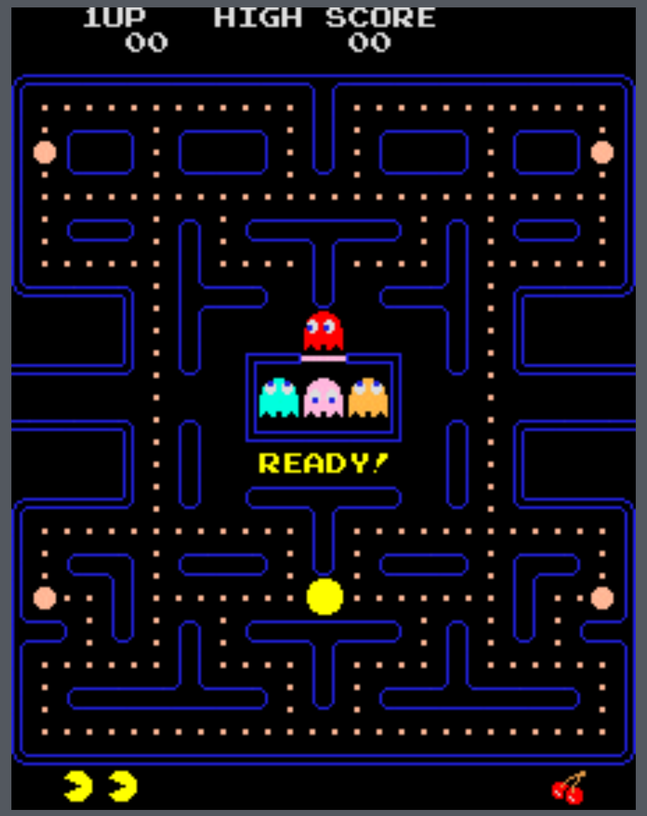
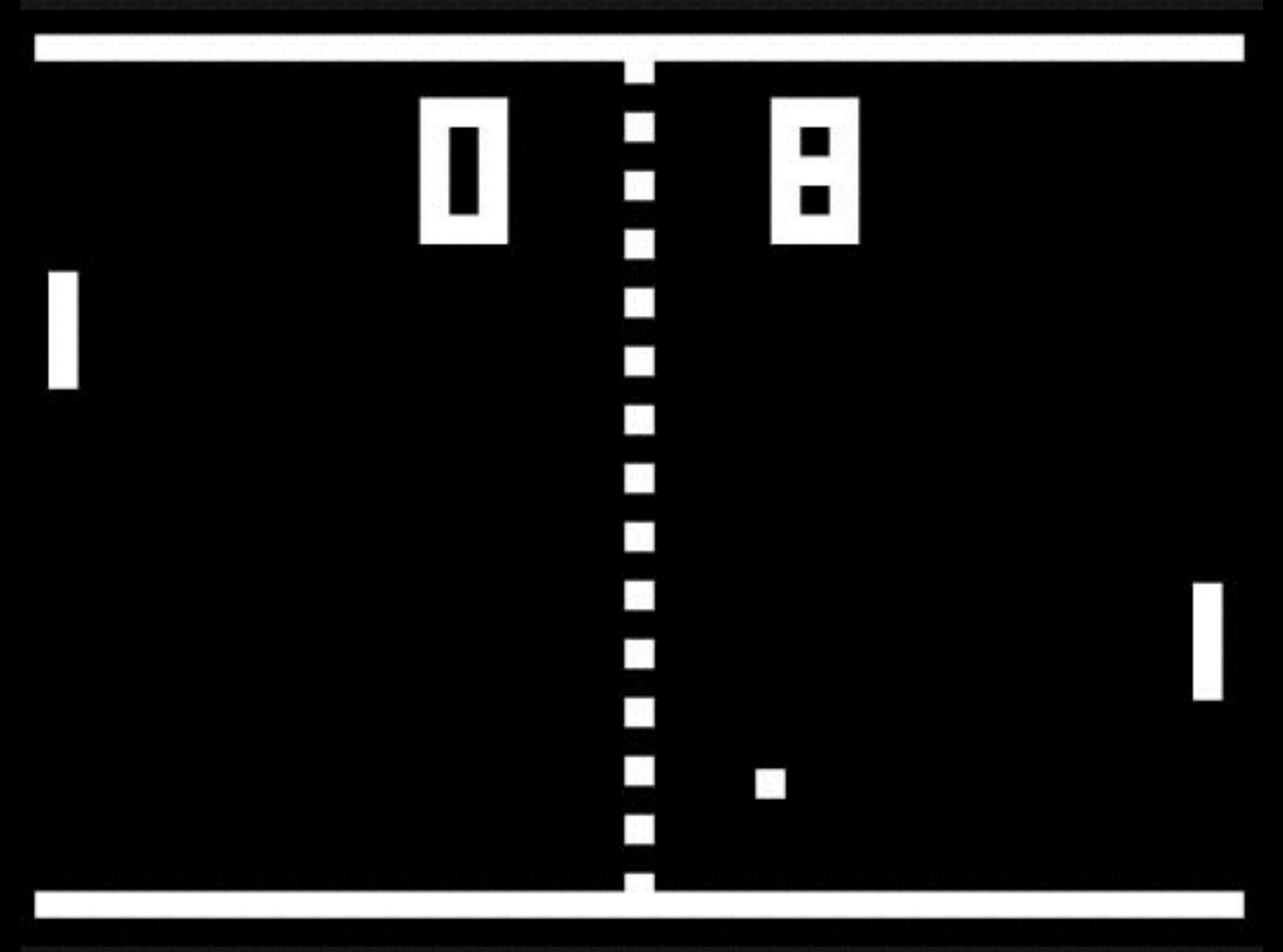
Basic **gameplay** programming.




PONG
PLAYER 1
PLAYER 2


1
8

Movement.

In **setup**

```
float lastFrameTicks = 0.0f;
```

In **game loop**

```
float ticks = (float)SDL_GetTicks()/1000.0f;
float elapsed = ticks - lastFrameTicks;
lastFrameTicks = ticks;
```

elapsed is how many seconds **elapsed since last frame**.

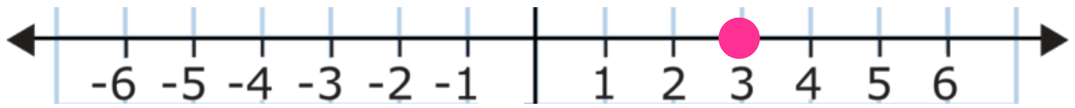
We will use this value to **move everything** in our game.

Linear motion.

```
y_position += elapsed *
distance_to_travel_in_one_second
```

Directional motion.

Vectors.

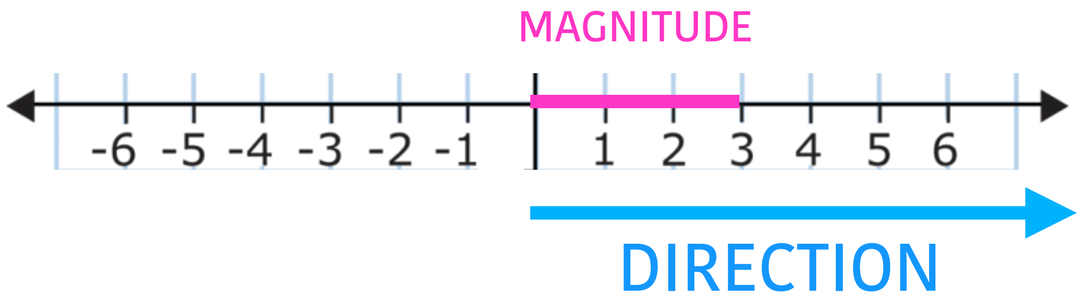


A vector is like a number...

but it has a **magnitude** and a **direction**!

A vector is like a number...

but it has a **magnitude**
and a **direction**!



A vector is like a number...

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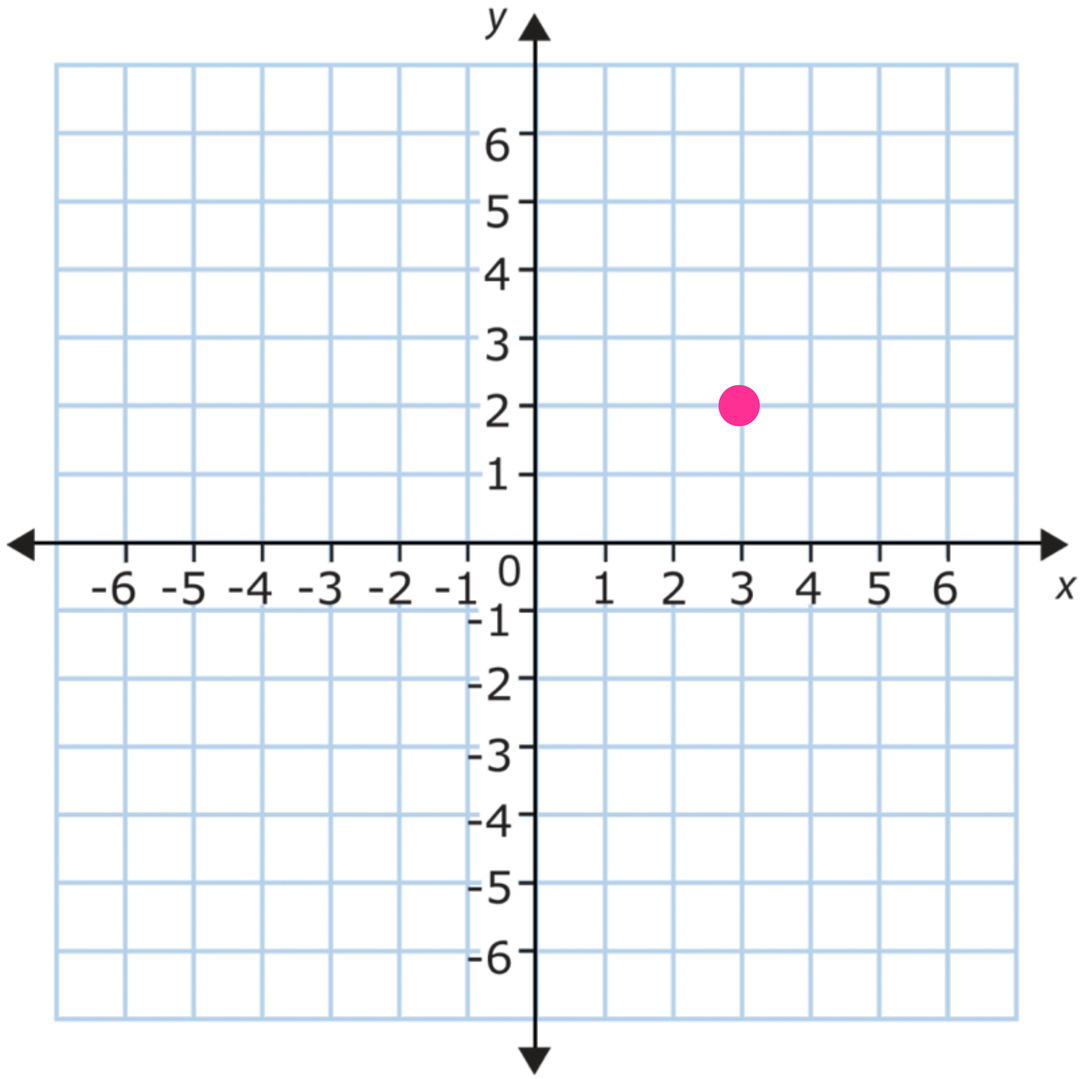
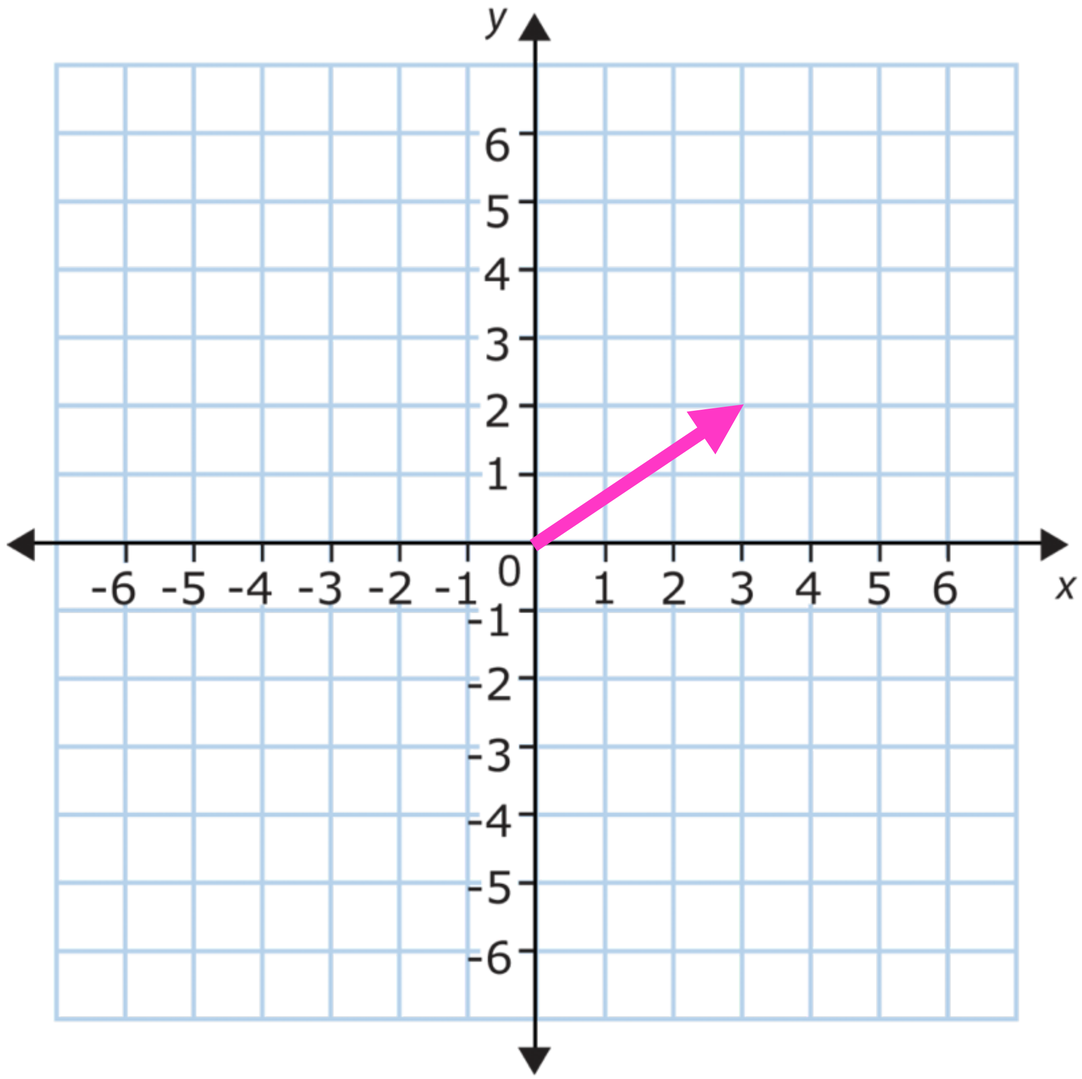
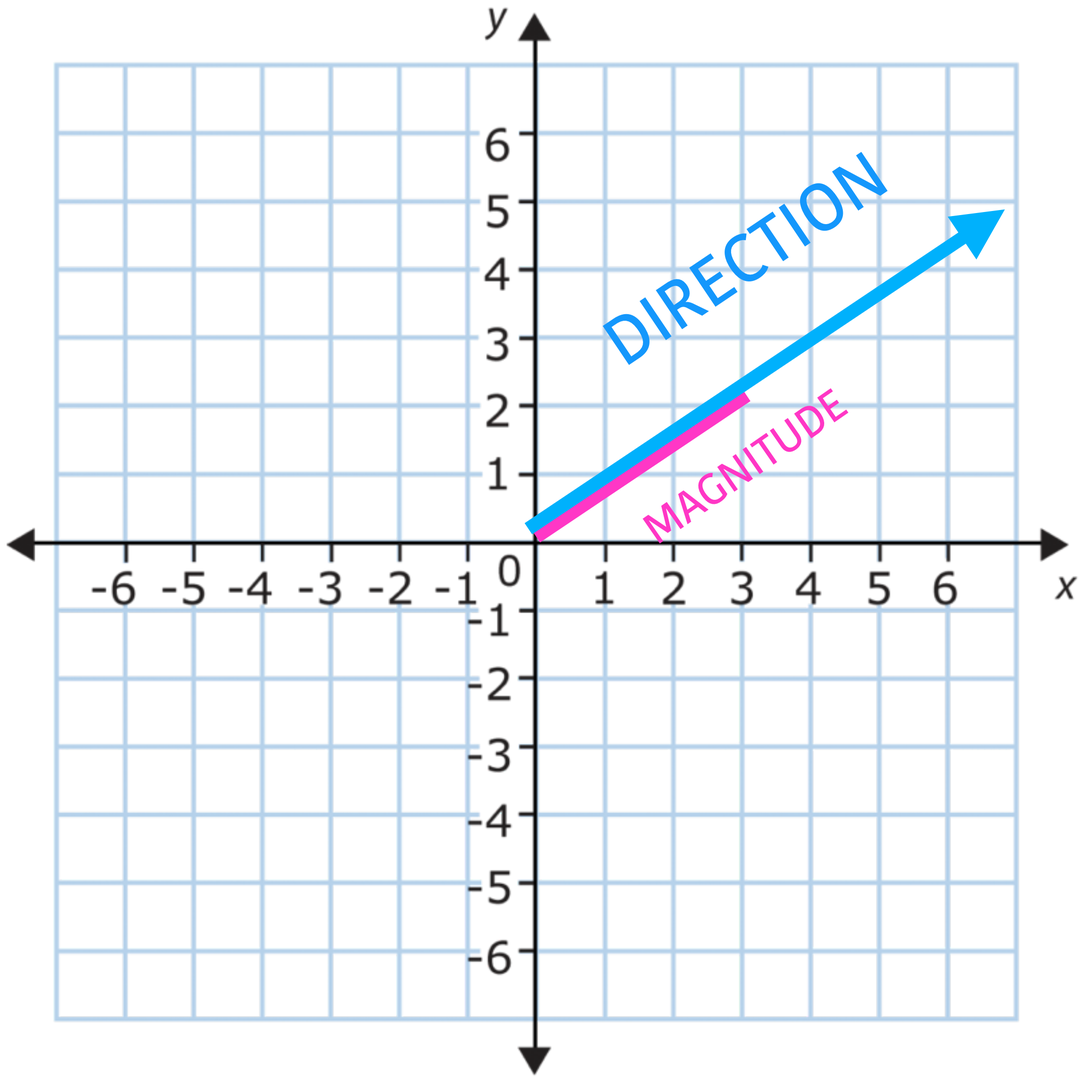


A **2D vector** is like a **2D coordinate**, but has a **magnitude** and a **direction**.



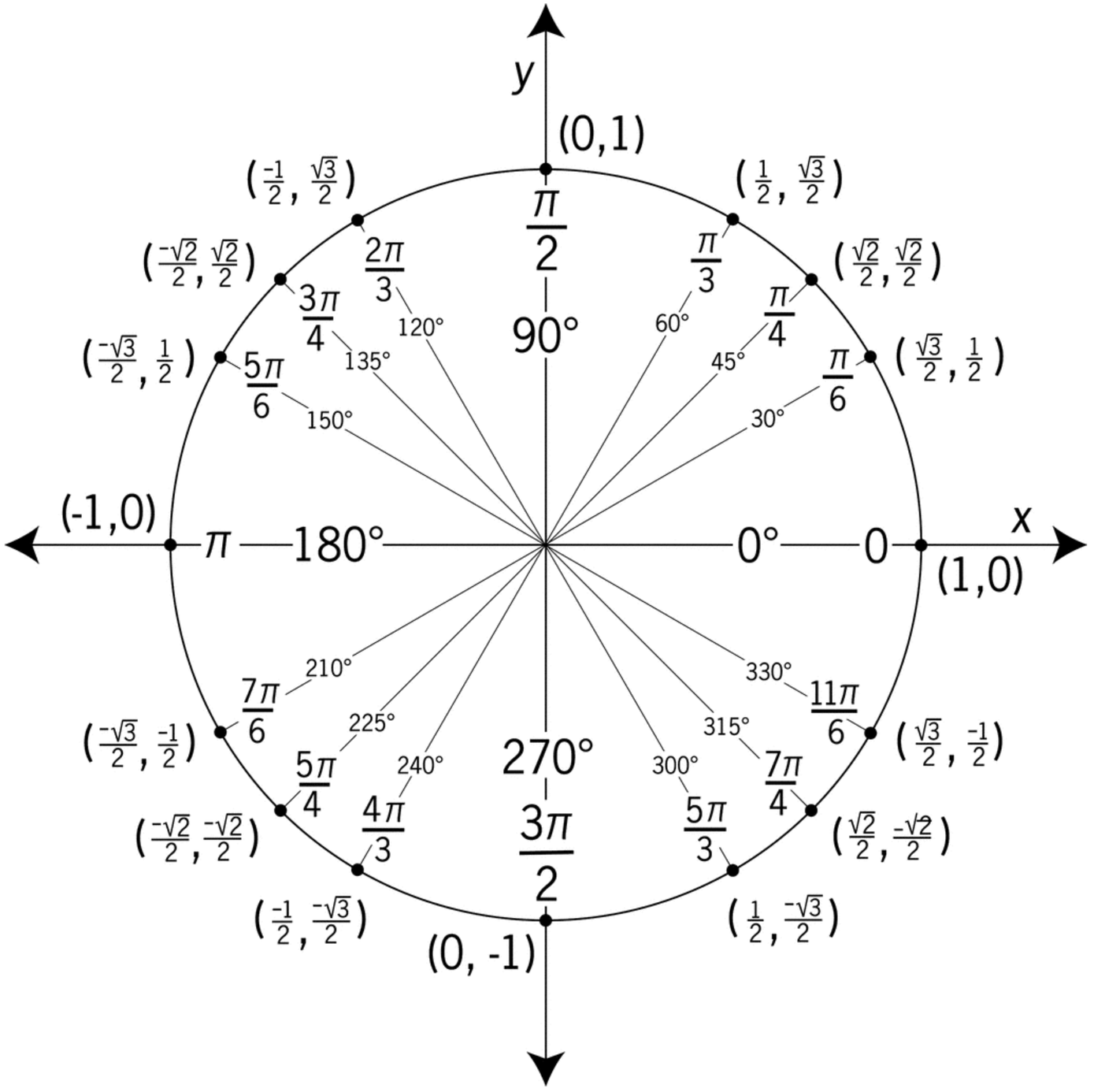
A **2D vector** is like a **2D coordinate**, but has a **magnitude** and a **direction**.

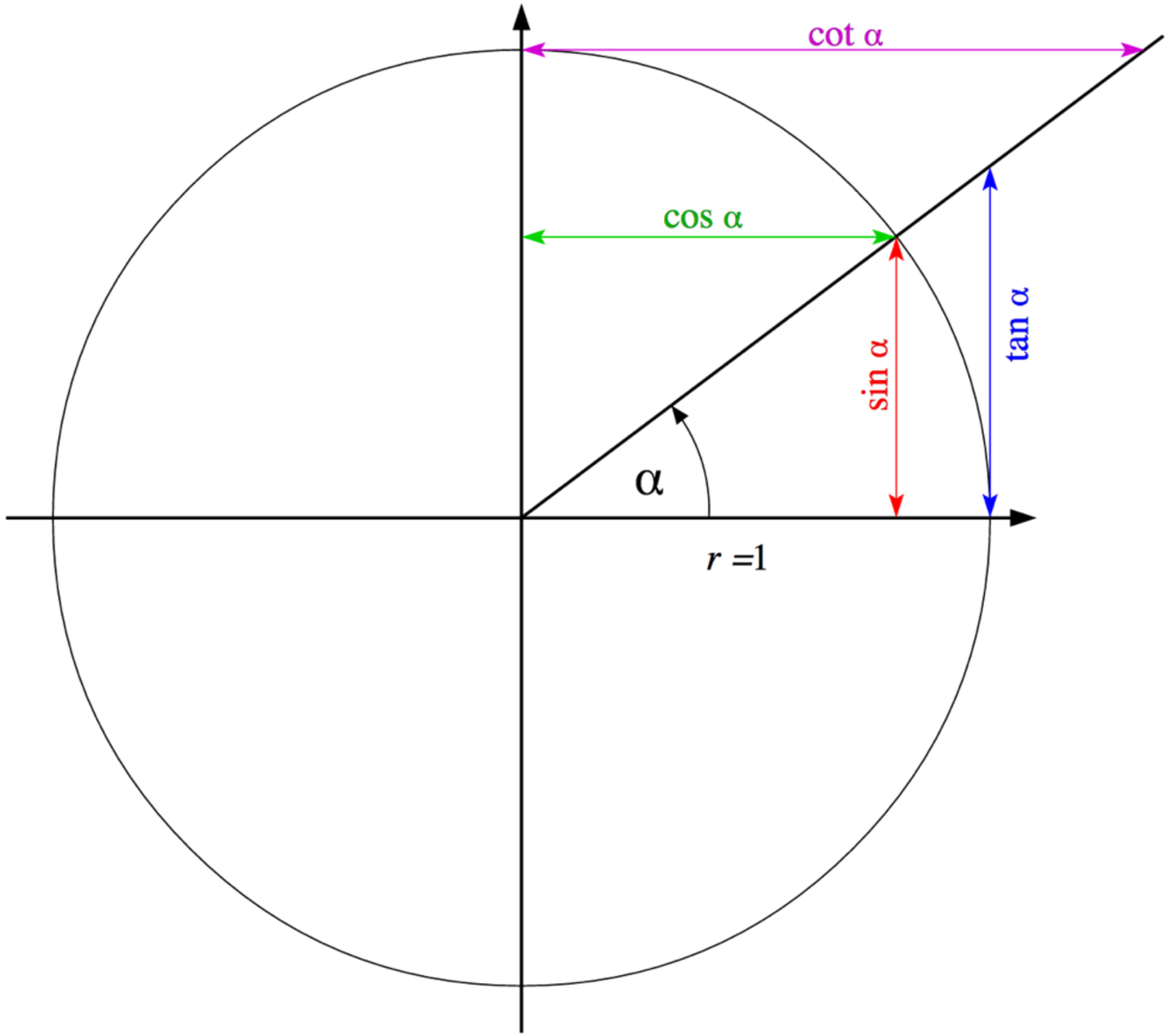


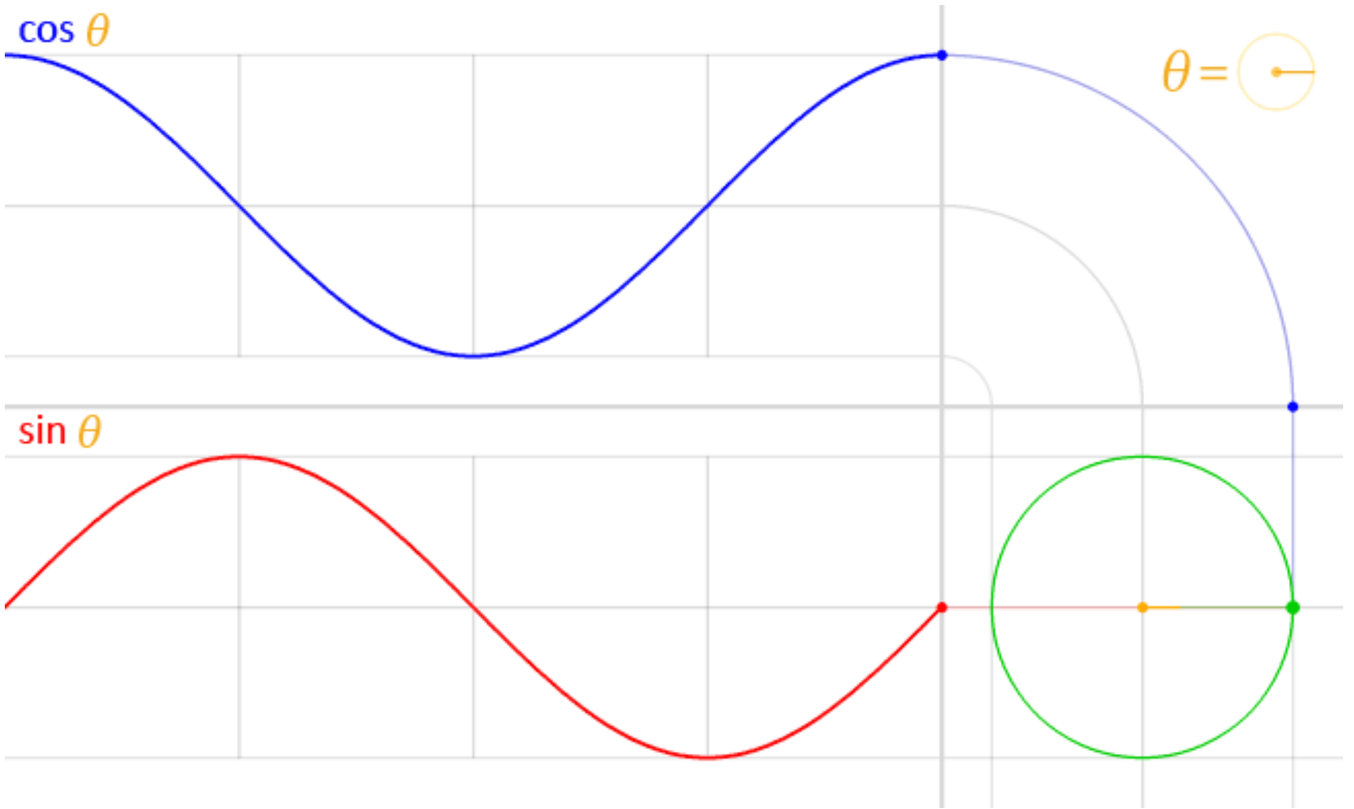
A **2D vector** is like a **2D coordinate**, but has a **magnitude** and a **direction**.

2D **direction**?

Unit vector!

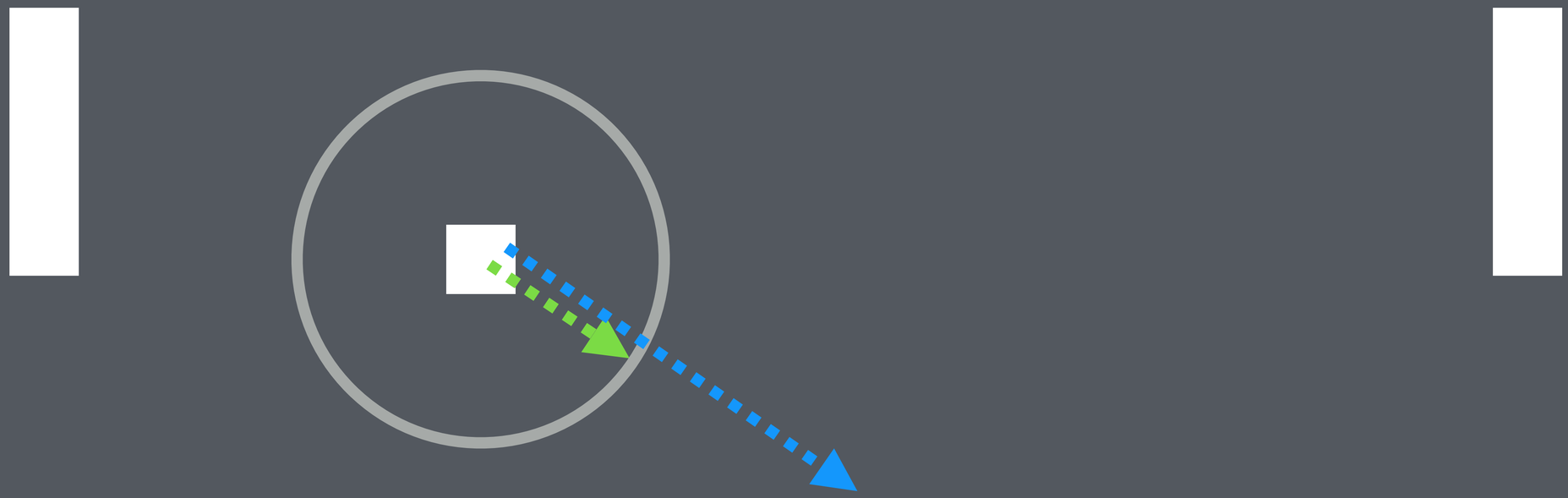

y
x
(0,1)
$\left(\frac{-1}{2}, \frac{\sqrt{3}}{2}\right)$
$\left(\frac{1}{2}, \frac{\sqrt{3}}{2}\right)$
$\frac{\pi}{2}$
$\frac{2\pi}{3}$
$\frac{\pi}{3}$
$\left(\frac{-\sqrt{2}}{2}, \frac{\sqrt{2}}{2}\right)$
$\left(\frac{\sqrt{2}}{2}, \frac{\sqrt{2}}{2}\right)$
$\frac{3\pi}{4}$
$\frac{\pi}{4}$
120°
60°
90°
$\left(\frac{-\sqrt{3}}{2}, \frac{1}{2}\right)$
$\left(\frac{\sqrt{3}}{2}, \frac{1}{2}\right)$
$\frac{5\pi}{6}$
$\frac{\pi}{6}$
135°
45°
150°
30°
(-1,0)
π
180°
0°
0
(1,0)
210°
330°
$\frac{7\pi}{6}$
$\frac{11\pi}{6}$
$\left(\frac{-\sqrt{3}}{2}, \frac{-1}{2}\right)$
$\left(\frac{\sqrt{3}}{2}, \frac{-1}{2}\right)$
225°
315°
$\frac{5\pi}{4}$
240°
270°
300°
$\frac{7\pi}{4}$
$\left(\frac{-\sqrt{2}}{2}, \frac{-\sqrt{2}}{2}\right)$
$\frac{4\pi}{3}$
$\frac{3\pi}{2}$
$\frac{5\pi}{3}$
$\left(\frac{\sqrt{2}}{2}, \frac{-\sqrt{2}}{2}\right)$
$\left(\frac{-1}{2}, \frac{-\sqrt{3}}{2}\right)$
$\left(\frac{1}{2}, \frac{-\sqrt{3}}{2}\right)$
(0, -1)


cot α
cos α
sin α
tan α
α
r =1


cos θ
θ =
sin θ

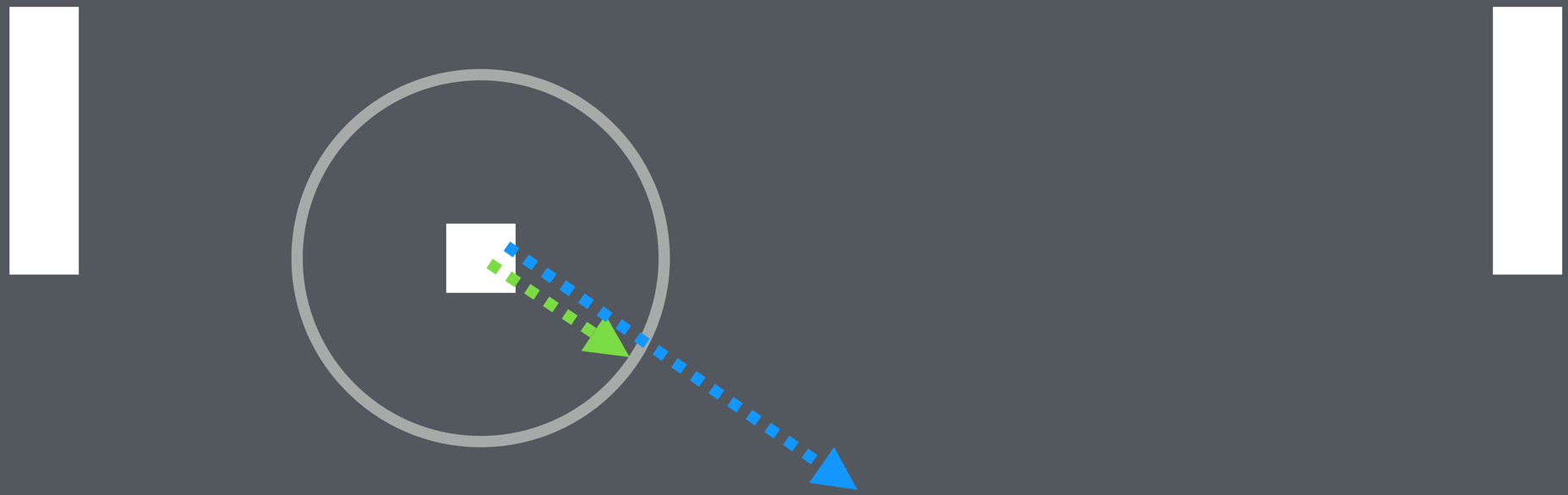
position += direction_vector

* elapsed * units_a_second



```
position.x += cos(angle) *
elapsed * units_a_second
```

```
position.y += sin(angle) *
elapsed * units_a_second
```



Reading **keyboard** input.

Polling input vs. input **events**.

Polling input

Checking to see if a key is **pressed**.
Useful for **continuous player actions**, such as **movement**, or checking modifier keys.

```
Uint8 *SDL_GetKeyboardState(int *numkeys);
```

Returns a **pointer to an array of key states**. A value of **1 means that the key is pressed** and a **value of 0 means that it is not**. Indexes into this array are obtained by using **SDL scancode values**. The pointer returned is a pointer to an internal SDL array. It will be valid for the whole lifetime of the application and **should not be freed by the caller**. We can pass it a pointer to an int if we want to know the size of the array.

```
const Uint8 *keys = SDL_GetKeyboardState(NULL);

if(keys[SDL_SCANCODE_LEFT]) {
    // go left!
} else if(keys[SDL_SCANCODE_RIGHT]) {
    // go right!
}
```

SDL **scancodes**:

All start with **SDL_SCANCODE_**

Full list here:
https://wiki.libsdl.org/SDL_Scancode

Input **events**.

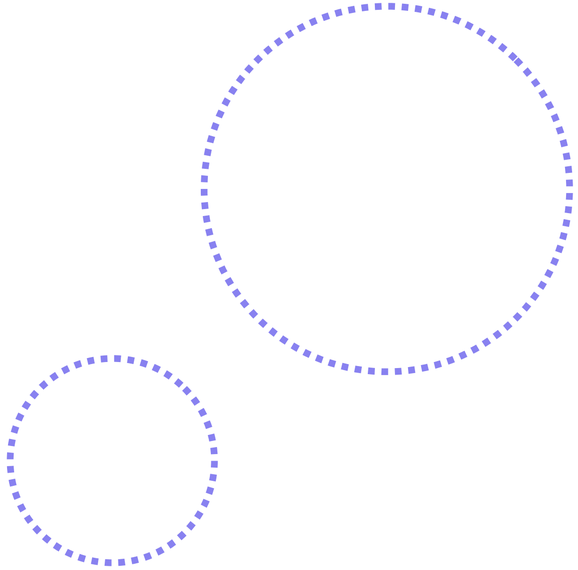
Knowing **exactly when the player pressed or released a key**. Useful for **action events** like **shooting** or **jumping**.

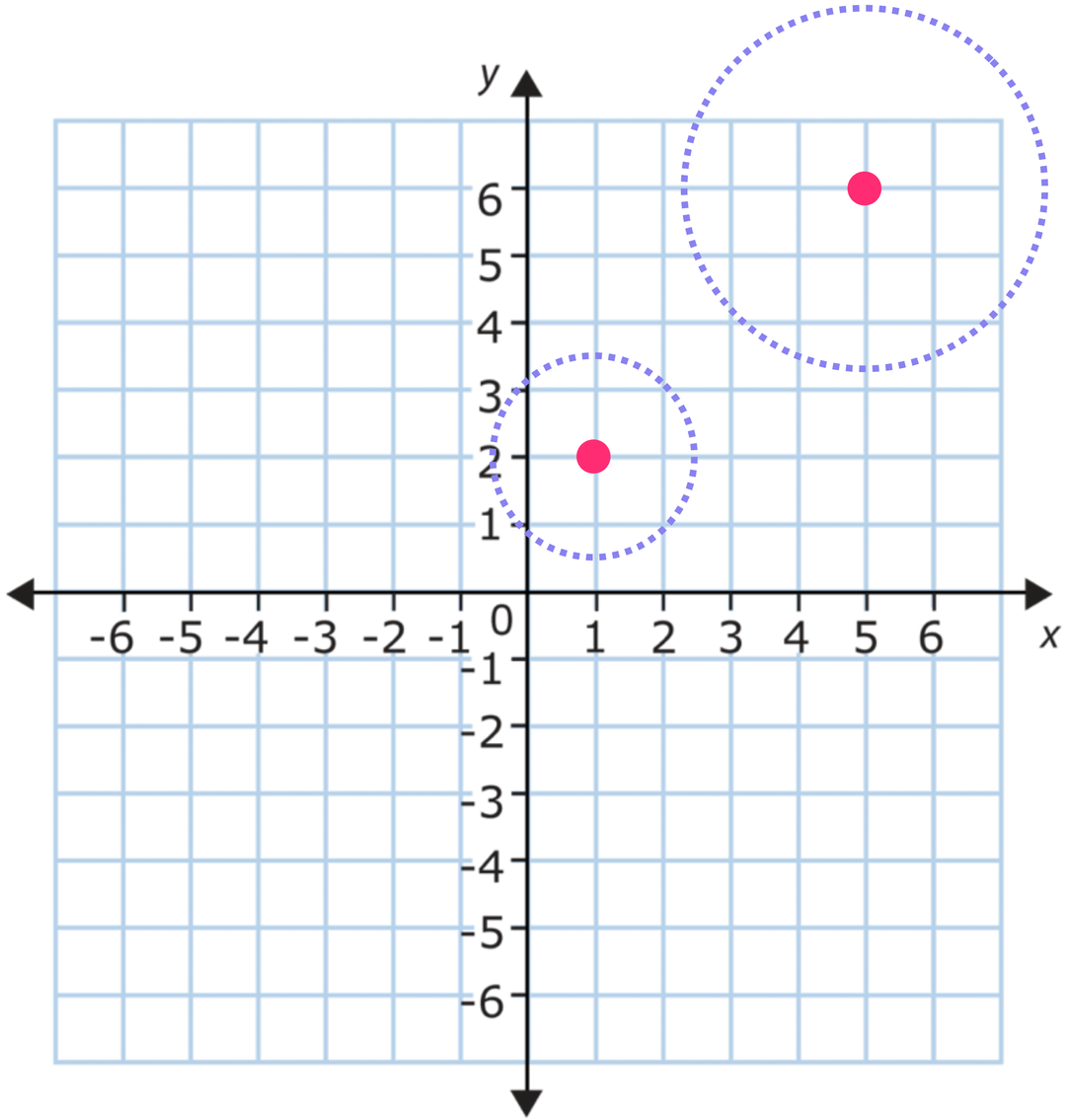
To read **input events**, we use our **event loop** to see if the event has a **type** of **SDL_KEYDOWN** or **SDL_KEYUP**. We can then **check the key** that was pressed or released by checking the **key** member of the **SDL event structure**.

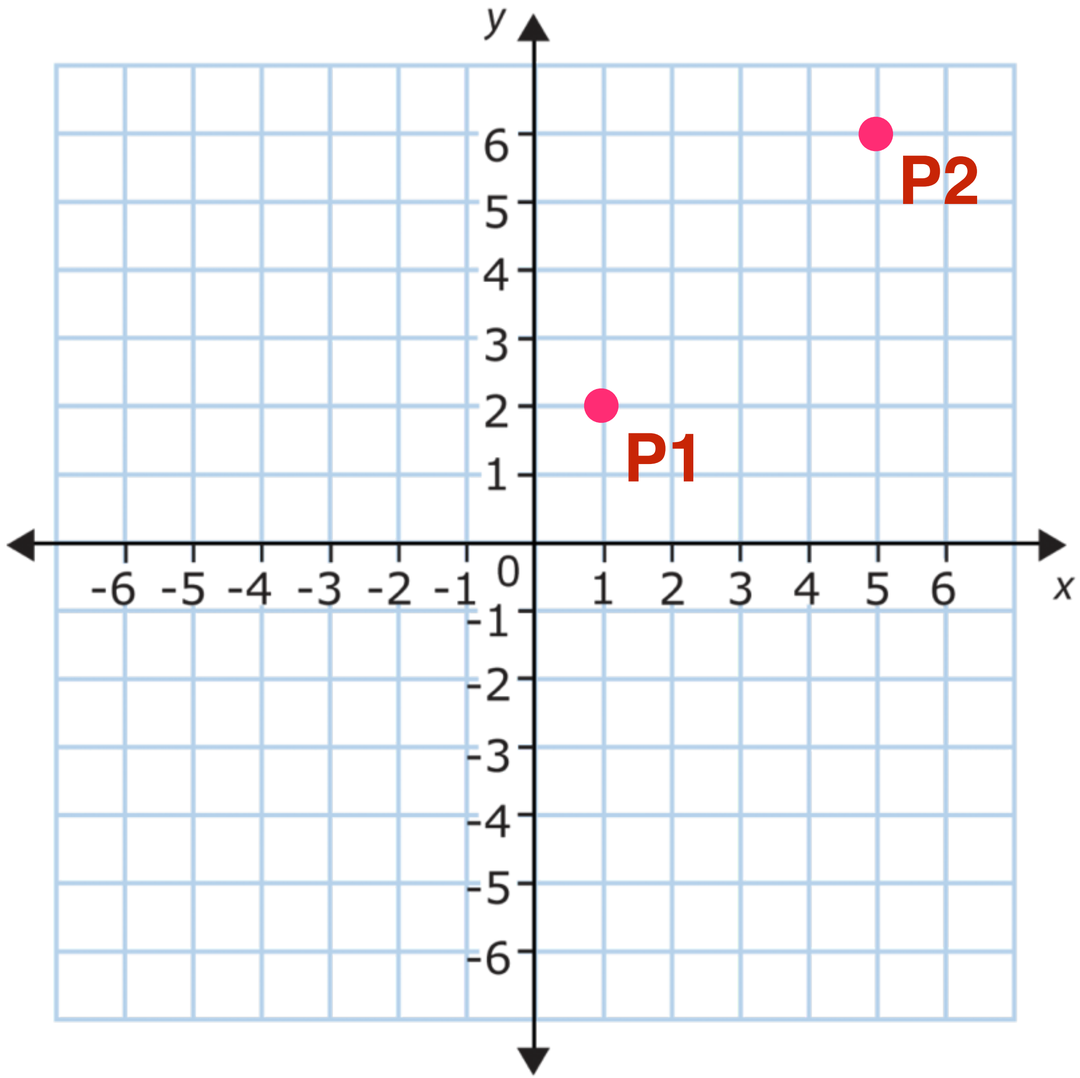
```
while (SDL_PollEvent(&event)) {
    if (event.type == SDL_QUIT || event.type == SDL_WINDOWEVENT_CLOSE) {
        done = true;
    } else if(event.type == SDL_KEYDOWN) {
        if(event.key.keysym.scancode == SDL_SCANCODE_SPACE) {
            // DO AN ACTION WHEN SPACE IS PRESSED!
        }
    }
}
```

Collision detection.

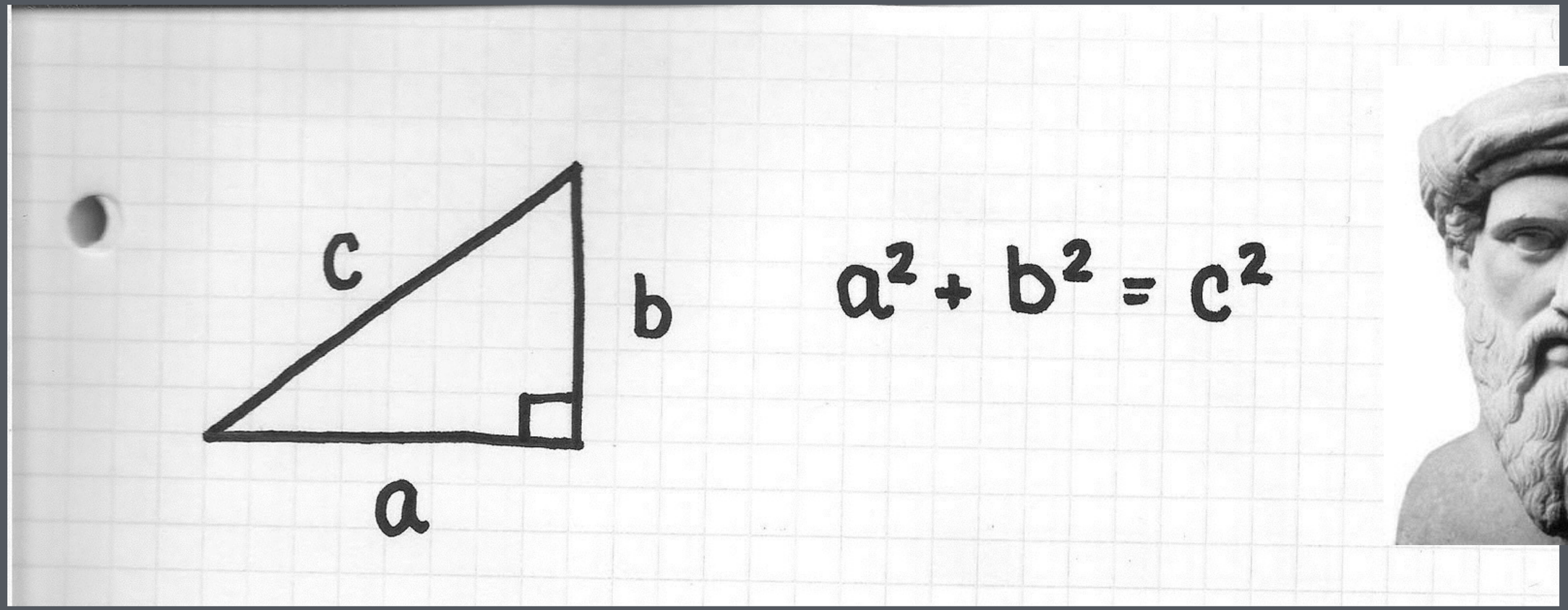
Circle - **circle** collision detection.

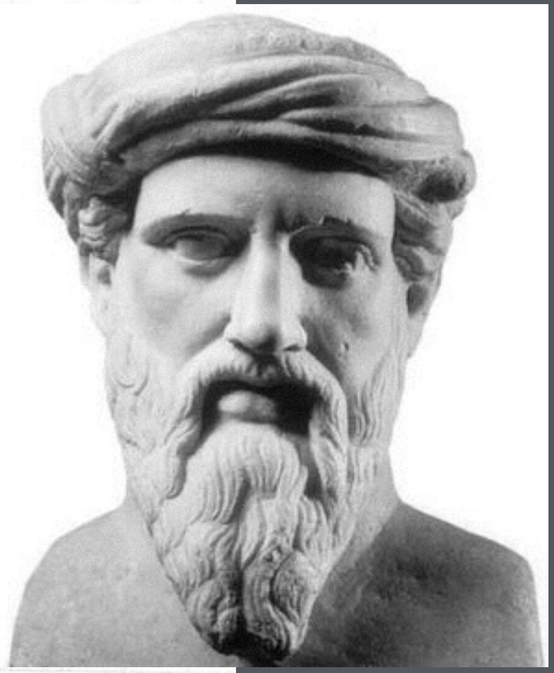



y
x
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-6 -5 -4 -3 -2 -1
1 2 3 4 5 6

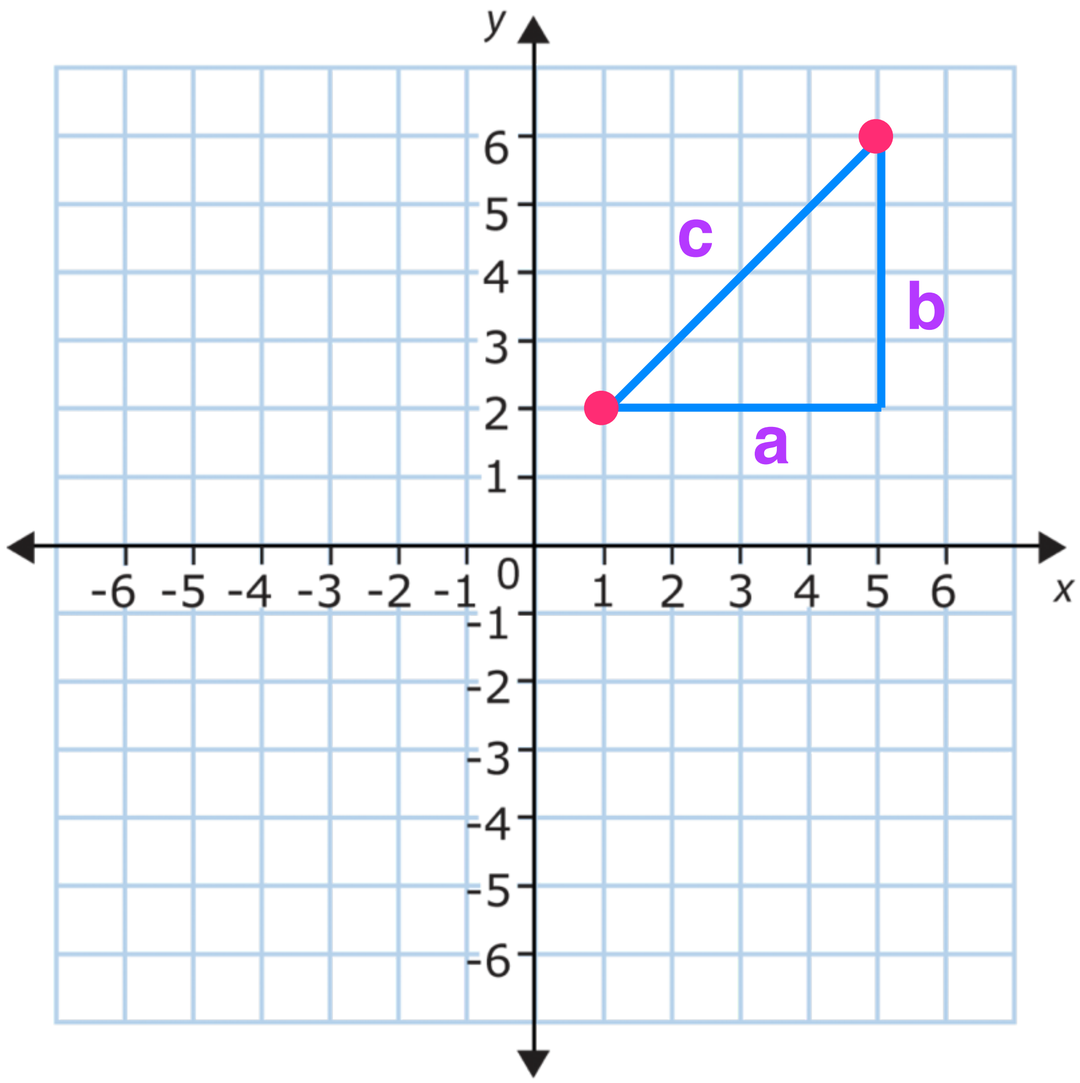

y
x
P1
P2
-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6
6 5 4 3 2 1 -1 -2 -3 -4 -5 -6

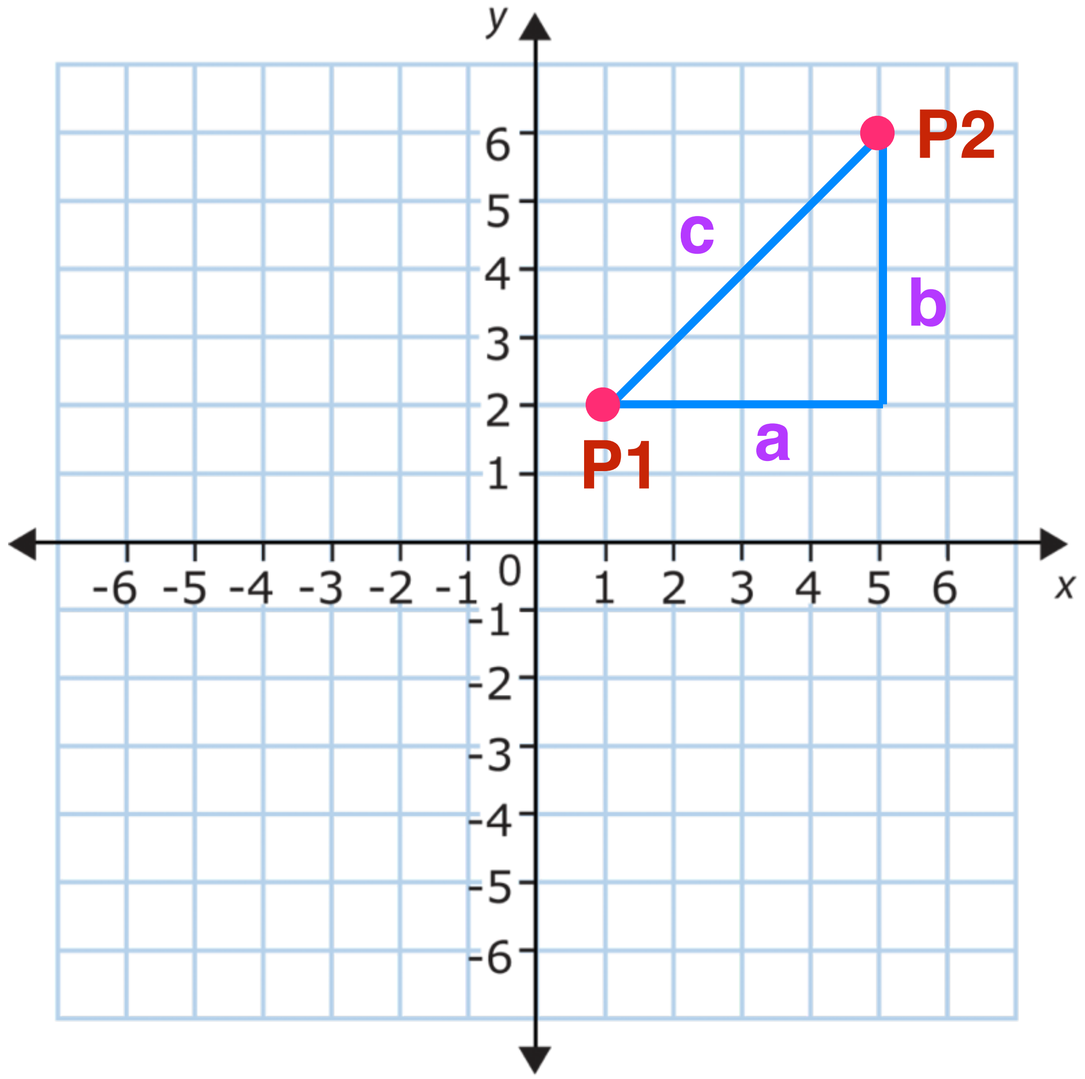
Pythagorean theorem





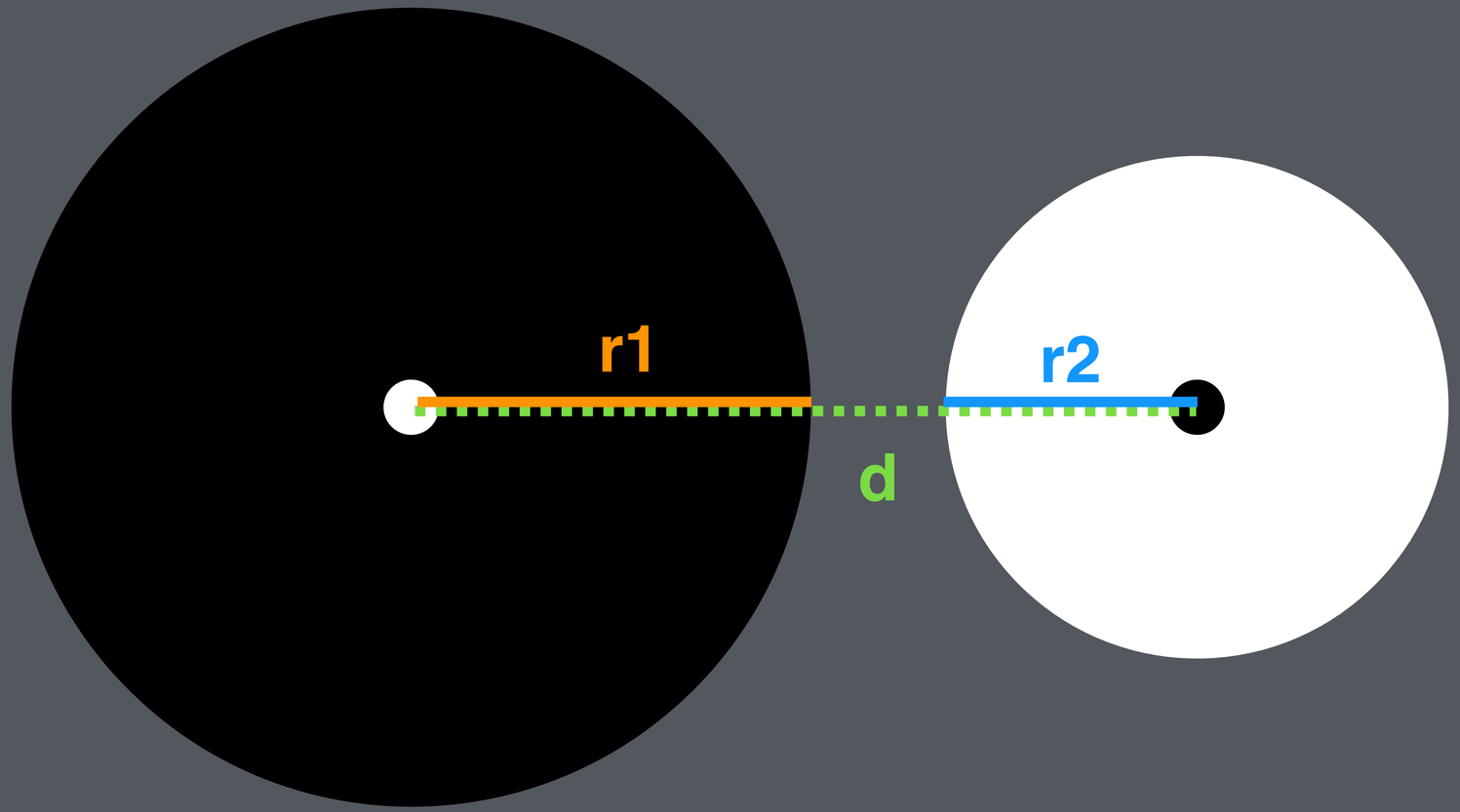
Distance between **2 points**.





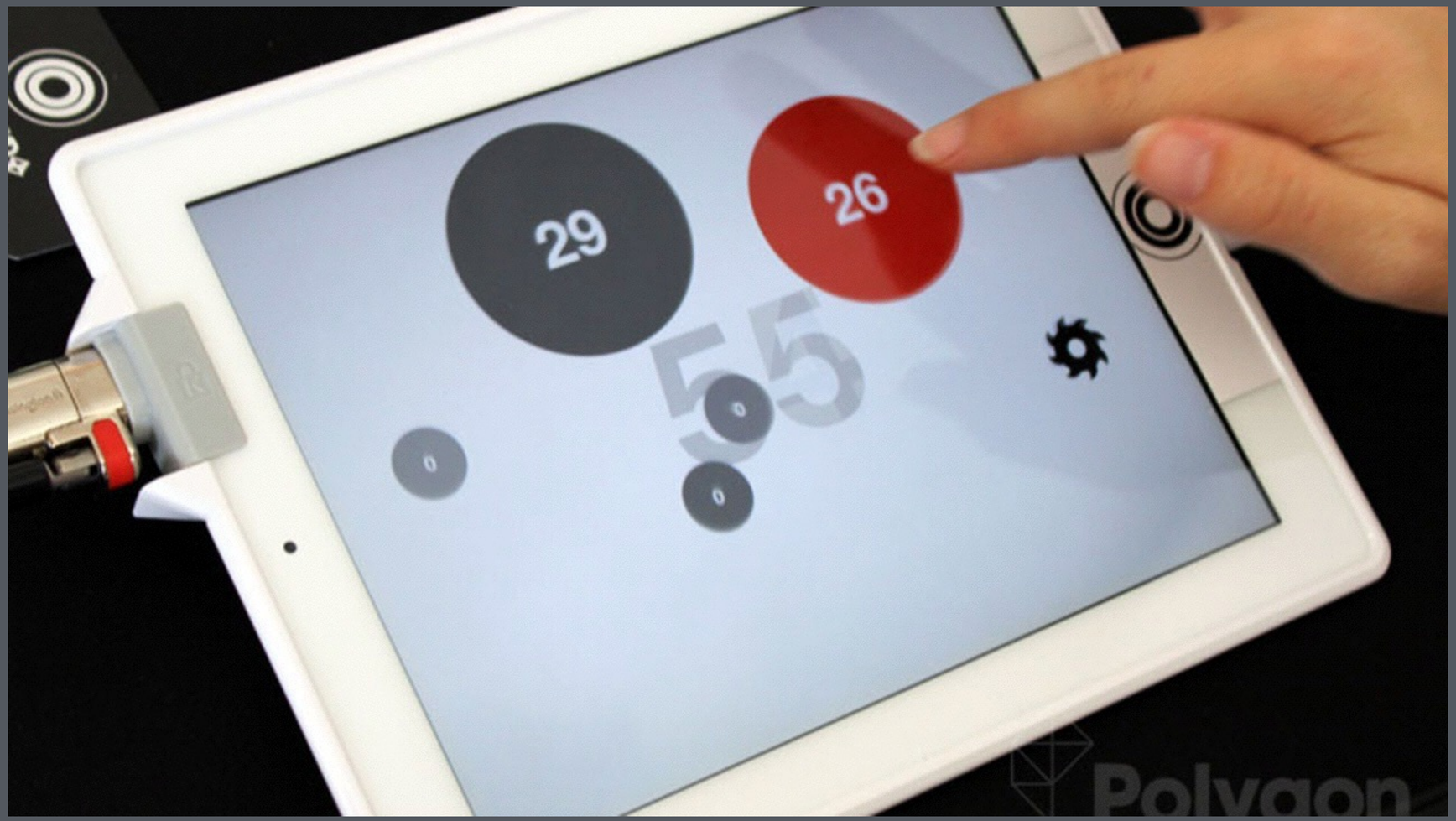
$$a = x_2 - x_1$$
$$b = y_2 - y_1$$
$$c^2 = a^2 - b^2$$
$$c = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

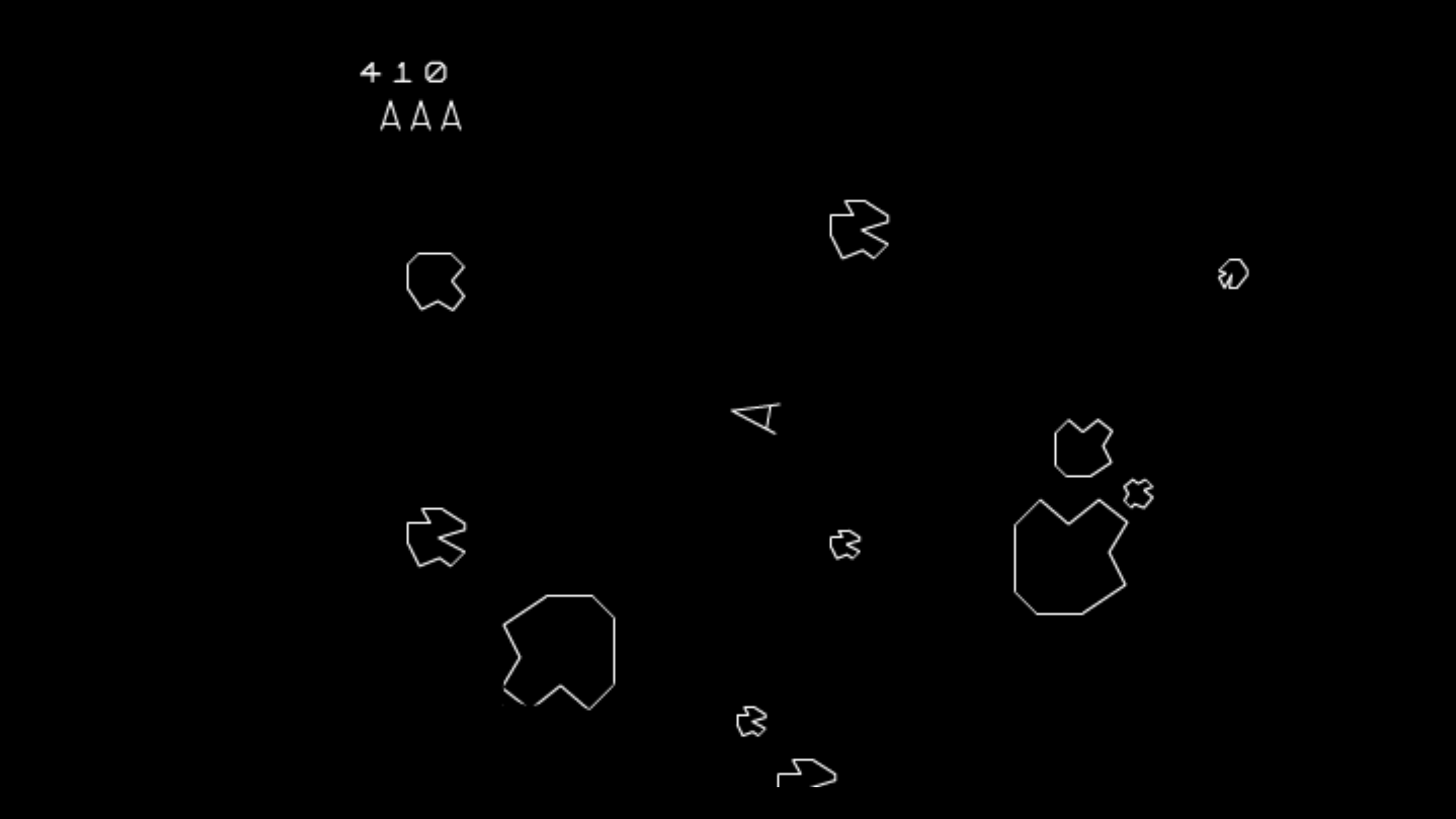
Circle - **circle** collision detection.

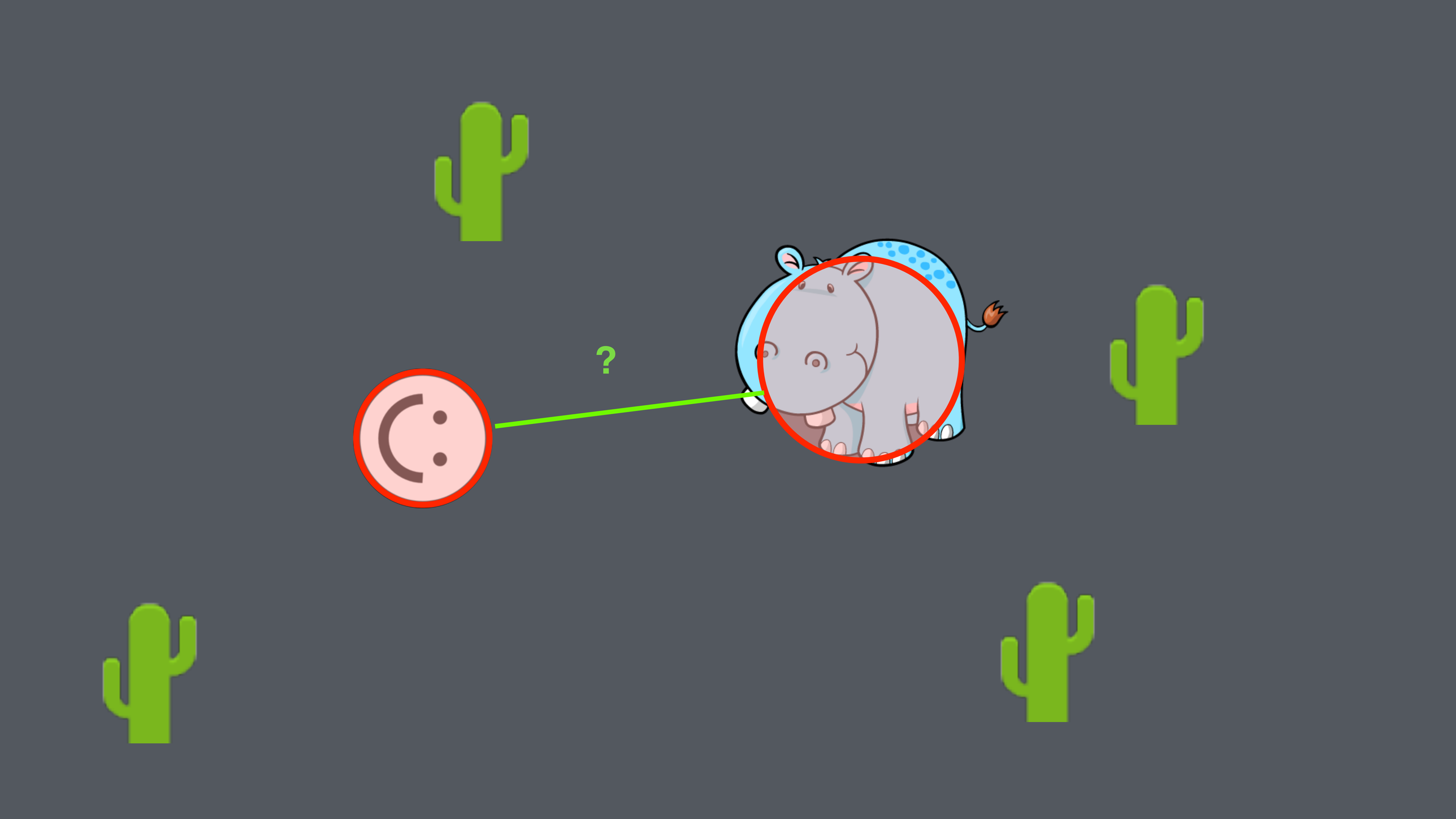


If the **distance** **between two circles** is **less than**
or equal to the sum of their radii, the circles are **colliding**!

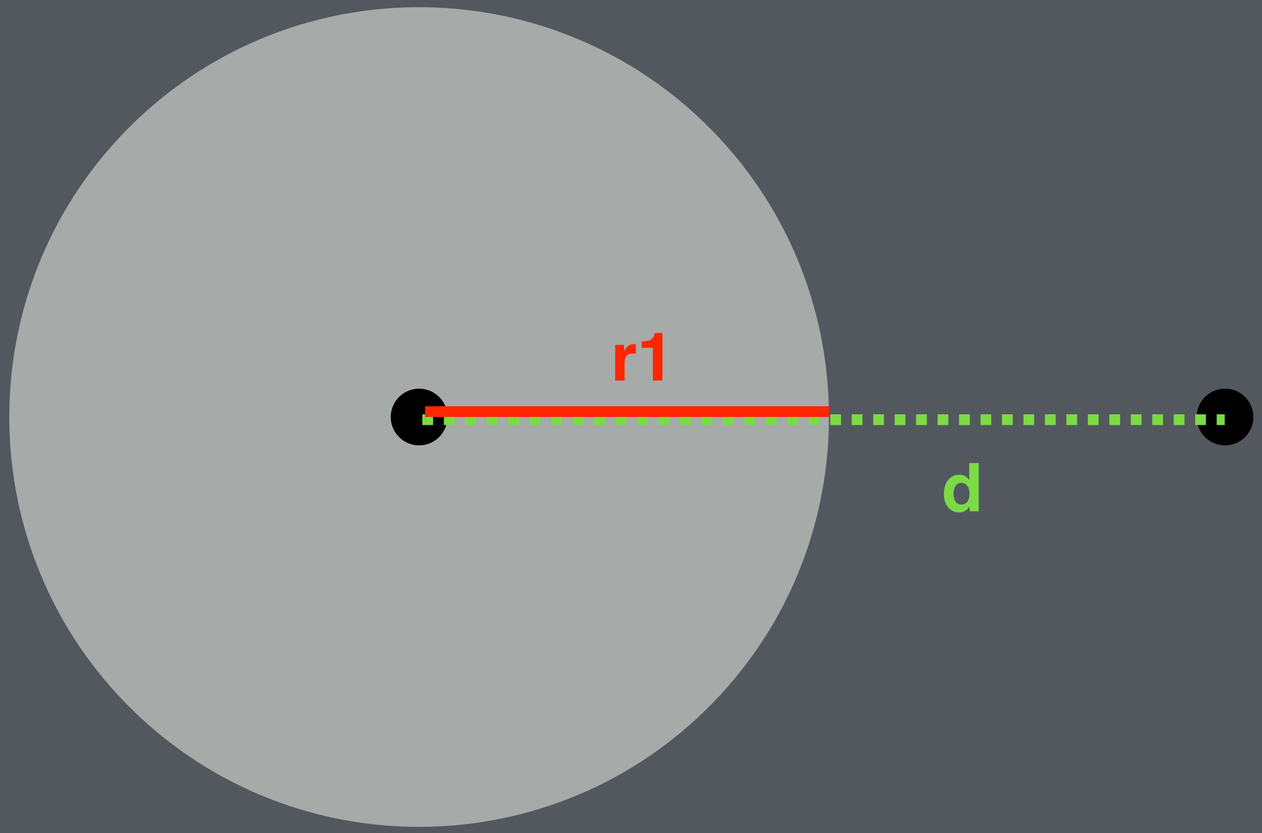

TIME: 00:15
SCORE: 500
PLAYER: 1


29
26
55
0
0
0
Polygon


410
AAA

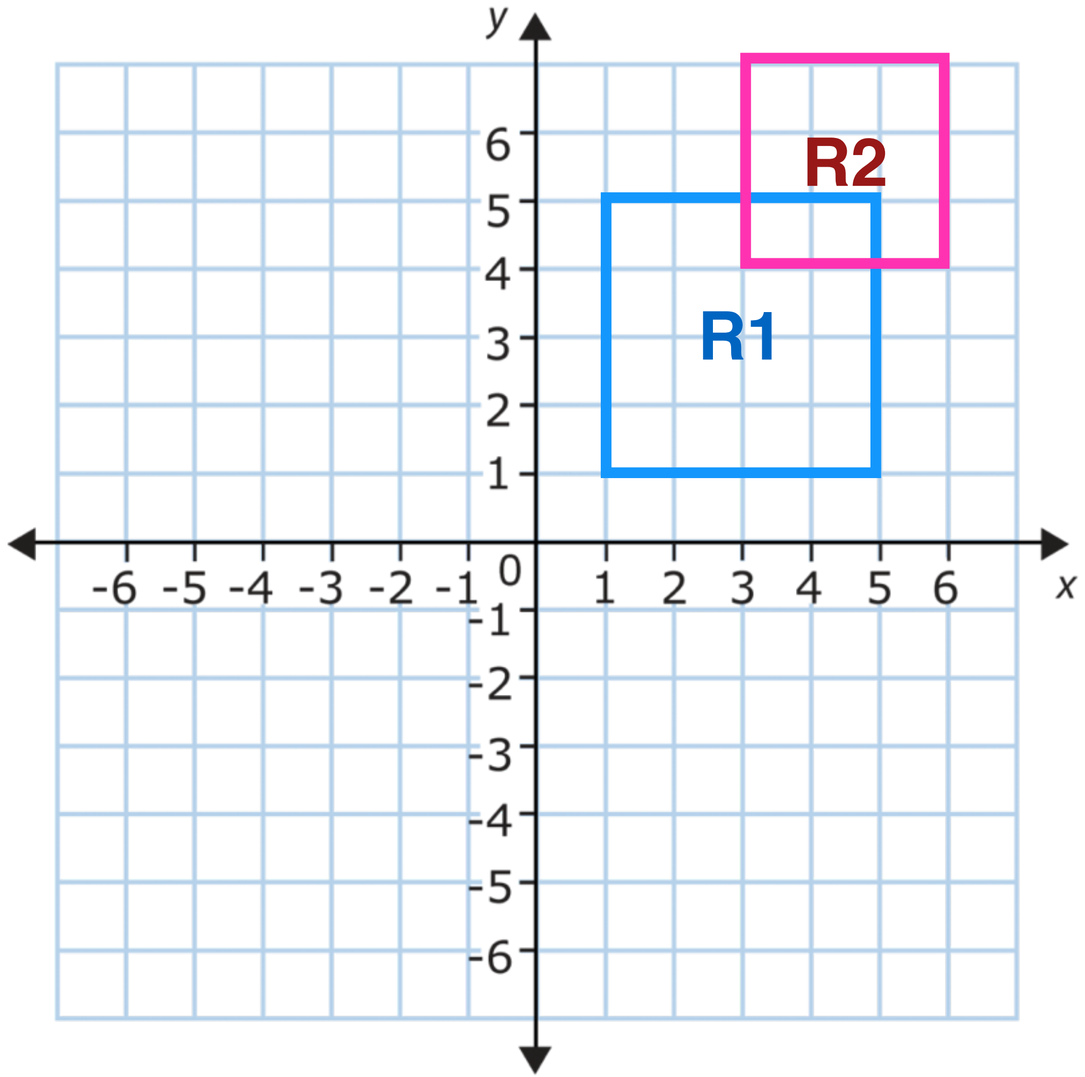


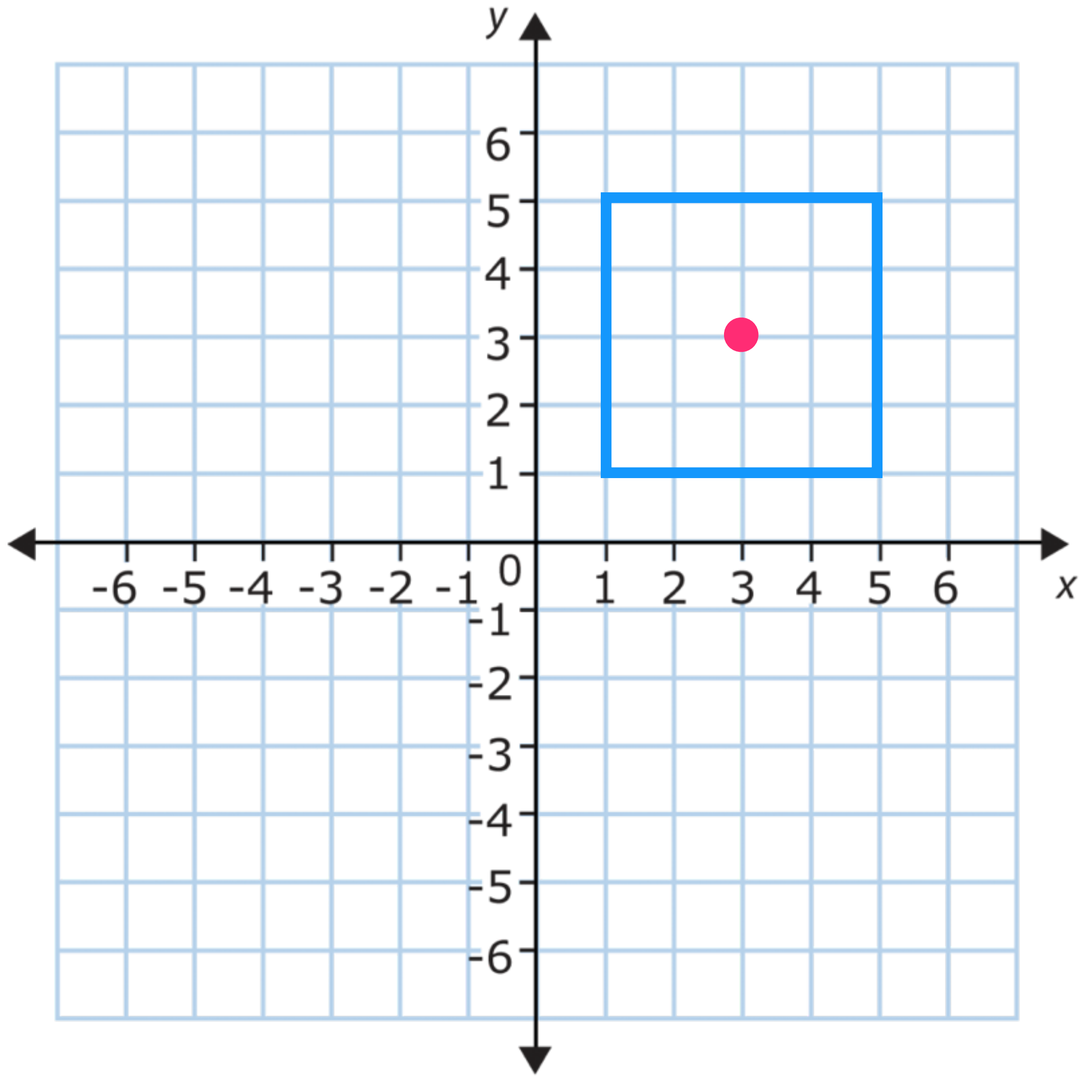
Circle-point collision detection.

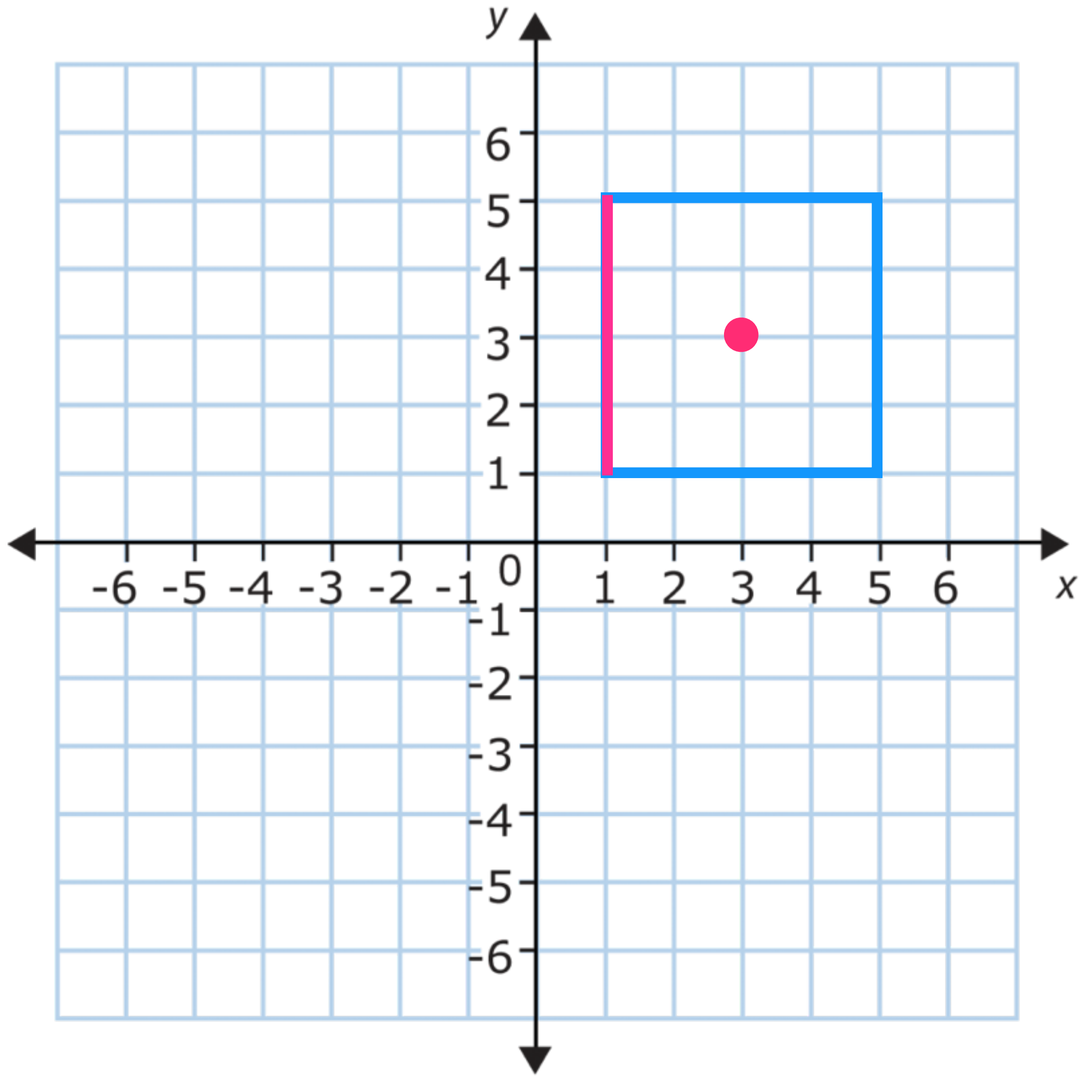


If the **distance between the point and the circle center** is less than its **radius**, then they are **colliding**.

Box-box collision detection.

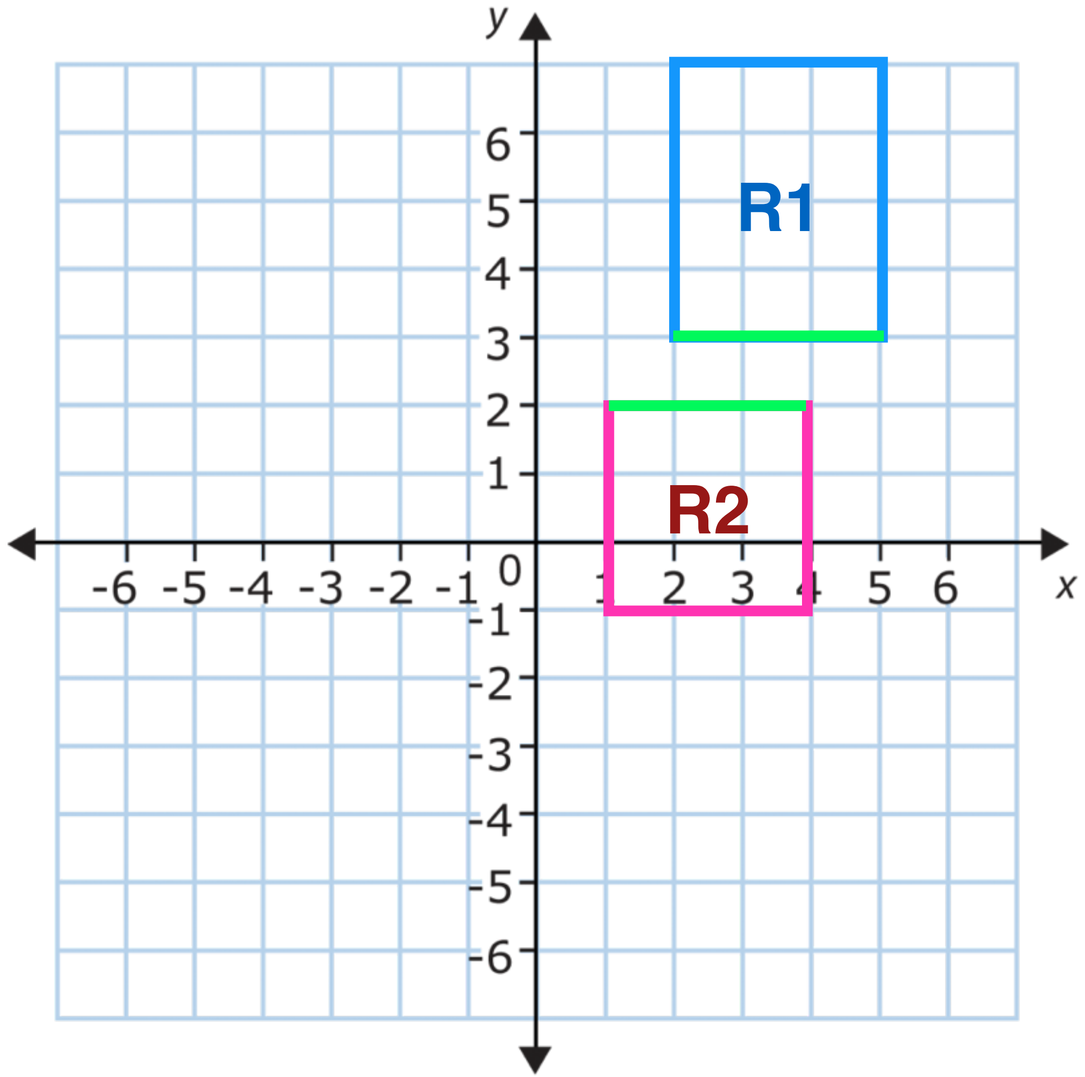

y
x
R2
R1
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-6 -5 -4 -3 -2 -1
1 2 3 4 5 6


y
x
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-6 -5 -4 -3 -2 -1
1 2 3 4 5 6

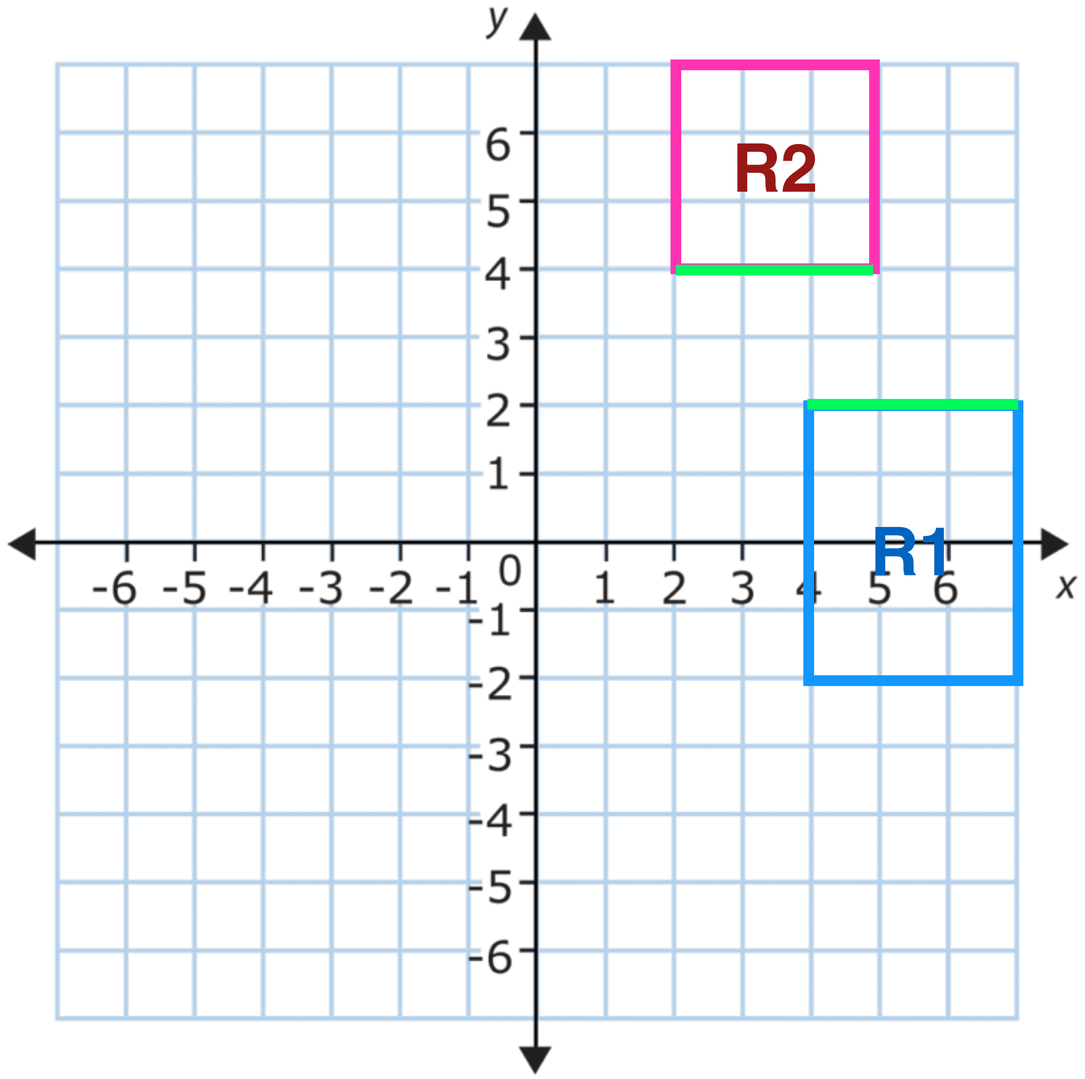


Left side

rectangle.x - rectangle.width / 2

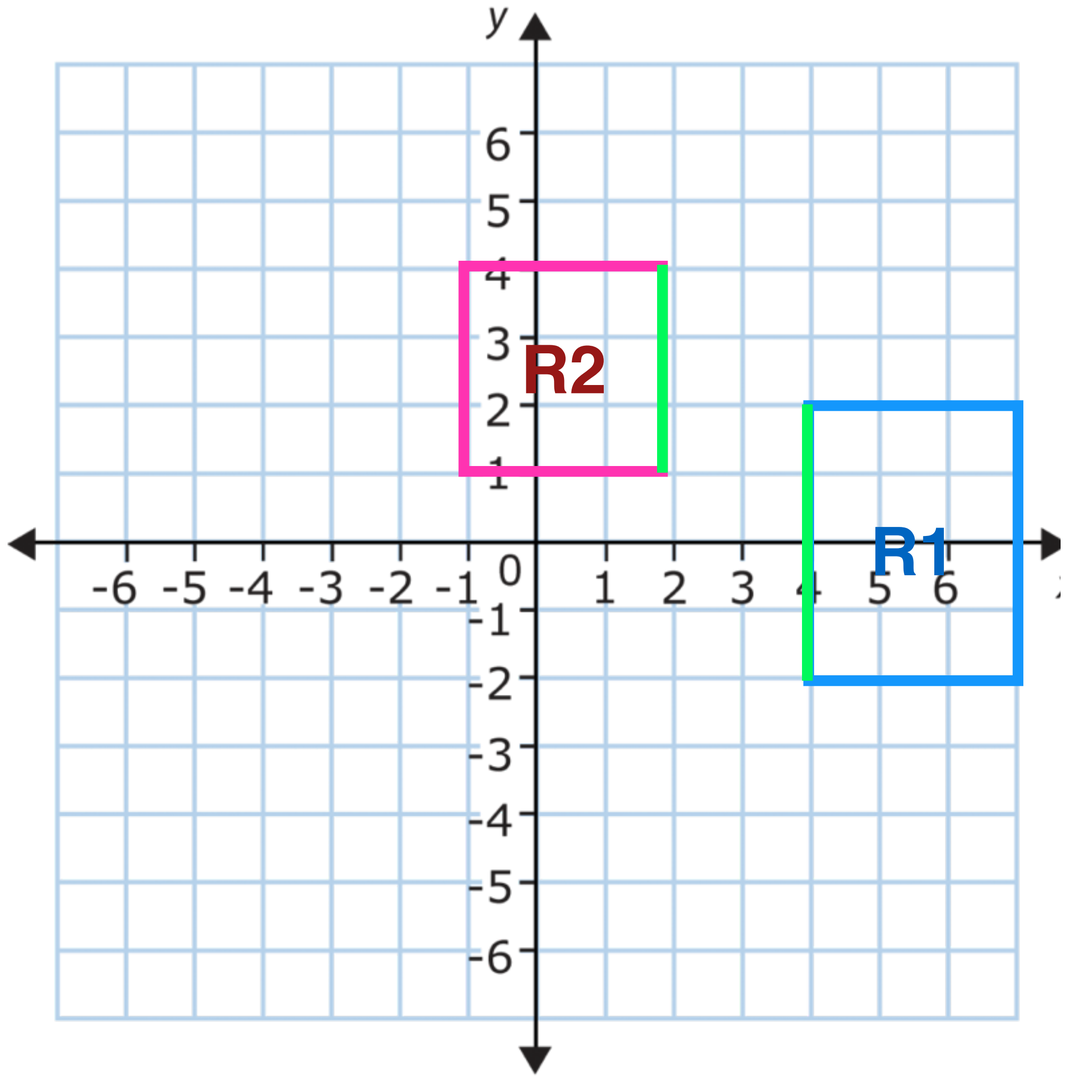


a) **R1's bottom** is higher than **R2's top**



a) **R1's bottom** is **higher** than **R2's top**

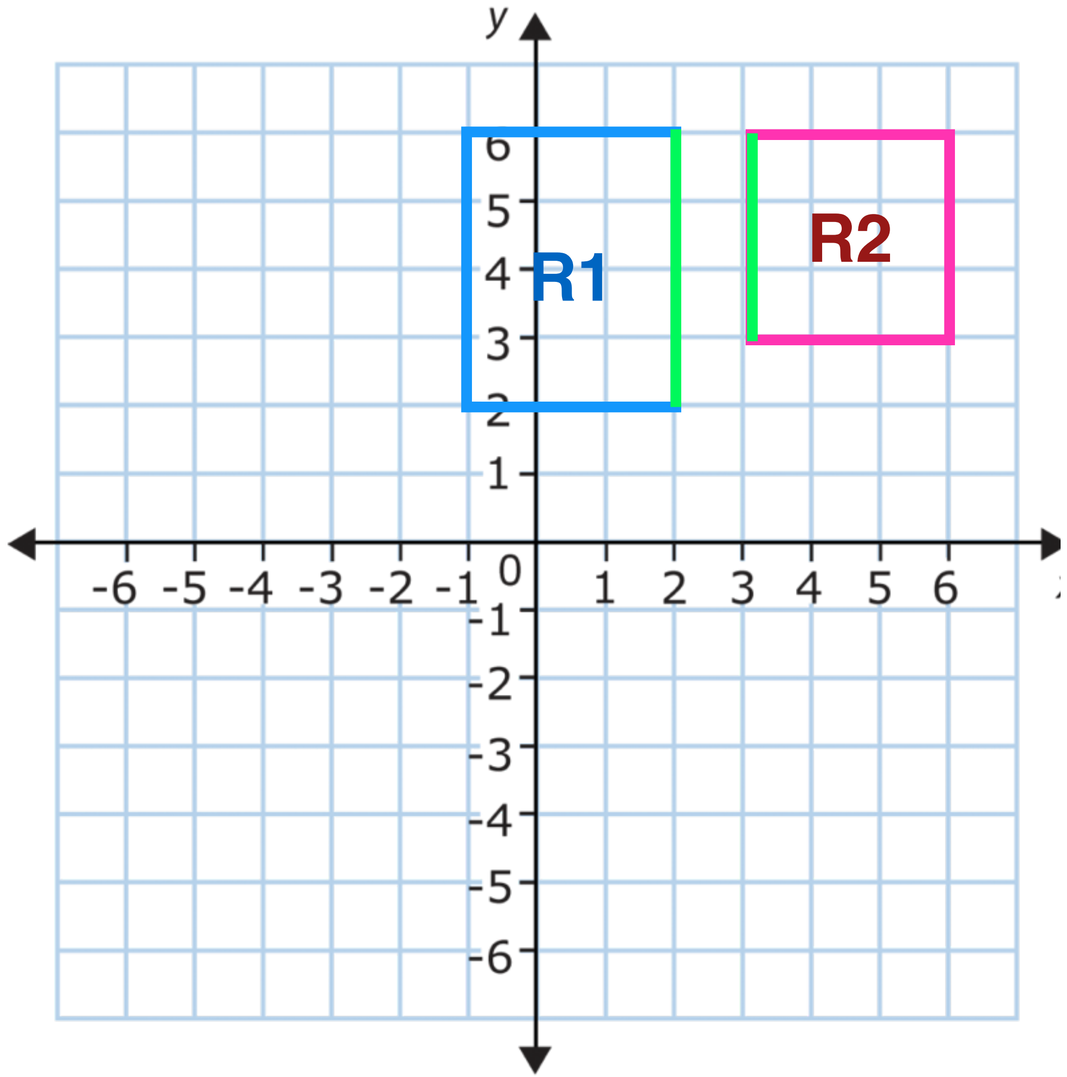
b) **R1's top** is lower than **R2's bottom**



a) **R1's bottom** is **higher** than **R2's top**

b) **R1's top** is **lower** than **R2's bottom**

c) **R1's left** is **larger** than **R2's right**



a) **R1's bottom** is **higher** than **R2's top**

b) **R1's top** is **lower** than **R2's bottom**

c) **R1's left** is **larger** than **R2's right**

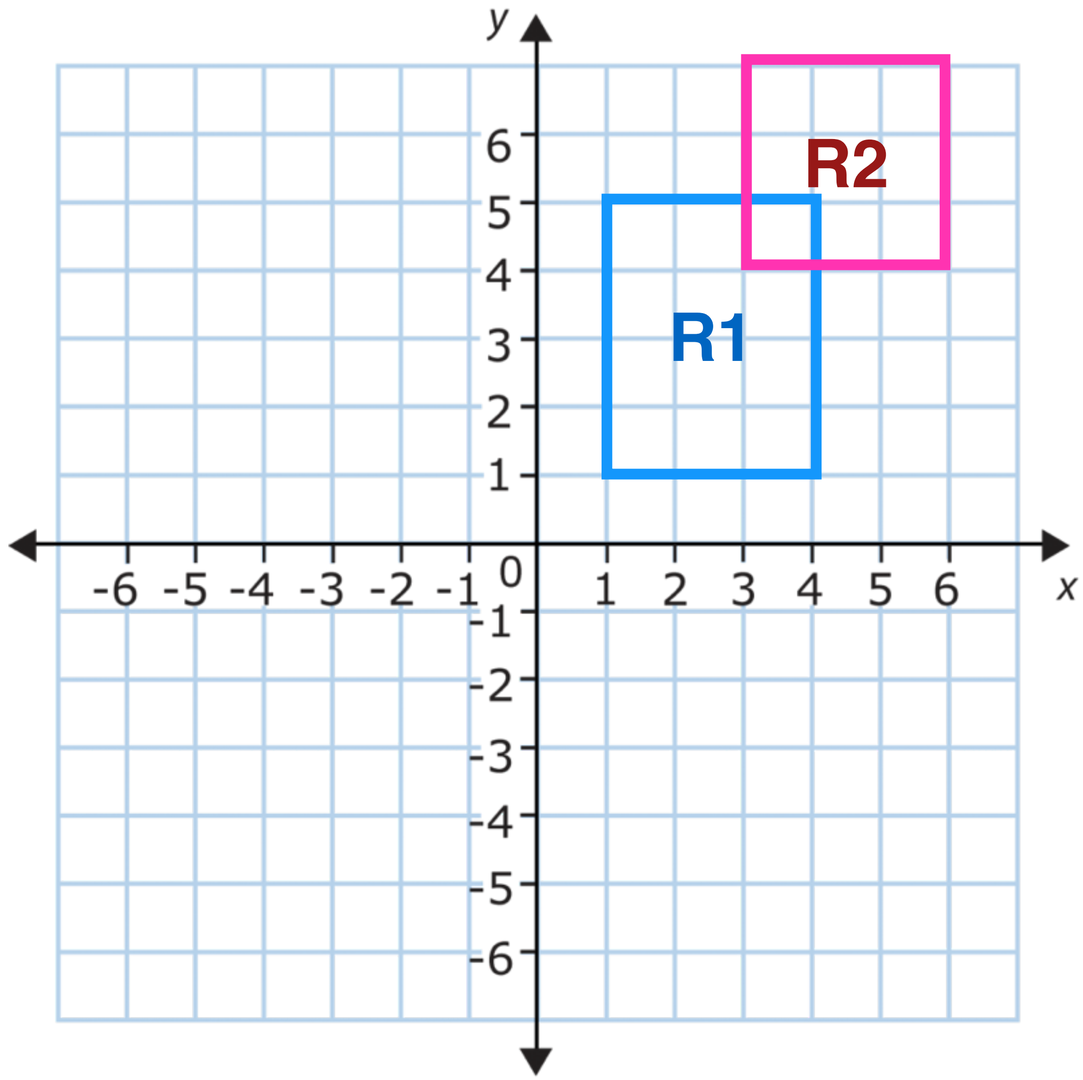
d) **R1's right** is **smaller** than **R2's left**

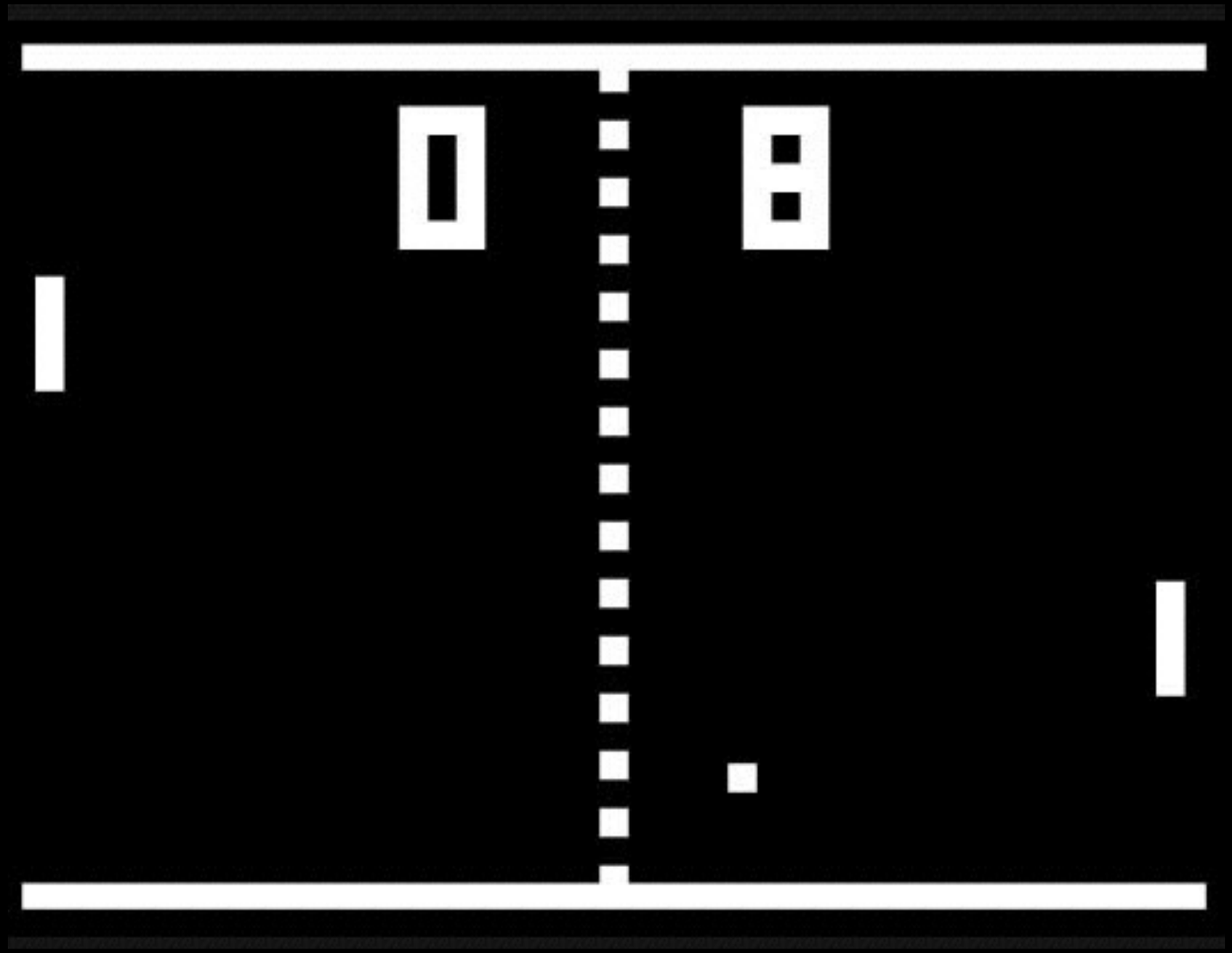
a) is R1's bottom higher than R2's top?
b) is R1's top lower than R2's bottom?
c) is R1's left larger than R2's right?
d) is R1's right smaller than R2's left

If **ANY** of the above are **true**, then the two rectangles are **NOT** intersecting!

OR

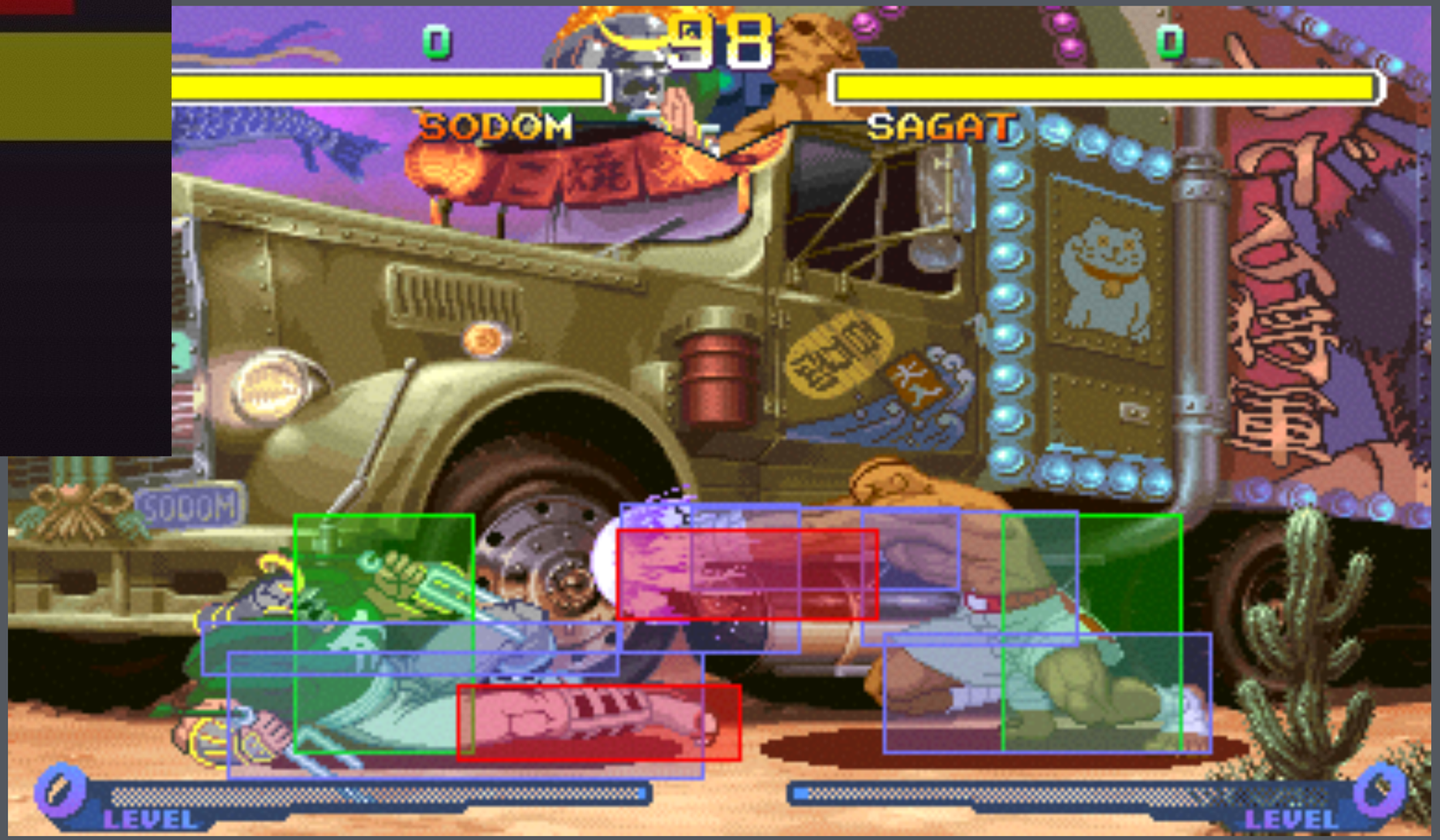
The rectangles are intersecting **if NONE of the above are true.**



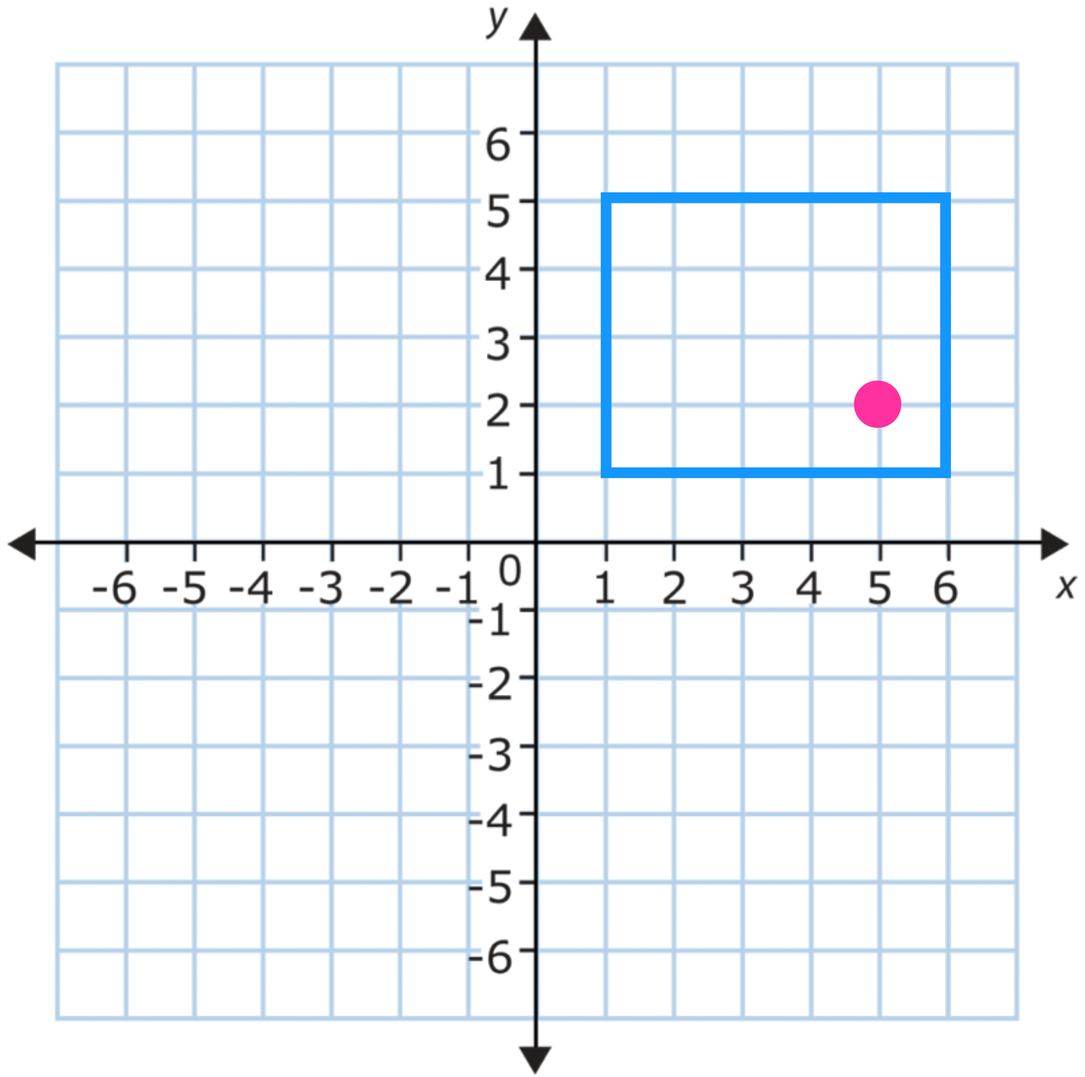



MARIO
004250
×05
WORLD
1-1
TIME
283
100


HP=UP REACH=0 .68 1 .28 1


0
98
0
SODOM
SAGAT
SODOM
LEVEL
LEVEL

Box-point collision detection.



collision **is happening if**:

- **point x** is **larger than box left** and **smaller than box right**

- **point y** is **larger than box bottom** and **smaller than box top**