

Code in Place 2024

Stanford CS106A

Section - Week 5

Functions & Graphics

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Today's Agenda



1. Check-In

How are we all doing?



2. Concepts Review

Functions, Graphics



3. Practice Problem

"Draw Random Circles"



Check-In

How are you all doing?
Hopefully your fourth week of CIP went well!

- What is something you've found most fun and/or challenging in CIP so far?

Concepts Review

Functions: Passing Data



Arguments & Parameters

- Pass data from a calling function to a helper function.

`return` statement

- Return data from helper function to calling function.

```
def main():  
    mid = average(7.2, 31.5)    # Function call.  Parameters: 7.2, 31.5  
    print(mid)  
  
def average(a, b):             # Function definition.  Arguments: a, b  
    sum = a + b  
    return sum / 2             # Ends the function and gives back a value.
```

Functions: Variable Scope



Variable scope

- When you define a variable within a function, it will have **local scope** (its scope lies ONLY within the function).
 - These types of variables are called **local variables**.
- Local variables exist only for as long as the function is running.
- Local variables cannot be changed or accessed from outside the function.

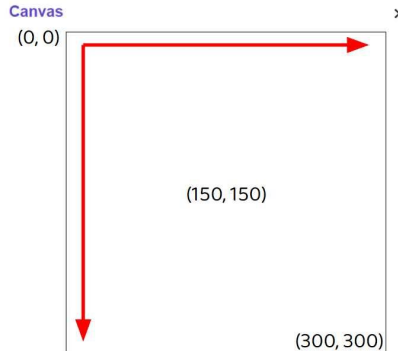
```
def greet():  
    message = "Hello"      # Local variable within the greet() function.  
    print(message)         # Print the local variable.  
  
def main():  
    print(message)         # Error! The variable message does not exist!
```

Graphics: Canvas



- We'll use Python's "Tkinter" package to draw on a **Canvas**.
 - Pixels start at position (0, 0) on the top-left corner.
 - x increases going right, y increases going down.

```
CANVAS_WIDTH = 300
CANVAS_HEIGHT = 300
def main():
    canvas = Canvas(CANVAS_WIDTH, CANVAS_HEIGHT)
```



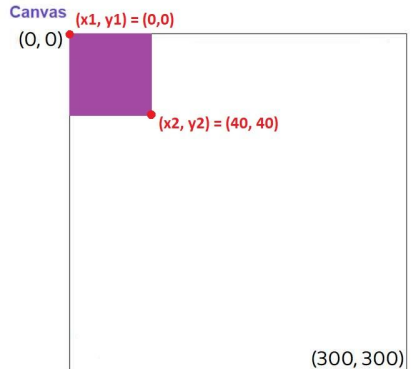
(Image source: Cameron Mohne)

Graphics: Draw Rectangle



- `canvas.create_rectangle(x1, y1, x2, y2, color)`
 - `(x1, y1)` = top-left corner
 - `(x2, y2)` = bottom-right corner

```
def main():  
    canvas = Canvas(300, 300)  
    canvas.create_rectangle(0, 0, 40, 40, "purple")
```



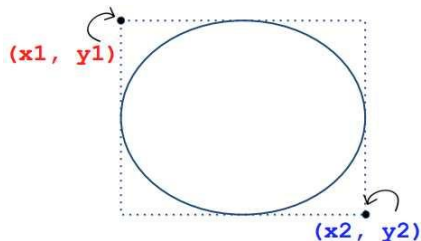
Graphics: More Shapes



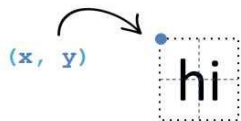
- `canvas.create_line(x1, y1, x2, y2, color)`



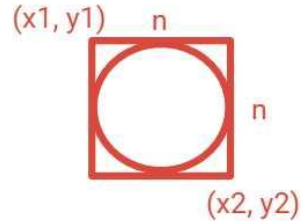
- `canvas.create_oval(x1, y1, x2, y2, color)`



- `canvas.create_text(x, y, text = "hi")`



How to Draw a Square or Circle?

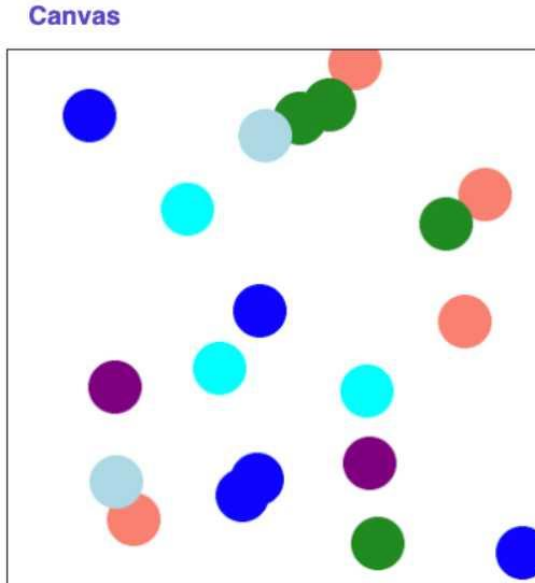


- Let's say you know the following:
 - Top-left corner has coordinates $(x1, y1)$
 - The side of the square has length n
 - n is also the diameter of the inscribed circle.
- How do you derive the bottom-right coordinate?
 - $x2 = x1 + n$
 - $y2 = y1 + n$
- `canvas.create_rectangle(x1, y1, x2, y2, color)`
- `canvas.create_oval(x1, y1, x2, y2, color)`

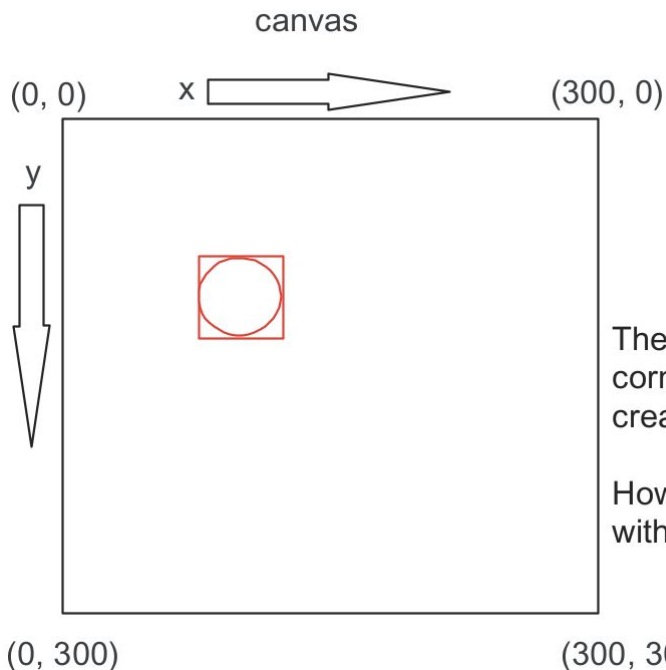
Section Exercise: “Draw Random Circles”



Draw 20 circles at random positions with random colors.



Section Exercise: “Draw Random Circles”



```
(x1, y1)          width = CIRCLE_SIZE
(x2, y2)          height = CIRCLE_SIZE

x1 = random.randint(0, CANVAS_WIDTH)
y1 = random.randint(0, CANVAS_HEIGHT)

canvas.create_oval(x1, y1, x2, y2, "red")
canvas.create_oval(x1, y1, x1 + CIRCLE_SIZE, y1 + CIRCLE_SIZE, "red")
```

The code above will randomly generate the top-left corner coordinates of a circle (x1, y1) and use them to create a circle on the canvas.

How do we ensure that the circle is always created with its entire body inside the canvas borders?

```
x1 = random.randint(0, CANVAS_WIDTH - CIRCLE_SIZE)
y1 = random.randint(0, CANVAS_HEIGHT - CIRCLE_SIZE)
```