МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РОССИЙСКОЙ ФЕДЕРАЦИИ

МОСКОВСКИЙ АВИАЦИОННЫЙ ИНСТИТУТ  
(НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ УНИВЕРСТИТЕТ)

**ЛАБОРАТОРНАЯ РАБОТА №5**

по курсу “Объектно-ориентированное программирование”

I семестр, 2021/22 учебный год

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**Задание:** Дополнить класс-контейнер из лабораторной работы №4 умными указателями.

**Вариант №28:**

* + Фигура: Трапеция
  + Контейнер: Очередь

**Описание программы:**

Исходный код разделён на 10 файлов:

* figure.h – описание класса фигуры
* point.h – описание класса точки
* point.cpp – реализация класса точки
* trapezoid.h – описание класса трапеции
* trapezoid.cpp – реализация класса трапеции
* tqueue\_item.h – описание элемента очереди
* tqueue\_item.cpp – реализация элемента очереди
* tqueue.h – описание очереди
* tqueue.cpp – реализация очереди
* main.cpp – основная программа

**Дневник отладки:**

ошибок не возникло.

**Вывод:**  
 В данной лабораторной работе я научился работе с умными указателями. Заменил переменные обычных указателей умными, тем самым изменив код интерфейся очереди.

**Листинг программ:**

**point.h:**

#ifndef POINT\_H

#define POINT\_H

#include <iostream>

class Point {

public:

Point();

Point(std::istream &is);

Point(double x, double y);

double dist(Point& other);

void SetX(double x);

void SetY(double y);

double GetX();

double GetY();

friend std::istream& operator>>(std::istream& is, Point& p);

friend std::ostream& operator<<(std::ostream& os, Point& p);

friend std::ostream& operator<<(std::ostream& os, const Point& p);

public:

double x\_;

double y\_;

};

#endif // POINT\_H

**point.cpp:**

#include "point.h"

#include <iostream>

#include <cmath>

Point::Point() : x\_(0.0), y\_(0.0) {}

Point::Point(double x, double y) : x\_(x), y\_(y) {}

Point::Point(std::istream &is) {

is >> x\_ >> y\_;

}

void Point::SetX(double x) {

this->x\_ = x;

}

void Point::SetY(double y) {

this->y\_ = y;

}

double Point::GetX() {

return this->x\_;

}

double Point::GetY() {

return this->y\_;

}

double Point::dist(Point& other) {

double dx = (other.x\_ - x\_);

double dy = (other.y\_ - y\_);

return std::sqrt(dx\*dx + dy\*dy);

}

std::istream& operator>>(std::istream& is, Point& p) {

is >> p.x\_ >> p.y\_;

return is;

}

std::ostream& operator<<(std::ostream& os, Point& p) {

os << "(" << p.x\_ << ", " << p.y\_ << ")";

return os;

}

std::ostream& operator<<(std::ostream& os, const Point& p) {

os << "(" << p.x\_ << ", " << p.y\_ << ")";

return os;

}

**figure.h:**

#ifndef FIGURE\_H

#define FIGURE\_H

#include <iostream>

class Figure {

public:

virtual size\_t VertexesNumber() = 0;

virtual double Area() = 0;

//virtual void Print(std::ostream& os) = 0;

virtual ~Figure() {};

};

#endif // FIGURE\_H

**trapezoid.h:**

#ifndef TRAPEZOID\_H

#define TRAPEZOID\_H

#include "figure.h"

#include <iostream>

#include <memory>

#include "point.h"

class Trapezoid : public Figure {

public:

Trapezoid();

Trapezoid(double a, double b, double c, double d);

Trapezoid(std::shared\_ptr<Trapezoid>& other);

friend std::istream& operator>>(std::istream& is, Trapezoid& obj);

friend std::ostream& operator<<(std::ostream& os, const Trapezoid& obj);

Trapezoid& operator=(const Trapezoid& right);

bool operator==(const Trapezoid& right);

virtual ~Trapezoid();

size\_t VertexesNumber();

double Area();

public:

double len\_ab, len\_bc, len\_cd, len\_da;

Point a\_, b\_, c\_, d\_;

};

#endif // TRAPEZOID\_H

**trapezoid.cpp:**

#include "trapezoid.h"

#include <cmath>

Trapezoid::Trapezoid()

: len\_ab(0.0),

len\_bc(0.0),

len\_cd(0.0),

len\_da(0.0) {

}

Trapezoid::Trapezoid(double ab, double bc, double cd, double da)

: len\_ab(ab),

len\_bc(bc),

len\_cd(cd),

len\_da(da) {

}

Trapezoid::Trapezoid(std::shared\_ptr<Trapezoid>& other)

: Trapezoid(other->len\_ab, other->len\_bc, other->len\_cd, other->len\_da) {

}

std::istream& operator>>(std::istream& is, Trapezoid& obj) {

std::cout << "Enter points: ";

is >> obj.a\_;

is >> obj.b\_;

is >> obj.c\_;

is >> obj.d\_;

obj.len\_ab = obj.a\_.dist(obj.b\_);

obj.len\_bc = obj.b\_.dist(obj.c\_);

obj.len\_cd = obj.c\_.dist(obj.d\_);

obj.len\_da = obj.d\_.dist(obj.a\_);

return is;

} //

std::ostream& operator<<(std::ostream& os, const Trapezoid& obj) {

std::cout << "Trapezoid: ";

os << obj.a\_; std::cout << " ";

os << obj.b\_; std::cout << " ";

os << obj.c\_; std::cout << " ";

os << obj.d\_; std::cout << std::endl;

return os;

}

Trapezoid& Trapezoid::operator=(const Trapezoid& other) {

if (this == &other)

return \*this;

len\_ab = other.len\_ab;

len\_bc = other.len\_bc;

len\_cd = other.len\_cd;

len\_da = other.len\_da;

a\_.x\_ = other.a\_.x\_;

a\_.y\_ = other.a\_.y\_;

b\_.x\_ = other.b\_.x\_;

b\_.y\_ = other.b\_.y\_;

c\_.x\_ = other.c\_.x\_;

c\_.y\_ = other.c\_.y\_;

d\_.x\_ = other.d\_.x\_;

d\_.x\_ = other.d\_.x\_;

std::cout << "Trapezoid copied" << std::endl;

return \*this;

} //

bool Trapezoid::operator==(const Trapezoid& other) {

if (this->len\_ab == other.len\_ab &&

this->len\_bc == other.len\_bc &&

this->len\_cd == other.len\_cd &&

this->len\_da == other.len\_da) {

std::cout << "Trapezoids are equal" << std::endl;

return 1;

} else {

std::cout << "Trapezoids are not equal" << std::endl;

return 0;

}

} //

size\_t Trapezoid::VertexesNumber() {

return 4;

}

double Trapezoid::Area() {

double p = (len\_ab + len\_bc + len\_cd + len\_da) / 2;

return (len\_bc + len\_da) \*

std::sqrt((p - len\_bc) \*

(p - len\_da) \*

(p - len\_da - len\_ab) \*

(p - len\_da - len\_cd)) /

std::abs(len\_bc - len\_da);

}

Trapezoid::~Trapezoid() {

std::cout << "Trapezoid deleted" << std::endl;

}

**tqueue\_item.h:**

#ifndef TQUEUE\_ITEM\_H

#define TQUEUE\_ITEM\_H

#include <memory>

#include "trapezoid.h"

class TQueueItem {

public:

TQueueItem(const std::shared\_ptr<Trapezoid>& trapezoid);

TQueueItem(const TQueueItem& other);

std::shared\_ptr<TQueueItem> SetNext(std::shared\_ptr<TQueueItem>& next);

std::shared\_ptr<TQueueItem> GetNext();

std::shared\_ptr<Trapezoid> GetTrapezoid() const;

friend std::ostream& operator<<(std::ostream& os, const TQueueItem& obj);

virtual ~TQueueItem();

public:

std::shared\_ptr<Trapezoid> trapezoid;

std::shared\_ptr<TQueueItem> next;

};

#endif // TQUEUE\_ITEM\_H

**tqueue\_item.cpp:**

#include "tqueue\_item.h"

#include <iostream>

TQueueItem::TQueueItem(const std::shared\_ptr<Trapezoid>& trapezoid) {

this->trapezoid = trapezoid;

this->next = nullptr;

std::cout << "Queue item: created" << std::endl;

}

TQueueItem::TQueueItem(const TQueueItem& other) {

this->trapezoid = other.trapezoid;

this->next = other.next;

std::cout << "Queue item: copied" << std::endl;

}

std::shared\_ptr<TQueueItem> TQueueItem::SetNext(std::shared\_ptr<TQueueItem> &next)

{

std::shared\_ptr<TQueueItem> old = this->next;

this->next = next;

return old;

}

std::shared\_ptr<Trapezoid> TQueueItem::GetTrapezoid() const {

return this->trapezoid;

}

std::shared\_ptr<TQueueItem> TQueueItem::GetNext() {

return this->next;

}

TQueueItem::~TQueueItem() {

std::cout << "Queue item: deleted" << std::endl;

}

std::ostream& operator<<(std::ostream& os, const TQueueItem& obj) {

os << obj.trapezoid->Area();

return os;

}

**tqueue.h:**

#ifndef TQUEUE\_H

#define TQUEUE\_H

#include "tqueue\_item.h"

#include <memory>

class TQueue {

public:

// Конструктор по умолчанию

TQueue();

// Конструктор копирования очереди.

TQueue(const TQueue& other);

// Метод, добавляющий фигуру в конец очереди.

void Push(std::shared\_ptr<Trapezoid> &&trapezoid); // here may be &&

// Метод, убирающий первую фигуру из очереди.

void Pop();

// Метод, возвращающий ссылку на первую в очереди фигуру

std::shared\_ptr<Trapezoid>& Top();

// Метод, проверяющий пустоту очереди

bool Empty();

// Метод, возвращающий длину очереди

size\_t Length();

// Оператор вывода очереди в формате:

// "=> Sn Sn-1 ... S1 =>", где Si - площадь фигуры,

// а n – номер последней фигуры в очереди

friend std::ostream& operator<<(std::ostream& os, const TQueue& queue);

// Метод, удаляющий все элементы контейнера,

// но позволяющий пользоваться им.

void Clear();

// Деструктор

virtual ~TQueue();

private:

std::shared\_ptr<TQueueItem> head, tail;

};

#endif // TQUEUE\_H

**tqueue.cpp:**

#include "tqueue.h"

#include <vector>

TQueue::TQueue() : head(nullptr), tail(nullptr) {

std::cout << "Default queue created" << std::endl;

}

TQueue::TQueue(const TQueue& other) {

head = other.head;

tail = other.tail;

std::cout << "Queue copied" << std::endl;

}

void TQueue::Push(std::shared\_ptr<Trapezoid> &&trapezoid) {

std::shared\_ptr<TQueueItem> other(new TQueueItem(trapezoid));

if (tail == nullptr) {

head = tail = other;

std::cout << "Added one trapezoid to tail. " << "Coordinates: " << \*other->trapezoid << ". Area = " << other->trapezoid->Area() << std::endl;

return;

}

tail->SetNext(other);

//tail->next = other;

tail = other;

tail->next = nullptr;

std::cout << "Added one trapezoid to tail. " << "Coordinates: " << \*other->trapezoid << ". Area = " << other->trapezoid->Area() << std::endl;

}

void TQueue::Pop() {

if (head == nullptr)

return;

std::cout << "Removed one trapezoid from head." << "Coordinates: " << \*head->trapezoid << ". Area = " << head->trapezoid->Area() << std::endl;

head = head->GetNext();

if (head == nullptr)

tail = nullptr;

}

std::shared\_ptr<Trapezoid>& TQueue::Top() {

return head->trapezoid;

}

bool TQueue::Empty() {

return (head == nullptr) && (tail == nullptr);

}

size\_t TQueue::Length() {

if (head == nullptr && tail == nullptr)

return 0;

std::shared\_ptr<TQueueItem> temp = head;

int counter = 0;

while (temp != tail->GetNext()) {

temp = temp->GetNext();

counter++;

}

return counter;

}

std::ostream& operator<<(std::ostream& os, const TQueue& queue) {

std::shared\_ptr<TQueueItem> temp = queue.head;

std::vector<std::shared\_ptr<TQueueItem>> v;

os << "Queue: ";

os << "=> ";

while (temp != nullptr) {

v.push\_back(temp);

//os << \*temp << " ";

temp = temp->GetNext();

}

for (int i = v.size() - 1; i >= 0; --i)

os << \*v[i] << " ";

os << "=>";

return os;

}

void TQueue::Clear() {

for (int i = 0; i < this->Length(); i++) {

this->Pop();

}

std::cout << "Queue was cleared but still exist" << std::endl;

}

TQueue::~TQueue() {

std::cout << "Queue was deleted" << std::endl;

}

**main.cpp:**

#include <iostream>

#include "tqueue.h"

int main(int argc, char\*\* argv) {

TQueue queue;

std::shared\_ptr<Trapezoid> tr(new Trapezoid(1, 2, 3, 4));

std::cout << "Enter n: ";

int n; std::cin >> n;

for (int i = 0; i < n; i++) {

std::cin >> \*tr;

std::cout << \*tr << std::endl;

queue.Push(std::shared\_ptr<Trapezoid>(new Trapezoid(\*tr)));

std::cout << queue;

std::cout << std::endl;

std::cout << "Length: " << queue.Length() << std::endl;

}

TQueue queue2 = queue;

std::cout << "Queue: " << queue << std::endl;

std::cout << "Queue2: " << queue2 << std::endl;

return 0;

}

**Пример работы:**

Default queue created

Enter n: 3

Enter points: 0 0 1 1 2 1 3 0

Trapezoid: (0, 0) (1, 1) (2, 1) (3, 0)

Queue item: created

Added one trapezoid to tail. Coordinates: Trapezoid: (0, 0) (1, 1) (2, 1) (3, 0)

. Area = 2

Queue: => 2 =>

Length: 1

Enter points: 0 0 5 5 8 5 9 0

Trapezoid: (0, 0) (5, 5) (8, 5) (9, 0)

Queue item: created

Added one trapezoid to tail. Coordinates: Trapezoid: (0, 0) (5, 5) (8, 5) (9, 0)

. Area = 30

Queue: => 30 2 =>

Length: 2

Enter points: 5 5 6 6 7 5 9 5

Trapezoid: (5, 5) (6, 6) (7, 5) (9, 5)

Queue item: created

Added one trapezoid to tail. Coordinates: Trapezoid: (5, 5) (6, 6) (7, 5) (9, 5)

. Area = 2.93926

Queue: => 2.93926 30 2 =>

Length: 3

Queue copied

Queue: Queue: => 2.93926 30 2 =>

Queue2: Queue: => 2.93926 30 2 =>

Queue was deleted

Trapezoid deleted

Queue was deleted

Queue item: deleted

Queue item: deleted

Queue item: deleted

Trapezoid deleted

Trapezoid deleted

Trapezoid deleted