

Comp 388/488 - Introduction to Game Design and Development

Spring Semester 2017 - Week 6

Dr Nick Hayward

Contents

- Game designers
- Python and Pygame
 - *moving shapes*
 - *events*
 - *interaction and control*
- Games and ideas
- References

Game designers

Designer example - Peter Molyneux

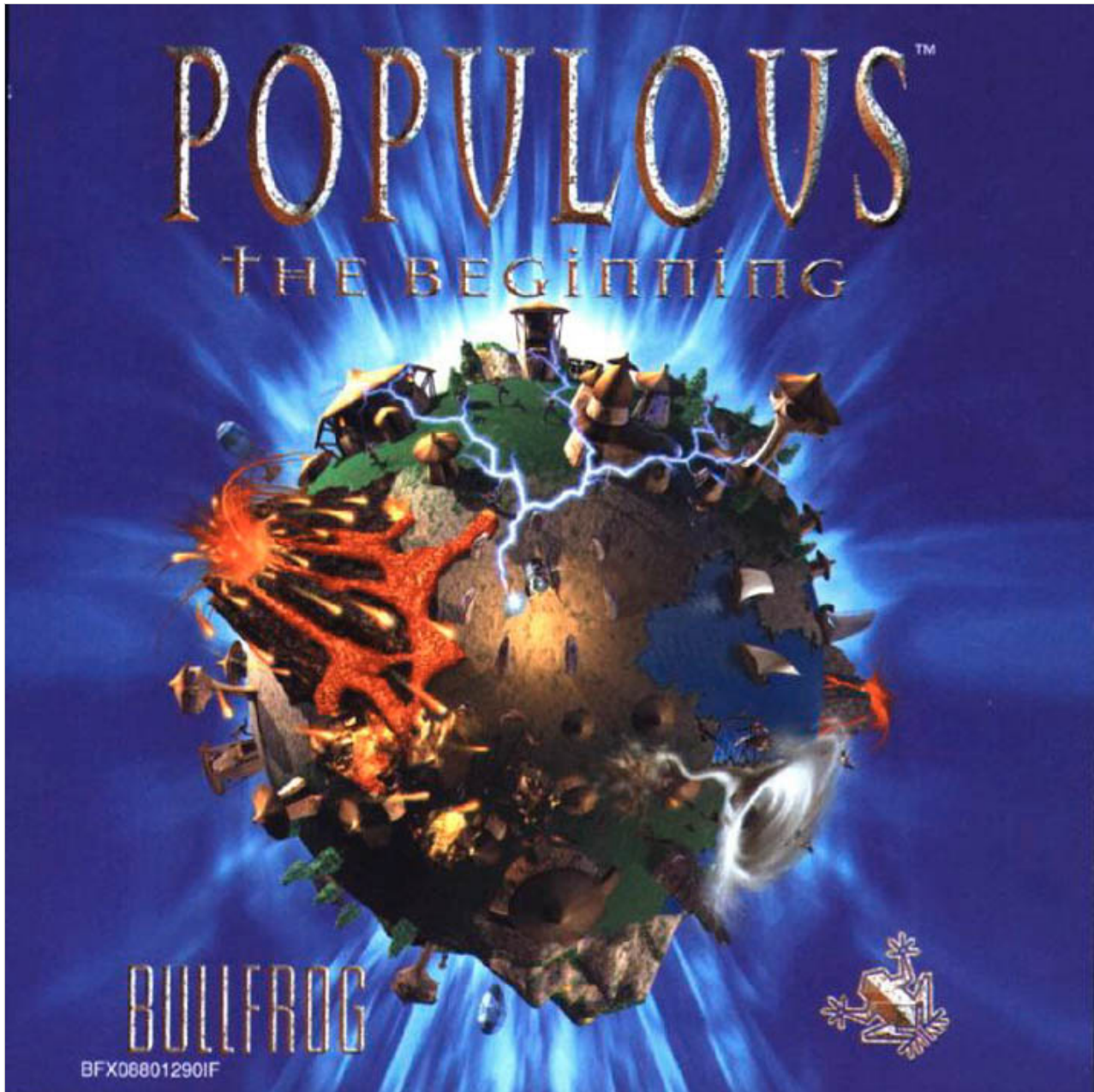
- well known example of a designer who pushed boundaries
 - *in particular, what we perceive as a game*
- breakthrough moment came with the design of the game **Populous**
 - *effectively created the **god** gaming genre*
- **Populous** was released in 1989 by his company **Bullfrog**
 - *sold over 4 million copies*
 - *best version originally released on the Commodore Amiga*
- **Black and White** game for Windows PCs released in 2001
 - *known for its unique design and gameplay*
 - *its overall depth and scope*
 - *renowned for its creatures' artificial intelligence*
 - *set a new Guinness World Record for its overall complexity*
- he also created game series such as
 - *Dungeon Keeper*
 - *Theme Park*
 - *Fable*
 - *The Trail*
 - ...

Image - Peter Molyneux



Peter Molyneux

Image - Populous - 1989



Populous cover

Video - Populous - Amiga

Populous, Amiga - Part 1 - Overlooked Oldies



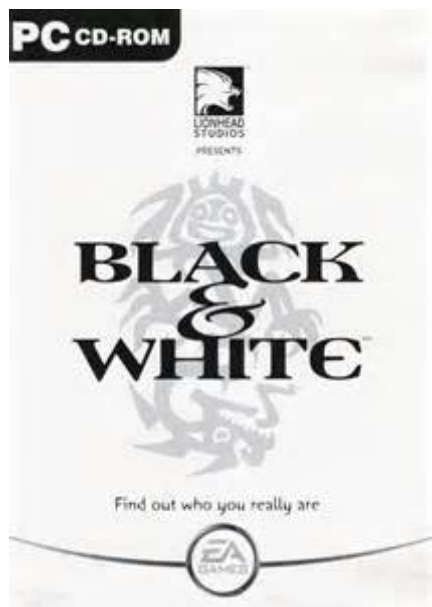
Source - [Populous on the Amiga, Youtube](#)

Image - Black and White - 2001

Black cover



White cover



Video - Peter Molyneux's Black and White

Black & White (PC) - Retro Review



Source - Black and White review, YouTube

Python and Pygame - moving shapes

basic animation - vertical - up

- move, and animate, our shapes using a vertical path
 - *from top to bottom, up and down*
- **move up**
 - *decrease or remove the Y value of a shape's position*
 - *e.g. simply remove 4 pixels per iteration of the game loop*

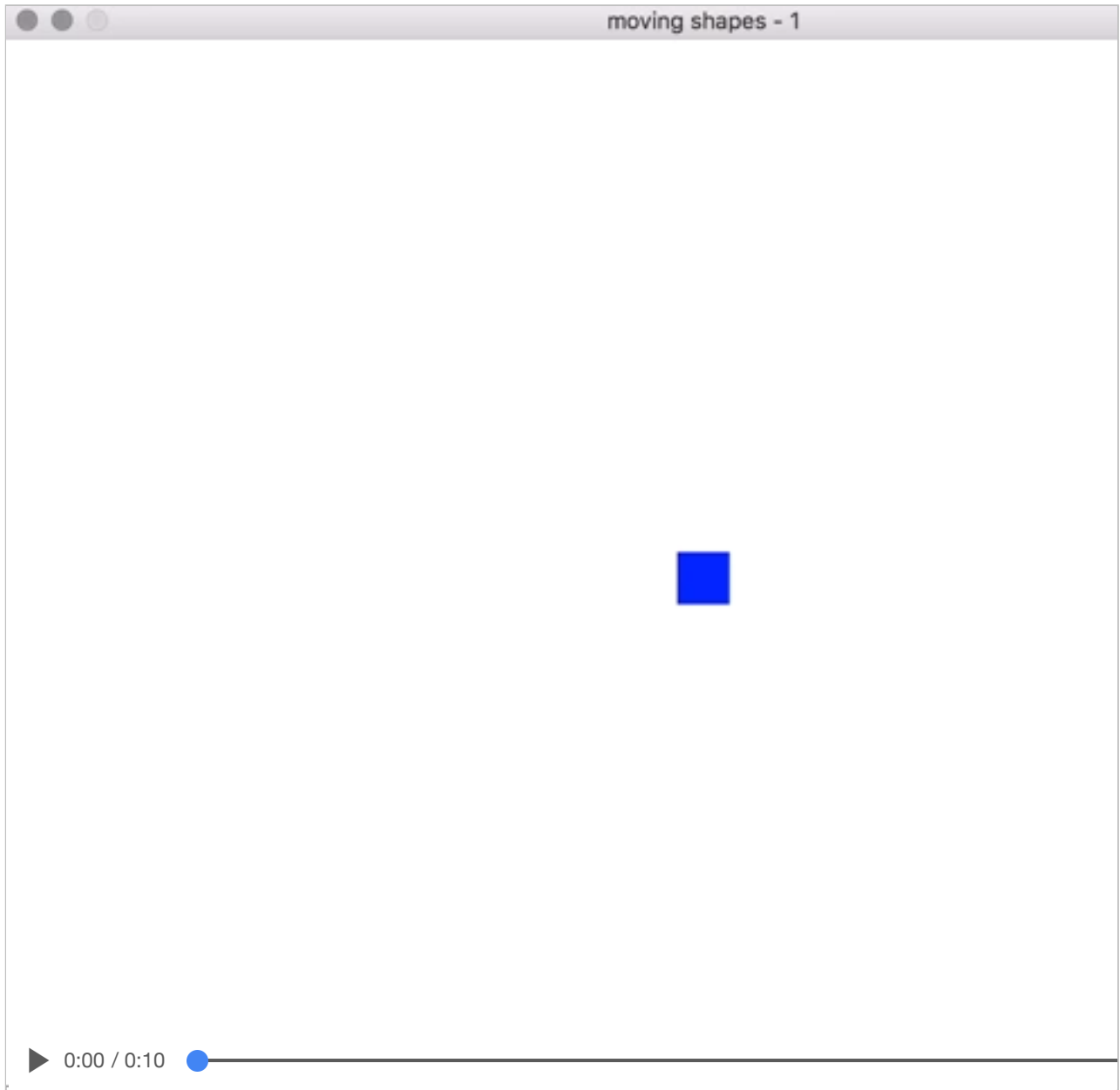
```
...  
rectY -= 4  
...
```

- detect our shape's position relative to the top edge of the window
 - *then animate it up from the bottom*

```
# check position of rectY and continue animation  
if rectY < 0:  
    rectY = winHeight  
else:  
    rectY -=4
```

Video - Moving Shapes

basic animation - move up



Python and Pygame - moving shapes

basic animation - vertical - down

■ move down

- *increase or add the Y value of a shape's position*
- *e.g. simply add 4 pixels per iteration of the game loop*

```
...  
rectY += 4  
...
```

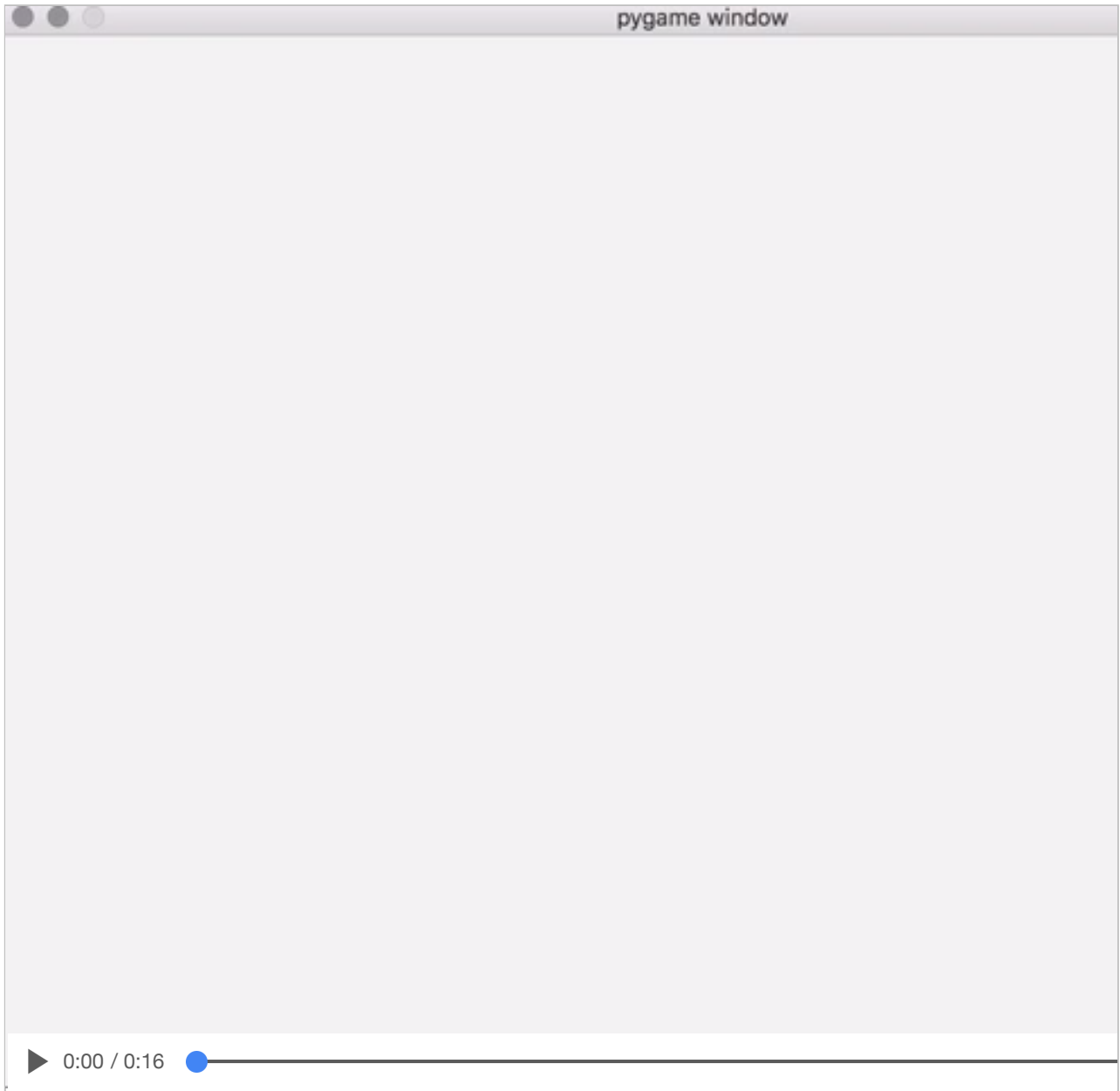
■ check as the shape leaves the game window

- *continue animation from the top of the window*

```
# check position of rectY and continue animation  
if rectY > winHeight:  
    rectY = 0  
else:  
    rectY +=4
```

Video - Moving Shapes

basic animation - move down



Python and Pygame - events

intro

- detect interaction events with Pygame
 - *then allow a player to control shapes, animations, &c*
- as the *game loop* is executed
 - *Pygame keeps a record of interaction events for the game window*
- regardless of the execution point of the *game loop*
 - *e.g. update or drawing...*
 - *each event is added to `events`...where applicable*
- we may then check `events` to see if a particular key has been pressed
 - *or perhaps a controller button clicked*
- we start by importing `pygame.event`
 - *may be used with the keyboard, mouse, &c. events...*

```
import pygame.event
```

Python and Pygame - events

keyboard

- detect interaction events for keys pressed by a player whilst the Pygame window is running
- if we wanted to check for a given key press
 - *we may add a generic listener for KEYDOWN, KEYUP, KEY_ESCAPE...*

```
...  
# check keyboard events - keydown  
if event.type == pygame.KEYDOWN:  
...
```

- then check a specific key event relative to keydown
 - *perhaps a player request to move a shape left or right...*

```
# check keyboard events - keydown  
if event.type == pygame.KEYDOWN:  
    if event.key == pygame.K_LEFT:  
        leftDown = True  
    if event.key == pygame.K_RIGHT:  
        rightDown = True
```

- we may also check specific lettered keys
 - *such as the f character, again as part of a key press down*

```
if event.key == pygame.K_f:
```

- simply listening for a key press on the f key on the player's keyboard
 - *perhaps allowing a player to toggle the game window fullscreen*
- many more examples listed on the Pygame website,
 - *Pygame - key*

Python and Pygame - events

keyboard - control shape left to right - part I

- create a standard listener for an interaction event
 - e.g. *a keyboard event*
- we may then move our shape using one of 4-points on a coordinate plane
 - *left, right, up, and down*
- then check a specific key event relative to keydown
 - *perhaps a player request to move a shape left or right*
- on the KEYDOWN event, we update the boolean value for the requested key

```
# check keyboard events - keydown
if event.type == pygame.KEYDOWN:
    if event.key == pygame.K_LEFT:
        leftDown = True
    if event.key == pygame.K_RIGHT:
        rightDown = True
```

- then reset it to FALSE on the KEYUP event,

```
# check keyboard events - keyup
if event.type == pygame.KEYUP:
    if event.key == pygame.K_LEFT:
        leftDown = False
    if event.key == pygame.K_RIGHT:
        rightDown = False
```


Python and Pygame - events

keyboard - control shape left to right - part 2

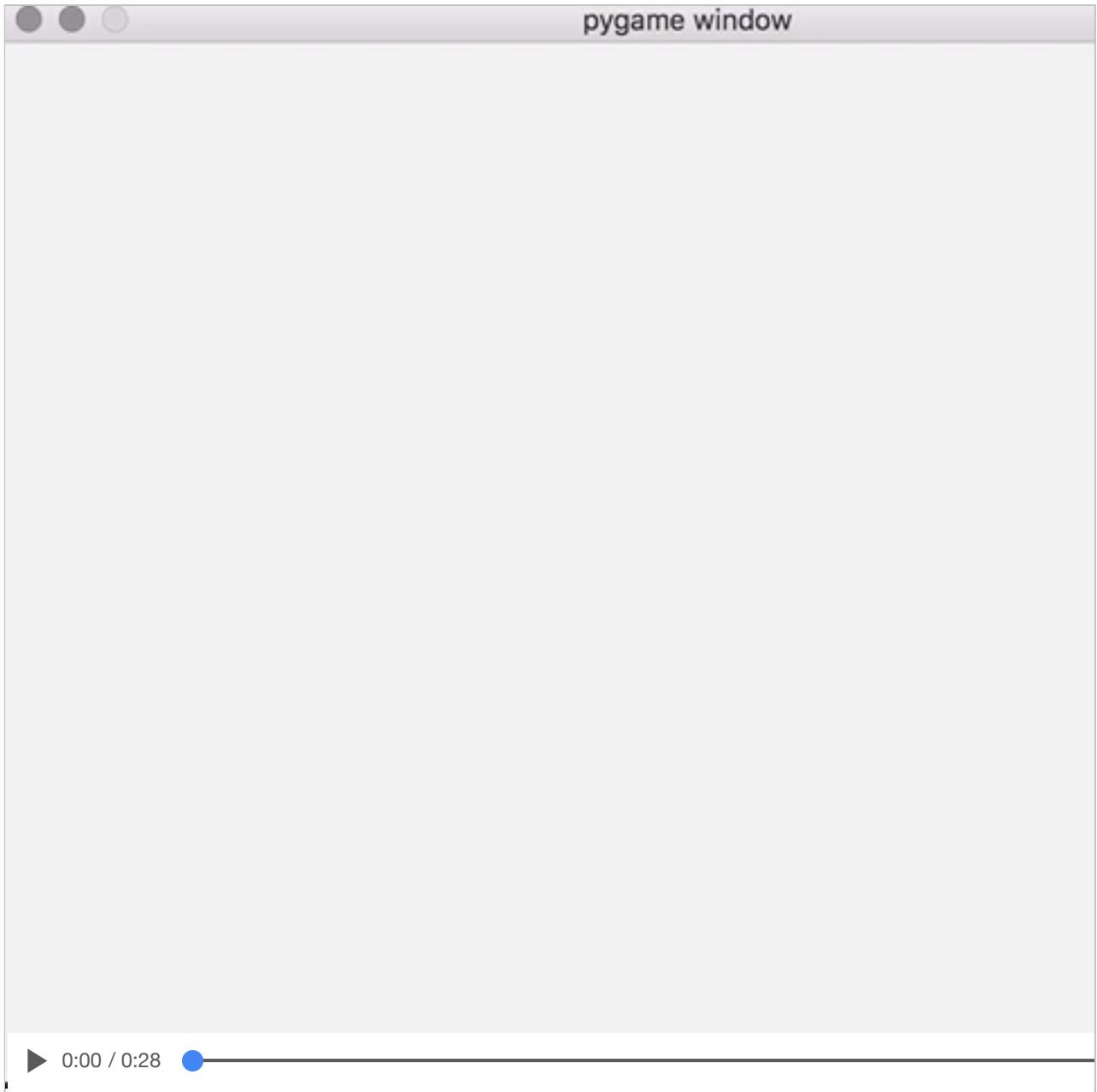
- we can use the set *boolean* value to modify the animation of a shape, e.g.

```
...
# event variables - keyboard
leftDown = False
rightDown = False
# some rect variables
rectSpeed = 4.0
...
# move left
if leftDown:
    # check shape doesn't exit window to left
    if rectX > 0.0:
        rectX -= rectSpeed
# move right
if rightDown:
    # check shape doesn't exit window to right
    if rectX + rectSize < winWidth:
        rectX += rectSpeed
...
```

- we're checking the boolean value for left or right key down
 - if set to true, i.e. the player has pressed the key down
 - we can then check the shape's x coordinate position
- check either the left or right side of the game window relative to the key pressed
- then, either increment or decrement the shape's x coordinate
 - by the set speed for our animation

Video - Interaction Events

keyboard - control shape - left to right



Python and Pygame - events

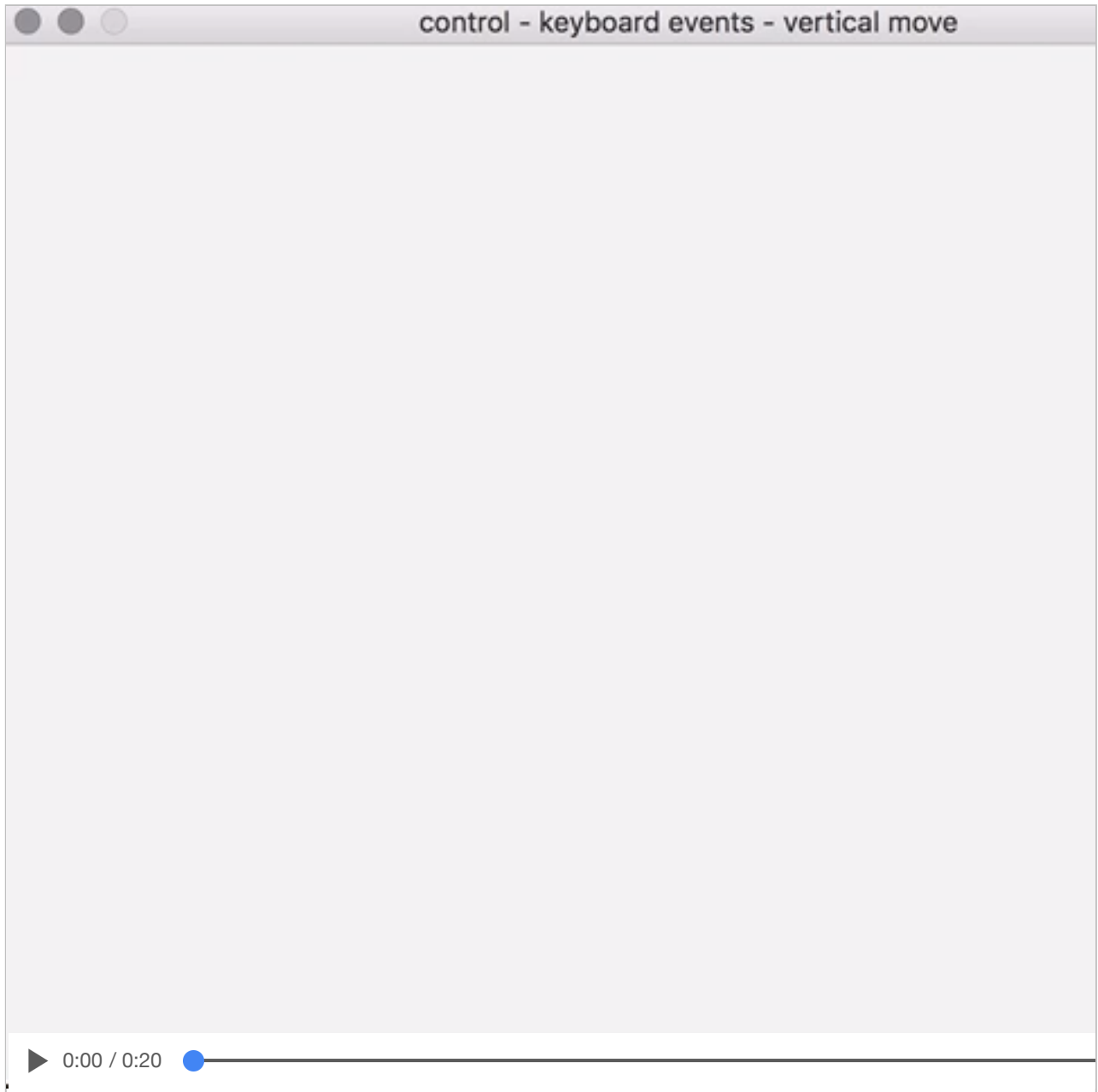
keyboard - control shape - up and down

- also use such interaction events to animate our shape up or down the screen
 - set a boolean value to *TRUE* or *FALSE*
 - relative to the *KEYUP* or *KEYDOWN* event
- then, we can animate our shape up and down the game window

```
...
# event variables - keyboard
upDown = False
downDown = False
# some rect variables
rectSpeed = 4.0
...
# move up
if upDown:
    # check shape doesn't exit window at top
    if rectY > 0.0:
        rectY -= rectSpeed
# move down
if downDown:
    # check shape doesn't exit window at bottom
    if rectY + rectSize < winHeight:
        rectY += rectSpeed
```

Video - Interaction Events

keyboard - control shape - up and down



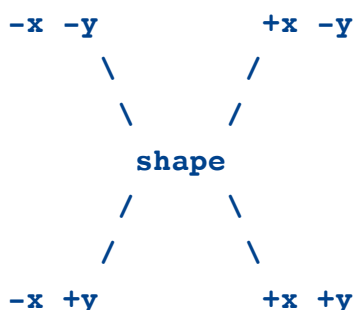
Python and Pygame - events

keyboard - control shape - 8-point move

- in addition to the standard left, right, up, and down directions...
 - *combine these events to allow a user to move a shape in a diagonal direction*
- a player may simultaneously press KEYDOWN on both up and right
 - *allows a player to move a shape at a 45 degree angle*

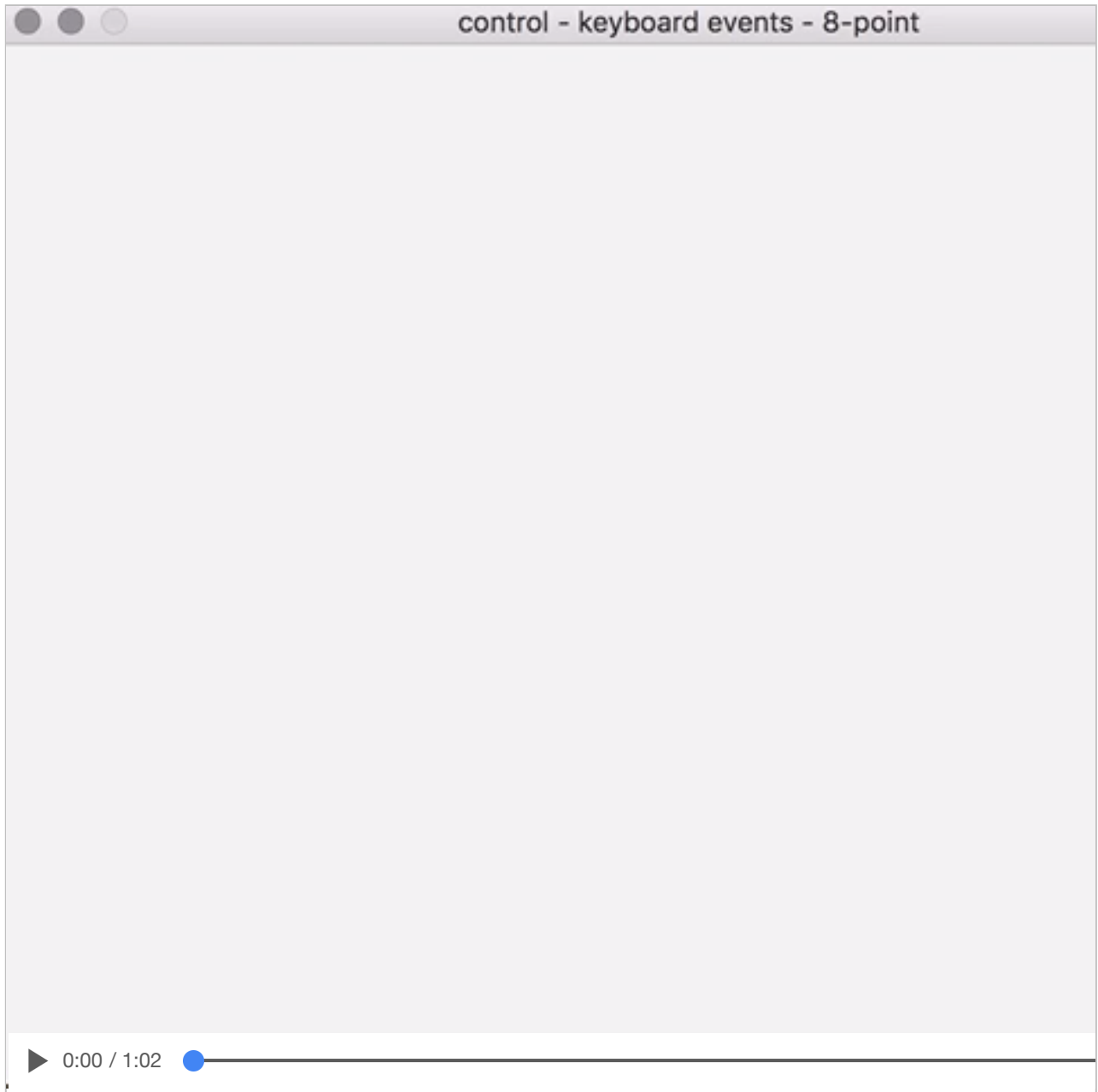
```
...
# move up
if upDown:
    # check shape doesn't exit window at top
    if rectY > 0.0:
        rectY -= rectSpeed
# move right
if rightDown:
    # check shape doesn't exit window to right
    if rectX + rectSize < winWidth:
        rectX += rectSpeed
```

- a player may also use other available combinations to move the shape
 - *at one of 4 available angles of 45 degrees...*



Video - Interaction Events

keyboard - control shape - 8-point move



Python and Pygame - events

keyboard - control shape - jump - part I

- to make a shape *jump*
 - we may start by defining a useful boolean variable *shapeJump*
- then simply update this value
 - defines whether the character is jumping or not
- also define a default pixel height for the jump itself
 - simply defining how far to move the shape up the game window

```
jumpHeight = 30.0
```

- then, we can add a listener for the defined key
 - e.g. we might simply use the obvious *UP* directional arrow on our keyboard

```
...
# check keyboard events - keydown
if event.type == pygame.KEYDOWN:
    # check for directional UP key
    if event.key == pygame.K_UP:
        if not shapeJump:
            shapeJump = True
            shapeJY += jumpHeight
...
```

- we're listening for the standard player KEYDOWN event
 - then the actual directional UP key event
- check the boolean value of the variable *shapeJump*
 - update to *True* if the shape is not already jumping
- then, incrementally update value of the shape's requested jump Y value, *shapeJY*

Python and Pygame - events

keyboard - control shape - jump - part 2

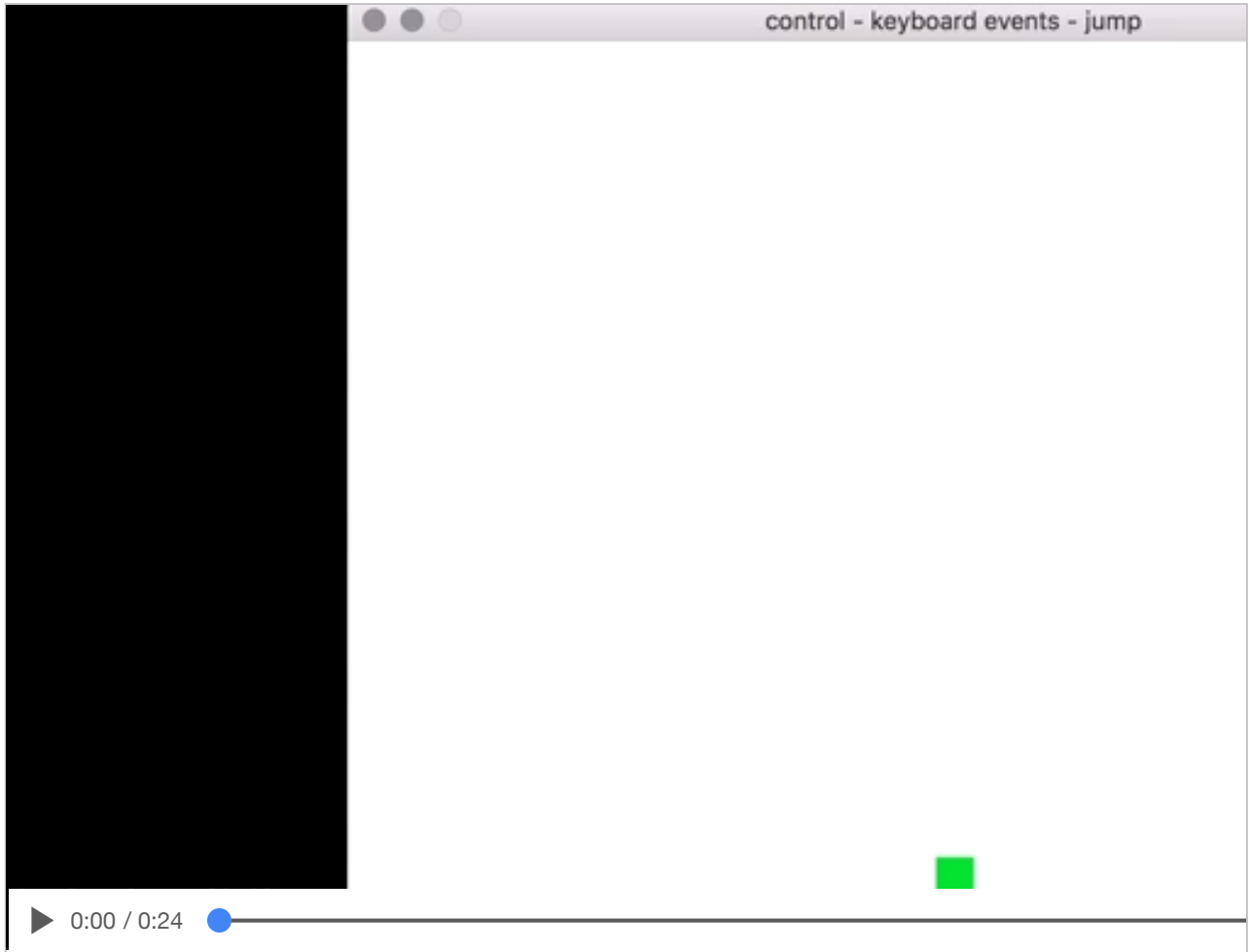
- to make the shape jump, or effectively move up the screen per iteration of the game loop
 - *we can define a function to handle this jump, `jump()`*

```
def jump():  
    global shapeY, shapeJY, shapeJump  
  
    # check if shape in air - use gravity to descend  
    if shapeJump == True:  
        shapeY -= shapeJY  
        print("in the air %8.2f" % (shapeJY))  
        shapeJump = False
```

- check the output of the jump up the screen
 - *e.g. printing the formatted float to the terminal.*
- if you run this example...
 - *you'll notice that the shape will keep jumping as the player presses the UP directional key*
 - *well beyond the bounds of the top of the game window*
- Pygame window needs to scroll...

Video - Interaction Events

keyboard - control shape - jump, jump, jump...



Python and Pygame - events

keyboard - control shape - jump and fall

- we could make the shape move down the window
 - e.g. by listening for an explicit key press on the **DOWN** directional key
- it's more natural, and expected behaviour, to allow our shape to fall
 - after the player has pressed the **UP** directional key
 - allowing our shape to jump, and then fall
 - fall with a real-world behaviour of **gravity**
- to make it fall, we need to check that the shape is *in the air*
- then gradually modify gravity to lower the shape
 - lower to the original starting position in the Pygame window

Python and Pygame - events

keyboard - control shape - jump and fall

code example

```
def jump():
    global shapeY, shapeJY, shapeJump, gravity
    # check upward speed > 1.0
    if shapeJY > 1.0:
        # gradually decrease upward speed to less than 1.0
        shapeJY = shapeJY * 0.9
    else:
        # less than 1.0, reset to 0.0 to allow shape to fall
        shapeJY = 0.0
        # stop jump
        shapeJump = False

    # check if shape in air - use gravity to descend
    if shapeY < winHeight - shapeSize:
        shapeY += gravity
        gravity = gravity * 1.1
    else:
        shapeY = winHeight - shapeSize
        gravity = 1.0

    shapeY -= shapeJY
```

Python and Pygame - events

keyboard - control shape - jump and fall

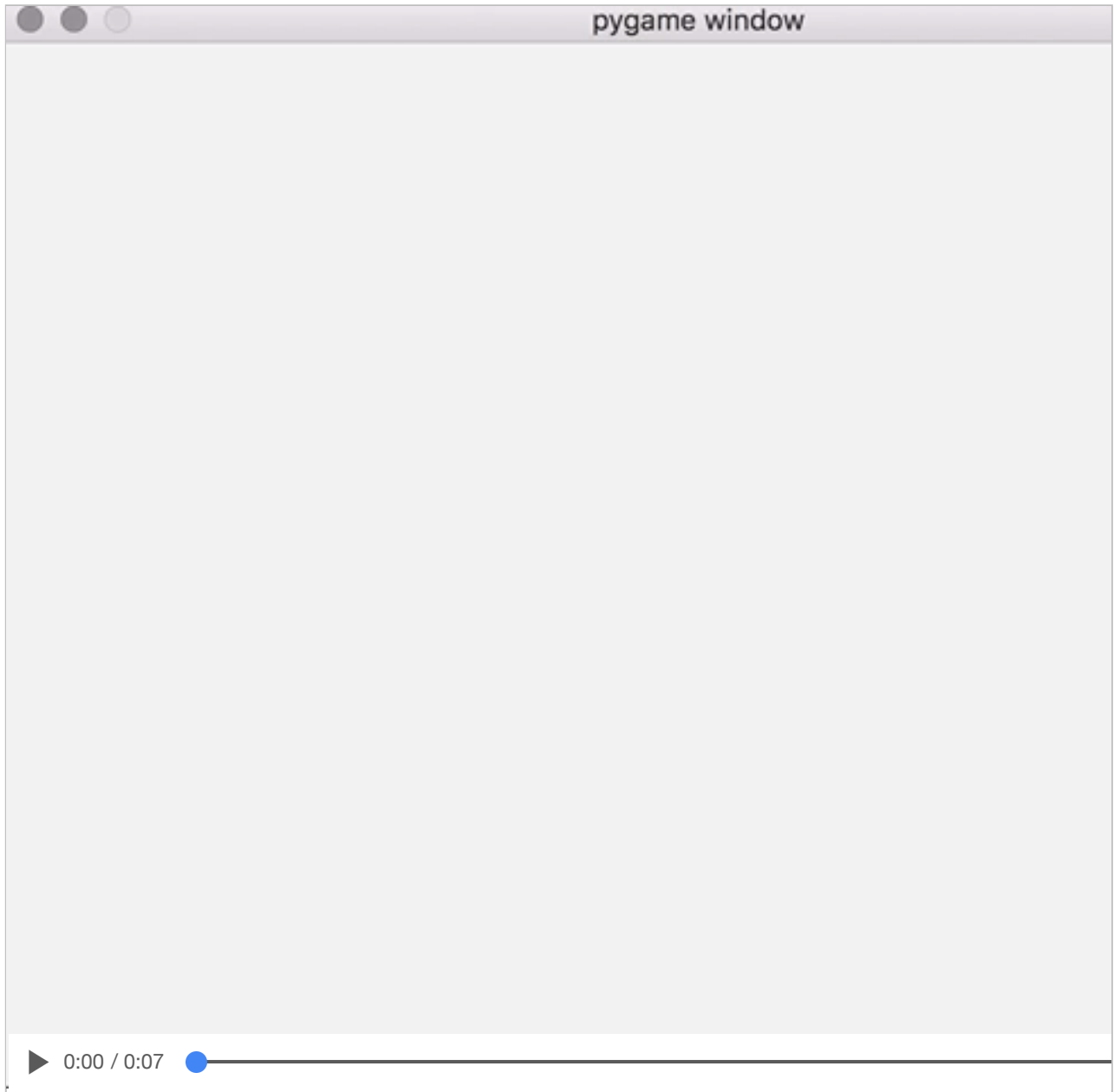
code example outline

- in the previous code example
 - *start by checking whether the shape is still moving up the screen*
 - *effectively if the jump is still in progress*
- whilst the upward speed of the shape is still above 1.0
 - *gradually start to decrease the speed*
 - *it will eventually reach a limit for the jump*
- faster we decrease this upward motion
 - *the shorter the shape will appear to jump*
- also negates the overall effect of the value of the variable `jumpHeight`
 - *now has less iterations of the game loop to move the shape up the screen*
- need to check if the shape is actually moving up the screen
 - *or effectively in the **air** for the jump*
- if not, then the shape will simply come to a halt as it rises up the screen
 - *due to the decrease in upward speed and motion*
- we need to add the perception of **gravity** to the shape's motion
 - *whilst the shape appears to be in the **air**, or jumping up the screen*
 - *start to add the number of pixels we define for the variable **gravity***
 - *add pixels to our shape's upward movement*

- as the shape starts to fall down the game window
 - *slowly increase the value of the `gravity` variable*
 - *helps to suggest a realistic downward fall*
- if not, the jump and fall will not be timed correctly
 - *a player will perceive the shape's fall as very slow*
 - *the fall will seem unrealistic, as though the gravity is too low...*

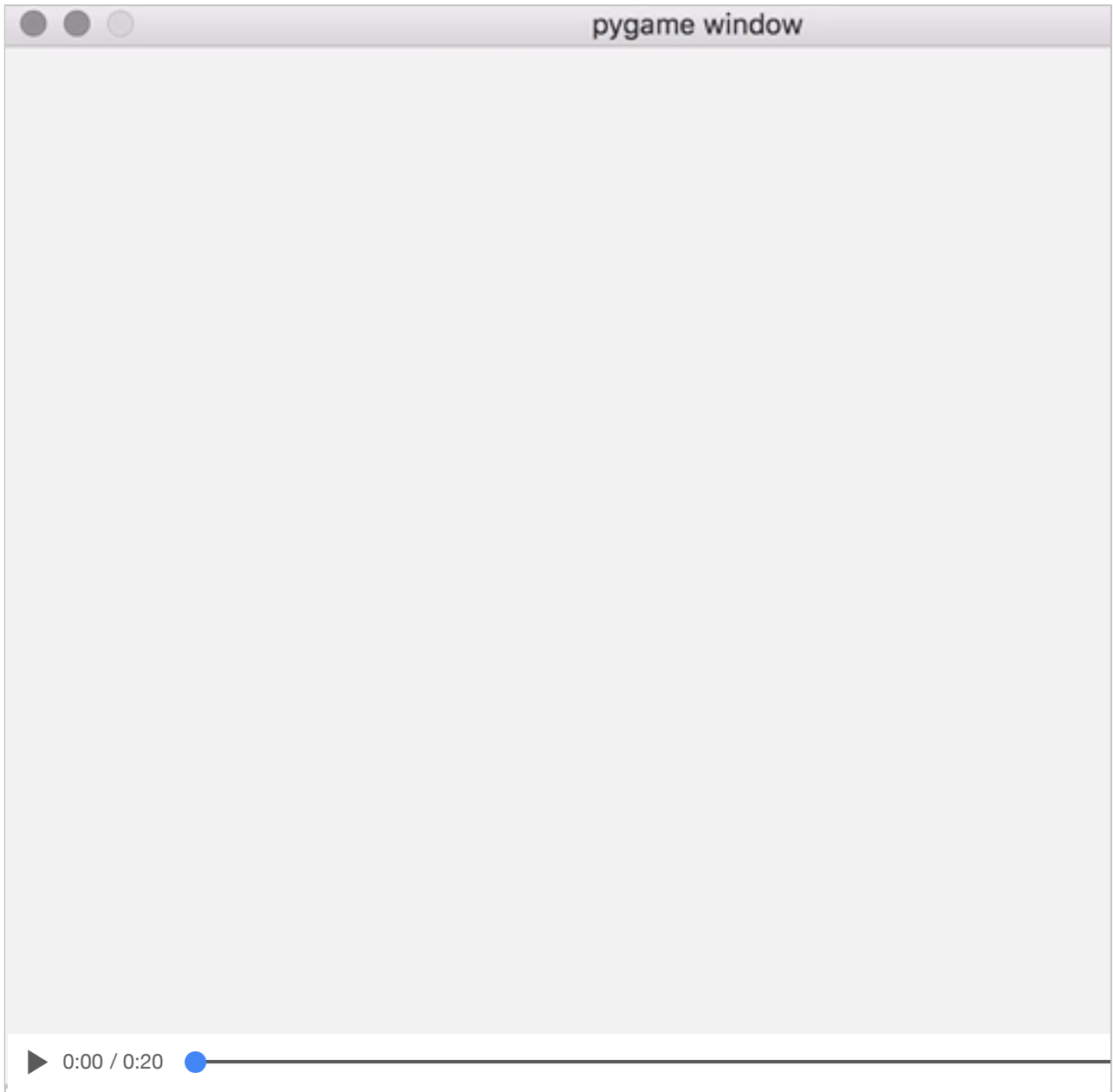
Video - Interaction Events

keyboard - control shape - jump and freeze



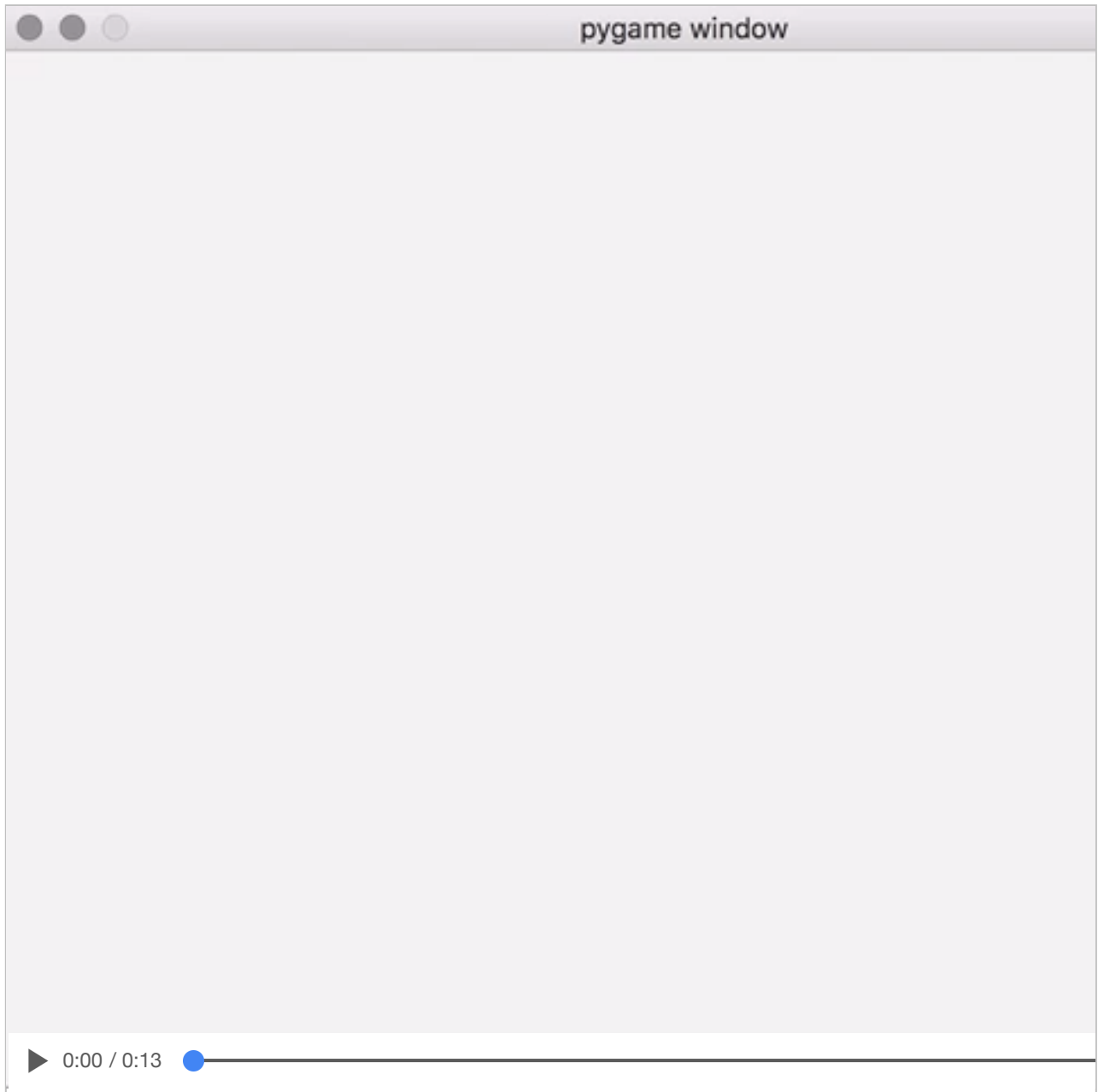
Video - Interaction Events

keyboard - control shape - jump and fall slowly



Video - Interaction Events

keyboard - control shape - jump and fall with gravity



Python and Pygame - events

keyboard - control shape - move, jump...

- now combine moving a shape horizontally, vertically, and jumping
 - *create a shape that a player can move and control freely in the Pygame window*

```
def move():
    global shapeX, shapeY, shapeRX, shapeJY, shapeJump, gravity

    # move left
    if leftDown:
        # check shape not exit window to left
        if shapeX > 0.0:
            shapeX -= shapeSpeed
    # move right
    if rightDown:
        # check shape not exit window to right
        if shapeX + shapeSize < winWidth:
            shapeX += shapeSpeed

    # check upward speed > 1.0
    if shapeJY > 1.0:
        # gradually decrease upward speed to less than 1.0
        shapeJY = shapeJY * 0.9
    else:
        # less than 1.0, reset to 0.0 to allow shape to fall
        shapeJY = 0.0
        # stop jump
        shapeJump = False

    # check if shape in air - use gravity to descend
    if shapeY < winHeight - shapeSize:
        shapeY += gravity
        gravity = gravity * 1.1
    else:
        shapeY = winHeight - shapeSize
        gravity = 1.0
```

```
shapeY -= shapeJY
```

- move function combines horizontal movement with a vertical jump
 - *player can now make the shape move from left to right*
 - *and jump at the same time*

Python and Pygame - events

keyboard - control shape - move, jump...

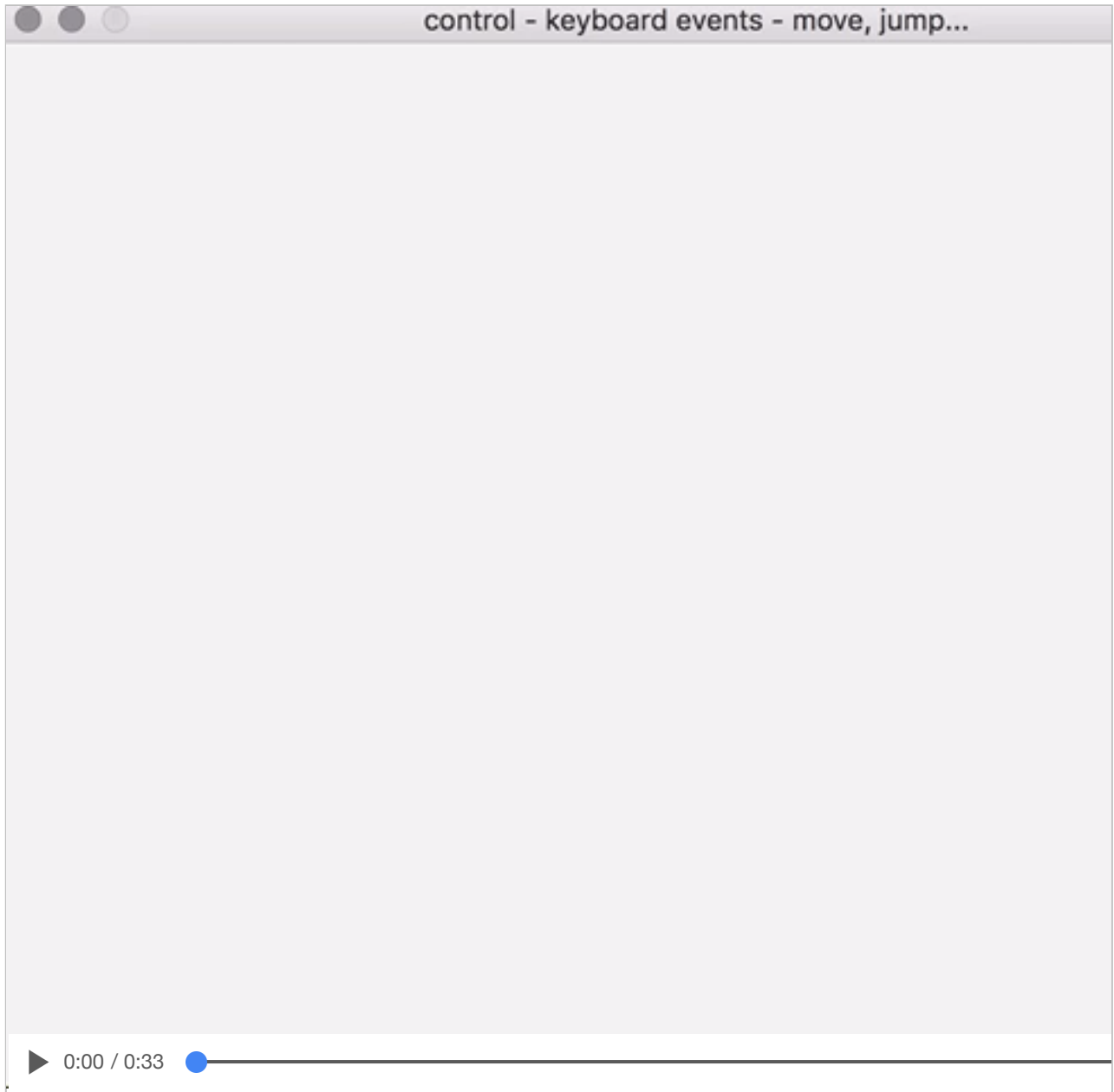
- update the **game loop** to include required listeners and handlers for horizontal movement
 - *add the required listener for KEYUP*
 - stop our shape from continuously moving right or left
- shape can now walk and jump across the game window

```
# create game loop
while True:
    # set clock
    #msElapsed = clock.tick(max_fps)
    #print(msElapsed)
    # 'processing' inputs (events)
    for event in EVENTS.get():
        # check keyboard events - keydown
        if event.type == pygame.KEYDOWN:
            # check for directional - LEFT and RIGHT
            if event.key == pygame.K_LEFT:
                leftDown = True
            if event.key == pygame.K_RIGHT:
                rightDown = True
            # check for directional - UP
            if event.key == pygame.K_UP:
                if not shapeJump:
                    shapeJump = True
                    shapeJY += jumpHeight
            # check for ESCAPE key
            if event.key == pygame.K_ESCAPE:
                gameExit()

        # check keyboard events - keyup
        if event.type == pygame.KEYUP:
            if event.key == pygame.K_LEFT:
                leftDown = False
            if event.key == pygame.K_RIGHT:
                rightDown = False
```


Video - Interaction Events

keyboard - control shape - move and jump



Games and Ideas

express ideas in video games - part I

- often begin game development by representing behaviour and structure of real-world system
 - e.g. cars driving, people walking, planes flying...
 - such systems are apparent throughout our games
- begin building our game
 - usually start with a known model of our chosen system
 - also coding potential outcomes
 - one of the inherent features of coding and development
- such outcomes are developed to meet the defined requirements for a set of rules
 - usually those defined for the system itself
 - or combined with the rules of the game
- J. Murray, in 1997
 - referred to this simply as a **procedural representation**
 - video games are good at this type of representation
- classic example of such procedural representation is the popular game *Sim City*
 - models urban development, planning, general dynamics of city and urban living...
 - able to model societal and cultural patterns within this urban environment
 - e.g. crime rates, pollution levels, economy...
- Ian Bogost explains that

“video games represent processes in the material world-war, urban planning, sports, and so forth- and create new possibility spaces for exploring those topics.”

Bogost, I, *The Rhetoric of Video Games*. in *The Ecology of Games...* Salen, E. MIT Press. Cambridge, MA. 2008.

Games and Ideas

express ideas in video games - part 2

- as we begin development of our game
 - *we are expressing ideas of a given system*
 - *often in a procedural manner*
- as our players experience the game
 - *they begin to form an impression or idea of the system itself*
 - *the underlying system being represented*
- the game has started to impart its ideas upon the player
- designers and developers represent their own interpretations and impressions
 - *of the underlying real-world system in the game*
- does this system actually exist in the first place?
 - *Bogost, I. has argued such video game systems inherently speculative*
 - *derived from the developer, not directly from the system itself*
- such subjectivity naturally creates a tension and dissonance, according to Bogost, I.
 - *between the player's pre-conceptions of a system*
 - *and the developer's implementation*
- tension helps express the game itself, encouraging a player to
 - *explore*
 - *question*
 - *and test the game's own systems, concepts, and general gameplay*
- can be a valuable reason to continue playing the game

Games and Ideas

express ideas in video games - part 2

- Bogost describes models as a good form of representing procedural game play
- Sid Meir's **Civilization** series of games
 - *each game can be thought of in terms of a model*
 - *a model of how real world, perceived global affairs occur...*
- specifics of the game may use ancient history and societies its model
 - *may serve as a model of many principles governing international relations today*
 - *game processes, logical outcomes reflect known world operations*
- each game uses a procedural model
 - *a player still maintains a certain degree of agency*
- player's gameplay procedure may affect the experience
 - *to an equal extent as the game's procedure...*
- each game provides an opportunity to interpret systems, rules, and procedures
- player may decide how to interpret and modify their meaning
 - *within their gameplay and experience...*
- *Civilization* series is a great example of **procedural representation** in gaming

Video - Procedural Representation

Civilization series



Source - Sid Meier's Civilization, Youtube

Video - Procedural Representation

Animal Crossing



Source - Animal Crossing, YouTube

Games and development

quick exercise

Consider the following real-world systems:

Motion

- cars and driving
- planes and flying
- human motion and interaction

Societal

- informal groups
- hierarchy and formal organisations
- family

Then,

- define the known models for at least one of these systems per group, *Motion* and *Societal*
- consider potential outcomes for your chosen systems
- consider how a game may then use such systems and outcomes in a procedural representation
- consider how your game may then modify and push such systems and outcomes to create a sense of *play*

Video - a fun example

The Last Starfighter - Theatrical Trailer



Source - The Last Startfighter, YouTube

References

- Bogost, I. *Persuasive Games: The Expressive Power of Videogames*. MIT Press. Cambridge, MA. 2007.
- Bogost, I, *The Rhetoric of Video Games*. in *The Ecology of Games...* Salen, E. MIT Press. Cambridge, MA. 2008.
- Bogost, I. *Unit Operations: An Approach to Videogame Criticism*. MIT Press. Cambridge, MA. 2006.

References - Games

- Animal Crossing
- Black and White
- Civilization series
- Populous
- Proteus

References - Pygame

- `pygame.event`
- `pygame.key`
- `pygame.locals`

References - Various

- God Game
- Peter Molyneux
- Populous

Videos

- Animal Crossing
- Black and White review - YouTube
- Populous on the Amiga - Youtube
- Sid Meier's Civilization, Youtube
- The Last Startfighter, YouTube