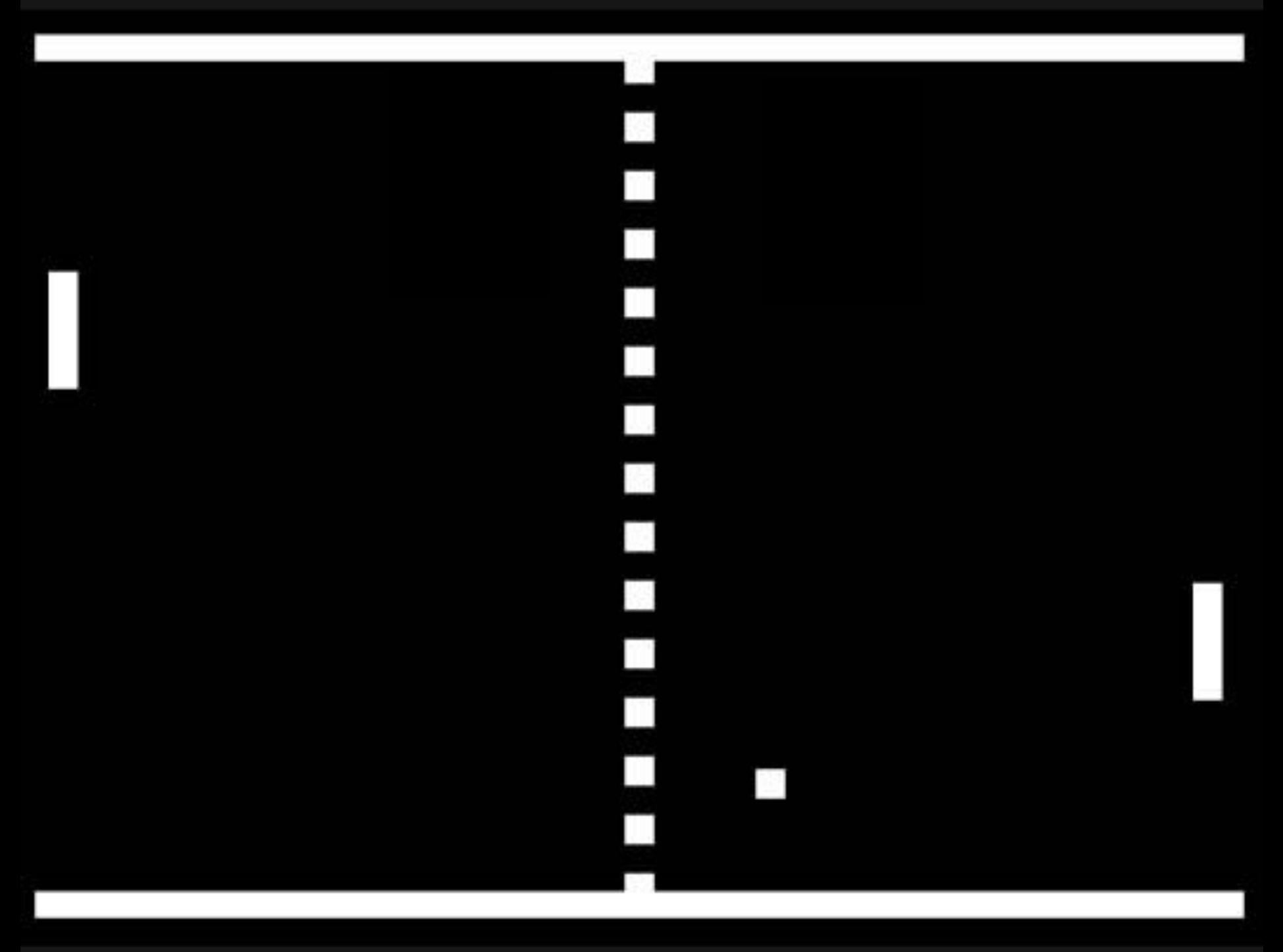
Basic gameplay programming.


PONG
PLAYER 1
PLAYER 2



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**!

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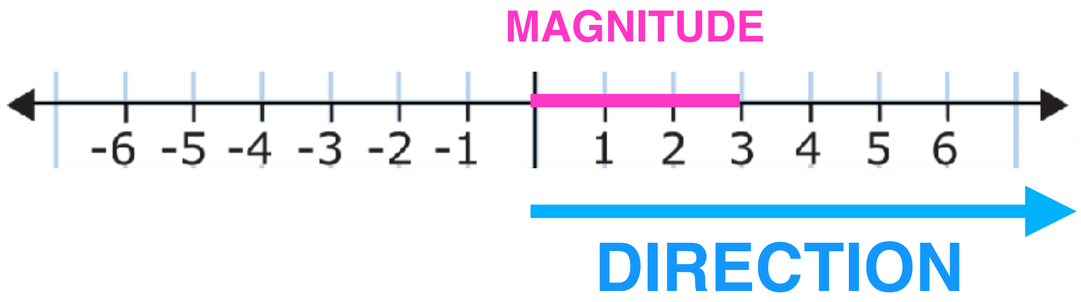

A vector is like a number...

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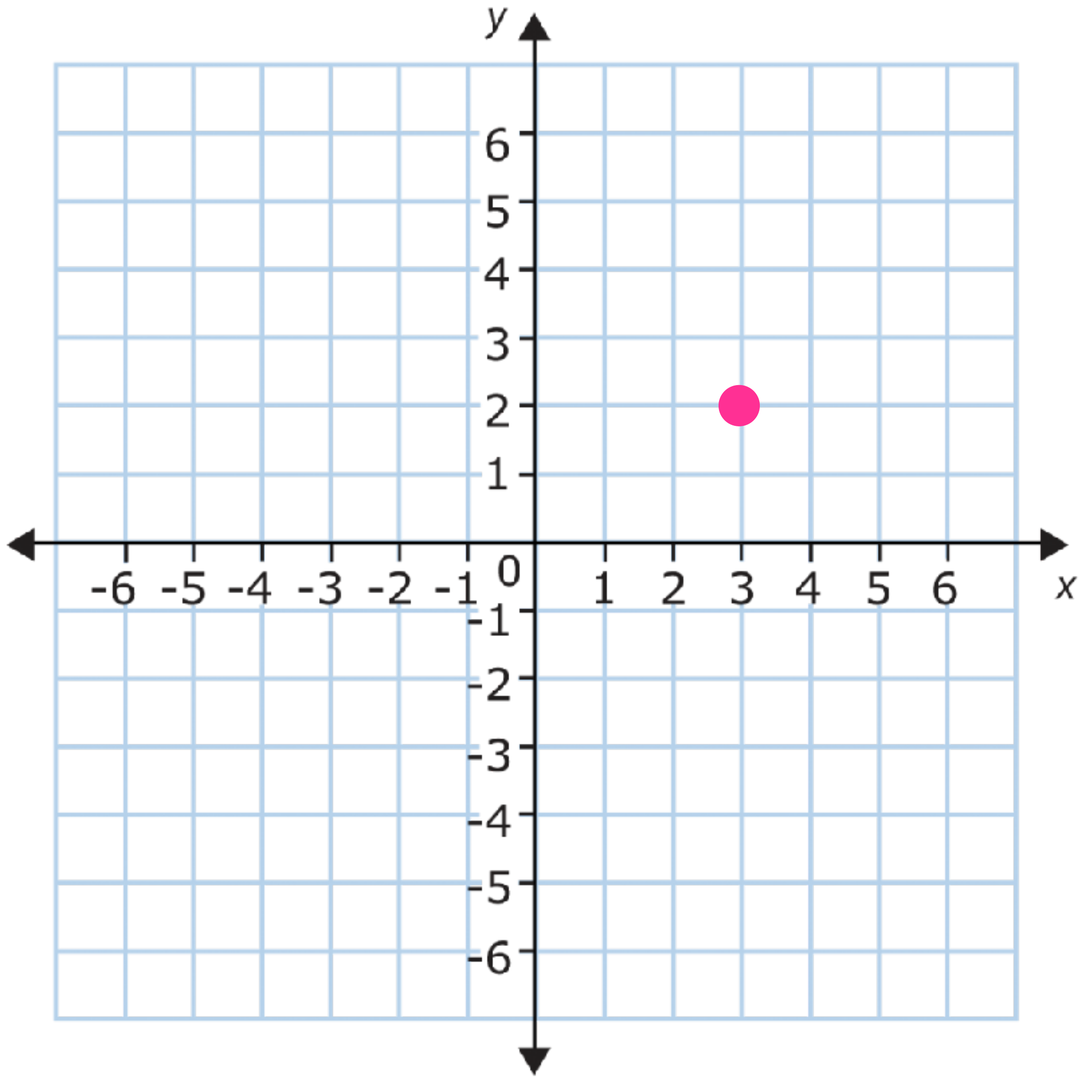
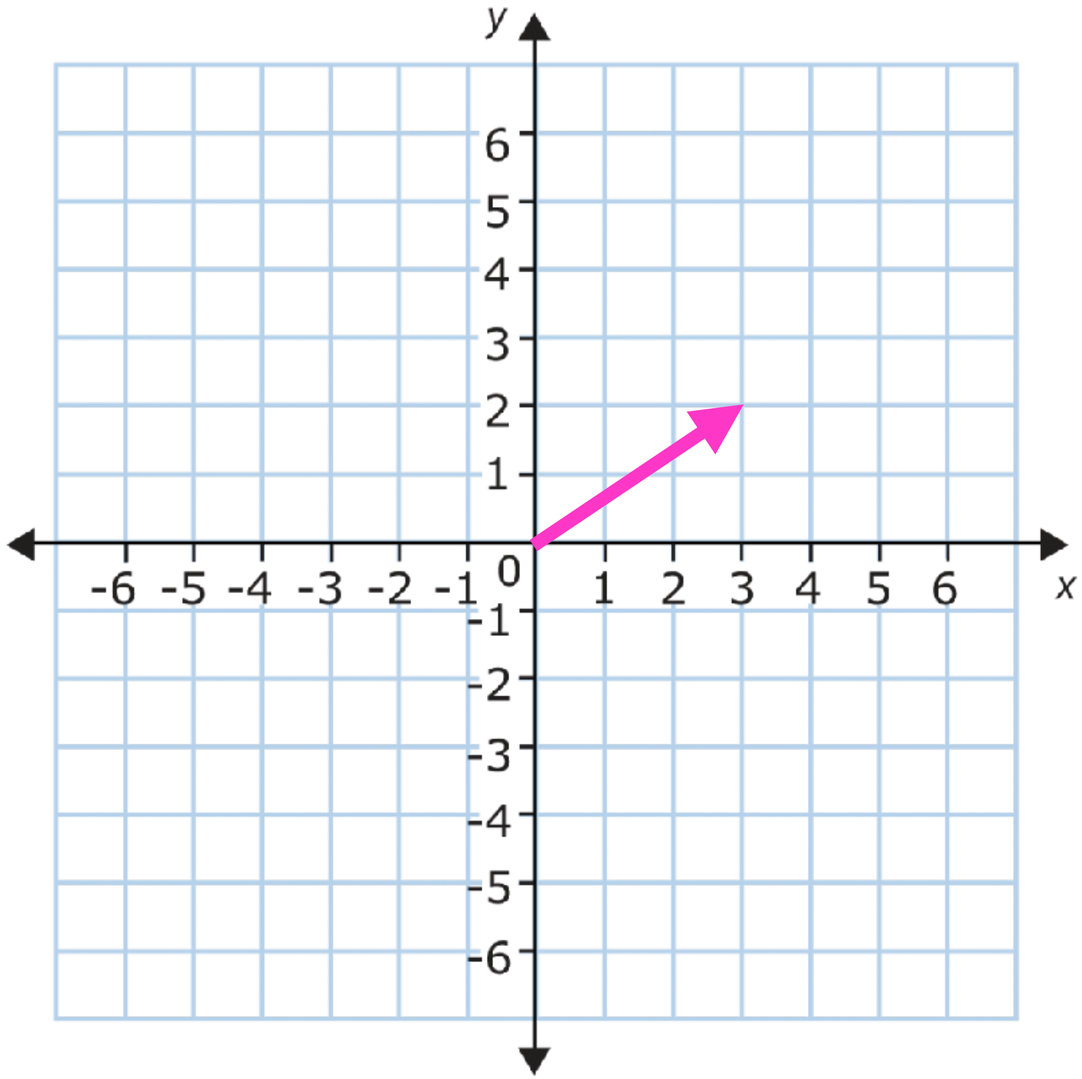
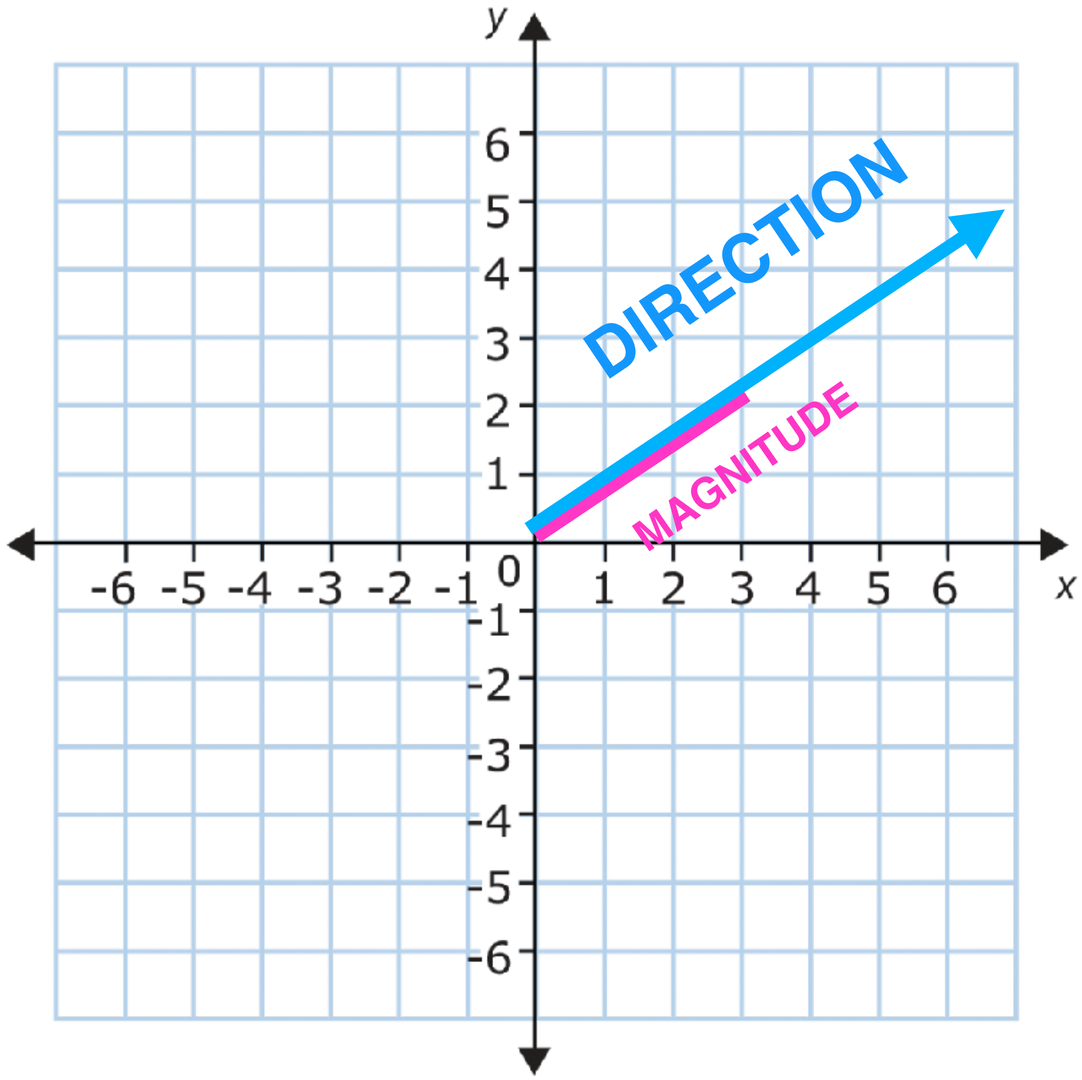


A **2D vector** is like a **2D coordinate**, but has a **magnitude** and a **direction**.



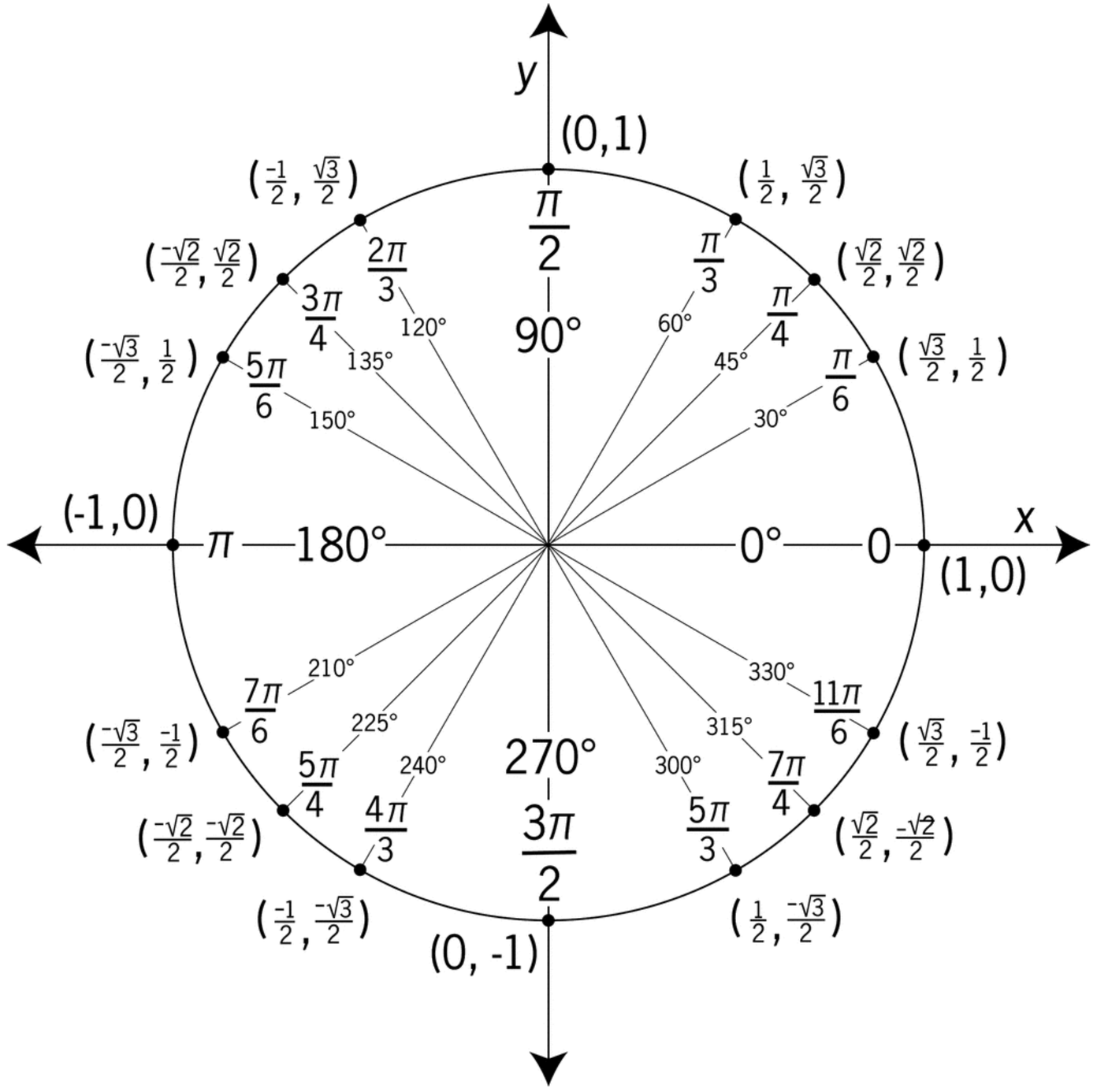
A **2D vector** is like a **2D coordinate**, but has a **magnitude** and a **direction**.

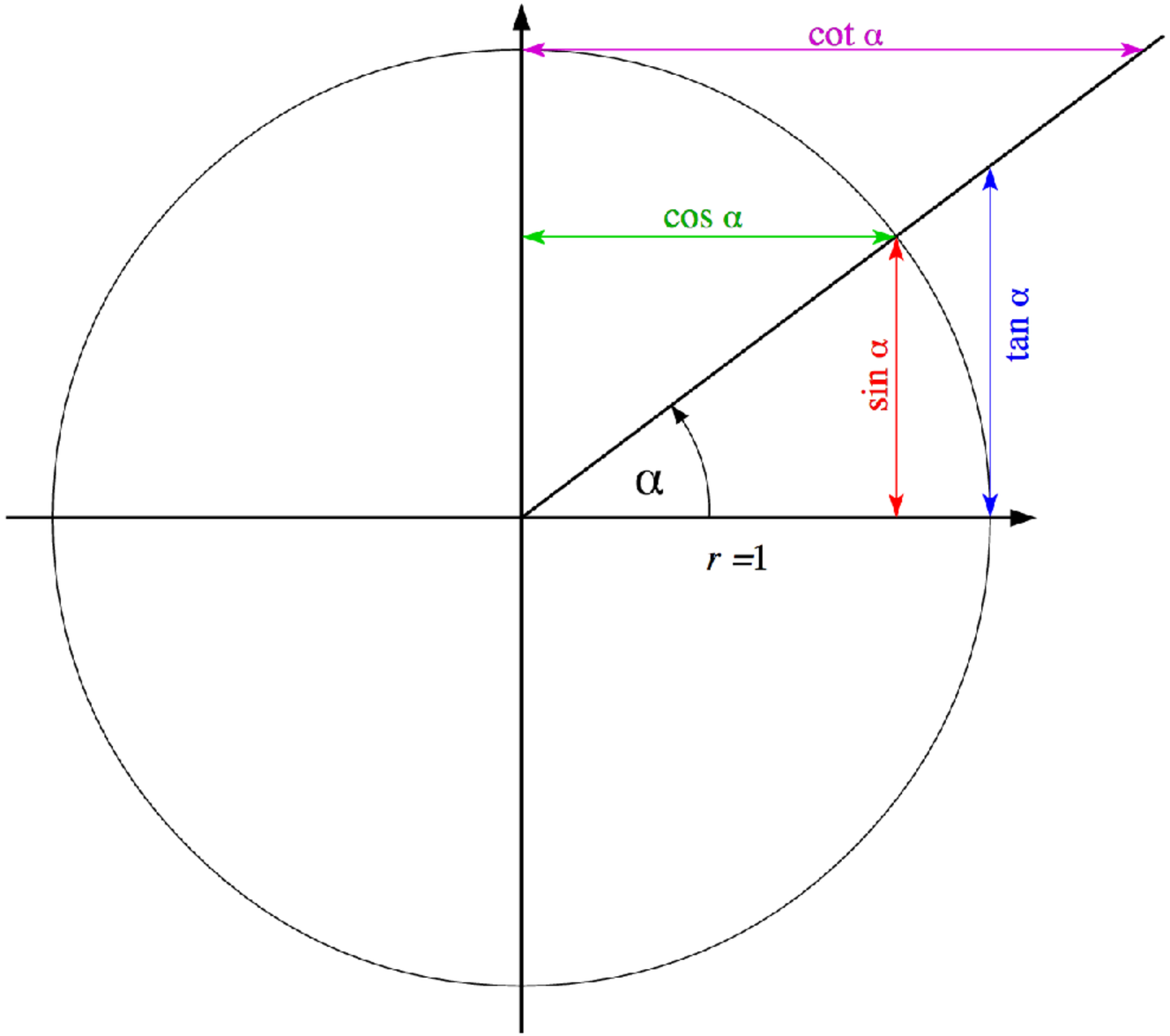


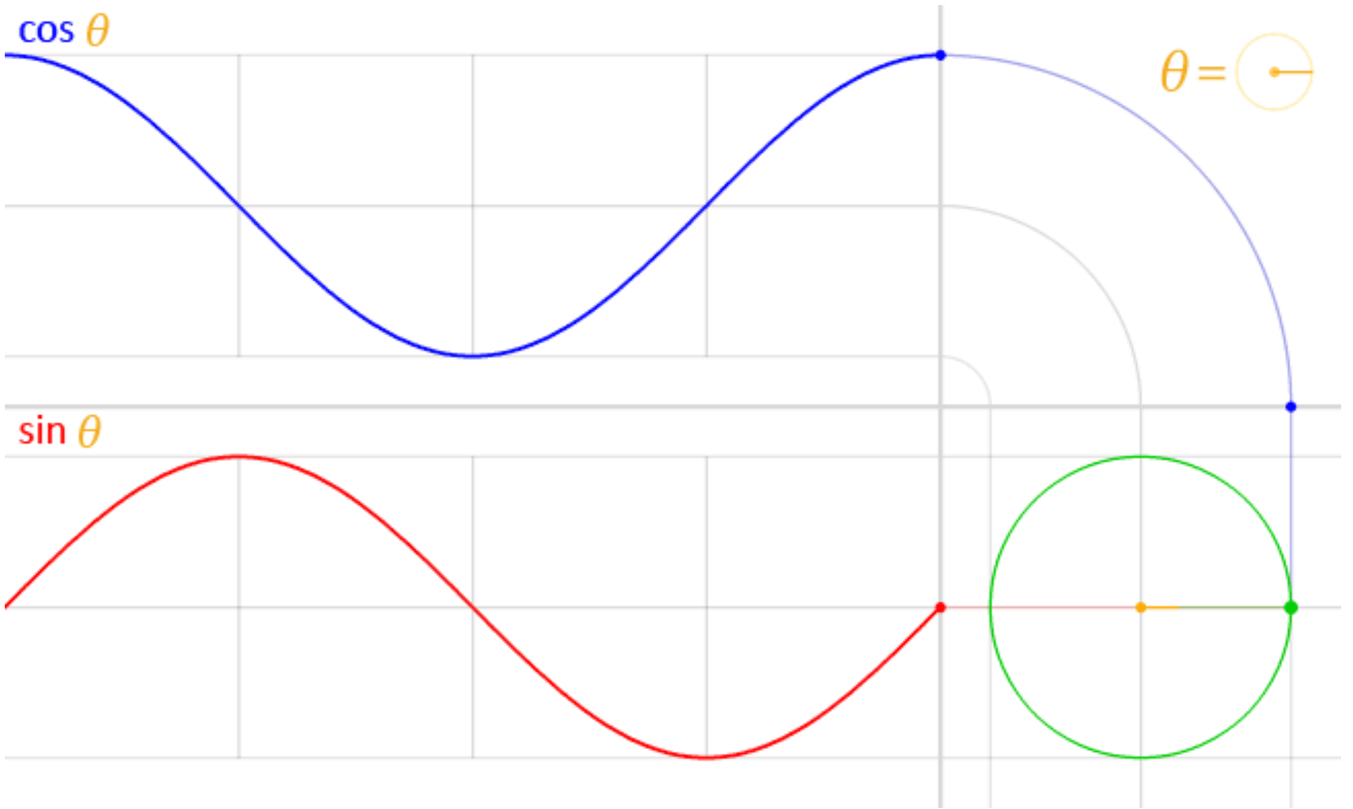
A **2D vector** is like a **2D coordinate**, but has a **magnitude** and a **direction**.

2D direction?

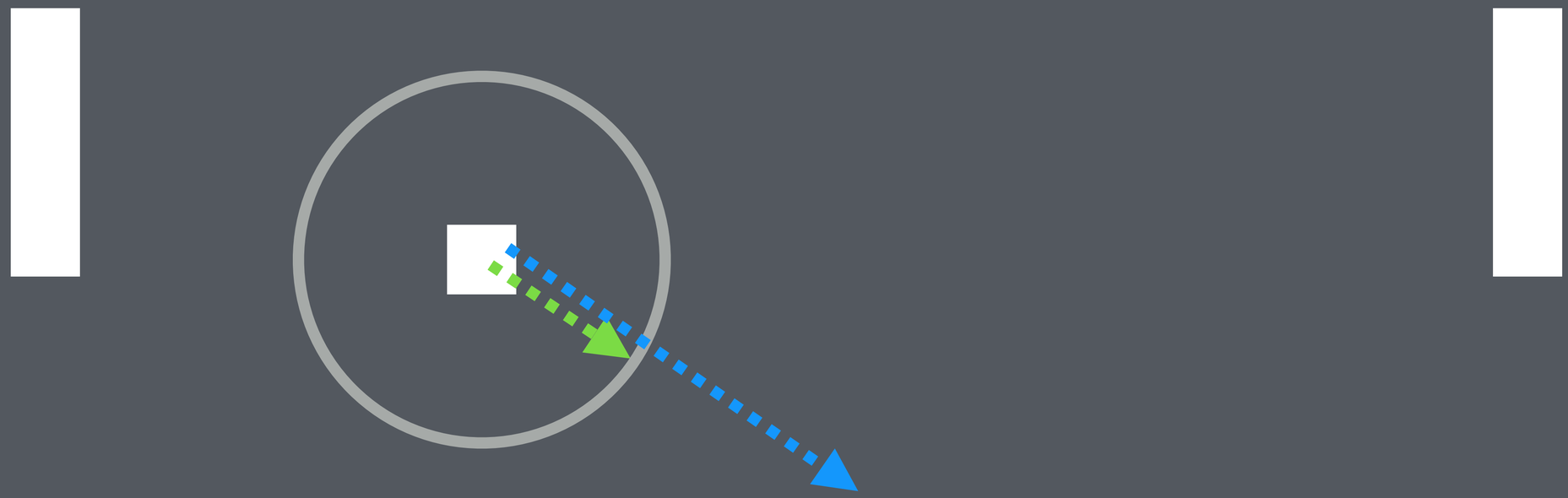
Unit vector!


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°
$\left(\frac{-\sqrt{3}}{2}, \frac{1}{2}\right)$
$\left(\frac{\sqrt{3}}{2}, \frac{1}{2}\right)$
135°
45°
$\frac{5\pi}{6}$
$\frac{\pi}{6}$
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

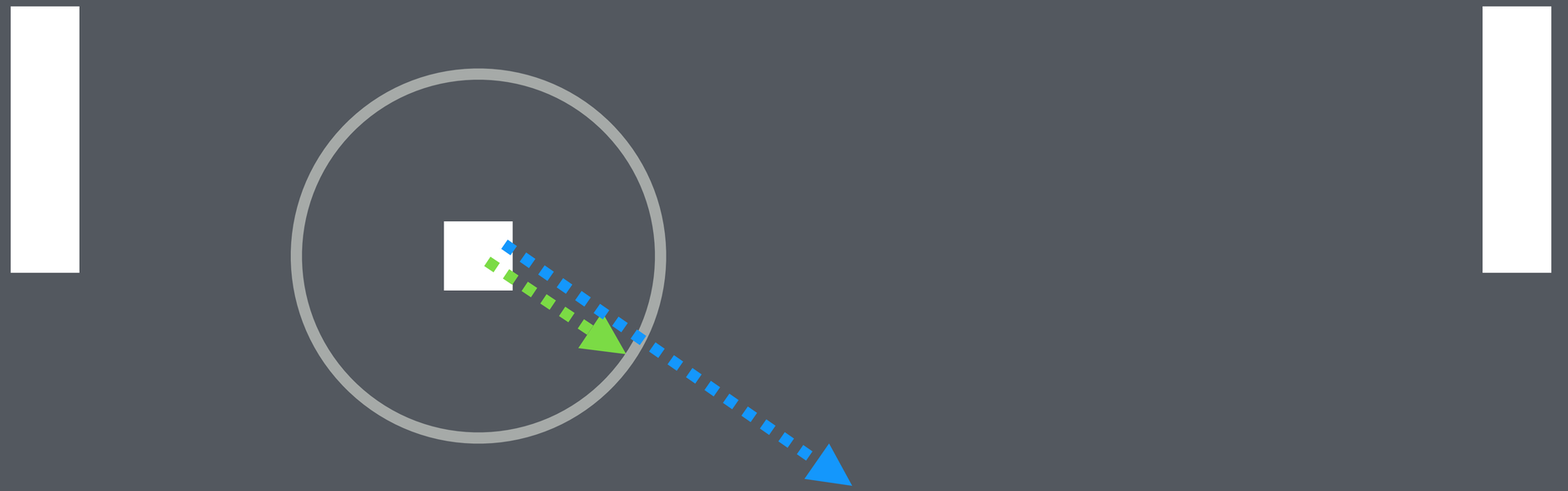

cos θ
θ =
sin θ

position += direction_vector
* elapsed * units_a_second



position.x += direction.x *
elapsed * units_a_second

position.y += direction.y *
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.

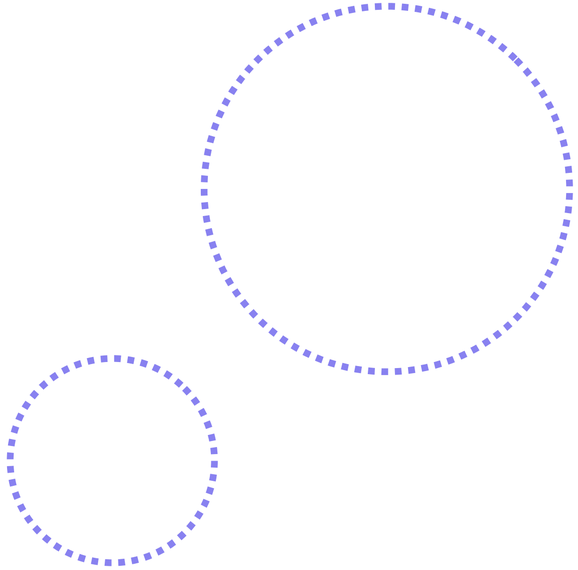
Knowing **exactly when the player pressed or released a key**. Useful for **action events** like **shooting** or **jumping**.

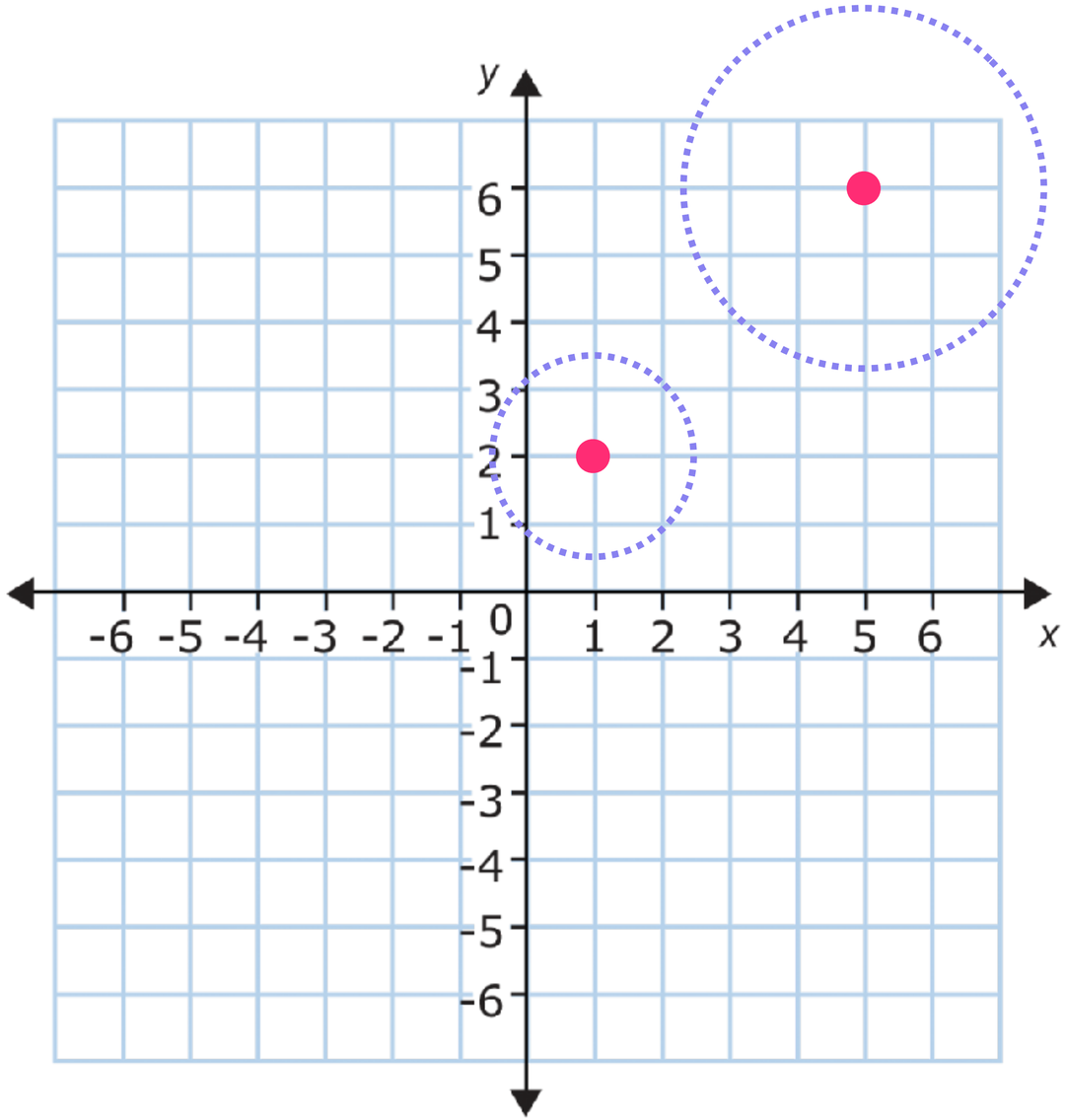
To read **input events**, we use our **event loop** to see if the event has a **type** of **SDL_KEYDOWN** or **SDL_KEYUP**. We can then **check the key** that was pressed or released by checking the **key** member of the **SDL event structure**.

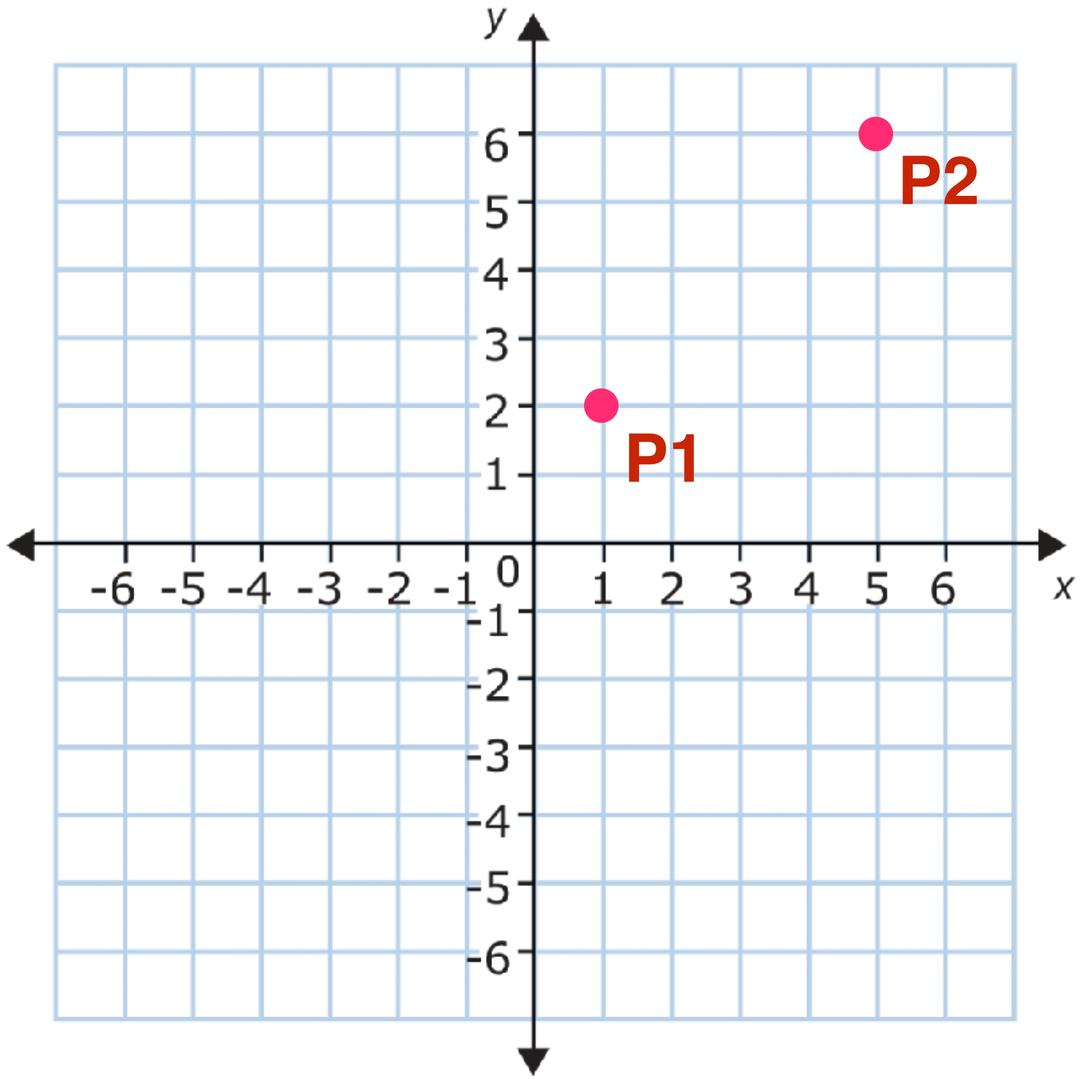
```
while (SDL_PollEvent(&event)) {
    if (event.type == SDL_QUIT || event.type == SDL_WINDOWEVENT_CLOSE) {
        done = true;
    } else if(event.type == SDL_KEYDOWN) {
        if(event.key.keysym.scancode == SDL_SCANCODE_SPACE) {
            // DO AN ACTION WHEN SPACE IS PRESSED!
        }
    }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

Collision detection.

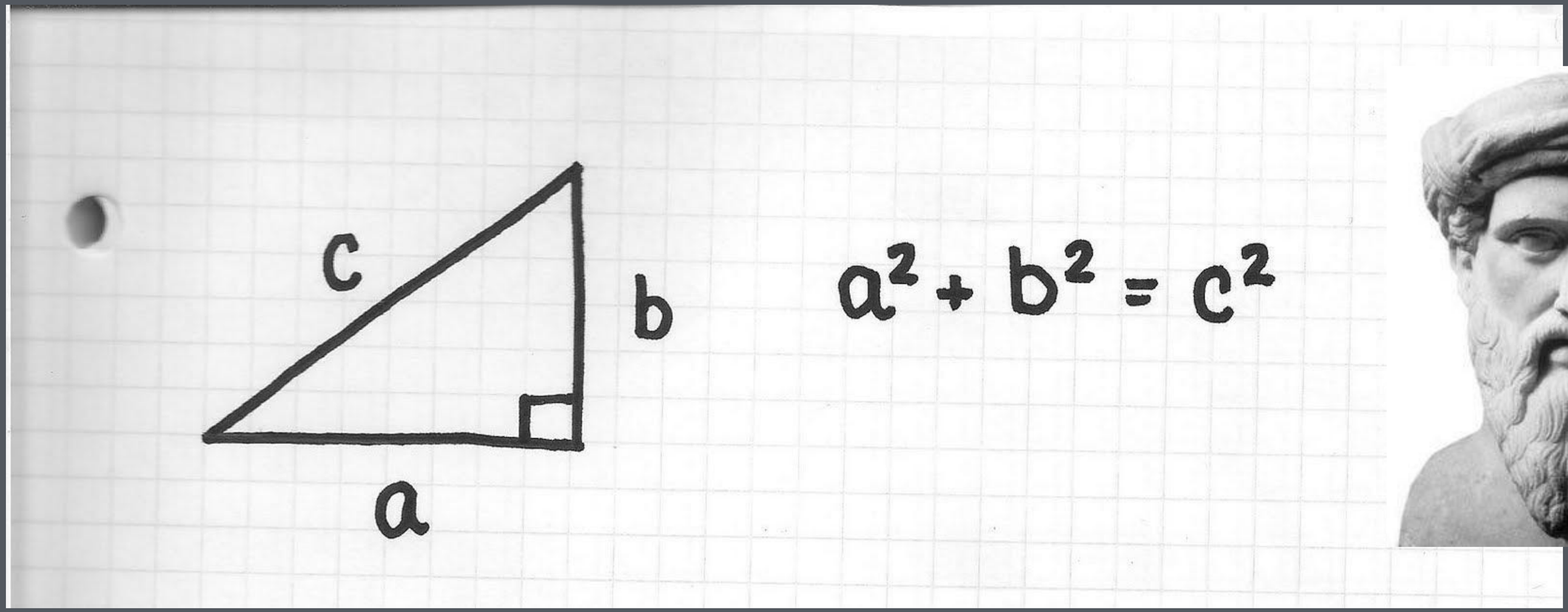
Circle - circle collision detection.

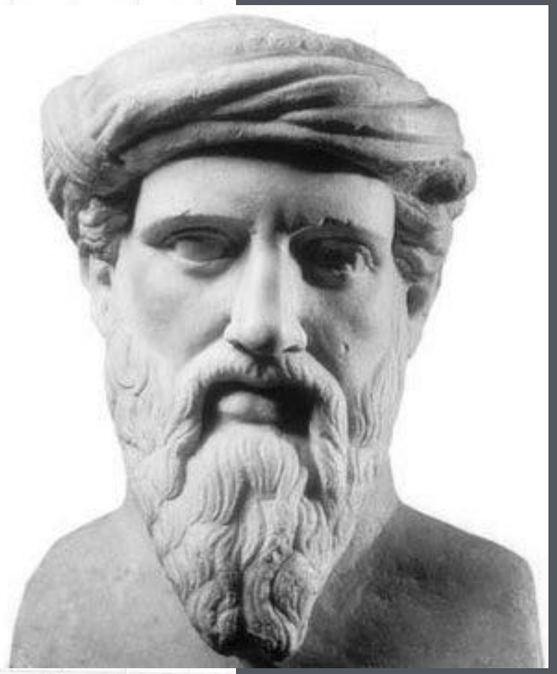



y
x
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-6 -5 -4 -3 -2 -1
1 2 3 4 5 6

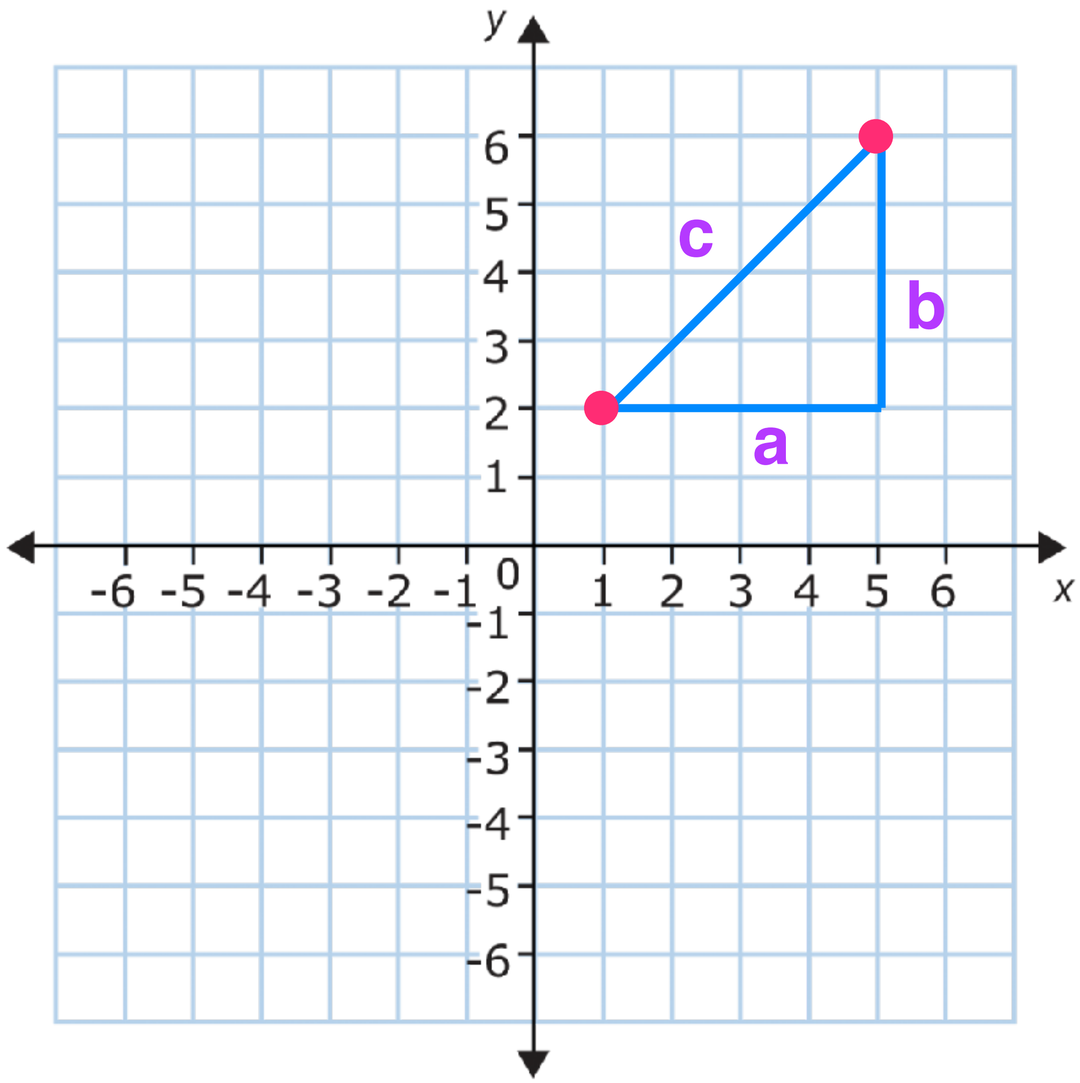

y
x
P1
P2
6
5
4
3
2
1
0
-1
-2
-3
-4
-5
-6
-6 -5 -4 -3 -2 -1
1 2 3 4 5 6

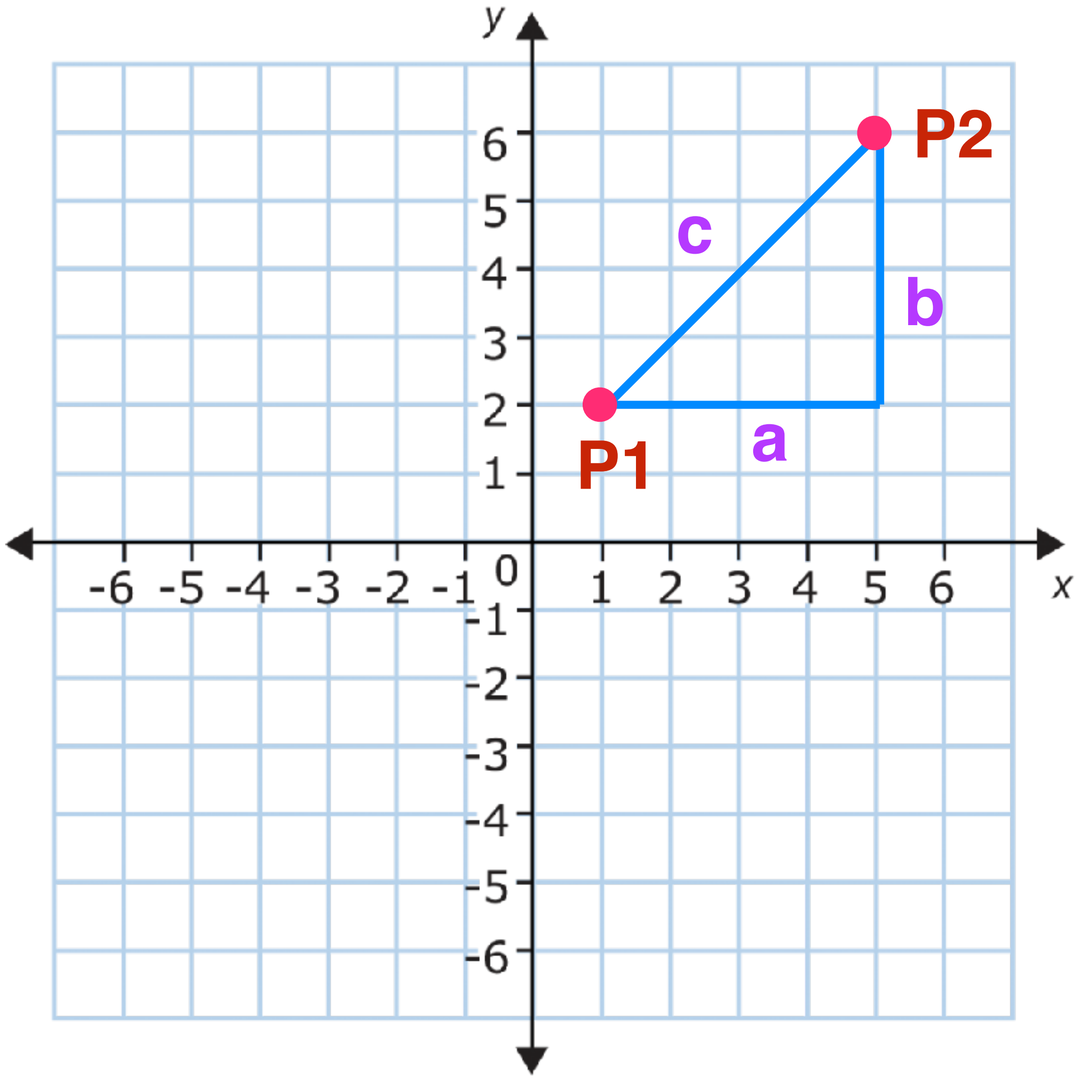
Pythagorean theorem





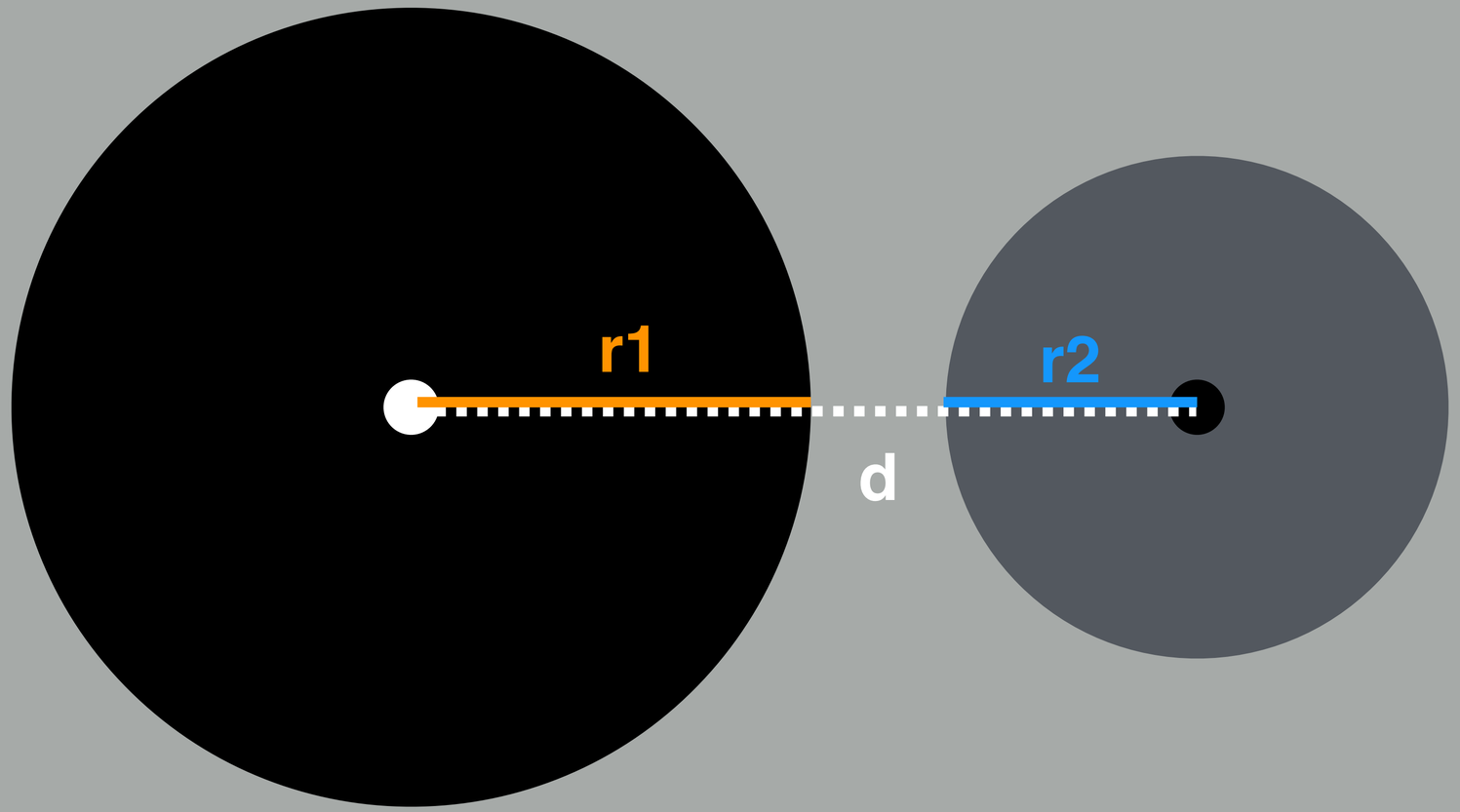
Distance between 2 points.





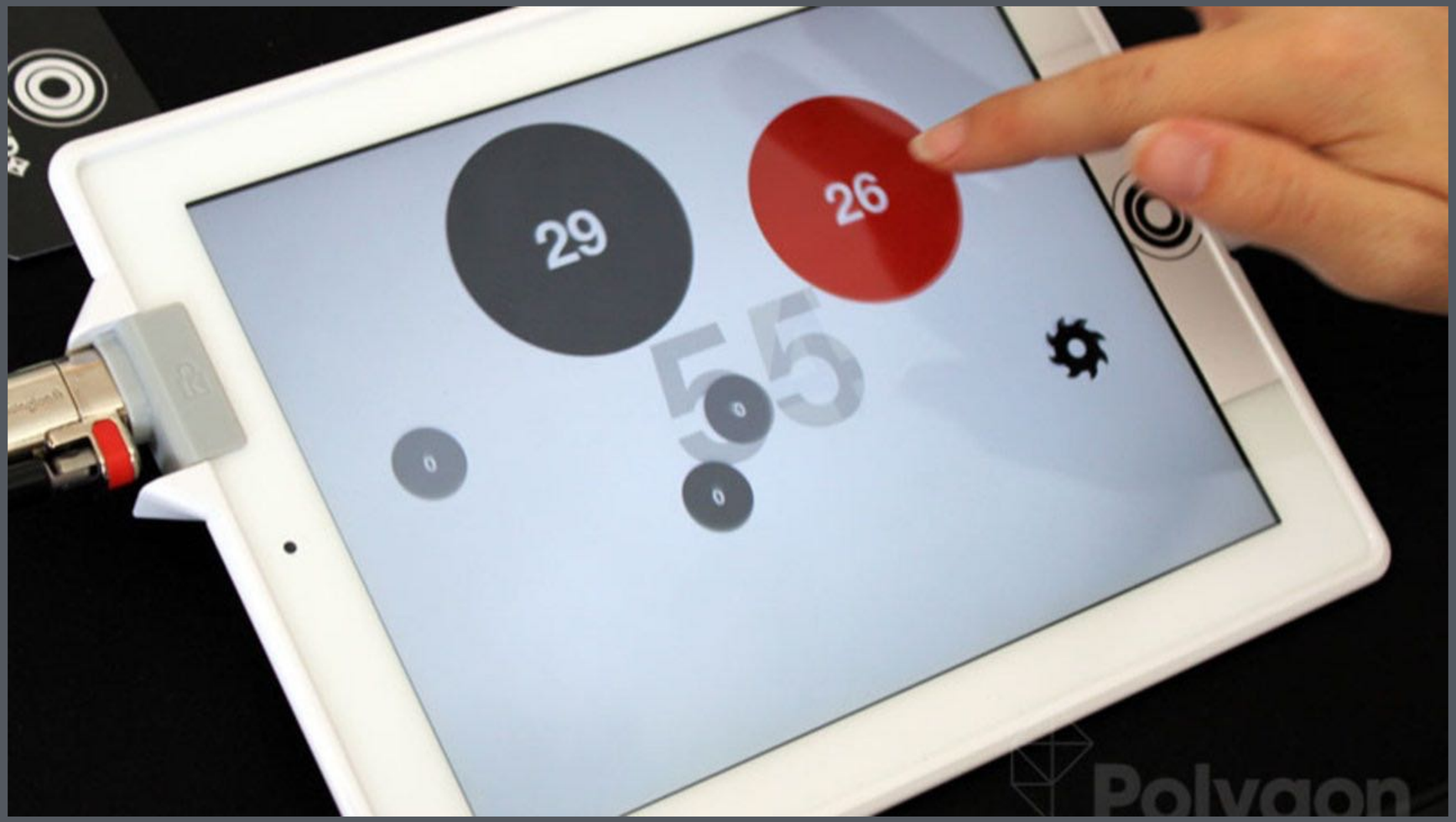
$$a = x_2 - x_1$$
$$b = y_2 - y_1$$
$$c^2 = a^2 - b^2$$
$$c = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

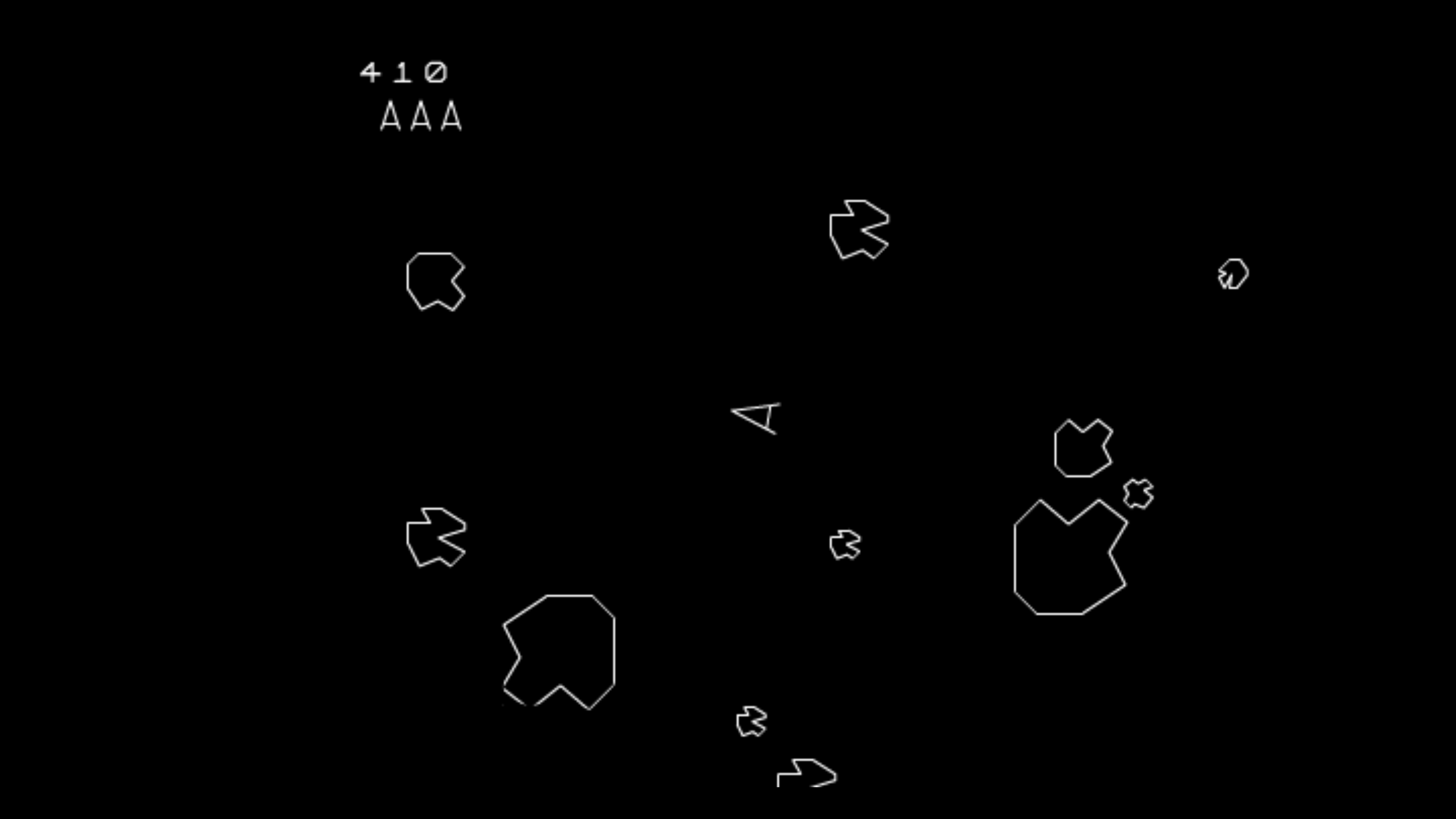
Circle - circle collision detection.

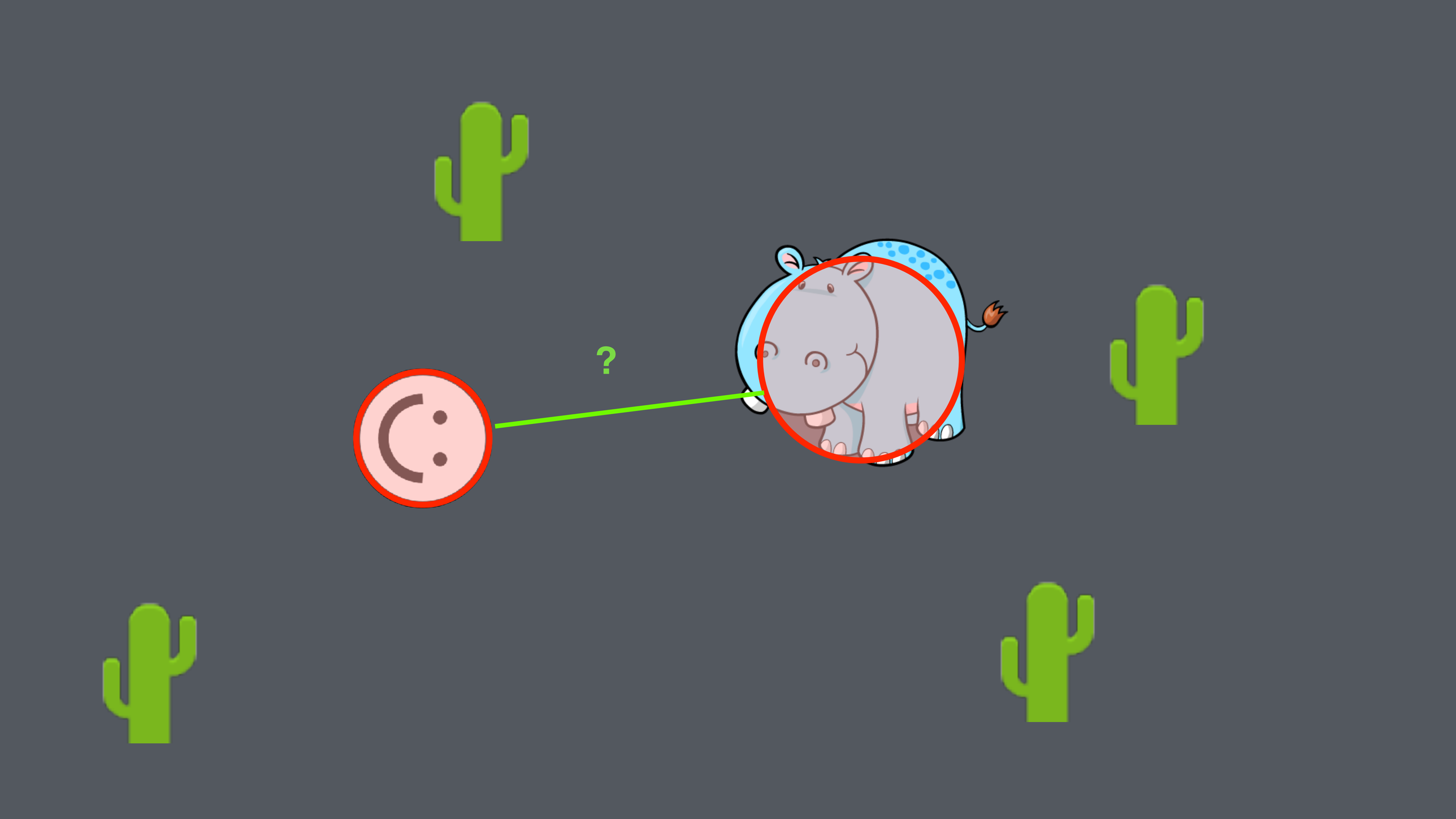


If the distance between two circles is less than the sum of their radii, the circles are colliding!

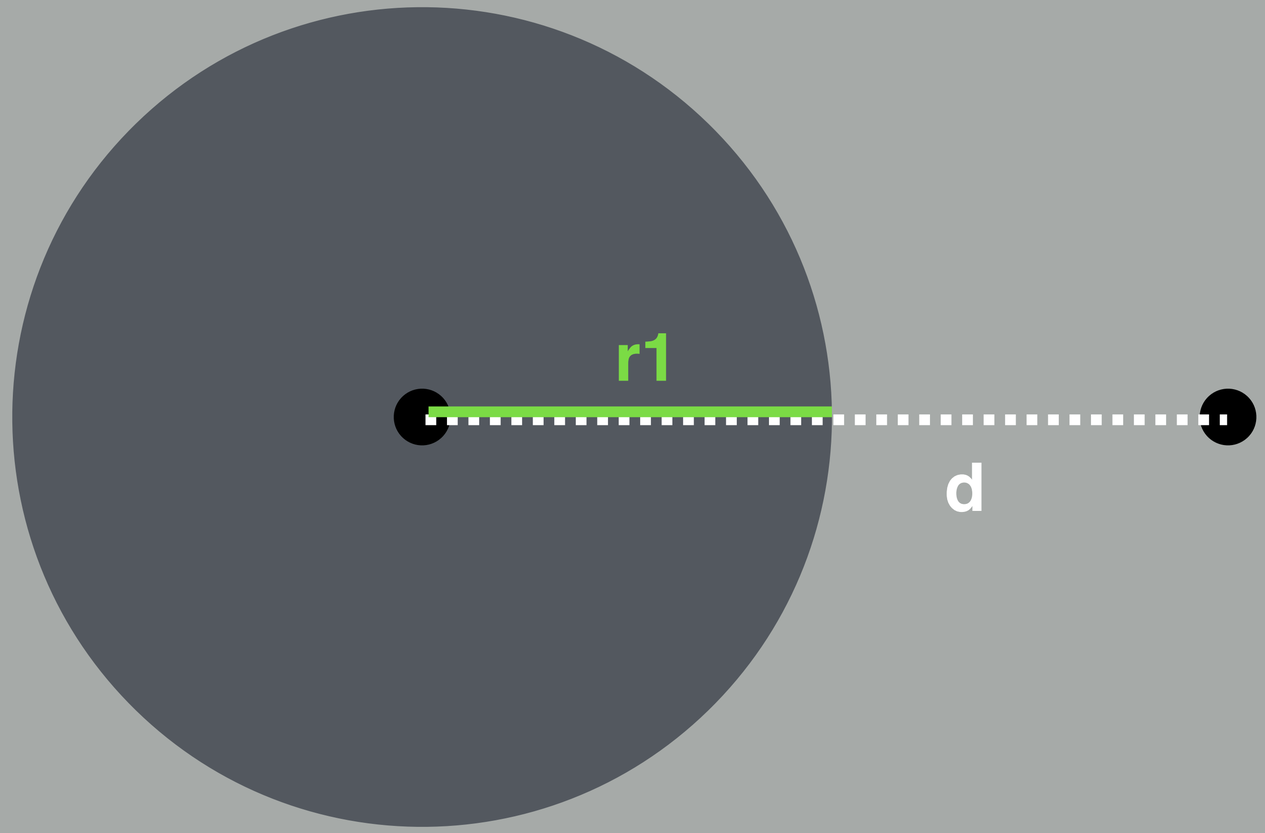

TIME: 00:15
SCORE: 500
PLAYER: 1


29
26
55
0
0
0
Polygon


410
AAA



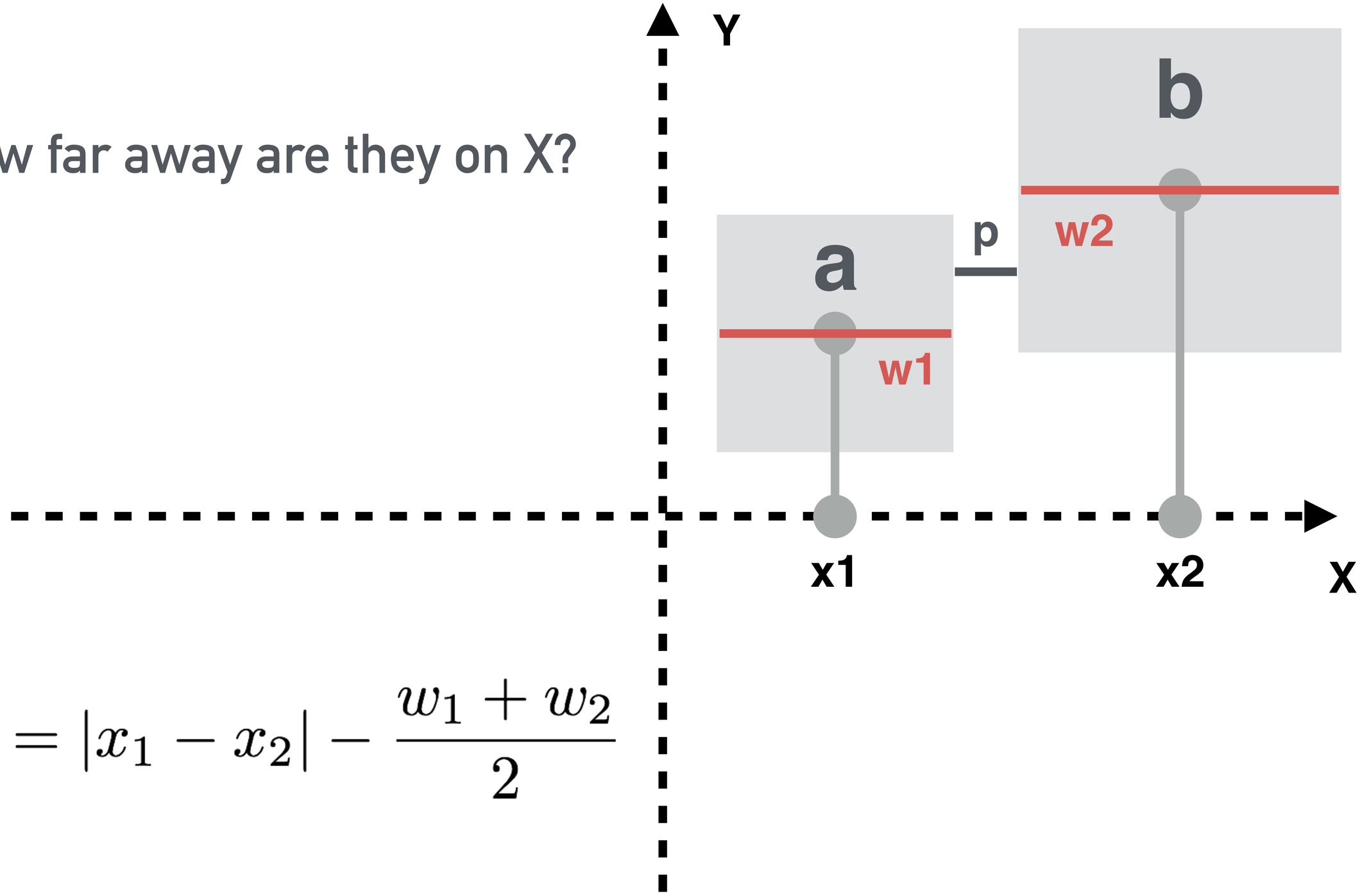
Circle-point collision detection.



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

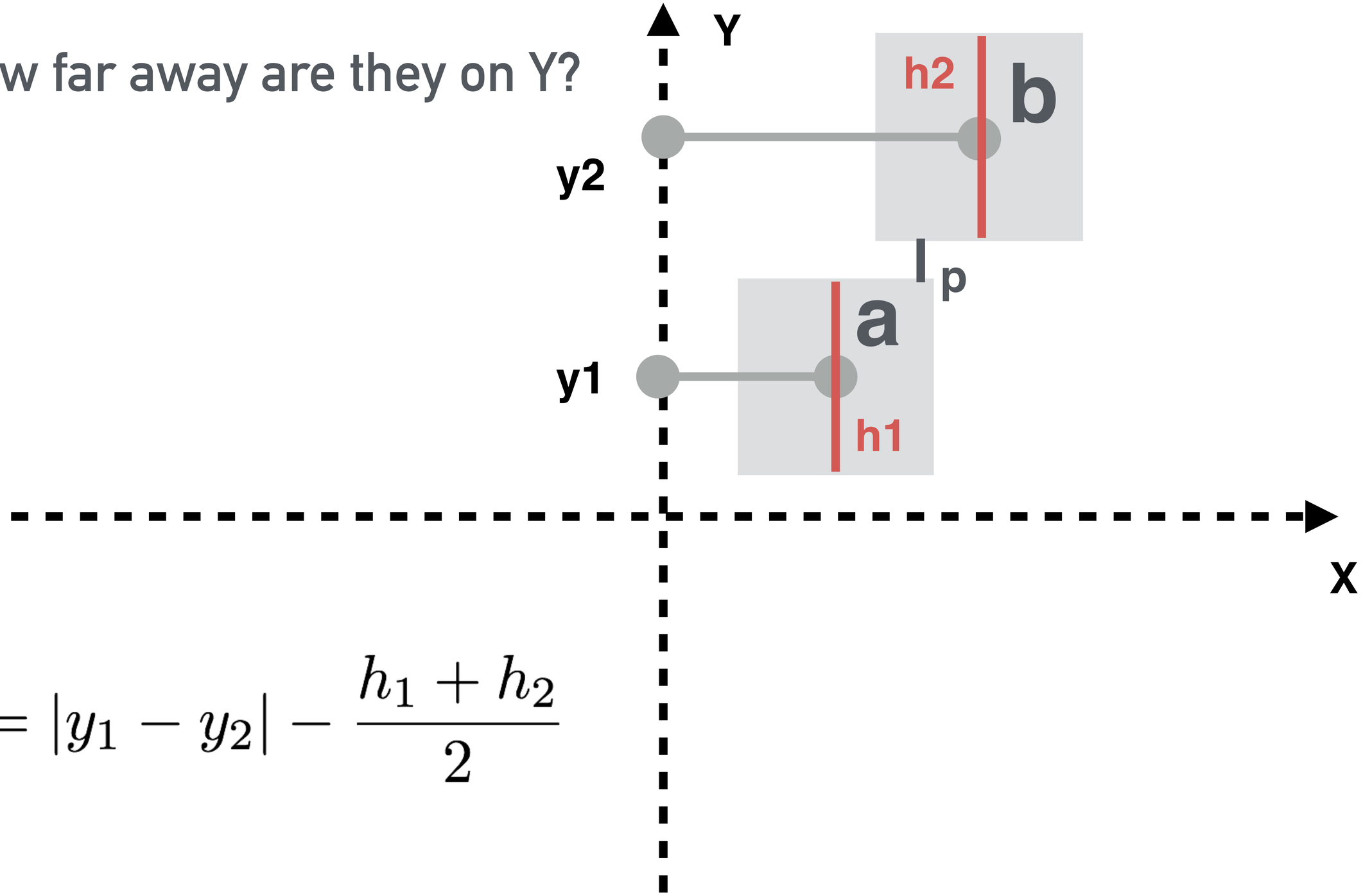
Box-box collision detection.

How far away are they on X?



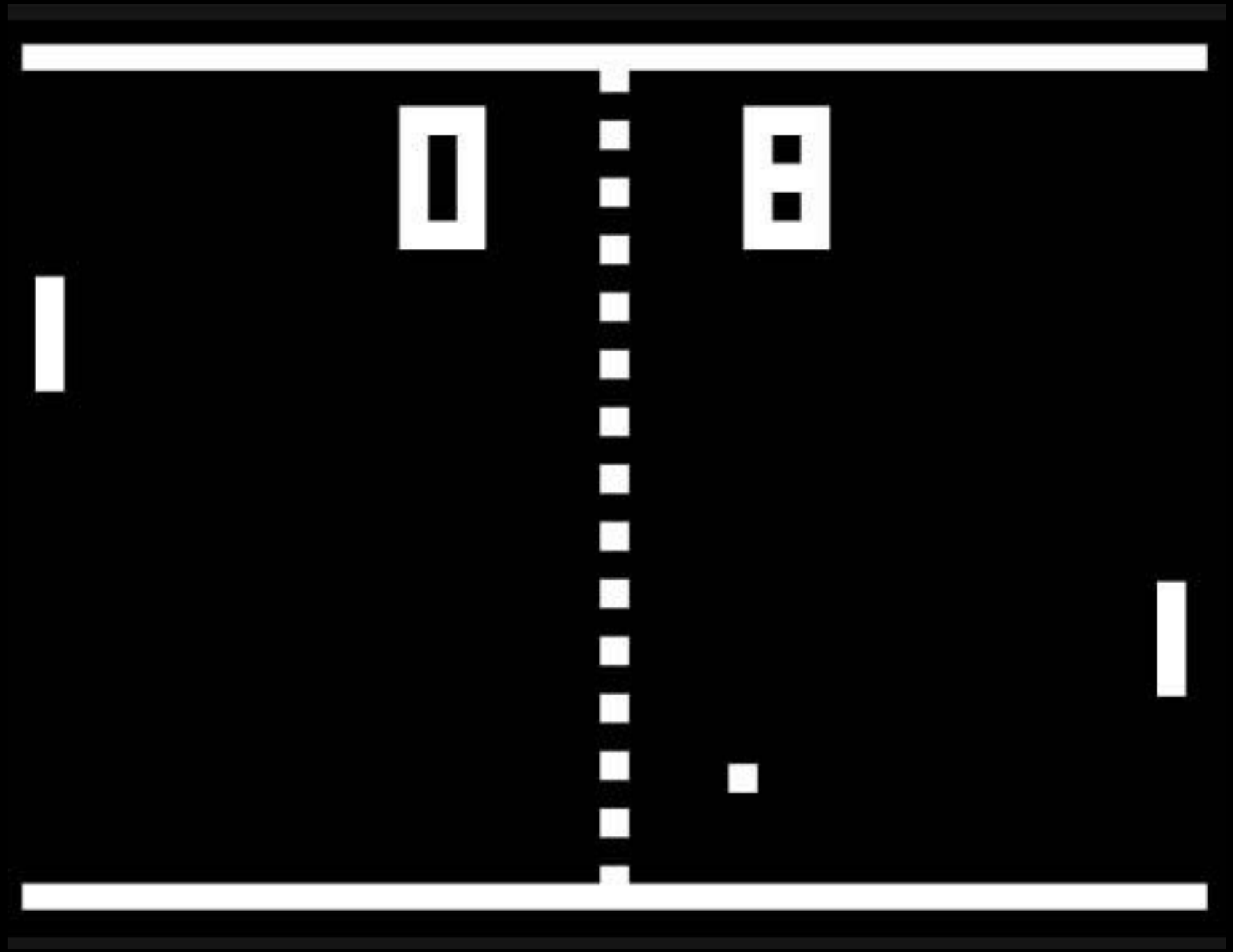
$$p = |x_1 - x_2| - \frac{w_1 + w_2}{2}$$

How far away are they on Y?



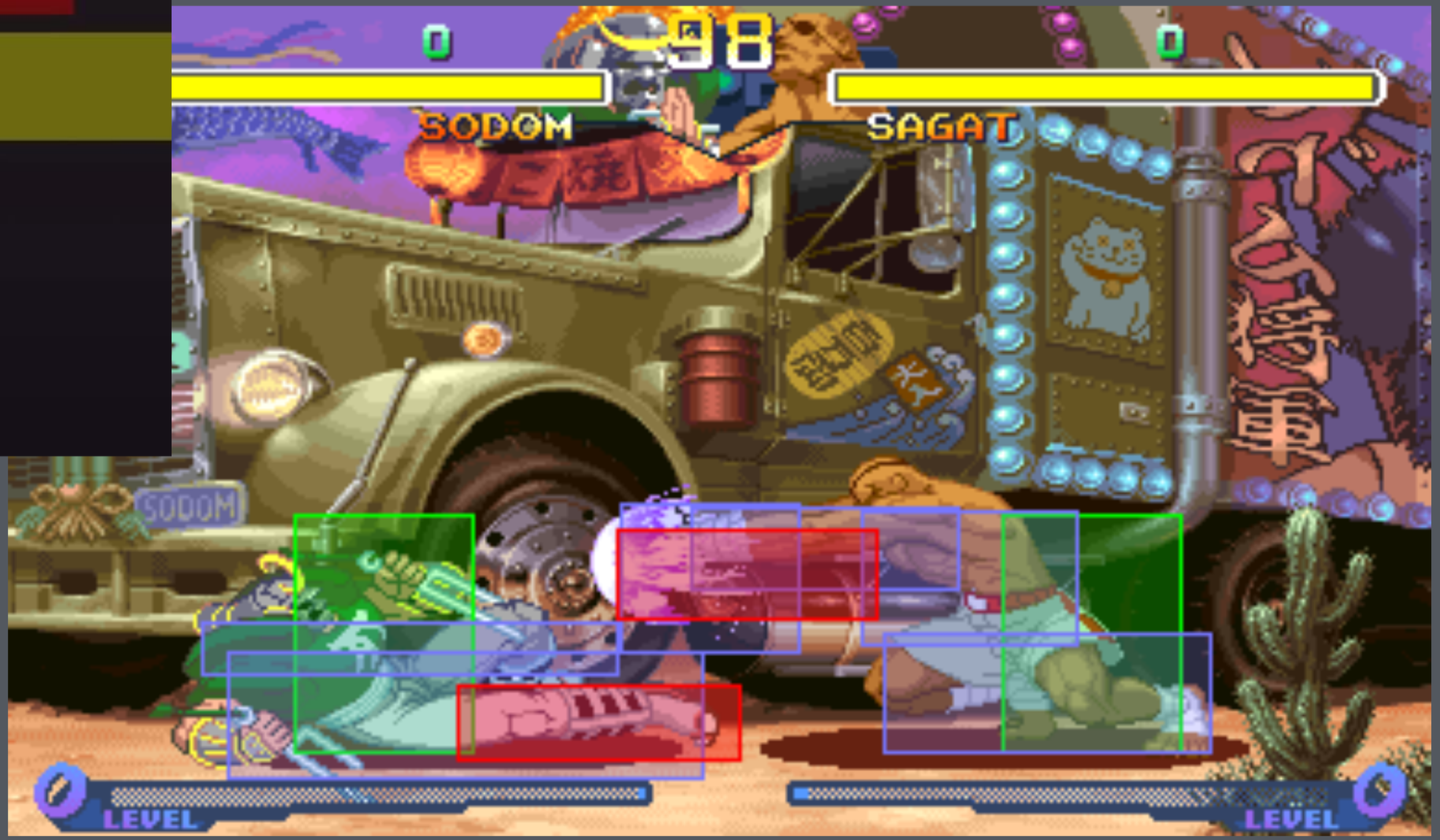
$$p = |y_1 - y_2| - \frac{h_1 + h_2}{2}$$

If both X and Y distances are < 0, then the rectangles are colliding.

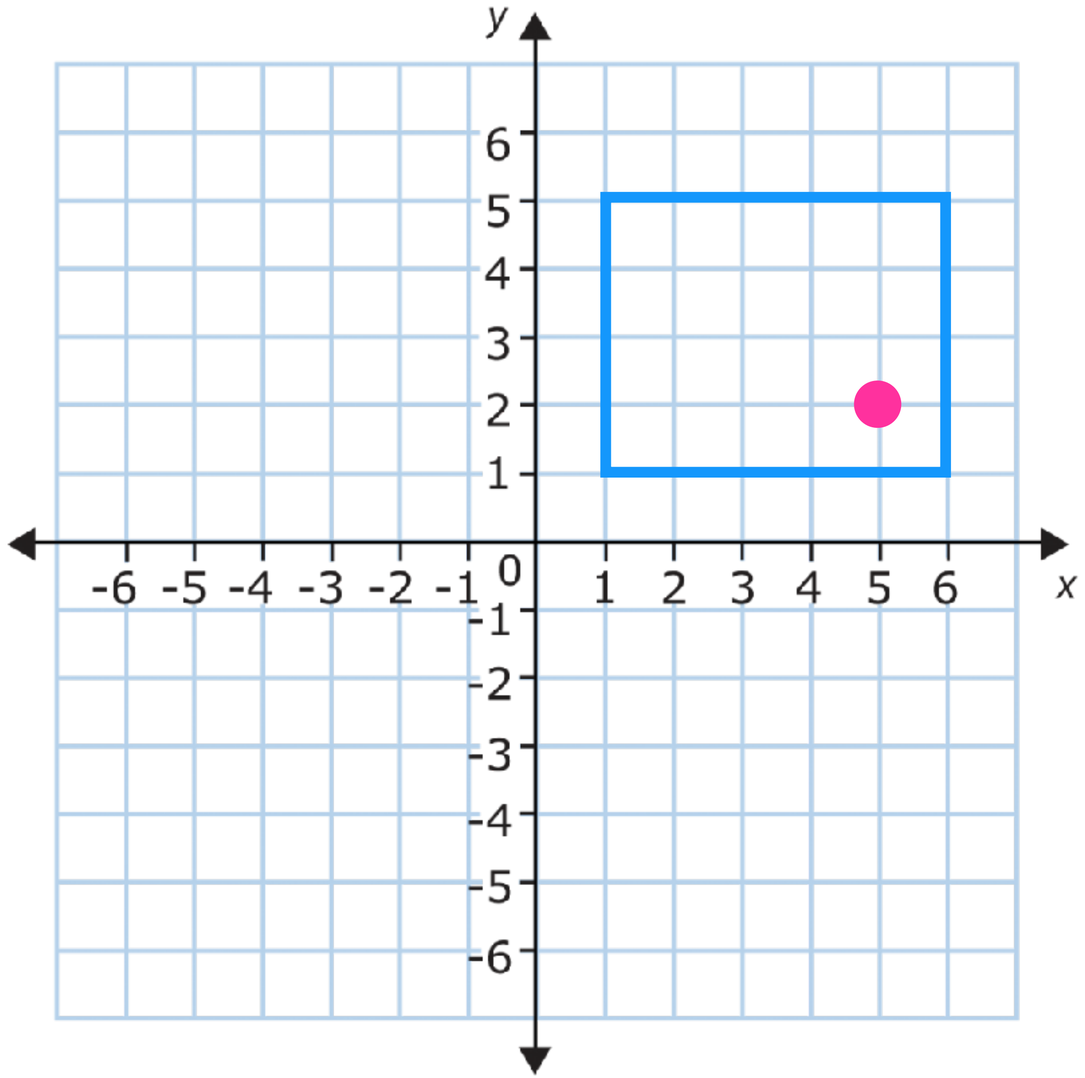



MARIO
004250
×05
WORLD
1-1
TIME
283
100


HP=UP REACH=0.681 1.281


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