Московский Авиационный Институт

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Факультет информационных технологий и прикладной математики

Кафедра вычислительной математики и программирования

Курсовой проект по курсу

«Операционные системы»

Тема работы

“Проектирование консольной клиент-серверной игры”

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Дата: ____________

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Содержание

Репозиторий

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Постановка задачи

Необходимо спроектировать и реализовать программный прототип в соответствии с выбранным вариантом. Произвести анализ и сделать вывод на основании данных, полученных при работе программного прототипа.

Базовый функционал должен быть следующим:

• Клиент может присоединиться к серверу, введя логин (у меня это ID процесса).

• С сервером одновременно много играть несколько клиентов.

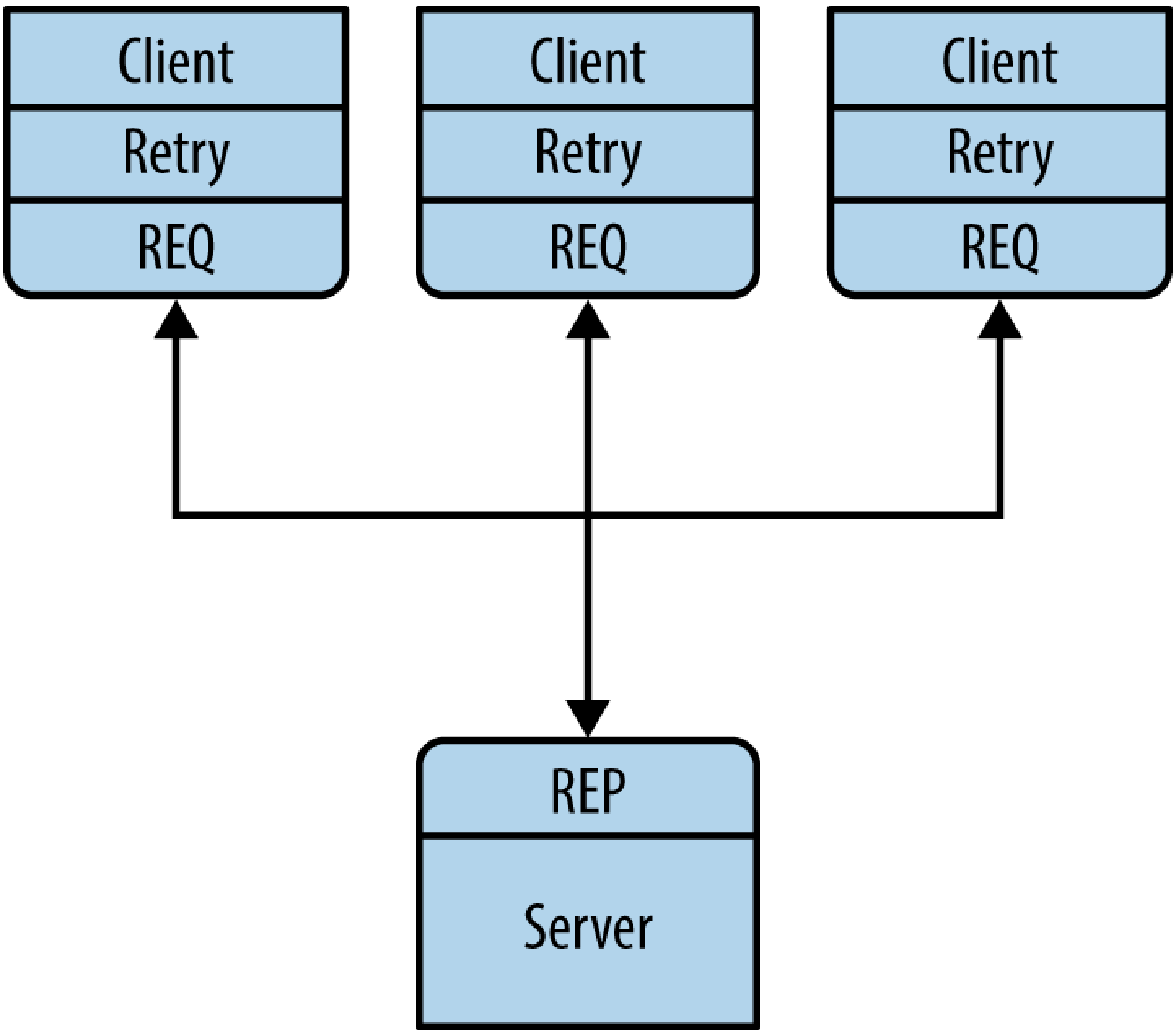
3. Морской бой. Общение между сервером и клиентом необходимо организовать при помощи очередей сообщений (например, ZeroMQ). Каждый игрок должен при запуске ввести свой логин. Для каждого игрока должна вестись статистика игр (сколько побед/поражений). Игрок может посмотреть свою статистику.

Общие сведения о программе

Программа состоит из двух файлов – server.cpp, client.cpp, в которых расположены код сервера, код клиента. Для удобства также был создан Makefile.

Общий метод и алгоритм решения

Общение между клиентом и сервером осуществляется как на схеме, изображённой ниже:



Сначала запускается сервер, потом запускаются клиенты, они сразу же посылают сигнал серверу, что готовы играть, там он их регистрирует по ID процессов. На сервере также хранятся словари с полями игроков, их статистикой, количествами уничтоженных кораблей и так далее. Когда сервер получают какую-то команду, то он получает также и ID игрока, достаёт из словарей всю связанную с игроком информацию и в зависимости от этого выбирает свою команду, посылаемую игроком.

Исходный код

server.cpp

```
#include
<zmq.hpp>
            #include <iostream>
            #include <unistd.h>
            #include <map>
```

```
#include <set>
#include <string>
#include <vector>


void random(std::vector<std::vector<char>>& p)
{
    int j=-1, k, v, l, x[2], y;
    srand(time(0));
    for(l=4; l>0; l--)
        for(k=5;k-l;k--)
        {
            v = 1&rand();
            //v = rand() % 2;
            do for (x[v] = 1 + rand() % 10, x[1 - v] = 1 + rand() % 7, y = j =
0; j - l; y |= p[x[0]][x[1]] != '.', x[1 - v]++, j++); while(y);
            x[1 - v] -= l + 1, p[x[0]][x[1]] = '/', x[v]--, p[x[0]][x[1]]='/',
x [v]+=2, p[x [0]][x[1]]='/', x[v]--, x[1 - v]++;
            for (j = -1; ++j - l; p[x[0]][x[1]] = 'X', x[v]--, p[x[0]][x[1]] =
'/', x[v]+=2, p[x[0]][x[1]]='/', x[v]--, x[1 - v]++);
            p[x[0]][x[1]] = '/', x[v]--, p[x[0]][x[1]] = '/', x[v]+=2,
p[x[0]][x[1]] = '/';
        }
        for (int i = 0; i < 12; ++i)
        {
                std::replace(p[i].begin(), p[i].end(), '/', '.');
        }
}


void send_message(std::string message_string, zmq::socket_t& socket)
{
    zmq::message_t message_back(message_string.size());
    memcpy(message_back.data(), message_string.c_str(), message_string.size());
    if(!socket.send(message_back))
    {
        std::cout << "Error: can't send message from node with pid " <<
getpid() << "\n";
    }
}


void print(std::vector<std::vector<char>>& p)
{
        for (int i = 1; i < 11; ++i)
        {
                for (int j = 1; j < 11; ++j)
                {
                        std::cout << p[i][j];
                }
                std::cout << "\n";
        }
}


int main()
{
        zmq::context_t context (1);
         zmq::socket_t socket (context, ZMQ_REP);
        std::string port, reply;
        std::cout << "Enter the port\n";
        std::cin >> port;
        socket.bind("tcp://*:" + port);
        unsigned milliseconds;
        std::cout << "Enter the time that socket should wait for answer from 
client and send message to client (it is a single value)\n";
        std::cin >> milliseconds;
        socket.setsockopt(ZMQ_SNDTIMEO, (int)milliseconds);
        std::map<int, std::pair<unsigned, unsigned>> statistics;
        std::map<int, std::pair<unsigned, unsigned>> amount;
        std::map<int, std::pair<std::vector<std::vector<char>>, 
std::vector<std::vector<char>>>> fields;
        std::map<int, std::vector<std::pair<unsigned, unsigned>>> 
possible_turns;
        std::map<int, std::pair<unsigned, unsigned>> last_commands;
        std::map<int, bool> finishing;
        std::map<int, std::vector<std::pair<unsigned, unsigned>>> variants;
        while (true)
        {
                zmq::message_t request;
                socket.recv(&request);
                std::string message(static_cast<char*>(request.data()), 
request.size()), reply;
                std::string command = message.substr(0, message.find(" "));
                int ID = std::stoi(message.substr(message.find(" ") + 1));
                std::cout << message << "\n";
                if (command == "ID")
                {
                        statistics[ID] = {0, 0};
                        amount[ID] = {0, 0};
                        //reply = "OK";
                        send_message("OK", socket);
                }
                else if (command == "Statistics")
                {
                        if (statistics.find(ID) != statistics.end())
                        {
                                std::pair<unsigned, unsigned> numbers =
statistics[ID];
                                reply = std::to_string(numbers.first) + " " +
std::to_string(numbers.second);
                        }
                        else
                        {
                                reply = "Error: player with such ID already
exists";
                        }
                        send_message(reply, socket);
                }
                else if (command == "Get")
                {
                        print(fields[ID].first);
                        send_message("OK", socket);
                }
                else if (command == "Exit")
                {
                        if (statistics.find(ID) != statistics.end())
                        {
                                statistics.erase(ID);
                                amount.erase(ID);
                                fields.erase(ID);
                                possible_turns.erase(ID);
                                last_commands.erase(ID);
                                finishing.erase(ID);
                                variants.erase(ID);
                        }
                        //reply = "It was nice to play with you, bye!";
                        send_message("It was nice to play with you, bye!",
socket);
                }
                else if (command == "Begin")
                {
                        //std::cout << "Recieved Begin\n";
                        amount[ID] = {0, 0};
                        std::vector<std::vector<char>> server_field (12,
std::vector<char>(12, '.'));
                        std::vector<std::vector<char>> player_field (12,
std::vector<char>(12, '.'));
                        //std::cout << "Created vectors\n";
                        random(server_field);
                        fields[ID] = {server_field, player_field};
                        //std::cout << "Created fields\n";
                        server_field.clear();
                        player_field.clear();
```

```
            //std::cout << "Cleared vectors\n";
            std::vector<std::pair<unsigned, unsigned>> turns (100);
            for (int i = 0; i < 10; i++)
            {
                for (int j = 0; j < 10; ++j)
                {
                    turns[i * 10 + j] = {i, j};
                }
            }
            //std::cout << "Created turns\n";
            possible_turns[ID] = turns;
            finishing[ID] = false;
            last_commands[ID] = {-1, -1};
            variants[ID] = {{1, 0}, {-1, 0}, {0, 1}, {0, -1}};
            turns.clear();
            //reply = "Start";
            send_message("Start", socket);
        }
        else if (command.substr(0, 3) == "Try")
        {
            std::string coordinates = message.substr(0,
message.find(" "));
            std::cout << coordinates << "\n";
            unsigned horizontal = unsigned(coordinates[3]) -
unsigned('0') + 1;
             unsigned vertical = unsigned(coordinates[4]) -
unsigned('0') + 1;
            std::cout << horizontal << " " << vertical << "\n";
            std::pair<std::vector<std::vector<char>>,
std::vector<std::vector<char>>> squares = fields[ID];
            if (squares.first[vertical][horizontal] == 'X')
            {
                squares.first[vertical][horizontal] = 'K';
                //std::vector<std::pair<unsigned, unsigned>> turns
= possible_turns[ID];
                for (int i = -1; i < 2; ++i)
                {
                    for (int j = -1; j < 2; ++j)
                    {
                        if ((vertical + i > 0) && (vertical
+ i < 11) && (horizontal + j > 0) && (horizontal + j < 11))
                        {
                            if (squares.first[vertical +
i][horizontal + j] == '.')
                            {

    squares.first[vertical + i][horizontal + j] = 'w';
    /*std::vector<std::pair<int, int>>::iterator it;
                                if ((it = 
std::find(turns.begin(), turns.end(), std::make_pair(vertical + i, horizontal + 
j))) != turns.end())
                                {

arr.erase(arr.begin() + std::distance(turns.begin(), it);
                                }*/


                            }
                        }
                    }
                }
                //possible_turns[ID] = turns;
                reply = "Killed";
                int v = vertical, h = horizontal;
                while ((v > 1) && (squares.first[v][h] == 'K'))
                {
                    --v;
                }
                if (squares.first[v][h] == 'X')
                {
                    reply = "Wounded";
                }
                if (reply == "Killed")
                {
                    v = vertical; h = horizontal;
                    while ((v < 10) && (squares.first[v][h] == 
'K'))
                    {
                        ++v;
                    }
                    if (squares.first[v][h] == 'X')
                    {
                        reply = "Wounded";
                    }
                    if (reply == "Killed")
                    {
                        v = vertical; h = horizontal;
                        while ((h > 1) && 
(squares.first[v][h] == 'K'))
                        {
                            --h;
                        }
                        if (squares.first[v][h] == 'X')
                        {
                            reply = "Wounded";
                        }
                        if (reply == "Killed")
                        {
                            v = vertical; h =
horizontal;
                            while ((h < 10) &&
(squares.first[v][h] == 'K'))
                            {
                                ++h;
                            }
                            if (squares.first[v][h] ==
'X')
                            {
                                reply = "Wounded";
                            }
                        }
                    }
                }
                if (reply == "Killed")

                {
                    amount[ID] = {++amount[ID].first,
amount[ID].second};
                    if (amount[ID].first == 10)
                    {
                        reply = "Won";
                        statistics[ID] =
{++statistics[ID].first, statistics[ID].second};
                    }
                }
            }
            else if ((squares.first[vertical][horizontal] == 'K') ||
(squares.first[vertical][horizontal] == 'w'))
            {
                reply = "Another";
            }
            else if (squares.first[vertical][horizontal] == '.')
            {
                reply = "Missed";
                squares.first[vertical][horizontal] = 'w';
            }
            fields[ID] = {squares.first, squares.second};
            send_message(reply, socket);
        }
        else if (command == "Amount")
        {
            std::cout << "Amount: " << amount[ID].first << "\n";
```

```
                        send_message("OK", socket);
                }
                else if (command == "Turns")
                {
                        std::vector<std::pair<unsigned, unsigned>> turns =
possible_turns[ID];
                        for (int i = 0; i < turns.size(); i++)
                        {
                                std::cout << turns[i].first << " " <<
turns[i].second << "\n";
                        }
                        std::cout << "Length is " << turns.size() << "\n";
                        send_message("Ok", socket);
                }
                else if ((command == "Do") || (command == "Killed"))
                {
                        if (command == "Killed")
                        {
                                std::pair<std::vector<std::vector<char>>,
std::vector<std::vector<char>>> squares = fields[ID];
                                std::vector<std::pair<unsigned, unsigned>> turns =
possible_turns[ID];
                                unsigned vertical = last_commands[ID].first,
horizontal = last_commands[ID].second;
                                squares.second[vertical][horizontal] = 'K';
                                //turns.erase(turns.begin() +
std::distance(turns.begin(), std::find(turns.begin(), turns.end(),
std::make_pair(vertical, horizontal))));
                                for (int i = -1; i < 2; ++i)
                                {
                                        for (int j = -1; j < 2; ++j)
                                        {
                                                if ((vertical + i > 0) && (vertical
+ i < 11) && (horizontal + j > 0) && (horizontal + j < 11))
                                                {

        std::vector<std::pair<unsigned, unsigned>>::iterator it;
                                                        if ((it =
std::find(turns.begin(), turns.end(), std::make_pair(vertical + i, horizontal +
j))) != turns.end())
                                                        {

        turns.erase(turns.begin() + std::distance(turns.begin(), it));
                                                        }
                                                        if (squares.second[vertical
+ i][horizontal + j] == '.')
                                                        {
```

```
       squares.second[vertical + i][horizontal + j] = 'w';

       /*std::vector<std::pair<unsigned, unsigned>>::iterator it;
                                                  if ((it =
std::find(turns.begin(), turns.end(), std::make_pair(vertical + i, horizontal +
j))) != turns.end())
                                                  {

       turns.erase(turns.begin() + std::distance(turns.begin(), it));
                                                  }*/
                                              }
                                          }
                                      }
                              }
                              fields[ID] = {squares.first, squares.second};
                              possible_turns[ID] = turns;
                              finishing[ID] = false;
                              variants[ID] = {{1, 0}, {-1, 0}, {0, 1}, {0, -1}};
                              amount[ID] = {amount[ID].first,
++amount[ID].second};
                              if (amount[ID].second == 10)
                              {
                                      reply = "Lost";
                                      amount[ID] = {0, 0};
                              }
                      }
                      if (!finishing[ID])
                      {
                              int length = possible_turns[ID].size();
                              srand(time(0));
                              int number = rand() % length;
                              std::vector<std::pair<unsigned, unsigned>>
coordinates = possible_turns[ID];
                              std::pair<unsigned, unsigned> turn =
coordinates[number];
                              std::cout << "Turn is " << turn.first << " " <<
turn.second << "\n";
                              coordinates.erase(coordinates.begin() + number);
                              possible_turns[ID] = coordinates;
                              last_commands[ID] = turn;
                              reply = "Try" + std::to_string(turn.first) +
std::to_string(turn.second);
                              std::cout << "Tried coordinates " << turn.first <<
" " << turn.second << "\n";
                      }
                      else
                      {
                              int length, number, k = 1;
                              std::vector<std::pair<unsigned, unsigned>>
positions;
                              std::pair<unsigned, unsigned> turn;
                              do
                              {
                                      length = variants[ID].size();
                                      number = rand() % length;
                                       positions = variants[ID];
                                      turn = positions[number];
                                          positions.erase(positions.begin() +
number);
                              }
                              while ((length > 0) && (!((last_commands[ID].first
+ turn.first > 0) && (last_commands[ID].first + turn.first < 11) &&
(last_commands[ID].second + turn.second > 0)
                                      && (last_commands[ID].second + turn.second
< 11))));
                              std::pair<std::vector<std::vector<char>>,
std::vector<std::vector<char>>> squares = fields[ID];
                              std::vector<std::pair<unsigned, unsigned>> turns =
possible_turns[ID];
                              unsigned vertical, horizontal;
                              do
                              {
                                      send_message("Try" +
std::to_string(last_commands[ID].first + turn.first * k) +
std::to_string(last_commands[ID].second + turn.second * k), socket);
                                      ++k;
                                      zmq::message_t answer;
                                      socket.recv(&answer);
                                      std::string
string(static_cast<char*>(answer.data()), answer.size());
                                      reply = string.substr(0, string.find(" "));

                                      vertical = last_commands[ID].first +
turn.first * k, horizontal = last_commands[ID].second + turn.second * k;
                                      turns.erase(turns.begin() +
std::distance(turns.begin(), std::find(turns.begin(), turns.end(),
std::make_pair(vertical, horizontal))));
                                      if ((reply == "Wounded") || (reply ==
"Killed"))
                                      {

       squares.second[vertical][horizontal] = 'K';
                                          for (int i = -1; i < 2; ++i)
                                          {
                                              for (int j = -1; j < 2; ++j)
```

```
                                                        {
                                                                if ((vertical + i >
0) && (vertical + i < 11) && (horizontal + j > 0) && (horizontal + j < 11))
                                                                {

        std::vector<std::pair<unsigned, unsigned>>::iterator it;
                                                                                if ((it
= std::find(turns.begin(), turns.end(), std::make_pair(vertical + i, horizontal
+ j))) != turns.end())
                                                                                {

turns.erase(turns.begin() + std::distance(turns.begin(), it));
                                                                                }
                                                                        if
(squares.second[vertical + i][horizontal + j] == '.')
                                                                        {

        squares.second[vertical + i][horizontal + j] = 'w';

        /*std::vector<std::pair<unsigned, unsigned>>::iterator it;
                                                                                if
((it = std::find(turns.begin(), turns.end(), std::make_pair(vertical + i,
horizontal + j))) != turns.end())
                                                                                {

        turns.erase(turns.begin() + std::distance(turns.begin(), it));
                                                                                }*/
                                                                        }
                                                                }
                                                        }
                                                }
                                        }
                                        else if (reply == "Missed")
                                        {

        squares.second[vertical][horizontal] = 'w';
                                        }
                                        //fields[ID] = {squares.first,
squares.second};
                                }
                                while (reply == "Wounded");
                                fields[ID] = {squares.first, squares.second};
                                possible_turns[ID] = turns;
                                variants[ID] = positions;
                                if (reply == "Missed")
                                {
                                        reply = "Do";
                                }
```

```
                              else if (reply == "Killed")
                              {
                                     finishing[ID] = false;
                                     variants[ID] = {{1, 0}, {-1, 0}, {0, 1},
{0, -1}};
                                     amount[ID] = {amount[ID].first,
++amount[ID].second};
                                     if (amount[ID].second == 10)
                                     {
                                            reply = "Lost";
                                            amount[ID] = {0, 0};
                                     }
                                     else
                                     {
                                            int length =
possible_turns[ID].size();
                                            srand(time(0));
                                            int number = rand() % length;
                                            std::vector<std::pair<unsigned,
unsigned>> coordinates = possible_turns[ID];
                                            std::pair<unsigned, unsigned> turn
= coordinates[number];

       coordinates.erase(coordinates.begin() + number);
                                            possible_turns[ID] = coordinates;
                                            last_commands[ID] = turn;
                                            reply = "Try" +
std::to_string(turn.first) + std::to_string(turn.second);
                                            std::cout << "Tried coordinates "
<< turn.first << " " << turn.second << "\n";
                                     }
                              }
                       }
                       send_message(reply, socket);
              }
              else if (command == "Missed")
              {
                       std::pair<std::vector<std::vector<char>>,
std::vector<std::vector<char>>> squares = fields[ID];

squares.second[last_commands[ID].first][last_commands[ID].second] = 'w';
                         fields[ID] = {squares.first, squares.second};
                       send_message("Do", socket);
              }
              else if (command == "Wounded")
              {
                       finishing[ID] = true;
                       int length, number, k = 1;
```

```
                        std::vector<std::pair<unsigned, unsigned>> positions;
                        std::pair<unsigned, unsigned> turn;
                        do
                        {
                                length = variants[ID].size();
                                number = rand() % length;
                                positions = variants[ID];
                                turn = positions[number];
                                positions.erase(positions.begin() + number);
                        }
                        while ((length > 0) && (!((last_commands[ID].first +
turn.first > 0) && (last_commands[ID].first + turn.first < 11) &&
(last_commands[ID].second + turn.second > 0)
                                && (last_commands[ID].second + turn.second <
11))));
                        std::pair<std::vector<std::vector<char>>,
std::vector<std::vector<char>>> squares = fields[ID];
                        std::vector<std::pair<unsigned, unsigned>> turns =
possible_turns[ID];
                          unsigned vertical, horizontal;
                        do
                        {
                                send_message("Try" +
std::to_string(last_commands[ID].first + turn.first * k) +
std::to_string(last_commands[ID].second + turn.second * k), socket);
                                ++k;
                                zmq::message_t answer;
                                socket.recv(&answer);
                                std::string
string(static_cast<char*>(answer.data()), answer.size());
                                reply = string.substr(0, string.find(" "));
                                vertical = last_commands[ID].first + turn.first *
k, horizontal = last_commands[ID].second + turn.second * k;
                                turns.erase(turns.begin() +
std::distance(turns.begin(), std::find(turns.begin(), turns.end(),
std::make_pair(vertical, horizontal))));
                                if ((reply == "Wounded") || (reply == "Killed"))
                                {
                                        squares.second[vertical][horizontal] = 'K';
                                        for (int i = -1; i < 2; ++i)
                                        {
                                                for (int j = -1; j < 2; ++j)
                                                {
                                                        if ((vertical + i > 0) &&
(vertical + i < 11) && (horizontal + j > 0) && (horizontal + j < 11))
                                                        {

        std::vector<std::pair<unsigned, unsigned>>::iterator it;
```

```
                                                        if ((it =
std::find(turns.begin(), turns.end(), std::make_pair(vertical + i, horizontal +
j))) != turns.end())
                                                        {

       turns.erase(turns.begin() + std::distance(turns.begin(), it));
                                                        }
                                                        if
(squares.second[vertical + i][horizontal + j] == '.')
                                                        {

       squares.second[vertical + i][horizontal + j] = 'w';

       std::vector<std::pair<unsigned, unsigned>>::iterator it;
                                                               /*if ((it =
std::find(turns.begin(), turns.end(), std::make_pair(vertical + i, horizontal +
j))) != turns.end())
                                                               {

       turns.erase(turns.begin() + std::distance(turns.begin(), it));
                                                               }*/
                                                        }
                                                 }
                                          }
                                   }
                            }
                            else if (reply == "Missed")
                            {
                                   squares.second[vertical][horizontal] = 'w';
                            }
                            //fields[ID] = {squares.first, squares.second};
                     }
                     while (reply == "Wounded");
                     fields[ID] = {squares.first, squares.second};
                     variants[ID] = positions;
                     if (reply == "Missed")
                     {
                            reply = "Do";
                     }
                     else if (reply == "Killed")
                     {
                            finishing[ID] = false;
                            variants[ID] = {{1, 0}, {-1, 0}, {0, 1}, {0, -1}};
                            amount[ID] = {amount[ID].first,
++amount[ID].second};
                            if (amount[ID].second == 10)
                            {
                                   reply = "Lost";
```

```
                                        amount[ID] = {0, 0};
                                        statistics[ID] = {statistics[ID].first,
++statistics[ID].second};
                                }
                                else
                                {
                                        int length = possible_turns[ID].size();
                                        srand(time(0));
                                        int number = rand() % length;
                                        std::vector<std::pair<unsigned, unsigned>>
coordinates = possible_turns[ID];
                                        std::pair<unsigned, unsigned> turn =
coordinates[number];
                                        coordinates.erase(coordinates.begin() +
number);
                                        possible_turns[ID] = coordinates;
                                        last_commands[ID] = turn;
                                        reply = "Try" + std::to_string(turn.first)
+ std::to_string(turn.second);
                                        std::cout << "Tried coordinates " <<
turn.first << " " << turn.second << "\n";
                                }
                        }
                        send_message(reply, socket);
                }
                /*
                else if (command == "Left")
                {
                        std::pair<unsigned, unsigned> last_command =
last_commands[ID];
                        last_command = {last_command.first, last_command.second -
1};
                        last_commands[ID] = last_command;
                        reply = "Try" + std::to_string(last_command.first) +
std::to_string(last_command.second - 1);
                }
                else if (command == "Right")
                 {
                         std::pair<unsigned, unsigned> last_command =
last_commands[ID];
                         last_command = {last_command.first, last_command.second
+ 1};
                         last_commands[ID] = last_command;
                         reply = "Try" + std::to_string(last_command.first) +
std::to_string(last_command.second + 1);
                 }
                 else if (command == "Up")
                 {
                        std::pair<unsigned, unsigned> last_command =
last_commands[ID];
                        last_command = {last_command.first - 1,
last_command.second};
                        last_commands[ID] = last_command;
                        reply = "Try" + std::to_string(last_command.first - 1)
+ std::to_string(last_command.second);
                }
                else if (command == "Down")
                {
                        std::pair<unsigned, unsigned> last_command =
last_commands[ID];
                        last_command = {last_command.first + 1,
last_command.second};
                        last_commands[ID] = last_command;
                        reply = "Try" + std::to_string(last_command.first + 1)
+ std::to_string(last_command.second);
                }
               send_message(reply, socket);*/
       }
       return 0;
}
```

client.cpp

```
#include
<zmq.hpp>
#include <iostream>
#include <unistd.h>
#include <vector>
#include <algorithm>


void send_message(std::string message_string, zmq::socket_t& socket)
{
    zmq::message_t message_back(message_string.size());
    memcpy(message_back.data(), message_string.c_str(), message_string.size());
    if(!socket.send(message_back))
    {
        std::cout << "Error: can't send message from node with pid " <<
getpid() << "\n";
    }
}


std::string recieve_message(zmq::socket_t& socket)
{
       zmq::message_t reply;
       if (!socket.recv(&reply))
```

```
        {
                std::cout << "There's no answer from server\n";
                exit(1);
        }
        std::string message(static_cast<char*>(reply.data()), reply.size());
        return message;
}


void random(std::vector<std::vector<char>>& p)
{
    int j=-1, k, v, l, x[2], y;
    srand(time(0));
    for(l=4; l>0; l--)
        for(k=5;k-l;k--)
        {
            v = 1&rand();
            do for (x[v] = 1 + rand() % 10, x[1 - v] = 1 + rand() % 7, y = j =
0; j - l; y |= p[x[0]][x[1]] != '.', x[1 - v]++, j++); while(y);
            x[1 - v] -= l + 1, p[x[0]][x[1]] = '/', x[v]--, p[x[0]][x[1]] =
'/', x [v] += 2, p[x [0]][x[1]] = '/', x[v]--, x[1 - v]++;
            for (j = -1; ++j - l; p[x[0]][x[1]] = 'X', x[v]--, p[x[0]][x[1]] =
'/', x[v] += 2, p[x[0]][x[1]] = '/', x[v]--, x[1 - v]++);
            p[x[0]][x[1]] = '/', x[v]--, p[x[0]][x[1]] = '/', x[v]+=2,
p[x[0]][x[1]] = '/';
        }
        for (int i = 0; i < 12; ++i)
        {
                std::replace(p[i].begin(), p[i].end(), '/', '.');
        }
}


void flood(std::vector<std::vector<char>>& p)
{
        for (int i = 0; i < 12; i++)
        {
                p[i].clear();
                p[i] = std::vector<char>(12, '.');
        }
}


void print(std::vector<std::vector<char>>& p)
{
        for (int i = 1; i < 11; ++i)
        {
                for (int j = 1; j < 11; ++j)
                {
                        std::cout << p[i][j];
                }
                std::cout << "\n";
        }
}


int main()
{
        zmq::context_t context (1);
         zmq::socket_t socket (context, ZMQ_REQ);
        std::string port;
        std::cout << "Enter the port\n";
        std::cin >> port;
         std::cout << "Connecting to hello world server…" << std::endl;
        unsigned milliseconds;
         std::cout << "Enter the time that socket should wait for answer from
server\n";
         std::cin >> milliseconds;
         socket.setsockopt(ZMQ_SNDTIMEO, (int)milliseconds);
        socket.setsockopt(ZMQ_RCVTIMEO, (int)milliseconds);
         socket.connect ("tcp://localhost:" + port);
        send_message("ID " + std::to_string(getpid()), socket);
        zmq::message_t reply;
        /*if (!socket.recv(&reply))
        {
                std::cout << "There's no answer from server\n";
                return 0;
        }*/
        recieve_message(socket);
        std::cout << "If you want to start a game, input Begin\n";
        std::vector<std::vector<char>> my_field(12, std::vector<char> (12,
'.'));
        std::vector<std::vector<char>> server_field (12, std::vector<char> (12,
'.'));
         std::string command;
        bool playing = false;
        while (std::cin >> command)
        {
                if (command == "Begin")
                {
                        playing = true;
                        int number;
                        flood(my_field);
                        flood(server_field);
                        std::cout << "Do you want to arrange the ships by
yourself or generate a random combination? If the first, input 1, else - 2\n";
```

```
			do
			{
				std::cin >> number;
				if ((number < 1) || (number > 2))
				{
					std::cout << "Error, input 1 or 2\n";
				}
			}
			while ((number < 1) || (number > 2));
			if (number == 1)
			{
				int amount = 0, amounts[4], v1, v2;
				for (int i = 0; i < 4; ++i)
				{
					amounts[i] = 0;
				}
				char h1, h2;
				std::cout << "You should input 10 fours of 
symbols: for example, A 1 A 4, or B 3 E 3\n";
				while (amount < 10)
				{
					std::cin >> h1 >> v1 >> h2 >> v2;
					if ((v1 < 1) || (v2 < 1) || (v1 > 10) || 
(v2 > 10))
					{
						std::cout << "Number must be 
greater than 0 and less than 11\n";
						continue;
					}
					if (!((h1 >= 'A') && (h1 <= 'J') && (h2 >= 
'A') && (h2 <= 'J')))
					{
						std::cout << "Letters must be not 
less than A and not greater than J\n";
						continue;
					}
					if ((v1 != v2) && (h1 != h2))
					{
						std::cout << "Ship must be parallel 
to one of the coordinate axis\n";
						continue;
					}
					if ((v1 - v2 > 4) || (h1 - h2 > 4))
					{
						std::cout << "These ships are too 
long\n";
						continue;
					}
```

```
                                    int ih1 = int(h1) - int('A') + 1, ih2 =
int(h2) - int('A') + 1;
                                    if (v2 < v1)
                                    {
                                           std::swap(v1, v2);
                                    }
                                    if (ih2 < ih1)
                                    {
                                           std::swap(ih1, ih2);
                                    }
                                    if (v1 == v2)
                                    {
                                           bool possible = true;
                                           for (int i = ih1 - 1; i < ih2 + 2;
++i)
                                           {
                                                   for (int j = -1; j < 2;
++j)
                                                   {
                                                          if ((v1 + j > 0) &&
(v1 + j < 11) && (i > 0) && (i < 11))
                                                          {
                                                                 if
(my_field[v1 + j][i] == 'X')
                                                                 {

possible = false;

break;
                                                                 }
                                                          }
                                                   }
                                                  if (!possible)
                                                  {
                                                         break;
                                                  }
                                           }
                                           if (!possible)
                                           {
                                                  std::cout << "It is
impossible to put the ship, as it will come into contact with another\n";
                                                  continue;
                                           }
                                           else
                                           {
                                                  int number = ih2 - ih1;
                                                  if (amounts[number] == 4 -
number)
```

```
                                                  {
                                                         std::cout << "You
already have enough ships of this type\n";
                                                         continue;
                                                  }
                                                  ++amounts[number];

                                                  for (int i = ih1; i < ih2 +
1; ++i)
                                                  {
                                                         my_field[v1][i] =
'X';
                                                  }
                                                  ++amount;
                                                  std::cout << "Successfully
created ship\n";
                                           }
                                    }
                                    else if (ih1 == ih2)
                                    {
                                           bool possible = true;
                                               for (int i = v1 - 1; i < v2 +
2; ++i)
                                               {
                                                       for (int j = -1; j < 2;
++j)
                                                       {
                                                               if ((ih1 + j >
0) && (ih1 + j < 11) && (i > 0) && (i < 11))
                                                               {
                                                                       if
(my_field[i][ih1 + j] == 'X')
                                                                       {

possible = false;

break;
                                                                       }
                                                               }
                                                       }
                                                       if (!possible)
                                                       {
                                                               break;
                                                       }
                                               }
                                               if (!possible)
                                               {
```

```
                                                        std::cout << "It is
impossible to put the ship, as it will come into contact with another\n";
                                                        continue;
                                                }
                                                else
                                                {
                                                   int number = v2 - v1;
                                                        if (amounts[number] ==
4 - number)
                                                        {
                                                                std::cout <<
"You already have enough ships of this type\n";
                                                                continue;
                                                        }
                                                   ++amounts[number];
                                                        for (int i = v1; i < v2
+ 1; ++i)
                                                        {

my_field[i][ih1] = 'X';
                                                        }
                                                        ++amount;
                                                   std::cout << "Successfully
created ship\n";
                                                }
                                        }
                                }
                        }
                        else if (number == 2)
                        {
                                std::cout << "Random generations of ships will be
displayed, if you choose input 1, else 2 - then another arrangement will be
displayed\n";
                                 int indicator;
                                do
                                {
                                        flood(my_field);
                                        random(my_field);
                                        print(my_field);
                                        /*for (int i = 1; i < 11; ++i)
                                        {
                                                for (int j = 1; j < 11; ++j)
                                                {
                                                        std::cout << my_field[i][j];
                                                }
                                                std::cout << "\n";
                                        }*/
                                        do
```

```
					{
						std::cin >> indicator;
						if ((indicator < 1) || (indicator >
2))
						{
							std::cout << "Indicator must
be 1 or 2\n";
						}
					}
					while ((indicator < 1) || (indicator > 2));
				}
				while (indicator != 1);
			}
			send_message("Begin " + std::to_string(getpid()),
socket);
			recieve_message(socket);
			std::cout << "Input move\n";
			continue;
		}
		else if (command == "Get")
		{
			send_message("Get " + std::to_string(getpid()), socket);
			recieve_message(socket);
		}
		if (command == "Exit")
		{
			send_message("Exit " + std::to_string(getpid()), socket);
			std::string reply = recieve_message(socket);
			std::cout << reply;
			std::cout << "Input move\n";
			return 0;
		}
		if (command == "Statistics")
		{
			send_message("Statistics " + std::to_string(getpid()),
socket);
			std::string reply = recieve_message(socket);
			std::cout << "You have " + reply.substr(0, reply.find("
")) + " wons and " + reply.substr(reply.find(" ") + 1) + " loses\n";
			std::cout << "Input move\n";
			continue;
		}
		if (command == "My")
		{
			std::cout << "Here is your field\n";
			print(my_field);
			std::cout << "Input move\n";
			continue;
		}
		if (command == "Amount")
		{
			send_message("Amount " + std::to_string(getpid()),
socket);
			recieve_message(socket);
			continue;
		}
		if (command == "Server")
		{
			std::cout << "Here is server's field\n";
			print(server_field);
			std::cout << "Input move\n";
			continue;
		}
		if (command == "Turns")
		{
			send_message("Turns " + std::to_string(getpid()),
socket);
			recieve_message(socket);
		}
		if (command == "Try")
		{
			if (!playing)
			{
				std::cout << "You aren't playing at the moment.
Start a new game\n";
				continue;
			}
			else
			{
				int v;
				char h;
				while (true)
				{
					std::cin >> h >> v;
					if (!((h >= 'A') && (h <= 'J')))
					{
						std::cout << "Letters must be not
less than A and not greater than J\n";
						continue;
					}
					else if ((v < 1) || (v > 10))
					{
						std::cout << "Numbers must be
greater than 0 and less than 11\n";
						continue;
					}
```

```
                                        break;
                                }
                                send_message("Try" + std::to_string(int(h) -
int('A')) + std::to_string(v - 1) + " " + std::to_string(getpid()), socket);
                                std::string reply = recieve_message(socket);
                                std::cout << "Reply: " << reply << "\n";
                                if ((reply == "Killed") || (reply == "Wounded"))
                                {
                                        server_field[v][int(h) - int('A') + 1] =
'K';
                                        if (reply == "Killed")
                                        {
                                                std::cout << "You killed one of the
server's ships\n";
                                        }
                                        else
                                        {
                                                std::cout << "You wounded one of
the server's ships\n";
                                        }
                                        std::cout << "Input move\n";
                                        continue;
                                }
                                if (reply == "Another")
                                {
                                        std::cout << "You have already entered
these coordinates. Input something new\n";
                                        continue;
                                }
                                if (reply == "Won")
                                {
                                        std::cout << "You won this game!\n";
                                        playing = false;
                                        continue;
                                }
                                if (reply == "Missed")
                                {
                                        server_field[v][int(h) - int('A') + 1] =
'w';
                                        send_message("Do " +
std::to_string(getpid()), socket);
                                        while (true)
                                          {
                                                reply = recieve_message(socket);
                                                 if (reply.substr(0, 3) == "Try")
                                                     {
```

```
                                                  std::cout << "Server's turn: 
" << char(int(reply[4] - int('0') + 'A')) << " " << int(reply[3]) - int('0') + 
1 << "\n";
                                                        //reply = 
std::to_string(int(reply[4]) - int('0')) + " " + reply[3];
                                                }
                                           else
                                           {
                                                  std::cout << "Server's 
reply: " << reply << "\n";
                                           }
                                           if ((reply == "Lost") || (reply == 
"Do"))

                                           {
                                                  break;
                                           }
                                           int hor = int(reply[4]) - int('0') 
+ 1, ver = int(reply[3]) - int('0') + 1;
                                           if (my_field[ver][hor] == 'X')
                                           {
                                                  reply = "Killed";
                                                  int v = ver, h = hor;
                                                  my_field[v][h] = 'K';
                                                  for (int i = -1; i < 2; i++)
                                                  {
                                                         for (int j = -1; j < 
2; ++j)

                                                         {
                                                                if 
(my_field[v + i][h + j] == '.')

                                                                {


       my_field[v + i][h + j] = 'w';


                                                                }
                                                         }
                                                  }
                                                  while ((v > 1) && 
(my_field[v][h] == 'K'))

                                                  {
                                                         --v;
                                                  }
                                                  if (my_field[v][h] == 'X')
                                                  {
                                                         reply = "Wounded";
                                                  }
                                                  if (reply == "Killed")
                                                  {
                                                         v = ver; h = hor;
```

```
                                                          while ((v < 10) &&
(my_field[v][h] == 'K'))
                                                          {
                                                                 ++v;
                                                          }
                                                          if (my_field[v][h] ==
'X')
                                                          {
                                                                 reply =
"Wounded";
                                                          }
                                                          if (reply ==
"Killed")
                                                          {
                                                                 v = ver; h =
hor;
                                                                 while ((h >
1) && (my_field[v][h] == 'K'))
                                                                 {
                                                                        --h;
                                                                 }
                                                                 if
(my_field[v][h] == 'X')
                                                                 {
                                                                        reply
= "Wounded";
                                                                 }
                                                                 if (reply ==
"Killed")
                                                                 {
                                                                        v =
ver; h = hor;
                                                                        while
((h < 10) && (my_field[v][h] == 'K'))
                                                                        {

       ++h;
                                                                        }
                                                                        if
(my_field[v][h] == 'X')
                                                                        {

       reply = "Wounded";
                                                                        }
                                                                 }
                                                          }
                                                   }
                                            }
```

```
                                                else
                                                {
                                                        reply = "Missed";
                                                        my_field[ver][hor] = 'w';
                                                }
                                                std::cout << "Our reply is " <<
reply << "\n";
                                                send_message(reply + " " +
std::to_string(getpid()), socket);
                                        }
                                        if (reply == "Lost")
                                        {
                                                std::cout << "You lost this
game\n";
                                                playing = false;
                                                continue;
                                        }
                                }
                        }
                }
        }
         return 0;
}
```

Демонстрация работы программы

Её не будет, так как игра долгая.

Минусы: я попытался реализовать интеллектуальную систему, где если сервер ранит корабль, то старается его добить следующими ходами. Из-за этого программа иногда зацикливается, возможно это происходит с кораблями, соприкасающимися с границей, однако точного объяснения у меня нет.

Выводы

Данный курсовой проект оказался довольно интересным. Я закрепил свои знания по zeromq, однако программа писалась хоть и на скорую руку, но в процессе довольно долго, поэтому получилась недоделка.