

CS Bridge, Lecture 10

Animation

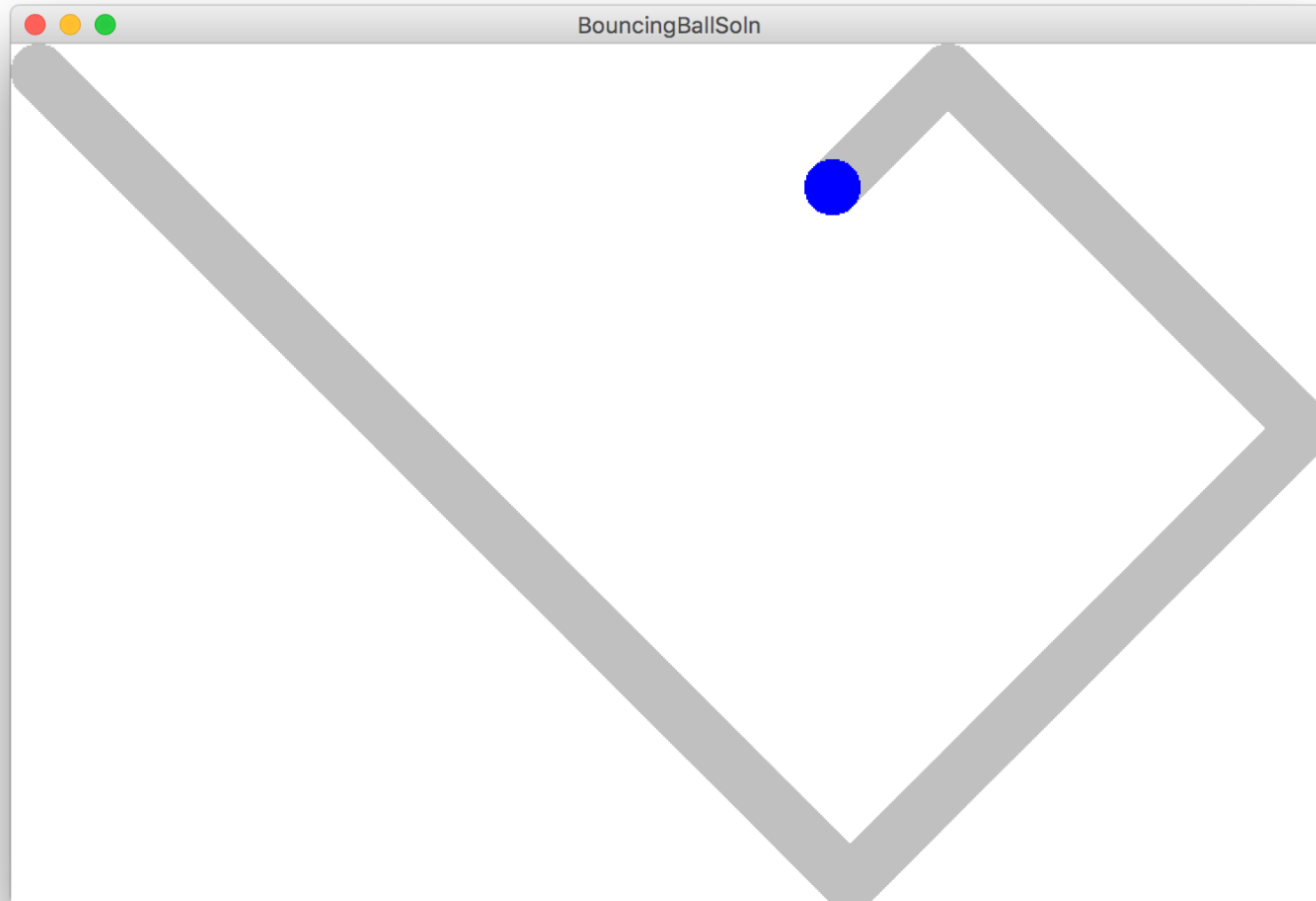


Learning Goals

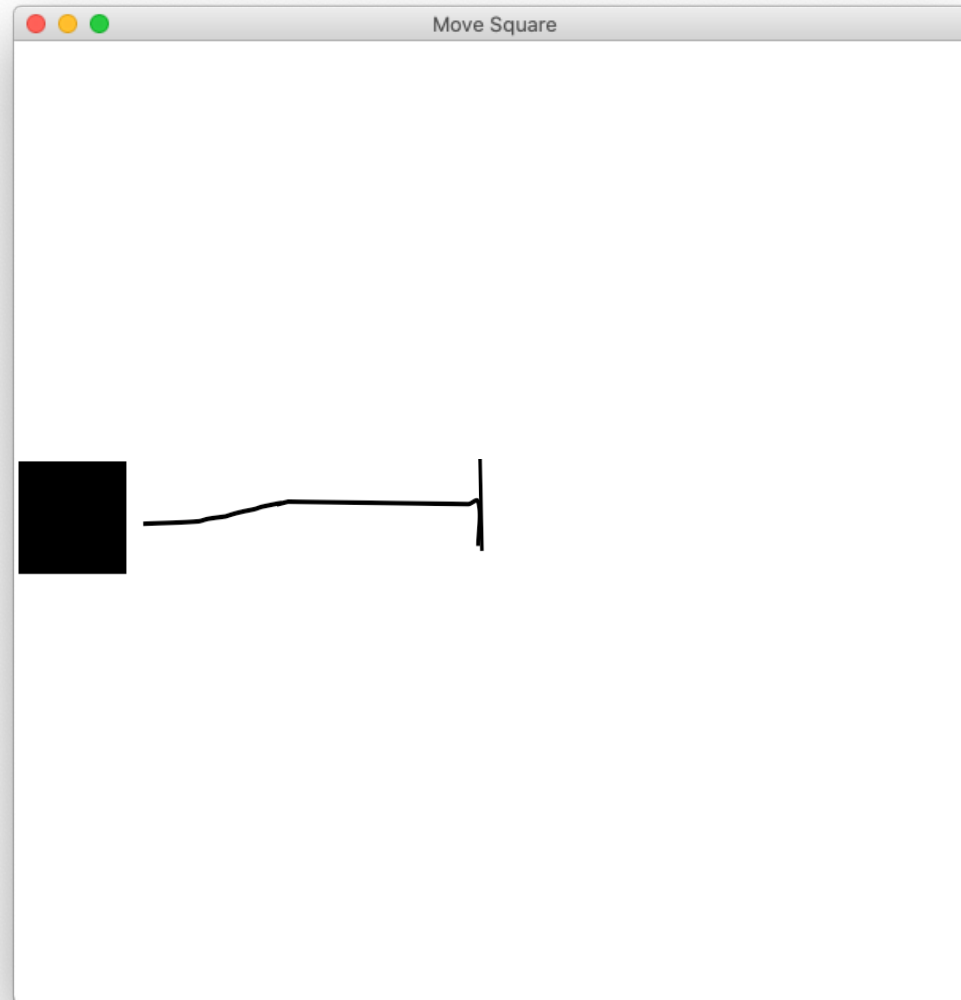
1. Get more practice writing programs with graphics
2. Understand how parameters are passed between functions
3. Write graphics programs with animation



End Goal: Bouncing Ball!



Checkpoint: "Move To Center"



Lecture Plan

- **Review:** Graphics
- Animation Loop Structure
- **Example:** Move To Center
- **Practice:** Bouncing Ball
- Passing Parameters

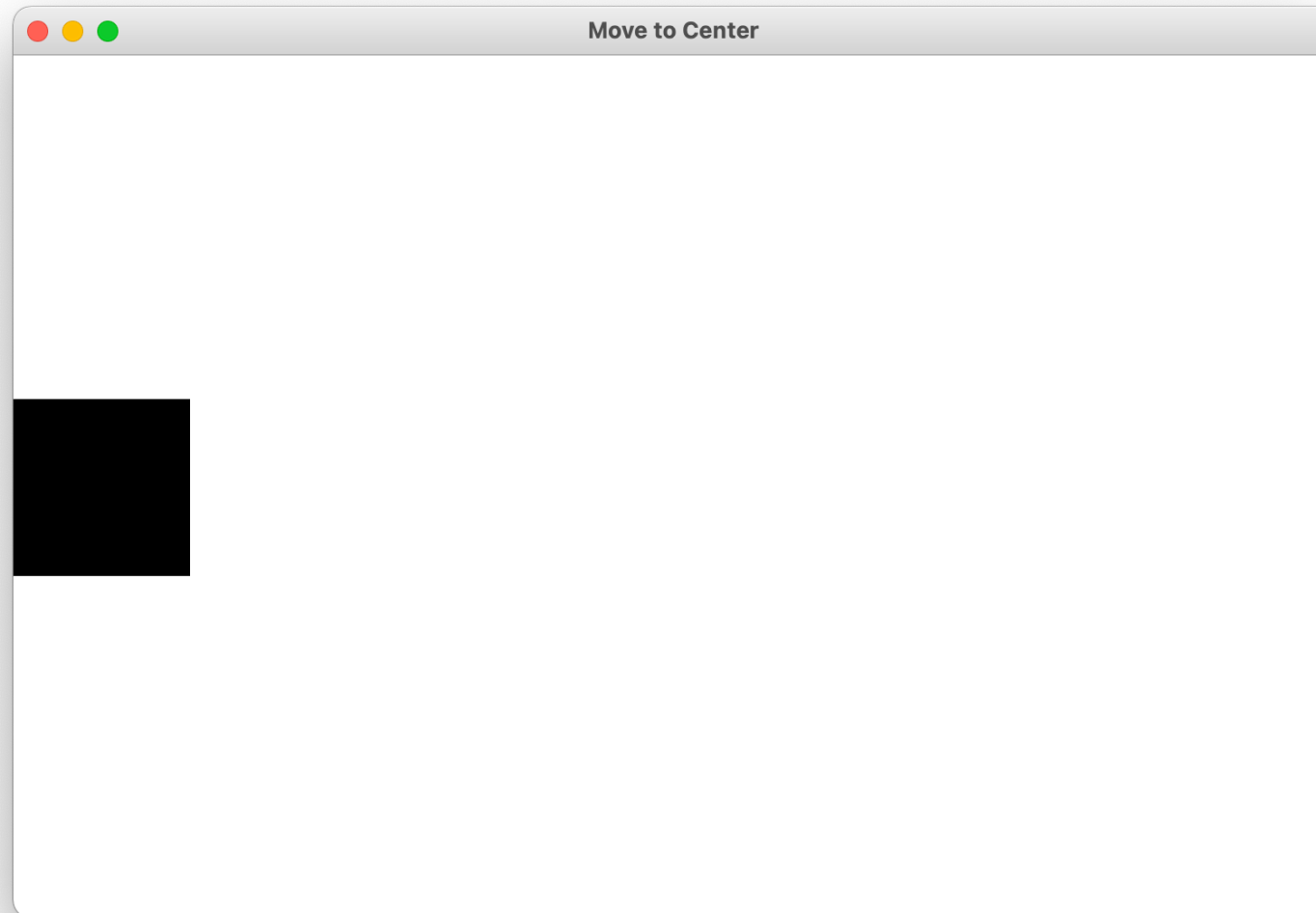
Lecture Plan

- **Review:** Graphics
- Animation Loop Structure
- **Example:** Move To Center
- **Practice:** Bouncing Ball
- Passing Parameters

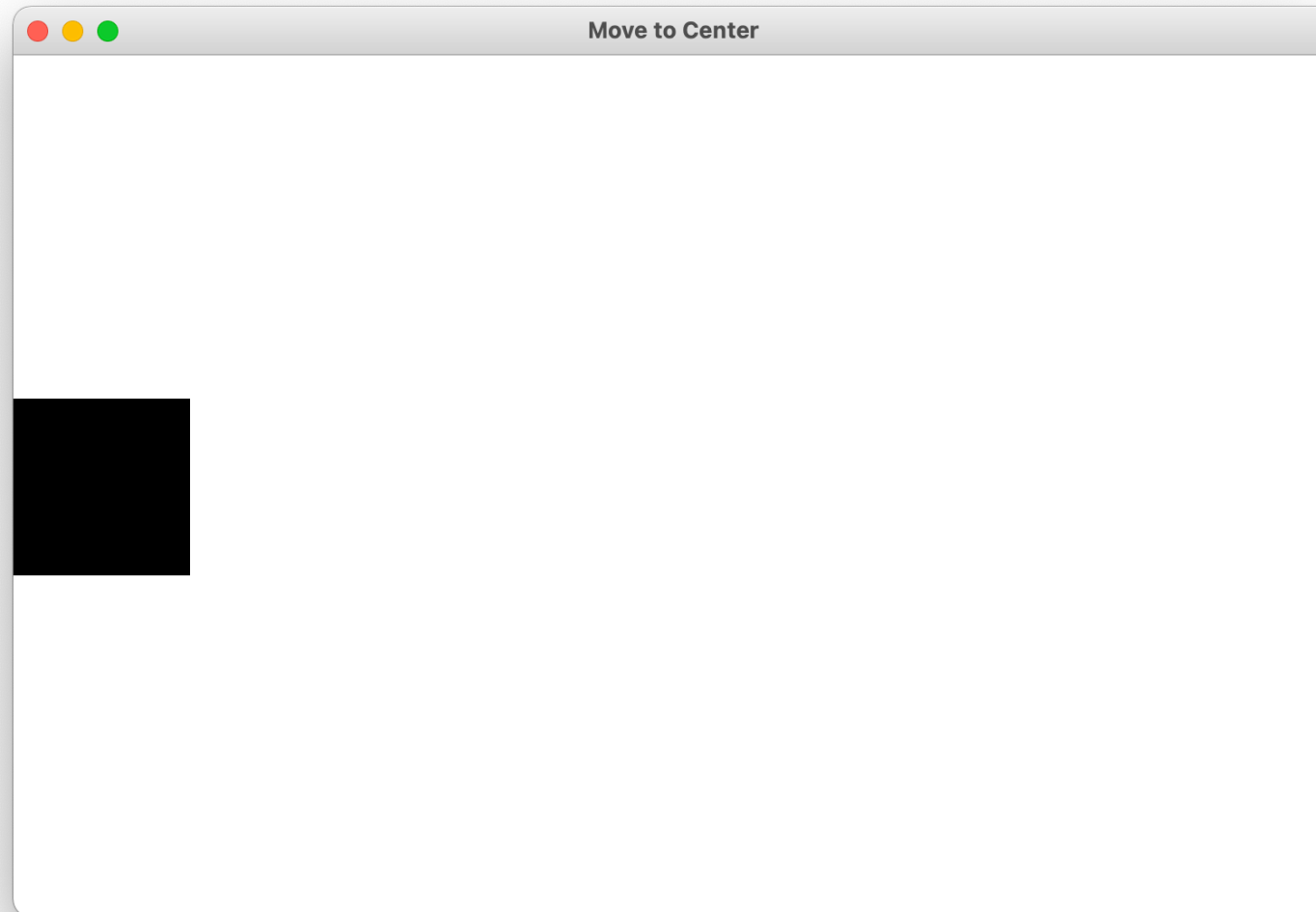
In our last episode...

Graphics From Tkinter

```
from graphics import Canvas
```



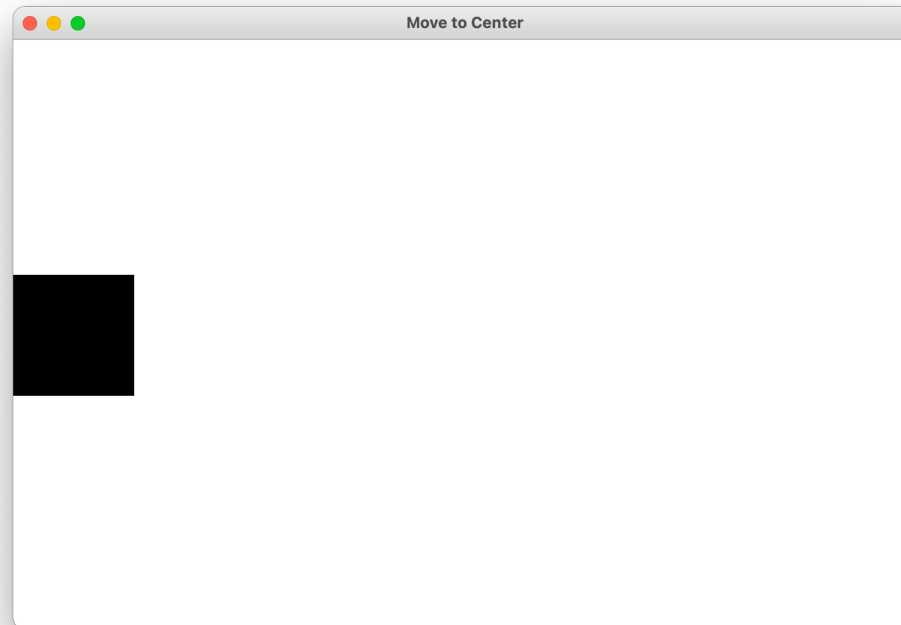
Add Square



Add Square

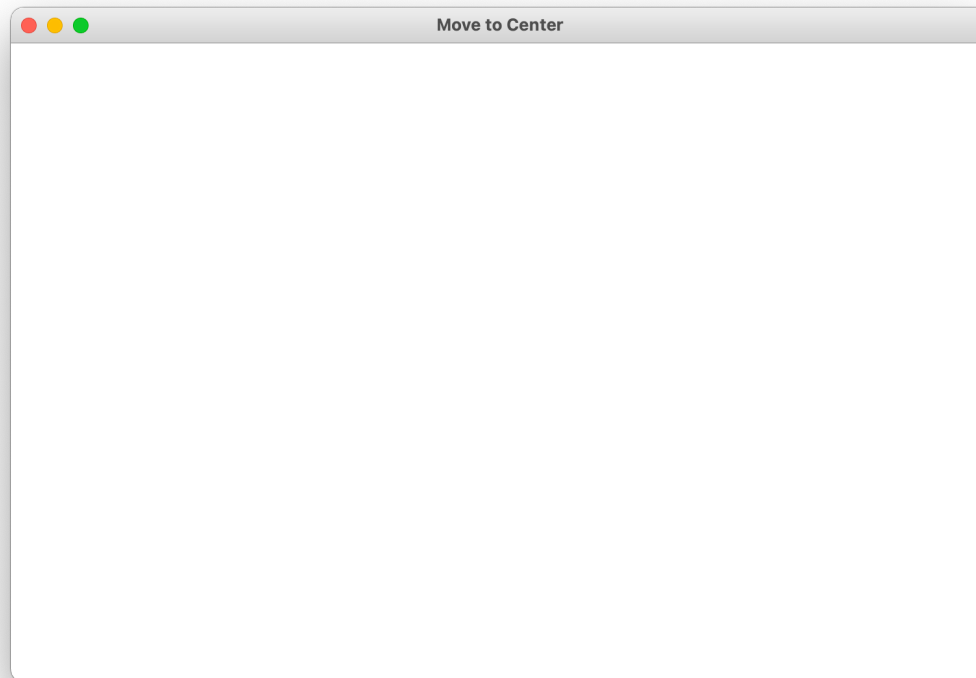
```
SQUARE_SIZE = 100
```

```
def main():  
    canvas = Canvas()  
    canvas.set_canvas_title("Move to Center")  
    square_top_y = canvas.get_canvas_height() / 2 - SQUARE_SIZE / 2  
    rect = canvas.create_rectangle(0, square_top_y, SQUARE_SIZE, square_top_y + SQUARE_SIZE)  
    canvas.set_color(rect, "black")  
    canvas.mainloop()
```



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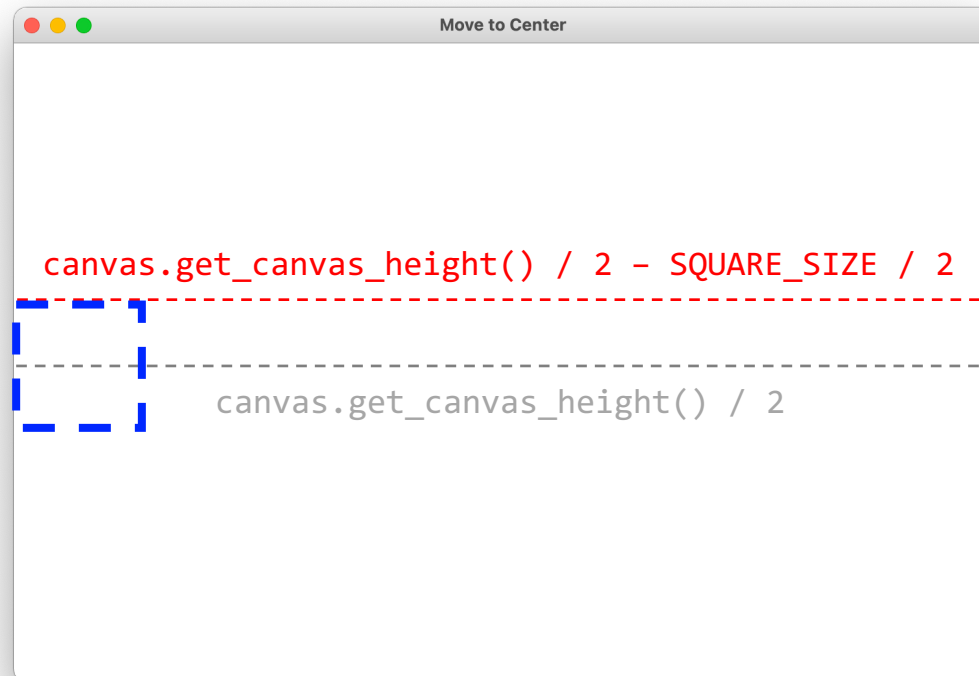
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canvas.mainloop()
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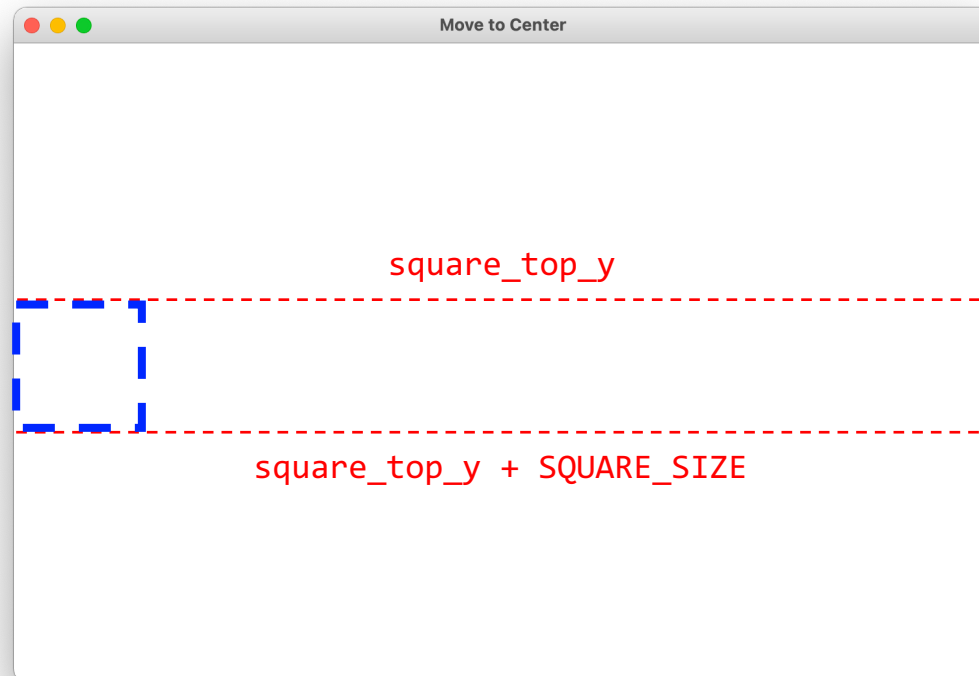
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Add Square

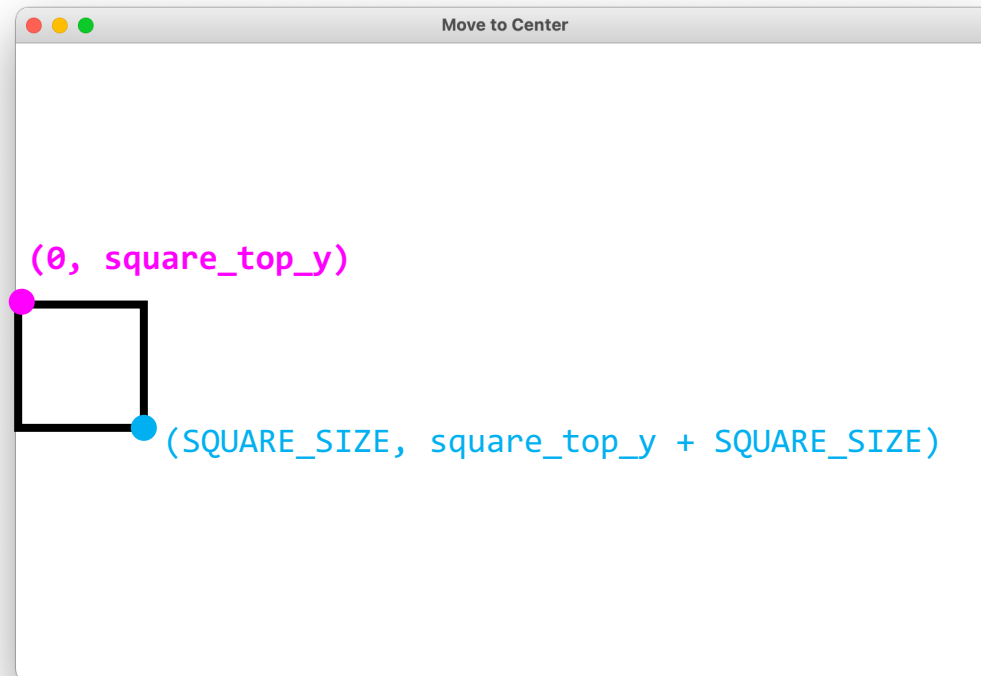
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canvas.set_color(rect, "black")
canvas.mainloop()
```



Some “heavy
duty” variables
allow you to call
functions on them

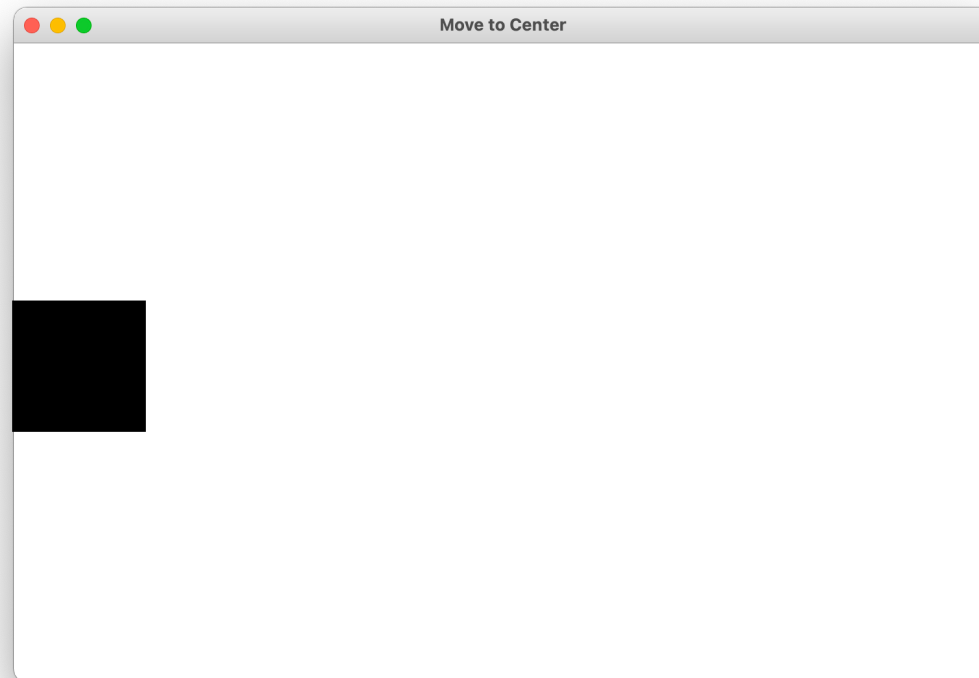
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canvas.mainloop()
```



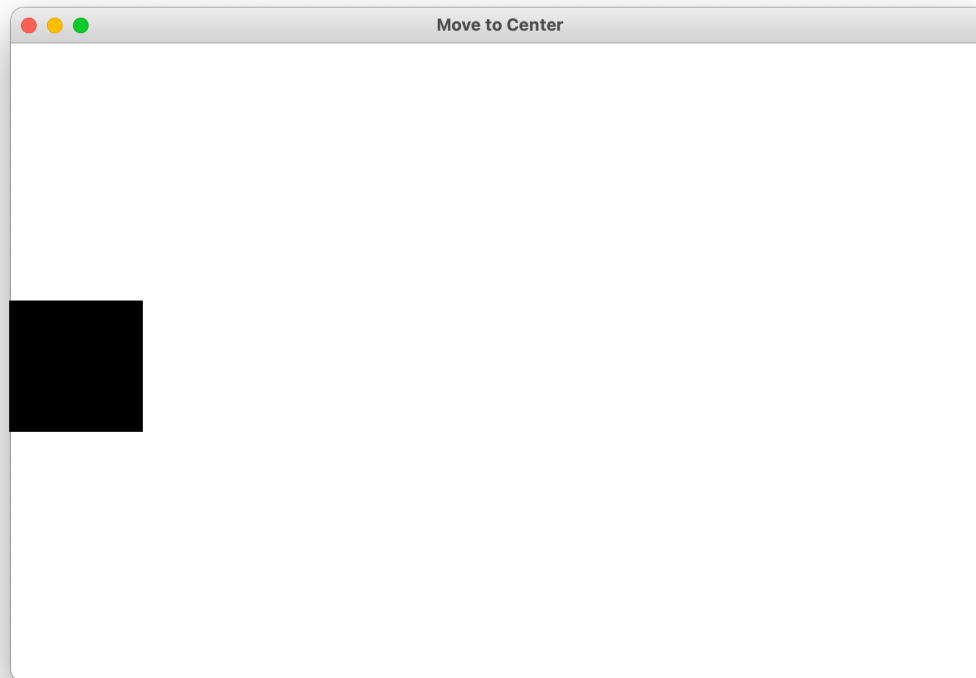
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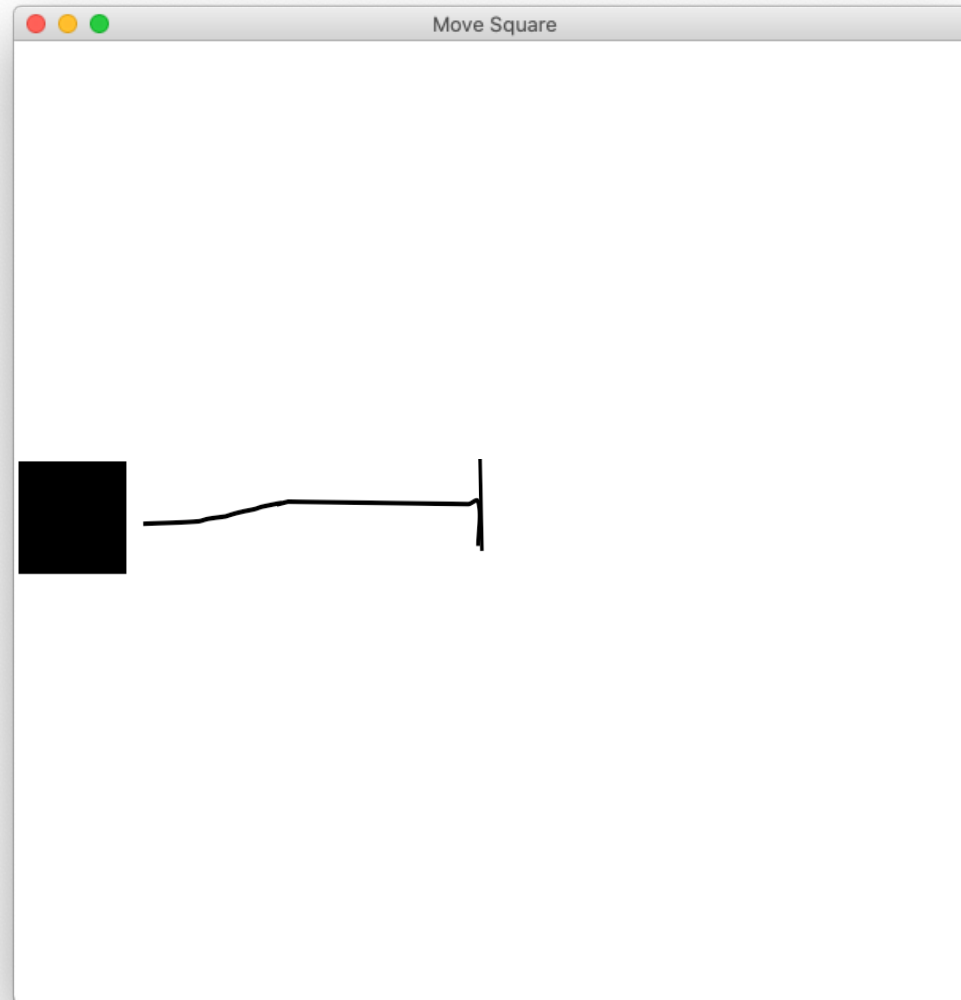
End of review!

Lecture Plan

- **Review:** Graphics
- **Animation Loop Structure**
- **Example:** Move To Center
- **Practice:** Bouncing Ball
- Passing Parameters

How do movies or games
animate?

Checkpoint: “Move To Center”



Animation Loop

```
def main():  
    # setup done once  
  
    while ???:  
        # update world  
  
        # pause  
        time.sleep(DELAY)  
  
    canvas.mainloop()
```

Animation Loop

```
def main():  
    # setup done once  
  
    while ???:  
        # update world  
  
        # pause  
        time.sleep(DELAY)  
  
    canvas.mainloop()
```

Make all the variables
you need.

Animation Loop

```
def main():  
    # setup done once  
    while ???:  
        # update world  
  
        # pause  
        time.sleep(DELAY)  
  
    canvas.mainloop()
```

The animation loop is a repetition of heartbeats, either forever (while True) or until some condition is no longer true.

Animation Loop

```
def main():  
    # setup done once  
  
    while ???:  
        # update world  
  
        # pause  
        time.sleep(DELAY)  
  
    canvas.mainloop()
```

Each heart-beat, update the world forward one frame

Animation Loop

```
def main():  
    # setup done once  
  
    while ???:  
        # update world  
        # pause  
        time.sleep(DELAY)  
  
    canvas.mainloop()
```

If you don't pause, humans
won't be able to see it!

Animation Loop

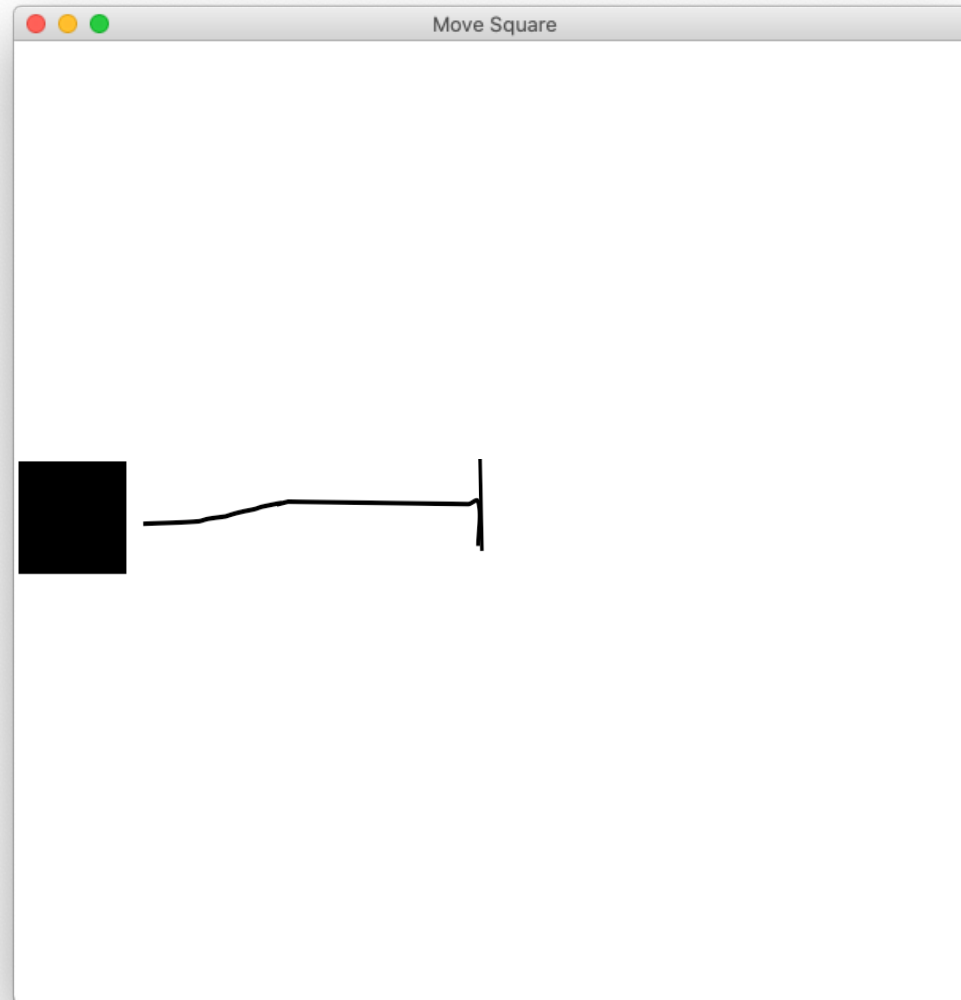
```
def main():  
    # setup done once  
  
    while ???:  
        # update world  
  
        # pause  
        time.sleep(DELAY)  
    canvas.mainloop()
```

Make sure to call
mainloop() to make your
program run correctly.

Lecture Plan

- Review: Graphics
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- **Example: Move To Center**
- Practice: Bouncing Ball
- Passing Parameters

Checkpoint: "Move To Center"



Animation Loop

```
def main():  
    # setup done once  
  
    while ???:  
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        # pause  
        time.sleep(DELAY)  
  
    canvas.mainloop()
```

Animation Loop

```
def main():
    # setup done once
    canvas = Canvas()
    canvas.set_canvas_title("Move to Center")
    square_top_y = canvas.get_canvas_height() / 2 - SQUARE_SIZE / 2
    rect = canvas.create_rectangle(0, square_top_y, SQUARE_SIZE, square_top_y + SQUARE_SIZE)
    canvas.set_color(rect, "black")

    while ???:
        # update world

        # pause
        time.sleep(DELAY)

    canvas.mainloop()
```

Animation Loop

```
def main():
    # setup done once
    canvas = Canvas()
    canvas.set_canvas_title("Move to Center")
    square_top_y = canvas.get_canvas_height() / 2 - SQUARE_SIZE / 2
    rect = canvas.create_rectangle(0, square_top_y, SQUARE_SIZE, square_top_y + SQUARE_SIZE)
    canvas.set_color(rect, "black")

    while ???:
        # update world
        canvas.move(rect, 1, 0)
        canvas.update()

        # pause
        time.sleep(DELAY)

    canvas.mainloop()
```


Animation Loop

```
def main():  
    # setup done once  
    canvas = Canvas()  
    canvas.set_canvas_title("Move to Center")  
    square_top_y = canvas.get_canvas_height() / 2 - SQUARE_SIZE / 2  
    rect = canvas.create_rectangle(0, square_top_y, SQUARE_SIZE, square_top_y + SQUARE_SIZE)  
    canvas.set_color(rect, "black")  
  
    while ???:  
        # update world  
        canvas.move(rect, 1, 0)    Move the rectangle 1 pixel to the right.  
        canvas.update()  
  
        # pause  
        time.sleep(DELAY)  
  
    canvas.mainloop()
```

Animation Loop

```
def main():
    # setup done once
    canvas = Canvas()
    canvas.set_canvas_title("Move to Center")
    square_top_y = canvas.get_canvas_height() / 2 - SQUARE_SIZE / 2
    rect = canvas.create_rectangle(0, square_top_y, SQUARE_SIZE, square_top_y + SQUARE_SIZE)
    canvas.set_color(rect, "black")

    while ???:
        # update world
        canvas.move(rect, 1, 0)
        canvas.update()

        # pause
        time.sleep(DELAY)

    canvas.mainloop()
```

Tells the canvas to update the screen. Don't forget this!
Call it once you are finished making all canvas changes
for now.

Animation Loop

```
def main():  
    # setup done once  
    canvas = Canvas()  
    canvas.set_canvas_title("Move to Center")  
    square_top_y = canvas.get_canvas_height() / 2 - SQUARE_SIZE / 2  
    rect = canvas.create_rectangle(0, square_top_y, SQUARE_SIZE, square_top_y + SQUARE_SIZE)  
    canvas.set_color(rect, "black")  
  
    while ???:  
        # update world  
        canvas.move(rect, 1, 0)  
        canvas.update()  
  
        # pause  
        time.sleep(DELAY)  
  
    canvas.mainloop()
```

When do we want to stop the animation loop?

Let's live code!

Move to Center

```
def main():
    # setup done once
    canvas = Canvas()
    canvas.set_canvas_title("Move to Center")
    square_top_y = canvas.get_canvas_height() / 2 - SQUARE_SIZE / 2
    rect = canvas.create_rectangle(0, square_top_y, SQUARE_SIZE, square_top_y + SQUARE_SIZE)
    canvas.set_color(rect, "black")

    while is_not_past_center(canvas, rect):
        # update world
        canvas.move(rect, 1, 0)
        canvas.update()

        # pause
        time.sleep(DELAY)

    canvas.mainloop()
```

More Helpful Graphics Functions

<code>canvas.move(obj, dx, dy)</code>	Moves obj using the displacements dx and dy.
<code>canvas.moveto(obj, x, y)</code>	Sets the location of obj to the specified coordinates.

move shape to some new coordinates

```
canvas.moveto(shape, new_x, new_y)
```

move shape by a given change_x and change_y

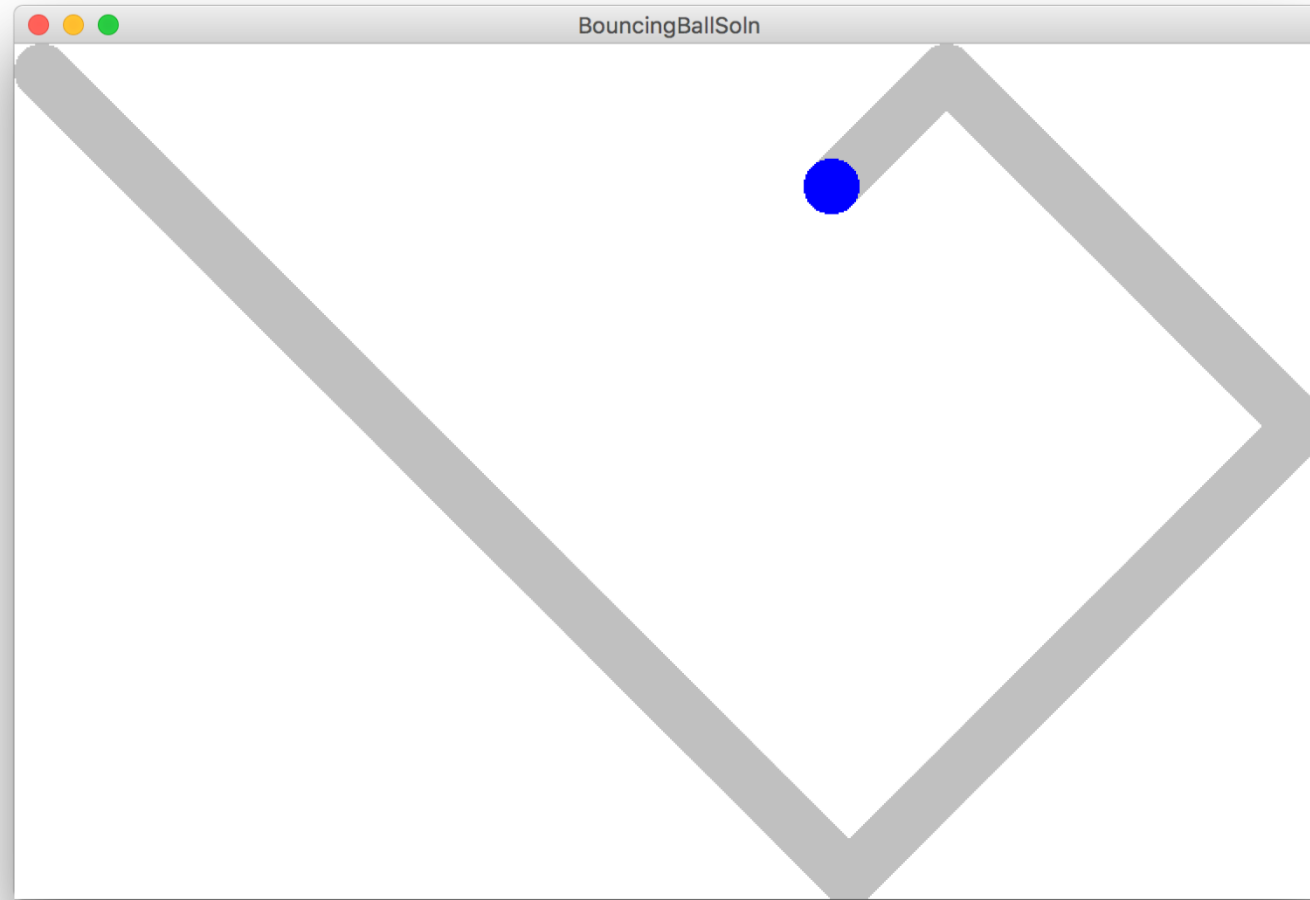
```
canvas.move(shape, change_x, change_y)
```

We are ready...

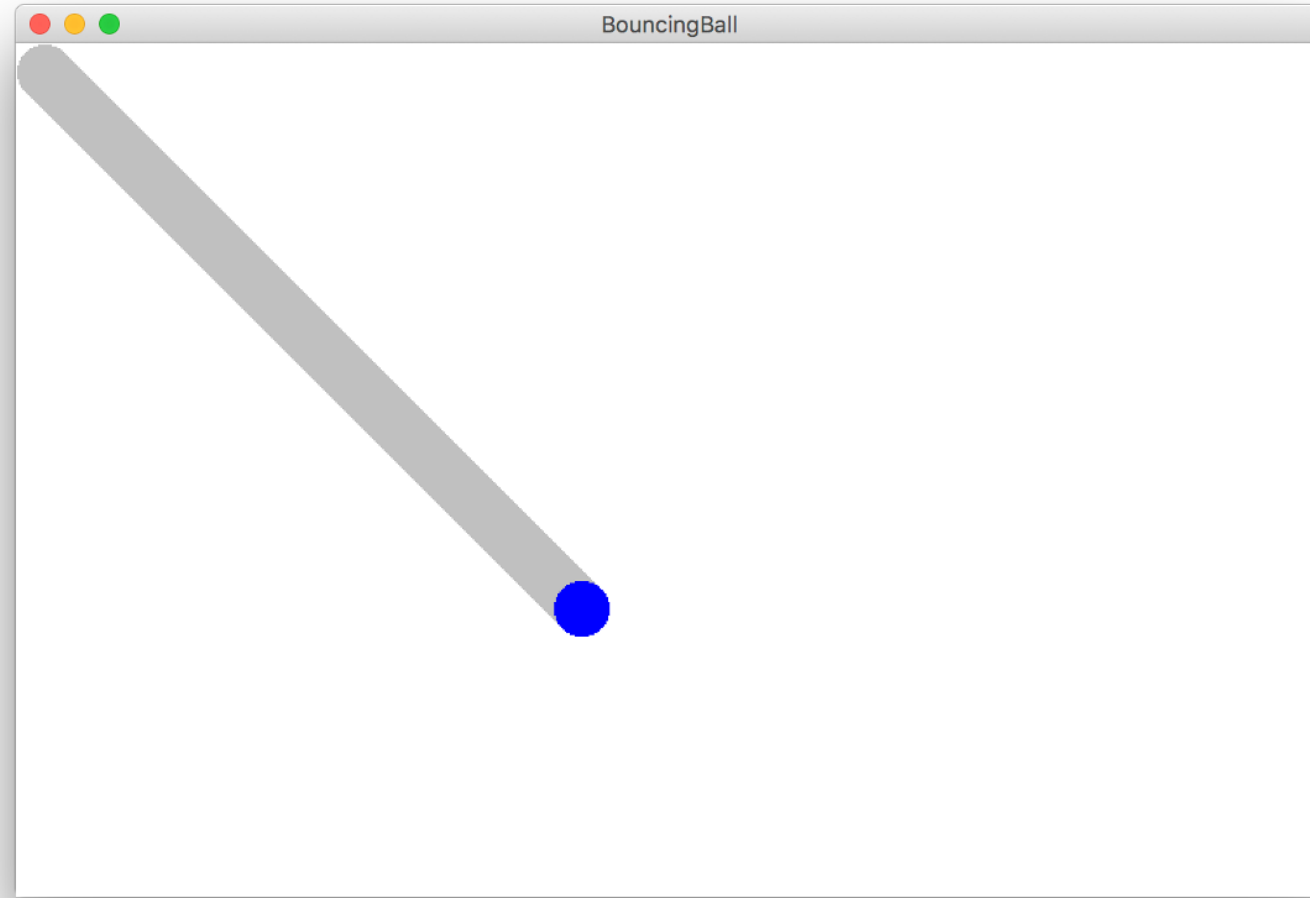
Lecture Plan

- Review: Graphics
- Animation Loop Structure
- Example: Move To Center
- **Practice: Bouncing Ball**
- Passing Parameters

Bouncing Ball

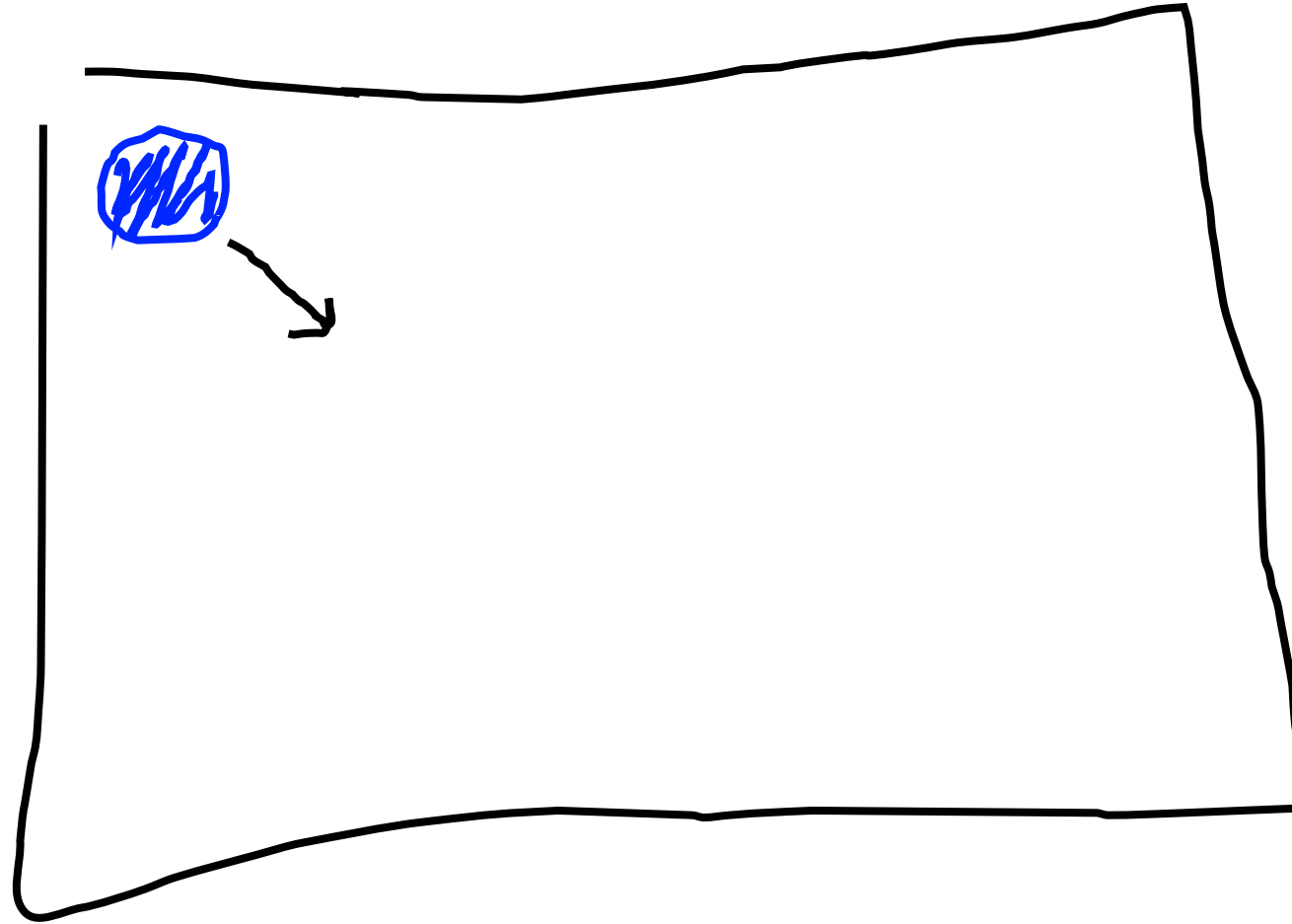


Bouncing Ball: Milestone 1 - Movement



Bouncing Ball

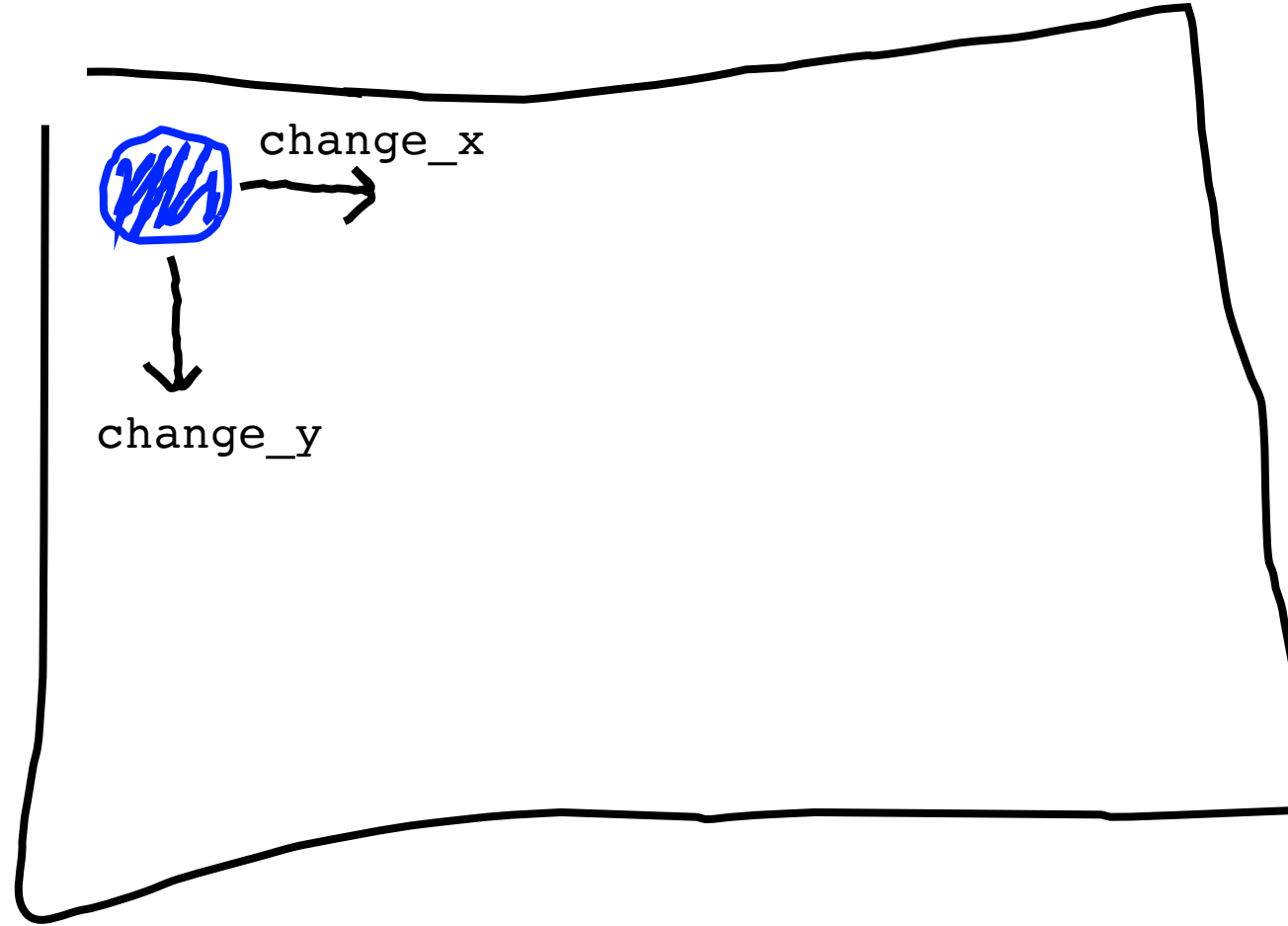
First heartbeat



Key variable: how much the ball position
change each heartbeat?

Bouncing Ball

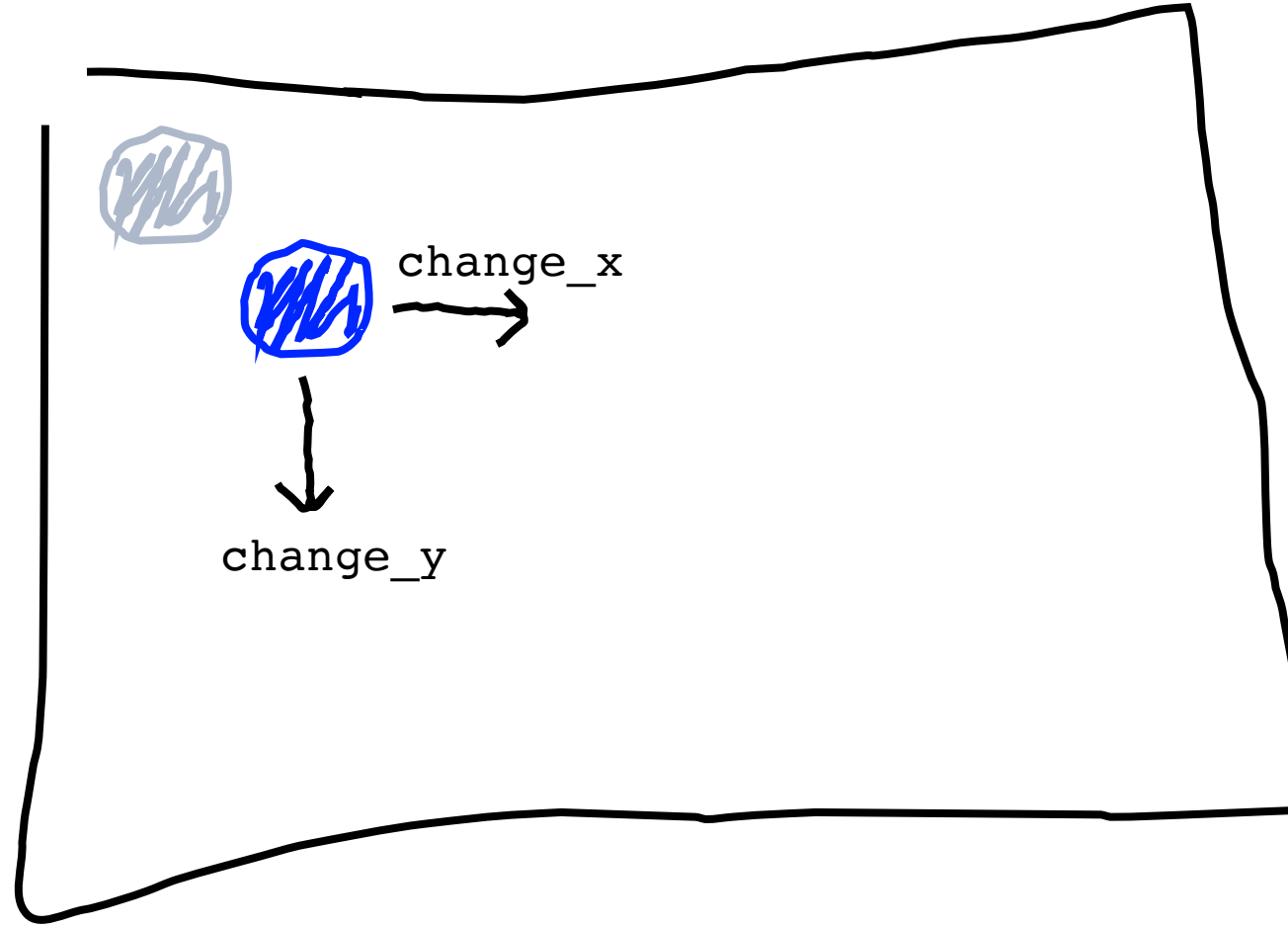
First heartbeat



The **move** function takes in
a change in x and a change in y

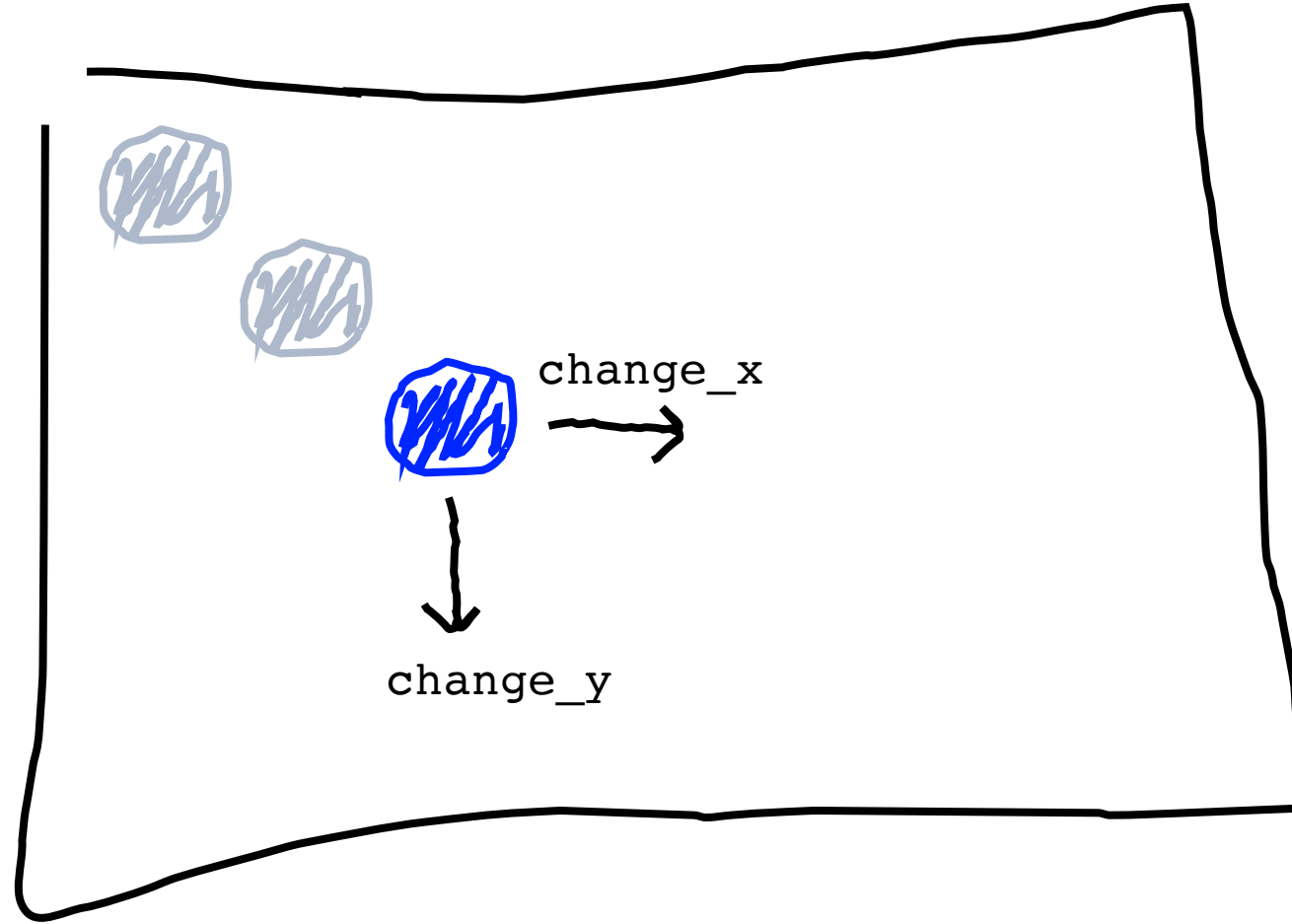
Bouncing Ball

Second heartbeat



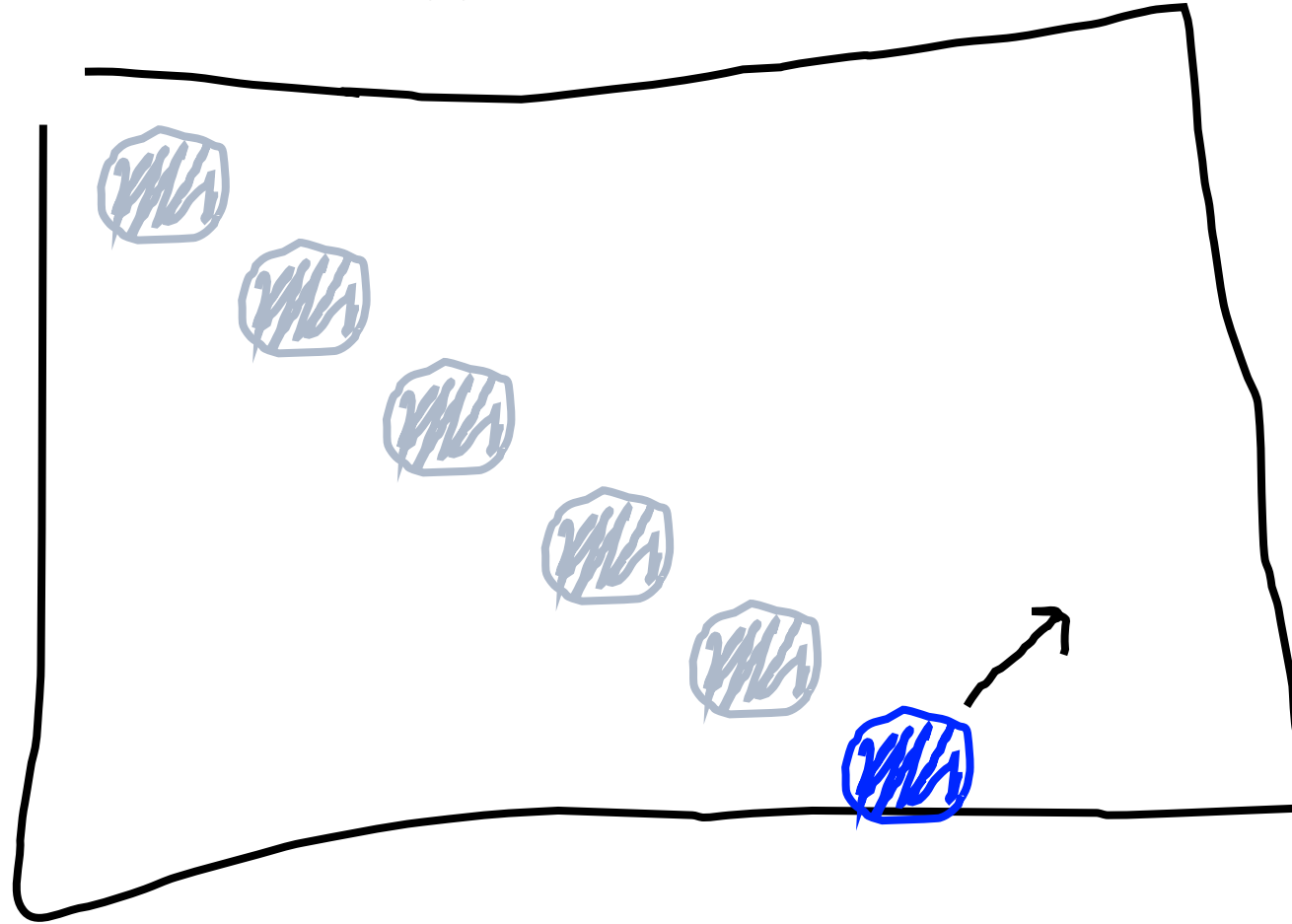
Bouncing Ball

Third heartbeat



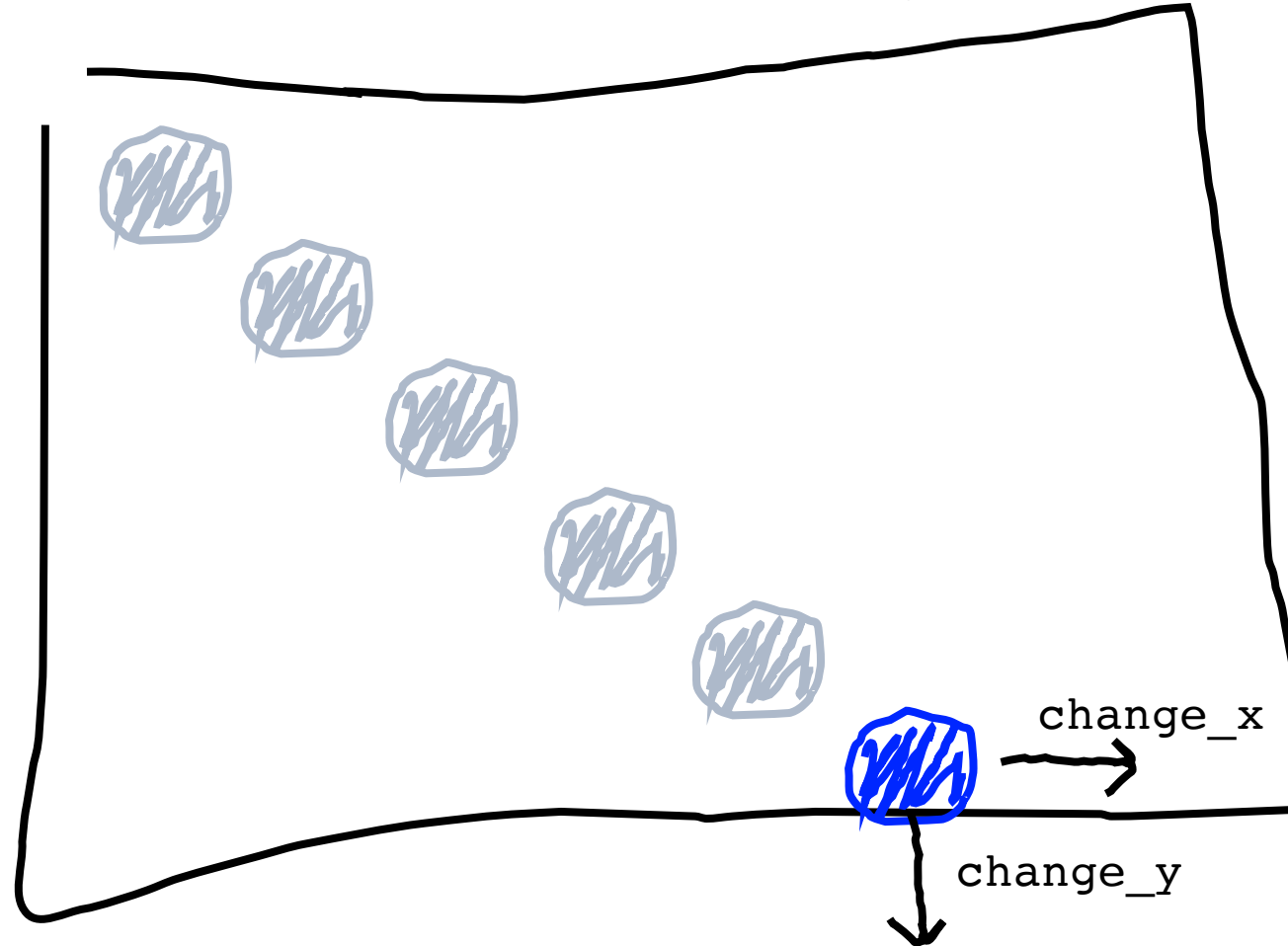
Bouncing Ball

What happens when we hit a wall?



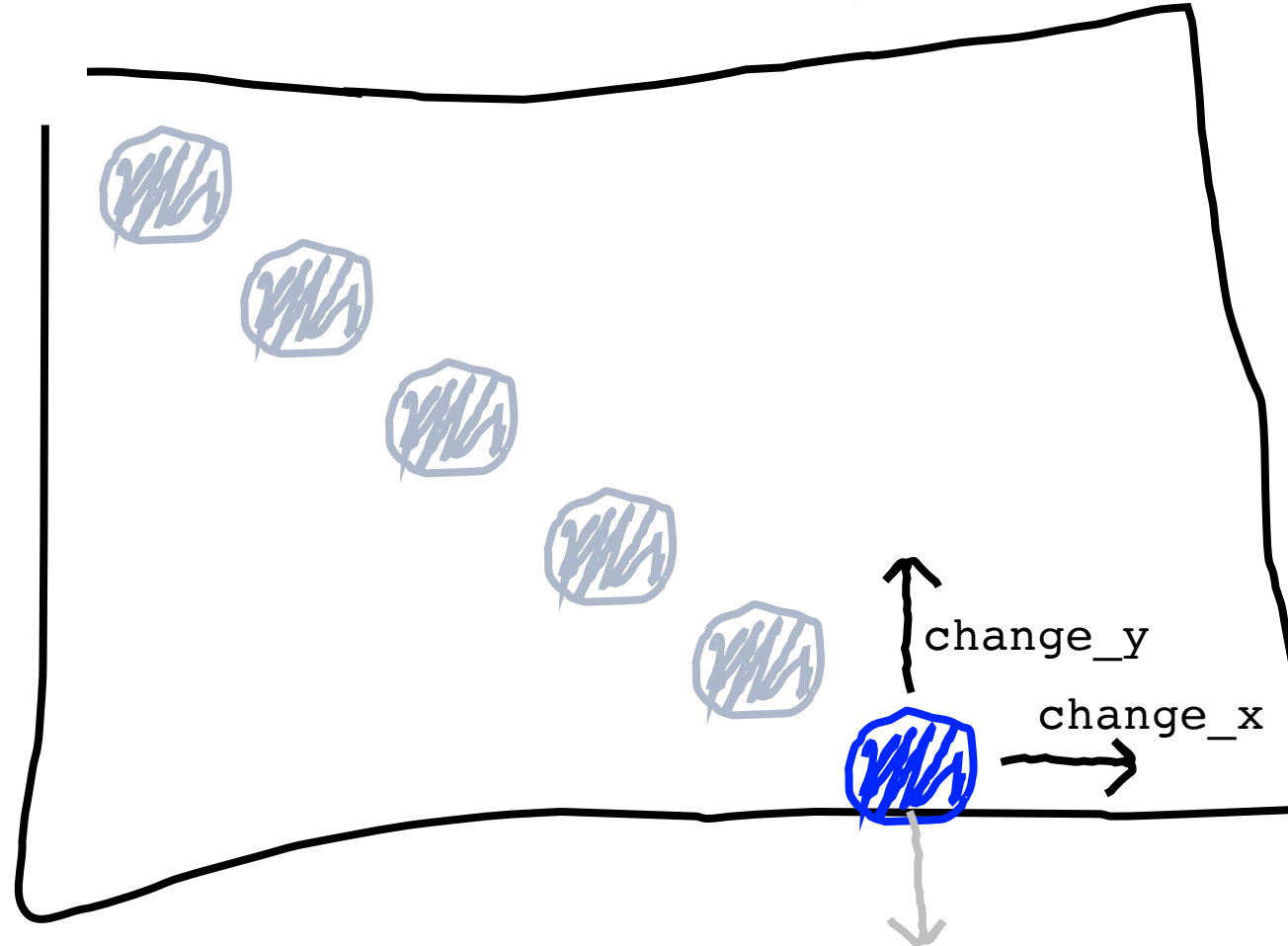
Bouncing Ball

We have this velocity



Bouncing Ball

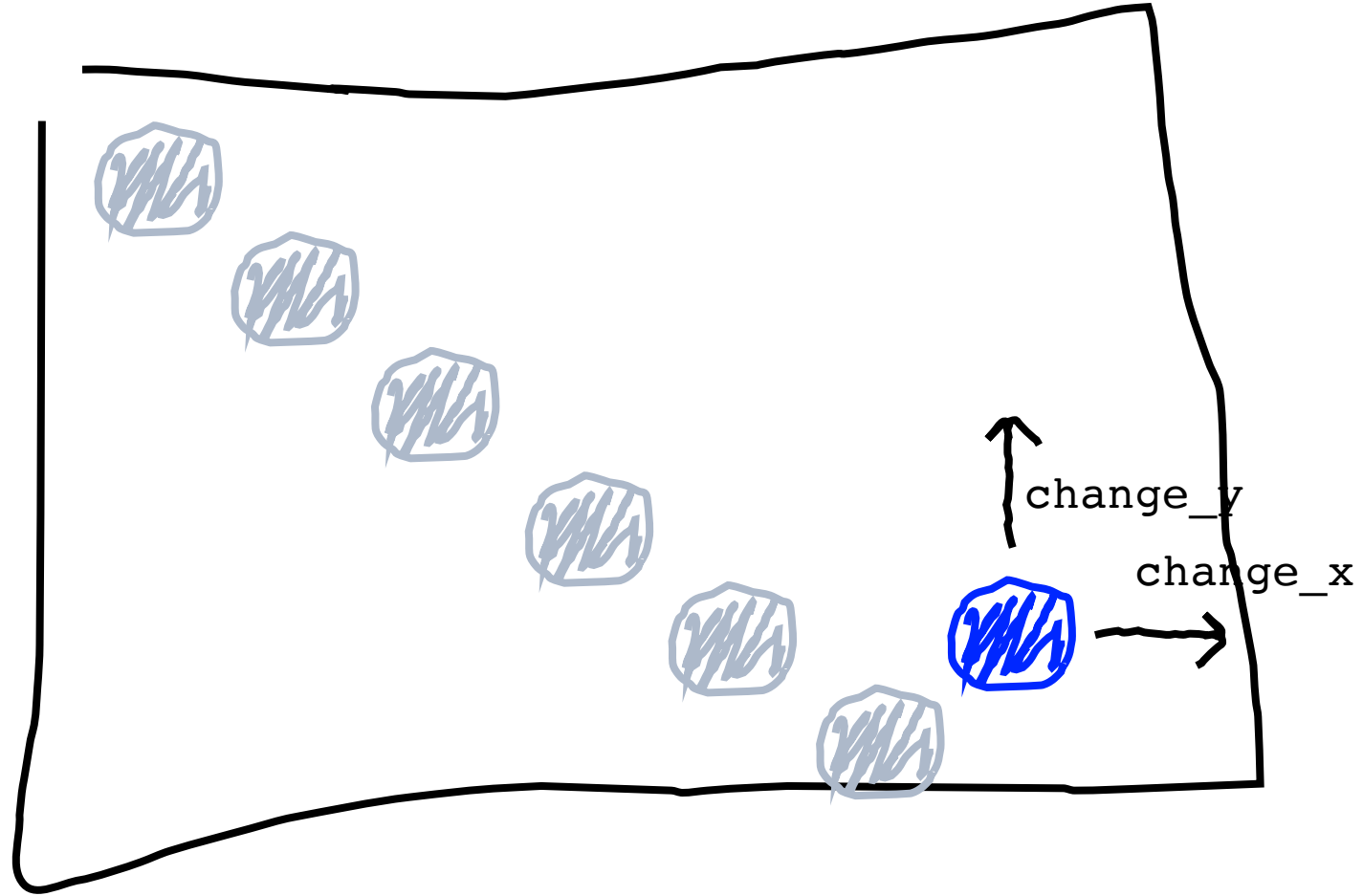
Our new velocity



When reflecting vertically: $\text{change_y} = -\text{change_y}$

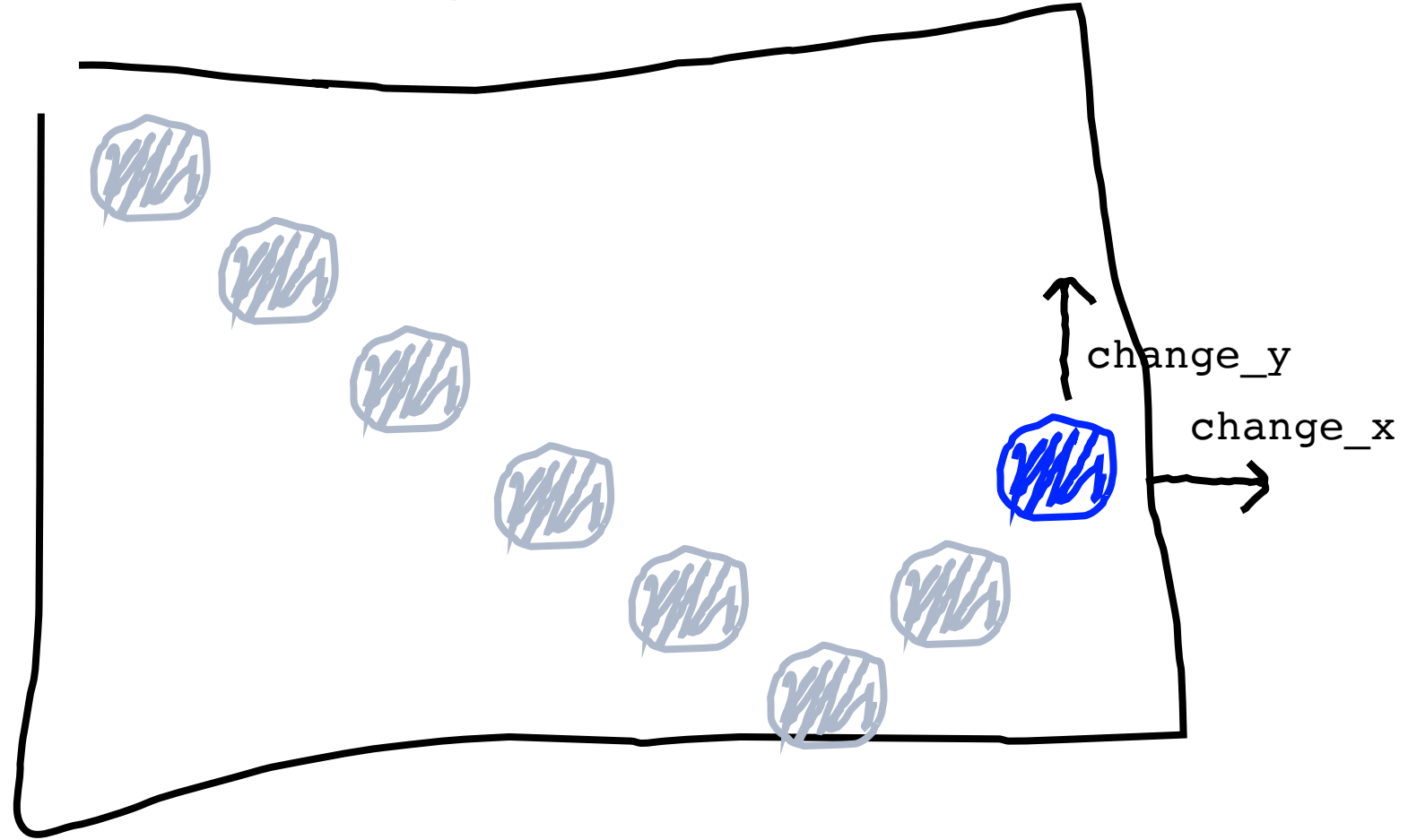
Bouncing Ball

Seventh heartbeat



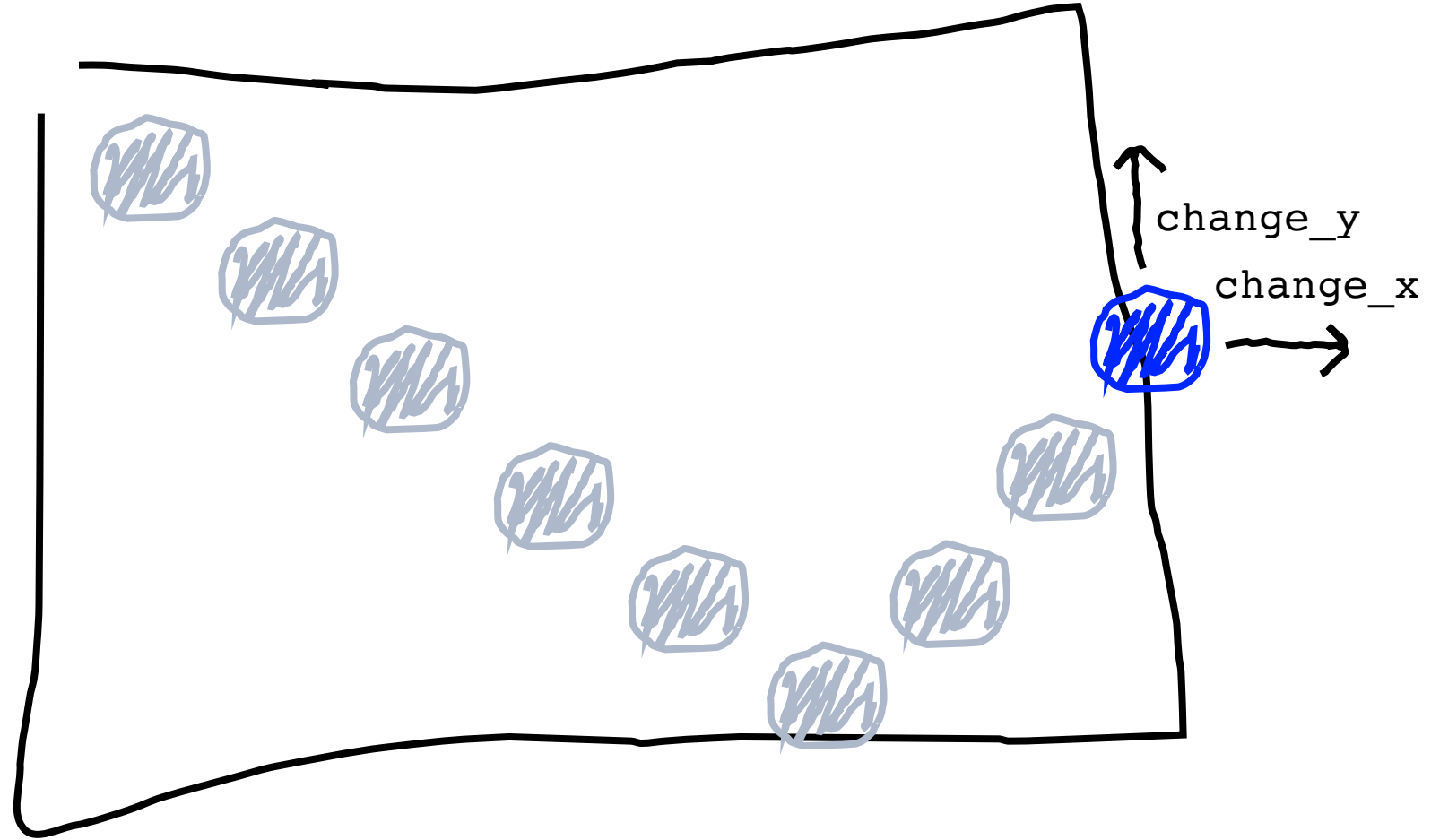
Bouncing Ball

Eighth heartbeat



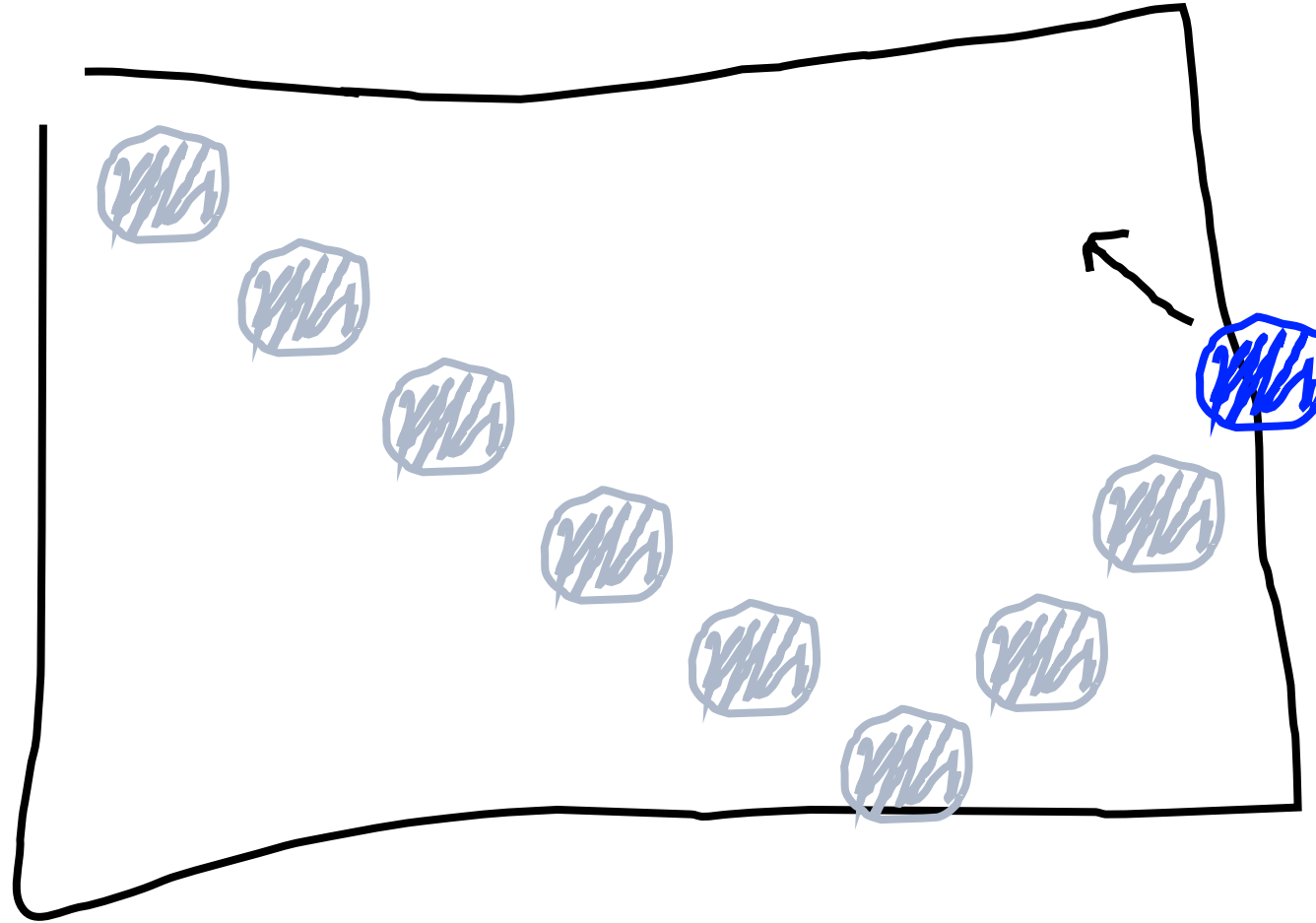
Bouncing Ball

Ninth heartbeat



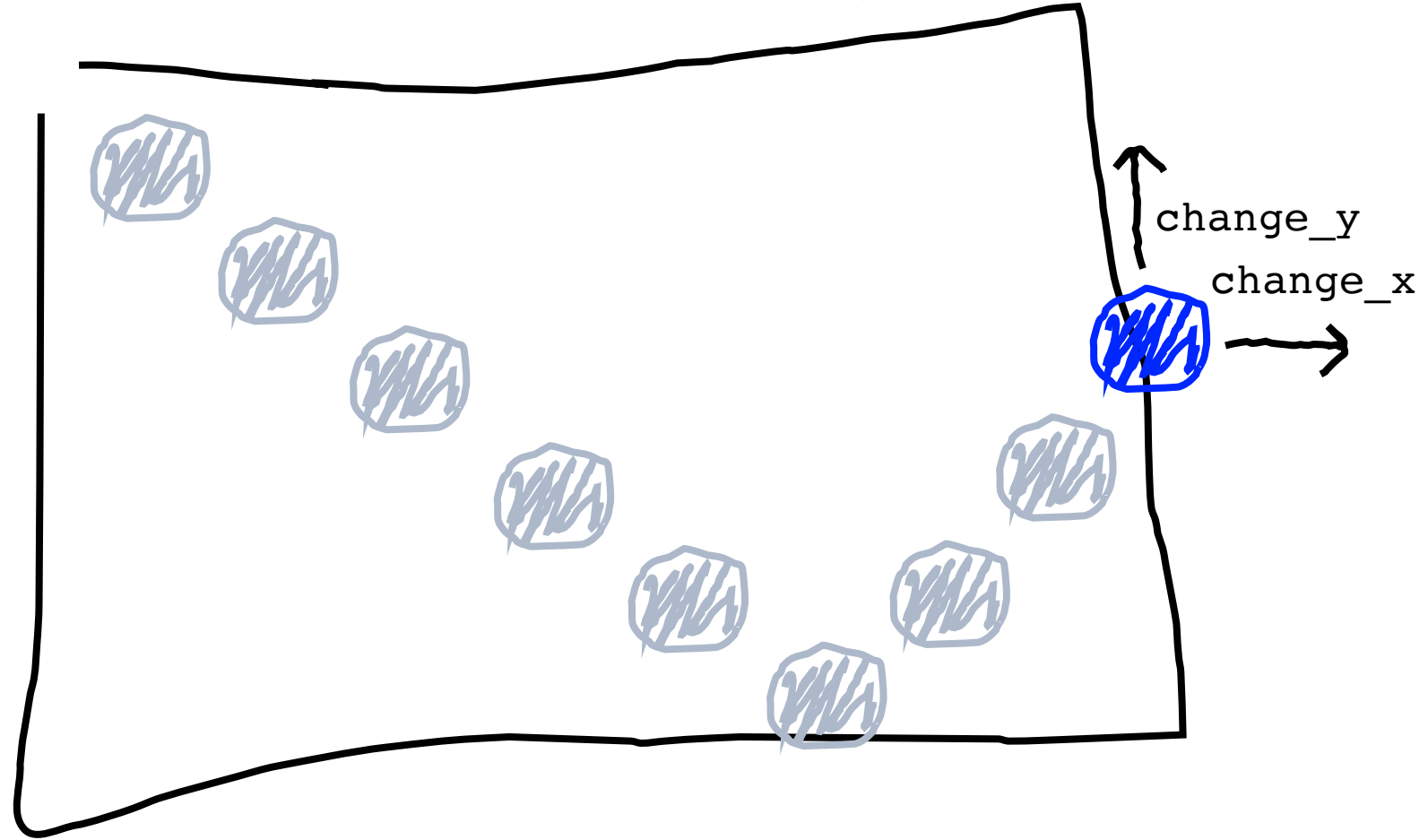
Bouncing Ball

We want this!



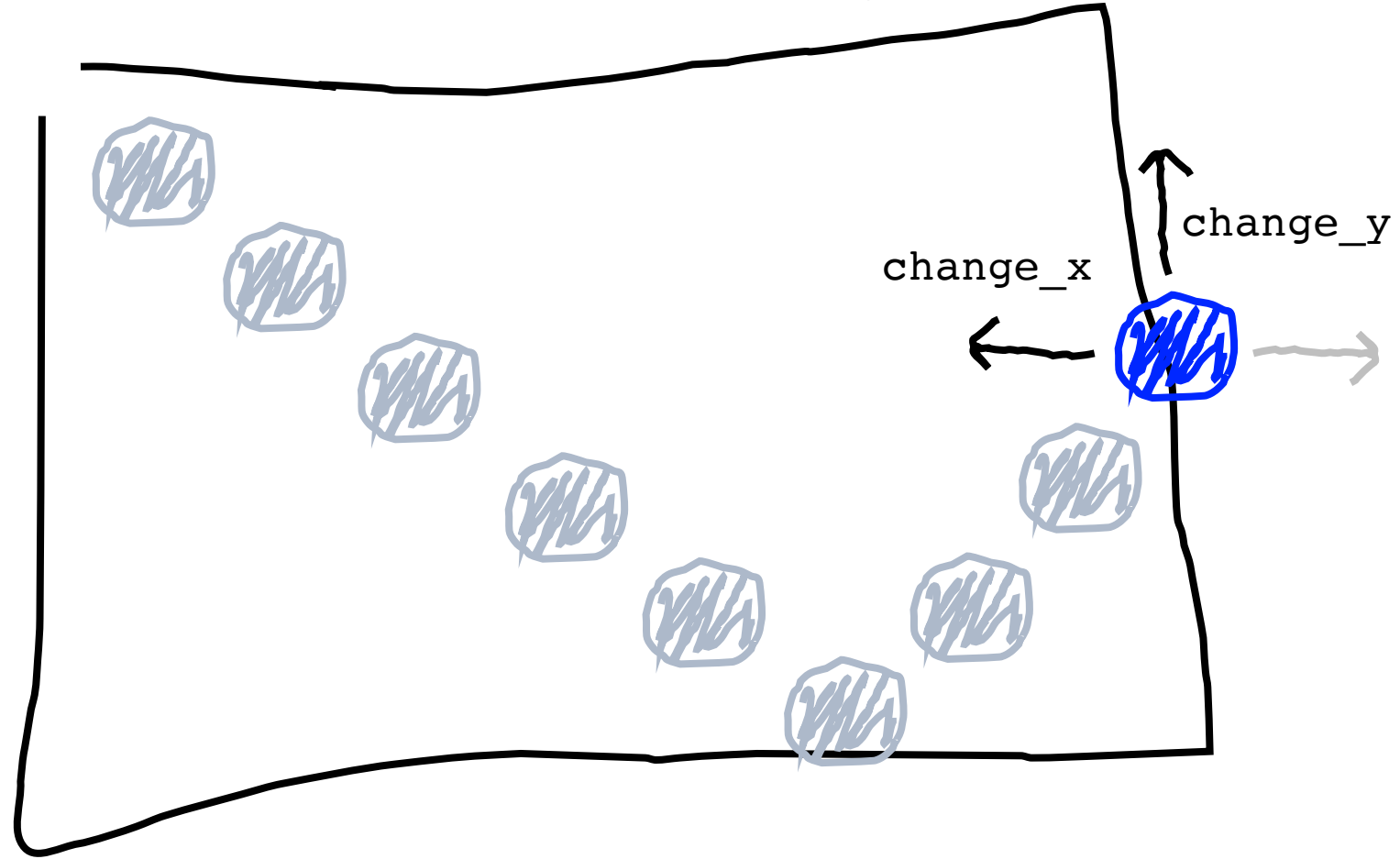
Bouncing Ball

This was our old velocity



Bouncing Ball

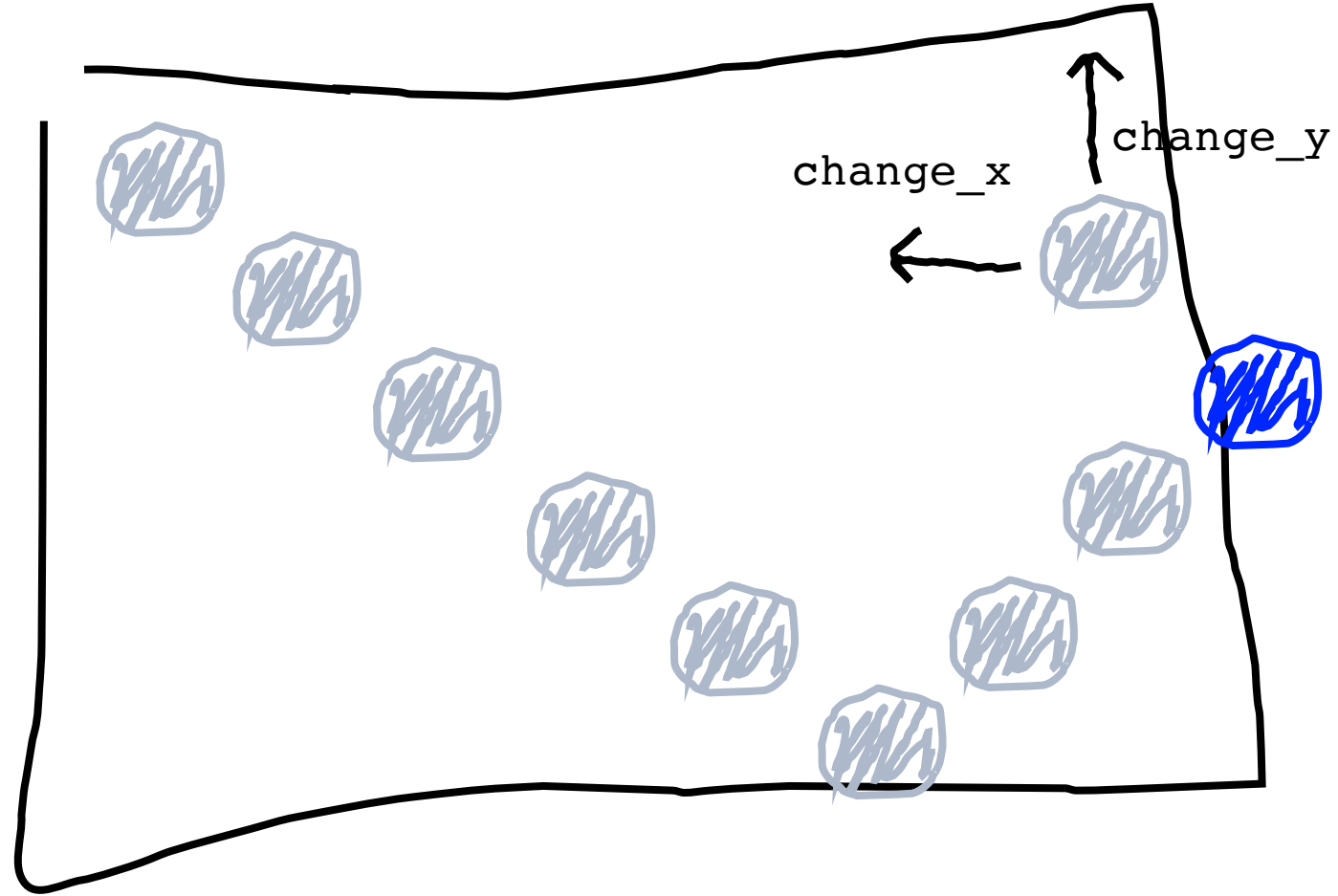
This is our new velocity



When reflecting horizontally: $\text{change_x} = -\text{change_x}$

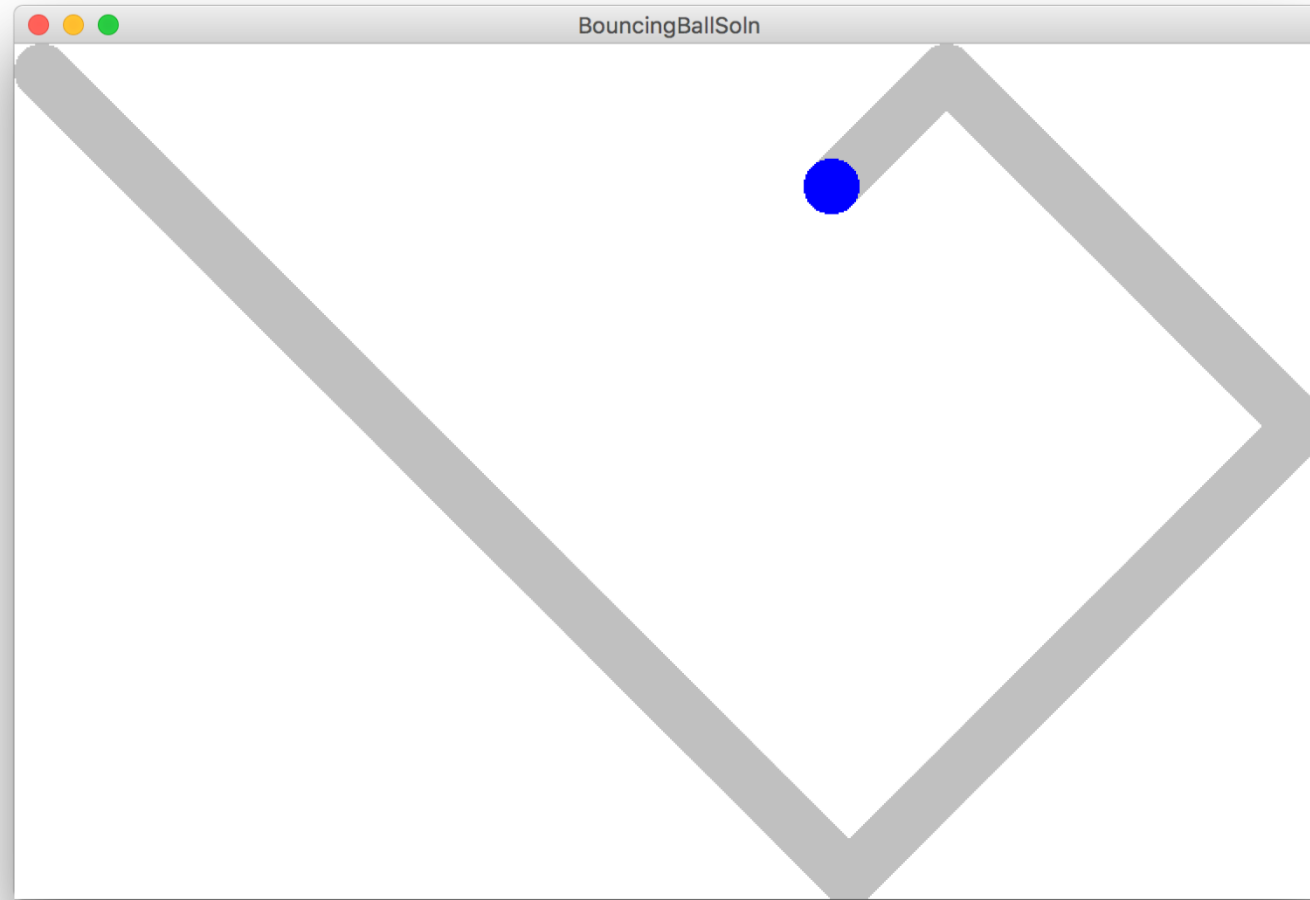
Bouncing Ball

Tenth heartbeat



When reflecting horizontally: $\text{change_x} = -\text{change_x}$

Bouncing Ball



Let's write some code!

Wait a minute....

```
def make_ball(canvas):
```

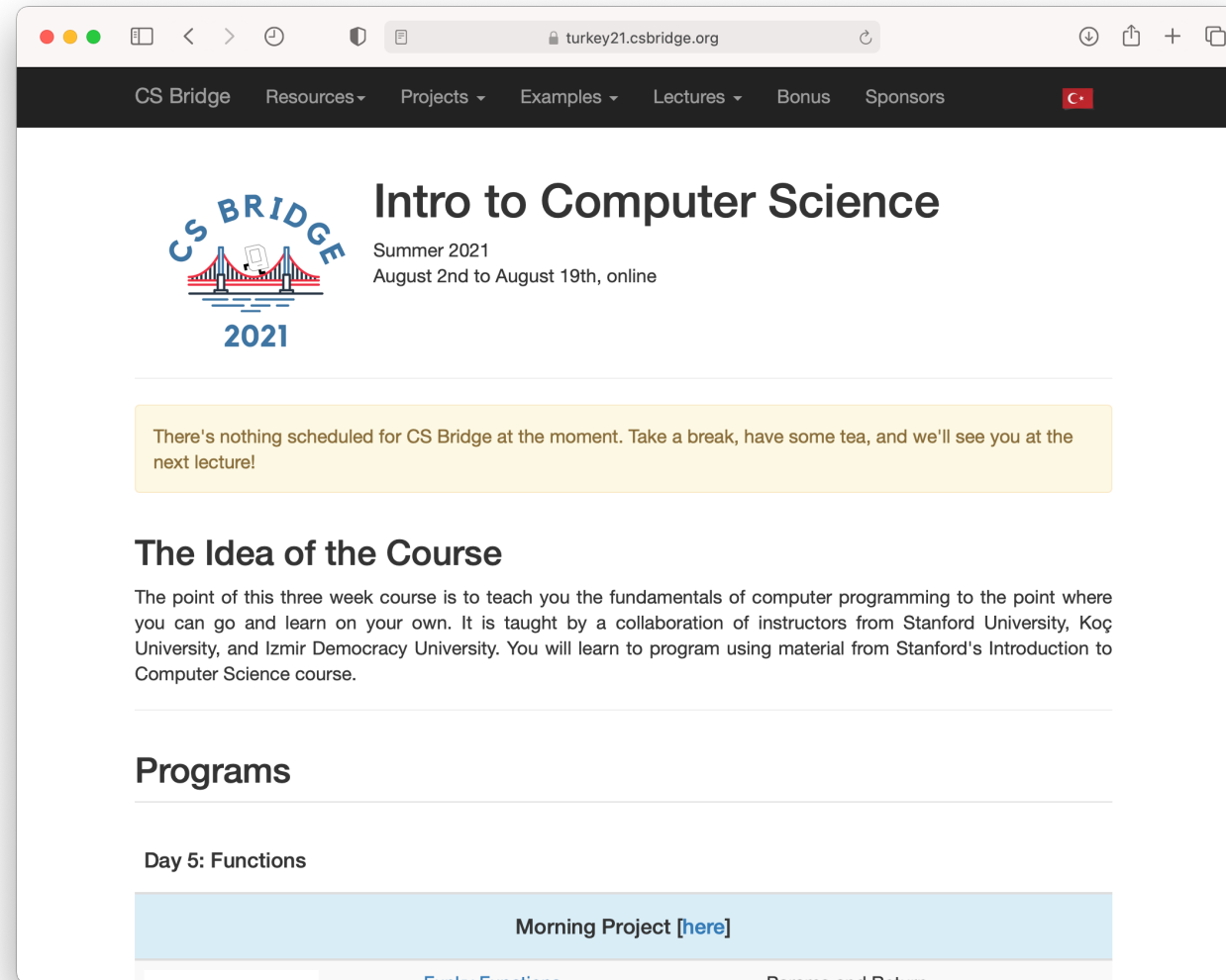
Does this copy the canvas??!!

*Variables are stored using a reference.
Which is like a **URL**. The URL gets copied
when you pass the variable*

Lecture Plan

- Review: Graphics
- Animation Loop Structure
- **Example:** Move To Center
- **Practice:** Bouncing Ball
- **Passing Parameters**

How do we share websites?



turkey21.csbridge.org

Passing Parameters

```
def main():  
    canvas = Canvas()  
    make_ball(canvas)  
  
def make_ball(canvas):  
    canvas.create_oval( ... )
```

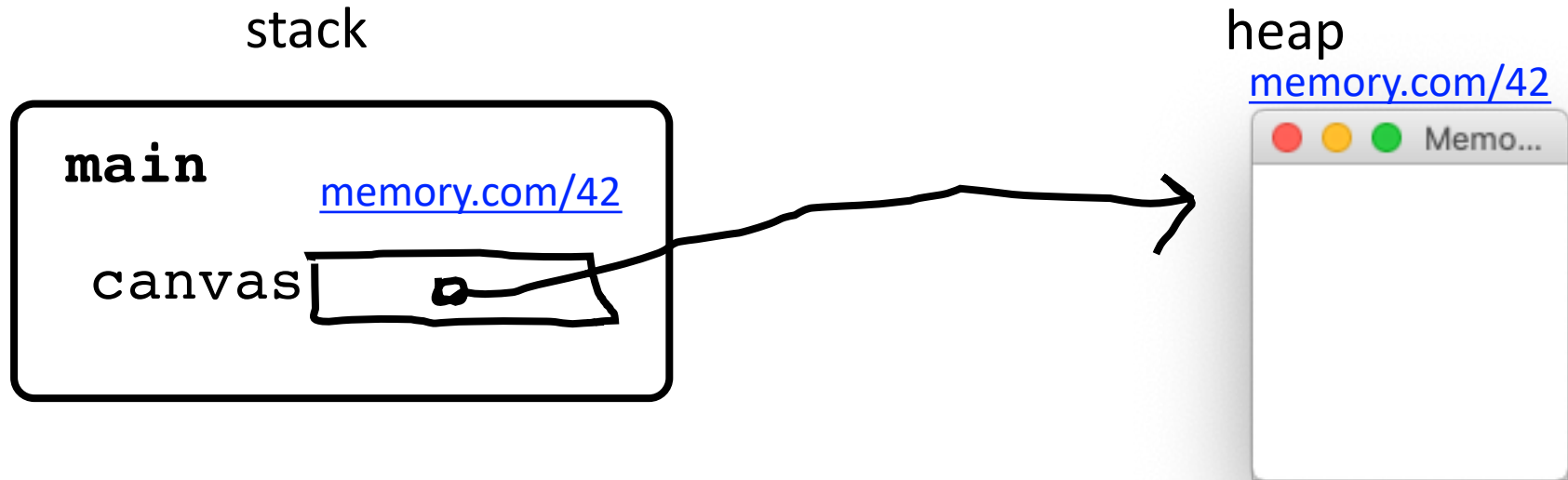
stack

heap

main

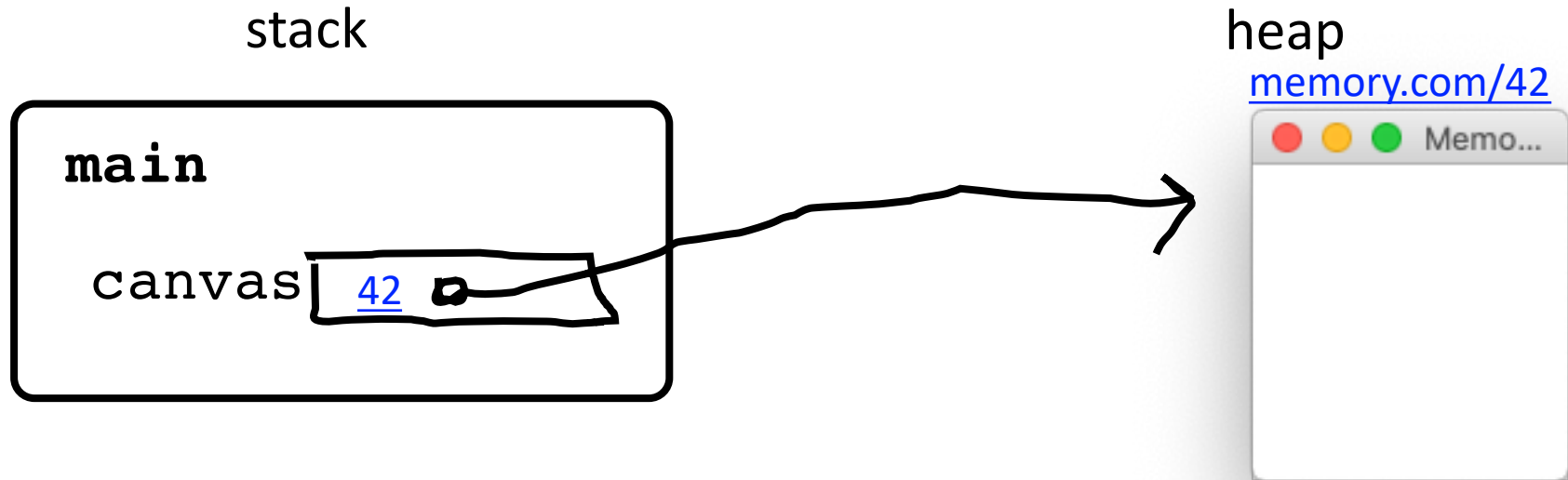
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Passing Parameters

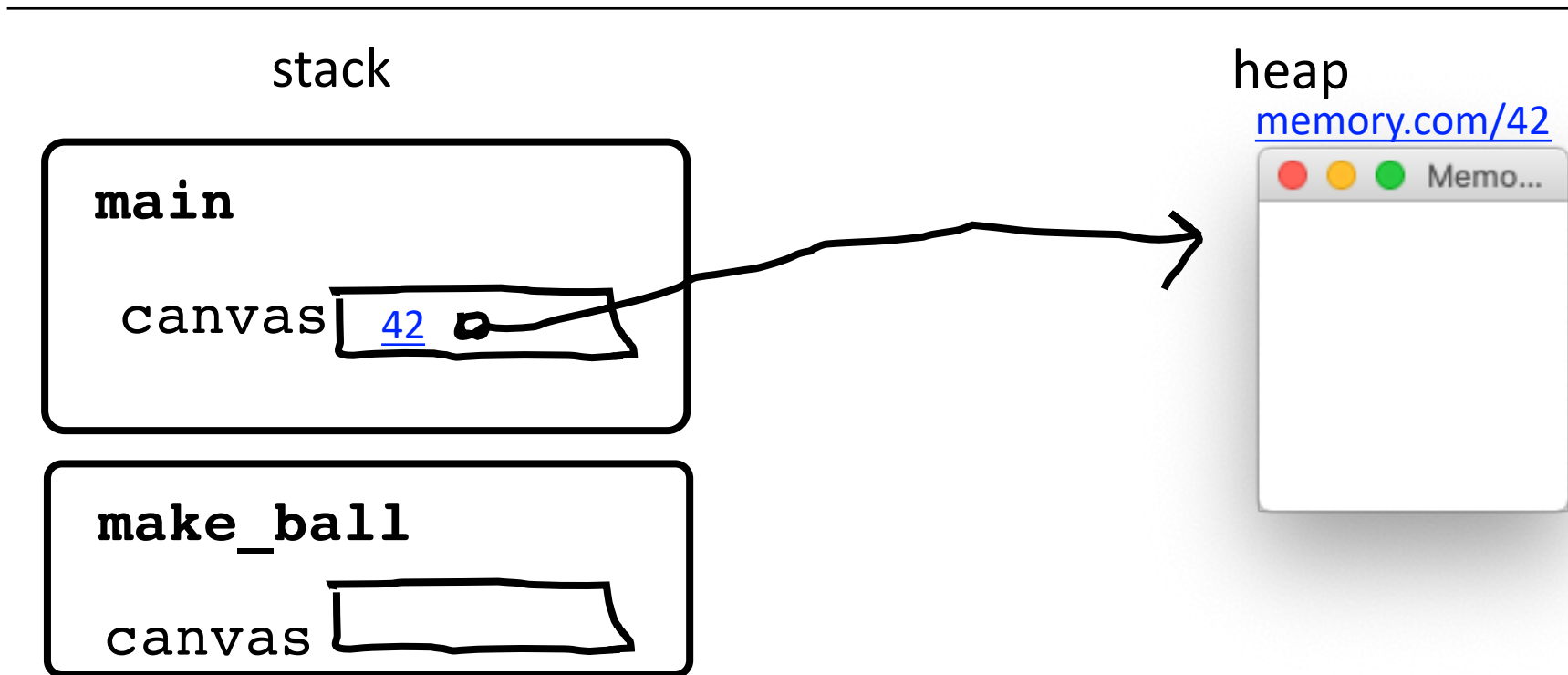
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Passing Parameters

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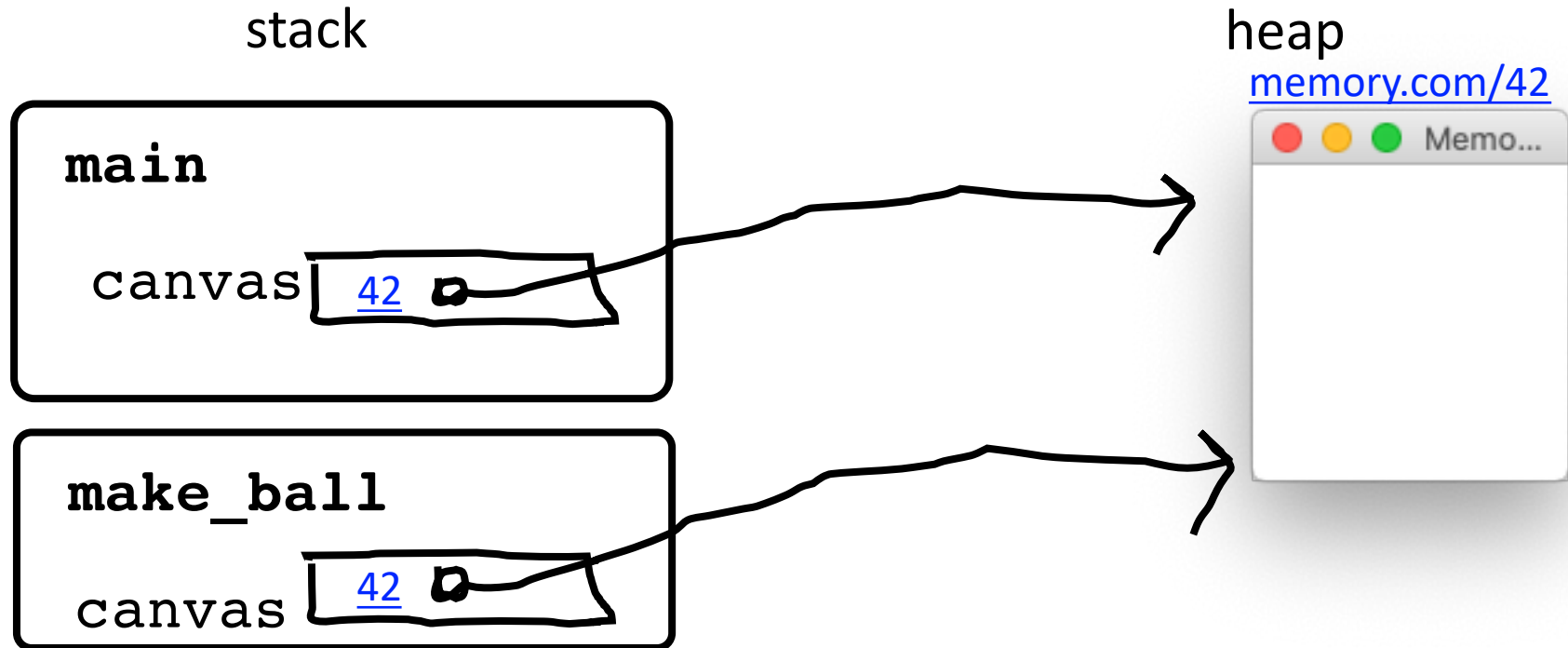
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def make_ball(canvas):  
    canvas.create_oval( ... )
```



Passing Parameters

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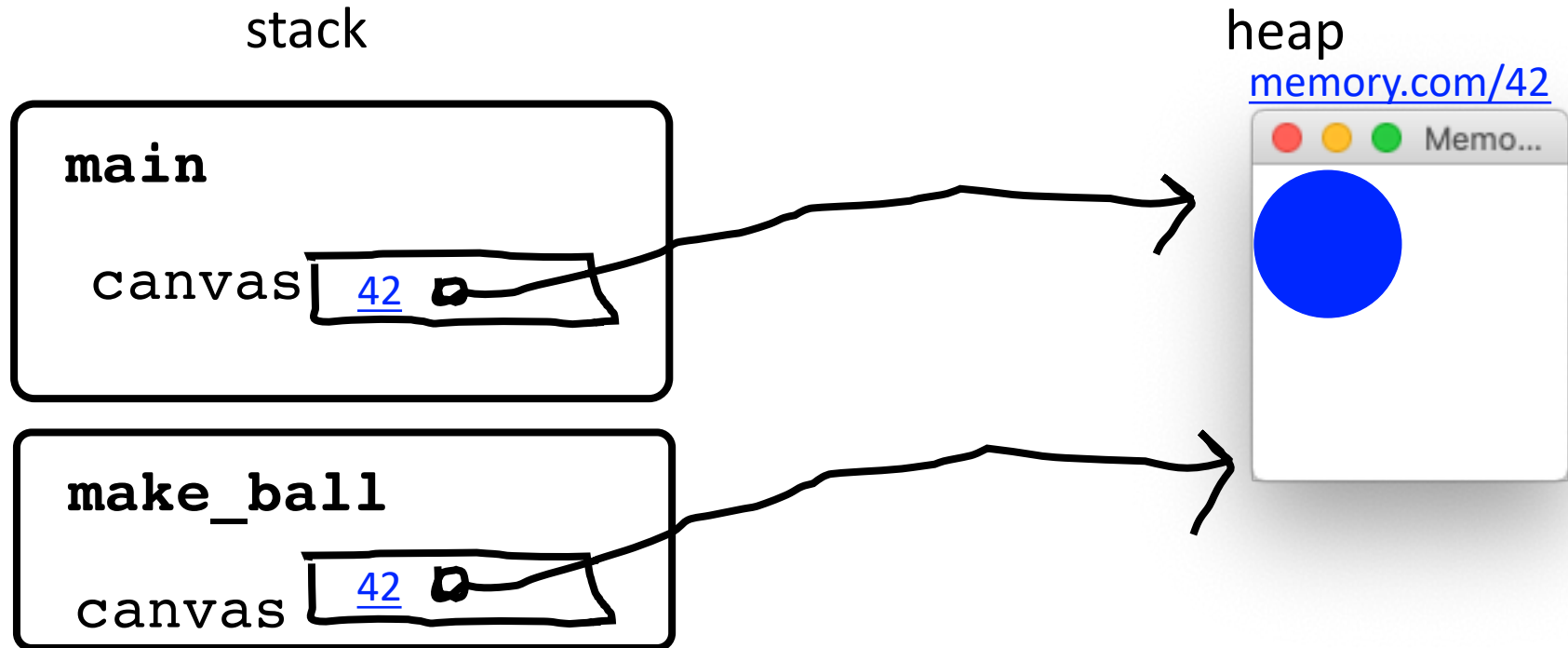
```
def make_ball(canvas):  
    canvas.create_oval( ... )
```



Passing Parameters

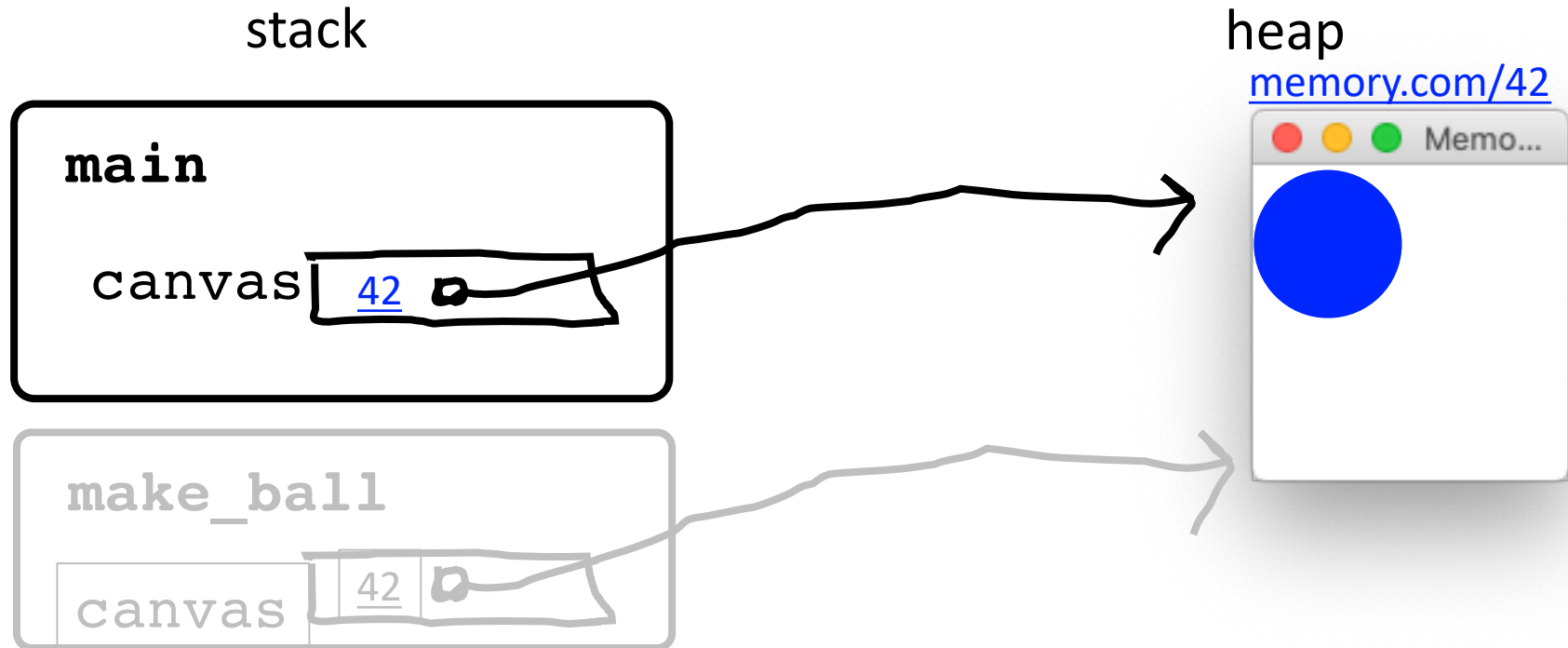
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    make_ball(canvas)
```

```
def make_ball(canvas):  
    canvas.create_oval( ... )
```



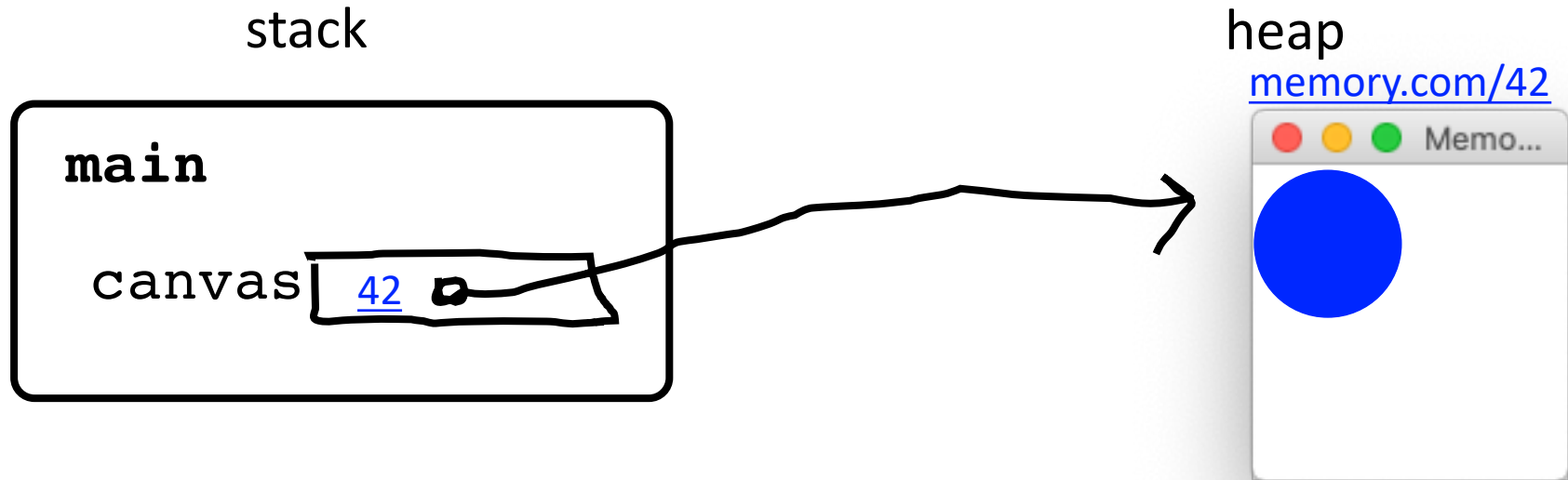
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Passing Parameters

```
def main():  
    canvas = Canvas()  
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Key Idea: Passing Parameters



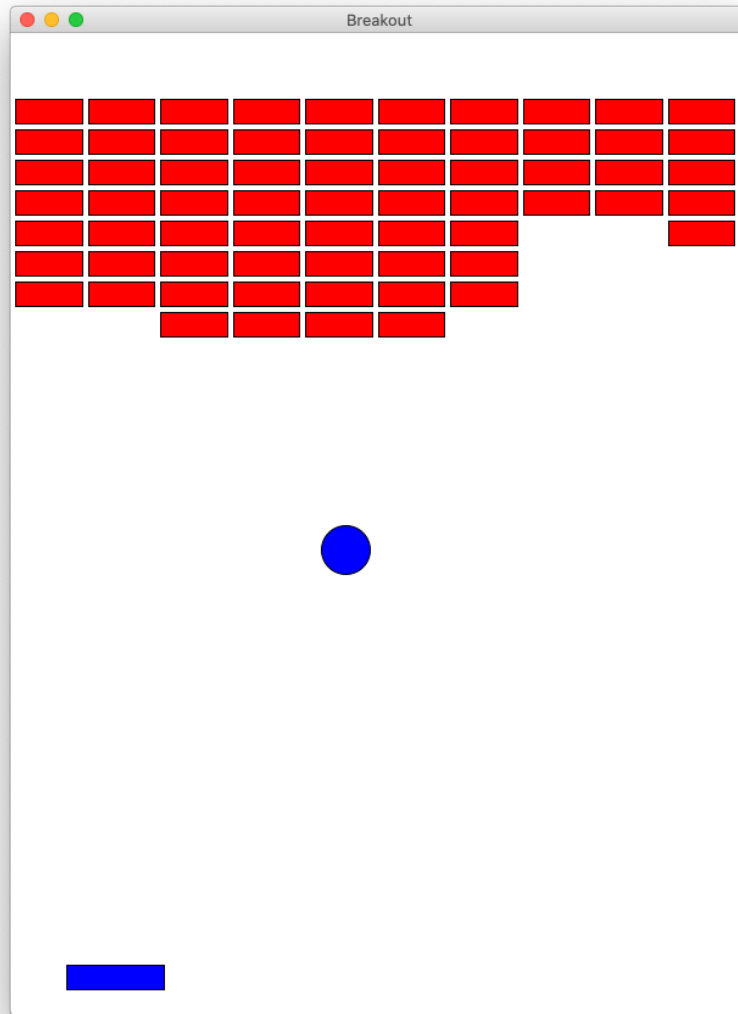
When passing variables,
some act just like you are
passing a URL.

That allows functions to
modify the variable

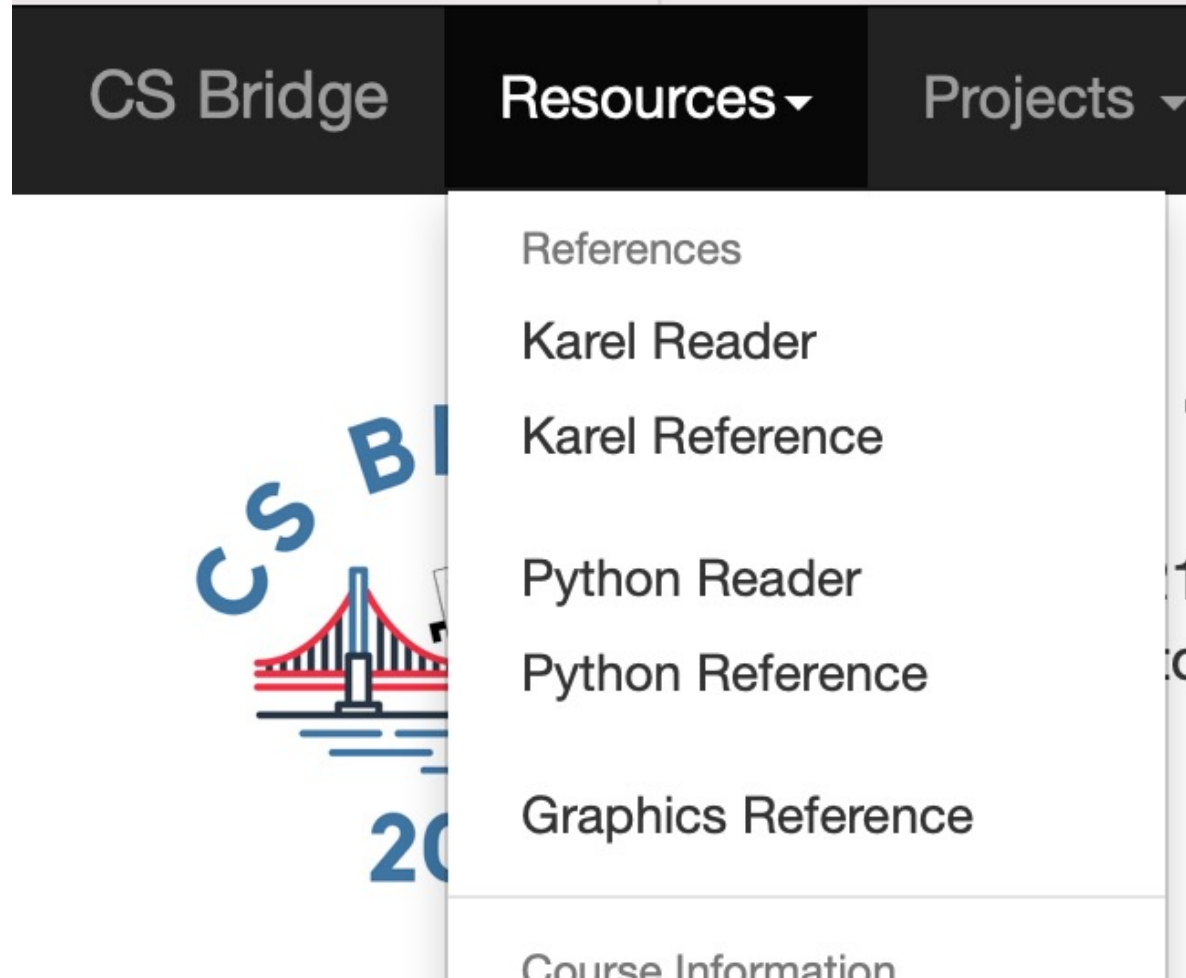
Lecture Plan

- **Review:** Graphics
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- **Example:** Move To Center
- **Practice:** Bouncing Ball
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Coming soon...

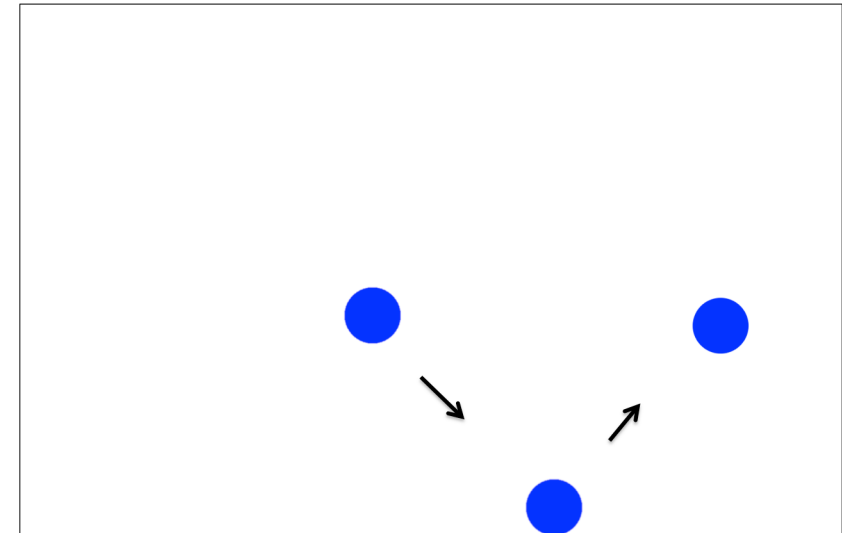
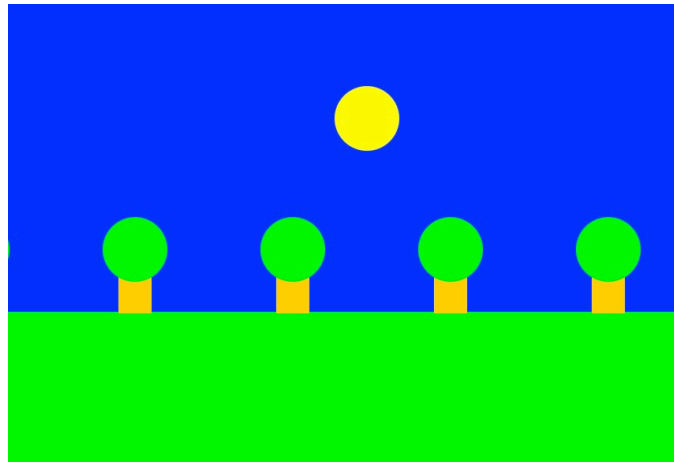
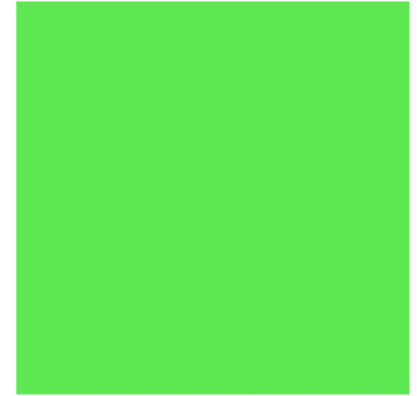


Graphics Resources



Rest Of Today

- **Quickstart:** Program a mystery square... (???)
- **Section:** Complete the implementation of the bouncing ball program
- **Project:** Use animation to create your own short film!



What's Next?

- Time for your section's quickstart time!
- Check your section's Ed group for more information