Министерство высшего образования и науки Российской Федерации

Федеральное государственное бюджетное образовательное учреждение высшего образования

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Кафедра «Информационные технологии и автоматизированные системы»

ОТЧЁТ

по лабораторной работе

Тема: «Задача Коммивояжера»

Выполнил

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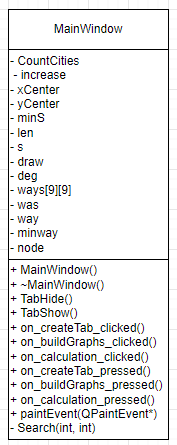
**Постановка задачи**

1) Создание и визуализация графа

2) Выполнение задачи Коммивояжера

Принцип работы кода заключается в реализации алгоритма коммивояжера с использованием метода ветвей и границ.

**Uml-Диаграмма**



**Код программы**

#ifndef GRAPHWIDGET\_H

#define GRAPHWIDGET\_H

#include <QGraphicsView>

#include <QGraphicsScene>

#include <QGraphicsEllipseItem>

#include <QGraphicsLineItem>

#include <QGraphicsTextItem>

#include <QVector>

#include <algorithm>

#include <cmath>

#include <iostream>

#include <QPushButton>

#include <QInputDialog>

#include <QMessageBox>

#include <QTextEdit>

*struct* **Point** {

double x;

double y;

};

*struct* **Edge** {

int source;

int destination;

double weight;

};

*class* **GraphWidget** : *public* QGraphicsView {

*public*:

**GraphWidget**(QVector<Point>& points, QVector<Edge>& edges, QWidget\* parent = *nullptr*);

void **drawPoints**();

void **drawLines**();

void **solveTSP**();

void **drawOptimalPath**();

void **addPoint**();

void **removePoint**();

void **addEdge**();

void **removeEdge**();

*private*:

QGraphicsScene\* scene;

QVector<Point>& points;

QVector<Edge>& edges;

std::vector<int> optimalPath;

QTextEdit\* textOutput;

double minDistance;

void **updateMinDistance**() {

minDistance = std::numeric\_limits<double>::infinity();

solveTSP();

textOutput->clear();

textOutput->append("Minimum distance: " + QString::number(minDistance));

}

double **calculateDistance**(*const* Point& p1, *const* Point& p2) {

double dx = p1.x - p2.x;

double dy = p1.y - p2.y;

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

}

};

#endif *//* *GRAPHWIDGET\_H*

#include "graphwidget.h"

#include <QApplication>

#include <QGraphicsView>

#include <QGraphicsScene>

#include <QGraphicsEllipseItem>

#include <QGraphicsLineItem>

#include <QGraphicsTextItem>

#include <QVector>

#include <algorithm>

#include <cmath>

#include <iostream>

#include <QPushButton>

#include <QInputDialog>

#include <QMessageBox>

#include <QTextEdit>

GraphWidget::**GraphWidget**(QVector<Point>& points, QVector<Edge>& edges, QWidget\* parent)

: QGraphicsView(*parent*), scene(*new* QGraphicsScene(*this*)), points(points), edges(edges) {

scene->setSceneRect(-200, -200, 400, 400);

setScene(*scene*);

drawPoints();

drawLines();

setRenderHint(QPainter::*Antialiasing*);

setWindowTitle(tr("Traveling Salesman Problem"));

*//* *Создание* *поля* *для* *вывода* *текста*

textOutput = *new* QTextEdit(*this*);

textOutput->setReadOnly(*true*);

textOutput->setGeometry(10, 130, 150, 80);

solveTSP();

textOutput->append("Minimum distance: " + QString::number(minDistance));

QPushButton\* addPointButton = *new* QPushButton("Add Point", *this*);

addPointButton->move(10, 10);

connect(addPointButton, &QPushButton::clicked, *this*, &GraphWidget::addPoint);

QPushButton\* removePointButton = *new* QPushButton("Remove Point", *this*);

removePointButton->move(10, 40);

connect(removePointButton, &QPushButton::clicked, *this*, &GraphWidget::removePoint);

QPushButton\* addEdgeButton = *new* QPushButton("Add Edge", *this*);

addEdgeButton->move(10, 70);

connect(addEdgeButton, &QPushButton::clicked, *this*, &GraphWidget::addEdge);

QPushButton\* removeEdgeButton = *new* QPushButton("Remove Edge", *this*);

removeEdgeButton->move(10, 100);

connect(removeEdgeButton, &QPushButton::clicked, *this*, &GraphWidget::removeEdge);

}

void GraphWidget::**drawPoints**() {

*for* (int i = 0; i < points.size(); ++i) {

*const* Point& p = points[i];

QGraphicsEllipseItem\* pointItem = scene->addEllipse(p.x - 3, p.y - 3, 6, 6);

pointItem->setBrush(Qt::*red*);

QGraphicsTextItem\* textItem = scene->addText(QString::number(i + 1));

textItem->setPos(p.x + 5, p.y - 5);

}

}

void GraphWidget::**drawLines**() {

*for* (*const* Edge& edge : edges) {

*const* Point& p1 = points[edge.source];

*const* Point& p2 = points[edge.destination];

double distance = edge.weight;

*if* (distance > 0) {

QGraphicsLineItem\* lineItem = scene->addLine(p1.x, p1.y, p2.x, p2.y);

lineItem->setPen(QPen(Qt::*black*, 1, Qt::*SolidLine*, Qt::*RoundCap*, Qt::*RoundJoin*));

QGraphicsTextItem\* textItem = scene->addText(QString::number(distance));

textItem->setPos((p1.x + p2.x) / 2, (p1.y + p2.y) / 2);

}

}

}

void GraphWidget::**solveTSP**() {

int numPoints = points.size();

std::vector<int> path(numPoints);

*for* (int i = 0; i < numPoints; ++i) {

path[i] = i;

}

minDistance = std::numeric\_limits<double>::infinity();

*do* {

double distance = 0.0;

*for* (int i = 0; i < numPoints - 1; ++i) {

int source = path[i];

int destination = path[i + 1];

*auto* edgeIt = std::find\_if(edges.begin(), edges.end(), [&](*const* Edge& edge) {

*return* (edge.source == source && edge.destination == destination) ||

(edge.source == destination && edge.destination == source);

});

*if* (edgeIt != edges.end()) {

distance += edgeIt->weight;

} *else* {

distance += calculateDistance(points[source], points[destination]);

}

}

int lastSource = path[numPoints - 1];

int firstDestination = path[0];

*auto* edgeIt = std::find\_if(edges.begin(), edges.end(), [&](*const* Edge& edge) {

*return* (edge.source == lastSource && edge.destination == firstDestination) ||

(edge.source == firstDestination && edge.destination == lastSource);

});

*if* (edgeIt != edges.end()) {

distance += edgeIt->weight;

} *else* {

distance += calculateDistance(points[lastSource], points[firstDestination]);

}

*if* (distance < minDistance) {

minDistance = distance;

optimalPath = path;

}

} *while* (std::next\_permutation(path.begin() + 1, path.end()));

std::cout << "Minimum distance: " << minDistance << std::endl;

drawOptimalPath();

}

void GraphWidget::**drawOptimalPath**() {

*if* (optimalPath.empty())

*return*;

QPen pen(Qt::*blue*, 2, Qt::*SolidLine*, Qt::*RoundCap*, Qt::*RoundJoin*);

QGraphicsLineItem\* lineItem = *nullptr*;

*for* (int i = 0; i < optimalPath.size() - 1; ++i) {

int source = optimalPath[i];

int destination = optimalPath[i + 1];

*const* Point& p1 = points[source];

*const* Point& p2 = points[destination];

lineItem = scene->addLine(p1.x, p1.y, p2.x, p2.y, pen);

}

*//* *Connect* *the* *last* *and* *first* *points*

int lastSource = optimalPath.back();

int firstDestination = optimalPath.front();

*const* Point& p1 = points[lastSource];

*const* Point& p2 = points[firstDestination];

lineItem = scene->addLine(p1.x, p1.y, p2.x, p2.y, pen);

}

void GraphWidget::**addPoint**() {

bool ok;

double x = QInputDialog::getDouble(*this*, "Add Point", "Enter X coordinate:", 0, -1000, 1000, 1, *&ok*);

*if* (!ok)

*return*;

double y = QInputDialog::getDouble(*this*, "Add Point", "Enter Y coordinate:", 0, -1000, 1000, 1, *&ok*);

*if* (!ok)

*return*;

Point point;

point.x = x;

point.y = y;

points.push\_back(point);

QGraphicsEllipseItem\* pointItem = scene->addEllipse(x - 3, y - 3, 6, 6);

pointItem->setBrush(Qt::*red*);

QGraphicsTextItem\* textItem = scene->addText(QString::number(points.size()));

textItem->setPos(x + 5, y - 5);

solveTSP();

updateMinDistance();

}

void GraphWidget::**removePoint**() {

*if* (points.isEmpty()) {

QMessageBox::information(*this*, "Remove Point", "No points to remove.");

*return*;

}

bool ok;

int index = QInputDialog::getInt(*this*, "Remove Point", "Enter point index:", 1, 1, points.size(), 1, *&ok*);

*if* (!ok)

*return*;

index--; *//* *Adjust* *index* *to* *0-based*

points.remove(index);

scene->clear();

drawPoints();

drawLines();

solveTSP();

updateMinDistance();

}

void GraphWidget::**addEdge**() {

*if* (points.size() < 2) {

QMessageBox::information(*this*, "Add Edge", "At least two points are required to add an edge.");

*return*;

}

bool ok;

int sourceIndex = QInputDialog::getInt(*this*, "Add Edge", "Enter source point index:", 1, 1, points.size(), 1, *&ok*);

*if* (!ok)

*return*;

int destinationIndex = QInputDialog::getInt(*this*, "Add Edge", "Enter destination point index:", 1, 1, points.size(), 1, *&ok*);

*if* (!ok)

*return*;

double weight = QInputDialog::getDouble(*this*, "Add Edge", "Enter edge weight:", 0, 0, 1000, 1, *&ok*);

*if* (!ok)

*return*;

sourceIndex--; *//* *Adjust* *indices* *to* *0-based*

destinationIndex--;

edges.append({sourceIndex, destinationIndex, weight});

*const* Point& p1 = points[sourceIndex];

*const* Point& p2 = points[destinationIndex];

QGraphicsLineItem\* lineItem = scene->addLine(p1.x, p1.y, p2.x, p2.y);

lineItem->setPen(QPen(Qt::*black*, 1, Qt::*SolidLine*, Qt::*RoundCap*, Qt::*RoundJoin*));

QGraphicsTextItem\* textItem = scene->addText(QString::number(weight));

textItem->setPos((p1.x + p2.x) / 2, (p1.y + p2.y) / 2);

solveTSP();

updateMinDistance();

}

void GraphWidget::**removeEdge**() {

*if* (edges.isEmpty()) {

QMessageBox::information(*this*, "Remove Edge", "No edges to remove.");

*return*;

}

bool ok;

int sourceIndex = QInputDialog::getInt(*this*, "Remove Edge", "Enter source point index:", 1, 1, points.size(), 1, *&ok*);

*if* (!ok)

*return*;

int destinationIndex = QInputDialog::getInt(*this*, "Remove Edge", "Enter destination point index:", 1, 1, points.size(), 1, *&ok*);

*if* (!ok)

*return*;

sourceIndex--; *//* *Adjust* *indices* *to* *0-based*

destinationIndex--;

*auto* it = std::find\_if(edges.begin(), edges.end(), [&](*const* Edge& edge) {

*return* (edge.source == sourceIndex && edge.destination == destinationIndex) ||

(edge.source == destinationIndex && edge.destination == sourceIndex);

});

*if* (it != edges.end()) {

edges.erase(it);

scene->clear();

drawPoints();

drawLines();

solveTSP();

updateMinDistance();

} *else* {

QMessageBox::information(*this*, "Remove Edge", "Edge not found.");

}

}

#include <QApplication>

#include <QGraphicsView>

#include <QGraphicsScene>

#include <QGraphicsEllipseItem>

#include <QGraphicsLineItem>

#include <QGraphicsTextItem>

#include <QVector>

#include <algorithm>

#include <cmath>

#include <iostream>

#include <QPushButton>

#include <QInputDialog>

#include <QMessageBox>

#include <QTextEdit>

#include "graphwidget.h"

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

QApplication app(*argc*, *argv*);

QVector<Point> points;

points.append({100, 0});

points.append({0, 70});

points.append({50, 100});

points.append({150, 80});

points.append({100, 300});

points.append({-20, 200});

QVector<Edge> edges;

edges.append({0, 1, 17});

edges.append({0, 2, 21});

edges.append({0, 3, 48});

edges.append({1, 2, 25});

edges.append({2, 3, 6});

edges.append({3, 4, 13});

edges.append({4, 2, 8});

edges.append({4, 5, 40});

edges.append({5, 1, 3});

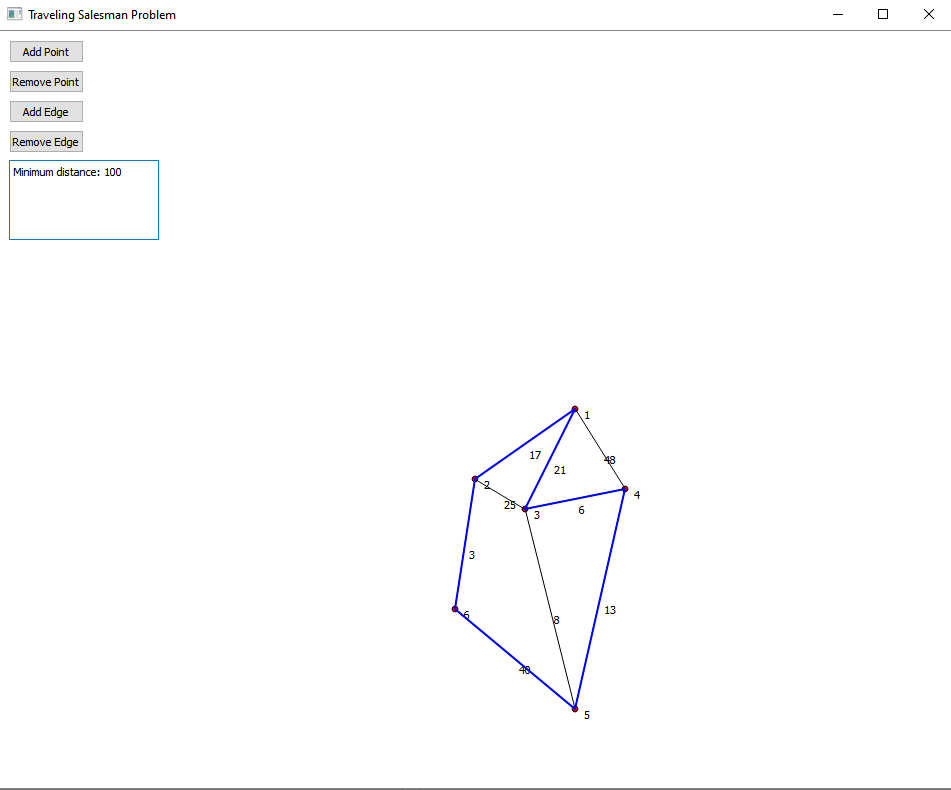
GraphWidget graphWidget(*points*, *edges*);

graphWidget.show();

*return* app.exec();

}

**Вывод**

****