CS559 Spring 2019

Module: Coordinate Systems (Transforms 1)

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Where do I draw?

Points (x,y) are interpreted in the **current coordinate system**

```
context.fillRect(40,60,80,50);
```

Canvas coordinates:

- origin at top left
- x to the right in "html pixels"
- y down in "html pixels"

Other Coodinates?

Mouse position is in window coordinates

```
let box = event.target.getBoundingClientRect();
let x = event.clientX - box.left;
let y = event.clientY - box.top;
```

Need to convert from window to Canvas

It is **convenient** to draw in Canvas Coordinates

One thing inside another

```
context.fillStyle="goldenrod";
context.fillRect(10,10,50,30);
context.fillStyle="red";
context.fillRect(20,20,10,10);
context.fillRect(40,20,10,10);
```

change where this "object" is?

```
context.fillStyle="goldenrod";
context.fillRect(60,10,50,30); // change this
context.fillStyle="red";
context.fillRect(20,20,10,10);
context.fillRect(40,20,10,10);
```

Oops!

move everything

```
context.fillStyle="goldenrod";
context.fillRect(50+10,10,50,30); // change this
context.fillStyle="red";
context.fillRect(50+20,20,10,10);
context.fillRect(50+40,20,10,10);
```

rect is weird since `width,height` is relative

better with a variable

```
let x=50;
context.fillStyle="goldenrod";
context.fillRect(x+10,10,50,30); // change this
context.fillStyle="red";
context.fillRect(x+20,20,10,10);
context.fillRect(x+40,20,10,10);
```

make the variables mean something

```
let x=60;
let y=10;
context.fillStyle="goldenrod";
context.fillRect(x,y,50,30); // change this
context.fillStyle="red";
context.fillRect(x+10,y+10,10,10);
context.fillRect(x+30,y+10,10,10);
```

move the coordinate system!

```
let x=60;
let y=10;
context.translate(x,y);

context.fillStyle="goldenrod";
context.fillRect( 0,0, 50,30); // change this
context.fillStyle="red";
context.fillRect(10,10,10,10);
context.fillRect(30,10,10,10);
```

don't forget to put things back

```
let x=60;
let y=10;
context.save();
context.translate(x,y);
context.fillStyle="goldenrod";
context.fillRect( 0,0, 50,30); // change this
context.fillStyle="red";
context.fillRect(10,10,10,10);
context.fillRect(30,10,10,10);
context.restore();

context.restore();
```

move objects, or coordinates?

```
context.fillStyle="goldenrod";
context.fillRect( 0,0, 50,50);
context.fillStyle="red";
context.save();
    context.translate(10,10);
    context.fillRect(0,0,10,10);
    context.translate(20,0);
    context.fillRect(0,0,10,10);
context.restore();
context.translate(0,20);
context.save();
    context.translate(10,10);
    context.fillRect(0,0,10,10);
    context.translate(20,0);
    context.fillRect(0,0,10,10);
context.restore();
```

Instancing

```
context.fillRect(0,0,10,10);
```

Same thing, used over and over...

make it once and put it into place

Key Ideas

- transformations apply to all points
- view transformations as: moving objects
- view transformations as: moving coordinate systems
- transformations **compose**
- use transformations to get convenient coordinates
- use transformations to build hierarchy