Computer Programming Fundamentals

CS 152
Professor: Leah Buechley
TAs: Melody Horn, Noah Garcia, Andrew Geyko, Juan Ormaza
Time: MWF 10:00-10:50am
https://handandmachine.cs.unm.edu/classes/CS152_Fall2021/

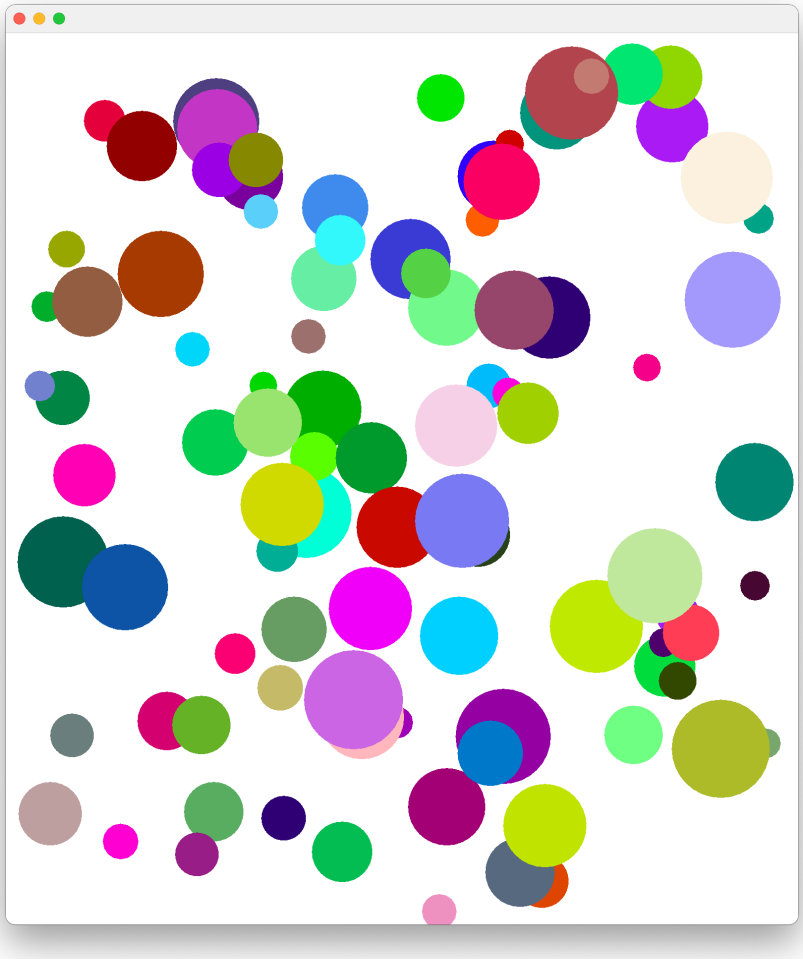
ASSIGNMENT 4

- Classes and objects
- Can work in a 2 person team if you wish
- Email me team member names by the end of today
- Due Friday 10/8

POST TOPICS FOR DEBUGGING + MIDTERM REVIEW

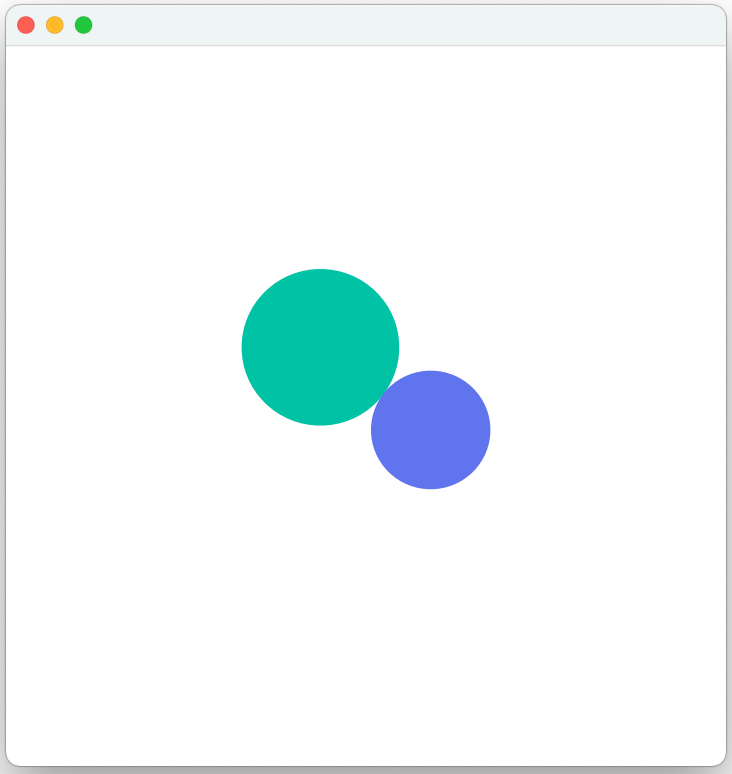
RETURNING TO OUR BALL CODE

ARRAY OF BALLS



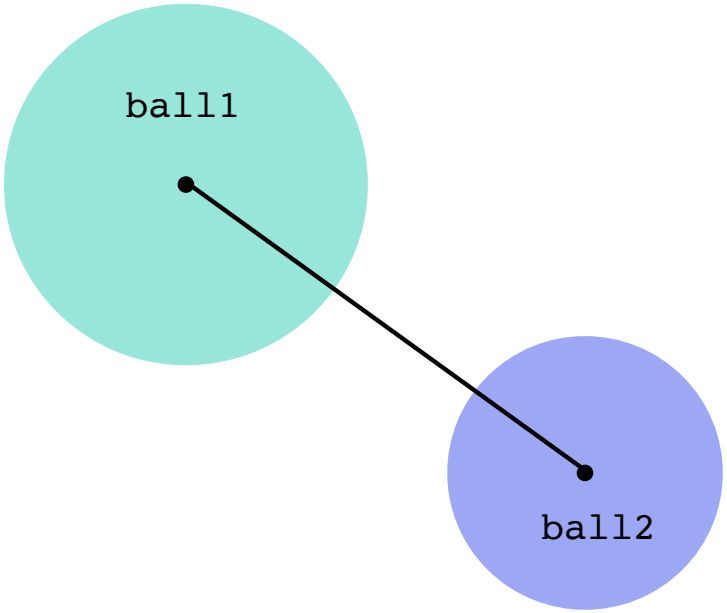
WANT TO KNOW WHEN BALLS ARE COLLIDING

COLLISION DETECTION

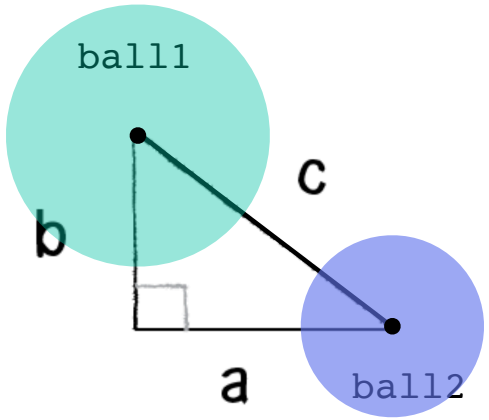


HOW DO WE KNOW
WHEN 2 BALLS ARE COLLIDING?

WHAT IS THE DISTANCE BETWEEN TWO BALLS?



WHAT IS THE DISTANCE BETWEEN TWO BALLS?

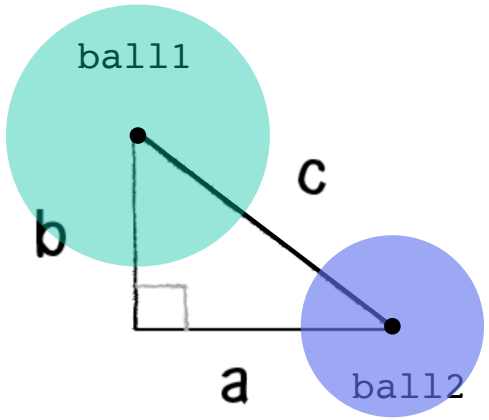


$$a^2 + b^2 = c^2$$

or

$$c = \sqrt{a^2 + b^2}$$

WHAT IS THE DISTANCE BETWEEN TWO BALLS?




```
a = ball2.xPosition - ball1.xPosition

b = ball2.yPosition - ball1.yPosition
```

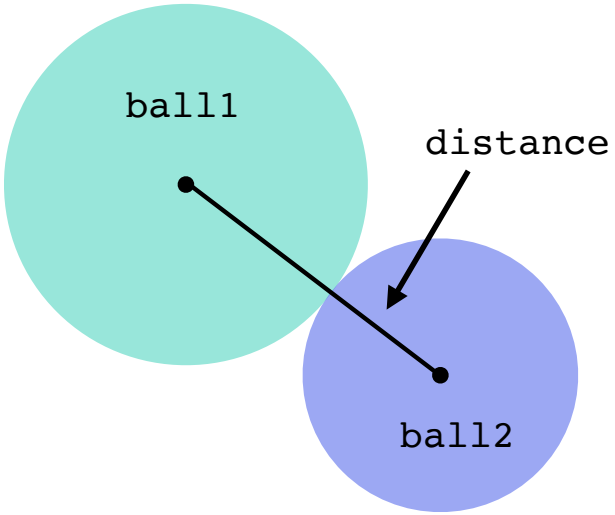
$$c = \sqrt{a^2 + b^2}$$

PUTTING IT TOGETHER IN CODE

```
double distanceBetween (Ball ball2) {
    int a = ball2.xPosition - this.xPosition;
    int b = ball2.yPosition - this.yPosition;
    double distance = Math.sqrt(a*a + b*b);
    return distance;
}
```

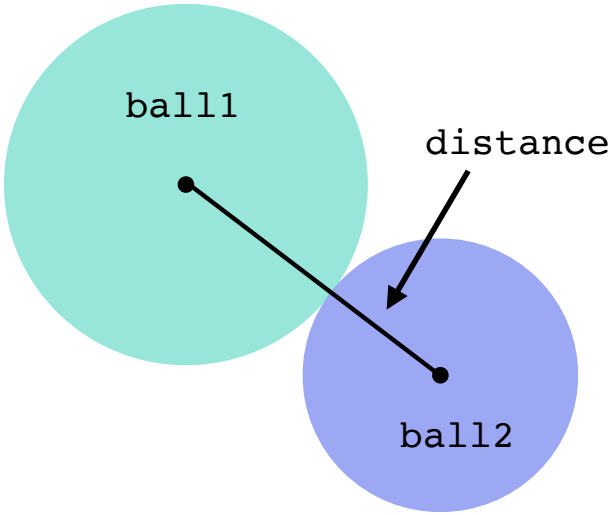
questions?

WHAT ARE THE VALUES OF DISTANCE WHEN BALLS ARE COLLIDING?




```
distance < ??
```

WHAT ARE THE VALUES OF DISTANCE WHEN BALLS ARE COLLIDING?




```
distance < ball1.size/2 + ball2.size/2
```

A SIMPLE COLLISION DETECTION METHOD

COLLISION DETECTION

```
boolean collision(Ball ball2) {
    if (distanceBetween(ball2) <= size/2 + ball2.size/2) {
        return true;
    }
    else {
        return false;
    }
}
```

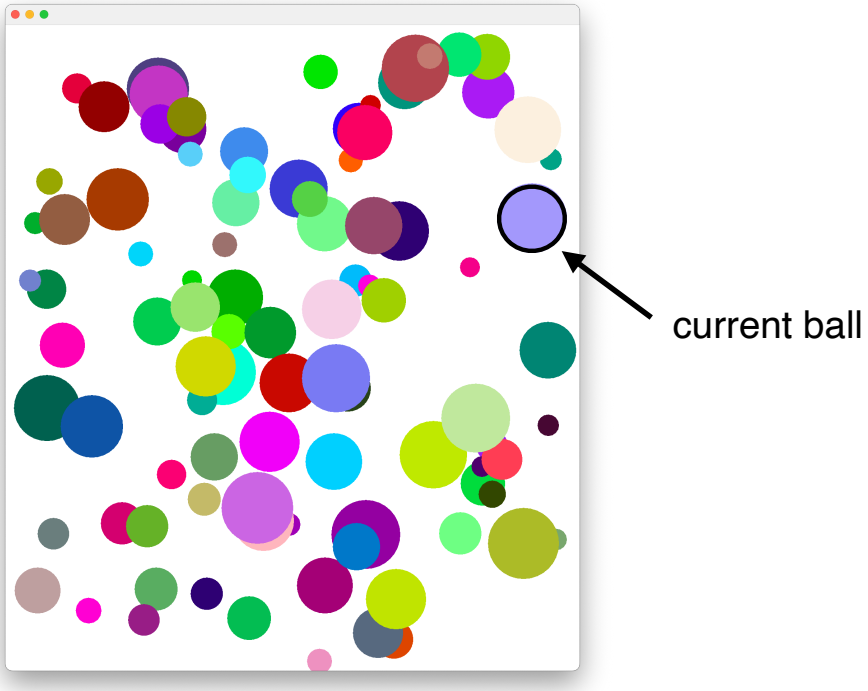
COLLISION DETECTION

```
boolean collision(Ball ball2) {
    if (distanceBetween(ball2) <= size/2 + ball2.size/2)
        return true;
   else
        return false;
}
```

questions?

USING COLLISION DETECTION

- How many balls do we have to check against?



All of the other balls!

USING COLLISION DETECTION

- Have to check each ball against every other ball
- Have to keep track of whether a ball is colliding
- Color colliding balls red

- Have to do this check & coloring every time we paint

A COLLISION VARIABLE

```
boolean colliding;

…
//initialize colliding to false in constructors
…


boolean checkCollision(Ball ball2) {
    if (distanceBetween(ball2) <= size/2 + ball2.size/2) {
        colliding = true;
        return true;
    }
    else
        return false;
}
```

CURRENT OBJECT IS COLLIDING
WHAT ELSE IS COLLIDING?

THE OTHER BALL

```
boolean colliding;

…

boolean checkCollision(Ball ball2) {
    if (distanceBetween(ball2) <= size/2 + ball2.size/2) {
        colliding = true;
        ball2.colliding = true;
        return true;
    }
    else
        return false;
}
```

why don't we set colliding variable to false here?

just because it's not colliding with ball2 doesn't mean it's not colliding with some other ball

questions?

COLOR COLLIDING BALLS RED

```
void draw (Graphics g) {
    if (colliding)
        g.setColor(Color.red);
    else
        g.setColor(color);
    g.fillOval(xPosition-size/2,yPosition-size/2,size,size);
}
```

CLEAR COLLISION VARIABLE

```
void clearCollision() {
    colliding = false;
}
```

DOING THE CHECKING FOR ALL BALLS

IN MyPanel

```
protected void paintComponent(Graphics g) {
    super.paintComponent(g);
    setBackground(Color.WHITE);

    for (int i=0;i<numberOfBalls;i++) {
        balls[i].move();
        balls[i].bounce(width,height);
        balls[i].draw(g);
    }
}
```

IN MyPanel

```
for (int i=0;i<numberOfBalls;i++) {
    balls[i].move();
    balls[i].bounce(width,height);
    for (int j=0;j<numberOfBalls;j++) {
        balls[i].checkCollision(balls[j]);
    }
    balls[i].draw(g);
}
```

check against all other balls

IN MyPanel

```
for (int i=0;i<numberOfBalls;i++) {
    balls[i].move();
    balls[i].bounce(width,height);
    for (int j=0;j<numberOfBalls;j++) {
        balls[i].checkCollision(balls[j]);
    }
    balls[i].draw(g);
    balls[i].clearCollision();
}
```

check against all other balls

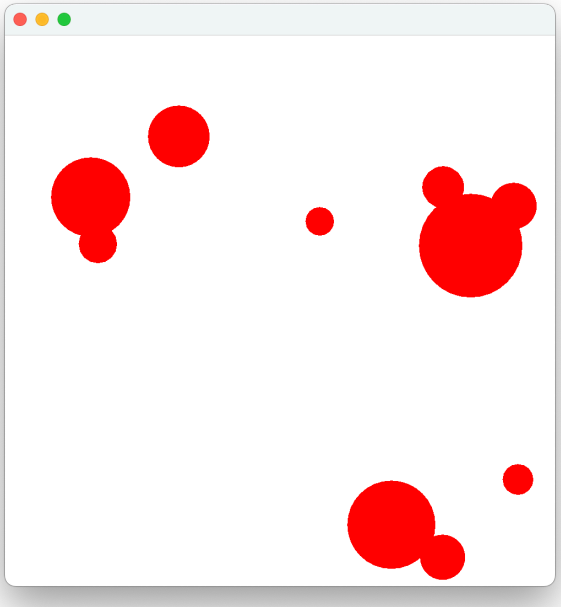
clear collision variable after painting

WHAT IS THE PROBLEM?

```
for (int i=0;i<numberOfBalls;i++) {
    balls[i].move();
    balls[i].bounce(width,height);
    for (int j=0;j<numberOfBalls;j++) {
        balls[i].checkCollision(balls[j]);
    }
    balls[i].draw(g);
    balls[i].clearCollision();
}
```

what happens when i==j??

every ball is colliding with itself!



A FIX

```
for (int i=0;i<numberOfBalls;i++) {
    balls[i].move();
    balls[i].bounce(width,height);
    for (int j=0;j<numberOfBalls;j++) {
        if (i!=j)
            balls[i].checkCollision(balls[j]);
    }
    balls[i].draw(g);
    balls[i].clearCollision();
}
```

(i != j)
i not equal to j

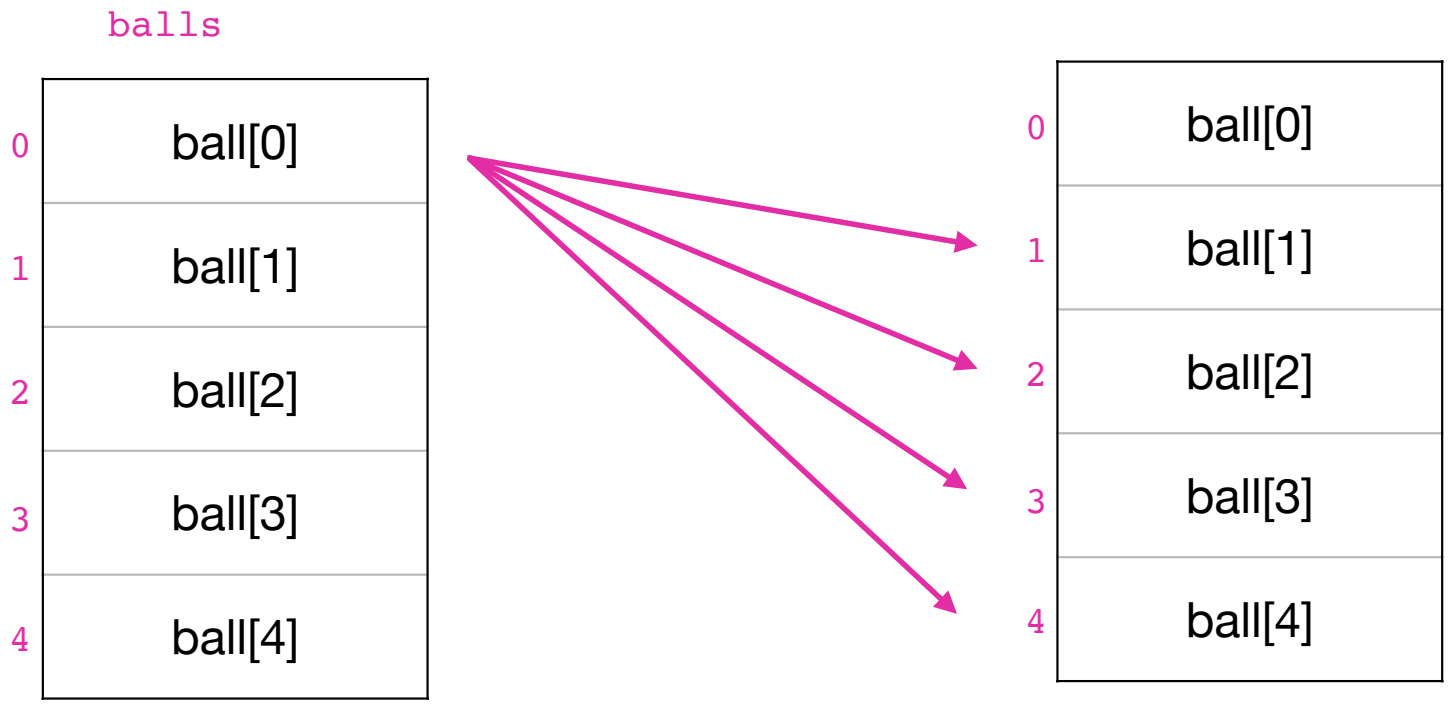
questions?

IS THERE A BETTER WAY?

IS THERE MORE EFFICIENT CODE?

AN EXERCISE FOR YOU…

LET'S THINK ABOUT THIS



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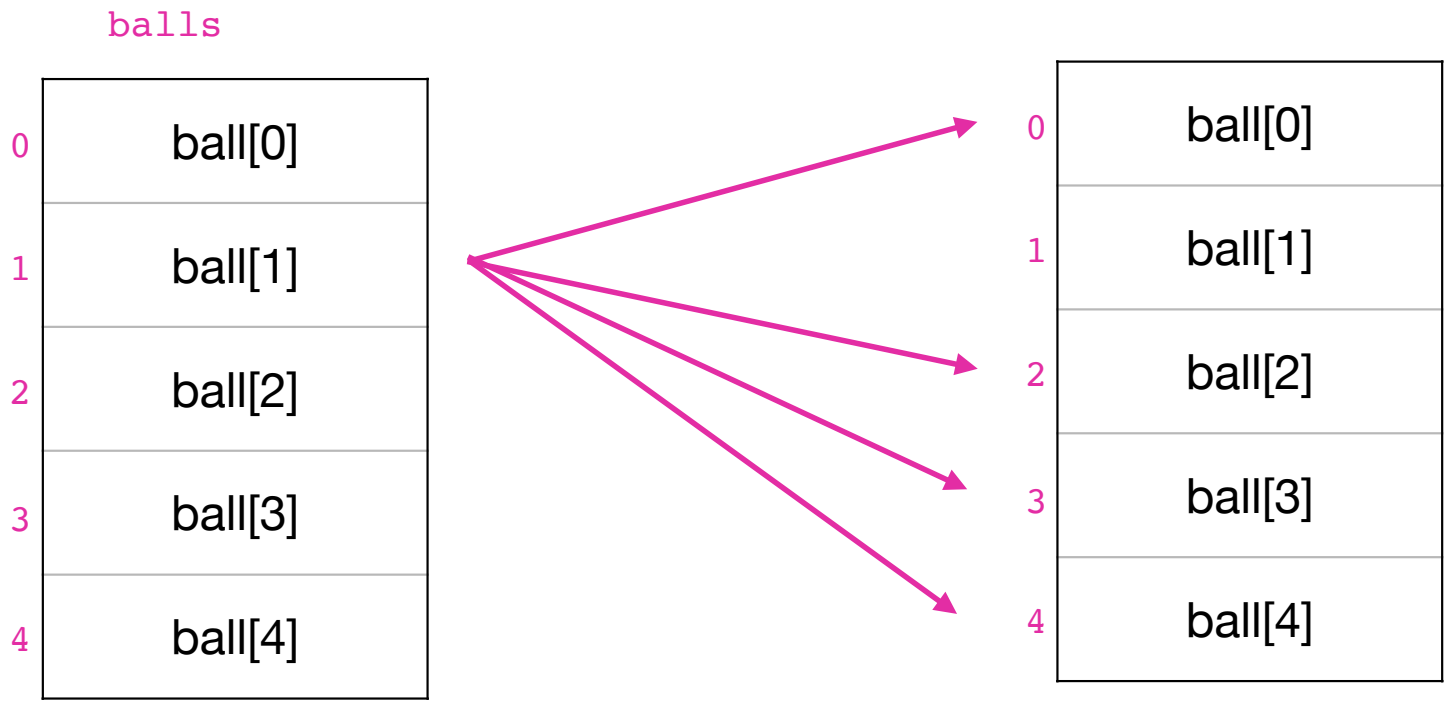

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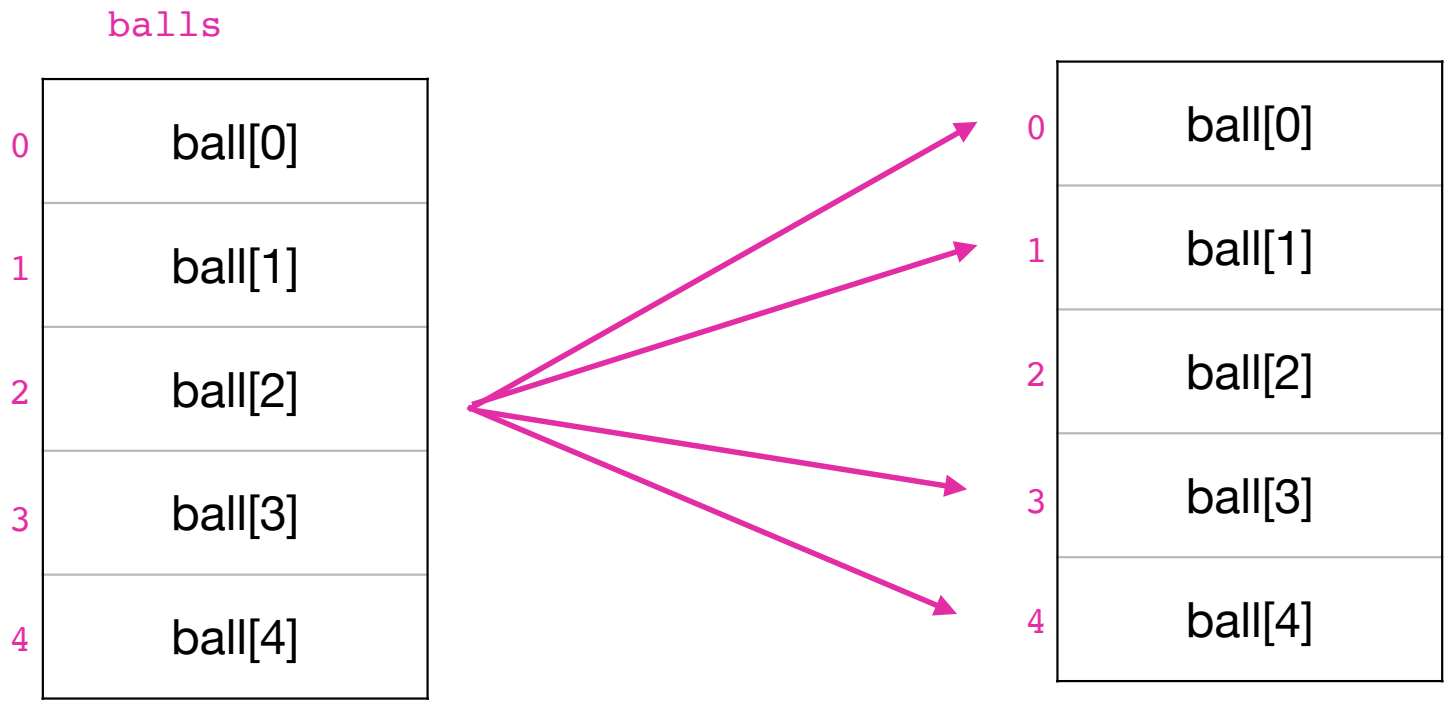
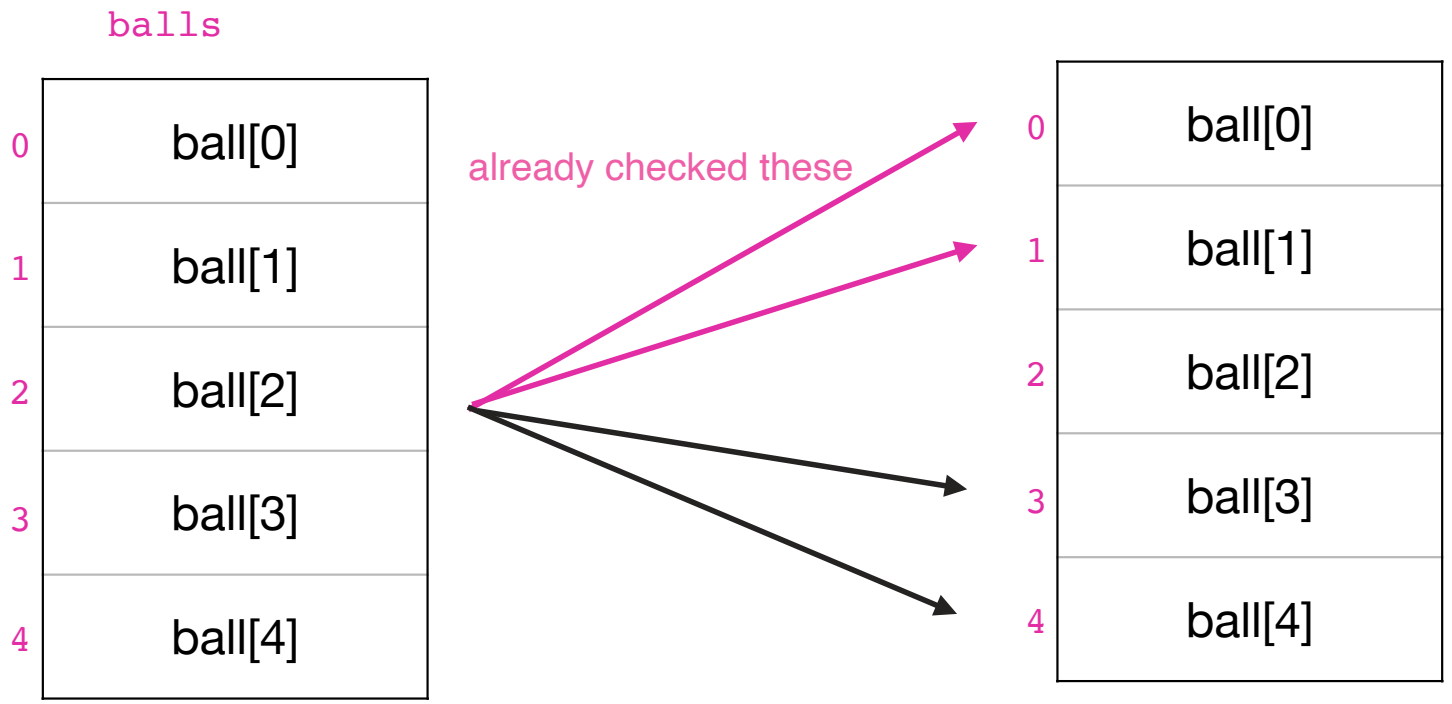


DUPLICATE CHECKS?

LET'S THINK ABOUT THIS



ORIGINAL CODE

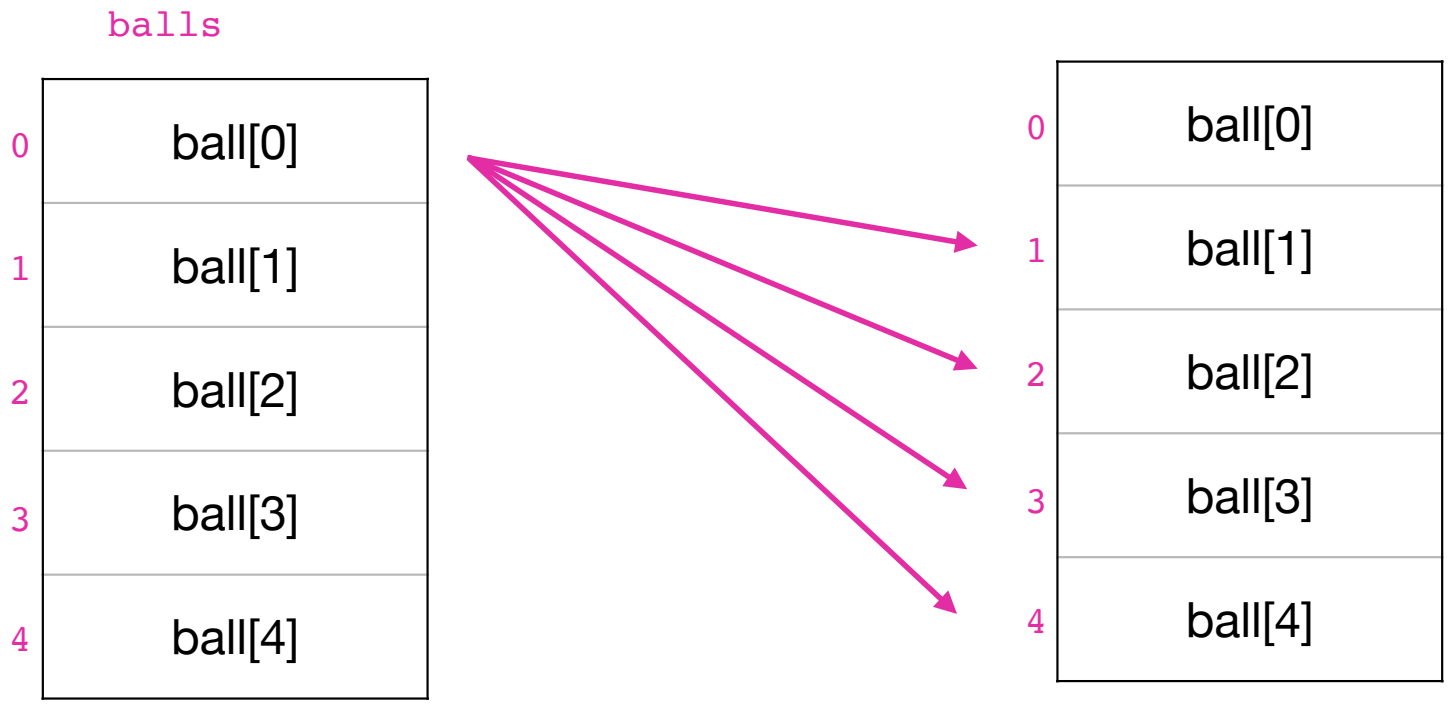
```
for (int i=0;i<numberOfBalls;i++) {
    balls[i].move();
    balls[i].bounce(width,height);
    for (int j=0;j<numberOfBalls;j++) {
        if (i!=j)
            balls[i].checkCollision(balls[j]);
    }
    balls[i].draw(g);
    balls[i].clearCollision();
}
```

MORE EFFICIENT CODE

```
for (int i=0;i<numberOfBalls;i++) {
    balls[i].move();
    balls[i].bounce(width,height);
    for (int j=i+1;j<numberOfBalls;j++) {
        balls[i].checkCollision(balls[j]);
    }
    balls[i].draw(g);
    balls[i].clearCollision();
}
```

eliminates redundant checking

LET'S THINK ABOUT THIS



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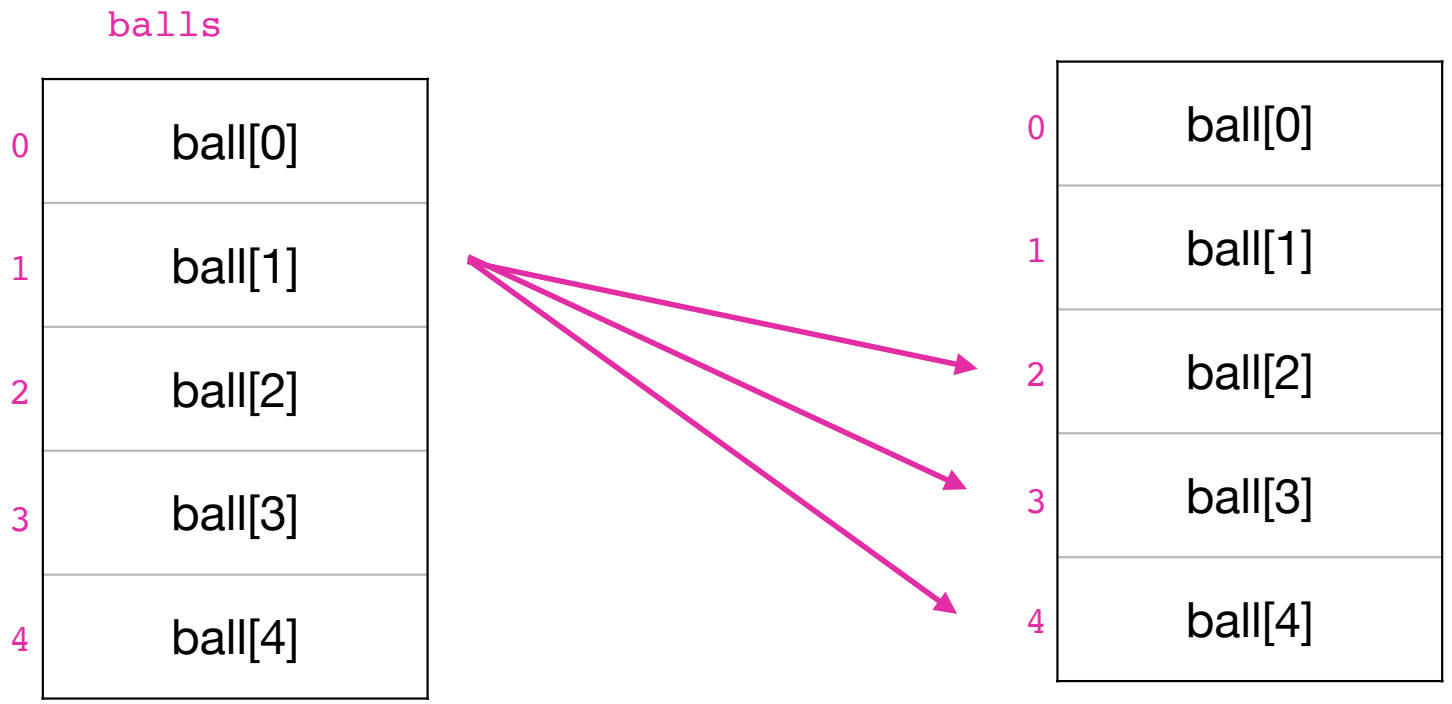

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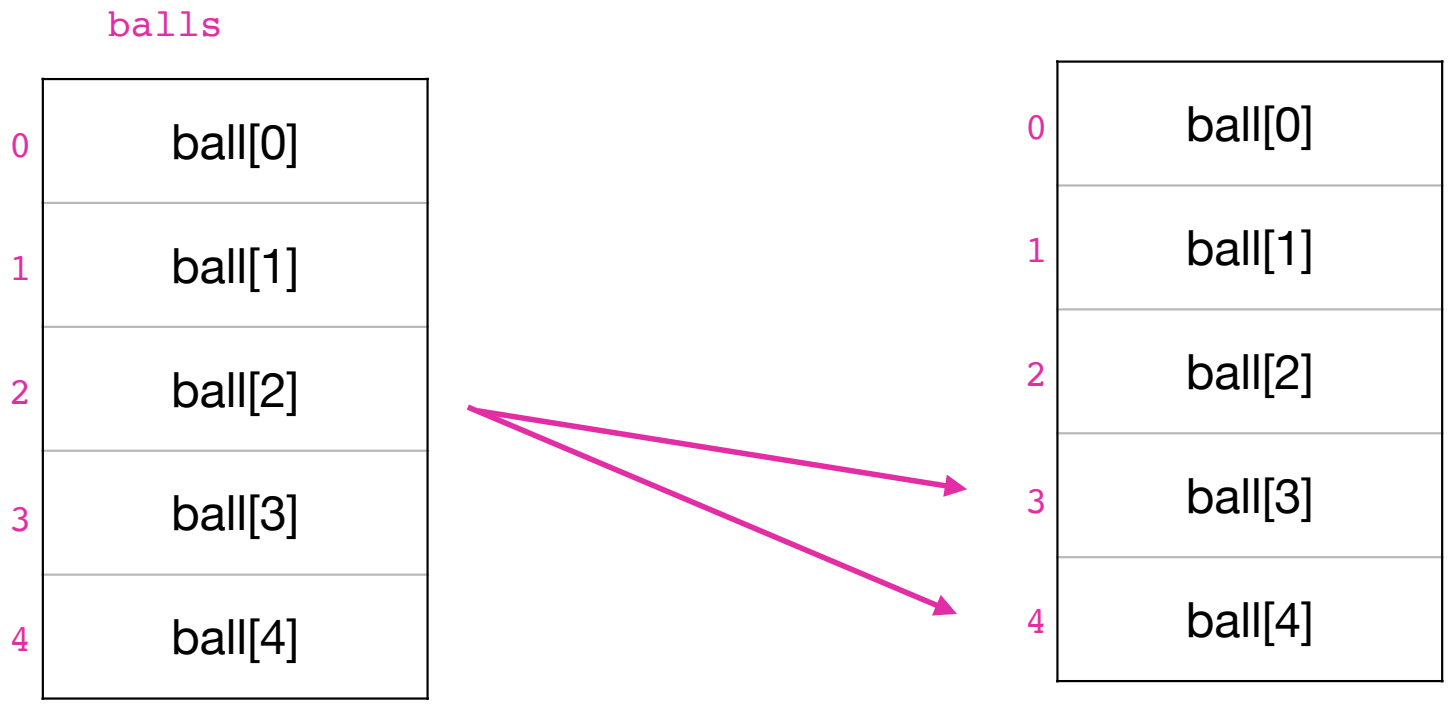

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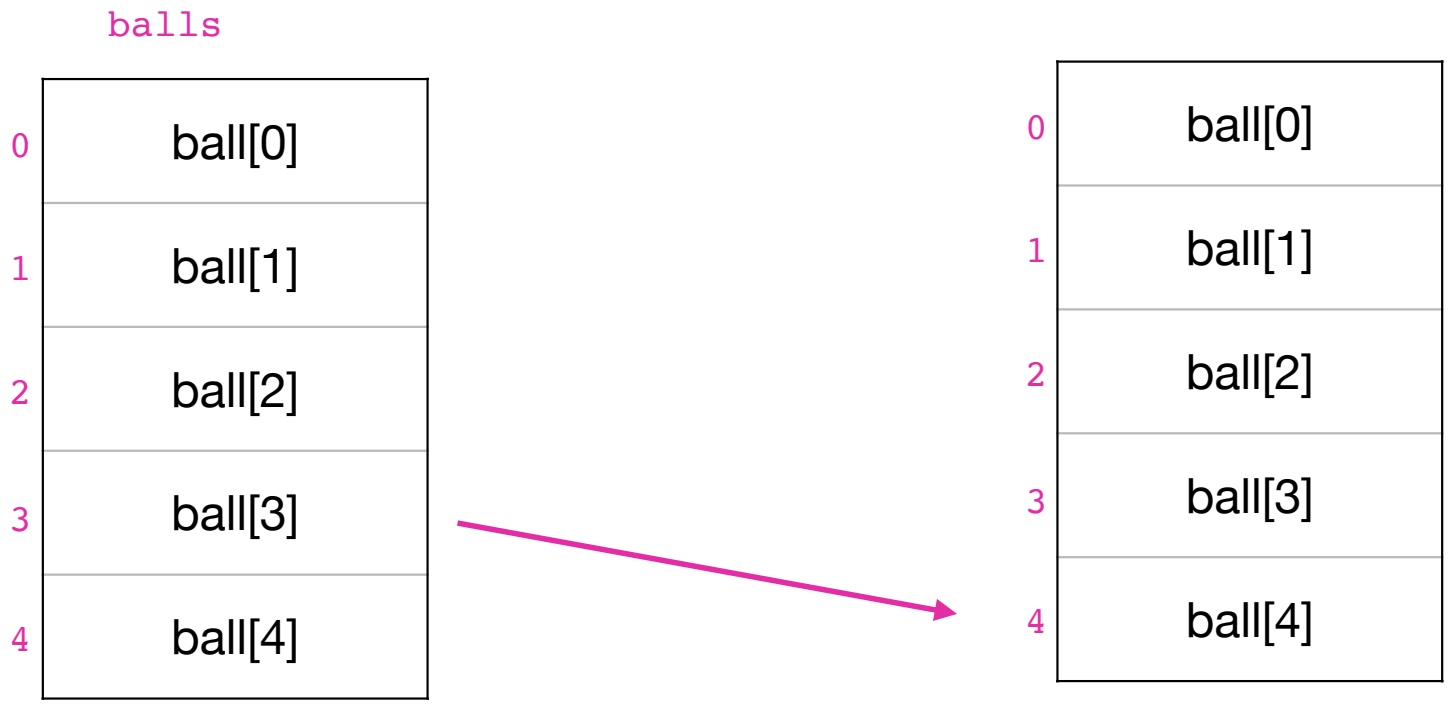

questions?