# Multimedia-Programmierung
# Übung 6

Ludwig-Maximilians-Universität München

Sommersemester 2016

# Today

- Sprites, Sprite Groups and Sprite Animations
- Illustrated with 

+ 

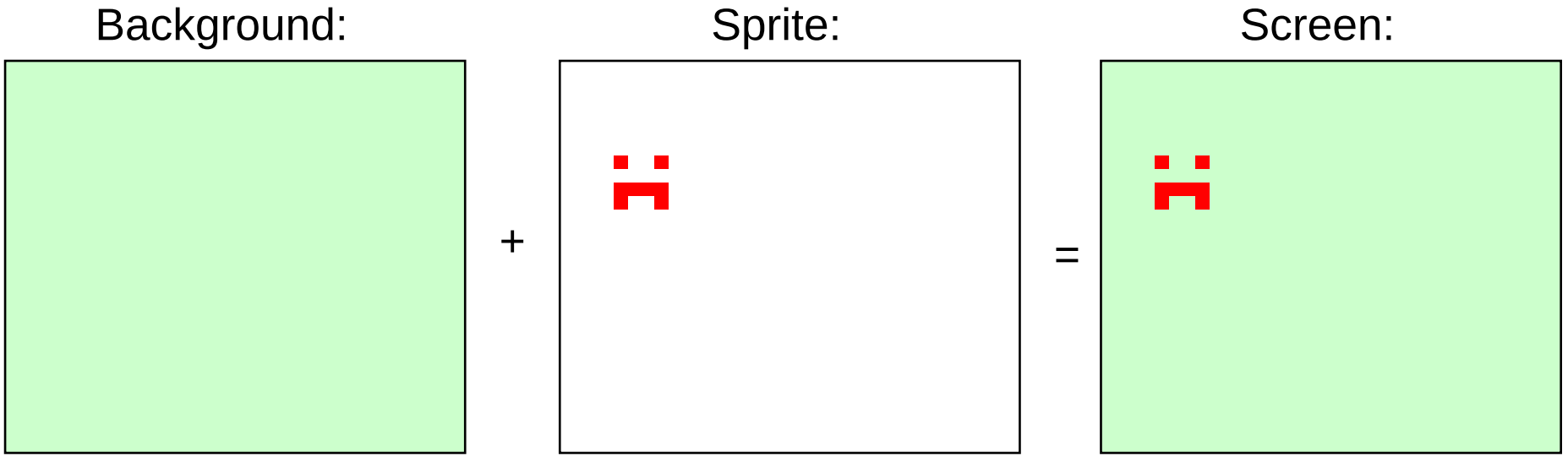

## Literature:

W. McGugan, Beginning Game Development with Python and Pygame, Apress 2007
ENGELBERT, Roger. Cocos2d-x by Example: Beginner's Guide. Packt Publishing Ltd, 2015.

# Sprites in General

**a.k.a. Spooky things that move but are not really there**

- Historically:
  - something that is laid over the background
  - implemented in hardware
- Today:
  - anything that moves over the screen
  - hardware fast enough -> sprites are now software-generated



# Sprites in Pygame

- Module pygame.sprite provides basic classes and methods to handle sprites
- Class pygame.sprite.Sprite used as base class for game objects
- Group Objects are provided as containers/lists for sprites
- Collision detection included (see next tutorial)
- http://www.pygame.org/docs/ref/sprite.html

# The Sprite Class

- Sprite objects **must** contain an image and a location
- self.image is a Surface that contains the image information
- self.rect is a Rect object that determines the location of the sprite
- A subclass of Sprite should also overwrite the update() method
- Contains derived methods that handle the object in groups:
  - kill() removes the sprite from all groups
  - remove(*groups) removes the sprite from a list of groups
  - add(*groups) adds the sprite to groups
  - groups() returns a list of groups the sprite belongs to
  - alive() tests whether the sprite belongs to any groups

# Basic Sprite Example

```
import pygame
from pygame.locals import *

class Box(pygame.sprite.Sprite):
    def __init__(self, color, initial_position):
        pygame.sprite.Sprite.__init__(self)
        self.image = pygame.Surface((20,20))
        self.image.fill(color)
        self.rect = self.image.get_rect()
        self.rect.topleft = initial_position

    def update(self):
        pass

pygame.init()
screen = pygame.display.set_mode((640, 480), 0, 32)
box = Box((255,0,0),(0,0))
while True:
    for event in pygame.event.get():
        if event.type == QUIT:
            exit()
    screen.fill((0, 0, 0))
    screen.blit(box.image,box.rect)
    pygame.display.update()
```

call the superclass constructor

define the image Surface

define the rect

blit the sprite

Result:

# Using the update Method

- Update can hold any number of arguments
- For efficient use of groups, sprites that do the same should have the same arguments

```
class Box(pygame.sprite.Sprite):
    def __init__(self, color, initial_position):
        pygame.sprite.Sprite.__init__(self)
        self.image = pygame.Surface((20,20))
        self.image.fill(color)
        self.rect = self.image.get_rect()
        self.rect.topleft = initial_position
        self.speed = 300

    def update(self, time_passed):
        moved_distance = time_passed * self.speed
        self.rect.left += moved_distance
```

# Using the update Method II

```
import pygame
from pygame.locals import *
... # Box Class here

pygame.init()
screen = pygame.display.set_mode((640, 480), 0, 32)

box = Box((255,0,0),(0,0))
clock = pygame.time.Clock()

while True:
    for event in pygame.event.get():
        if event.type == QUIT:
            exit()
    screen.fill((0, 0, 0))
    time_passed = clock.tick() / 1000.0
    box.update(time_passed)
    screen.blit(box.image,box.rect)
    pygame.display.update()
```

update the sprite

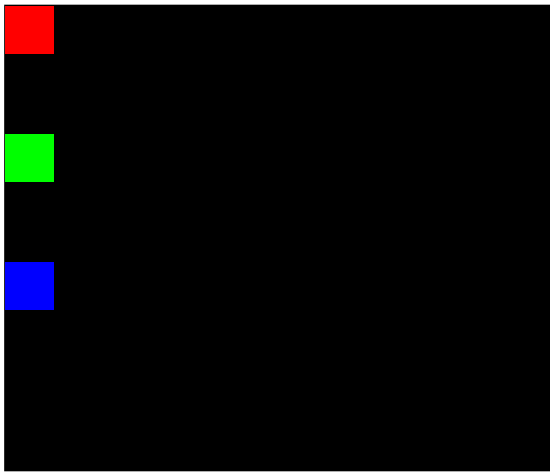
Result:

# Using the update Method - Several Objects

```
import pygame
from pygame.locals import *
... # Box Class here
pygame.init()
screen = pygame.display.set_mode((640, 480), 0, 32)

box = Box((255,0,0),(0,0))
box2 = Box((0,255,0),(0,60))
box3 = Box((0,0,255),(0,120))
clock = pygame.time.Clock()

while True:
    for event in pygame.event.get():
        if event.type == QUIT:
            exit()
    screen.fill((0, 0, 0))
    time_passed = clock.tick() / 1000.0
    box.update(time_passed)
    box2.update(time_passed)
    box3.update(time_passed)
    screen.blit(box.image,box.rect)
    screen.blit(box2.image,box2.rect)
    screen.blit(box3.image,box3.rect)
    pygame.display.update()
```

too cumbersome

Result:



# Sprite Groups

- Sprite groups (e.g. pygame.sprite.Group) are basically lists for sprites
- Handle the cumbersome details for the programmer:
  - sprites() returns a list of the sprites in that group
  - copy() returns a copy of the group
  - add(*sprites) adds a sprite to the list
  - remove(*sprites) removes the specified sprites from the list
  - has(*sprites) determines whether all sprites are in this group
  - update(*args) calls the update method of all sprites in this group (requires that they use the same arguments)
  - draw(surface) draws all the sprites in this group to the specified surface (uses Sprite.image and Sprite.rect)
  - clear(surface,background) erases the last drawn sprites from the list
  - empty() removes all sprites from the list

# Handling Complexity using Groups

```
import pygame
from pygame.locals import *
... # Box Class here
pygame.init()
screen = pygame.display.set_mode((640, 480), 0, 32)

boxes = ([(255,0,0),(0,0)],[(0,255,0),(0,60)],[(0,0,255),(0,120)])
sprites = pygame.sprite.Group()
for box in boxes:
    sprites.add(Box(box[0],box[1]))

clock = pygame.time.Clock()

while True:
    for event in pygame.event.get():
        if event.type == QUIT:
            exit()
    screen.fill((0, 0, 0))
    time_passed = clock.tick() / 1000.0
    sprites.update(time_passed)

    sprites.draw(screen)
    pygame.display.update()
```

create a group

call update on the group

draw all sprites in the group onto the screen surface

# Advanced Groups (RenderUpdates)

- Drawing the whole screen every time a sprite moves is inefficient
- RenderUpdates helps to avoid this
- Special draw() method:
  - draw(*sprites) returns a list of Rect objects that define the areas that have been changed
  - Efficient for non-animated backgrounds

# Using RenderUpdates

```
import pygame
from pygame.locals import *
... # Box Class here
pygame.init()
screen = pygame.display.set_mode((640, 480), 0, 32)

boxes = ([(255,0,0),(0,0)],[(0,255,0),(0,60)],[(0,0,255),(0,120)])
sprites = pygame.sprite.RenderUpdates()
for box in boxes:
    sprites.add(Box(box[0],box[1]))
clock = pygame.time.Clock()

background = pygame.surface.Surface((640,480))
background.fill((0,0,0))
screen.blit(background,(0,0))

while True:
    ... QUIT procedure here
    time_passed = clock.tick() / 1000.0
    sprites.update(time_passed)
    rects = sprites.draw(screen)
    pygame.display.update(rects)
    sprites.clear(screen,background)
```

RenderUpdates group

call draw and store the changed areas

clear the changes done

# Advanced Groups (OrderedUpdates)

- Remembers the order in which sprites are added
- Order is used for drawing the sprites to the screen
- Helps painting objects in the correct order
- Slower to add and remove sprites than other groups

## Iterating Sprite Groups

```
sprites = pygame.sprite.Group()
...
for sprite in sprites:
print sprite
```

# Sprites in Cocos2d-x


- Module CCSprite.h provides basic classes and methods to handle sprites
- Class Sprite::create() used as base class for game objects
- If *rect* is not specified, Cocos2d-x will automatically use the full width and height of the image file you specify.
- http://www.cocos2d-x.org/docs/programmers-guide/3/index.html

```
auto mySprite = Sprite::create("mysprite.png");

auto mySprite = Sprite::create("mysprite.png",Rect(0,0,200,200));
```

# Sprite Groups


- Grouping sprites may be required for tracking different object classes
- Add the two member variables to the header file
- These will store different sprite groups

```
cocos2d::CCArray *_group1;
cocos2d::CCArray *_group2;
```

# Sprite Groups


- New sprites are added to the array
- Its tag is set to an individual identifier (e.g. 1)

```
group1->setTag(1);
_group1->addObject(group1);

group2->setTag(2);
_group2->addObject(group2);
```

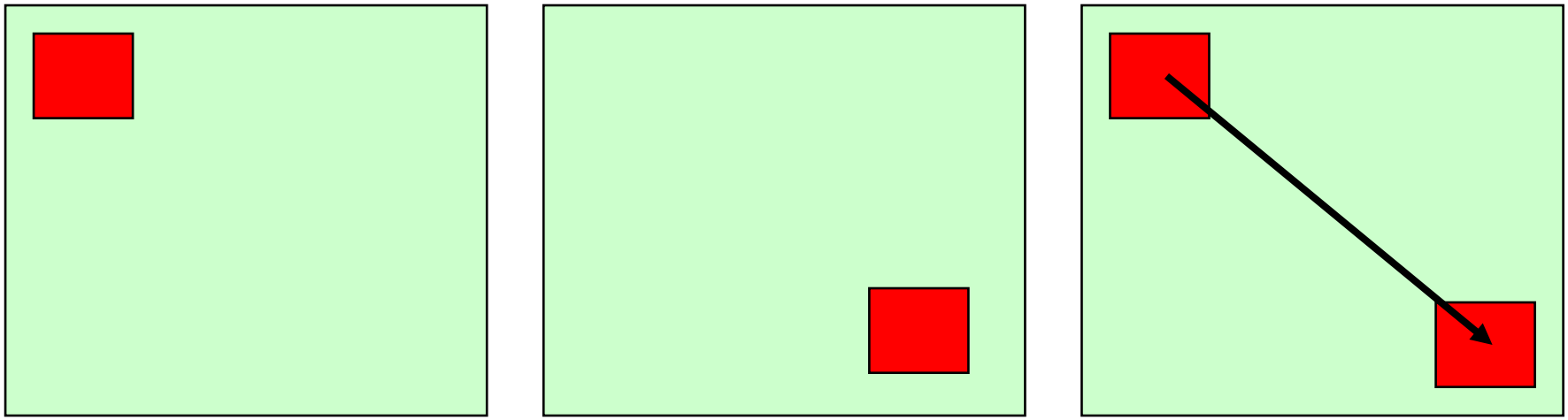
# Sprite Groups


- Now, you can identify the sprite groups and do something
- For example, delete objects after collision:

```
if (sprite->getTag() == 1)  // object1
 {
   _object1->removeObject(sprite);
 }
```

# Keyframe Animations (Recap)

- Keyframes are defined
- Intermediate steps are interpolated
- Basic interpolators/tweens/... built into many programming environments (e.g. CreateJS, JavaFX, Cocos2d-x)
- Examples: motion, color, shape
- **BUT**: PyGame does not provide built-in interpolators!



# Sprite Animations

- Animations consist of frames that are displayed one after another

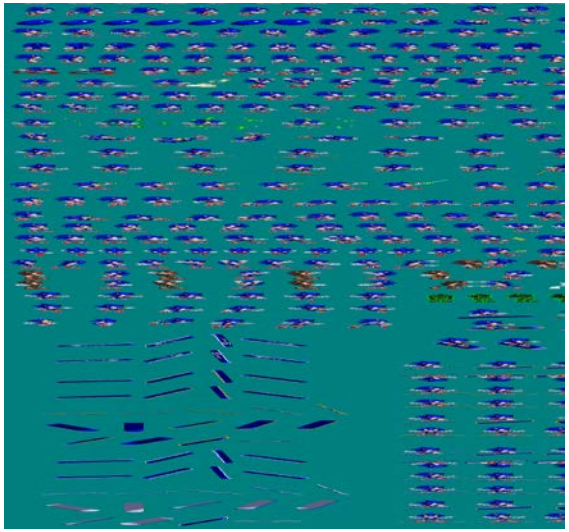
Frame 1 ... Frame 7

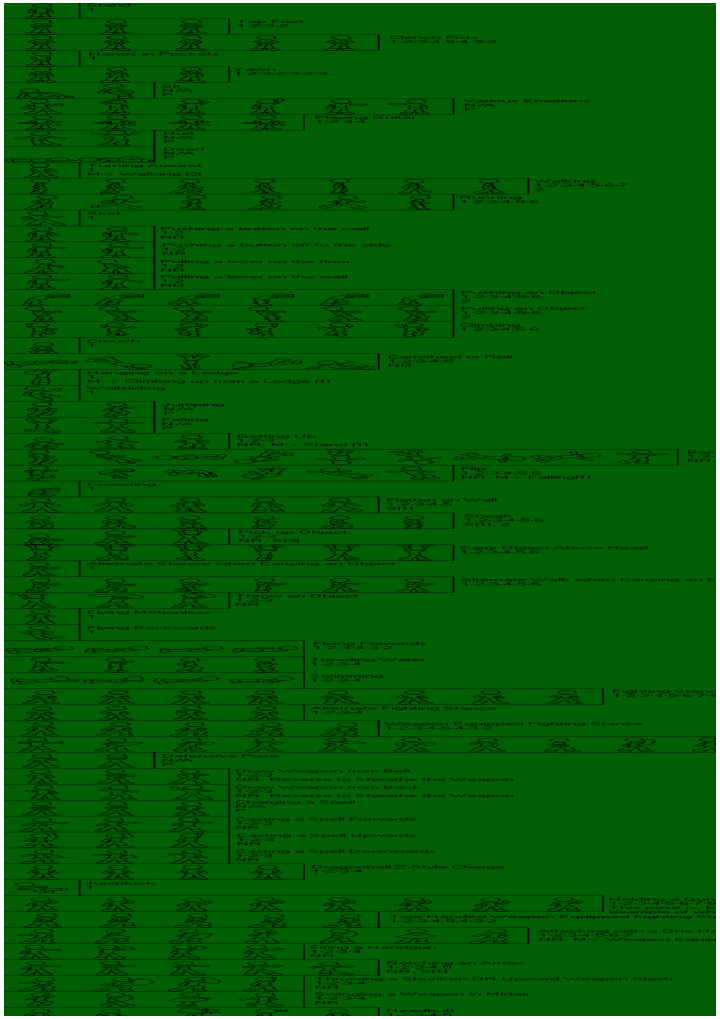
- Either imported as single graphics or with sprite sheets
- Single graphics are not recommended as loading each file takes time, switching between the files is expensive and sprites can't be optimized

Graphic from http://shinylittlething.com/2009/07/21/pygame-and-animated-sprites/
Contains small tutorial on creating animations with sprite sheets in Pygame

# Sprite Sheets & Spriting

- Sprite sheets contain all possible movements for a character
- If no meta data is provided, each Sprite should have the same size for easy slicing in software

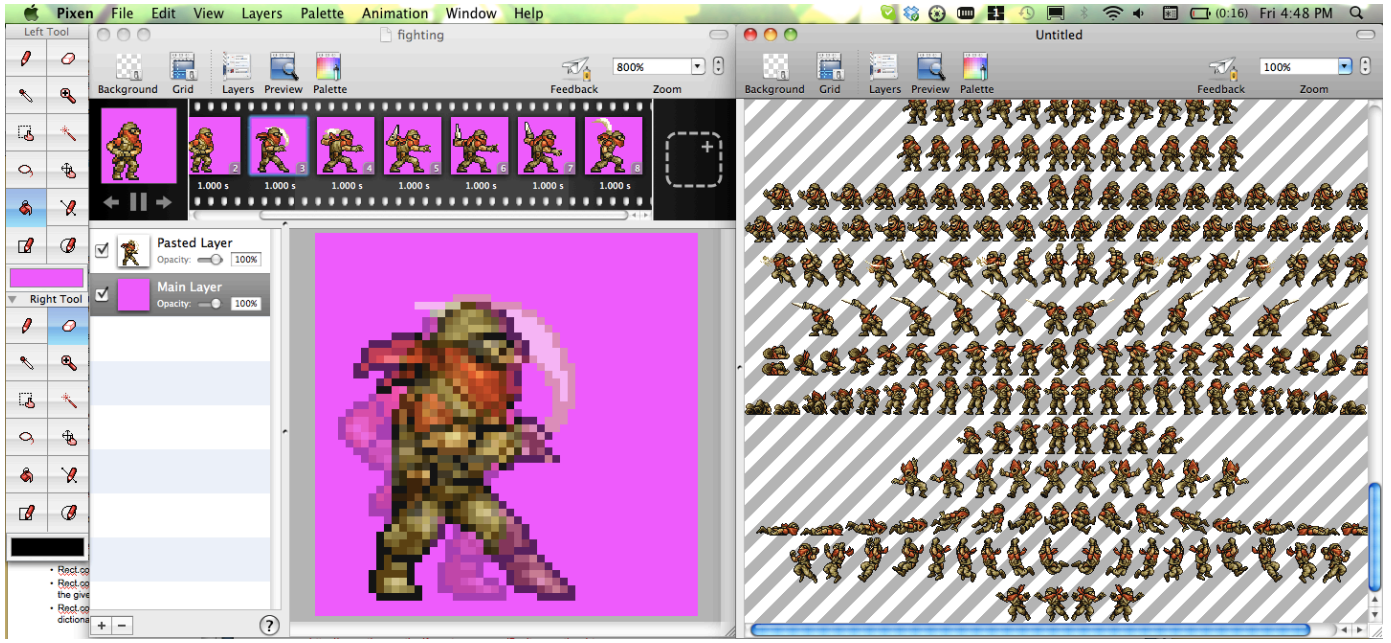




http://www.yoyogames.com/extras/resource/file/san1/90/90/male_character_outline_final.png
http://www.themysticalforestzone.com/Sprite_section.htm

# Creating Sprite Sheets

- Editing with Photoshop, Gimp, Pixen etc.
- Pay attention to positioning of character and background color (should not appear in character)
- Tool support sprite sheet generation (see next slide)



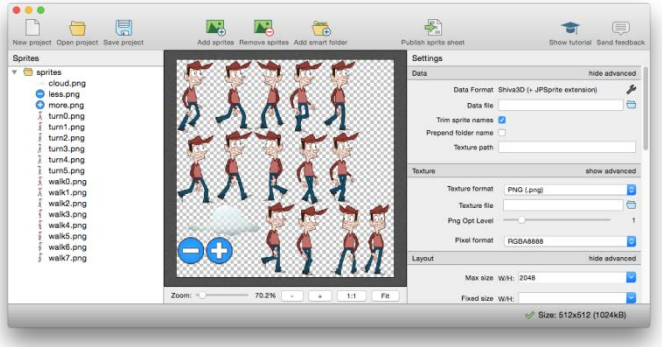

Pixen (Mac only)

# Tools for Creating Sprite Sheets

For example:

- https://zwopple.com/zwoptex/
- https://www.codeandweb.com/texturepacker
- http://renderhjs.net/shoebox/


https://zwopple.com/zwoptex/




https://www.codeandweb.com/texturepacker

- Optimize image size
- Remove transparent pixels
- Target multiple scales and fortmats
- Generate plist files

# Slicing Sprite Sheets

```
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
```

set transparent color, background color of sprite sheet

create subsurfaces

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

# First Sprite Animation 1

```
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 current frame

Based on the frames per second (fps) calculate the time needed for animation changes

Frame changed?
Change frame

# First Sprite Animation 2

```
...
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()
```

two bombs in two different framerates

# Sprite Sheets in Cocos2d-x


- Generate sprite sheet (and plist XML)
- Load sprite sheet in SpriteFrameCache for quick access
- The must be SpriteFrame is loaded only once

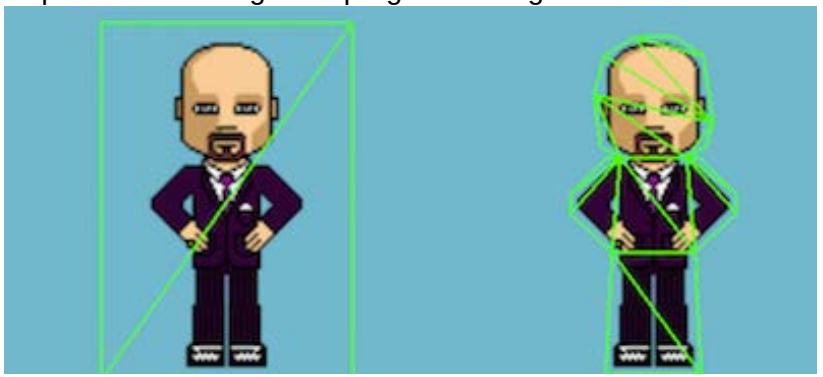
```
// load the Sprite Sheet
auto spritecache = SpriteFrameCache::getInstance();

// the .plist file can be generated with Cocos Studio or ShoeBox
spritecache->addSpriteFramesWithFile("sprites.plist");
```

```
// load the Sprite Sheet
auto mysprite = Sprite::createWithSpriteFrameName("mysprite.png");
```

# Polygone Sprites

- GPU has to process transparent and visible pixels
- Polygone sprites are made of a series of triangles
- This improves performance by saving pixels

http://cocos2d-x.org/docs/programmers-guide/3/



10285 Pixels 4089 Pixels

# Polygone Sprites


- AutoPolygon processes an image into a 2d polygon mesh at runtime.

```
// Generate polygon info automatically.
auto pinfo = AutoPolygon::generatePolygon("filename.png");

// Create a sprite with polygon info.
auto sprite = Sprite::create(pinfo);
```

# Frame by Frame Animation with Sprite Sheets I


```
Vector HelloWorld::getAnimation(const char *format, int count)
{
    auto spritecache = SpriteFrameCache::getInstance();
    Vector animFrames;
    char str[100];
    for(int i = 1; i <= count; i++)
    {
        sprintf(str, format, i);
        animFrames.pushBack(spritecache->getSpriteFrameByName(str));
    }
    return animFrames;
}
```

https://www.codeandweb.com/texturepacker/tutorials/animations-and-spritesheets-in-cocos2d-x

# Frame by Frame Animation with Sprite Sheets II


```
auto frames = getAnimation("capguy/walk/%04d.png", 8);
auto sprite = Sprite::createWithSpriteFrame(frames.front());
background->addChild(sprite);
sprite->setPosition(100,620);

auto animation = Animation::createWithSpriteFrames(frames, 1.0f/8);
sprite->runAction(RepeatForever::create(Animate::create(animation)));
```

https://www.codeandweb.com/texturepacker/tutorials/animations-and-spritesheets-in-cocos2d-x

# Useful Links

- http://www.pygame.org/docs
- http://www.cocos2d-x.org/wiki/Sprites