2 Multimedia Programming with Python and Pygame

2.1 Introduction to Python

2.2 SDL/Pygame:
Multimedia/Game Framework for Python

2.3 SDL: Background of Pygame

Literature:

www.pygame.org
kidscancode.org/blog/2015/09/pygame_install/
https://www.youtube.com/c/KidsCanCodeOrg
www.libsdl.org

History of SDL & Pygame

- Sam Lantinga, 1998:
  Simple DirectMedia Layer (SDL) framework
  - To simplify porting games among platforms
  - Common and simple way to create displays and to process input, abstracting away from platform particularities; written in C
  - Basis for hundreds of games, among them *Angry Birds*, *Unreal Tournament*
  - *Current version: 2.0.4 (January 2016)*
- ***Pygame*** is a *language binding* for SDL *Version **1.2*** to Python
  - Use the SDL library from Python code
- Pygame and SDL are open source projects
  - Version 1.9.2a0 (2012?) is latest version of Pygame, using SDL 1.2.15
- Documentation :
  - www.pygame.org/docs
- More recent versions of SDL: SDL2 (www.libsdl.org)
  - Python bindings under development

Modules in the Pygame Package

`pygame.cdrom`	Controls CD drives
`pygame.cursors`	Loads cursor images
`pygame.display`	Accesses display
`pygame.draw`	2D vector graphics
`pygame.event`	External events
`pygame.font`	Uses System fonts
`pygame.image`	Loads and saves an image
`pygame.joystick`	Special input
`pygame.key`	Keyboard input
`pygame.mixer`	Loads and plays sounds
`pygame.mouse`	Manages mouse
`pygame.movie`	Plays movie files

`pygame.music`	Works with music and streaming audio
`pygame.overlay`	Advanced video overlays
`pygame`	High level functions
`pygame.rect`	Manages areas
`pygame.sndarray`	Manipulates sound data
`pygame.sprite`	Manages moving images
`pygame.surface`	Manages images and the screen
`pygame.surfarray`	Manipulates image pixel data
`pygame.time`	Manages timing and frame rate
`pygame.transform`	Resizes and moves images

Slide Show Example in Pygame

```
import pygame
from pygame.locals import *
from sys import exit

background = pygame.Color(255, 228, 95, 0)
sc_w = 356
sc_h = 356

pygame.init()

# Create program display area
screen = pygame.display.set_mode([sc_w, sc_h])
pygame.display.set_caption("Simple Slide Show")

# Set background color
screen.fill(background)

# Load slide and show it on the screen
slide = pygame.image.load('pics/tiger.jpg').convert()
screen.blit(slide, (50, 50))
pygame.display.update()
...
```

Copy image to screen
(bit block image transfer)

Display Setup

`pygame.display.set_mode(`*`rect`*`, `*`flags`*`, `*`depth`*`)`

- ***`rect:`*** Size of the display window (pixels)
  - Either **`[w, h]`** or (**`w, h)`**
- ***`flags:`*** Properties of the display which can be switched on/off (can also be combined to some extent)
  - **`FULLSCREEN`**
  - **`DOUBLEBUF`** Double buffering
  - **`HWSURFACE`** Hardware-accelerated display (must be full screen)
  - **`OPENGL`** OpenGL rendering
  - **`RESIZABLE`**
  - **`NOFRAME`**
- ***`depth:`*** Bit depth of display
  - Can be omitted (set automatically)

Slide Show Example in Pygame, contd.

```
...
pygame.time.wait(4000)

# Load slide and show it on the screen
slide = pygame.image.load('pics/elephant.jpg').convert()
screen.blit(slide, (50, 50))
pygame.display.update()
pygame.time.wait(4000)

# Load slide and show it on the screen
slide = pygame.image.load('pics/jbeans.jpg').convert()
screen.blit(slide, (50, 50))
pygame.display.update()
pygame.time.wait(4000)
...
```

QUIZ

- How can we achieve that the slideshow application can be terminated by the user before running to its end?

Slide Show Example in Pygame, contd. Catching the QUIT Event

```
...
pygame.time.wait(4000)

# Event loop for possible termination
for event in pygame.event.get():
  if event.type == QUIT:
    exit()

# Load slide and show it on the screen
slide = pygame.image.load('pics/elephant.jpg').convert()
screen.blit(slide, (50, 50))
pygame.display.update()
pygame.time.wait(4000)

# Event loop for possible termination
...
```

Event Loop

- Why ask for events?
  - Program termination (clicking close icon of window) is QUIT event
  - Other events: clicks, mouse movement, timeout, …
- Typical standard structure: (Potentially) **infinite** loop:
  - Asking for new events
  - Breaking the loop if termination event found
- Type 1 of "waiting for input" (explicit/passive waiting, **`pygame.time.wait`**)
  - Frees resources during wait time
  - Not very precise in timing (dependent on external scheduling)
  - Not responsive during wait time
- Type 2 of "waiting for input" (active waiting, see next example)
  - Always responsive
  - Precise in timing
  - More resource demanding

Slide Show with Active Waiting (Part 1)

- Preliminary optimization:
  - Slide array for easier access in a loop

```
# Preload slide files
slides = []
slides.append(pygame.image.load('pics/tiger.jpg').convert())
slides.append(pygame.image.load('pics/elephant.jpg').convert())
slides.append(pygame.image.load('pics/jbeans.jpg').convert())
slides.append(pygame.image.load('pics/peppers.jpg').convert())
slides.append(pygame.image.load('pics/butterfly.jpg').convert())
```

Slide Show with Active Waiting (Part 2)

```
slideindex = 0
running = True
updatePicture = True

while running:
    if updatePicture:
        screen.blit(slides[slideindex],(50,50))
        pygame.display.update()
        updatePicture = False
        timer = pygame.time.get_ticks() # set timer

    for event in pygame.event.get():
        if event.type == QUIT:
            running = False

    if pygame.time.get_ticks() > timer+interval:
        slideindex = (slideindex+1)%len(slides)
        updatePicture = True
```

QUIZ

- Question 1: What is the meaning of **`(slideindex+1)%len(slides)`**? What happens if we just increase the slideindex?
- Question 2: What happens if we omit the if-clause comparing the current time with timer+interval? (Assume we replace the if-condition by True.)
- Question 3: Can't we consider the end of the timer runtime as an event like the QUIT event?

Interactive Slide Show – Keyboard Control

```
slideindex = 0
running = True
updatePicture = True

while running:
     if updatePicture:
         … as above …

     for event in pygame.event.get():
         if event.type == QUIT:
             running = False
         if event.type == pygame.KEYDOWN:
             if event.key in [K_SPACE,K_RIGHT]:
                slideindex = (slideindex+1)%len(slides)
                updatePicture = True
           if event.key == K_LEFT:
                slideindex = (slideindex-1)%len(slides)
                updatePicture = True
            if event.key == K_q:
                running = False
```

Key pressed

Individual keys

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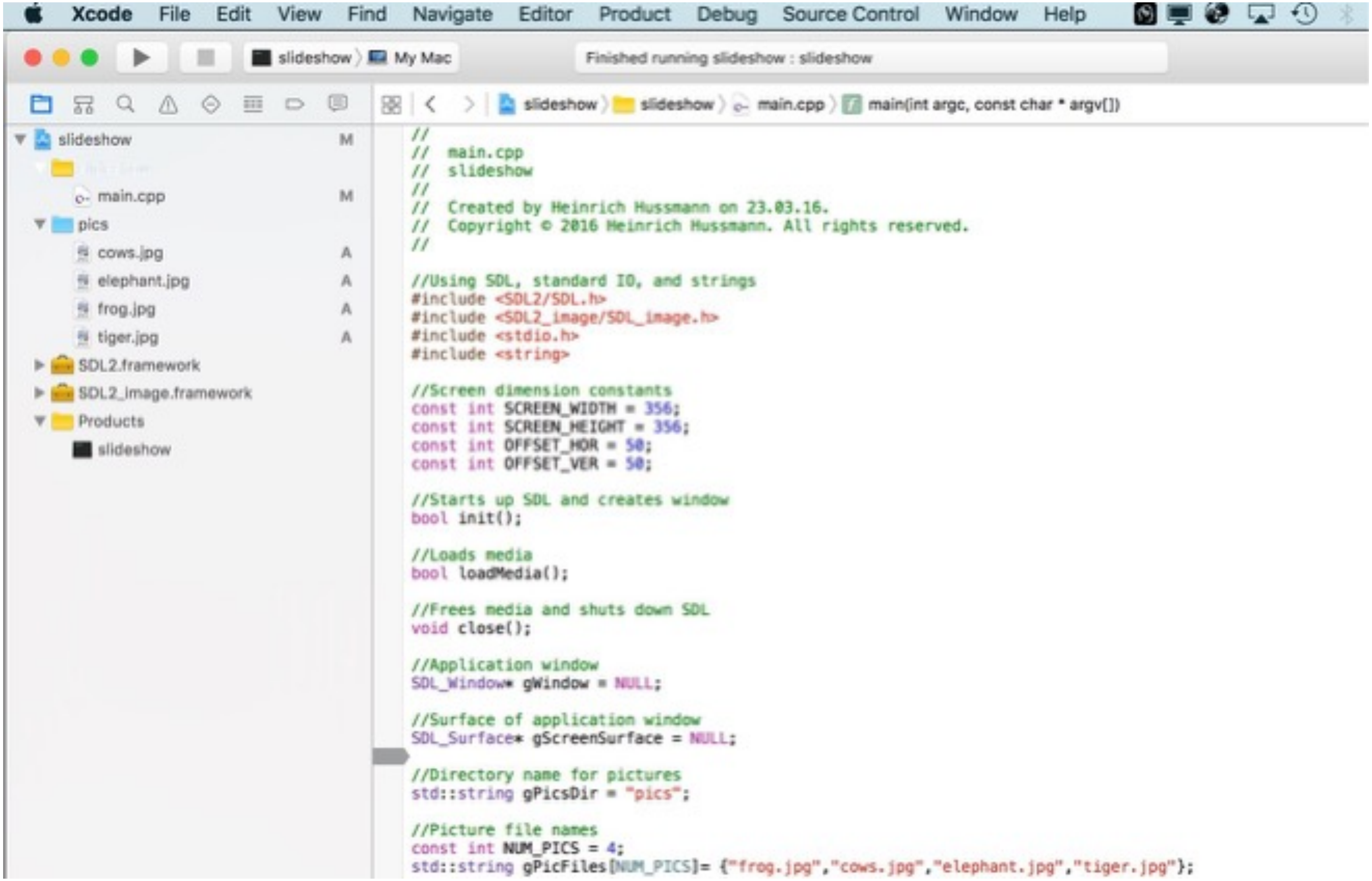
Moving on to Serious Programming…


Xcode File Edit View Find Navigate Editor Product Debug Source Control Window Help
slideshow 〉 My Mac
Finished running slideshow : slideshow
slideshow 〉 slideshow 〉 main.cpp 〉 main(int argc, const char * argv[])
slideshow M
main.cpp M
pics
cows.jpg A
elephant.jpg A
frog.jpg A
tiger.jpg A
SDL2.framework
SDL2_image.framework
Products
slideshow

```
//
//  main.cpp
//  slideshow
//
//  Created by Heinrich Hussmann on 23.03.16.
//  Copyright © 2016 Heinrich Hussmann. All rights reserved.
//

//Using SDL, standard IO, and strings
#include <SDL2/SDL.h>
#include <SDL2_image/SDL_image.h>
#include <stdio.h>
#include <string>

//Screen dimension constants
const int SCREEN_WIDTH = 356;
const int SCREEN_HEIGHT = 356;
const int OFFSET_HOR = 50;
const int OFFSET_VER = 50;

//Starts up SDL and creates window
bool init();

//Loads media
bool loadMedia();

//Frees media and shuts down SDL
void close();

//Application window
SDL_Window* gWindow = NULL;

//Surface of application window
SDL_Surface* gScreenSurface = NULL;

//Directory name for pictures
std::string gPicsDir = "pics";

//Picture file names
const int NUM_PICS = 4;
std::string gPicFiles[NUM_PICS]= {"frog.jpg","cows.jpg","elephant.jpg","tiger.jpg"};
```

Pure SDL2 Slide Show (Main Loop Part 1)

```
//Main loop
int slideIndex = 0;
bool running = true;
bool updatePicture = true;
int timer = 0;
while (running) {

    //Display next picture if necessary
    if (updatePicture) {
        SDL_BlitSurface( gLoadedPics[slideIndex], NULL,
           gScreenSurface, &destRect );
        SDL_UpdateWindowSurface( gWindow );
        updatePicture = false;
        timer = SDL_GetTicks();
    }

    while (SDL_PollEvent(&e) != 0) {
        //User requests quit
        if(e.type == SDL_QUIT) {
            running = false;
        } else if (e.type == SDL_KEYDOWN) {
            switch (e.key.keysym.sym) {
   ...
```

Pure SDL2 Slide Show (Main Loop Part 2)

…

```
             case SDLK_LEFT:
                    slideIndex = (slideIndex+NUM_PICS-1) % NUM_PICS;
                    //Note the strange C++ definition of modulo operator
                    updatePicture = true;
                    break;
                case SDLK_RIGHT:
                    slideIndex = (slideIndex+1) % NUM_PICS;
                    updatePicture = true;
                    break;
            }
        }
    };

    // Check time interval
    if (SDL_GetTicks() > timer+gInterval) {
        slideIndex = (slideIndex+1) % NUM_PICS;
        updatePicture = true;
    }
};
```

…