МИНОБРНАУКИ РОССИИ

Федеральное государственное автономное образовательное учреждения высшего образования

«ЮЖНЫЙ ФЕДЕРАЛЬНЫЙ УНИВЕРСИТЕТ»

Институт компьютерных технологий и информационной безопасности

Кафедра математического обеспечения и применения ЭВМ

**ЛАБОРАТОРНАЯ РАБОТА № 1**

по дисциплине

**«Объектно-ориентированное программирование»**

на тему:

**«Классы и объекты С++»**

*Вариант № 13*

Выполнил:

Студент группы

КТбо2-8

Макаров С. В.

Проверил:

Тарасов С. А.

Оценка

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«\_\_\_\_» \_\_\_\_\_\_\_\_\_\_\_\_\_ 2020 г.

Таганрог 2020

# **1 ФОРМУЛИРОВКА ЗАДАНИЯ**

Согласно варианту задания, требуется создать класс Треугольник (Triangle) c полями, в которых фиксируются координаты ее вершин (на плоскости). Методы: определения центра тяжести, площади, периметра, перемещения, изменения размеров, сравнения площадей двух объектов.

При выполнении работы необходимо: − разработать соответствующие классы, конструкторы, поля и методы; − поля класса сделать закрытыми; для чтения и изменения их значений определить открытые методы; – предусмотреть во всех вариантах консольный ввод данных для создания объектов и консольный вывод результатов. – во всех вариантах необходимо использовать хотя бы один раз блоки try catch. Это можно сделать для контроля арифметических ошибок, для проверки существования файлов и т. п. Отсутствие такового карается дополнительным уменьшением оценки. – во всех перечисленных вариантах запрещено пользоваться контейнерами STL, кроме string.

# **2 СПЕЦИФИКАЦИЯ КЛАССОВ**

struct Point

{

float x;

float y;

Point(float \_x, float \_y) : x(\_x), y(\_y)

{}

void Add(const Point& other);

friend Point operator+(const Point& left, const Point& right);

friend Point operator-(const Point& left, const Point& right);

static float FindMagnitude(const Point& from, const Point& to);

};

class Triangle

{

public:

Triangle() = delete;

Triangle(const Point& p1, const Point& p2, const Point& p3);

Triangle(float x1, float y1, float x2, float y2, float x3, float y3);

Point FindCenter() const;

float FindArea() const;

float FindPerimeter() const;

void Move(Point offset);

Point GetFirstPoint() const;

Point GetSecondPoint() const;

Point GetThirdPoint() const;

void SetFirstPoint(const Point& other);

void SetSecondPoint(const Point& other);

void SetThirdPoint(const Point& other);

bool IsAreasEqual(const Triangle& other) const;

bool IsExisting() const;

friend bool operator>(const Triangle& left, const Triangle& right);

friend bool operator<(const Triangle& left, const Triangle& right);

friend bool operator>=(const Triangle& left,

const Triangle& right);

friend bool operator<=(const Triangle& left,

const Triangle& right);

private:

Point points[3];

void \_CalculateMagnitudes(float& a, float& b, float& c) const;

int \_CompareArea(const Triangle& other) const;

};

class TriangleExistingException : public std::exception

{

public:

TriangleExistingException(const Triangle \_triangle);

const char\* what() const noexcept;

private:

std::string what\_string;

Triangle triangle;

};

class ConsoleInteractor

{

public:

void Run();

private:

void \_UpdateConsole(const Triangle& t1, const Triangle& t2);

Point \_ReadPointFromConsole();

};

# **3 ИСПОЛЬЗУЕМЫЕ МАТЕМАТИЧЕСКИЕ ЗАВИСИМОСТИ И АЛГОРИТМЫ**

При выполнении лабораторной работы использовались следующие математические зависимости:

Формула вычисления периметра треугольника.

Формула Герона для нахождения площади треугольника.

Формула вычисления точки центра масс.

Формула для вычисления длины вектора между двумя точками.

# **4 ДИАГРАММА КЛАССОВ**

Uml диаграмма классов изображена на рисунке 1.

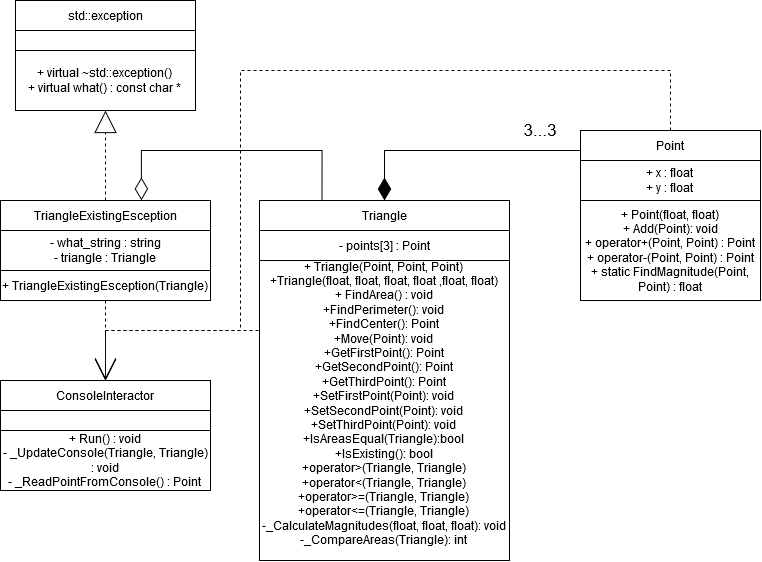


Рисунок 1 – Диаграмма классов

**ЛИСТИНГ ПРОГРАММЫ**

class ConsoleInteractor

{

public:

void Run();

private:

void \_UpdateConsole(const Triangle& t1, const Triangle& t2);

Point \_ReadPointFromConsole();

};

struct Point

{

float x;

float y;

Point(float \_x, float \_y) : x(\_x), y(\_y)

{}

void Add(const Point& other);

friend Point operator+(const Point& left, const Point& right);

friend Point operator-(const Point& left, const Point& right);

static float FindMagnitude(const Point& from, const Point& to);

};

class Triangle

{

public:

Triangle() = delete;

Triangle(const Point& p1, const Point& p2, const Point& p3);

Triangle(float x1, float y1, float x2, float y2, float x3, float y3);

Point FindCenter() const;

float FindArea() const;

float FindPerimeter() const;

void Move(Point offset);

Point GetFirstPoint() const;

Point GetSecondPoint() const;

Point GetThirdPoint() const;

void SetFirstPoint(const Point& other);

void SetSecondPoint(const Point& other);

void SetThirdPoint(const Point& other);

bool IsAreasEqual(const Triangle& other) const;

bool IsExisting() const;

friend bool operator>(const Triangle& left, const Triangle& right);

friend bool operator<(const Triangle& left, const Triangle& right);

friend bool operator>=(const Triangle& left, const Triangle& right);

friend bool operator<=(const Triangle& left, const Triangle& right);

private:

Point points[3];

void \_CalculateMagnitudes(float& a, float& b, float& c) const;

int \_CompareArea(const Triangle& other) const;

};

class TriangleExistingException : public std::exception

{

public:

TriangleExistingException(const Triangle \_triangle);

const char\* what() const noexcept;

private:

std::string what\_string;

Triangle triangle;

};

Triangle::Triangle(const Point& p1, const Point& p2, const Point& p3)

: points{ p1, p2, p3 }

{}

Triangle::Triangle(float x1, float y1, float x2, float y2, float x3, float y3)

: Triangle({ x1, y1 }, { x2, y2 }, { x3, y3 })

{}

Point Triangle::FindCenter() const

{

if (!IsExisting())

{

throw TriangleExistingException(\*this);

}

float centerX = (points[0].x + points[1].x + points[2].x) / 3;

float centerY = (points[0].y + points[1].y + points[2].y) / 3;

return Point(centerX, centerY);

}

float Triangle::FindArea() const

{

if (!IsExisting())

{

throw TriangleExistingException(\*this);

}

float a, b, c;

\_CalculateMagnitudes(a, b, c);

float p = (a + b + c) / 2;

return sqrt(p \* (p - a) \* (p - b) \* (p - c));

}

float Triangle::FindPerimeter() const

{

if (!IsExisting())

{

throw TriangleExistingException(\*this);

}

float a, b, c;

\_CalculateMagnitudes(a, b, c);

return a + b + c;

}

void Triangle::Move(Point offset)

{

points[0].Add(offset);

points[1].Add(offset);

points[2].Add(offset);

}

Point Triangle::GetFirstPoint() const

{

return points[0];

}

Point Triangle::GetSecondPoint() const

{

return points[1];

}

Point Triangle::GetThirdPoint() const

{

return points[2];

}

void Triangle::SetFirstPoint(const Point& other)

{

points[0] = other;

}

void Triangle::SetSecondPoint(const Point& other)

{

points[1] = other;

}

void Triangle::SetThirdPoint(const Point& other)

{

points[2] = other;

}

bool Triangle::IsAreasEqual(const Triangle& other) const

{

if (this->\_CompareArea(other) == 0)

{

return true;

}

return false;

}

bool Triangle::IsExisting() const

{

float a, b, c;

\_CalculateMagnitudes(a, b, c);

if ((a + b > c) && (b + c > a) && (a + c > b))

{

return true;

}

return false;

}

void Triangle::\_CalculateMagnitudes(float& a, float& b, float& c) const

{

a = Point::FindMagnitude(points[0], points[1]);

b = Point::FindMagnitude(points[1], points[2]);

c = Point::FindMagnitude(points[2], points[0]);

}

int Triangle::\_CompareArea(const Triangle& other) const

{

float S1 = this->FindArea();

float S2 = other.FindArea();

if (S1 > S2)

{

return 1;

}

else if (S1 == S2)

{

return 0;

}

else

{

return -1;

}

}

bool operator>(const Triangle& left, const Triangle& right)

{

if (left.\_CompareArea(right) > 0)

{

return true;

}

return false;

}

bool operator<(const Triangle& left, const Triangle& right)

{

if (left.\_CompareArea(right) < 0)

{

return true;

}

return false;

}

bool operator>=(const Triangle& left, const Triangle& right)

{

if (left.\_CompareArea(right) >= 0)

{

return true;

}

return false;

}

bool operator<=(const Triangle& left, const Triangle& right)

{

if (left.\_CompareArea(right) <= 0)

{

return true;

}

return false;

}

void Point::Add(const Point& other)

{

x += other.x;

y += other.y;

}

float Point::FindMagnitude(const Point& from, const Point& to)

{

float subX = to.x - from.x;

float subY = to.y - from.y;

return sqrt(subX \* subX + subY \* subY);

}

Point operator+(const Point& left, const Point& right)

{

return Point(left.x + right.x, left.y + right.y);

}

Point operator-(const Point& left, const Point& right)

{

return Point(left.x - right.x, left.y - right.y);

}

TriangleExistingException::TriangleExistingException(const Triangle \_triangle)

: triangle(\_triangle)

{

std::stringstream sstream;

Point p1 = triangle.GetFirstPoint();

Point p2 = triangle.GetSecondPoint();

Point p3 = triangle.GetThirdPoint();

sstream << "Triangle doesn't exist with points: \n"

<< "x1: " << p1.x << " y1: " << p1.y << "\n"

<< "x2: " << p2.x << " y2: " << p2.y << "\n"

<< "x3: " << p3.x << " y3: " << p3.y;

what\_string = sstream.str();

}

const char\* TriangleExistingException::what() const noexcept

{

return what\_string.c\_str();

}

void ConsoleInteractor::Run()

{

float x1, y1, x2, y2, x3, y3;

cout << "Enter a coords of first triangle vertexes in format: \nx1 y1\nx2 y2\nx3 y3\n\n";

cin >> x1 >> y1 >> x2 >> y2 >> x3 >> y3;

Triangle t1(x1, y1, x2, y2, x3, y3);

cout << "Enter a coords of second triangle vertexes in format: \nx1 y1\nx2 y2\nx3 y3\n\n";

cin >> x1 >> y1 >> x2 >> y2 >> x3 >> y3;

Triangle t2(x1, y1, x2, y2, x3, y3);

\_UpdateConsole(t1, t2);

int switch\_on;

Point C1(0.f, 0.f);

Point C2(0.f, 0.f);

while (true)

{

cout << ">>> ";

cin >> switch\_on;

try

{

switch (switch\_on)

{

case 0:

return;

break;

case 1:

cout << "-------------------------------------\n";

cout << "Perimeter of first triangle = " << t1.FindPerimeter() << "\n";

cout << "Perimeter of second triangle = " << t2.FindPerimeter() << "\n";

cout << "-------------------------------------\n\n";

break;

case 2:

cout << "-------------------------------------\n";

cout << "Area of first Triangle = " << t1.FindArea() << "\n";

cout << "Area of second Triangle = " << t2.FindArea() << "\n";

cout << "-------------------------------------\n\n";

break;

case 3:

cout << "-------------------------------------\n";

C1 = t1.FindCenter();

C2 = t2.FindCenter();

cout << "Coords of first triangle's center = x: " << C1.x << " y: " << C1.y << "\n";

cout << "Coords of second triangle's center = x: " << C2.x << " y: " << C2.y << "\n";

cout << "-------------------------------------\n\n";

break;

case 4:

cout << "-------------------------------------\n";

t1.Move(\_ReadPointFromConsole());

cout << "-------------------------------------\n\n";

\_UpdateConsole(t1, t2);

break;

case 5:

cout << "-------------------------------------\n";

t2.Move(\_ReadPointFromConsole());

cout << "-------------------------------------\n\n";

\_UpdateConsole(t1, t2);

break;

case 6:

cout << "-------------------------------------\n";

cout << "Result of 'First Triagnle > Second Triangle' is " << ((t1 > t2) ? "true\n" : "false\n");

cout << "-------------------------------------\n\n";

break;

case 7:

cout << "-------------------------------------\n";

cout << "Result of 'First Triagnle < Second Triangle' is " << ((t1 < t2) ? "true\n" : "false\n");

cout << "-------------------------------------\n\n";

break;

case 8:

cout << "-------------------------------------\n";

cout << "Result of 'First Triagnle >= Second Triangle' is " << ((t1 >= t2) ? "true\n" : "false\n");

cout << "-------------------------------------\n\n";

break;

case 9:

cout << "-------------------------------------\n";

cout << "Result of 'First Triagnle <= Second Triangle' is " << ((t1 <= t2) ? "true\n" : "false\n");

cout << "-------------------------------------\n\n";

break;

case 10:

cout << "-------------------------------------\n";

cout << "Result of 'Is areas Equal?' is " << (t1.IsAreasEqual(t2) ? "true\n" : "false\n");

cout << "-------------------------------------\n\n";

break;

case 11:

cout << "-------------------------------------\n";

t1.SetFirstPoint(\_ReadPointFromConsole());

cout << "-------------------------------------\n\n";

\_UpdateConsole(t1, t2);

break;

case 12:

cout << "-------------------------------------\n";

t1.SetSecondPoint(\_ReadPointFromConsole());

cout << "-------------------------------------\n\n";

\_UpdateConsole(t1, t2);

break;

case 13:

cout << "-------------------------------------\n";

t1.SetThirdPoint(\_ReadPointFromConsole());

cout << "-------------------------------------\n\n";

\_UpdateConsole(t1, t2);

break;

case 14:

cout << "-------------------------------------\n";

t2.SetFirstPoint(\_ReadPointFromConsole());

cout << "-------------------------------------\n\n";

\_UpdateConsole(t1, t2);

break;

case 15:

cout << "-------------------------------------\n";

t2.SetSecondPoint(\_ReadPointFromConsole());

cout << "-------------------------------------\n\n";

\_UpdateConsole(t1, t2);

break;

case 16:

cout << "-------------------------------------\n";

t2.SetThirdPoint(\_ReadPointFromConsole());

cout << "-------------------------------------\n\n";

\_UpdateConsole(t1, t2);

break;

case 17:

\_UpdateConsole(t1, t2);

break;

default:

cout << "Invalid command. Try again\n";

break;

}

}

catch (const std::exception & e)

{

cerr << e.what() << "\n";

}

}

}

void ConsoleInteractor::\_UpdateConsole(const Triangle& t1, const Triangle& t2)

{

system("cls");

cout << "COMMANDS: 1 - Find Perpimeter. 2 - Find Area. 3 - Find Center of Mass.\n";

cout << " 4 - Move first Triangle. 5 - Move second Triangle.\n";

cout << " 6 - Compare with operator >. 7 - Compare with operator <.\n";

cout << " 8 - Compare with operator >=. 9 - Compare with operator <=.\n";

cout << " 10 - Is areas equal? 0 - to Exit\n";

cout << " 11 - Set first point of first triangle. 12 - Set second point of first triangle\n";

cout << " 13 - Set third point of first triangle.\n";

cout << " 14 - Set first point of second triangle. 15 - Set second point of second triangle\n";

cout << " 16 - Set third point of second triangle.\n";

cout << " 17 - To refresh console.\n";

Point p1 = t1.GetFirstPoint();

Point p2 = t1.GetSecondPoint();

Point p3 = t1.GetThirdPoint();

cout << "\nCurrent Triangles: \n";

cout << setw(10) << left << "First: " << "|";

cout << "x1: " << p1.x << " y1: " << p1.y << "|";

cout << "x2: " << p2.x << " y2: " << p2.y << "|";

cout << "x3: " << p3.x << " y3: " << p3.y << " | \n\n";

p1 = t2.GetFirstPoint();

p2 = t2.GetSecondPoint();

p3 = t2.GetThirdPoint();

cout << setw(10) << left << "Second: " << "|";

cout << "x1: " << p1.x << " y1: " << p1.y << "|";

cout << "x2: " << p2.x << " y2: " << p2.y << "|";

cout << "x3: " << p3.x << " y3: " << p3.y << " | \n\n";

}

Point ConsoleInteractor::\_ReadPointFromConsole()

{

float x1, y1;

cout << "Enter a point if format: x y\n";

cin >> x1 >> y1;

return Point(x1, y1);

}

int main()

{

ConsoleInteractor program;

program.Run();

return 0;

}