Московский Авиационный Институт

(Национальный исследовательский Университет)

Факультет: «Информационные технологии и прикладная математика»

Кафедра: 806 «Вычислительная математика и программирование»

**Лабораторная работа**

**по курсу «ООП»**

**Тема:**

**Асинхронное программирование.**

|  |  |
| --- | --- |
| Студент: | Суворова С. А. |
| Группа: | М80-206Б-18 |
| Преподаватель: | Журавлев А.А. |
| Вариант: | 22 |
| Оценка: |  |
| Дата: |  |

Москва

2019

1.**Код на C++:**

point.h:

#ifndef D\_POINT\_H\_

#define D\_POINT\_H\_

#include <iostream>

struct point{

double x,y;

};

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

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

point operator+(point x1,point x2);

point& operator/= (point& x1, int number);

#endif

point.cpp:

#include <iostream>

#include "point.h"

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 << p.x << " " << p.y;

return os;

}

point operator+(point x1,point x2){

point x3;

x3.x=x1.x+x2.x;

x3.y=x1.y+x2.y;

return x3;

}

point& operator/= (point& x1, int number){

x1.x=x1.x/number;

x1.y=x1.y/number;

return x1;

}

figure.h:

#ifndef D\_FIGURE\_H\_

#define D\_FIGURE\_H\_

#include <iostream>

#include "point.h"

struct figure{

virtual point center() const = 0;

virtual void print(std::ostream &os) const = 0;

virtual void help\_print(std::ostream &os) const = 0;

virtual double square() const = 0;

virtual ~figure() {};

};

#endif

five\_angles.h:

#ifndef D\_FIVE\_ANGLES\_H\_

#define D\_FIVE\_ANGLES\_H\_

#include <iostream>

#include "figure.h"

struct five\_angles : figure{

five\_angles(std::istream &is);

point center() const override;

void print(std::ostream &os) const override;

void help\_print(std::ostream &os) const override;

double square() const override;

private:

point one,two,three,four,five;

};

#endif

five\_angles.cpp:

#include <iostream>

#include "five\_angles.h"

five\_angles::five\_angles(std::istream &is){

is >> one >> two >> three >> four >> five;

}

point five\_angles::center() const {

point p;

p=one+two+three+four+five;

p/=5;

return p;

}

void five\_angles::print(std::ostream &os) const {

os << one << " " << two << " " << three << " " << four << " " << five <<"\n";

}

void five\_angles::help\_print(std::ostream &os) const {

os << "five\_angles " << one << " " << two << " " << three << " " << four << " " << five <<"\n";

}

double five\_angles::square() const {

double s=0;

s=(one.x\*two.y+two.x\*three.y+three.x\*four.y+four.x\*five.y+five.x\*one.y-two.x\*one.y-

three.x\*two.y-four.x\*three.y-five.x\*four.y-one.x\*five.y)/2;

if(s<0){

return -s;

}else {

return s;

}

}

six\_angles.h:

#ifndef D\_SIX\_ANGLES\_H\_

#define D\_SIX\_ANGLES\_H\_

#include <iostream>

#include "figure.h"

struct six\_angles : figure{

six\_angles(std::istream &is);

point center() const override;

void print(std::ostream &os) const override;

void help\_print(std::ostream &os) const override;

double square() const override;

private:

point one,two,three,four,five,six;

};

#endif

six\_angles.cpp:

#include <iostream>

#include "six\_angles.h"

six\_angles::six\_angles(std::istream &is){

is >> one >> two >> three >> four >> five >>six;

}

point six\_angles::center() const {

point p;

p=one+two+three+four+five+six;

p/=6;

return p;

}

void six\_angles::print(std::ostream &os) const {

os << one << " " << two << " " << three << " " << four << " " << five << " " << six <<"\n";

}

void six\_angles::help\_print(std::ostream &os) const {

os <<"six\_angles " << one << " " << two << " " << three << " " << four << " " << five << " " << six <<"\n";

}

double six\_angles::square() const {

double s=0;

s=(one.x\*two.y+two.x\*three.y+three.x\*four.y+four.x\*five.y+five.x\*six.y+six.x\*one.y-two.x\*one.y-

three.x\*two.y-four.x\*three.y-five.x\*four.y-six.x\*five.y-one.x\*six.y)/2;

if(s<0){

return -s;

}else {

return s;

}

}

eight\_angles.h:

#ifndef D\_EIGHT\_ANGLES\_H\_

#define D\_EIGHT\_ANGLES\_H\_

#include <iostream>

#include "figure.h"

struct eight\_angles : figure{

eight\_angles(std::istream &is);

point center() const override;

void print(std::ostream &os) const override;

void help\_print(std::ostream &os) const override;

double square() const override;

private:

point one,two,three,four,five,six,seven,eight;

};

#endif

eight\_angles.cpp:

#include <iostream>

#include "eight\_angles.h"

eight\_angles::eight\_angles(std::istream &is){

is >> one >> two >> three >> four >> five >>six >>seven >>eight;

}

point eight\_angles::center() const {

point p;

p=one+two+three+four+five+six+seven+eight;

p/=8;

return p;

}

void eight\_angles::print(std::ostream &os) const {

os << one << " " << two << " " << three << " " << four << " " << five << " " << six << " " << seven

<< " " << eight<<"\n";

}

void eight\_angles::help\_print(std::ostream &os) const {

os <<"eight\_angles " << one << " " << two << " " << three << " " << four << " " << five << " " << six << " " << seven

<< " " << eight<<"\n";

}

double eight\_angles::square() const {

double s=0;

s=(one.x\*two.y+two.x\*three.y+three.x\*four.y+four.x\*five.y+five.x\*six.y+six.x\*seven.y+seven.x\*eight.y+

eight.x\*one.y-two.x\*one.y-three.x\*two.y-four.x\*three.y-five.x\*four.y-six.x\*five.y-seven.x\*six.y

-eight.x\*seven.y-one.x\*eight.y)/2;

if(s<0){

return -s;

}else {

return s;

}

}

processor.h:

#ifndef D\_PROCESSOR\_H\_

#define D\_PROCESSOR\_H\_

#include <iostream>

#include <memory>

#include <vector>

#include <fstream>

struct processor {

virtual void process(const std::vector<std::unique\_ptr<figure>> &data) const = 0;

};

struct screen\_writer : processor {

void process(const std::vector<std::unique\_ptr<figure>> &data) const {

for (size\_t i=0;i<data.size();++i) {

data[i]->print(std::cout);

}

}

};

struct file\_writer : processor {

void process(const std::vector<std::unique\_ptr<figure>> &data) const {

std::ofstream os(std::to\_string(file\_id)+".txt");

file\_id += 1;

for (size\_t i=0;i<data.size();++i) {

data[i]->help\_print(os);

}

}

mutable int file\_id = 0;

};

#endif

executor.h:

#ifndef D\_EXECUTOR\_H\_

#define D\_EXECUTOR\_H\_

#include <iostream>

#include <vector>

#include <memory>

#include <thread>

#include <mutex>

#include <condition\_variable>

#include "figure.h"

#include "processor.h"

inline std::mutex mut;

inline std::condition\_variable con;

struct exec{

exec(){

screen\_writer pp1;

file\_writer pp2;

std::unique\_ptr<screen\_writer> p1=std::make\_unique<screen\_writer>(pp1);

std::unique\_ptr<file\_writer> p2=std::make\_unique<file\_writer>(pp2);

processors.push\_back(std::move(p1));

processors.push\_back(std::move(p2));

}

void exec\_set(std::vector<std::unique\_ptr<figure>> data);

static void worker(exec\* one);

std::thread work{worker,this};

bool working=false;

bool doing=false;

private:

std::vector<std::unique\_ptr<figure>> data;

std::vector<std::unique\_ptr<processor>> processors;

};

#endif

executor.cpp:

#include <iostream>

#include "executor.h"

void exec::worker(exec \*one){

while(!one->working) {

std::unique\_lock<std::mutex> lock(mut);

con.wait(lock);

if(one->doing) {

std::cout << "\n";

for (size\_t i = 0; i < one->processors.size(); ++i) {

one->processors[i]->process(one->data);

}

con.notify\_one();

}

}

}

void exec::exec\_set(std::vector<std::unique\_ptr<figure>> data1){

data=std::move(data1);

}

main.cpp:

#include <iostream>

#include "five\_angles.h"

#include "six\_angles.h"

#include "eight\_angles.h"

#include "processor.h"

#include <vector>

#include <string>

#include <thread>

#include <fstream>

#include <memory>

#include <mutex>

#include <condition\_variable>

#include "executor.h"

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

if (argc != 2) {

std::cerr << "ERROR" << "\n";

return 1;

}

size\_t buffer\_size = (size\_t)std::stoi(argv[1]);

std::vector<std::unique\_ptr<figure>> buffer;

buffer.reserve(buffer\_size);

exec make;

std::unique\_ptr<figure> value;

std::string figures;

while (std::cin >> figures) {

std::unique\_lock<std::mutex> lock(mut);

if(figures == "five\_angles"){

std::unique\_ptr<figure> new\_figure;

new\_figure=std::make\_unique<five\_angles>(five\_angles(std::cin));

buffer.push\_back(std::move(new\_figure));

}else if(figures == "six\_angles"){

std::unique\_ptr<figure> new\_figure;

new\_figure=std::make\_unique<six\_angles>( six\_angles(std::cin));

buffer.push\_back(std::move(new\_figure));

}else if(figures == "eight\_angles"){

std::unique\_ptr<figure> new\_figure;

new\_figure=std::make\_unique<eight\_angles>( eight\_angles(std::cin));

buffer.push\_back(std::move(new\_figure));

}

make.doing= true;

if (buffer.size() != buffer\_size) {

continue;

}else {

make.exec\_set(std::move(buffer));

con.notify\_one();

buffer.clear();

}

}

make.doing= false;

make.working = true;

con.notify\_one();

make.work.join();

return 0;

}

2. **Ссылка на репозиторий в GitHub:**

https://github.com/Suvorova-Sofya/oop\_exercise\_08

3.**Набор testcases:**

test1:

test2:

five\_angles 1 1 2 2 3 3 4 4 5 5

five\_angles 1 1 2 2 3 3 4 4 5 5

five\_angles 1 1 2 2 3 3 4 4 5 5

five\_angles 1 1 2 2 3 3 4 4 5 5

five\_angles 1 1 2 2 3 3 4 4 5 5

test3:

five\_angles 1 1 2 2 3 3 4 4 5 5

six\_angles 1 1 2 2 3 3 4 4 5 5 6 6

eight\_angles 1 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8

five\_angles 1 1 2 2 3 3 4 4 5 5

six\_angles 1 1 2 2 3 3 4 4 5 5 6 6

eight\_angles 1 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8

five\_angles 1 1 2 2 3 3 4 4 5 5

six\_angles 1 1 2 2 3 3 4 4 5 5 6 6

eight\_angles 1 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8

five\_angles 1 1 2 2 3 3 4 4 5 5

five\_angles 1 1 2 2 3 3 4 4 5 5

six\_angles 1 1 2 2 3 3 4 4 5 5 6 6

eight\_angles 1 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8

five\_angles 1 1 2 2 3 3 4 4 5 5

six\_angles 1 1 2 2 3 3 4 4 5 5 6 6

eight\_angles 1 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8

five\_angles 1 1 2 2 3 3 4 4 5 5

six\_angles 1 1 2 2 3 3 4 4 5 5 6 6

eight\_angles 1 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8

five\_angles 1 1 2 2 3 3 4 4 5 5

4.**Результаты выполнения программы:**

test1:

test2:

.................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................

1 1 2 2 3 3 4 4 5 5

1 1 2 2 3 3 4 4 5 5

1 1 2 2 3 3 4 4 5 5

1 1 2 2 3 3 4 4 5 5

1 1 2 2 3 3 4 4 5 5

test3:

.................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................

1 1 2 2 3 3 4 4 5 5

1 1 2 2 3 3 4 4 5 5 6 6

1 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8

1 1 2 2 3 3 4 4 5 5

1 1 2 2 3 3 4 4 5 5 6 6

1 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8

1 1 2 2 3 3 4 4 5 5

1 1 2 2 3 3 4 4 5 5 6 6

1 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8

1 1 2 2 3 3 4 4 5 5

.................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................................

1 1 2 2 3 3 4 4 5 5

1 1 2 2 3 3 4 4 5 5 6 6

1 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8

1 1 2 2 3 3 4 4 5 5

1 1 2 2 3 3 4 4 5 5 6 6

1 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8

1 1 2 2 3 3 4 4 5 5

1 1 2 2 3 3 4 4 5 5 6 6

1 1 2 2 3 3 4 4 5 5 6 6 7 7 8 8

1 1 2 2 3 3 4 4 5 5

5**. Объяснение результатов работы программы:**

Пользователь вводит фигуры и их координаты. Когда буфер будет заполнен данными фигурами, запустится обработчик, выполняющийся в отдельном потоке, который выведет всё содержимое буфера на экран и в файл.

6.**Вывод:**

В данной программе показывается ,каким образом можно производить асинхронную обработку данных, используя потоки, для уменьшения времени работы программы.