Министерство образования и молодежной политики Свердловской области



ГАПОУ СО «Екатеринбургский колледж транспортного строительства»

Отчёт по программе «**Разработка игры Pacman на Python**»

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**Задание:**

Разработать игру Pacman на языке Python

**Листинг программы**

import pygame

import numpy as np

import tcod

import random

from enum import Enum

class Direction(Enum):

    DOWN = -90

    RIGHT = 0

    UP = 90

    LEFT = 180

    NONE = 360

class ScoreType(Enum):

    COOKIE = 10

    POWERUP = 50

    GHOST = 400

class GhostBehaviour(Enum):

    CHASE = 1

    SCATTER = 2

def translate\_screen\_to\_maze(in\_coords, in\_size=16):

    return int(in\_coords[0] / in\_size), int(in\_coords[1] / in\_size)

def translate\_maze\_to\_screen(in\_coords, in\_size=16):

    return in\_coords[0] \* in\_size, in\_coords[1] \* in\_size

class GameObject:

    def \_\_init\_\_(self, in\_surface, x, y, in\_size: int, in\_color=(255, 0, 0), is\_circle: bool = False):

        self.\_size = in\_size

        self.\_renderer: GameRenderer = in\_surface

        self.\_surface = in\_surface.\_screen

        self.y = y

        self.x = x

        self.\_color = in\_color

        self.\_circle = is\_circle

        self.\_shape = pygame.Rect(self.x, self.y, in\_size, in\_size)

    def draw(self):

        if self.\_circle:

            pygame.draw.circle(self.\_surface, self.\_color, (self.x, self.y), self.\_size)

        else:

            rect\_object = pygame.Rect(self.x, self.y, self.\_size, self.\_size)

            pygame.draw.rect(self.\_surface, self.\_color, rect\_object, border\_radius=1)

    def tick(self):

        pass

    def get\_shape(self):

        return pygame.Rect(self.x, self.y, self.\_size, self.\_size)

    def set\_position(self, in\_x, in\_y):

        self.x = in\_x

        self.y = in\_y

    def get\_position(self):

        return (self.x, self.y)

class Wall(GameObject):

    def \_\_init\_\_(self, in\_surface, x, y, in\_size: int, in\_color=(0, 0, 255)):

        super().\_\_init\_\_(in\_surface, x \* in\_size, y \* in\_size, in\_size, in\_color)

class GameRenderer:

    def \_\_init\_\_(self, in\_width: int, in\_height: int, pacman\_game):

        pygame.init()

        self.\_width = in\_width

        self.\_height = in\_height

        self.\_screen = pygame.display.set\_mode((in\_width, in\_height), pygame.RESIZABLE)

        pygame.display.set\_caption('Pacman')

        self.\_clock = pygame.time.Clock()

        self.\_done = False

        self.\_won = False

        self.\_game\_objects = []

        self.\_walls = []

        self.\_cookies = []

        self.\_powerups = []

        self.\_ghosts = []

        self.\_hero: Hero = None

        self.\_lives = 3

        self.\_score = 0

        self.\_score\_cookie\_pickup = 10

        self.\_score\_ghost\_eaten = 400

        self.\_score\_powerup\_pickup = 50

        self.\_kokoro\_active = False # powerup, special ability

        self.\_current\_mode = GhostBehaviour.SCATTER

        self.\_mode\_switch\_event = pygame.USEREVENT + 1  # custom event

        self.\_kokoro\_end\_event = pygame.USEREVENT + 2

        self.\_pakupaku\_event = pygame.USEREVENT + 3

        self.\_ghost\_respawn\_event = pygame.USEREVENT + 4

        self.\_modes = [

            (7, 20),

            (7, 20),

            (5, 20),

            (5, 999999)  # 'infinite' chase seconds

        ]

        self.\_current\_phase = 0

        self.pacman\_game = pacman\_game

    def tick(self, in\_fps: int):

        black = (0, 0, 0)

        self.handle\_mode\_switch()

        pygame.time.set\_timer(self.\_pakupaku\_event, 200) # open close mouth

        while not self.\_done:

            for game\_object in self.\_game\_objects:

                game\_object.tick()

                game\_object.draw()

            self.display\_text(f"[Score: {self.\_score}]  [Lives: {self.\_lives}]")

            if self.\_hero is None: self.display\_text("YOU DIED", (self.\_width / 2 - 256, self.\_height / 2 - 256), 100)

            if self.get\_won(): self.display\_text("YOU WON", (self.\_width / 2 - 256, self.\_height / 2 - 256), 100)

            pygame.display.flip()

            self.\_clock.tick(in\_fps)

            self.\_screen.fill(black)

            self.\_handle\_events()

        print("Game over")

    def handle\_mode\_switch(self):

        current\_phase\_timings = self.\_modes[self.\_current\_phase]

        print(f"Current phase: {str(self.\_current\_phase)}, current\_phase\_timings: {str(current\_phase\_timings)}")

        scatter\_timing = current\_phase\_timings[0]

        chase\_timing = current\_phase\_timings[1]

        if self.\_current\_mode == GhostBehaviour.CHASE:

            self.\_current\_phase += 1

            self.set\_current\_mode(GhostBehaviour.SCATTER)

        else:

            self.set\_current\_mode(GhostBehaviour.CHASE)

        used\_timing = scatter\_timing if self.\_current\_mode == GhostBehaviour.SCATTER else chase\_timing

        pygame.time.set\_timer(self.\_mode\_switch\_event, used\_timing \* 1000)

    def start\_kokoro\_timeout(self):

        pygame.time.set\_timer(self.\_kokoro\_end\_event, 15000)  # 15s

    def add\_game\_object(self, obj: GameObject):

        self.\_game\_objects.append(obj)

    def add\_cookie(self, obj: GameObject):

        self.\_game\_objects.append(obj)

        self.\_cookies.append(obj)

    def add\_ghost(self, obj: GameObject):

        self.\_game\_objects.append(obj)

        self.\_ghosts.append(obj)

    def add\_powerup(self, obj: GameObject):

        self.\_game\_objects.append(obj)

        self.\_powerups.append(obj)

    def activate\_kokoro(self):

        self.\_kokoro\_active = True

        self.set\_current\_mode(GhostBehaviour.SCATTER)

        self.start\_kokoro\_timeout()

    def set\_won(self):

        self.\_won = True

    def get\_won(self):

        return self.\_won

    def add\_score(self, in\_score: ScoreType):

        self.\_score += in\_score.value

    def get\_hero\_position(self):

        return self.\_hero.get\_position() if self.\_hero != None else (0, 0)

    def set\_current\_mode(self, in\_mode: GhostBehaviour):

        self.\_current\_mode = in\_mode

    def get\_current\_mode(self):

        return self.\_current\_mode

    def end\_game(self):

        if self.\_hero in self.\_game\_objects:

            self.\_game\_objects.remove(self.\_hero)

        self.\_hero = None

    def kill\_pacman(self):

        self.\_lives -= 1

        self.\_hero.set\_position(32, 32)

        self.\_hero.set\_direction(Direction.NONE)

        if self.\_lives == 0: self.end\_game()

    def display\_text(self, text, in\_position=(32, 0), in\_size=30):

        font = pygame.font.SysFont('Arial', in\_size)

        text\_surface = font.render(text, False, (255, 255, 255))

        self.\_screen.blit(text\_surface, in\_position)

    def is\_kokoro\_active(self):

        return self.\_kokoro\_active

    def add\_wall(self, obj: Wall):

        self.add\_game\_object(obj)

        self.\_walls.append(obj)

    def get\_walls(self):

        return self.\_walls

    def get\_cookies(self):

        return self.\_cookies

    def get\_ghosts(self):

        return self.\_ghosts

    def get\_powerups(self):

        return self.\_powerups

    def get\_game\_objects(self):

        return self.\_game\_objects

    def add\_hero(self, in\_hero):

        self.add\_game\_object(in\_hero)

        self.\_hero = in\_hero

    def \_handle\_events(self):

        for event in pygame.event.get():

            if event.type == pygame.QUIT:

                self.\_done = True

            if event.type == self.\_mode\_switch\_event:

                self.handle\_mode\_switch()

            if event.type == self.\_kokoro\_end\_event:

                self.\_kokoro\_active = False

            if event.type == self.\_pakupaku\_event:

                if self.\_hero is None: break

                self.\_hero.mouth\_open = not self.\_hero.mouth\_open

            if event.type == self.\_ghost\_respawn\_event:

                self.respawn\_ghosts()

        pressed = pygame.key.get\_pressed()

        if self.\_hero is None: return

        if pressed[pygame.K\_UP]:

            self.\_hero.set\_direction(Direction.UP)

        elif pressed[pygame.K\_LEFT]:

            self.\_hero.set\_direction(Direction.LEFT)

        elif pressed[pygame.K\_DOWN]:

            self.\_hero.set\_direction(Direction.DOWN)

        elif pressed[pygame.K\_RIGHT]:

            self.\_hero.set\_direction(Direction.RIGHT)

    def respawn\_ghosts(self):

        for ghost in self.\_ghosts:

            ghost.set\_position(\*translate\_maze\_to\_screen(random.choice(self.pacman\_game.ghost\_spawns)))

            ghost.set\_direction(Direction.NONE)

class MovableObject(GameObject):

    def \_\_init\_\_(self, in\_surface, x, y, in\_size: int, in\_color=(255, 0, 0), is\_circle: bool = False):

        super().\_\_init\_\_(in\_surface, x, y, in\_size, in\_color, is\_circle)

        self.current\_direction = Direction.NONE

        self.direction\_buffer = Direction.NONE

        self.last\_working\_direction = Direction.NONE

        self.location\_queue = []

        self.next\_target = None

        self.image = pygame.image.load('images/ghost.png')

    def get\_next\_location(self):

        return None if len(self.location\_queue) == 0 else self.location\_queue.pop(0)

    def set\_direction(self, in\_direction):

        self.current\_direction = in\_direction

        self.direction\_buffer = in\_direction

    def collides\_with\_wall(self, in\_position):

        collision\_rect = pygame.Rect(in\_position[0], in\_position[1], self.\_size, self.\_size)

        collides = False

        walls = self.\_renderer.get\_walls()

        for wall in walls:

            collides = collision\_rect.colliderect(wall.get\_shape())

            if collides: break

        return collides

    def check\_collision\_in\_direction(self, in\_direction: Direction):

        desired\_position = (0, 0)

        if in\_direction == Direction.NONE: return False, desired\_position

        if in\_direction == Direction.UP:

            desired\_position = (self.x, self.y - 1)

        elif in\_direction == Direction.DOWN:

            desired\_position = (self.x, self.y + 1)

        elif in\_direction == Direction.LEFT:

            desired\_position = (self.x - 1, self.y)

        elif in\_direction == Direction.RIGHT:

            desired\_position = (self.x + 1, self.y)

        return self.collides\_with\_wall(desired\_position), desired\_position

    def automatic\_move(self, in\_direction: Direction):

        pass

    def tick(self):

        self.reached\_target()

        self.automatic\_move(self.current\_direction)

    def reached\_target(self):

        pass

    def draw(self):

        self.image = pygame.transform.scale(self.image, (16, 16))

        self.\_surface.blit(self.image, self.get\_shape())

class Hero(MovableObject):

    def \_\_init\_\_(self, in\_surface, x, y, in\_size: int):

        super().\_\_init\_\_(in\_surface, x, y, in\_size, (255, 255, 0), False)

        self.last\_non\_colliding\_position = (0, 0)

        self.open = pygame.image.load("images/paku.png")

        self.closed = pygame.image.load("images/man.png")

        self.image = self.open

        self.mouth\_open = True

    def tick(self):

        # TELEPORT

        if self.x < 0:

            self.x = self.\_renderer.\_width - self.\_size

        elif self.x > self.\_renderer.\_width - self.\_size:

            self.x = 0

        elif self.y < 0:

            self.y = self.\_renderer.\_height - self.\_size

        elif self.y > self.\_renderer.\_height - self.\_size:

            self.y = 0

        self.last\_non\_colliding\_position = self.get\_position()

        if self.check\_collision\_in\_direction(self.direction\_buffer)[0]:

            self.automatic\_move(self.current\_direction)

        else:

            self.automatic\_move(self.direction\_buffer)

            self.current\_direction = self.direction\_buffer

        if self.collides\_with\_wall((self.x, self.y)):

            self.set\_position(self.last\_non\_colliding\_position[0], self.last\_non\_colliding\_position[1])

        self.handle\_cookie\_pickup()

        self.handle\_ghosts()

    def automatic\_move(self, in\_direction: Direction):

        collision\_result = self.check\_collision\_in\_direction(in\_direction)

        desired\_position\_collides = collision\_result[0]

        if not desired\_position\_collides:

            self.last\_working\_direction = self.current\_direction

            desired\_position = collision\_result[1]

            self.set\_position(desired\_position[0], desired\_position[1])

        else:

            self.current\_direction = self.last\_working\_direction

    def handle\_cookie\_pickup(self):

        collision\_rect = pygame.Rect(self.x, self.y, self.\_size, self.\_size)

        cookies = self.\_renderer.get\_cookies()

        powerups = self.\_renderer.get\_powerups()

        game\_objects = self.\_renderer.get\_game\_objects()

        cookie\_to\_remove = None

        for cookie in cookies:

            collides = collision\_rect.colliderect(cookie.get\_shape())

            if collides and cookie in game\_objects:

                game\_objects.remove(cookie)

                self.\_renderer.add\_score(ScoreType.COOKIE)

                cookie\_to\_remove = cookie

        if cookie\_to\_remove is not None:

            cookies.remove(cookie\_to\_remove)

        if len(self.\_renderer.get\_cookies()) == 0:

            self.\_renderer.set\_won()

        for powerup in powerups:

            collides = collision\_rect.colliderect(powerup.get\_shape())

            if collides and powerup in game\_objects:

                if not self.\_renderer.is\_kokoro\_active():

                    game\_objects.remove(powerup)

                    self.\_renderer.add\_score(ScoreType.POWERUP)

                    self.\_renderer.activate\_kokoro()

    def handle\_ghosts(self):

        collision\_rect = pygame.Rect(self.x, self.y, self.\_size, self.\_size)

        ghosts = self.\_renderer.get\_ghosts()

        game\_objects = self.\_renderer.get\_game\_objects()

        for ghost in ghosts:

            collides = collision\_rect.colliderect(ghost.get\_shape())

            if collides and ghost in game\_objects:

                if self.\_renderer.is\_kokoro\_active():

                    game\_objects.remove(ghost)

                    self.\_renderer.add\_score(ScoreType.GHOST)

                    pygame.time.set\_timer(self.\_renderer.\_ghost\_respawn\_event, 10000)  # 10s

                else:

                    if not self.\_renderer.get\_won():

                        self.\_renderer.kill\_pacman()

    def draw(self):

        half\_size = self.\_size / 2

        self.image = self.open if self.mouth\_open else self.closed

        self.image = pygame.transform.rotate(self.image, self.current\_direction.value)

        super(Hero, self).draw()

class Ghost(MovableObject):

    def \_\_init\_\_(self, in\_surface, x, y, in\_size: int, in\_game\_controller, sprite\_path="images/ghost\_fright.png"):

        super().\_\_init\_\_(in\_surface, x, y, in\_size)

        self.game\_controller = in\_game\_controller

        self.sprite\_normal = pygame.image.load(sprite\_path)

        self.sprite\_fright = pygame.image.load("images/ghost\_fright.png")

    def reached\_target(self):

        if (self.x, self.y) == self.next\_target:

            self.next\_target = self.get\_next\_location()

        self.current\_direction = self.calculate\_direction\_to\_next\_target()

    def set\_new\_path(self, in\_path):

        for item in in\_path:

            self.location\_queue.append(item)

        self.next\_target = self.get\_next\_location()

    def calculate\_direction\_to\_next\_target(self) -> Direction:

        if self.next\_target is None:

            if self.\_renderer.get\_current\_mode() == GhostBehaviour.CHASE and not self.\_renderer.is\_kokoro\_active():

                self.request\_path\_to\_player(self)

            else:

                self.game\_controller.request\_new\_random\_path(self)

            return Direction.NONE

        diff\_x = self.next\_target[0] - self.x

        diff\_y = self.next\_target[1] - self.y

        if diff\_x == 0:

            return Direction.DOWN if diff\_y > 0 else Direction.UP

        if diff\_y == 0:

            return Direction.LEFT if diff\_x < 0 else Direction.RIGHT

        if self.\_renderer.get\_current\_mode() == GhostBehaviour.CHASE and not self.\_renderer.is\_kokoro\_active():

            self.request\_path\_to\_player(self)

        else:

            self.game\_controller.request\_new\_random\_path(self)

        return Direction.NONE

    def request\_path\_to\_player(self, in\_ghost):

        player\_position = translate\_screen\_to\_maze(in\_ghost.\_renderer.get\_hero\_position())

        current\_maze\_coord = translate\_screen\_to\_maze(in\_ghost.get\_position())

        path = self.game\_controller.p.get\_path(current\_maze\_coord[1], current\_maze\_coord[0], player\_position[1],

                                               player\_position[0])

        new\_path = [translate\_maze\_to\_screen(item) for item in path]

        in\_ghost.set\_new\_path(new\_path)

    def automatic\_move(self, in\_direction: Direction):

        if in\_direction == Direction.UP:

            self.set\_position(self.x, self.y - 1)

        elif in\_direction == Direction.DOWN:

            self.set\_position(self.x, self.y + 1)

        elif in\_direction == Direction.LEFT:

            self.set\_position(self.x - 1, self.y)

        elif in\_direction == Direction.RIGHT:

            self.set\_position(self.x + 1, self.y)

    def draw(self):

        self.image = self.sprite\_fright if self.\_renderer.is\_kokoro\_active() else self.sprite\_normal

        self.image = pygame.transform.scale(self.image, (16, 16))

        super(Ghost, self).draw()

class Cookie(GameObject):

    def \_\_init\_\_(self, in\_surface, x, y):

        super().\_\_init\_\_(in\_surface, x, y, 4, (255, 255, 0), True)

class Powerup(GameObject):

    def \_\_init\_\_(self, in\_surface, x, y):

        super().\_\_init\_\_(in\_surface, x, y, 8, (255, 255, 255), True)

class Pathfinder:

    def \_\_init\_\_(self, in\_arr):

        cost = np.array(in\_arr, dtype=np.bool\_).tolist()

        self.pf = tcod.path.AStar(cost=cost, diagonal=0)

    def get\_path(self, from\_x, from\_y, to\_x, to\_y) -> object:

        res = self.pf.get\_path(from\_x, from\_y, to\_x, to\_y)

        return [(sub[1], sub[0]) for sub in res]

class PacmanGameController:

    def \_\_init\_\_(self):

        self.ascii\_maze = [

            "XXXXXXXXXXXXXXXXXXXXXXXXXXXX",

            "XP           XX            X",

            "X  XXX XXXXX XX XXXXX XXXX X",

            "X XXXXOXXXXX XX XXXXXOXXXX X",

            "X XXXX XXXXX XX XXXXX XXXX X",

            "X                          X",

            "X XXXX XX XXXXXXXX XX XXXX X",

            "X XXXX XX XXXXXXXX XX XXXX X",

            "X      XX    XX    XX      X",

            "XXXXXX XXXXX XX XXXXX XXXXXX",

            "XXXXXX XXXXX XX XXXXX XXXXXX",

            "XXXXXX XX     G    XX XXXXXX",

            "XXXXXX XX XXX  XXX XX XXXXXX",

            "XXXXXX XX X      X XX XXXXXX",

            "   G      X      X          ",

            "XXXXXX XX X      X XX XXXXXX",

            "XXXXXX XX XXXXXXXX XX XXXXXX",

            "XXXXXX XX    G     XX XXXXXX",

            "XXXXXX XX XXXXXXXX XX XXXXXX",

            "XXXXXX XX XXXXXXXX XX XXXXXX",

            "X            XX            X",

            "X XXXX XXXXX XX XXXXX XXXX X",

            "X XXXX XXXXX XX XXXXX XXXX X",

            "X   XX       G        XX   X",

            "XXX XX XX XXXXXXXX XX XX XXX",

            "XXX XX XX XXXXXXXX XX XX XXX",

            "X      XX    XX    XX      X",

            "X XXXXXXXXXX XX XXXXXXXXXX X",

            "X XXXXXXXXXX XX XXXXXXXXXX X",

            "X   O                 O    X",

            "XXXXXXXXXXXXXXXXXXXXXXXXXXXX",

        ]

        self.numpy\_maze = []

        self.cookie\_spaces = []

        self.powerup\_spaces = []

        self.reachable\_spaces = []

        self.ghost\_spawns = []

        self.ghost\_colors = [

            "images/ghost.png",

            "images/ghost\_pink.png",

            "images/ghost\_orange.png",

            "images/ghost\_blue.png"

        ]

        self.size = (0, 0)

        self.convert\_maze\_to\_numpy()

        self.p = Pathfinder(self.numpy\_maze)

    def request\_new\_random\_path(self, in\_ghost: Ghost):

        random\_space = random.choice(self.reachable\_spaces)

        current\_maze\_coord = translate\_screen\_to\_maze(in\_ghost.get\_position())

        path = self.p.get\_path(current\_maze\_coord[1], current\_maze\_coord[0], random\_space[1],

                               random\_space[0])

        test\_path = [translate\_maze\_to\_screen(item) for item in path]

        in\_ghost.set\_new\_path(test\_path)

    def convert\_maze\_to\_numpy(self):

        for x, row in enumerate(self.ascii\_maze):

            self.size = (len(row), x + 1)

            binary\_row = []

            for y, column in enumerate(row):

                if column == "G":

                    self.ghost\_spawns.append((y, x))

                if column == "X":

                    binary\_row.append(0)

                else:

                    binary\_row.append(1)

                    self.cookie\_spaces.append((y, x))

                    self.reachable\_spaces.append((y, x))

                    if column == "O":

                        self.powerup\_spaces.append((y, x))

            self.numpy\_maze.append(binary\_row)

if \_\_name\_\_ == "\_\_main\_\_":

    unified\_size = 16

    pacman\_game = PacmanGameController()

    size = pacman\_game.size

    game\_renderer = GameRenderer(size[0] \* unified\_size, size[1] \* unified\_size, pacman\_game)

    for y, row in enumerate(pacman\_game.numpy\_maze):

        for x, column in enumerate(row):

            if column == 0:

                game\_renderer.add\_wall(Wall(game\_renderer, x, y, unified\_size))

    for cookie\_space in pacman\_game.cookie\_spaces:

        translated = translate\_maze\_to\_screen(cookie\_space)

        cookie = Cookie(game\_renderer, translated[0] + unified\_size / 2, translated[1] + unified\_size / 2)

        game\_renderer.add\_cookie(cookie)

    for powerup\_space in pacman\_game.powerup\_spaces:

        translated = translate\_maze\_to\_screen(powerup\_space)

        powerup = Powerup(game\_renderer, translated[0] + unified\_size / 2, translated[1] + unified\_size / 2)

        game\_renderer.add\_powerup(powerup)

    for i, ghost\_spawn in enumerate(pacman\_game.ghost\_spawns):

        translated = translate\_maze\_to\_screen(ghost\_spawn)

        ghost = Ghost(game\_renderer, translated[0], translated[1], unified\_size, pacman\_game,

                      pacman\_game.ghost\_colors[i % 4])

        game\_renderer.add\_ghost(ghost)

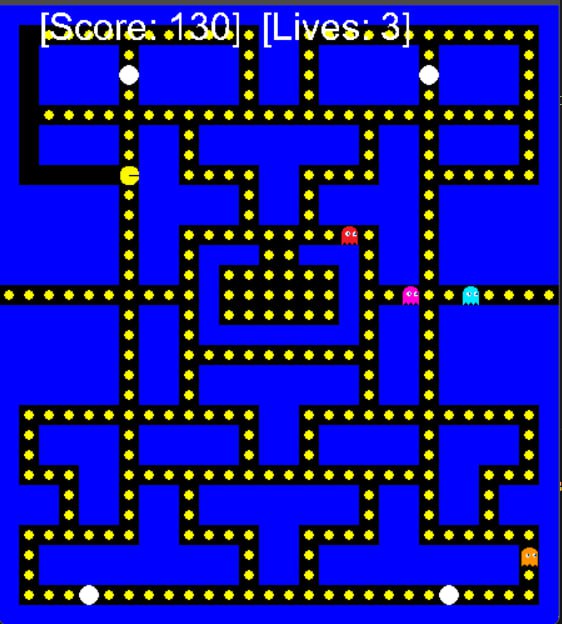
    pacman = Hero(game\_renderer, unified\_size, unified\_size, unified\_size)

    game\_renderer.add\_hero(pacman)

    game\_renderer.set\_current\_mode(GhostBehaviour.CHASE)

    game\_renderer.tick(120)

**Скрин-шот экранов**

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