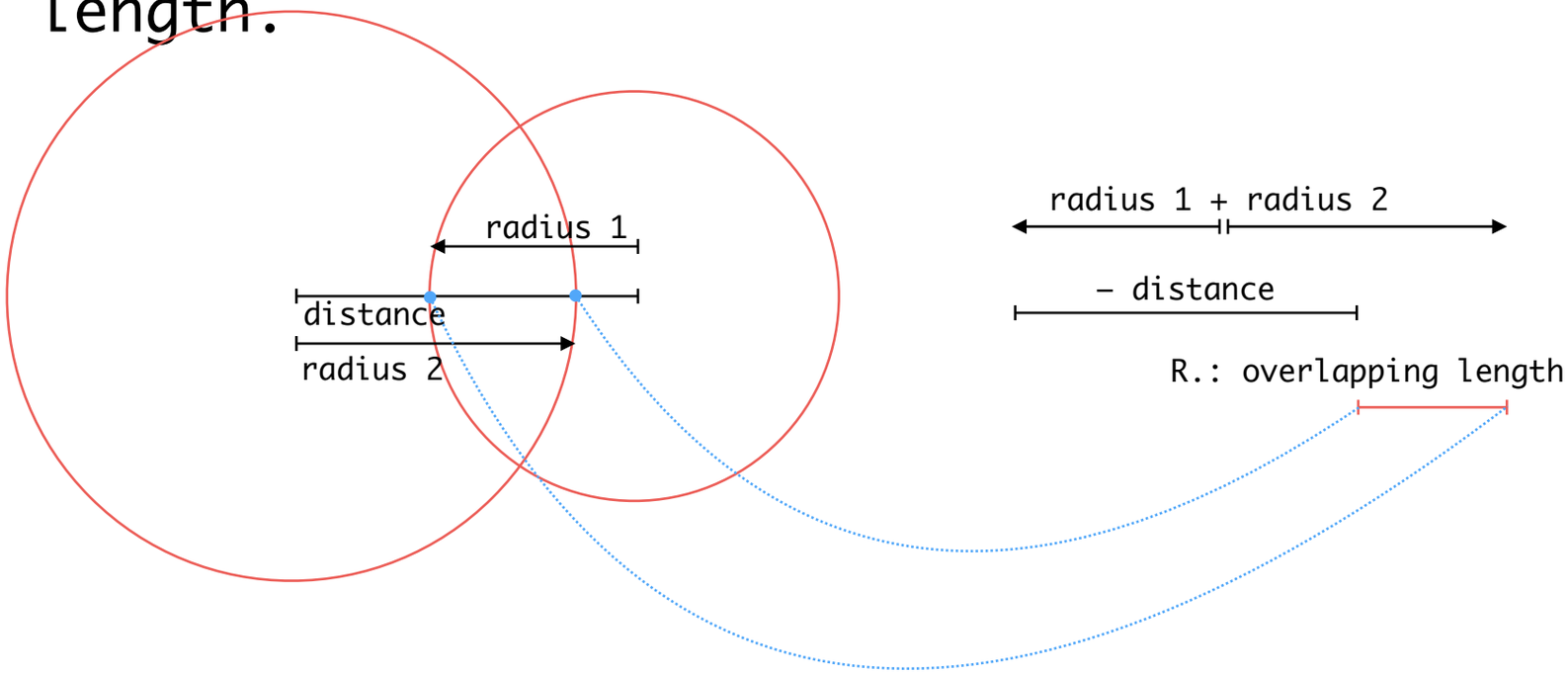
Pair-wise comparison

```
for(var i=0; i<particleSystem.length-1; i++){
    for(var j=i+1; j<particleSystem.length; j++){
        var pa = particleSystem[i];
        var pb = particleSystem[j];
        …
    }
}
```



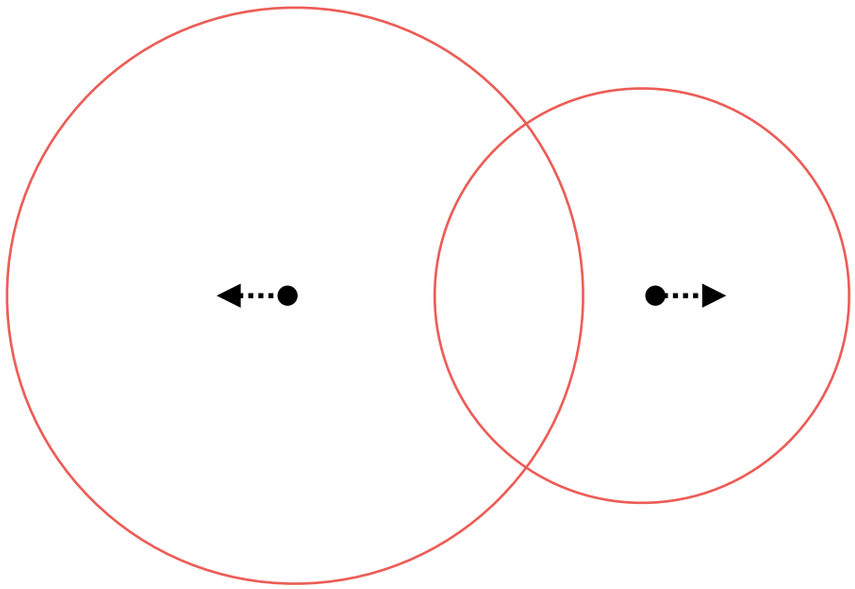
Making collisions

Adjusting the positions for each pair of particles consists of pushing each particle away from the other in a distance that nullifies their overlapping length.



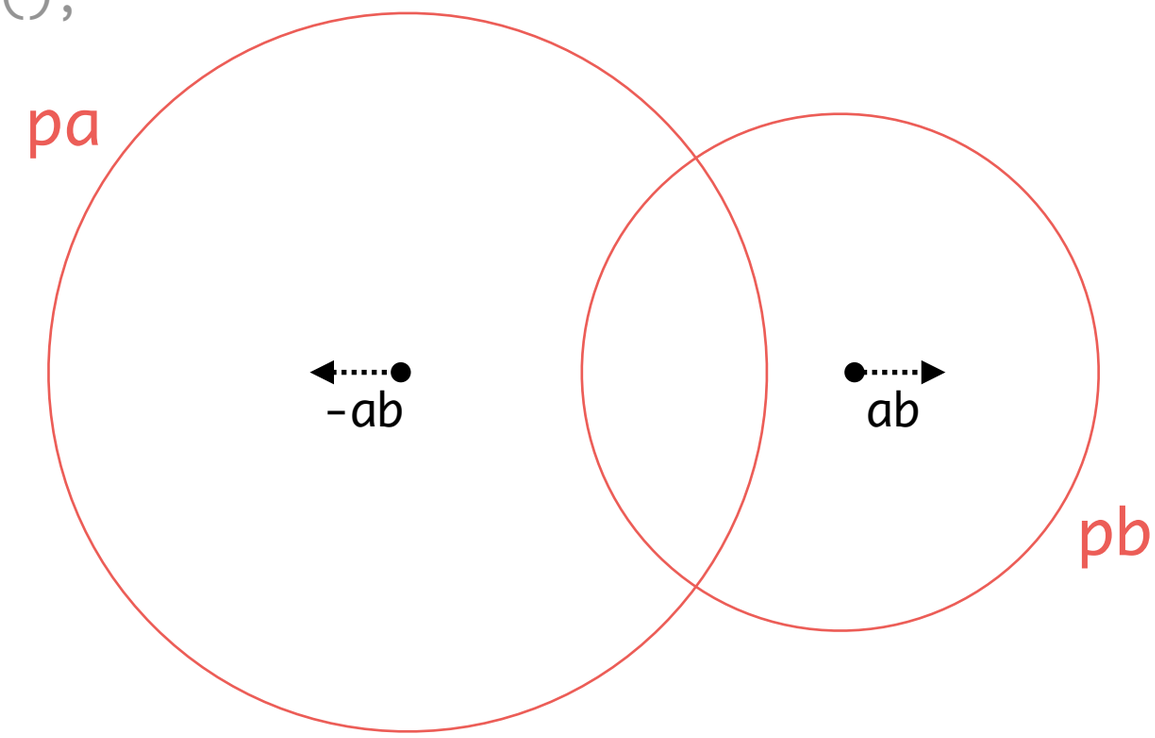
Making collisions

Two vectors that shift the positions of each particle in opposing directions, having each of these vectors a length that is half of the total overlapping length.



Making collisions

```
var pa = particleSystem[i];
var pb = particleSystem[j];
var ab = p5.Vector.sub(pb.pos, pa.pos);
var distSq = ab.magSq();
if(distSq <= sq(pa.radius + pb.radius)){
    var dist = sqrt(distSq);
var overlap = (pa.radius + pb.radius) - dist;
ab.div(dist); //ab.normalize();
ab.mult(overlap*0.5);
pb.pos.add(ab);
ab.mult(-1);
pa.pos.add(ab);
```



Making collisions – relaxation

```
for(var STEPS = 0; STEPS<3; STEPS++){
    for(var i=0; i<particleSystem.length-1; i++){
        for(var j=i+1; j<particleSystem.length; j++){
            var pa = particleSystem[i];
            var pb = particleSystem[j];
            var ab = p5.Vector.sub(pb.pos, pa.pos);
            var distSq = ab.magSq();
            if(distSq <= sq(pa.radius + pb.radius)){
                var dist = sqrt(distSq);
                var overlap = (pa.radius + pb.radius) - dist;
                ab.div(dist); //ab.normalize();
                ab.mult(overlap*0.5);
                pb.pos.add(ab);
                ab.mult(-1);
                pa.pos.add(ab);
            }
        }
    }
}
```

Initial conditions

Arrange circles radially while making bigger circles stay the center of the canvas, and the

```
var tempAng = random(TWO_PI);
this.pos = createVector(cos(tempAng), sin(tempAng));
this.pos.div(this.radius);
this.pos.mult(1000);
this.pos.set(this.pos.x + width/2, this.pos.y + height/2);
```

Assignment:interacting with packed bubbles

1. When the mouse is over a circle, it expands.
2. When the mouse exits the circle, it returns to its normal size.
3. When the circle attained its maximum size, it displays the name of the country.