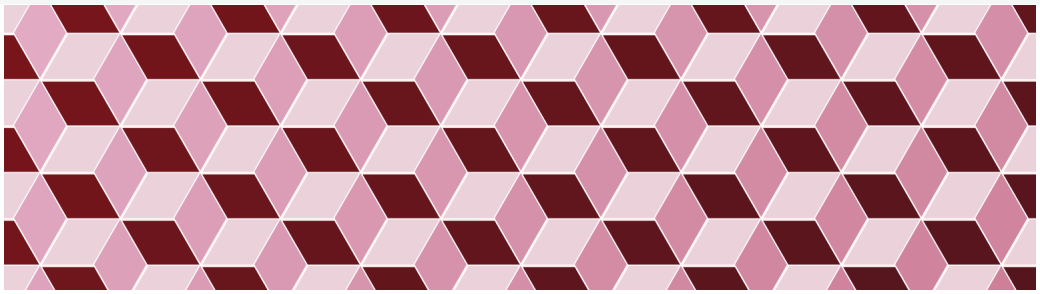

15-104 Introduction to Computing for Creative Practice

Fall 2020

06 Transformations

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Transformations

- In p5.js, you can perform a transformation on the canvas to create interesting effects.
- Types of transformations:
  - Translation (shift horizontally and/or vertically)
  - Rotation (rotate a certain number of degrees around a point)
  - Scaling (expand or contract)
- Transformations occur by moving the coordinate system of the canvas, not the object itself.

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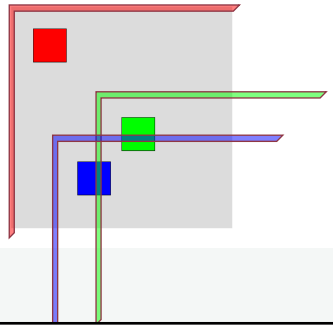
Translation

```
function setup() {
   createCanvas(500, 500);
   background(220);
}
function draw() {
   fill(255, 0, 0);
   rect(50, 50, 75, 75);
   translate(200, 200);
   fill(0, 255, 0);
   rect(50, 50, 75, 75);
   translate(-100, 100);
   fill(0, 0, 255);
   rect(50, 50, 75, 75);
}
```

Now the origin is at (200, 200)!

Now the origin is at (100, 300)!



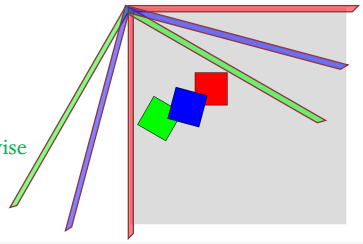
3

Rotation

```
function setup() {
   createCanvas(500, 500);
   background(220);
}
function draw() {
   fill(255, 0, 0);
   rect(150, 150, 75, 75);
   fill(0, 255, 0);
   rotate(radians(30));
   rect(150, 150, 75, 75);
   fill(0, 0, 255);
   rotate(radians(-15));
   rect(150, 150, 75, 75);
}
```

Rotate the coordinate system 30 degrees clockwise around the origin!

Rotate the coordinate system 15 degrees counter-clockwise around the origin!



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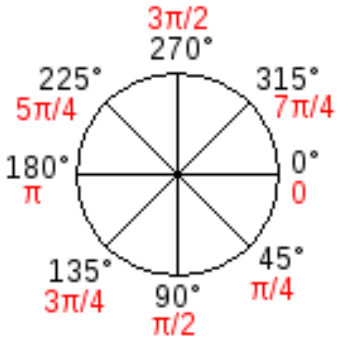
rotate

- `rotate()` requires a parameter in **radians**
- `radians()` takes a value in degrees and converts it to radians
- Examples:
  Rotating 90 degrees (pi/2 radians)
  `rotate(radians(90));`
  `rotate(PI/2);`



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push and pop

- `push` saves the current coordinate system and drawing properties.
- Then you can perform a transformation and draw with different colors, strokes, etc.
- `pop` returns you back to your previously saved coordinate system and drawing properties.
- You can nest push and pop inside each other to create a stack of coordinate system snapshots.

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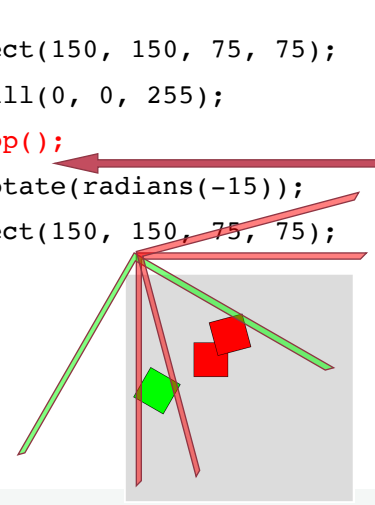
push and pop

```
function setup() {
    createCanvas(500, 500);
    background(220);
}
function draw() {
    fill(255, 0, 0);
    rect(150, 150, 75, 75);
    push();
    fill(0, 255, 0);
    rotate(radians(30));
    rect(150, 150, 75, 75);
    fill(0, 0, 255);
    pop();
    rotate(radians(-15));
    rect(150, 150, 75, 75);
}
```

Fill resorts back to red
Rotation resorts back to 0 degrees.



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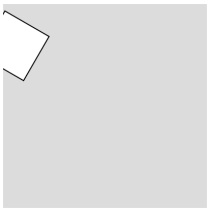
Rotating around the origin

```
var angle = 0;

function setup() {
    createCanvas(200, 200);
}

function draw() {
    background(220);
    push();
    rotate(radians(angle));
    rect(5, 5, 50, 50);
    pop();
    angle = angle + 5;
}
```



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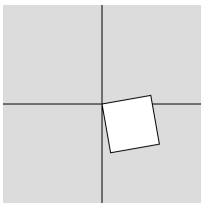
Rotating Around the Center

```
var angle = 0;

function setup() {
    createCanvas(200, 200);
}

function draw() {
    background(220);
    line(width/2, 0,
         width/2, height);
    line(0, height/2,
         width, height/2);
    push();
    translate(100, 100);
    rotate(radians(angle));
    // note: now we draw
    // the rectangle at 0,0:
    rect(0, 0, 50, 50);
    pop();
    angle += 5;
}
```



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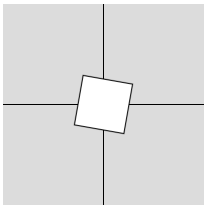
Spin on Center

```
var angle = 0;

function setup() {
    createCanvas(200, 200);
}

function draw() {
    background(220);
    line(width/2, 0,
         width/2, height);
    line(0, height/2,
         width, height/2);
    fill(255);
    stroke(0);
    push();
    translate(100, 100);
    rotate(radians(angle));
    rectMode(CENTER);
    rect(0, 0, 50, 50);
    pop();
    angle += 5;
}
```



`rectMode(CENTER)` interprets the first two parameters as the shape's center point, while the third and fourth parameters are its width and height.

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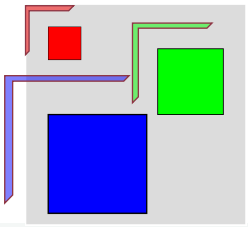
Scaling

```
function setup() {
    createCanvas(500, 500);
    background(220);
}

function draw() {
    fill(255, 0, 0);
    rect(50, 50, 75, 75);
    translate(200, 0);
    scale(2.0);   // 2X
    fill(0, 255, 0);
    rect(50, 50, 75, 75);
    translate(-150, 50);
    scale(1.5);    // 3X
    fill(0, 0, 255);
    rect(50, 50, 75, 75);
}
```

Scale: 100 X 100



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Try this:

- How would you spin the square on the location of the mouse?
- How can you create a spiral?
  HINTS:
  - The image is created over time by repeatedly drawing a small black circle.
  - There are two global variables: angle as in the examples above, and another variable to represent where to draw the circle.
  - Both variables increase by a small increment each time draw() is called.

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