1 Overview

The package graphics.py is a simple object oriented graphics library designed to make it very easy for novice programmers to experiment with computer graphics in an object oriented fashion. It was written by John Zelle for use with the book “Python Programming: An Introduction to Computer Science” (Franklin, Beedle & Associates). The most recent version of the library can obtained at http://mcsp.wartburg.edu/zelle/python. This document is a reference to the functionality provided in the library. See the comments in the file for installation instructions.

There are two kinds of objects in the library. The GraphWin class implements a window where drawing can be done, and various GraphicsObjects are provided that can be drawn into a GraphWin. As a simple example, here is a complete program to draw a circle of radius 10 centered in a 100x100 window:

```python
from graphics import *

def main():
    win = GraphWin("My Circle", 100, 100)
    c = Circle(Point(50,50), 10)
    c.draw(win)
    win.getMouse() # pause for click in window
    win.close()

main()
```

GraphWin objects support coordinate transformation through the setCoords method and pointer-based input through getMouse. The library provides the following graphical objects: Point, Line, Circle, Oval, Rectangle, Polygon, Text, Entry (for text-based input), and Image. Various attributes of graphical objects can be set such as outline-color, fill-color and line-width. Graphical objects also support moving and hiding for animation effects.

2 GraphWin Objects

A GraphWin object represents a window on the screen where graphical images may be drawn. A program may define any number of GraphWins. A GraphWin understands the following methods:

GraphWin(title, width, height, autoflush) Constructs a new graphics window for drawing on the screen. The parameters are optional, the default title is “Graphics Window,” and the default size is 200 x 200. The autoflush parameter, if True causes the window to be immediately updated after every drawing operation. The default value is False, allowing operations to “batch up” for better efficiency.

plot(x, y, color) Draws the pixel at (x, y) in the window. Color is optional, black is the default. Note: pixel-level operations are very inefficient and this method should be avoided.

plotPixel(x, y, Color) Draws the pixel at the “raw” position (x, y) ignoring any coordinate transformations set up by setCoords. Note: pixel-level operations are very inefficient and this method should be avoided.
setBackground(color) Sets the window background to the given color. The initial background is gray. See Section 5.8.5 for information on specifying colors.

close() Closes the on-screen window. Once a window is closed, further operations on the window will raise a GraphicsError exception.

isClosed() Returns a Boolean indicating if the window has been closed either by an explicit call to close or a click on its close box.

getMouse() Pauses for the user to click in the window and returns where the mouse was clicked as a Point object. Raises GraphicsError if the window is closed while getMouse is in progress.

setCoords(xll, yll, xur, yur) Sets the coordinate system of the window. The lower left corner is (xll, yll) and the upper right corner is (xur, yur). All subsequent drawing will be done with respect to the altered coordinate system (except for plotPixel).

update() Causes any pending window operations to be performed. Normally, this will happen automatically during idle periods. Explicit update() calls may be useful for animations.

3 Graphics Objects

The module provides the following classes of drawable objects: Point, Line, Circle, Oval, Rectangle, Polygon, and Text. All objects are initially created unfilled with a black outline. All graphics objects support the following generic set of methods:

setFill(color) Sets the interior of the object to the given color.

setOutline(color) Sets the outline of the object to the given color.

setWidth(pixels) Sets the width of the outline of the object to this many pixels. (Does not work for Point.)

draw(aGraphWin) Draws the object into the given GraphWin. An object may only be drawn in one window at a time.

undraw() Undraws the object from a graphics window. Returns silently if object is not drawn.

move(dx, dy) Moves the object dx units in the x direction and dy units in the y direction. If the object is currently drawn, its image is adjusted to the new position.

clone() Returns a duplicate of the object. Clones are always created in an undrawn state. Other than that, they are identical to the cloned object.

3.1 Point Methods

Point(x, y) Constructs a point having the given coordinates.

g getX() Returns the x coordinate of a point.

getY() Returns the y coordinate of a point.

3.2 Line Methods

Line(point1, point2) Constructs a line segment from point1 to point2.

setArrow(string) Sets the arrowhead status of a line. Arrows may be drawn at either the first point, the last point, or both. Possible values of string are 'first', 'last', 'both', and 'none'. The default setting is 'none'.

getCenter() Returns a clone of the midpoint of the line segment.

getP1(), getP2() Returns a clone of the corresponding endpoint of the segment.
3.3 Circle Methods

Circle(centerPoint, radius) Constructs a circle with given center point and radius.

gGetCenter() Returns a clone of the center point of the circle.

gGetRadius() Returns the radius of the circle.

gGetP1(), gGetP2() Returns a clone of the corresponding corner of the circle’s bounding box. These are opposite corner points of a square that circumscribes the circle.

3.4 Rectangle Methods

Rectangle(point1, point2) Constructs a rectangle having opposite corners at point1 and point2.

gGetCenter() Returns a clone of the center point of the rectangle.

gGetP1(), gGetP2() Returns a clone of corner points originally used to construct the rectangle.

3.5 Oval Methods

Oval(point1, point2) Constructs an oval in the bounding box determined by point1 and point2.

gGetCenter() Returns a clone of the point at the center of the oval.

gGetP1(), gGetP2() Returns a clone of the corresponding point used to construct the oval.

3.6 Polygon Methods

Polygon(point1, point2, point3, ...) Constructs a polygon having the given points as vertices. Also accepts a single parameter that is a list of the vertices.

gGetPoints() Returns a list containing clones of the points used to construct the polygon.

3.7 Text Methods

Text(anchortPoint, string) Constructs a text object that displays the given string centered at anchortPoint. The text is displayed horizontally.

setText(string) Sets the text of the object to string.

gGetText() Returns the current string.

gGetAnchor() Returns a clone of the anchor point.

setFace(family) Changes the font face to the given family. Possible values are: ’helvetica’, ’courier’, ’times roman’, and ’arial’.

setSize(point) Changes the font size to the given point size. Sizes from 5 to 36 points are legal.

setStyle(style) Changes font to the given style. Possible values are ’normal’, ’bold’, ’italic’, and ’bold italic’.

setTextColor(color) Sets the color of the text to color. Note: setFill has the same effect.
4 Entry Objects

Objects of type Entry are displayed as text entry boxes that can be edited by the user of the program. Entry objects support the generic graphics methods move(), draw(graphwin), undraw(), setFill(color), and clone(). The Entry specific methods are given below.

Entry(centerPoint, width) Constructs an Entry having the given center point and width. The width is specified in number of characters of text that can be displayed.

getAnchor() Returns a clone of the point where the entry box is centered.

setText(string) Sets the text in the entry box to the given string. Changes the font face to the given family. Possible values are: 'helvetica', 'courier', 'times roman', and 'arial'.

setSize(point) Changes the font size to the given point size. Sizes from 5 to 36 points are legal.

5 Displaying Images

The graphics module also provides minimal support for displaying certain image formats into a GraphWin. Most platforms will support bitmap, PPM, and GIF images. Display is done with an Image object. Images support the generic methods move(dx,dy), draw(graphwin), undraw(), and clone(). Image specific methods are given below.

Image(centerPoint, filename) Constructs an image from contents of the given file, centered at the given center point.

getAnchor() Returns a clone of the point where the image is centered.

6 Generating Colors

Colors are indicated by strings. Most normal colors such as 'red', 'purple', 'green', 'cyan', etc. should be available. Many colors come in various shades, such as 'red1', 'red2', 'red3', 'red4', which are increasingly darker shades of red.

The graphics module also provides a function for mixing your own colors numerically. The function color_rgb(red, green, blue) will return a string representing a color that is a mixture of the intensities of red, green and blue specified. These should be ints in the range 0–255. Thus color_rgb(255, 0, 0) is a bright red, while color_rgb(130, 0, 130) is a medium magenta.

7 Using an IDE

The graphics library is written as a thin wrapper on top of Tkinter, the standard Python graphics module based on the Tk widget set. Sometimes the use of graphics packages inside of an IDE can lead to issues with “dueling event-loops.” As of Version 3.0, graphics.py runs its Tk event loop in a separate thread. This allows it to play well with IDLE (Python’s default IDE) as long as IDLE is being run in its normal mode (with subprocesses). One particularly nice feature is the ability to experiment with graphics interactively in the IDLE Python shell. The package will also work with IDLE running in the no-subprocess (-n) mode, but IDLE will be unresponsive during getMouse operations.