Game of Pong

Overview and starting development

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Topics list

- Overview of PongGameV8.0
- Developing:
  - PongGameV1.0 (Ball class)
  - PongGameV2.0 (Paddle class)
  - PongGameV3.0 (Collision detection)
  - PongGameV4.0 (Lives lost, lives per game, score)
  - PongGameV5.0 (Tournament functionality)
  - PongGameV6.0 (Player class – array, no statistics)
  - PongGameV7.0 (Player class – array, with statistics)
  - PongGameV8.0 (JOptionPane for I/O)

Idea is based on Reas and Fry (2014) example

Demo of
Pong Game V3.0

Classes in the PongGameV3.0

PongGame

ball
paddle

setup()
draw()
hitPaddle(paddle, ball)

No changes in Ball and Paddle class.

In PongGame, the draw() method is updated to call the new hitPaddle method.

hitPaddle uses a collision detection algorithm and returns true if the paddle and ball are touching and false otherwise.

Paddle

Xcoord
yCoord
paddleHeight
paddleWidth

Paddle(int, int)
update()
display()
getXCoord()
getYCoord()
getPaddleWidth()
getPaddleHeight()
setPaddleWidth(int)
setPaddleHeight(int)

Ball

xCoord
yCoord
diameter
speedX
speedY

Ball(float)
update()
display()
hit()
getXCoord()
getYCoord()
getDiameter()
setDiameter(float)
resetBall()

Collision Detection Algorithm

Method signature:

```
boolean hitPaddle(Paddle paddle, Ball ball)
```

Algorithm:

- Measure the magnitude of the gap between the paddle and the ball.
- If the ball is too far away from the Paddle on the X axis to have a collision → return false
- If the ball is too far away from the Paddle on the Y axis to have a collision → false
- Otherwise → return true.

Collision Detection Algorithm

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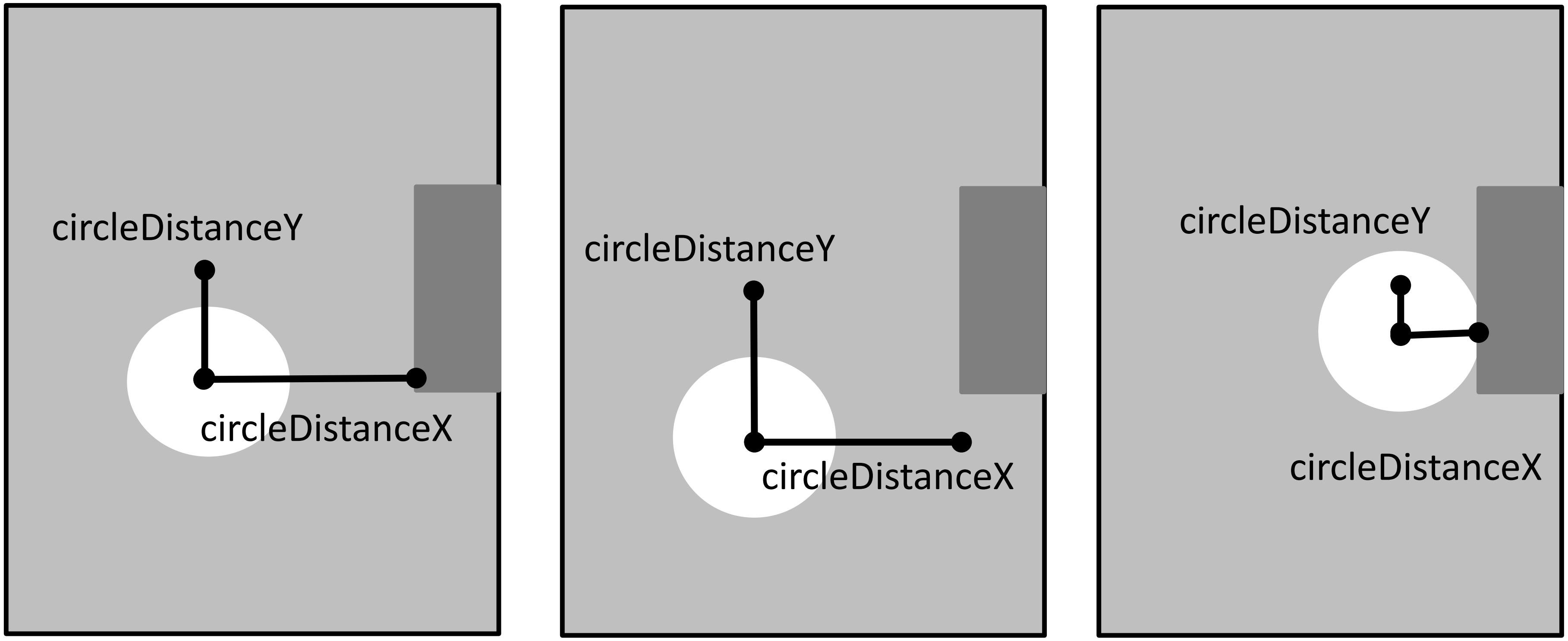
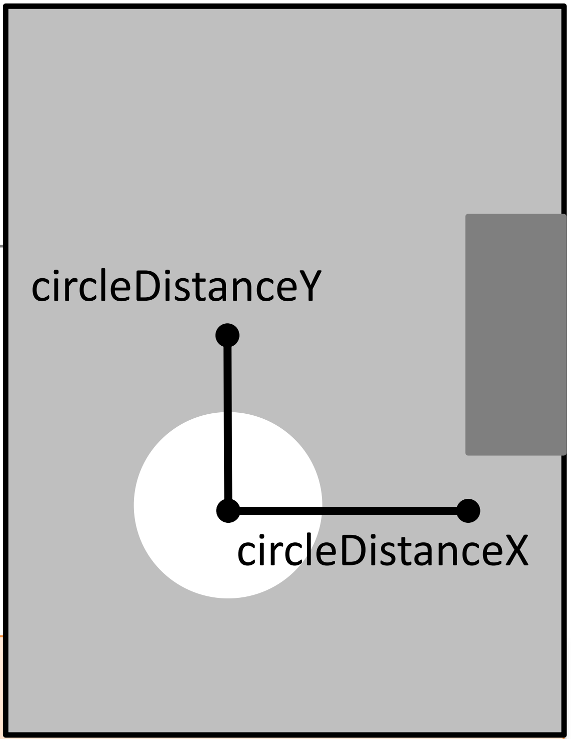
- If the ball is too far away from the Paddle on the Y axis to have a collision → false
- Otherwise → return true.

Measuring magnitude of the gap between the paddle and ball.

We need to first calculate how far away the ball is from the paddle on both the x and the y axis e.g.:



Measuring magnitude of the gap between the paddle and ball.



```
boolean hitPaddle(Paddle paddle, Ball ball)
{

//These variables measure the magnitude of the gap between the paddle and ball.
  float circleDistanceX
              = abs(ball.getXCoord() - paddle.getXCoord());
  float circleDistanceY
              = abs(ball.getYCoord() - paddle.getYCoord() - paddle.getPaddleHeight()/2);

}
```

Collision Detection Algorithm

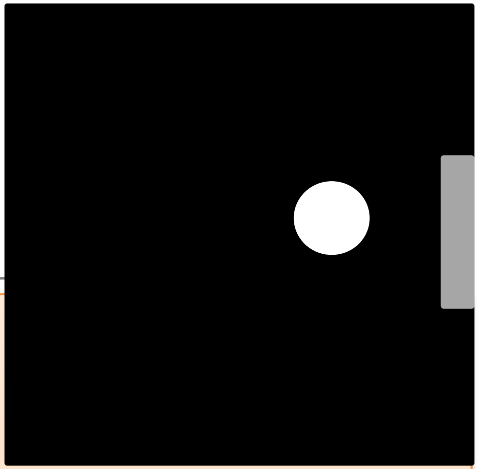
Method signature:

```
boolean hitPaddle(Paddle paddle, Ball ball)
```

Algorithm:

- Measure the magnitude of the gap between the paddle and the ball.
- If the ball is too far away from the Paddle on the X axis to have a collision → return false
- If the ball is too far away from the Paddle on the Y axis to have a collision → false
- Otherwise → return true.

If ball is too far away from the Paddle on the X axis → return false



```
boolean hitPaddle(Paddle paddle, Ball ball)
{

  //These variables measure the magnitude of the gap between the paddle and ball.
  float circleDistanceX
             = abs(ball.getXCoord() - paddle.getXCoord());
  float circleDistanceY
             = abs(ball.getYCoord() - paddle.getYCoord() - paddle.getPaddleHeight()/2);

   //The Ball is too far away from the Paddle on the X axis to have a collision,
   //so abandon collision detection
   if (circleDistanceX > (ball.getDiameter()/2)) {
     return false;
   }
   // more code omitted…
}
```

Collision Detection Algorithm

Method signature:

boolean hitPaddle(Paddle paddle, Ball ball)

Algorithm:

- Measure the magnitude of the gap between the paddle and the ball.
- If the ball is too far away from the Paddle on the X axis to have a collision → return false
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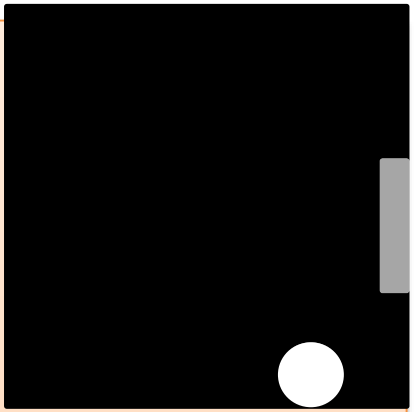
- Otherwise → return true.

```
boolean hitPaddle(Paddle paddle, Ball ball)
{

float circleDistanceX
            = abs(ball.getXCoord() - paddle.getXCoord());
 float circleDistanceY
            = abs(ball.getYCoord() - paddle.getYCoord() - paddle.getPaddleHeight()/2);

  //The Ball is too far away from the Paddle on the X axis to have a collision,
  //so abandon collision detection
  if (circleDistanceX > (ball.getDiameter()/2)) {
    return false;
  }

  //The Ball is too far away from the Paddle on the Y axis to have a collision,
  //so abandon collision detection
  if (circleDistanceY > (paddle.getPaddleHeight()/2 + ball.getDiameter()/2)) {
     return false;
  }
  // more code omitted…
}
```



If ball is too far away from the Paddle on the Y axis → return false

Collision Detection Algorithm

Method signature:

```
boolean hitPaddle(Paddle paddle, Ball ball)
```

Algorithm:

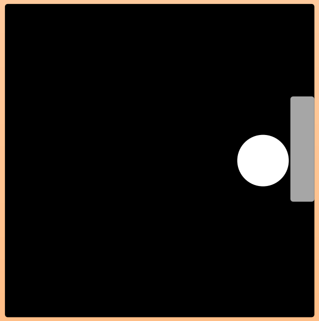
- Measure the magnitude of the gap between the paddle and the ball.
- If the ball is too far away from the Paddle on the X axis to have a collision → return false
- If the ball is too far away from the Paddle on the Y axis to have a collision → false
- Otherwise → return true.

```
boolean hitPaddle(Paddle paddle, Ball ball)
{
 //These variables measure the magnitude of the gap between the paddle and ball.
 float circleDistanceX
            = abs(ball.getXCoord() - paddle.getXCoord());
 float circleDistanceY
            = abs(ball.getYCoord() - paddle.getYCoord() - paddle.getPaddleHeight()/2);

  //The Ball is too far away from the Paddle on the X axis to have a collision,
  //so abandon collision detection
  if (circleDistanceX > (ball.getDiameter()/2)) {
    return false;
  }

  //The Ball is too far away from the Paddle on the Y axis to have a collision,
  //so abandon collision detection
  if (circleDistanceY > (paddle.getPaddleHeight()/2 + ball.getDiameter()/2)) {
     return false;
  }
  //We have a collision
  return true;
}
```

We have a collision



hitPaddle(paddle, ball) method

- We will call the hit(ball, paddle) method from the draw() method in our main PongGame class.

```
void draw(){
   background(0);       //Clear the background
   paddle.update();    //Update the paddle location in line with the cursor
   paddle.display();   //Draw the paddle in this new location
   ball.update();        // update the ball position.
   ball.display();       //Draw the ball at its new location

   //Set variable to true if ball and paddle are overlapping, false if not
   boolean collision = hitPaddle(paddle, ball);
   if (collision == true){
      ball.hit();       //the ball is hit i.e. reverse direction.
   }
}
```

Topics list

- Overview of PongGameV8.0
- Developing:
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  - PongGameV2.0 (Paddle class)
  - PongGameV3.0 (Collision detection)
  - PongGameV4.0 (Lives lost, lives per game, score)
  - PongGameV5.0 (Tournament functionality)
  - PongGameV6.0 (Player class – array, no statistics)
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  - PongGameV8.0 (JOptionPane for I/O)

Idea is based on Reas and Fry (2014) example

Demo of
Pong Game V4.0

PongGameV4.0

- This version stores game information:
  - The number of lives lost
  - The maximum lives allowed per game
  - The score of the game
- The game ends when the user loses the number of lives allowed per game.
- There are no changes in the Ball and Paddle class; all changes will be in the PongGameV4.0 class.

Classes in the PongGameV4.0

PongGame
ball
Paddle
livesLost
score
maxLivesPerGame
setup()
draw()
hitPaddle(paddle, ball)

Paddle
Xcoord
yCoord
paddleHeight
paddleWidth
Paddle(int, int)
update()
display()
getXCoord()
getYCoord()
getPaddleWidth()
getPaddleHeight()
setPaddleWidth(int)
setPaddleHeight(int)

Ball
xCoord
yCoord
diameter
speedX
speedY
Ball(float)
update()
display()
hit()
getXCoord()
getYCoord()
getDiameter()
setDiameter(float)
resetBall()

PongGameV4.0 class – global fields

```
//Current game data
int livesLost = 0;           //keeps track of number of lives lost in current game
int score = 0;               //high score of the current game
int maxLivesPerGame = 3;     //maximum number of lives that can be lost
                             //before the game ends
```

PongGameV4.0 class – draw (1)

Version 3.0

```
 // Update the ball position.
ball.update();
```

Version 4.0

```
// Update the ball position.  If true is returned, the ball has left the display
 // window i.e. a life is lost
 if (ball.update() == true){
      livesLost++;
      println("Lives lost:  "  + livesLost);
}
```

PongGameV4.0 class – draw (2)

Version 3.0

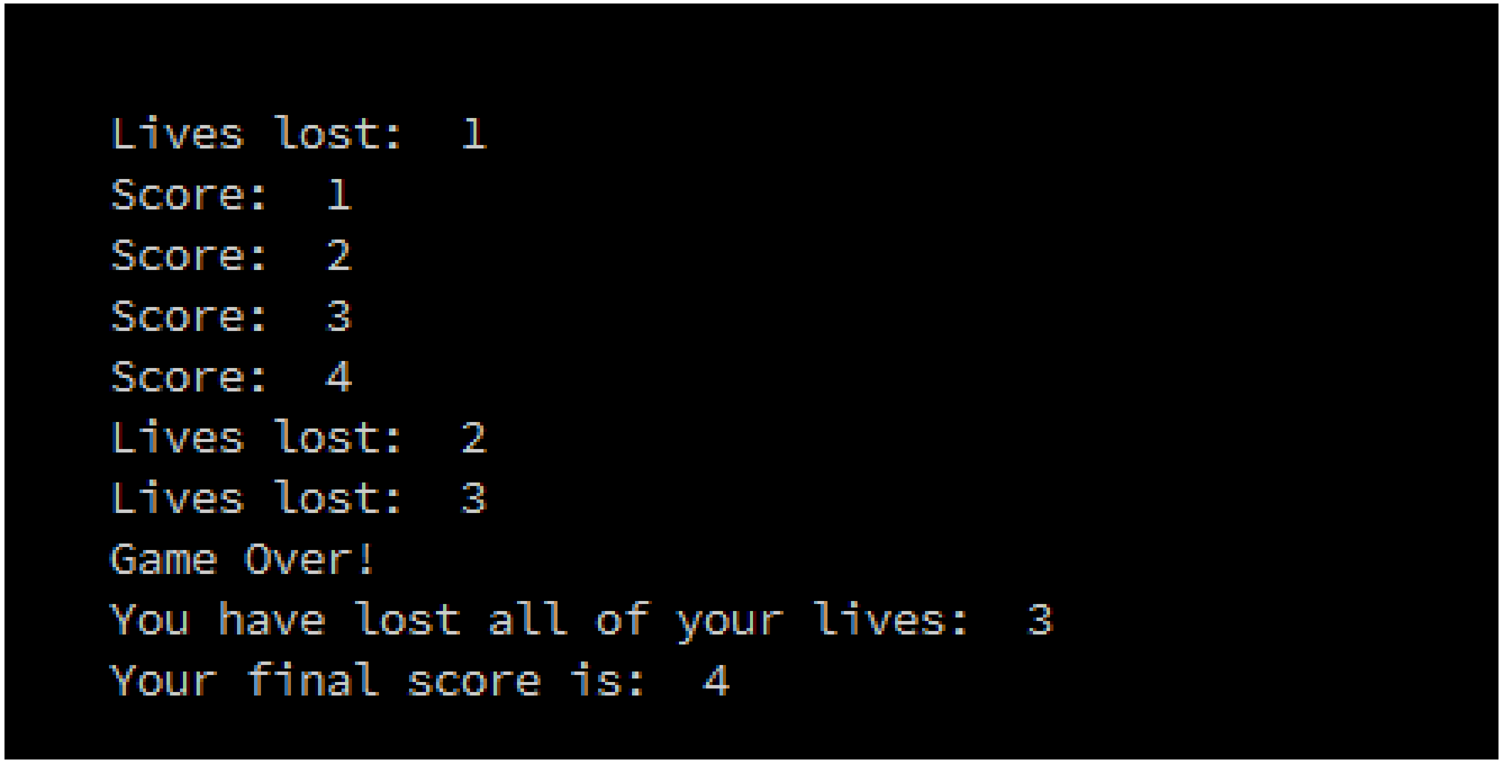
```
//Draw the ball at its new location and check for a collision with the paddle
ball.display();
//Set variable to true if ball and paddle are overlapping, false if not
boolean collision = hitPaddle(paddle, ball);
if (collision == true){
  ball.hit();       //the ball is hit i.e. reverses direction.
}
```

PongGameV4.0 class – draw (3)

Version 4.0

```
//If the player still has a life left in the current game,
//draw the ball at its new location and check for a collision with the paddle
if (livesLost < maxLivesPerGame){
  ball.display();
  //Set variable to true if ball and paddle are overlapping, false if not
  boolean collision = hitPaddle(paddle, ball);
  if (collision == true){
    ball.hit();     //the ball is hit i.e. reverses direction.
    score++;        //increase score in the current game by 1, if the player hit the ball.
    println("Score:  "  + score);
  }
}
//The player has no lives left so the game ends
else{
   println("Game Over!");
   println("You have lost all of your lives:  "  + livesLost);
   println("Your final score is:  "  + score);
   exit();
 }
```

PongGameV4.0 – sample output



```
Lives lost:  1
Score:  1
Score:  2
Score:  3
Score:  4
Lives lost:  2
Lives lost:  3
Game Over!
You have lost all of your lives:  3
Your final score is:  4
```

Topics list

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Idea is based on Reas and Fry (2014) example

Demo of
Pong Game V5.0

PongGameV5.0

- This version stores tournament information:
  - The number of games in a tournament.
  - The number of games played so far.
- If the number of games in the tournament is over, end the program.
- There are no changes in the Ball and Paddle class; all changes will be in the PongGameV5.0 class.

Classes in the PongGameV5.0

PongGame
ball
Paddle
livesLost
score
maxLivesPerGame
maxNumberOfGames
numberOfGamesPlayed
setup()
draw()
resetGame()
tournamentOver()
hitPaddle(paddle, ball)

Paddle
Xcoord
yCoord
paddleHeight
paddleWidth
Paddle(int, int)
update()
display()
getXCoord()
getYCoord()
getPaddleWidth()
getPaddleHeight()
setPaddleWidth(int)
setPaddleHeight(int)

Ball
xCoord
yCoord
diameter
speedX
speedY
Ball(float)
update()
display()
hit()
getXCoord()
getYCoord()
getDiameter()
setDiameter(float)
resetBall()

PongGameV5.0 class – global fields

```
//Tournament data
int maxNumberOfGames = 5;      //maximum number of games in a tournament
int numberOfGamesPlayed = 0;  //num of games played, so far, in a tournament
```

PongGameV5.0 class – draw (1)

Version 4.0

```
//If the player still has a life left in the current game,
//draw the ball at its new location and check for a collision with the paddle
if (livesLost < maxLivesPerGame){
   //displays the ball code
   //if the ball and paddle are overlapping, hit the ball and increase the score by 1
}
//The player has no lives left so the game ends
else{
    println("Game Over!");
    println("You have lost all of your lives:  "  + livesLost);
    println("Your final score is:  "  + score);
    exit();
}
```

PongGameV5.0 class – draw (2)

Version 5.0

```
//If the player still has a life left in the current game,
//draw the ball at its new location and check for a collision with the paddle
if (livesLost < maxLivesPerGame){
    //displays the ball code
    //if the ball and paddle are overlapping, hit the ball and increase the score by 1
}
//The player has no lives left so the game ends
else{
    numberOfGamesPlayed++;
    //If the player has more games left in the tournament,
    //display their score and ask them if they want to continue with tournament.
    if (numberOfGamesPlayed < maxNumberOfGames)
        resetGame();
    else
        //the player has no more games left in the tournament
        tournamentOver();
}
```

PongGameV5.0 class – resetGame()

```
// method prepares for the next game by resetting the variables //
that store the current game information.
void resetGame()
{
    println("Game Over!");
    println("Starting a new game...");
    livesLost = 0;      //resets the lives lost in the current game to zero
    score = 0;          //resets the score of the current game to zero
}
```

PongGameV5.0 class – tournamentOver ()

```
// method displays the player information, before exiting
// the program.
void tournamentOver()
{
    println("Game Over!");
    println("Tournament Over!");
    exit();
}
```

PongGameV5.0 – sample output

```
Score:  1
Score:  2
Lives lost:  1
Score:  3
Lives lost:  2
Score:  4
Lives lost:  3
Game Over!
Starting a new game...
Lives lost:  1
Lives lost:  2
Lives lost:  3
Game Over!
```

```
Starting a new game...
Score:  1
Score:  2
Lives lost:  1
Score:  3
Lives lost:  2
Lives lost:  3
Game Over!
Starting a new game...
Score:  1
Lives lost:  1
Score:  2
Lives lost:  2
Lives lost:  3
Game Over!
```

```
Starting a new game...
Lives lost:  1
Score:  1
Score:  2
Lives lost:  2
Lives lost:  3
Game Over!
Tournament Over!
```

5 games in tournament
3 lives in a game

Questions?

References

- Reas, C. & Fry, B. (2014) Processing – A Programming Handbook for Visual Designers and Artists, 2nd Edition, MIT Press, London.