**Московский авиационный институт**

**(Национальный исследовательский университет)**

Факультет: «Информационные технологии и прикладная математика»

Кафедра: 806 «Вычислительная математика и программирование»

Дисциплина: «Объектно-ориентированное программирование»

**Лабораторная работа № 7**

Тема: Проектирование структуры классов

Студент: Баранников Степан Алексеевич

Группа: 80-201

Преподаватель: Чернышов Л.Н.

Дата:

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* Постановка задачи

Реализовать простейший графический редактор с возможностью сохранения документов в файлы, и загрузки из них. Применить паттерн “Фабрика”.

* Репозиторий github

https://github.com/devepodete/oop\_exercise\_07

* Описание программы

Пользователь может добавить или удалить одну из 3 фигур в начало или конец файла, сохранить, импортировать данные из файла, выполнить операцию undo. В случае, если файл не сохранен, выдаются предупреждающие сообщения.

* Набор testcases

test\_01.txt

push\_begin square 0 0 1 0 1 1 0 1

push\_begin rectangle 0 0 3 0 3 1 0 1

exit

n

export myFigures.bin

exit

//Проверка предупреждения о том, что файл не сохранен

test\_02.txt

import myFigures.bin

undo

pop\_back

pop\_end

export myFigures.bin

y

exit

//проверка проверки ввода команд, импорта из файла, сохранения в существующий файл

* Результаты выполнения тестов.

Исключения создаются и отлавливаются, программа выдает правильные ответы.

* Листинг программы

main.cpp

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| /\* Фигурный редактор М8О-201Б-18 Баранников Степан Алексеевич \*/  #include <iostream> #include <vector> #include <memory> #include <string>  #include "figures.hpp" #include "serialize.hpp"  void print\_actions(){  std::cout << "Actions:\n";  std::cout << "-\tgenerate N\n";  std::cout << "-\tpush\_begin <figure name> <cords>\n";  std::cout << "-\tpush\_end <figure name> <cords>\n";  std::cout << "-\tpop\_begin\n";  std::cout << "-\tpop\_end\n";  std::cout << "-\tundo\n";  std::cout << "-\timport <filename>\n";  std::cout << "-\texport <filename>\n"; }  int main(){  std::unique\_ptr<Square\_Factory> square\_factory(new Square\_Factory);  std::unique\_ptr<Rectangle\_Factory> rectangle\_factory(new Rectangle\_Factory);  std::unique\_ptr<Trapezoid\_Factory> trapezoid\_factory(new Trapezoid\_Factory);   Serializable\_Vector sv;    print\_actions();   std::string action = "";  while(action != "exit"){  std::cout << "\nBUFFER:\n";  sv.print();  std::cout << "------------------\n";  std::cout << "> ";  std::cin >> action;    std::string figure\_name;  std::string file\_name;   if(action == "push\_begin" || action == "push\_end"){  std::cin >> figure\_name;  std::vector<Cords> v(4);  std::cin >> v;   if(figure\_name == "square"){  if(action == "push\_begin"){  sv.push\_begin(square\_factory->create\_figure(v));  }else{  sv.push\_end(square\_factory->create\_figure(v));  }  }else if(figure\_name == "rectangle"){  if(action == "push\_begin"){  sv.push\_begin(rectangle\_factory->create\_figure(v));  }else{  sv.push\_end(rectangle\_factory->create\_figure(v));  }  }else if(figure\_name == "trapezoid"){  if(action == "push\_begin"){  sv.push\_begin(trapezoid\_factory->create\_figure(v));  }else{  sv.push\_end(trapezoid\_factory->create\_figure(v));  }  }else{  std::cout << "Error: wrong figure name\n";  }  }else if(action == "pop\_begin"){  sv.pop\_begin();  }else if(action == "pop\_end"){  sv.pop\_end();  }else if(action == "import" || action == "export"){  std::cin >> file\_name;  if(action == "import"){  sv.import\_file(file\_name);  }else{  sv.export\_file(file\_name);  }  }else if(action == "undo"){  sv.undo();  }else if(action == "generate"){  unsigned n;  std::cin >> n;  sv.generate(n);  }else if(action == "exit"){  if(!sv.is\_saved()){  std::cout << "Warning! Your buffer is not saved.\n";  std::cout << "Continue? (y/n): ";  char ans;  std::cin >> ans;  if(ans != 'y'){  action = "";  }  }  }else{  std::cout << "Wrong command\n";   }  } } |

serialize.hpp

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| #ifndef \_SERIALIZE\_HPP\_ #define \_SERIALIZE\_HPP\_  #include <fstream> #include <iostream> #include <stack> #include <vector> #include <string> #include <ctime> #include <cstdlib> #include <cmath>  #include "figures.hpp"  struct command\_figure{  char figure\_type;  std::string cmd;  Figure \*f; };  class Serializable\_Vector{ private:  Square\_Factory \*s\_factory;  Rectangle\_Factory \*r\_factory;  Trapezoid\_Factory \*t\_factory;   std::vector<Figure\*> storage;  std::fstream file;   bool file\_opened;  bool buffer\_saved;   std::stack<command\_figure> undo\_commands;  public:  Serializable\_Vector(){  srand(time(NULL));  buffer\_saved = true;  file\_opened = false;  s\_factory = new Square\_Factory;  r\_factory = new Rectangle\_Factory;  t\_factory = new Trapezoid\_Factory;  }  ~Serializable\_Vector(){  if(file.is\_open()){  file.close();  }    clear\_storage();  clear\_stack();  delete s\_factory;  delete r\_factory;  delete t\_factory;  }   bool open\_document(std::string str){  bool file\_exist = check\_exist(str);  while(file\_exist){  std::cout << "Warning! File with name \'"<< str << "\' already exists.\n" <<  "Continuing will cause full data loss\n" <<  "Continue? (y/n): ";  char ans;  std::cin >> ans;  if(ans != 'y'){  return false;  }  }   std::ofstream ofs;  ofs.open(str);   if(ofs.is\_open()){  ofs.close();  file.open(str, std::ios::in | std::ios::out | std::ios::binary);  if(file.is\_open()){  file\_opened = true;  return true;  }else{  std::cout << "Can not open fstream file\n";  return false;  }  }else{  std::cout << "Can not open ofstream file\n";  return false;  }  }   void push\_begin(Figure \*f){  char type = f->get\_figure();  storage.insert(storage.begin(), f);  undo\_commands.push({type, "pop\_begin", nullptr});  buffer\_saved = false;  }   void pop\_begin(){  if(!storage.empty()){  Figure \*f = storage.front();  char type = f->get\_figure();  storage.erase(storage.begin());  undo\_commands.push({type, "push\_begin", f});  buffer\_saved = false;  }  }   void push\_end(Figure \*f){  char type = f->get\_figure();  storage.push\_back(f);  undo\_commands.push({type, "pop\_end", nullptr});  buffer\_saved = false;  }   void pop\_end(){  if(!storage.empty()){  Figure \*f = storage.back();  char type = f->get\_figure();  storage.pop\_back();  undo\_commands.push({type, "push\_end", f});  buffer\_saved = false;  }  }   bool export\_file(std::string str){   bool file\_exist = check\_exist(str);  if(file\_exist){  std::cout << "Warning! File with name \'"<< str << "\' already exists.\n" <<  "Continuing will cause full data loss\n" <<  "Continue? (y/n): ";  char ans;  std::cin >> ans;  if(ans != 'y'){  return false;  }  }   std::ofstream temp;  temp.open(str);  temp.close();   std::fstream file\_to\_export;  file\_to\_export.open(str, std::ios::out | std::ios::binary);   if(!file\_to\_export.is\_open()){  std::cout << "Can not open file for export data\n";  return false;  }   size\_t storage\_size = storage.size();  file\_to\_export.write( (char\*)&storage\_size, sizeof(storage.size()) );  for(size\_t i = 0; i < storage\_size; i++){    char figure\_type = storage[i]->get\_figure();  file\_to\_export.write((char\*)&figure\_type, sizeof(figure\_type));   for(size\_t j = 0; j < storage[i]->cords.size(); j++){  file\_to\_export.write( (char\*)(&storage[i]->cords[j]), sizeof(Cords) );  }  }  file\_to\_export.close();  buffer\_saved = true;  return true;  }   bool import\_file(std::string str){  if(!buffer\_saved){  std::cout << "Warning! You have unsaved buffer\n" <<  "Continuing will cause full data loss\n" <<  "Continue? (y/n): ";    char ans;  std::cin >> ans;  if(ans != 'y'){  return false;  }  }  clear\_storage();  clear\_stack();   if(file.is\_open()){  file.close();  }   file.open(str, std::ios::in | std::ios::out | std::ios::binary);    if(!file.is\_open()){  std::cout << "Error. Can not import file\n";  file\_opened = false;  return false;  }else{  size\_t figures\_number;  file.read((char\*)&figures\_number, sizeof(figures\_number));  for(size\_t i = 0; i < figures\_number; i++){  char figure\_type;  file.read((char\*)&figure\_type, sizeof(figure\_type));  Cords figure\_cords[4];  for(size\_t j = 0; j < 4; j++){  file.read((char\*)&figure\_cords[j], sizeof(figure\_cords[j]));  }  switch(figure\_type){  case 's':{  storage.push\_back(s\_factory->create\_figure(figure\_cords[0],figure\_cords[1],figure\_cords[2],figure\_cords[3]));  break;  }  case 'r':{  storage.push\_back(r\_factory->create\_figure(figure\_cords[0],figure\_cords[1],figure\_cords[2],figure\_cords[3]));  break;  }  case 't':{  storage.push\_back(t\_factory->create\_figure(figure\_cords[0],figure\_cords[1],figure\_cords[2],figure\_cords[3]));  break;  }  default:  std::cout << "Error while reading from import\_file file: wrong figure class\n";  break;  }  }  buffer\_saved = true;  file.close();  file\_opened = false;  return true;  }  }   void undo(){  if(undo\_commands.empty()){  std::cout << "There is no operations to undo\n";  }else{  char figure\_type = undo\_commands.top().figure\_type;  std::string action = undo\_commands.top().cmd;   if(action == "push\_begin"){  if(figure\_type == 's'){  storage.insert(storage.begin(), s\_factory->create\_figure(undo\_commands.top().f->cords));  }else if(figure\_type == 'r'){  storage.insert(storage.begin(), r\_factory->create\_figure(undo\_commands.top().f->cords));  }else if(figure\_type == 't'){  storage.insert(storage.begin(), t\_factory->create\_figure(undo\_commands.top().f->cords));  }else{  std::cout << "Error while undo: incorrect figure type\n";  }  delete undo\_commands.top().f;  }else if(action == "pop\_begin"){  if(!storage.empty()){  delete storage.front();  storage.erase(storage.begin());  }  }else if(action == "push\_end"){  if(figure\_type == 's'){  storage.push\_back(s\_factory->create\_figure(undo\_commands.top().f->cords));  }else if(figure\_type == 'r'){  storage.push\_back(r\_factory->create\_figure(undo\_commands.top().f->cords));  }else if(figure\_type == 't'){  storage.push\_back(t\_factory->create\_figure(undo\_commands.top().f->cords));  }else{  std::cout << "Error while undo: incorrect figure type\n";  }  delete undo\_commands.top().f;  }else if(action == "pop\_end"){  if(!storage.empty()){  delete storage.back();  storage.pop\_back();  }  }else if(action == "clear"){  clear\_storage();   }else{  std::cout << "Error while undo: wrong action\n";  }  undo\_commands.pop();  buffer\_saved = false;  }  }   bool check\_exist(std::string str){  std::fstream fs;  fs.open(str);  if(fs.is\_open()){  fs.close();  return true;  }else{  return false;  }  }   void print(){  for(size\_t i = 0; i < storage.size(); i++){  storage[i]->print();  }  }   size\_t size(){  return storage.size();  }   void clear\_storage(){  while(!storage.empty()){  delete storage.back();  storage.pop\_back();  }  }   void clear\_stack(){  while(!undo\_commands.empty()){  delete undo\_commands.top().f;  undo\_commands.pop();  }  }   void generate(unsigned number){  if(file\_opened && !buffer\_saved){  std::cout << "Warning! Generating random figures will cause full data loss\n";  std::cout << "Continue? (y/n): ";  char ans;  std::cin >> ans;  if(ans != 'y'){  return;  }  }  if(file.is\_open()){  file.close();  }  file\_opened = false;   clear\_stack();  clear\_storage();   for(size\_t i = 0; i < number; i++){  std::vector<Cords> svc(4);  unsigned figure\_type = rand()%3;  generate\_figure(svc, svc.size());  if(figure\_type == 0){  storage.push\_back(s\_factory->create\_figure(svc));  }else if(figure\_type == 1){  storage.push\_back(r\_factory->create\_figure(svc));  }else{  storage.push\_back(t\_factory->create\_figure(svc));  }  }  buffer\_saved = false;  undo\_commands.push({'c', "clear", nullptr});  }   void generate\_figure(std::vector<Cords> &v, unsigned n){  if(n == 0){  return;  }  double x0 = static\_cast<double>(rand()%20);  double y0 = static\_cast<double>(rand()%20);  double r = static\_cast<double>(rand()%20+1);  for(unsigned i = 0; i < n; i++){  v[i].x = x0 + r\*std::cos(2\*M\_PI\*i/n);  v[i].y = y0 + r\*std::sin(2\*M\_PI\*i/n);  }  }   bool is\_saved(){  return buffer\_saved;  }  };  #endif |

figures.hpp

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| #ifndef \_FIGURES\_HPP\_ #define \_FIGURES\_HPP\_  #include <iostream> #include <vector>  struct Cords{  double x, y; };  std::istream &operator>>(std::istream &is, Cords &c){  is >> c.x >> c.y;  return is; }  std::istream &operator>>(std::istream &is, std::vector<Cords> &v){  for(size\_t i = 0; i < v.size(); i++){  std::cin >> v[i];  }  return is; }  std::ostream &operator<<(std::ostream &os, Cords c){  os << "<" << c.x << ", " << c.y << ">";  return os; }  class Figure{ public:  std::vector<Cords> cords;    Figure(){}  Figure(const Figure &f){  for(size\_t i = 0; i < f.cords.size(); i++){  cords.push\_back(f.cords[i]);  }  }  virtual ~Figure(){}   void read\_cords(){  for(size\_t i = 0; i < cords.size(); i++){  std::cin >> cords[i];  }  }    virtual void print\_name() = 0;  virtual char get\_figure() = 0;   void print(){  print\_name();  for(size\_t i = 0; i < cords.size(); i++){  std::cout << cords[i] << " ";  }  std::cout << '\n';  } };  class Square: public Figure{ public:  Square(){  for(size\_t i = 0; i < 4; i++){  cords.push\_back({0, 0});  }  }  Square(const Cords &c1, const Cords &c2, const Cords &c3, const Cords &c4){  cords.push\_back(c1);  cords.push\_back(c2);  cords.push\_back(c3);  cords.push\_back(c4);  }  Square(const Square &s){  cords = s.cords;  }  Square(const std::vector<Cords> &v){  cords = v;  }  ~Square(){}   void print\_name(){  std::cout << "Square: ";  }   char get\_figure(){  return 's';  }   };  class Rectangle: public Figure{ public:  Rectangle(){  for(size\_t i = 0; i < 4; i++){  cords.push\_back({0,0});  }  }  Rectangle(const Cords &c1, const Cords &c2, const Cords &c3, const Cords &c4){  cords.push\_back(c1);  cords.push\_back(c2);  cords.push\_back(c3);  cords.push\_back(c4);  }  Rectangle(const Rectangle &r){  cords = r.cords;  }  Rectangle(const std::vector<Cords> &v){  cords = v;  }  ~Rectangle(){}   void print\_name(){  std::cout << "Rectangle: ";  }   char get\_figure(){  return 'r';  } };  class Trapezoid: public Figure{ public:  Trapezoid(){  for(size\_t i = 0; i < 4; i++){  cords.push\_back({0,0});  }  }  Trapezoid(const Cords &c1, const Cords &c2, const Cords &c3, const Cords &c4){  cords.push\_back(c1);  cords.push\_back(c2);  cords.push\_back(c3);  cords.push\_back(c4);  }  Trapezoid(const Trapezoid &t){  cords = t.cords;  }  Trapezoid(const std::vector<Cords> &v){  cords = v;  }  ~Trapezoid(){}    void print\_name(){  std::cout << "Trapezoid: ";  }   char get\_figure(){  return 't';  } };  class Factory{ public:  virtual Figure \*create\_figure() = 0;  virtual ~Factory(){} };  class Square\_Factory: public Factory{ public:  Figure \*create\_figure(){  return reinterpret\_cast<Figure\*>(new Square());  }  Figure \*create\_figure(const Cords &c1, const Cords &c2, const Cords &c3, const Cords &c4){  return reinterpret\_cast<Figure\*>(new Square(c1, c2, c3, c4));  }  Figure \*create\_figure(const std::vector<Cords> &v){  return reinterpret\_cast<Figure\*>(new Square(v));  } };  class Rectangle\_Factory: public Factory{ public:  Figure \*create\_figure(){  return reinterpret\_cast<Figure\*>(new Rectangle());  }  Figure \*create\_figure(const Cords &c1, const Cords &c2, const Cords &c3, const Cords &c4){  return reinterpret\_cast<Figure\*>(new Rectangle(c1, c2, c3, c4));  }  Figure \*create\_figure(const std::vector<Cords> &v){  return reinterpret\_cast<Figure\*>(new Rectangle(v));  } };  class Trapezoid\_Factory: public Factory{ public:  Figure \*create\_figure(){  return reinterpret\_cast<Figure\*>(new Trapezoid());  }  Figure \*create\_figure(const Cords &c1, const Cords &c2, const Cords &c3, const Cords &c4){  return reinterpret\_cast<Figure\*>(new Trapezoid(c1, c2, c3, c4));  }  Figure \*create\_figure(const std::vector<Cords> &v){  return reinterpret\_cast<Figure\*>(new Trapezoid(v));  } };  #endif |

* Вывод

Применение определенных паттернов программирования позволяет во многих случаях легче поддерживать код в долгосрочных проектах, изменять меньшую его часть при внесении правок.

Программа позволяет выполнять простейшие действия над файлом. Возможно также расширение программы операциями вставки и удаления элемента с любой позиции в файле, добавление команды redo.

* Список литературы

Справочник по языку С++ [Электронный ресурс]. URL:

<https://en.cppreference.com/w/> (дата обращения: 10.12.2019).