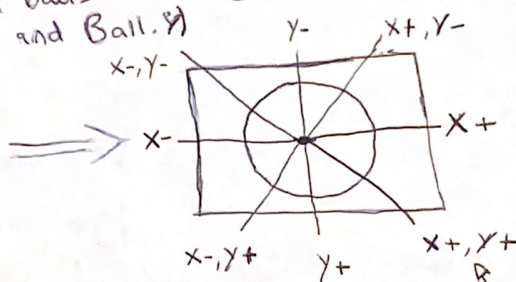
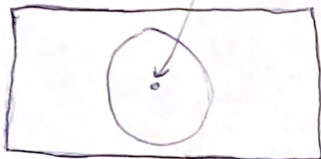


## Ball Movement

Velocity = speed + Direction

Center of ball = (Ball.x and Ball.y)



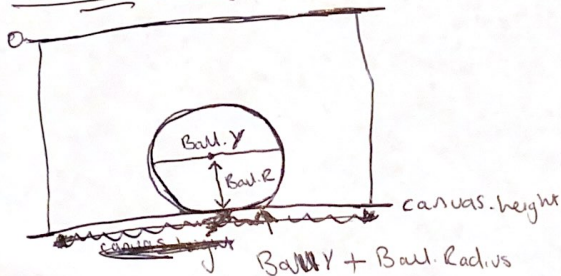
Ball.x += velocity.x  
- (means ball moves in x+ direction).

Ball.y += velocity.y  
- (means ball moves in y+ direction).

- Both equations put together = x+, y+.  
(Ball moves South east of center position).

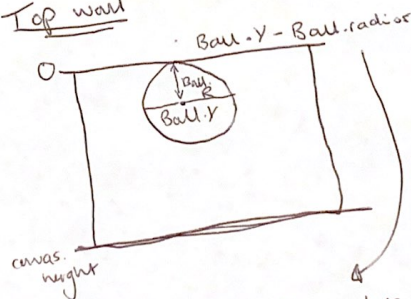
## Wall Collision

### Bottom Wall



So, ball.y + Ball.radius > canvas.height

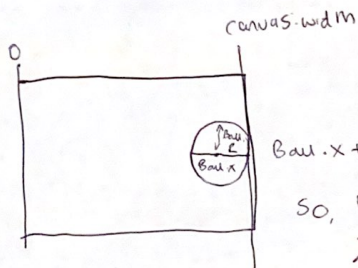
### Top wall



So, Ball.y - Ball.radius < 0.

⇒ if both of these occur, then velocity should be reversed.  
(-velocity.y).

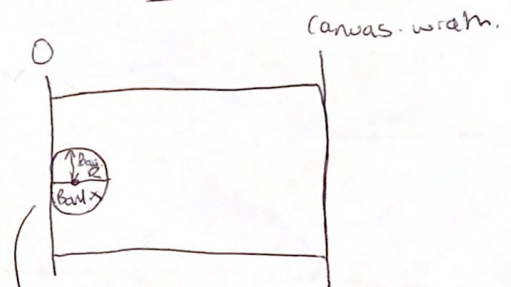
### Right wall



$$\text{Ball.x} + \text{Ball.radius}$$

So,  $\text{Ball.x} + \text{Ball.radius}$  is  
 $\geq \text{canvas.wdm}$ ,  
user scores one point.

### Left wall

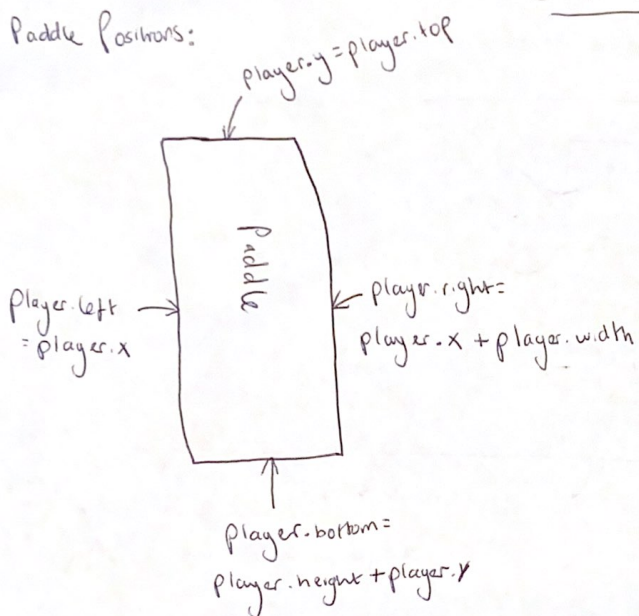


$$\text{Ball.x} - \text{Ball.radius}$$

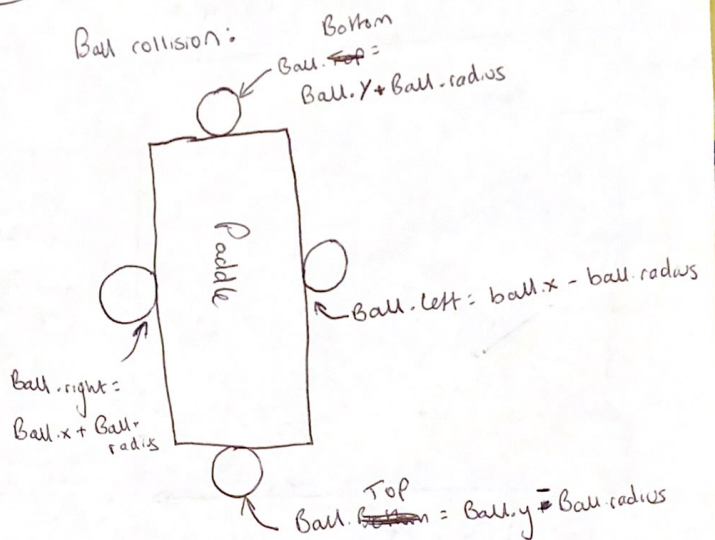
So, if  $\text{Ball.x} - \text{Ball.radius}$  is  
 $\leq 0$ , AI scores one  
point.

## Collision Detection

Paddle Positions:



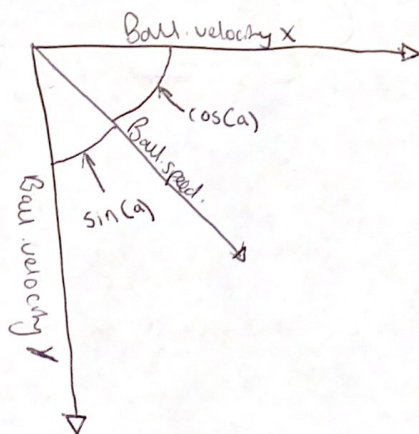
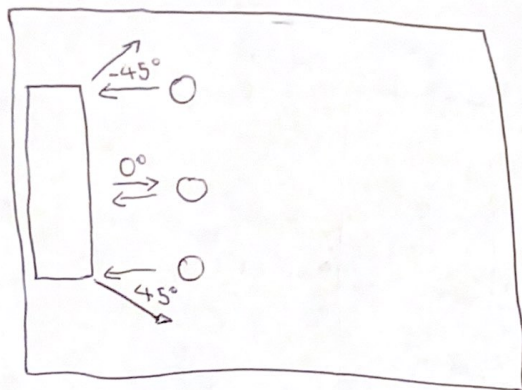
Ball collision:



combining Both to generate a return statement:

$\text{Ball.right} > \text{player.left}, \text{Ball.left} < \text{player.right}, \text{Ball.top} < \text{player.bottom},$   
 $\text{Ball.bottom} > \text{player.top}.$

$$45^\circ = \text{Math.PI}/4$$



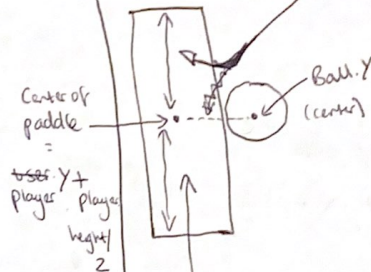
### Collision Equation

Default Angle =  $0^\circ$

(top half)

so, if  $\text{Ball.Y} < \text{player.Y} + \text{player.height}/2$

angle =  $-45^\circ$  (math.PI/4 x -1)



so, if  $\text{ball.Y} > \text{player.Y} + \text{player.height}/2$

angle =  $45^\circ$  (math.PI/4)

So, to calculate

$$\cos(a) = \frac{\text{Ball velocity x}}{\text{Ball speed}}$$

$$\text{so velocity x} = \text{speed} \times \cos(a)$$

$$\sin(a) = \frac{\text{Ball velocity y}}{\text{Ball speed}}$$

$$\text{so velocity y} = \text{speed} \times \sin(a)$$