Sights & Sounds

Week #8

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More than Numerical Calculations?

- Notion of computation extends far beyond simple numerical calculations

- Using basic computational techniques you have learned so far, you can do computations on shapes and sounds

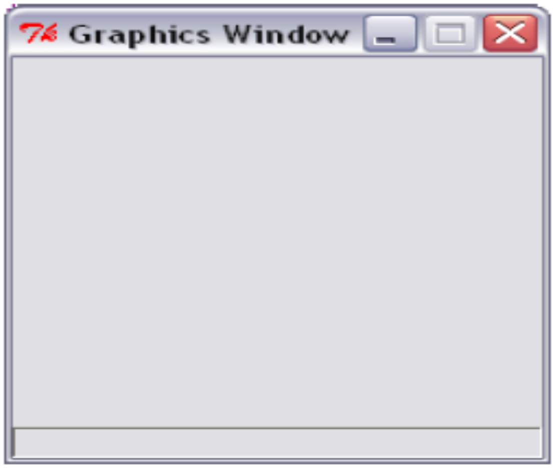
Sights: Drawing

- Have you ever used drawing applications on your computer?

- To draw something using Python, you first need a place to draw it

```
myCanvas = GraphWin()
```

A Graphics window



Sights: Drawing

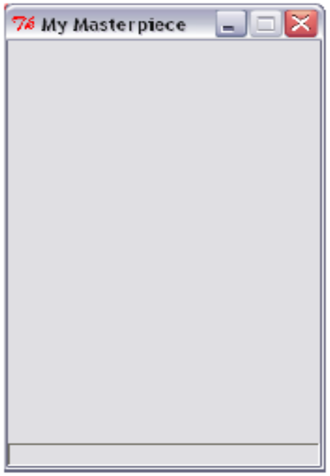
- To make the window go away, type

myCanvas.close()

- To create a graphics window of any size and a name that you specify, type

myCanvas = GraphWin(“My Masterpiece”, 200, 300)

My Masterpiece 200x300



Sights: Drawing

- To change the background color

myCanvas.setBackground(“white”)

- You can even try “red”, “blue”, “yellow” or more exotic colors ranging from “AntiqueWhite” to “LavenderBlush” to “WhiteSmoke”

Sights: Drawing

- You know how to create a canvas, and now it is time to draw in it ☺
- You can create and draw all kinds of geometrical objects: points, lines, circles, rectangel, even text and images
- To draw things:
  - You should first create it and then draw it
  - You should also know the coordinate system of the window

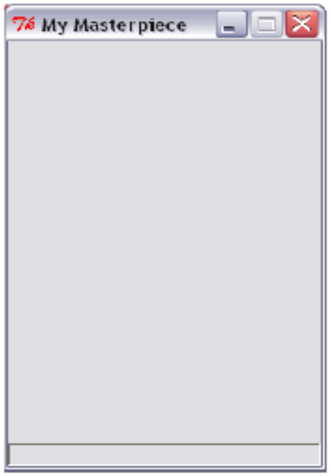
Coordinates

- Graphics window with width, **W**, and height, **H**, has

  W × **H** pixels

- The pixel (0,0) is at the top left corner
- The pixel (199, 299) is at the bottom right corner

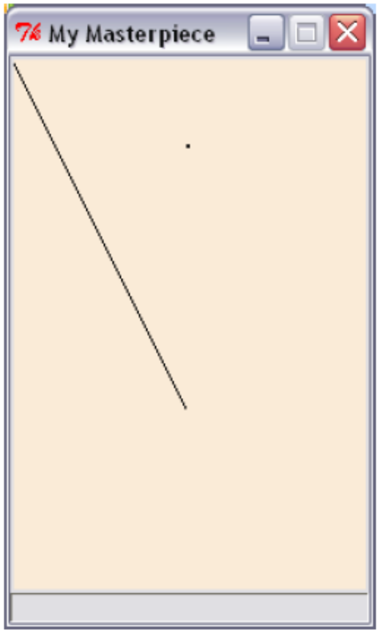
My Masterpiece 200x300



Then Create and Draw it

- The simplest object is a point

```
p = Point(100, 50)     → CREATE WITH COORDINATES
p.draw(myCanvas)     → DRAW IT
```



- *The general form of commands issued on objects*

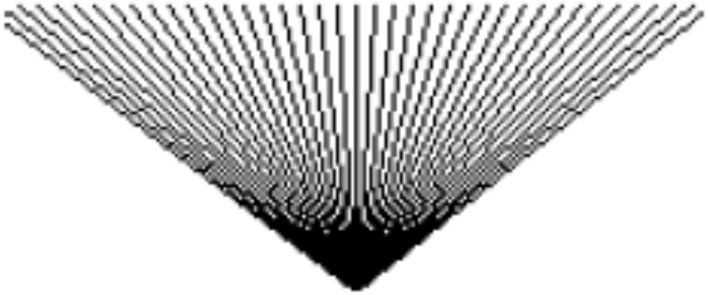
```
<object>.<function>(<parameters>)
```

- A line requires the two end points specified

```
L = Line(Point(0, 0), Point(100,200))     → CREATE WITH COORDINATES
L.draw(myCanvas)     → DRAW IT
```

Sights: Drawing

- **Can you draw this?**



```
for n in range(0, 200, 5):
        L=Line(Point(n,25),Point(100,100))
        L.draw(myCanvas)
```

Sights: Drawing

- Try these

```
for n in range(0, 200, 5):
        L = Line(Point(n, 25), Point(100, 100))
        L.draw(myCanvas)
        wait(0.3)
        L.undraw()
```

```
C = Circle(centerPoint, radius)
C.draw(myCanvas)

C = Circle(Point(100, 150), 30)
C.draw(myCanvas)
```

Sights: Drawing

- Also try these

You can get the center point of a circle:

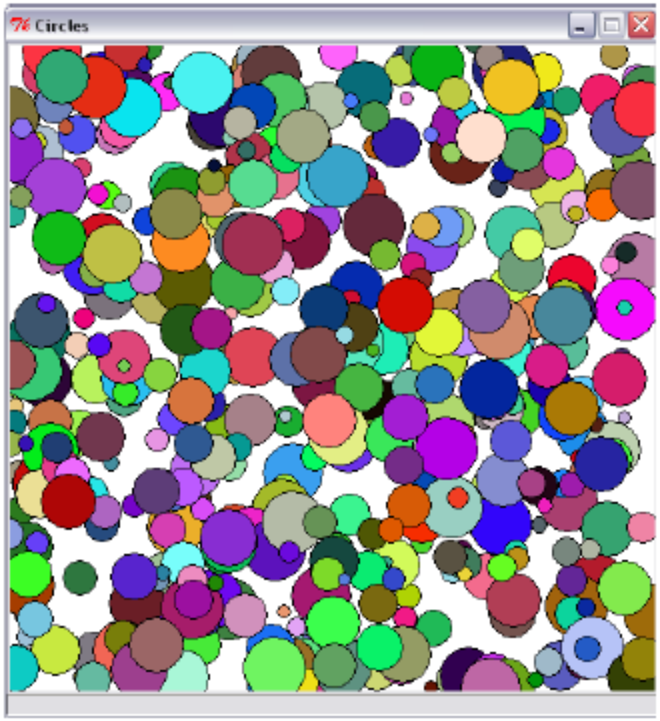
centerPoint = C.getCenter()

You can specify color for objects:

C = Circle(Point(100, 150), 30)
C.draw(myCanvas)
C.setOutline(“red”)
C.setFill(“yellow”)

Exercise

- Can you draw this?



Exercise

```
# Program to draw a bunch of # random colored
    circles
from myro import *
from random import *

def makeCircle(x, y, r):
    # creates a Circle centered at point (x, y) of radius r
    return Circle(Point(x, y), r)

def makeColor():
    # creates a new color using random RGB values
    red = randrange(0, 256)
    green = randrange(0, 256)
    blue = randrange(0, 256)
    return color_rgb(red, green,blue)
```

```
def  main():
        # Create and display a
        # graphics window
        width = 500
        height = 500
        myCanvas =
        GraphWin(‘Circles’,width,height)

        myCanvas.setBackground("white")

        # draw a bunch of random
        # circles with random
        # colors.
        N = 500
        for i in range(N):
                # pick random center
                # point and radius
                # in the window
                x = randrange(0,width)
                y = randrange(0,height)
                r = randrange(5, 25)
                c = makeCircle(x, y, r)
                # select a random color
                c.setFill(makeColor())

                c.draw(myCanvas)
main()
```

Drawing Text and Images

- To place text in a graphics window

  myText = Text (<anchor point>, <string>)

- To place an image in a graphics window

  myPhoto = Image(<center point>, <filename>)

Sound

- Try

beep(1, 440)

- This command instructs the robot to play a tone at 440Hz for 1 second

- The letters Hz are an abbreviation for Hertz

- We use Hertz as a unit for specifying frequencies

1 Hertz = 1 cycle/second

Sound

- The most common use of frequencies is in specifying the clock speeds of computer CPU's

1 GigaHertz = 10^9 cycles/second

- The human ear is capable of distinguishing sounds that differ only by a few Hertz, as little as 1 Hz. *Try these, can you feel the difference?*

beep(1, 440)

beep(1, 450)

Musical Scales

- In western music, a scale is divided into 12 notes (from 7 major notes: ABCDEFG). Further there are octaves.

- An octave in C comprises of the 12 notes:

C C#/Db D D#/Eb E F F#/Gb G G#/Ab A A#/Bb B

- Frequencies corresponding to a specific note, say C, are multiplier (or divided) by 2 to achieve the same note in a higher (or lower) octave

Musical Scales

- What is the relationship between these two tones?

  beep(1, 440)

  beep(1, 880)

- The second tone is exactly one octave the first. To raise a tone by an octave, you simply multiply the frequency by 2.

- To make a tone an octave lower, you divide by 2

Musical Scales

- In common tuning the 12 notes are equidistant. Thus if the frequency doubles every octave, each successive note is $2^{1/2}$ apart

- If C4 is 261.63 Hz, what will be C# (or Db)?

$$C\#4/Db4 = 261.63\ \text{Hz} \times 2^{1/2} = 277.18\ \text{Hz}$$

Making Music

- Making songs by frequency is a lot of work
- Luckily, Myro contains a set of functions
- A Myro song is a set of characters composed like so:

NOTE1 [NOTE2] WHOLEPART

NOTE1 is either a frequency or a NOTENAME,
NOTE2 is the same, and optional. Use for Chords.
WHOLEPART is a number representing how much of a whole note to play.

Making Music

- NOTENAMES are case-insensitive strings. Here is an entire scale of NOTENAMES:

C C#/Db D D#/Eb E F F#/Gb G G#/Ab A A#/Bb B C

- 5th octave version can be written as

C5 C#5/Db5 D5 D#5/Eb5 E5 F5 F#5/Gb5 G5 G#5/Ab5 A5 A#5/Bb5 B5 C6

Making Music

- Try this:

```
c 1
c .5
c .5
c 1
c .5
c .5
e 1
c .5
c .5
c 2
e 1
e .5
e .5
e 1
e .5
e .5
g 1
e .5
e .5
e 2
```

Using a Song

- You need to initialize the robot in a different way

  Robot = scribbler ()

- If your song is in a file, you can read it

  s = readSong(filename)

- The you can play it on the robot

  robot.playSong(s)

  Or on the computer

  computer.playSong(s)

- You can also *makesong(text)* to make a song

  s = makeSong("c 1; d 1; e 1; f 1; g 1; a 1; b 1; c7 1;")