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Week 10

Writing Games with Pygame, continued

Special thanks to Scott Shawcroft, Ryan Tucker, and Paul Beck for their work on these slides.

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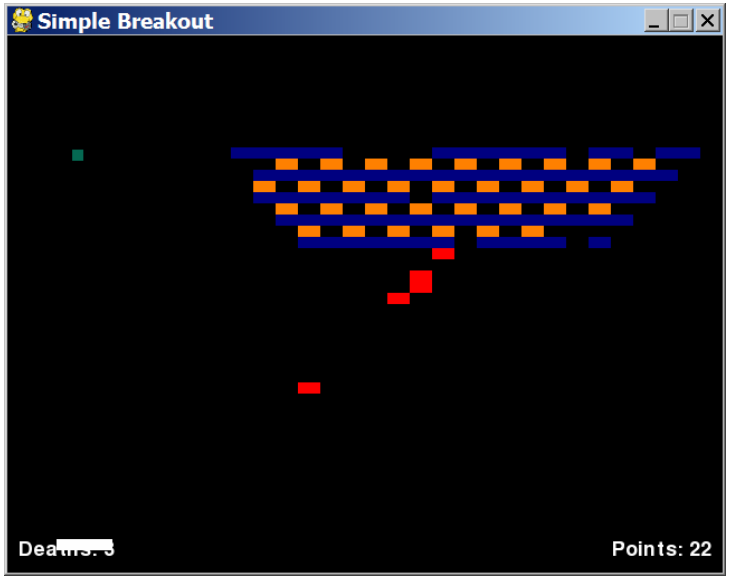
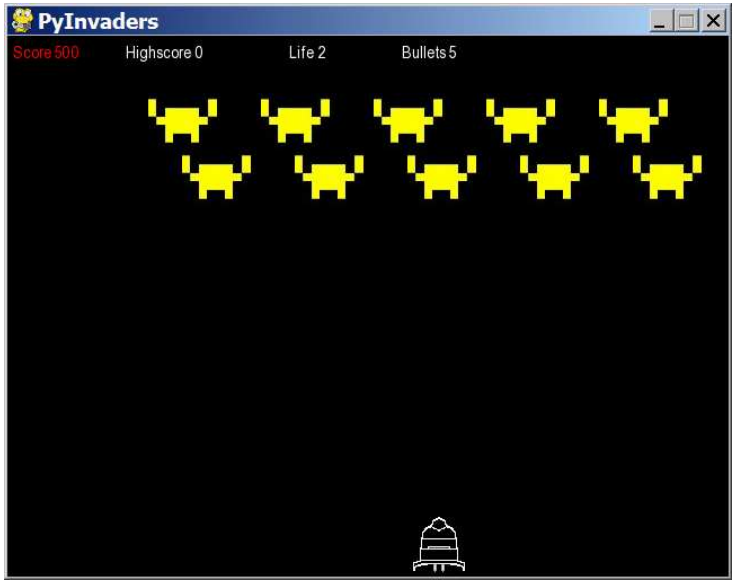
Animated Action Games

- Consider an action game such as Space Invaders or Mario. How does it differ from our Whack-a-Mole game?
  - What features are present in an action game?
  - What are some major challenges in writing such a game?





Our Task

- Implement Pong!
  - 800x480 screen, 10px white border around all edges
  - 15x15 square ball bounces off of any surface it touches
  - two 20x150 paddles move when holding Up/Down arrows
  - game displays score on top/center of screen in a 72px font

Major Steps

1. Set up the (non-moving) paddle/ball/wall sprites
2. Handle key presses, sprite movement, and animation
3. Handle collisions
4. Scoring

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Step 1

Setting Up Sprites

Recall: Sprites

```
class name(Sprite):
    # constructor
    def __init__(self):
        Sprite.__init__(self)
        self.image = image.load("filename")
        # or, self.image = Surface((w, h))
        self.rect = self.image.get_rect()
        self.rect.center = (x, y)

    other methods (if any)
```

- Pre-defined fields in every sprite:

  `self.image` - the image or shape to draw for this sprite
  - images are `Surface` objects, which includes shapes and images

  `self.rect` - position and size of where to draw the image

Recall: `Surface`

- In Pygame, every 2D object is an object of type `Surface`
  - The screen object returned from `display.set_mode()`, each game character, images, etc.
  - Useful methods in each `Surface` object:

Method Name	Description
`Surface((`**width**`, `**height**`))`	constructs new Surface of given size
`fill((`**red**`, `**green**`, `**blue**`))`	paints surface in given color *(rgb 0-255)*
`get_width()`, `get_height()`	returns the dimensions of the surface
`get_rect()`	returns a `Rect` object representing the x/y/w/h bounding this surface
`blit(`**src**`, `**dest**`)`	draws this surface onto another surface

RectangularSprite

- Suggested template for simple white rectangular sprites:

```
class RectangularSprite(Sprite):
    def __init__(self, size, center):
        Sprite.__init__(self)
        self.image = Surface(size)
        self.image.fill((255, 255, 255))
        self.rect = self.image.get_rect()
        self.rect.center = center
```

  - Now the various sprites in the Pong game can be `RectangularSprites` or extend `RectangularSprite` to add their own behavior

Recall: Sprite Groups

name = Group(**sprite1**, **sprite2**, **...**)

- To draw sprites on screen, they must be put into a Group

Example:

```
my_mole = Mole()     # create a Mole object
other_mole = Mole()
all_sprites = Group(my_mole, other_mole)
```

Group methods:

- draw(**surface**) - draws all sprites in group onto a surface
- update() - updates every sprite's appearance

Exercise

- Define the sprites for the PyPong game:
  - four 15px-thick borders around the 800x480 board edges
  - two 20x150 paddles, centered vertically, at L/R edges of board
  - a 15x15 ball, in the center of the board

    - Use `RectangularSprite` as the basis for your sprites.
    - The sprites don't move yet.

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Step 2

Animation and Key Presses

Recall: Event Loop

```
# after Pygame's screen has been created
while True:
    name = event.wait()      # wait for an event
    if name.type == QUIT:
        pygame.quit()        # exit the game
        break
    elif name.type == type:
        code to handle another type of events
    ...

    code to update/redraw the game between events
```

Timer Events

```
time.set_timer(USEREVENT, delayMS)
```

- Animation is done using **timers**
  - Events that automatically occur every *delayMS* milliseconds
  - Your event loop can check for these events. Each one is a "frame" of animation

```
while True:
    ev = event.wait()
    if ev.type == USEREVENT:
        # the timer has ticked; move sprites,
        # redraw the screen, etc.
```

Key Presses

http://www.pygame.org/docs/ref/key.html

- `key.get_pressed()` returns an array of keys held down
  - indexes are constants like `K_UP` or `K_F1`
  - values are booleans (`True` means pressed)
  - Constants for keys: `K_LEFT`, `K_RIGHT`, `K_UP`, `K_DOWN`, `K_a` - `K_z`, `K_0` - `K_9`, `K_F1` - `K_F12`, `K_SPACE`, `K_ESCAPE`, `K_LSHIFT`, `K_RSHIFT`, `K_LALT`, `K_RALT`, `K_LCTRL`, `K_RCTRL`, ...

```
keys = key.get_pressed()
if keys[K_LEFT]:
    # left arrow is being held down...
```

Updating Sprites

```
class Jet(Sprite):
    def __init__(self):
        # ...

    def update(self):   # move right 3px / tick
        self.rect = self.rect.move(3, 0)
```

- Each sprite can have an `update` method that describes how to move that sprite on each timer tick.
  - Move a rectangle by calling its `move(`**`dx`**`, `**`dy`**`)` method.
  - Calling `update` on a `Group` updates all its sprites.

Exercise

- Implement animation and key response in PyPong:
  - Make a timer that ticks every 50 ms.
  - When the timer ticks:
    - Give the ball a dx/dy of 5px and move the ball by that amount. (The ball will fly off the screen after a moment.)
    - If the up arrow is held down, move the paddles up by 5px.
    - If the down arrow is held down, move the paddles down by 5px.

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Step 3

Collisions Between Sprites

Collisions Btwn. Rectangles

- Recall: Each `Sprite` contains a `Rect` collision rectangle
- `Rect` objects have useful methods for detecting collisions between the rectangle and another sprite:

Method Name	Description
`collidepoint(`**`p`**`)`	returns `True` if this Rect contains the point
`colliderect(`**`rect`**`)`	returns `True` if this Rect contains the rect

  - However, `Sprite` and `Group` objects have more useful methods to detect collisions...

Collisions Between Groups

`spritecollideany(`**`sprite`**`, `**`group`**`)`

– Returns `True` if sprite has collided with any sprite in the group

- Useful for finding collisions in a sprite's `update` method:

```
class name(Sprite):
    def update(self):
        if spritecollideany(self, group):
            # I collided with a sprite in group
```

Exercise

- Implement collision response in PyPong:
  - Constrain the paddles; if a paddle collides with one of the top/bottom borders, stop its movement.
  - Make the ball bounce off of the other sprites on the board:
    - If it hits the top or bottom walls, it should invert its y direction.
    - If it hits a paddle, it should invert its x direction.

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Step 4

Scoring, Polish, etc.

Font

- Text is drawn using a `Font` object:

  name `= Font(`**filename**`,` **size**`)`

  – Pass `None` for the file name to use a default font.

- A `Font` draws text as a `Surface` with its `render` method:

  name`.render("`**text**`", True, (`**red**`,` **green**`,` **blue**`))`

  Example:

```
my_font = Font(None, 16)
text = my_font.render("Hello", True, (0, 0, 0))
```

Displaying Text

- A `Sprite` can be text by setting that text's `Surface` to be its `.image` property.

Example:

```
class Banner(Sprite):
    def __init__(self):
        my_font = Font(None, 24)
        self.image = my_font.render("Hello",  \
                     True, (0, 0, 0))
        self.rect = self.image.get_rect()
        self.rect.center = (250, 170)
```

Exercise

- Implement scoring of points in PyPong.
  - Make a sprite to represent the current scoreboard.
    - Draw the score in 72px font, in the top/middle of the board.
    - Draw it in a format such as "0:0".
  - Expand the collision detection for the ball:
    - If it hits the right wall, it should score a point for Player 1.
    - If it hits the left wall, it should score a point for Player 2.

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Sounds

- Loading and playing a sound file:

```
from pygame.mixer import *
mixer.init()              # initialize sound system
mixer.stop()              # silence all sounds

Sound("filename").play()  # play a sound
```

- Loading and playing a music file:

```
music.load("filename")     # load bg music file
music.play(loops=0)         # play/loop music
                          # (-1 loops == infinite)
```

others: `stop`, `pause`, `unpause`, `rewind`, `fadeout`, `queue`

Further Exploration

- Physics: Sprites that accelerate; gravity; etc.
- AI: Computer opponents that play "intelligently"
- Supporting other input devices
  - See documentation for Pygame's `Joystick` module
- Multi-player (local or network)

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