Today

• Animations with Pygame

Literature: W. McGugan, Beginning Game Development with Python and Pygame, Apress 2007
Objects on the Screen don’t actually move

• Basically, only the colours of pixels are changed
• Everytime something changes, the whole screen is repainted
• Framerate defines the appearance of the animation (the higher, the better)
• Possible framerate depends on the hardware (e.g. hertz of the monitor)
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()
Timing and Framerate

• Problem: The previous example creates an animation that runs in different speed depending on the power of the cpu
• Solution: time-based animations
• `pygame.time.Clock()` provides an appropriate tool for time-based animations
• `Clock.tick()` returns the time that passed since its last call

```
clock = pygame.time.Clock()
clock.tick()
```
Moving an object time-based

```
... 

clock = pygame.time.Clock()

speed = 300.0  # speed in pixels per second

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

while True:
    time_passed = clock.tick() / 1000.0  # time passed since last tick() in seconds
    moved_distance = time_passed * speed  # distance moved since last call
    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 += moved_distance  # move the sprite the calculated distance
    pygame.display.update()
```
Diagonal Movement
or: Vectors, yeah!

• Moving a sprite to a specific coordinate requires movement on the x- and y-axis
• Best achieved using **vectors**
• E.g. a vector of (10,30) means move 10 pixels on the x- and 30 on the y-axis
• Store vectors as tuples, lists or create a class

![Diagram](image.png)
Vectors I

• Example class

```python
class Vector(object):
    def __init__(self, x, y):
        self.x = x
        self.y = y

    def __str__(self):
        return "vector (%s,%s)"%(self.x, self.y)

@classmethod
def vector_from_points(cls, from_p, to_p):
    return cls(to_p[0]-from_p[0], to_p[1]-from_p[1])
```

Use:

code: vector1 = Vector(10.0,20.0)
print vector1
print Vector.vector_from_points((10,10), (30,10))

Output:

code: vector (10.0,20.0)
vector (20,0)
Vectors II

- Vector magnitude

```python
import math
class Vector(object):
    ...

def get_magnitude(self):
    return math.sqrt(self.x**2 + self.y**2)
```

A (10, 30) → B (40, 10)

Vektor (30, -20)

\[ \sqrt{30^2 + (-20)^2} \]
Vectors 3

• Normalizing a vector

```python
class Vector(object):
    ...

    def normalize(self):
        magnitude = self.get_magnitude()
        self.x /= magnitude
        self.y /= magnitude
```

```
x = 0.83
y = -0.55
```

(10,30) → (40,10)
x = 0.83
y = -0.55
import pygame
from pygame.locals import *
from sys import exit
import math

class Vector(object):
    def __init__(self, x=0.0, y=0.0):
        self.x = x
        self.y = y

    def __str__(self):
        return "(%s, %s)"%(self.x, self.y)

    def get_magnitude(self):
        return math.sqrt(self.x**2 + self.y**2)

    def normalize(self):
        magnitude = self.get_magnitude()
        self.x /= magnitude
        self.y /= magnitude

    @classmethod
    def vector_from_points(cls,from_p,to_p):
        return cls(to_p[0]-from_p[0],to_p[1]-from_p[1])

Diagonal movement using vectors 1
mpos = (0.0, 0.0)  # start and end positions
destination = (500, 430)
player_image = 'head.jpg'
pygame.init()

screen = pygame.display.set_mode((640, 640), 0, 32)
pygame.display.set_caption("Animate X!")

mouseCursor = pygame.image.load(player_image).convert_alpha()
clock = pygame.time.Clock()

speed = 300.0  # pixels per second
heading = Vector.vector_from_points(mpos, destination)
heading.normalize()  # calculate the vector and normalize it

...
while True:
    for event in pygame.event.get():
        if event.type == QUIT:
            exit()
        screen.fill((255,255,255))

    time_passed = clock.tick() / 1000.0
    moved_distance = time_passed * speed

    screen.blit(mouse_cursor, mpos)
    mpos = (mpos[0] + heading.x * moved_distance, mpos[1] + heading.y * moved_distance)

    pygame.display.update()