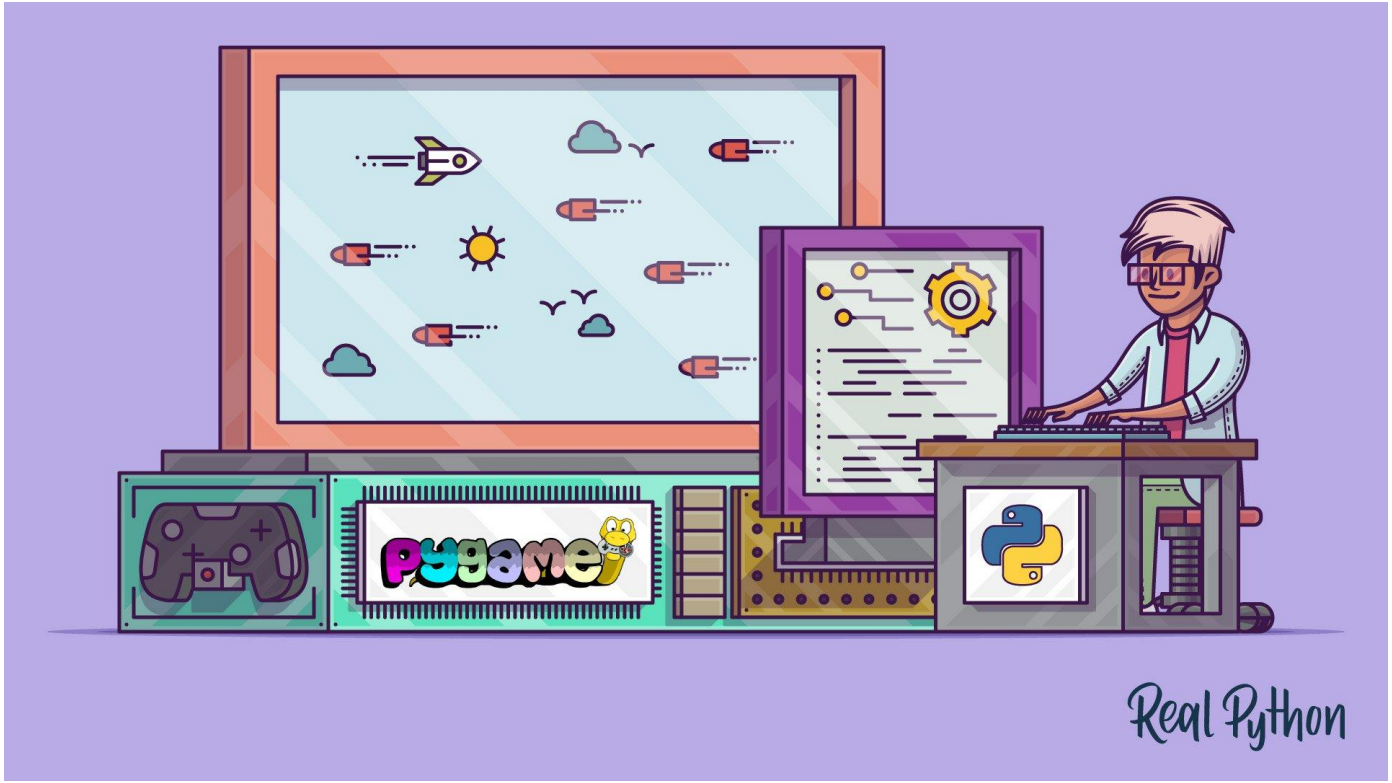
PyGame Primer



PyGame Primer

What will you learn how to do in PyGame?

- Draw items on your screen
- Play sound effects and music
- Handle user input
- Implement event loops
- Explore how game programming differs from standard procedural Python programming

PyGame Primer

Suggested background for this course

- User-defined functions
- Imports
- Loops
- Conditionals
- How to open files
- Basics of object-oriented Python

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PYGAME BACKGROUND AND SETUP

What is PyGame?

- A Wrapper for the SDL library
  - Simple DirectMedia Layer
  - Cross-platform multimedia hardware support

PYGAME BACKGROUND AND SETUP

Installing PyGame on your platform

- Install using pip

```
$ python3 -m pip install pygame
```

- To verify the installation try out one of the examples

```
$ python3 -m pygame.examples.aliens
```

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BASIC PYGAME PROGRAM

First steps - aka the PyGame “Hello, World”

- Import and initialize the PyGame library
- Set up your display window
- Set up a game loop
- Scan and handle events
- Fill the window with a color
- Draw a circle
- Update the display window
- Exit PyGame

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PYGAME CONCEPTS

Initialization and Modules

- The PyGame library is composed of a number of modules
  - `display`
  - `joystick`
  - `music`
  - `key`
  - `event`
  - `image`

PYGAME CONCEPTS

Initialization and Modules

- Importing the PyGame library
  - `import pygame`
- Initializing PyGame
  - `pygame.init()`
  - Initializes all of the included PyGame modules

PYGAME CONCEPTS

Displays and Surfaces

- `Surface`
  - A class that defines a rectangular area on which you can draw
- `display`
  - Can be a window or full screen
  - Created using `.set_mode()`
  - Contents of a `Surface` are pushed to the display when `pygame.display.flip()` is called

PYGAME CONCEPTS

Images and Rects

- `image` module
  - Allows the loading and saving of images
  - Images are loaded into `Surface` objects and then manipulated
- `Rect` class
  - A special class for storing rectangular coordinates
  - Used for managing and moving around on-screen objects
  - Used to manage collisions

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THE TUTORIAL GAME

Goals of the game

- Avoid the incoming obstacles
  - Player starts on left side of the screen
  - Obstacles enter randomly on the right and move left in a straight line
- The player can move left, right, up or down to avoid the obstacles
- The player cannot move off the screen
- The game ends either when the player is hit by an obstacle or when the user closes the window

THE TUTORIAL GAME

Not goals of the game

- No multiple lives
- No scorekeeping
- No player attack capabilities
- No advancing levels
- No boss characters

These are all excellent potential ways to explore growing your PyGame skills

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THE GAME LOOP

Important things the game loop does

- Processes user input
- Updates the state of all game objects
- Updates the display and audio output
- Maintains the speed of the game

THE GAME LOOP

Every cycle of the game loop is called a frame

- The quicker you can do things each cycle, the faster your game will run
- Frames continue until some condition to exit the game is met
    - Your design will look for two conditions
        - The player collides with an obstacle
        - The player closes the window

PROCESSING EVENTS

Events are placed in an event queue

- Every event has an event type
  - Keypresses are event type `KEYDOWN`
  - Closing the window is event type `QUIT`
- To access the list of active events
  - `pygame.event.get()`

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DRAWING ON THE SCREEN

Two commands you have used so far

- `screen.fill()` to fill the background
- `pygame.draw.circle()` to draw a circle

DRAWING ON THE SCREEN

Now for a third way

- You can use a `Surface`
  - A rectangular object on which you can draw
    - Like a blank sheet of paper
    - The `screen` object is a `Surface`
    - You will create several more for your game

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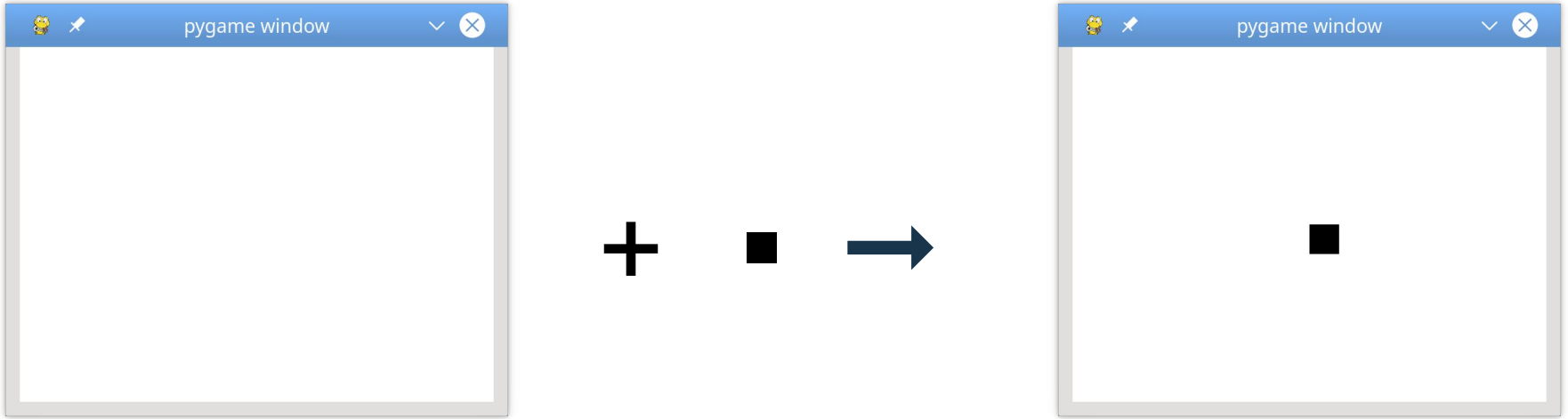
BLOCK TRANSFER

How do you get your new Surface to appear?

- `.blit()` stands for Block Transfer
  - Copies the contents of one `Surface` onto another `Surface`



BLOCK TRANSFER

How do you get your new Surface to appear?

- `.blit()` stands for Block Transfer
  - Copies the contents of one `Surface` onto another `Surface`
  - It takes two arguments
    - The `Surface` to draw
    - The location at which to draw it on the source `Surface`

UPDATING THE SCREEN

How to draw the changes?

- `pygame.display.flip()`
  - Updates the entire screen
  - Including everything that's been drawn since the previous flip

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THE TUTORIAL GAME

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SPRITES

A 2D representation of something on the screen

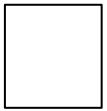
- PyGame provides a `Sprite` class
  - Advantages of it being a class
    - Creating multiple instances
    - Access to its built-in methods
    - Can be extended to allow new methods

RGB COLOR

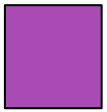
Computers represent everything as numbers

- RGB is a color model that converts colors into numbers that a computer can process
- RGB has 3 color channels
  - Red
  - Green
  - Blue
- The values per channel go from 0 to 255

Black
(**0**, **0**, **0**)



White
(**255**, **255**, **255**)

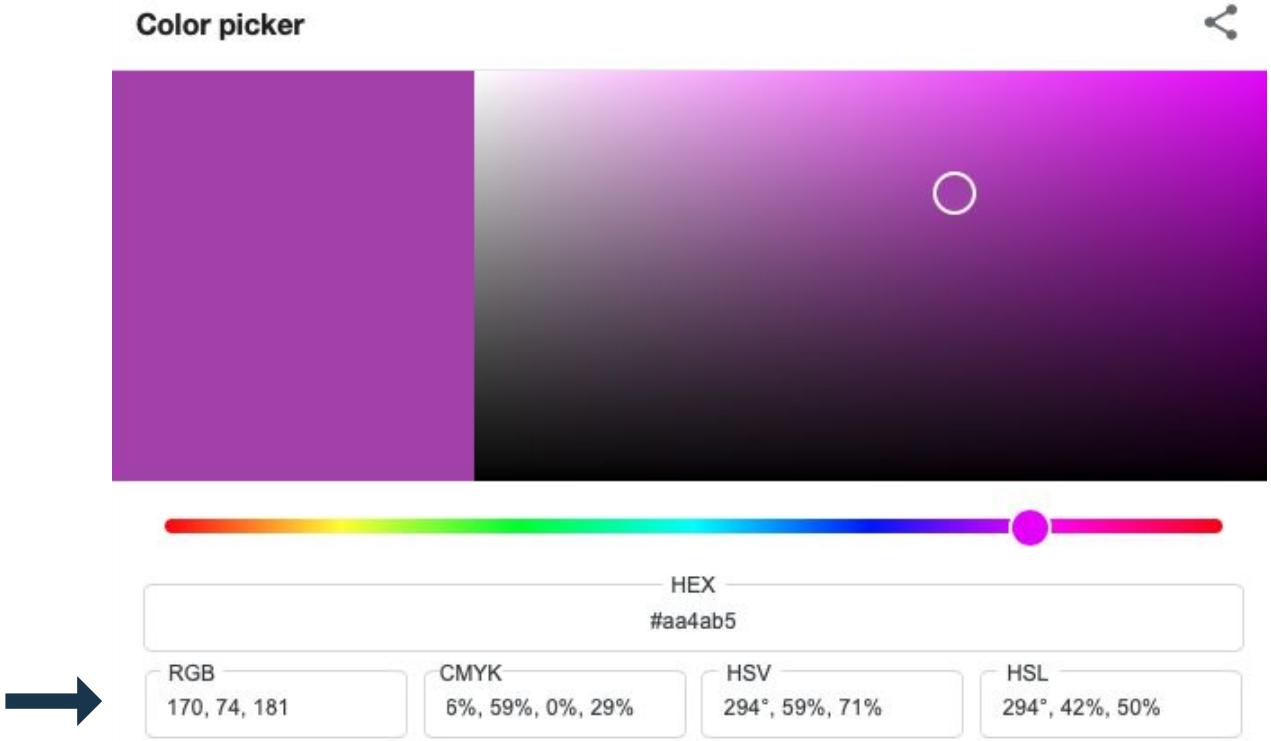


Cool Purple
(**170**, **74**, **181**)

RGB COLOR

Computers represent everything as numbers

- Google search - RGB to Hex



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USER INPUT

Adding keyboard control

- `pygame.event.get()`
  - Returns a list of the events in the event queue
  - Which you currently are scanning for KEYDOWN event types
- `pygame.event.get_pressed()`
  - Returns a dictionary containing all the KEYDOWN events in the queue
  - Put this in your game loop right after the event handling loop
    - This will return keys pressed at the beginning of every frame

USER INPUT

Adding an `update()` method to `Player`

- Defining movement behavior of the sprite based off the keys pressed
- Using `rect.move_ip()`

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STAYING ON THE SCREEN

You may have noticed two small problems

- The player rectangle can move off the screen
- The player can move very fast if a key is held down

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SPRITE GROUPS

`pygame.sprite.Group()`

- A super useful class
  - Holds and manages multiple `Sprite` objects
  - Includes methods for collision detection
  - Makes updating positions and rendering sprites easier

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CUSTOM EVENTS

How to have enemies appear at regular intervals?

- The event loop looks for random events and deals with them appropriately
- What about events that are not defined by PyGame?
  - You define custom events to handle as you see fit
    - PyGame defines events internally as integers
    - The last event PyGame reserves is called `USEREVENT`
      - `pygame.USEREVENT + 1` will ensure its unique

CUSTOM EVENTS

What about timing?

- `pygame.time` a module for monitoring time
  - `pygame.time.set_timer()`
    - Called outside the game loop
    - Can fire custom events throughout the entire game

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COLLISION DETECTION

Checking for collisions can be difficult

- PyGame makes this non-trivial math problem of determining when two sprites overlap easy
  - PyGame has several collision detection methods available
  - `pygame.sprite.spritecollideany()`
    - Arguments accepted are a `Sprite` and a `Group`
    - Checks every object in the `Group` if its `.rect` intersects with the `.rect` of the `Sprite`
    - Returns `True` if detected, and `False` otherwise

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SPRITE IMAGES

PyGame module for loading images and transferring to a `Surface`

- `pygame.image.load("filename.png")`
  - Loads an image from the disk
  - Returns a `Surface`
- `.convert()`
  - Optimizes the `Surface`, making future `.blit()` calls faster
- `.set_colorkey()`
  - Used to indicate the color PyGame will render as transparent

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ADDING BACKGROUND IMAGES

Let's make some clouds

- Create the `Cloud` class
- Add an image of a cloud to it
- Create a method `.update()` that moves the `cloud` toward the left side of the screen
- Create a custom event and handler to create new `cloud` objects at a set time interval
- Add the newly created `cloud` objects to a new `Group` called `clouds`
- Update and draw the `clouds` in your game loop

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GAME SPEED

Adjusting the frame rate

- The `time` module contains a `Clock` object
  - `pygame.time.Clock()`
- The `Clock` object contains a method to limit the maximum frame rate
  - `.tick()` takes an argument of frames per second

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ADDING MUSIC

Using the pygame `mixer` module

- The `mixer` module handles all the sound-related activities
  - `pygame.mixer.init()` sets up the mixer for playback
  - `pygame.mixer.music` sub-module for music playback
    - `.load("filename.ogg")` supports .ogg and .Mod
    - `.play(loops=-1)`
    - `.stop()`
  - `pygame.mixer.quit()` stops all sound playback

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ADDING SOUND EFFECTS

Attaching sounds to specific events

- Create an instance of the `.Sound` class for each sound effect
  - `pygame.mixer.Sound("filename.ogg")`
    - Audio files can be `.wav` or `.ogg`
    - `.play()` triggers the sound effect
    - `.stop()`
    - `.set_volume()` takes a `float` in the range 0.0 to 1.0

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A NOTE ON SOURCES

Resources for your own games

- Here are some sources for music, sound, and art
  - OpenGameArt.org - sounds, sound effects, sprites, and other artwork
  - Kenney.nl - sounds, sound effects, sprites, and other artwork
  - Game Art 2D - sprites and other artwork
  - CC Mixter - sounds and sound effects
  - Freesound - sounds and sound effects

A NOTE ON SOURCES

Licenses and proper attribution

- Make sure to pay attention to the license requirements
  - Attribution
  - Link to the license
  - Different requirements for commercial release

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CONGRATULATIONS!

YOU COMPLETED THE COURSE

THANKS FOR WATCHING!

MAKE SURE YOU PRACTICE WITH WHAT YOU HAVE LEARNED