Graphical User Interface

Adopted from Stanford Uni's CS106ap course slides by Kylie Jue and Sonja Johnson-Yu

Today's questions

How can we create graphical programs?

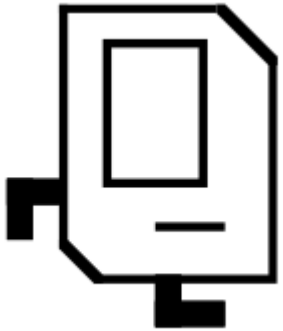
Today's topics

1. Review
2. Graphics

Review

Meet Karel the Robot!

Karel Knows 4 Commands



```
move
turn_left
put_beeper
pick_beeper
```

"functions"

For Loops

Instead, use a **for** loop:

```
for i in range(count):
    statement
    statement
    ...
```

Repeats the statements in the body ***count*** times.

Control Flow: While Loops

```
while condition:
   statement
   statement
   ...
```

Repeats the statements in the body until ***condition*** is no longer true.

Each time, Karel executes *all statements*, and **then** checks the condition.

Possible Questions

```
front_is_clear()        front_is_blocked()
beepers_present()       no_beepers_present()
beepers_in_bag()        no_beepers_in_bag()
left_is_clear()         left_is_blocked()
right_is_clear()        right_is_blocked()
facing_north()          not_facing_north()
facing_south()          not_facing_south()
facing_east()           not_facing_east()
facing_west()           not_facing_west()
```

This is taken from the Karel Reference.

If/Else Statements

What if we want to do one thing if some condition is true, and another otherwise? We can add an **else** statement:

```
if condition:
     statement
     statement
     ...
elif condition:
     statement
     statement
else:
     statement
     statement
     ...
```

Top-Down Design - Decomposition

- Start from a large task and break it up into smaller pieces
- Ok to write your program in terms of commands that don’t exist yet
- **Goal**: make our programs easily readable by humans
  - Commenting
  - Decomposition
- E.g. Going to the moon

Using Python

- **Python must be installed and configured prior to use**
  - One of the items installed is the Python interpreter
- **Python interpreter can be used in two modes:**
  - Interactive mode: enter statements on keyboard
  - Script mode: save statements in Python script

Create, Modify, Use

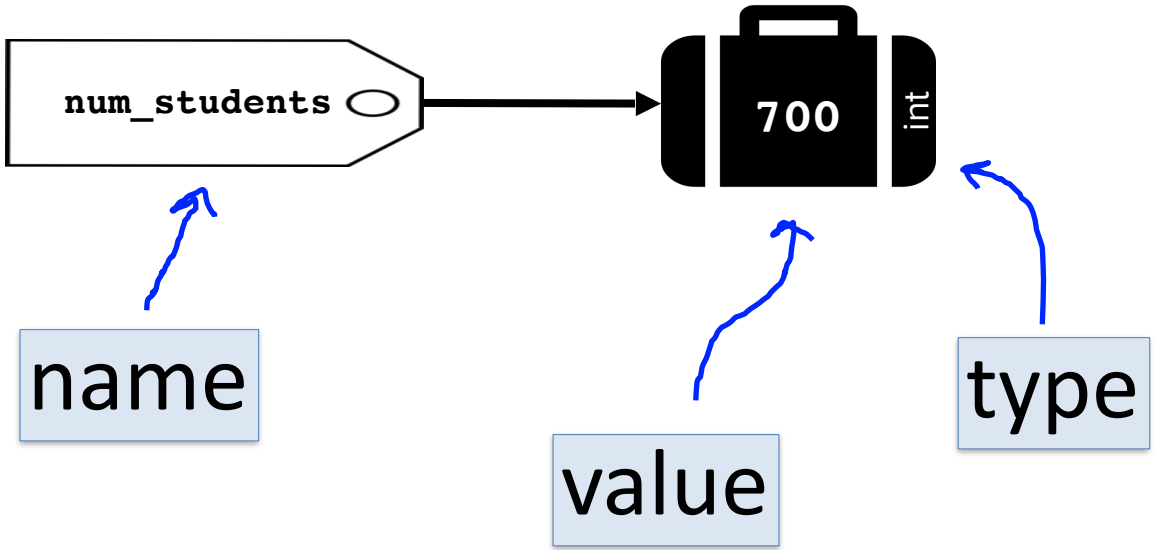
```
# Create a variable, of type int
# called age with the value 30.
age = int(input('What is your age: '))

# Modify age to be one greater.
age = age + 1

# Use the value in age (output it)
print("age is: " + age)
```

Variable Analogy

```
num_students = 700
```



`input` function

```
num1 = input("Enter first number: ")
```

- **`input`** command gets text input from the user
- Prints text specified in double/single quotes
  - Then waits for user input
  - Here, user input from **`input`** is put in a **variable** (**`num1`**)
  - The user input is considered text, even if user entered a number

Types

All Python objects have a type!

- Integers - numbers with no decimals

```
num_flowers = 5
```

- Floats - numbers with decimals

```
fraction = 0.2
```

- Booleans - true or false

```
is_raining_today = True
```

- Strings - collection of characters

```
myName = 'Ayca'
```

Binary Operators

+	Addition	*	Multiplication
–	Subtraction	/	Division

There are others too!

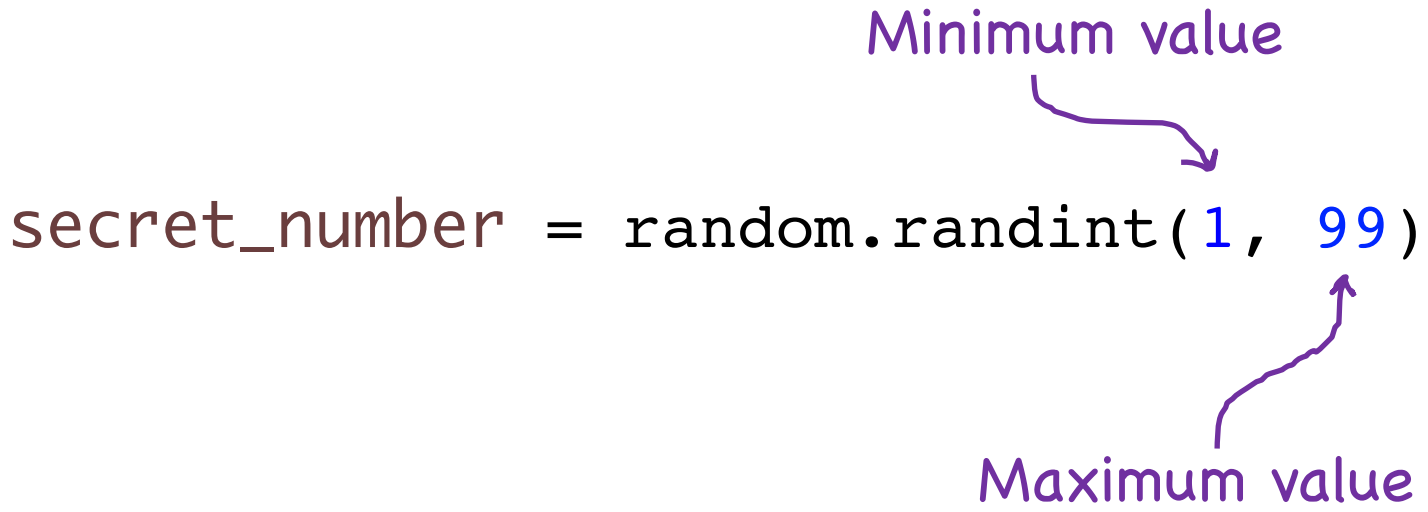
%	Remainder	//	Int Division
**	Exponentiation		

Comparison Operators

Operator	Meaning	Example	Value
==	equals	`1 + 1 == 2`	`True`
!=	does not equal	`3.2 != 2.5`	`True`
<	less than	`10 < 5`	`False`
>	greater than	`10 > 5`	`True`
<=	less than or equal to	`126 <= 100`	`False`
>=	greater than or equal to	`5.0 >= 5.0`	`True`

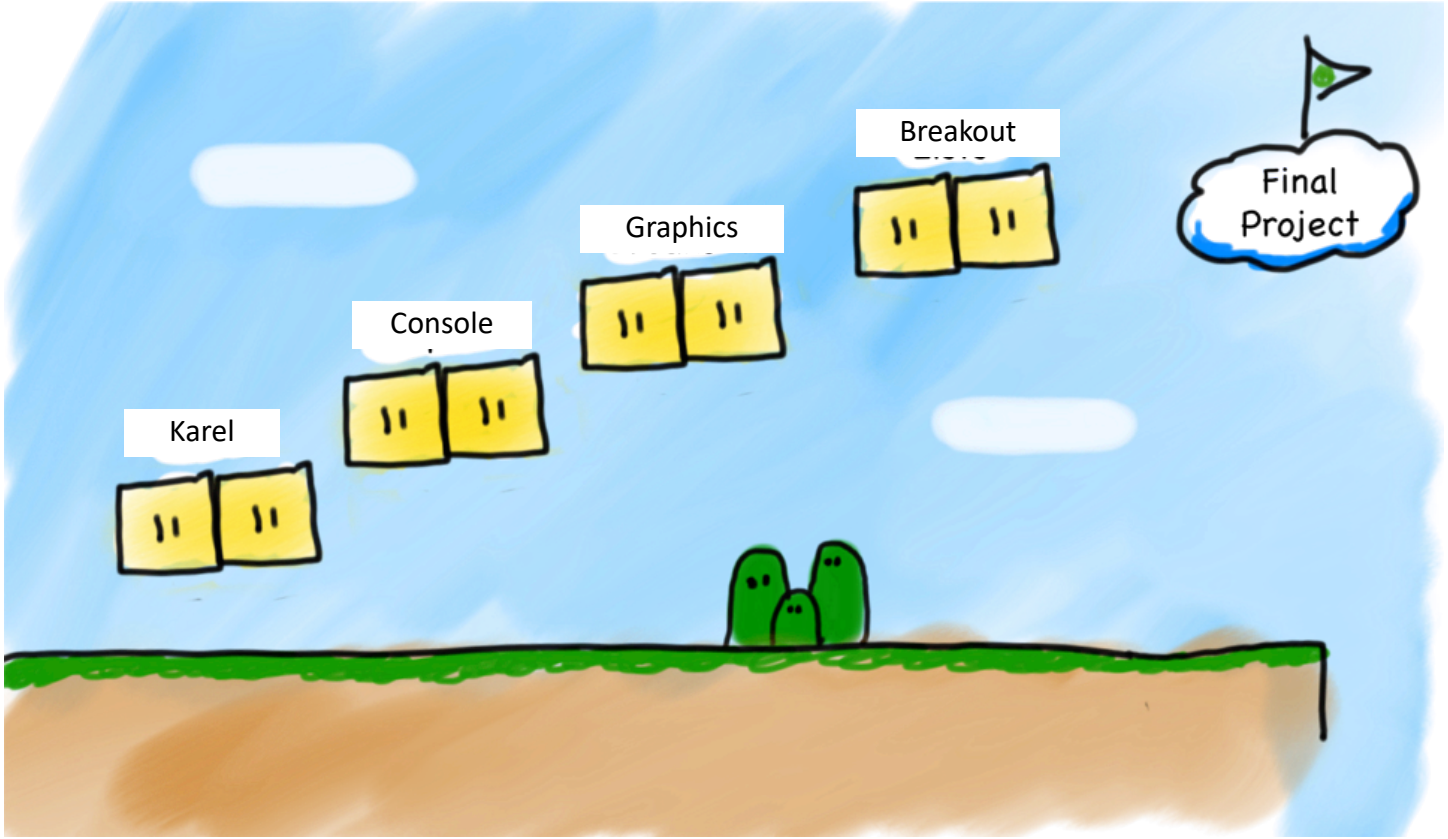
* All have equal precedence

Random Integers

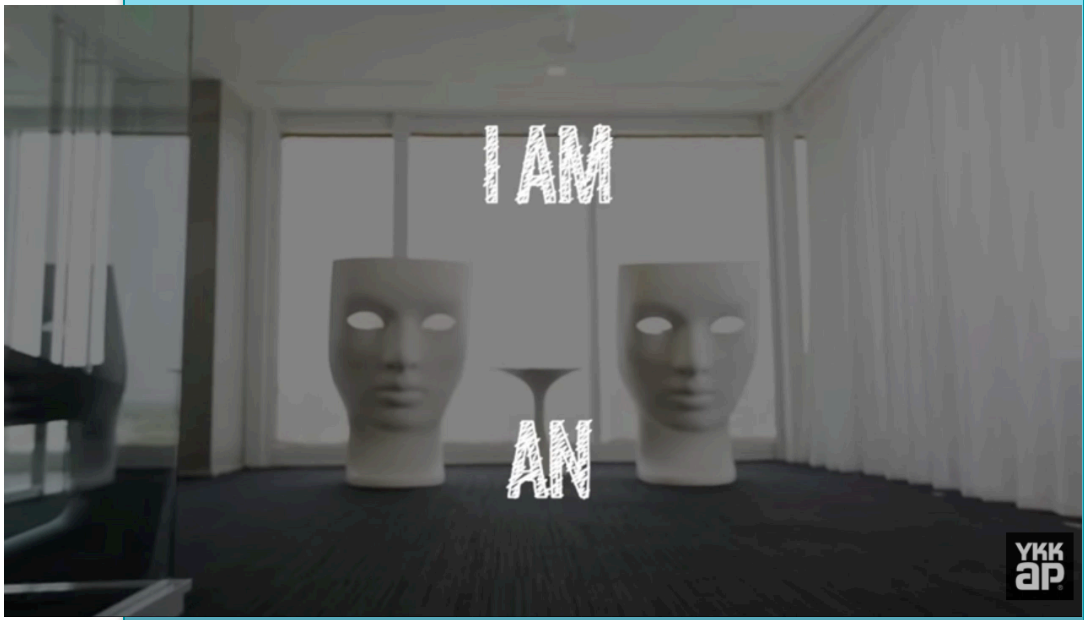


Minimum and max values are includes

What have we learned so far?

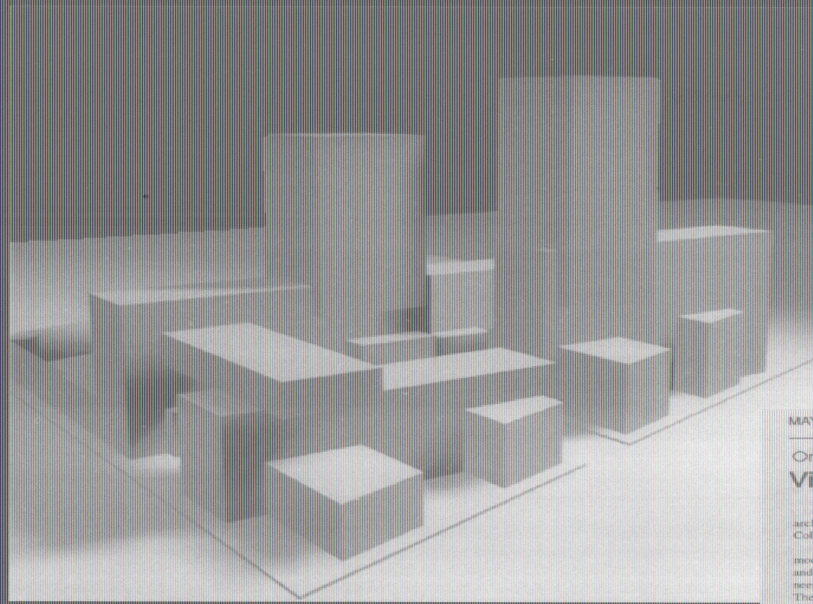


Fun fact!



HOUSING AND YOUTH COMPLEX ON NEW YORK'S TRIBECA

A mix use recrea
complex was desi
town Manhattan, N
complex included
"Y" type indoor re
The proposed de
community and fe
Trip on May 1995,



MAY, 1995

On May 3, Student Architects Present Designs for

Visions of Housing and a "Y" on

"Hey, Chan," called a fellow architecture student. "Is the College of Insurance around here?"

The students were readying the model of a 20 block area of Tribeca and that piece, freshly painted, was needed to help make it complete. There, within the six-by-eight-foot model stood miniature versions of P.S. 234, Stuyvesant High School and the bridge leading to it, Borough of Manhattan Community College, Washington Market Park, the nearby apartment houses along Greenwich Street, and Independence Plaza's 310 Greenwich St. which, as in real life, stood awkwardly above it all.

What remained empty were the spaces surrounding P.S. 234. One at a time, the men and women, third-year graduate architecture students at the New Jersey Institute of Technology in Newark, filled those lots with their own, widely varying models of housing and a much needed indoor recreation facility. Each had his or her own concept of how those structures could be integrated into the city-owned lots — the largest remaining vacant Tribeca property and the site of past battles over the building of a towering home for the Commodities Exchange.

The assignment is only partly

At the New Jersey Institute of Technology, housing and a Y on the empty lots next to P.S. fessor, Tribeca architect Julian Weiss.

The model and designs by these architecture students provide, for the first time, an opportunity for Tribeca residents to visualize how the neighborhood might look if that trade off takes place. It also underscores (to belief), held by many in the community, that a "Y"-type indoor recreation facility is an essential part of new residential construction.

The students will present their designs at 6 p.m. May 3 in the P.S. 234 auditorium.

How can we generate graphical programs?

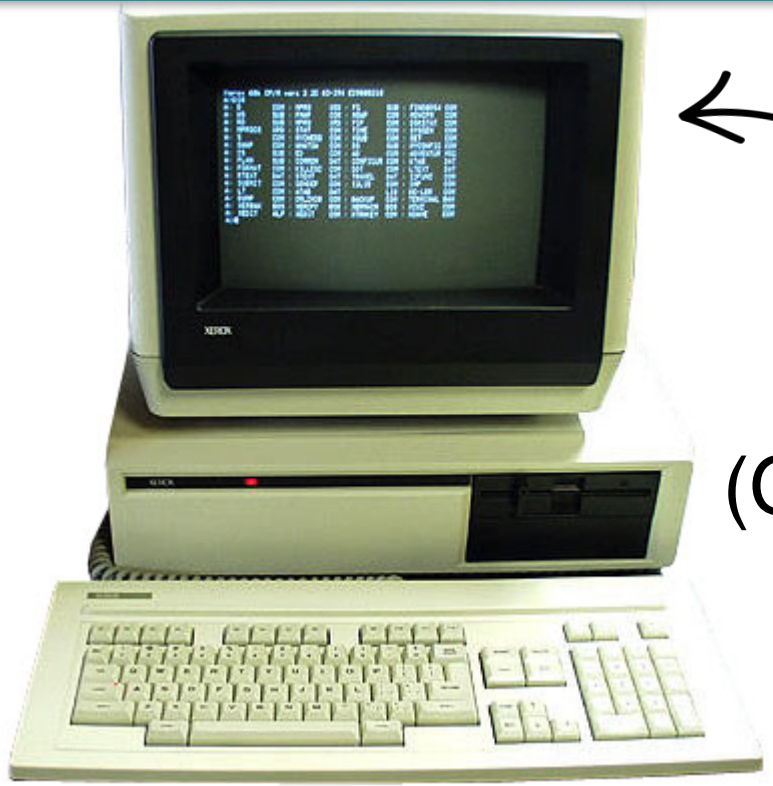
GUI libraries (modules)!

Definition

Graphical User Interface (GUI)

Visual elements that you interact with within applications (windows, buttons, scroll bars, etc.)

Console - Command Line



No GUI! All text-based
(Old computers used to only have a command line!)

Gui - Event Driven Program

- In text-based environments, programs determine the order in which things happen
  - The user can only enter data in the order requested by the program
- GUI environment is event-driven
  - The user determines the order in which things happen
    - User causes events to take place and the program responds to the events

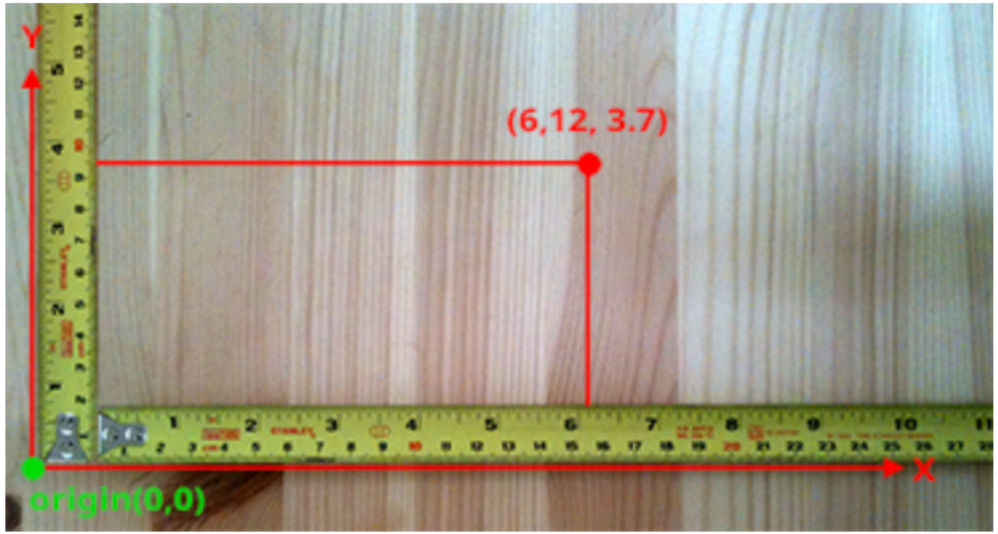
How does computer graphics get created?

Gui - Event Driven Program

- Windows, Mac OS, Linux each have their own GUI systems
- **GUI libraries** are modules that support the GUI (i.e. their functions allow you to interact with your computer's GUI system)
- **`tkinter`** is Python's standard GUI package
  - Many other GUI libraries are built on top of **`tkinter`**!

Drawing in Real Life

- Draw objects using Cartesian coordinate system

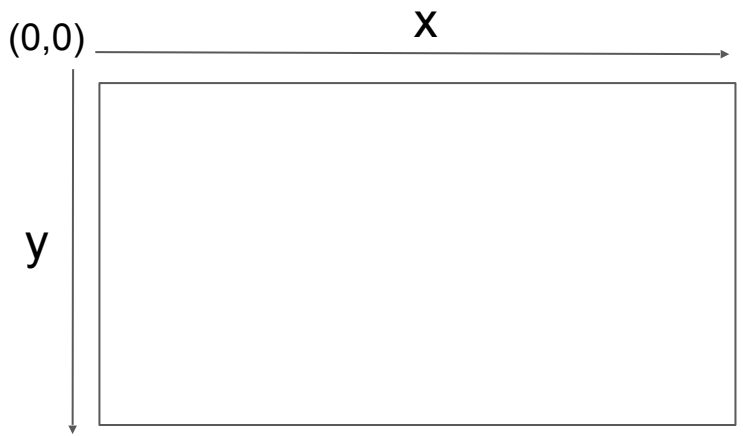


Drawing Computer Graphics

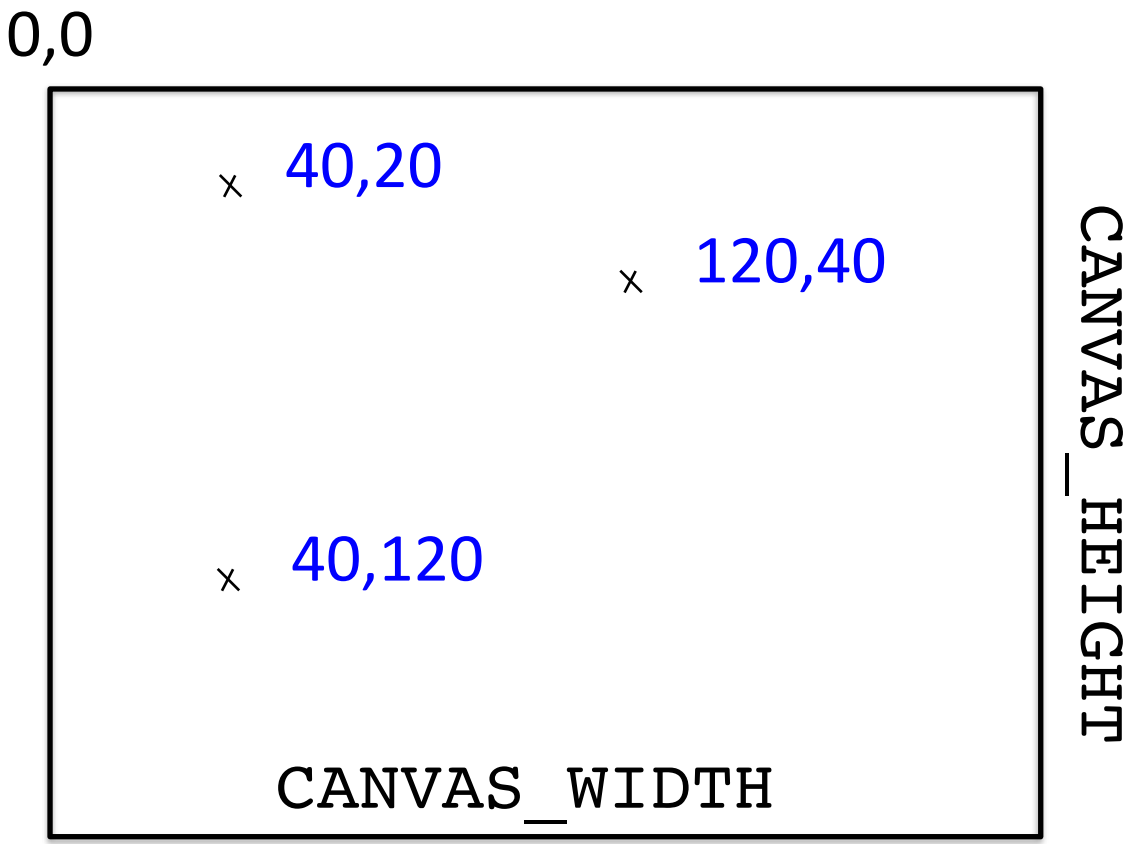
- When creating computer graphics we first somehow describe the shape (and the appearance) of objects
- Place objects on a background called “Canvas”
- Similar to “Felt board” metaphor -
  - The underlying model is similar to that of a collage in which an artist creates a composition by taking various objects and assembling them on a background canvas.

Canvas

- Everything gets drawn on a **`canvas`**
  - In today's examples, we'll provide the code for creating the canvas.



Canvas



Canvas

the following `main` creates a canvas with kitle with default size

```
def main():
     canvas = Canvas()
```

Canvas

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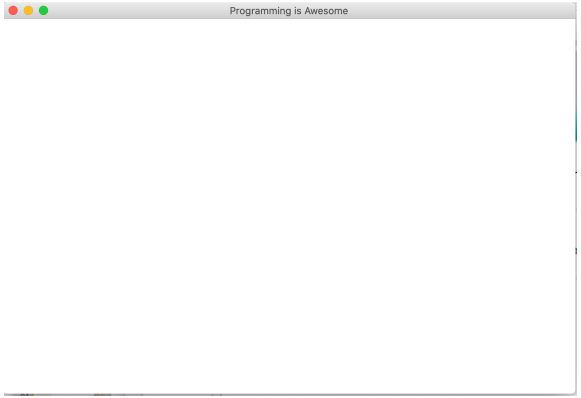
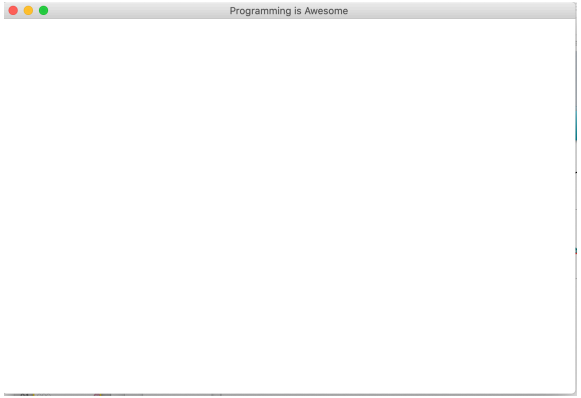
```
def main():
     canvas = Canvas()
     canvas.set_canvas_title("Programming is Awesome")
```



Canvas

the following `main` creates a canvas with kitle with default size

```
def main():
     canvas = Canvas(800, 600)
     canvas.set_canvas_title("Programming is Awesome")
```



How do we draw simple shapes?

Drawing Simple Shapes

- `canvas.create_text()`
- `canvas.create_line()`
- `canvas.create_rectangle()`
- `canvas.create_oval()`

Draw a Rectangle

the following `main` method displays a blue square

```
def main():
    canvas = Canvas(800, 200)
    canvas.set_canvas_title("Hello Rect")
```

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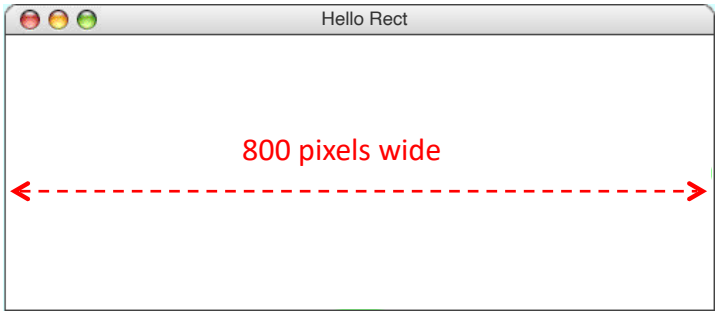

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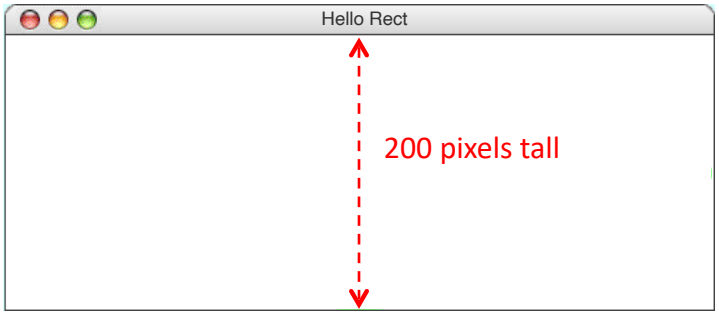

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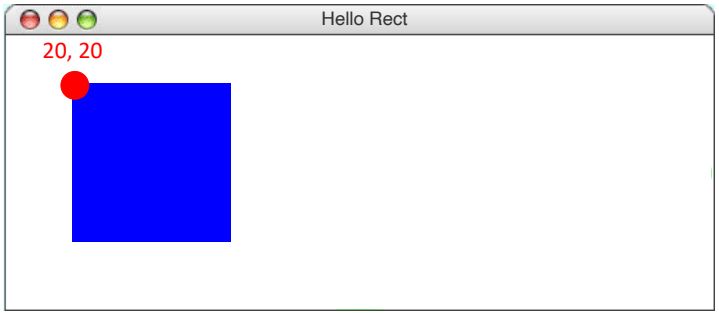
def main():
    canvas = Canvas(800, 200)
    canvas.set_canvas_title("Hello Rect")
    canvas.create_rectangle(20, 20, 100, 100, fill="blue")
```



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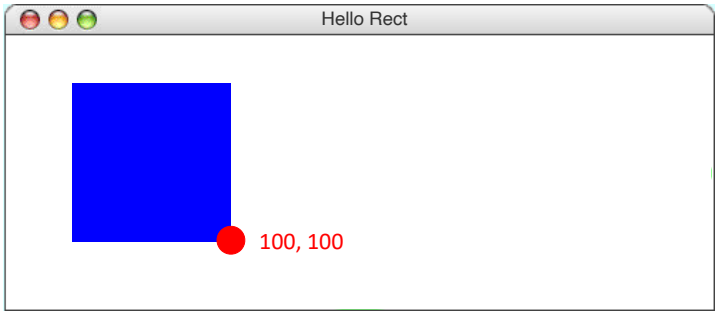

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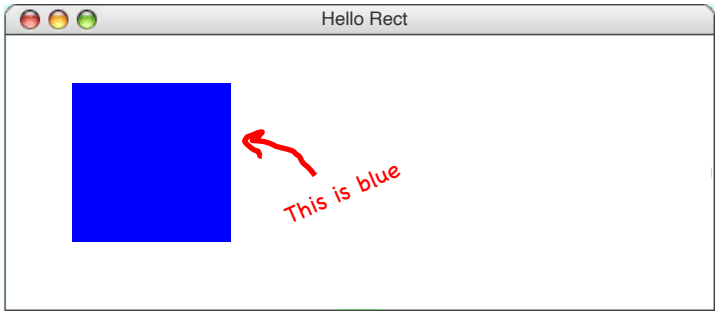

Aside: Named Arguments
This argument is named as filled. It allows functions to have arguments which you can ignore if you want a default value.

Draw a Rectangle

the following `main` method displays a blue square

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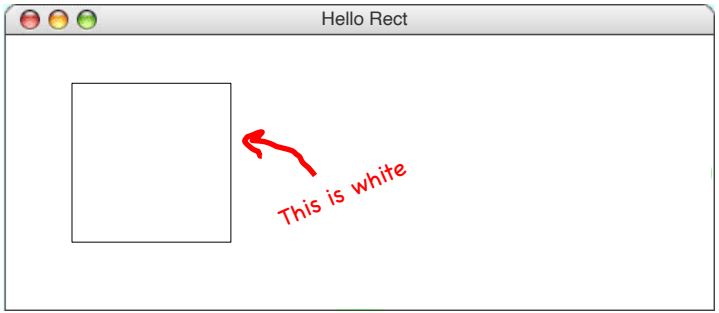

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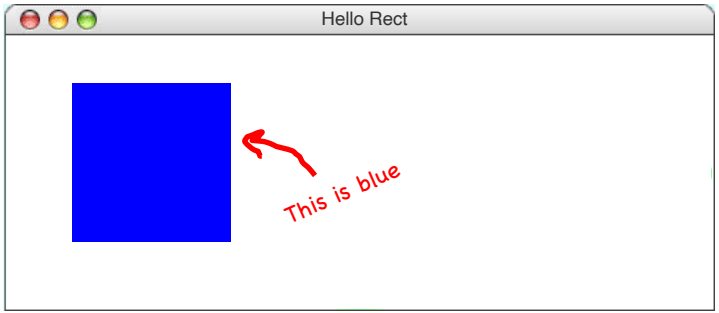

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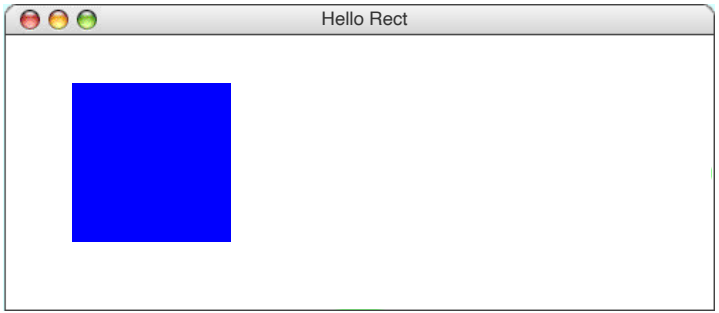
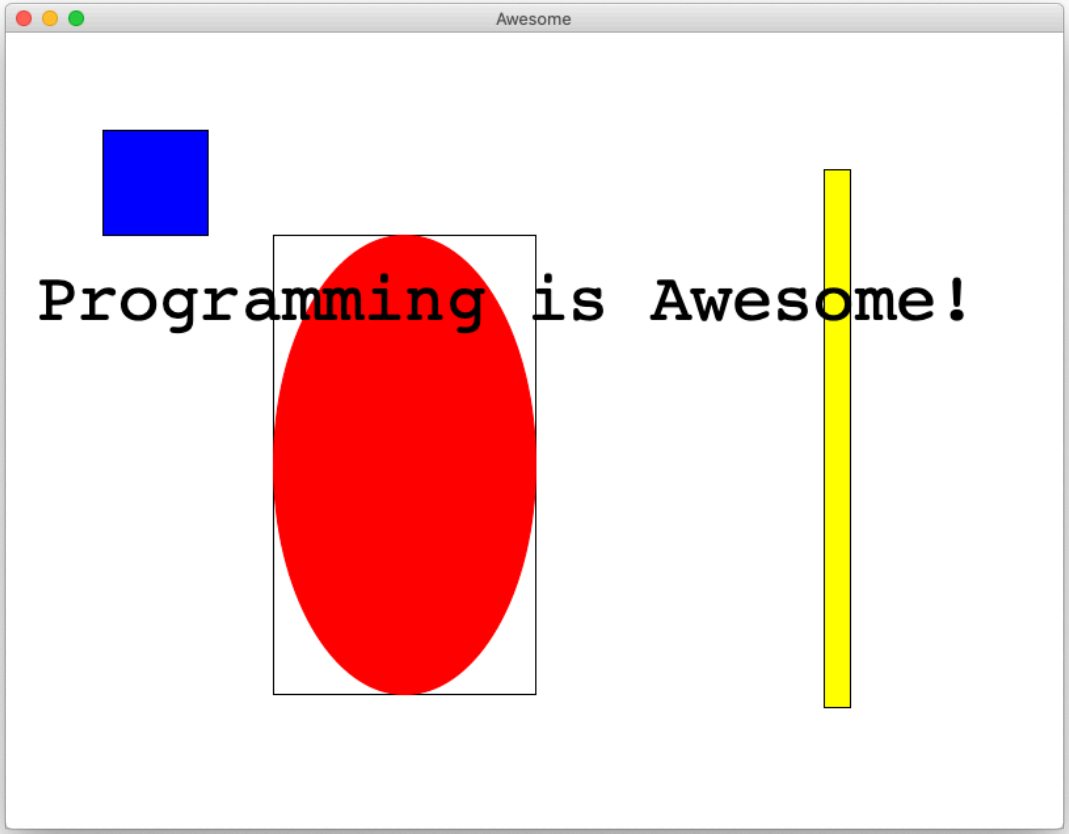
```
def main():
    canvas = Canvas(800, 200)
    canvas.set_canvas_title("Hello Rect")
    canvas.create_rectangle(20, 20, 100, 100, fill="blue")
    canvas.mainloop()
```



Mainloop is a method will loop forever, waiting for events from the user, until the user exits the program

Rectangle, Oval and Text



Drawing Line

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

Drawing Line

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

Drawing Oval

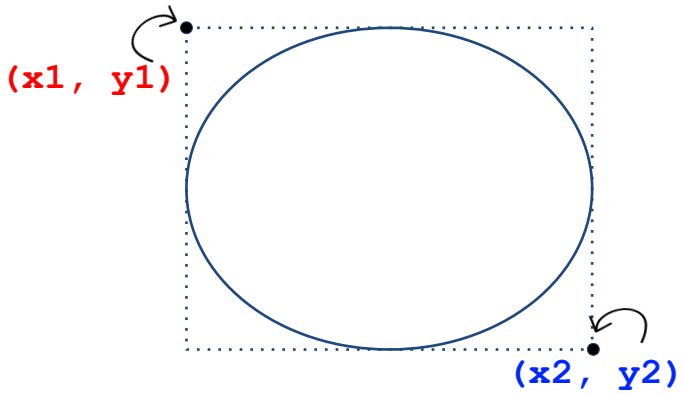
- `canvas.create_oval(x1, y1, x2, y2)`

Drawing Line

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

Drawing Oval

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

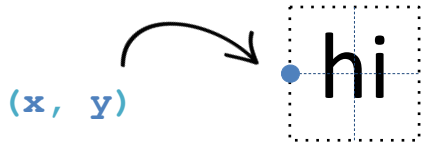


Drawing Text

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

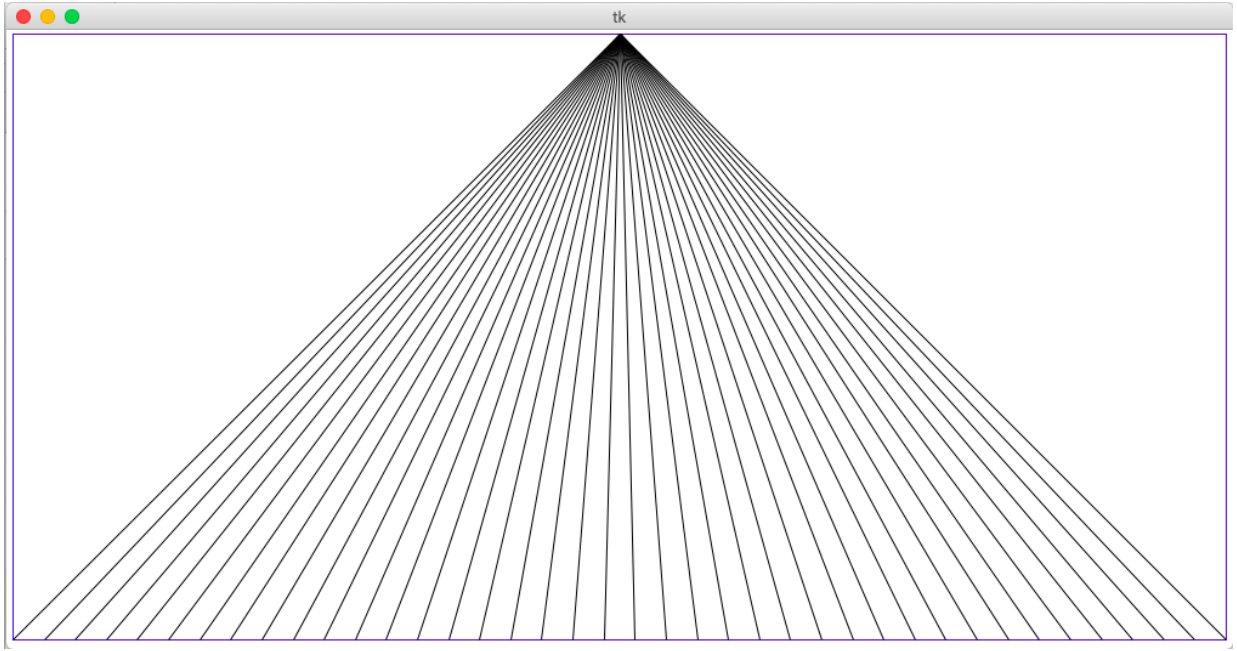
Drawing Text

- `canvas.create_text(x, y, text='hi', anchor='w')`



Proportional math: `draw_pyramid()`

draw_pyramid()



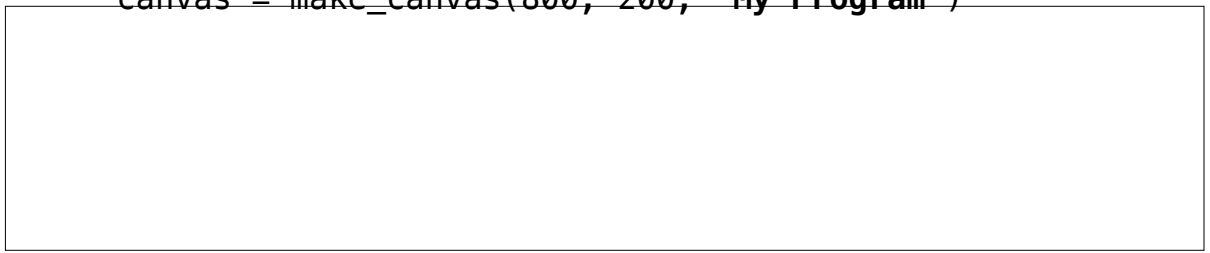
[demo]

Drawing Image

- `canvas.create_image(x, y, "name of the file")`

Get Canvas Information

```
def main():
    canvas = make_canvas(800, 200, 'My Program')
```



Get Canvas Information

```
def main():
    canvas = make_canvas(800, 200, 'My Program')
    canvas_width = canvas.get_canvas_width()
    canvas_height = canvas.get_canvas_height()
```

Get Canvas Information

```
def main():

    canvas = make_canvas(800, 200, 'My Program')

    canvas_width = canvas.get_canvas_width()

    canvas_height = canvas.get_canvas_height()

    #create centered text
    Label = canvas.create_text(canvas_width /2,
    canvas_height/2, 'I am centered')
```

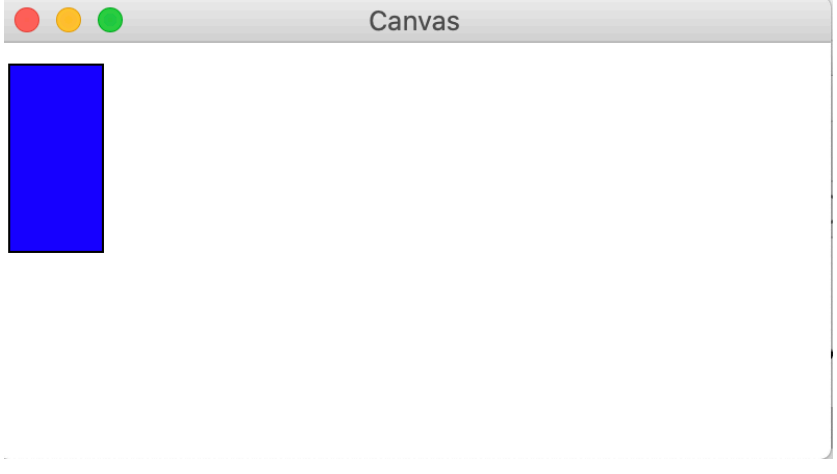
Get Object Information

```
def main():
    canvas = make_canvas(800, 200, 'Hello Rect')
    rect = canvas.create_rectangle(5, 10, 50, 100, fill="blue")
    print(canvas.get_width(rect) #print 50
    print(canvas.get_height(rect) #print 100
    print(canvas.get_left_x(rect) #print 5
    print(canvas.get_top_y(rect) #print 10
```

Update Object Information

```
def main():

     canvas = make_canvas(400, 200, 'My Program')
     rect = canvas.create_rectangle(5, 10, 50, 100, fill="blue")
```



Update Object Information

```
def main():

     canvas = make_canvas(800, 200, 'My Program')
     rect = canvas.create_rectangle(5, 10, 50, 100, fill="blue")
     canvas.set_outline_color(rect, 'red')
     canvas.set_fill_color(rect, 'yellow')
```

What is next?

Day 5: Graphics and Functions

Morning Project [here]		
	Programming is Awesome Quickstart SL Notes	Graphics
	Random Circles Project SL Notes	Graphics and Randomness