

## Point/point distance

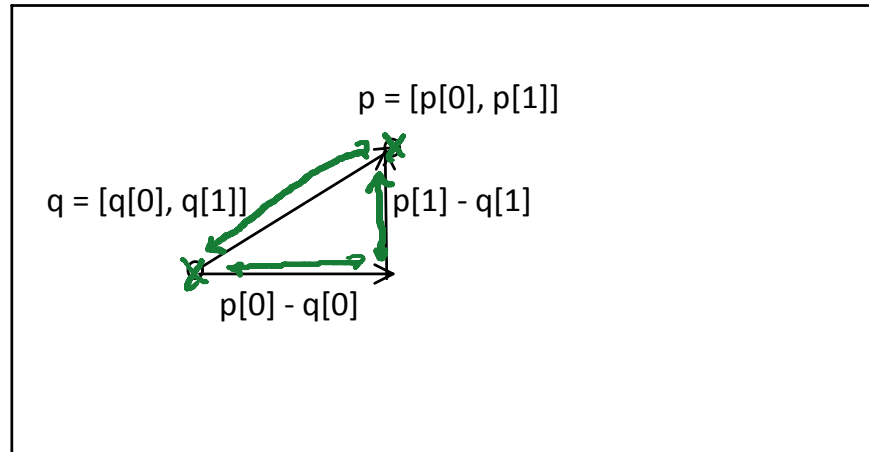
Two points

Math - points on canvas

$p, q$

Python - list of coordinates

$[p[0], p[1]], [q[0], q[1]]$



Pythagorean theorem

Math

$$\sqrt{\text{dist}(p, q)^2} = \sqrt{(p[0] - q[0])^2 + (p[1] - q[1])^2}$$

Python

def dist(p, q):

return math.sqrt((p[0] - q[0]) \*\* 2 + (p[1] - q[1]) \*\* 2)

## Vectors and motion

### Vector as difference of two points

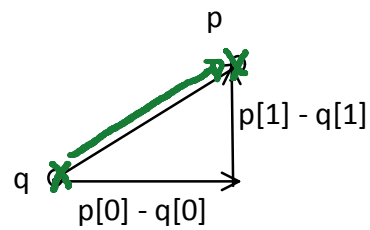
Math

$$\mathbf{v} = \mathbf{p} - \mathbf{q}$$

Python - list of components

$$\rightarrow v[0] = p[0] - q[0]$$

$$\rightarrow v[1] = p[1] - q[1]$$



### Move/translate point using a vector

Math

$$\mathbf{p} = \mathbf{q} + \mathbf{v}$$

Python

$$\rightarrow p[0] = q[0] + v[0]$$

$$\rightarrow p[1] = q[1] + v[1]$$

### Update for motion

Math - point at position p with velocity v

$$\mathbf{p} = \mathbf{p} + a * \mathbf{v}$$

Python

$$\rightarrow p[0] = p[0] + a * v[0]$$

$$\rightarrow p[1] = p[1] + a * v[1]$$

## Collisions

Motion update

$$p[0] = p[0] + a * v[0]$$
$$p[1] = p[1] + a * v[1]$$

Collision of point p with wall

Left wall

$$p[0] \leq 0$$

Right wall

$$p[0] \geq \text{width} - 1$$

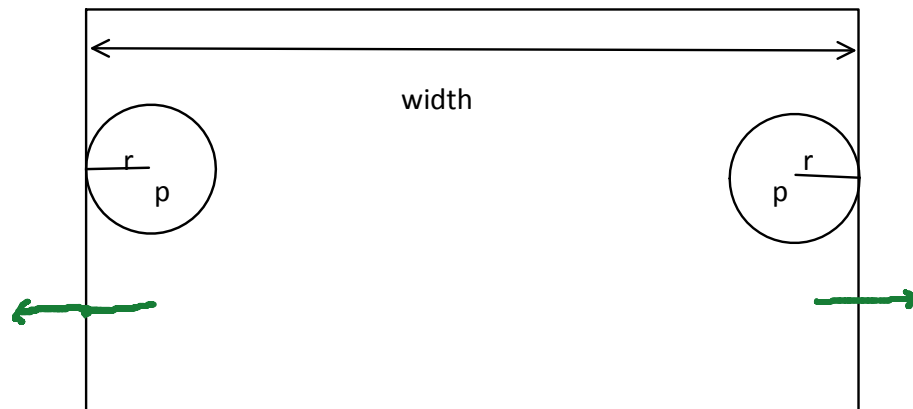
Collision of ball of with center p and radius r with wall

Left wall

$$p[0] \leq r$$

Right wall

$$p[0] \geq (\text{width} - 1) - r$$



# Reflections

Motion update

$$p[0] = p[0] + a * v[0]$$
$$p[1] = p[1] + a * v[1]$$

---

Reflections - update the velocity vector  $v$

Left wall

Compute reflected velocity vector

$$v[0] = -v[0]$$

$$v[1] = v[1]$$

