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Факультет "Информационные технологии и прикладная математика"

Лабораторная работа №7 по курсу "Объектно-ориентированное программирование"

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Вариант: 5

Оценка: ____________

Дата: ____________

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1 Исходный код

Ссылка на github : https://github.com/QElderDelta/oop_exercise_07

figure.hpp

```
#pragma once

#include<iostream>

#include "point.hpp"

enum class Figures {Rhombus, Pentagon, Hexagon};

class Figure {
public:
    virtual Point Center() const = 0;
    virtual double Square() const = 0;
    virtual void Print(std::ostream& os) const = 0;
    virtual ~Figure() = default;
    virtual void serialize(std::ostream& os) const = 0;
    virtual int getID() const = 0;
};
```

rhombus.hpp

```
#pragma once

#include <array>

#include "figure.hpp"
#include "point.hpp"

class Rhombus : public Figure {
public:
    Rhombus(Point* p, int id);
    Rhombus(std::istream& is, int id);
    Point Center() const override;
    double Square() const override;
    void Print(std::ostream& os) const override;
    int getID() const override;
    void serialize(std::ostream& os) const override;
private:
    std::array<Point, 4> points;
    double smallerDiagonal, biggerDiagonal;
    int id;
};
```

rhombus.cpp

```
#include "rhombus.hpp"

double checkIfRhombus(const Point& p1, const Point& p2, const
        Point& p3, const Point& p4) {
    double d1 = calculateDistance(p1, p2);
    double d2 = calculateDistance(p1, p3);
    double d3 = calculateDistance(p1, p4);
    if(d1 == d2) {
        return d3;
    } else if(d1 == d3) {
        return d2;
    } else if(d2 == d3) {
        return d1;
    } else {
        throw std::invalid_argument("Entered coordinates are not
    forming Rhombus. Try entering new coordinates");
    }
}

Rhombus::Rhombus(Point* p, int id) {
    Point p1, p2, p3, p4;
    p1 = p[0];
    p2 = p[1];
    p3 = p[2];
    p4 = p[3];
    try {
        double d1 = checkIfRhombus(p1, p2, p3, p4);
        double d2 = checkIfRhombus(p2, p1, p3, p4);
        double d3 = checkIfRhombus(p3, p1, p2, p4);
        double d4 = checkIfRhombus(p4, p1, p2, p3);
        if(d1 == d2 || d1 == d4) {
            if(d1 < d3) {
                smallerDiagonal = d1;
                biggerDiagonal = d3;

            } else {
                smallerDiagonal = d3;
                biggerDiagonal = d1;
            }
        } else if(d1 == d3) {
            if(d1 < d2) {
                smallerDiagonal = d1;
                biggerDiagonal = d2;
            } else {
                smallerDiagonal = d2;
                biggerDiagonal = d1;
            }
        }
    } catch(std::exception& e) {
        throw std::invalid_argument(e.what());
        return;
    }
    points[0] = p1;
    points[1] = p2;
    points[2] = p3;
    points[3] = p4;
    this->id = id;
}

Rhombus::Rhombus(std::istream& is, int id) {
    Point p1, p2, p3, p4;
    is >> p1 >> p2 >> p3 >> p4;
    try {
        double d1 = checkIfRhombus(p1, p2, p3, p4);
        double d2 = checkIfRhombus(p2, p1, p3, p4);
        double d3 = checkIfRhombus(p3, p1, p2, p4);
        double d4 = checkIfRhombus(p4, p1, p2, p3);
```

```cpp
        if(d1 == d2 || d1 == d4) {
            if(d1 < d3) {
                smallerDiagonal = d1;
                biggerDiagonal = d3;

            } else {
                smallerDiagonal = d3;
                biggerDiagonal = d1;
            }
        } else if(d1 == d3) {
            if(d1 < d2) {
                smallerDiagonal = d1;
                biggerDiagonal = d2;
            } else {
                smallerDiagonal = d2;
                biggerDiagonal = d1;
            }
        }
    } catch(std::exception& e) {
        throw std::invalid_argument(e.what());
        return;
    }
    points[0] = p1;
    points[1] = p2;
    points[2] = p3;
    points[3] = p4;
    this->id = id;
}

Point Rhombus::Center() const {
    if(calculateDistance(points[0], points[1]) == smallerDiagonal ||
            calculateDistance(points[0], points[1]) == biggerDiagonal) {
        return {((points[0].x + points[1].x) / 2.0), ((points[0].y + points[1].y) / 2.0)};
    } else if(calculateDistance(points[0], points[2]) == smallerDiagonal ||
            calculateDistance(points[0], points[2]) == biggerDiagonal) {
        return {((points[0].x + points[2].x) / 2.0), ((points[0].y + points[2].y) / 2.0)};
    } else {
        return {((points[0].x + points[3].x) / 2.0), ((points[0].y + points[3].y) / 2.0)};
    }
}

double Rhombus::Square() const {
    return smallerDiagonal * biggerDiagonal / 2.0;
}

void Rhombus::Print(std::ostream& os) const {
    os << "Rhombus: ";
    for(const auto& p : points) {
        os << p << ' ';
    }
    os << "Center: " << this->Center() << ' ';
    os << "Area: " << this->Square() << ' ';
    os << "ID: " << id;
    os << std::endl;
}

int Rhombus::getID() const {
    return id;
}

void Rhombus::serialize(std::ostream& os) const {
    os << 'R' << ' ';
    for(const auto& p : points) {
        os << p.x << ' ' << p.y << ' ';
    }
    os << std::endl;
}
```

pentagon.hpp

```cpp
#pragma once

#include <iostream>
#include <array>

#include "figure.hpp"
#include "point.hpp"

class Pentagon : public Figure {
public:
    Pentagon(Point* p, int id);
    Pentagon(std::istream& is, int id);
    Point Center() const override;
    double Square() const override;
    void Print(std::ostream& os) const override;
    int getID() const override;
    void serialize(std::ostream& os) const override;
private:
    std::array<Point, 5> points;
    int id;
};
```

pentagon.cpp

```cpp
#include <cmath>

#include "pentagon.hpp"

Pentagon::Pentagon(Point* p, int id) {
    for(int i = 0; i < 5; ++i) {
        points[i] = p[i];
    }
    this->id = id;
}

Pentagon::Pentagon(std::istream& is, int id) {
    is >> points[0] >> points[1] >> points[2] >> points[3] >>
   points[4];
    this->id = id;
}

```

```cpp
Point Pentagon::Center() const {
    Point insideFigure{0, 0};
    Point result{0, 0};
    double square = this->Square();
    for(unsigned i = 0; i < points.size(); ++i) {
        insideFigure.x += points[i].x;
        insideFigure.y += points[i].y;
    }
    insideFigure.x /= points.size();
    insideFigure.y /= points.size();
    for(unsigned i = 0; i < points.size(); ++i) {
        double tempSquare = triangleSquare(points[i], points[(i + 1) % points.size()],
                insideFigure);
        result.x += tempSquare * (points[i].x + points[(i + 1) % points.size()].x
                + insideFigure.x) / 3.0;
        result.y += tempSquare * (points[i].y + points[(i + 1) % points.size()].y
                + insideFigure.y) / 3.0;
    }
    result.x /= square;
    result.y /= square;
    return result;
}

double Pentagon::Square() const {
    double result = 0;
    for(unsigned i = 0; i < points.size(); ++i) {
        Point p1 = i ? points[i - 1] : points[points.size() - 1];
        Point p2 = points[i];
        result += (p1.x - p2.x) * (p1.y + p2.y);
    }
    return fabs(result) / 2.0;
}

void Pentagon::Print(std::ostream& os) const {
    os << "Pentagon: ";
    for(const auto& p : points) {
        os << p << ' ';
    }
    os << "Center: " << this->Center() << ' ';
    os << "Area: " << this->Square() << ' ';
    os << "ID: " << id;
    os << std::endl;
}

int Pentagon::getID() const {
    return id;
}

void Pentagon::serialize(std::ostream& os) const {
    os << 'P' << ' ';
    for(const auto& p : points) {
        os << p.x << ' ' << p.y << ' ';
    }
    os << std::endl;
}
```

hexagon.hpp

```cpp
#pragma once

#include <iostream>
#include <array>

#include "figure.hpp"
#include "point.hpp"

class Hexagon : public Figure {
public:
    Hexagon(Point* p, int id);
    Hexagon(std::istream& is, int id);
    Point Center() const override;
    double Square() const override;
    void Print(std::ostream& os) const override;
    int getID() const override;
    void serialize(std::ostream& os) const override;
private:
    std::array<Point, 6> points;
    int id;
};
```

hexagon.cpp

```cpp
#include <cmath>

#include "hexagon.hpp"

Hexagon::Hexagon(Point* p, int id) {
    for(int i = 0; i < 6; ++i) {
        points[i] = p[i];
    }
    this->id = id;
}

Hexagon::Hexagon(std::istream& is, int id) {
    is >> points[0] >> points[1] >> points[2] >> points[3] >>
    points[4] >> points[5];
    this->id = id;
}

Point Hexagon::Center() const {
    Point insideFigure{0, 0};
    Point result{0, 0};
    double square = this->Square();
    for(unsigned i = 0; i < points.size(); ++i) {
        insideFigure.x += points[i].x;
        insideFigure.y += points[i].y;
    }
    insideFigure.x /= points.size();
    insideFigure.y /= points.size();
    for(unsigned i = 0; i < points.size(); ++i) {
        double tempSquare = triangleSquare(points[i], points[(i +
    1) % points.size()],
                insideFigure);
        result.x += tempSquare * (points[i].x + points[(i + 1) %
    points.size()].x
                + insideFigure.x) / 3.0;
        result.y += tempSquare * (points[i].y + points[(i + 1) % points.size()].y
                    + insideFigure.y) / 3.0;
    }
    result.x /= square;
    result.y /= square;
    return result;
}

double Hexagon::Square() const {
    double result = 0;
    for(unsigned i = 0; i < points.size(); ++i) {
        Point p1 = i ? points[i - 1] : points[points.size() - 1];
        Point p2 = points[i];
        result += (p1.x - p2.x) * (p1.y + p2.y);
    }
    return fabs(result) / 2.0;
}

void Hexagon::Print(std::ostream& os) const {
    os << "Hexagon:";
    for(const auto& p : points) {
        os << p << ' ';
    }
    os << "Center: " << this->Center() << ' ';
    os << "Area: " << this->Square() << ' ';
    os << "ID: " << id;
    os << std::endl;
}

int Hexagon::getID() const {
    return id;
}

void Hexagon::serialize(std::ostream& os) const {
    os << 'H' << ' ';
    for(const auto& p : points) {
        os << p.x << ' ' << p.y << ' ';
    }
    os << std::endl;
}
```

point.hpp

```
#pragma once

#include <iostream>

struct Point {
    double x, y;
};

double calculateDistance(const Point& lhs, const Point& rhs);
bool operator<(const Point& lhs, const Point& rhs);
std::istream& operator>>(std::istream& is, Point& p);
std::ostream& operator<<(std::ostream& os, const Point& p);
double triangleSquare(const Point& p1, const Point& p2, const Point& p3);
```

point.cpp

```cpp
#include <iostream>
#include <cmath>
#include <iomanip>

#include "point.hpp"

double calculateDistance(const Point& lhs, const Point& rhs) {
    return sqrt(pow(rhs.x - lhs.x, 2) + pow(rhs.y - lhs.y, 2));
}

double triangleSquare(const Point& p1, const Point& p2, const
   Point& p3) {
    return 0.5 * fabs((p1.x - p3.x) * (p2.y - p3.y) - (p2.x - p3.x
   ) * (p1.y - p3.y));
}

bool operator<(const Point& lhs, const Point& rhs) {
    if(lhs.x != rhs.x) {
        return lhs.x < rhs.x;
    }
    return lhs.y < rhs.y;
}

std::istream& operator>>(std::istream& is, Point& p) {
    is >> p.x >> p.y;
    return is;
}

std::ostream& operator<<(std::ostream& os, const Point& p) {
    os << std::fixed << std::setprecision(3) << "[" << p.x << ", "
     << p.y << "]";
    return os;
}
```

command.hpp

```cpp
#pragma once

#include <memory>

#include "document.hpp"
#include "figure.hpp"

class Command {
public:
    virtual void exec() = 0;
    virtual void undo() = 0;
    virtual ~Command() = default;
protected:
    std::shared_ptr<Document> document;
};

class InsertCommand : public Command {
public:
    InsertCommand(std::shared_ptr<Document> document) {this->
   document = document;};
    void exec() override;
    void undo() override;
};

class RemoveCommand : public Command {
public:
    RemoveCommand(std::shared_ptr<Document> document, int id) :
        id(id), position(-1), figure(nullptr) {this->document =
    document;};
    void exec() override;
    void undo() override;
private:
    int id;
    int position;
    std::shared_ptr<Figure> figure;
};
```

command.cpp

```cpp
#include "command.hpp"


void InsertCommand::exec() {
   document->insert();
}

void InsertCommand::undo() {
    document->popBack();
}


void RemoveCommand::exec() {
    try {
        figure = document->getFigure(id);
        position = document->getPosition(id);
    } catch(std::exception& e) {
        std::cout << e.what() << std::endl;
        return;
    }
    document->remove(id);
}

void RemoveCommand::undo() {
    document->insert(position, figure);
}
```

editor.hpp

```cpp
#pragma once

#include <stack>

#include "command.hpp"
#include "document.hpp"
#include "figure.hpp"

class Editor {
public:
    Editor() : document(nullptr) {};
    void createDocument();
    void insert();
    void remove(int id);
    void saveDocument(const std::string& filename);
    void loadDocument(const std::string& filename);
    void undo();
    void print();
private:
    std::shared_ptr<Document> document;
    std::stack<std::shared_ptr<Command>> commandStack;
};
```

editor.cpp

```cpp
#include "editor.hpp"

void Editor::createDocument() {
    document = std::make_shared<Document>();
    while(!commandStack.empty()) {
        commandStack.pop();
    }
}

void Editor::insert() {
    std::shared_ptr<Command> command = std::shared_ptr<Command>(
   new InsertCommand(document));
    command->exec();
    commandStack.push(command);
}

void Editor::remove(int id) {
    try {
        std::shared_ptr<Command> command = std::shared_ptr<Command
   >(new RemoveCommand(document, id));
        command->exec();
        commandStack.push(command);
    } catch(std::exception& e) {
        std::cout << e.what() << std::endl;
    }
}

void Editor::saveDocument(const std::string& filename) {
    document->save(filename);
}

void Editor::loadDocument(const std::string& filename) {
    createDocument();
    document->load(filename);
}

void Editor::undo() {
    if(commandStack.empty()) {
        throw std::logic_error("Nothing to undo");
    }
    std::shared_ptr<Command> command = commandStack.top();
    command->undo();
    commandStack.pop();
}

void Editor::print() {
    document->print();
}
```

factory.hpp

```cpp
#pragma once

#include <memory>
#include <string>

#include "figure.hpp"
#include "rhombus.hpp"
#include "pentagon.hpp"
#include "hexagon.hpp"

class Factory {
public:
    std::shared_ptr<Figure> createFigure(int id);
};
```

factory.cpp

```cpp
#include "factory.hpp"

std::shared_ptr<Figure> Factory::createFigure(int id) {
    std::string figureType;
    std::cin >> figureType;
    std::shared_ptr<Figure> figure;
    if(figureType == "R") {
        try {
            figure = std::make_shared<Rhombus>(Rhombus{std::cin, id});
        } catch(std::exception& e) {
            std::cout << e.what() << std::endl;
        }
    } else if(figureType == "P") {
        figure = std::make_shared<Pentagon>(Pentagon{std::cin, id});
    } else if(figureType == "H") {
        figure = std::make_shared<Hexagon>(Hexagon{std::cin, id});
    } else {
        std::cout << "Unknown figure" << std::endl;
    }
    return figure;
}
```

document.hpp

```cpp
#pragma once

#include <vector>
#include <string>
#include <algorithm>
#include <fstream>
#include <stack>

#include "figure.hpp"
#include "factory.hpp"

```

```cpp
class Document {
friend class Command;
public:
    Document() : currentFigureID(0) {};
    void newDocument();
    void save(const std::string& fileName);
    void load(const std::string& fileName);
    void print();
    void insert();
    void insert(unsigned position, std::shared_ptr<Figure> figure)
   ;
    void remove(int id);
    void popBack();
    std::shared_ptr<Figure> getFigure(int id);
    int getPosition(int id);
private:
    int currentFigureID;
    std::vector<std::shared_ptr<Figure>> content;
    Factory factory;
    void serialize(const std::string& fileName);
    void deserialize(const std::string& fileName);
};
```

document.cpp

```cpp
#include "document.hpp"


void Document::newDocument() {
    content.clear();
    currentFigureID = 0;
}

void Document::save(const std::string& fileName) {
    serialize(fileName);
}

void Document::load(const std::string& fileName) {
    deserialize(fileName);
}

void Document::print() {
    for(const auto& figure : content) {
        figure->Print(std::cout);
    }
}

void Document::insert() {
    std::shared_ptr<Figure> figure = this->factory.createFigure(
   currentFigureID);
    if(figure) {
        content.push_back(figure);
        currentFigureID++;
    }
}

void Document::insert(unsigned position, std::shared_ptr<Figure>
   figure) {
    auto it = content.begin();
    std::advance(it, position);
    content.insert(it, figure);
}

void Document::remove(int id) {
    unsigned temp = content.size();
    auto it = std::remove_if(content.begin(), content.end(), [id](
   std::shared_ptr<Figure> f)
            {return id == f->getID();});
    content.erase(it, content.end());
    if(temp == content.size()) {
        throw std::invalid_argument("Figure this such ID doesn't
   exist");
    }
}

void Document::popBack() {
    if(!content.size()) {
        throw std::logic_error("Document is empty");
    }
    content.pop_back();
}

std::shared_ptr<Figure> Document::getFigure(int id) {
    for(const auto& figure : content) {
        if(id == figure->getID()) {
            return figure;
        }
    }
    throw std::invalid_argument("1:No figure this such ID");
}

int Document::getPosition(int id) {
    int n = content.size();
    for(int i = 0; i < n; ++i) {
        if(id == content[i]->getID()) {
            return i;
        }
    }
    throw std::invalid_argument("2:No figure with such ID");
}

void Document::serialize(const std::string& fileName) {
    std::ofstream os(fileName, std::ios::trunc);
    if(!os) {
        throw std::runtime_error("Couldn't open file");
    }
    os << content.size() << std::endl;
    for(const auto& figure : content) {
        figure->serialize(os);
    }
}

void Document::deserialize(const std::string& fileName) {
    std::ifstream is(fileName);
    if(!is) {
        throw std::runtime_error("Couldn't open file");
    }
    this->newDocument();
```

```cpp
    int numberOfFigures;
    is >> numberOfFigures;
    while(numberOfFigures--) {
        this->insert();
    }
}
```

main.cpp

```cpp
#include <iostream>
#include <string>

#include "editor.hpp"

void help() {
    std::cout << "new - Creates new document" << std::endl;
    std::cout << "save <path to file> - saves document to file" <<
    std::endl;
    std::cout << "load <path to file> - loads document from file"
    << std::endl;
    std::cout << "add R/P/H <coordinates> - adds Rhombus/Pentagon/
    Hexagon to the document" << std::endl;
    std::cout << "remove <Figure ID> - removes figure with given
    ID if it is present" << std::endl;
    std::cout << "undo - undo last action" << std::endl;
    std::cout << "print - prints information about all figures
    from document" << std::endl;
    std::cout << "help - do I really need to explain what help
    does?" << std::endl;
    std::cout << "exit - exit editor" << std::endl;
}

int main() {
    int id;
    std::string command;
    std::string filepath;
    std::string figureType;
    Editor e;
    help();
    while(std::cin >> command) {
        if(command == "new") {
            e.createDocument();
        } else if(command == "save") {
            std::cin >> filepath;
            try {
                e.saveDocument(filepath);
            } catch(std::exception& e) {
                std::cout << e.what() << std::endl;
            }
        } else if(command == "load") {
            std::cin >> filepath;
            try {
                e.loadDocument(filepath);
            } catch(std::exception& e) {
                std::cout << e.what() << std::endl;
            }
        } else if(command == "add") {
            e.insert();
        } else if(command == "remove") {
            std::cin >> id;
            try {
                e.remove(id);
            } catch(std::exception& e) {
                std::cout << e.what() << std::endl;
            }
        } else if(command == "undo") {
            try {
                e.undo();
            } catch(std::exception& e) {
                std::cout << e.what() << std::endl;
            }
        } else if(command == "print") {
            e.print();
        } else if(command == "help") {
            help();
        } else if(command == "exit") {
            break;
        } else {
            std::cout << "Unknown figure" << std::endl;
        }
    }
    return 0;
}
```

CMakeLists.txt

```
cmake_minimum_required(VERSION 3.1)

project(lab7)

add_executable(lab7
    main.cpp
    point.cpp
    rhombus.cpp
    pentagon.cpp
    editor.cpp
    factory.cpp
    hexagon.cpp
    command.cpp
    document.cpp)

set_property(TARGET lab7 PROPERTY CXX_STANDARD 17)

set(CMAKE_CXX_FLAGS "${CMAKE_CXX_FLAGS} -Wall -Wextra -Werror")
```

2 Тестирование

test_01.txt:

Попробуем добавить в документ фигуру с координатами (-5, 0), (-4, -1), (-3, -1), (-2, 0), которая очевидно не является ромбом, рассчитывая получить сообщение об ошибке. Затем добавим ромб с координатами (-5, 0), (-3, 1), (-1, 0), (-3, -1), площадь которого равна 4, а центр находится в точке (-3, 0), а также пятиугольник с координатами (-3.000, 0.000), (-2.000, 1.000), (-1.000, 1.000), (0.000, 0.000), (-1.000, -1.000), площадь которого равна 3.5 и шестиугольник с координатами (-3.000, 0.000), (-2.000, 1.000), (-1.000, 1.000), (0.000, 0.000), (-1.000, -1.000), (-2.000, -1.000), (-1.500, -0.000) с площадью равной 4. Затем удалим шестиугольник и пятиугольник, еще раз выведем содержимое документа и сделаем undo.

Результат:

```
new - Creates new document
save <path to file> - saves document to file
load <path to file> - loads document from file
add R/P/H <coordinates> - adds Rhombus/Pentagon/Hexagon to the document
remove <Figure ID> - removes figure with given ID if it is present
undo - undo last action
print - prints information about all figures from document
help - do I really need to explain what help does?
exit - exit editor
new
add R -5 0 -4 -1 -3 -1 -2 0
Entered coordinates are not forming Rhombus. Try entering new coordinates
print
add R -5 0 -3 1 -1 0 -3 -1
add P -3 0 -2 1 -1 1 0 0 -1 -1
add H -3 0 -2 1 -1 1 0 0 -1 -1 -2 -1
print
Rhombus: [-5.000, 0.000] [-3.000, 1.000] [-1.000, 0.000] [-3.000, -1.000] Center:
[-3.000, 0.000]
Area: 4.000 ID: 0
Pentagon: [-3.000, 0.000] [-2.000, 1.000] [-1.000, 1.000] [0.000, 0.000] [-1.000,
-1.000] Center:
[-1.429, 0.095] Area: 3.500 ID: 1
Hexagon:[-3.000, 0.000] [-2.000, 1.000] [-1.000, 1.000] [0.000, 0.000] [-1.000, -
1.000] [-2.000,
-1.000] Center: [-1.500, -0.000] Area: 4.000 ID: 2
remove 2
remove 1
print
Rhombus: [-5.000, 0.000] [-3.000, 1.000] [-1.000, 0.000] [-3.000, -1.000] Center:
[-3.000, 0.000]
Area: 4.000 ID: 0
undo
print
```

```
Rhombus: [-5.000, 0.000] [-3.000, 1.000] [-1.000, 0.000] [-3.000, -1.000] Center:
[-3.000, 0.000]
Area: 4.000 ID: 0
Pentagon: [-3.000, 0.000] [-2.000, 1.000] [-1.000, 1.000] [0.000, 0.000] [-1.000,
-1.000] Center:
[-1.429, 0.095] Area: 3.500 ID: 1
exit
```

test_02.txt

Добавим в документ ромб с координатами [4.000, 0.000], [8.000, 2.000], [12.000, 0.000], [8.000, -2.000], центром в точке [8, 0] и площадью равной 16, квадрат с координатами [4.000, 2.000], [8.000, 2.000], [8.000, -2.000], [4.000, -2.000] с центром в точке [6, 0] и площадью равной 16, пятиугольник с координатами [4.000, 0.000], [8.000, 2.000], [12.000, 0.000], [8.000, -2.000], [6.000, -2.000] и площадью равной 18. Затем выведем все фигуры и добавим шестиугольник с координатами [4.000, 0.000], [8.000, 2.000], [10.000, 2.000], [12.000, 0.000], [8.000, -2.000], [6.000, -2.000] и площадью равной 20. Еще раз выведем все фигуры, сделаем undo, удалим пятиугольник и квадрат и еще раз выведем все фигуры.

Результат:

```
new - Creates new document
save <path to file> - saves document to file
load <path to file> - loads document from file
add R/P/H <coordinates> - adds Rhombus/Pentagon/Hexagon to the document
remove <Figure ID> - removes figure with given ID if it is present
undo - undo last action
print - prints information about all figures from document
help - do I really need to explain what help does?
exit - exit editor
Rhombus: [4.000, 0.000] [8.000, 2.000] [12.000, 0.000] [8.000, -2.000] Center:
[8.000, 0.000]
Area: 16.000 ID: 0
Rhombus: [4.000, 2.000] [8.000, 2.000] [8.000, -2.000] [4.000, -2.000] Center:
[6.000, 0.000]
Area: 16.000 ID: 1
Pentagon: [4.000, 0.000] [8.000, 2.000] [12.000, 0.000] [8.000, -2.000] [6.000, -
2.000] Center:
[7.778, -0.148] Area: 18.000 ID: 2
Rhombus: [4.000, 0.000] [8.000, 2.000] [12.000, 0.000] [8.000, -2.000] Center:
[8.000, 0.000]
Area: 16.000 ID: 0
Rhombus: [4.000, 2.000] [8.000, 2.000] [8.000, -2.000] [4.000, -2.000] Center:
[6.000, 0.000]
Area: 16.000 ID: 1
Pentagon: [4.000, 0.000] [8.000, 2.000] [12.000, 0.000] [8.000, -2.000] [6.000, -
2.000] Center:
[7.778, -0.148] Area: 18.000 ID: 2
Hexagon:[4.000, 0.000] [8.000, 2.000] [10.000, 2.000] [12.000, 0.000] [8.000, -
2.000] [6.000,
-2.000] Center: [8.000, 0.000] Area: 20.000 ID: 3
```

Rhombus: [4.000, 0.000] [8.000, 2.000] [12.000, 0.000] [8.000, -2.000] Center: [8.000, 0.000]

Area: 16.000 ID: 0

3 Объяснение результатов работы программы

При вводе координат для создания ромба производится проверка этих координат, ведь они могут не образовывать ромб. Для этого реализована функция checkIfRhombus, которая вычисляет расстояния от одной точки до трёх остальных, а поскольку фигура является ромбом, то два из низ должны быть равны. Третье же значение функция возвращает ведь оно равно длине одной из диагоналей. Площадь ромба вычисляется как половина произведения диагоналей, центр - точка пересечения диагоналей. Методы вычисления площади и центра для пяти- и шестиугольника совпадают. Чтобы найти площадь необходимо перебрать все ребра и сложить площади трапеций, ограниченных этими ребрами. Чтобы найти центр необходимо разбить фигуры на треугольники(найти одну точку внутри фигуры), для каждого треугольника найти центроид и площадь и перемножить их, просуммировать полученные величины и разделить на общую площадь фигуры.

4 Выводы

В ходе выполнения работы я познакомился с некоторыми принципами и паттернами проектирования программ, что позволило достаточно неплохо организовать структуру классов моей программы.