

Methodological guidelines

Basics of Creating Games

STORYLINE:

The ProTeam company decided to start creating and promoting its commercial products, computer games. They chose the PyGame library as the main tool.

In order to start creating games of different genres, developers need to recall (or study) the basics of working with PyGame.



SUMMARY:

The **lesson goal** is to recall and put into practice the basics of game creation using the PyGame library.

In the first half of the lesson, students recall the concepts of “sprite”, “scene”, “game loop” and apply them to solve the training tasks. In the second half of the lesson, students recall how to handle keyboard events and work on the Catch-up mini-project.

Note. Some students may already be familiar with the PyGame library. However, we recommend starting the module with the basics. Introduce the first lesson to experienced students as a workshop that will help them work on upcoming projects more efficiently.

LINKS AND ACCESSORIES:

-  [Presentation](#),
-  Exercises for the lesson: [Catch-up](#) (Visual Studio Code).








EDUCATIONAL OUTCOMES

After the lesson, the students will:

The result is achieved when the students:

- | | |
|---|--|
| <ul style="list-style-type: none"> • be able to list the capabilities of PyGame; • describe how to handle keys using PyGame in their own words; • create the game window, set the background; • create a sprite image, set its properties, and place it on the scene; • create a game loop, configure the frame rate per second; • handle the game completion event (QUIT); • get a list of the keys pressed (key.get_pressed()), extract and handle pressing specific keys. | <ul style="list-style-type: none"> • have participated in the discussions and asked clarifying questions; • have listed commands for creating and configuring the game window; • have listed commands for creating and configuring the sprite image; • have programmed the game loop to handle keyboard events; • coped with the Catch-up mini-project; • have answered the teacher's questions during the review stage. |
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RECOMMENDED LESSON STRUCTURE

Time	Stage	Stage aims
5 min 	Storyline. Discussion: Game creation	<ul style="list-style-type: none"> ❑ Set the storyline-based task: take on projects related to creating games using PyGame. ❑ Arrive at the idea that it is required to review the basics of creating games and implement the Catch-up mini-project.
15 min 	Brainstorming: Game creation using PyGame	<ul style="list-style-type: none"> ❑ Discuss the basic concepts associated with creating games: "sprite", "scene", "game loop", FPS. ❑ List methods for creating a game window, sprite image, background. ❑ Go over the game completion event. ❑ Analyze the task of creating a play space with two sprites.
20 min 	Platform: "VSC. PyGame: Catch-up"	<ul style="list-style-type: none"> ❑ Organize completion of tasks 1 and 2 of the "PyGame: Catch-up" exercises.
5 min 	Break	<ul style="list-style-type: none"> ❑ Do a warm-up or change students' activity.
15 min 	Brainstorming: Handling Keyboard Events	<ul style="list-style-type: none"> ❑ Discuss that when objects change their position it is required to refresh the screen at a rate that is comfortable for the eye. ❑ Discuss handling keyboard events using the <code>keys.pressed()</code> method. ❑ Supplement the Catch-up program with the arrow keys press handling to move the sprites.
25 min 	Platform: "VSC. PyGame: Catch-up"	<ul style="list-style-type: none"> ❑ Have the students complete task 3 of the "PyGame: Catch-up" exercises.
5 min 	Wrapping up the lesson. Reflection	<ul style="list-style-type: none"> ❑ Conduct a technical interview based on the brainstorming material. ❑ Suggest that the students complete the extra exercise on the VS Code for additional practice.

Storyline. Discussion: Game creation

(5 min.)

Open the presentation. The developers do not need computers yet.

"Hello, colleagues! The ProTeam company decided to start creating and promoting its commercial products, computer games. They chose the PyGame library as the main tool".


Introduction to game creation

What do you know about creating games? Let's discuss:

What genres of games are there?

How is a game designer different from a game developer?

What is a game loop?



Emily, project manager

Discussing work tasks

Your role in the team is game developer

Development management

Product manager, Project manager, Producer

Development team


Developer, Game designer, Artist, Tester

Discussing work tasks

Game loop development

A **game loop** is a loop, at each step ("frame") of which there is:

- analysis and processing of events;
- rendering of the background and characters;
- a countdown.



sprite

Developers call the game space a scene, and one step of the game loop is a frame.

Discussing work tasks

Discuss what the developers know about games and how they are made: what games they play on their home computers. What genres of games do they know? Do they know how a game designer differs from a game developer?

Mention that in their work they will be focusing on game development and setting up the game loop. Briefly explain that a game loop is a loop that has events handled at every step (in every "frame") (events of the external world and the game itself, characters and scenes are being drawn, time is counted).

Show the slide with the expected interface of the interactive Maze game. Tell the developers that to create such a game, they need to be comfortable with the basics of PyGame. With this end in view, they will implement the training Catch-up project during the current workday.

Set the goal for the day and announce what shall be done.

Brainstorming: Game creation using PyGame


(15 min)

Invite the developers to study the appearance of the Catch-up game and list the app's functionality elements. Use a mind map to discuss the content of the game in detail. For example, the "Scene" (external representation of the game) and "Functionality" can become the basic components of your mind map. Think about which components of the PyGame library should you study first?


1. Creating a blank with a background

Let's program a blank for a game with a picture background.

Note: The picture must be in the project folder.



What do we need to know to create such a scene?



Brainstorming

The "Catch" game

Let's discuss the content of the game using a mind map:

- Game scene (appearance)
 - Scene background — picture
 - Sprites — pictures
 - High frame rate/sec: (smooth movement of sprites)
- Game functionality
 - Sprites are keyboard controlled
 - Each sprite has its own controls
 - Sprites cannot cross the border of the scene

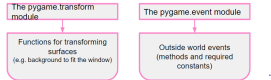
Brainstorming

pygame is a library for creating games

The pygame library is hierarchical.

There are lots of modules in it with ready-made tools for:

- creating sprites;
- processing in-game sprite events;
- processing events from the outside world;
- game timer settings;
- and more.



Brainstorming

Move on to analyzing the content of pygame. Tell the kids that like many other libraries, pygame is hierarchical and consists of many modules. Give examples of such modules: transform and event.


Discuss with the developers their first step in creating the Catch-up game: creating a blank with a background. Remind that the images used must be in the project folder.

“In Pygame, the origin is located in the upper left corner of the window. The size of the window is determined by the developer”.

Demonstrate the developers methods for creating a game window and a picture background. Mention that they can resize the picture to fit the window. Emphasize that even the simplest code creating the game window and setting the background will not work correctly without a game loop (the window will open and close immediately)!

1. Creating a blank with a background

In Pygame, the *origin* is located in the *upper left corner* of the window.
The size of the window is determined by the developer.



1. Creating a blank with a background

Let's program a blank for a game with a picture background.
Note: The picture must be in the project folder.

Command	Purpose
<code>window = display.set_mode((700, 500))</code>	Create window size: (width, length).
<code>display.set_caption('Catch')</code>	Set the window title.
<code>background = transform.scale(image.load('background.png'), (700, 500))</code>	Create a picture object, adapt the picture size to the window parameters.
<code>window.blit(background, (0, 0))</code>	Display the background picture in the window.

1. Creating a blank with a background

Let's program a blank for a game with a picture background.

```
from pygame import *
window = display.set_mode((700, 500))
display.set_caption('Catch')
background = transform.scale(image.load('background.png'), (700, 500))
window.blit(background, (0, 0))
```

There is **no game loop** in the program!
The window is displayed for a moment and then disappears.
What do we need to add so that the window is always displayed?

Arrive at the idea that it is required to program the simplest game loop displaying the window with a background until the user clicks on the “Close Window” button (red cross). Discuss the syntax of the required methods from the event module of the PyGame library. Specify that frames appearing on the screen with each step of the loop must be updated using the `display.update()` command.

1. Creating a blank with a background

The simplest game loop that displays the window until it is closed.

```
game = True — the game is going
while game:
    The game is still going?
    if No:
        game = False
    if Yes:
        Display the window with the background
        Was the 'Close-Window' button pressed?
        if Yes:
            game = False
        if No:
            game = True
```

1. Creating a blank with a background

New methods related to conditions that end the game.

Command	Purpose
<code>events = event.get()</code>	Returns a list of events that have occurred (events are instances of the ready-made Event class).
<code>events[e].type</code>	Each event object has a type property — event type (for example, “keydown”).

Type examples: QUIT — the “Close window” button is pressed (red x).
KEYDOWN — any key is down.
Program names for keys: K_LEFT — “Left Arrow” button pressed.
K_a — the “Letter A” (Latin) button is pressed.

1. Creating a blank with a background

Let's program a blank for a game with a picture background.

```
from pygame import *
window = display.set_mode((700, 500))
display.set_caption('Catch')
background = transform.scale(image.load('background.png'), (700, 500))

game = True
while game:
    window.blit(background, (0, 0))
    for e in event.get():
        if e.type == QUIT:
            game = False
    display.update()
```

The frames that appear on the screen with each step of the loop must be updated.

Say that sprites in the form of images (e.g., game characters) can also be adapted to the size we want (e.g., 100×100 pixels) and positioned at an arbitrary point in the window using coordinates.

Combine the fragments analyzed into a program, sum up your discussion, and proceed to work on the VS Code.

Platform: “VSC. PyGame: Catch-up”

(20 min)

Arrange the work on the VS Code. Invite the students to complete tasks 1 and 2 in the “PyGame: Catch-up” exercise.

You will find answers to the exercises at the end of the methodological guidelines.

Break

(5 min.)

Ask the developers to switch off their computers. The purpose of the break is to shift attention and have a [warm up](#).

Brainstorm: Handling Keyboard Events

(15 min)

Move on to the discussion of the next step in creating a game: exercise the FPS and sprites control using the keyboard. Show the slide comparing how the two games work.

“It is noteworthy that sprites move at the same speed. But why does the sprite in the game on the right move more smoothly and quickly? (Students’ answers). This actually happens because the game frames refresh with a different frame per second rate”.

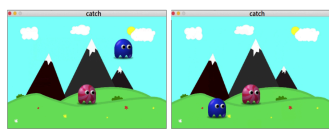
Tell the developers that every game has an important characteristic: the number of frames displayed per second. They also use the abbreviation FPS (frames per second). All other things being equal, a high refresh rate looks better but requires higher computer performance. For games, the frame rate comfortable for human eyes is 50–60 frames/sec.

To set the frame rate, we need to introduce a new object, Clock(), which is a “clock” that keeps track of time. The FPS we want is set in the game loop using the tick() method.


Technical comment. Actually, the tick() method does not set specifically the FPS. In fact, the second will be divided by 60 in each frame, and the next frame will appear with a delay of 1/60 of a second.

FPS (frames per seconds)
is the number of frames displayed in one second.

A comfortable frame rate for movies is 24, for games it's 50-60.



A rate of 5 frames/sec



A rate of 60 frames/sec

Brainstorming

1. Setting the frame rate
Let's create a special Clock() object and give it the rate we want.

Command	Purpose
clock = time.Clock()	Create a "clock" object that keeps track of time.
FPS = 60	Let's immediately create an FPS constant and set the frame rate we want.
clock.tick(FPS)	In each frame, a second will be divided by 60. There will be a delay of 1/60th of a second.

Let's place it in the game loop.

Brainstorming

2. Keyboard events
Let's take a look at the functions that simplify keyboard event processing.

Command	Purpose
keys_pressed = key.get_pressed()	Returns a structure with the current state of the keys (True is down, False is up).
if keys_pressed[K_UP]: y1 -= 10	If the 'Up Arrow' key is down, decrease the Y coordinate of Sprite1 by 10 pixels.
if keys_pressed[K_S] and y2 < 385: y2 += 10	If the 'S' key is down and the bottom of the screen has not been reached, increase the Y coordinate of Sprite2 by 10 pixels.

Brainstorming

Go to the discussion of moving the sprite using the keyboard. It turns out that handling all possible events “point-blank” will be too cumbersome. It will be especially difficult to program a situation where you hold down an arrow key and the sprite continues to move.


Show the syntax of the `get_pressed()` method returning the set of keys pressed. Then handling of the keyboard events will be reduced to the following analysis: is there a certain key in the structure received in this frame or not.

Technical comment. In fact, the `keys.get_pressed()` command returns a sequence of zeros and ones. At the same time, every number always corresponds to the same key, for example, the “right arrow” is 275. But there is no need to remember these numbers by heart, since the keys can be accessed by constants, for example, `K_UP`.

2. Keyboard events handling

Let's control spritel using the arrow keys.
Let's have a keystroke move the sprite 10 pixels.

How do we process the “up arrow” key pressed” event?
Wouldn't the conditional statement iterating all the control keys turn out to be too large?



2. Keyboard events

Let's take a look at the functions that simplify keyboard event processing.

Command	Purpose
<code>keys_pressed = key.get_pressed()</code>	Returns a structure with the current state of the keys (True is down, False is up).
<code>if keys_pressed[K_UP]:</code> <code>y1 -= 10</code>	If the 'Up Arrow' key is down, decrease the Y coordinate of Spritel by 10 pixels.
<code>if keys_pressed[K_S] and y2 < 395:</code> <code>y2 += 10</code>	If the 'S' key is down and the bottom of the screen has not been reached, increase the Y coordinate of Spritel2 by 10 pixels.

2. Keyboard events

The game loop after adding keyboard event processing:

```
while game:
    #...
    keys_pressed = key.get_pressed()

    if keys_pressed[K_LEFT] and x1 > 5:
        x1 -= speed
    if keys_pressed[K_RIGHT] and x1 < 595:
        x1 += speed
    if keys_pressed[K_UP] and y1 > 5:
        y1 -= speed
    if keys_pressed[K_DOWN] and y1 < 395:
        y1 += speed
    #...
```

You need to check if the sprite has left the scene every time.

Mention that movement of the sprite should be limited to the size of the screen. Wrap up the discussion and begin working on the VS Code.

Platform: “VSC. PyGame: Catch-up”

(25 min)

Arrange the work on the VS Code. Invite the students to complete task 3 in the “PyGame: Catch-up” exercise.

End of the lesson

(5 min.)

Use the presentation to sum up the workday. Conduct a technical interview with questions about the brainstorming materials.

Exercises answers

Exercise “VSC. PyGame: Catch-up”.

```
from pygame import *

window = display.set_mode((700, 500))
display.set_caption("catch")
background = transform.scale(image.load("background.png"), (700, 500))

#parameters of the image sprite
x1 = 100
y1 = 300

x2 = 300
y2 = 300

sprite1 = transform.scale(image.load('sprite1.png'), (100, 100))
sprite2 = transform.scale(image.load('sprite2.png'), (100, 100))
speed = 10

#game loop
run = True
clock = time.Clock()
FPS = 60

while run:
    window.blit(background,(0, 0))
    window.blit(sprite1, (x1, y1))
    window.blit(sprite2, (x2, y2))

    for e in event.get():
        if e.type == QUIT:
            run = False

    keys_pressed = key.get_pressed()

    if keys_pressed[K_LEFT] and x1 > 5:
        x1 -= speed
    if keys_pressed[K_RIGHT] and x1 < 595:
        x1 += speed
    if keys_pressed[K_UP] and y1 > 5:
        y1 -= speed
    if keys_pressed[K_DOWN] and y1 < 395:
        y1 += speed

    if keys_pressed[K_a] and x2 > 5:
        x2 -= speed
    if keys_pressed[K_d] and x2 < 595:
        x2 += speed
    if keys_pressed[K_w] and y2 > 5:
        y2 -= speed
    if keys_pressed[K_s] and y2 < 395:
        y2 += speed

    display.update()
    clock.tick(FPS)
```