Multimedia-Programmierung
Übung 7

Ludwig-Maximilians-Universität München
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Today

• Sprite animations in Pygame
• Advanced collision detection
• Sound
Keyframe Animations

- Keyframes are defined
- Intermediate steps are interpolated
- Basic interpolators/tweens/... built into many programming environments (e.g. Flash, JavaFX)
- Examples: motion, color, shape
Keyframe Animations

Keyframe Animations in Pygame

- Pygame has no built-in interpolators
- Logic has to be added by the programmer
- Question: How can we calculate the intermediate points?
import pygame
from pygame.locals import *
from sys import exit

player_image = 'head.jpg'
pygame.init()

screen = pygame.display.set_mode((640, 280), 0, 32)
pygame.display.set_caption("Animate X!")
mouse_cursor = pygame.image.load(player_image).convert_alpha()

x = 0 - mouse_cursor.get_width()
y = 10

while True:
    for event in pygame.event.get():
        if event.type == QUIT:
            exit()
    screen.fill((255,255,255))
    if x > screen.get_width():
        x = 0 - mouse_cursor.get_width()
    screen.blit(mouse_cursor, (x, y))
x+=10
    pygame.display.update()
Sprite Animations

- Animations consist of frames that are displayed one after another

  ![Sprite Animation Example]

  Frame 1  ...  Frame 7

- Either imported as single graphics or with sprite sheets

Contains small tutorial on creating animations with sprite sheets in Pygame
Sprite Sheets & Spriting

- Sprite sheets contain all possible movements for a character
- Each Sprite should have the same size for easy slicing in software
- Spriting means to adapt existing sprites or sprite sheets or create new ones (e.g. with empty outlines)

http://www.yoyogames.com/extras/resource/file/san/1/90/90/male_character_outline_final.png
http://www.themysticalforestzone.com/Sprite_section.htm
Creating Sprite Sheets

• Sprite Sheets in WWW usually do not have equal sizes for each sprite
• Editing needed, e.g. with Photoshop, Gimp, Pixen etc.
• Pay attention to positioning of character and background color (should not appear in character)
def load_sliced_sprites(self, w, h, filename):
    images = []
    master_image = pygame.image.load(os.path.join('ressources', filename)).convert_alpha()
    master_image.set_colorkey((255,0,255))
    master_width, master_height = master_image.get_size()
    for i in xrange(int(master_width/w)):
        images.append(master_image.subsurface((i*w,0,w,h)))
    return images

More specialized slicing function may be needed due to incompatible sprite sheet (e.g. with borders)
First Sprite Animation 1

```python
import os, pygame
from pygame.locals import *

def load_sliced_sprites(self, w, h, filename):
    ....

class BombWithAnimation(pygame.sprite.Sprite):
    def __init__(self, color, initial_position, fps):
        pygame.sprite.Sprite.__init__(self)
        self.act_frame = 0
        # create the images for the animation
        self.frames = load_sliced_sprites(20, 20, "explosed-sprite.png")
        self.image = self.frames[0]
        self.rect = self.image.get_rect()
        self.rect.topleft = initial_position
        self.fps = fps
        self.change_time = 1.0/self.fps
        self.time = 0

    def update(self, time_passed):
        self.time += time_passed
        if self.time >= self.change_time:
            self.act_frame = (self.act_frame + 1) % len(self.frames)
            self.image = self.frames[self.act_frame]
            self.time = 0
```

remember the current frame
create the frames (defined later)
Based on the frames per second (fps) calculate the time needed for animation changes
Frame changed? change frame
... 
pygame.init()

screen = pygame.display.set_mode((640, 480), 0, 32)
bomb1 = BombWithAnimation((0,0),4)
clock = pygame.time.Clock()

while True:
    for event in pygame.event.get():
        if event.type == QUIT:
            exit()
    screen.fill((100, 200, 0))
    time_passed = clock.tick() / 1000.0
    bomb1.update(time_passed)
    screen.blit(bomb1.image,bomb1.rect)
    pygame.display.update()
Multiple Parallel Animations

...pygame.init()

screen = pygame.display.set_mode((640, 480), 0, 32)
bomb1 = BombWithAnimation((0,0),4)
bomb2 = BombWithAnimation((40,40),2)
clock = pygame.time.Clock()

while True:
    for event in pygame.event.get():
        if event.type == QUIT:
            exit()
    screen.fill((100, 200, 0))
    time_passed = clock.tick() / 1000.0
    bomb1.update(time_passed)
    screen.blit(bomb1.image,bomb1.rect)
    bomb2.update(time_passed)
    screen.blit(bomb2.image,bomb2.rect)
    pygame.display.update()
Collision Detection

Rect

- Rect provides several methods to test collisions
  http://www.pygame.org/docs/ref/rect.html

- `Rect.collidepoint(point)` tests whether a point is within the Rect’s area

- `Rect.colliderect(rect)` tests whether two Rects intersect
Collision Detection

Rect II

- `Rect.collidelist(list)` tests whether the Rect collides with at least one Rect in the given list
- `Rect.collidelistall(list)` tests whether the Rect collides with all Rects in the list
- `Rect.collidedict(dict)` tests whether the Rect collides with at least one Rect in the given dictionary
- `Rect.collidedictall(dict)` tests whether the Rect collides with all Rects in the dictionary
Collision Detection

Sprites

• The module sprite provides several method to test collision

• `sprite.spritecollide(...)` returns a list of sprites within a group that intersect with a given sprite

• `sprite.collide_rect(a,b)` checks whether two sprites intersect (must have rects)

• `sprite.collide_circle(a,b)` checks whether the radius of two sprites intersect. Radius attribute should be defined in the sprite.

False  True
Collision Detection

Sprites 2

- `sprite.groupcollide(a,b)` returns a list of sprites of two groups that intersect
- `sprite.collide_mask(a,b)` checks whether two Sprite collide on a bitmap level (non-transparent pixels overlap)

```python
if pygame.sprite.collide_mask(head1,head2):
    print "collide"
```
Collision Detection

Masks

• Masks are 1bit per pixel representations of areas that can collide

• Module mask contains functions and classes to create and use masks
  http://www.pygame.org/docs/ref/mask.html

• mask.from_surface(surface,threshold=127) creates a mask of a surface. Threshold defines the alpha value that counts as collideable

• Class Mask contains methods to work with classes
Collision Detection

Conclusion

• Pygame offers various ways to check for collisions
• **Choose your collision detection algorithm wisely depending on the task**
• Pixel based collision detection is precise but slow
• Rect or radius based collision detection is fast but imprecise
Sound

- Sound is an essential part of multimedia applications
- Provides immediate feedback about an action
- Supports realism (e.g. games)
- Provides accessibility (e.g. for blind people)
- ...

Sound vs. No Sound

*click*
Sound in Pygame

Mixer

• Sounds are controlled using the `pygame.mixer` interface
• Mixer must be initialized
  ```python
  pygame.mixer.init(frequency, size, channels, buffer)
  ```
• Automatically initialized with `pygame.init()` using the default values
• Default values can be changed using
  ```python
  pygame.mixer.pre_init()
  ```
• The mixer “mixes” the sounds in background threads
  – Sounds are not blocking the rest of the application logic
Sound in Pygame

Sound Object

- `pygame.mixer.Sound` provides a class to load and control sound files (OGG and uncompressed WAV)
- `Sound.play(loops=0, maxtime=0, fade_ms=0)` plays the sound file
- Other methods: `stop()`, `fadeout(time)`, `set_volume(value)` etc.

```
playing a sound file
click_sound = pygame.mixer.Sound("click.wav")
click_sound.play()
```

```
playing a sound file in a loop 4(!) times

click_sound = pygame.mixer.Sound("click.wav")
click_sound.play(3)
```
Sound in Pygame

Channels

- A channel represents one of the channels that are mixed by the soundcard
- `Sound.play()` returns a Channel object (or None if all channels are blocked)
- Provides methods to manipulate the sound and create useful effects (e.g. `Channel.set_volume(left, right)`)

```python
channel = click_sound.play()
channel.set_volume(0.0, 1.0)
```

playing a sound file from the right speaker only
Sound in Pygame
Stereo Panning

• Create the illusion that sound is coming from a specific point at the screen
• Manipulate the volume of the different speakers
• Can be used to make a sound “move” over the screen

Stereo panning function

```python
def stereo_pan(x_coord, screen_width):
    right_volume = float(x_coord) / screen_width
    left_volume = 1.0 - right_volume
    return (left_volume, right_volume)
```

From: W. McGugan, Beginning Game Development with Python and Pygame, Apress 2007
Music in Pygame

• Don’t use pygame.mixer but pygame.mixer.music
• It enables **streaming** music which means that the file will be read in small chunks
• Supports MP3 and OGG files (OGG better supported across platforms)
• Other Methods include `stop()`, `pause()`, `rewind()` etc.
• **Attention**: only one song can be streamed at the same time

```python
playing a song using pygame

pygame.mixer.music.load("music.ogg")
pygame.mixer.music.play()
```
Creating your own Sound

• Record real sounds and edit them
• Free sound editor Audacity
  (http://audacity.sourceforge.net/?lang=de)
Useful Links

• Pygame Sprite Tutorial
  http://kai.vm.bytemark.co.uk/~piman/writing/sprite-tutorial.shtml

• Pygame API !!!!
  http://www.pygame.org/ctypes/pygame-api/