МИНОБРНАУКИ РОССИИ
САНКТ-ПЕТЕРБУРГСКИЙ ГОСУДАРСТВЕННЫЙ
ЭЛЕКТРОТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ
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Кафедра МОЭВМ

ОТЧЕТ

по лабораторной работе №1

по дисциплине «Параллельные алгоритмы»

ТЕМА: ИСПОЛЬЗОВАНИЕ ФУНКЦИЙ ОБМЕНА ДАННЫМИ «ТОЧКА-ТОЧКА» В БИБЛИОТЕКЕ MPI.

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Цель

Ознакомиться с функциями библиотеки MPI класса точка-точка. Написать программу с их использованием, избегая применения джокеров.

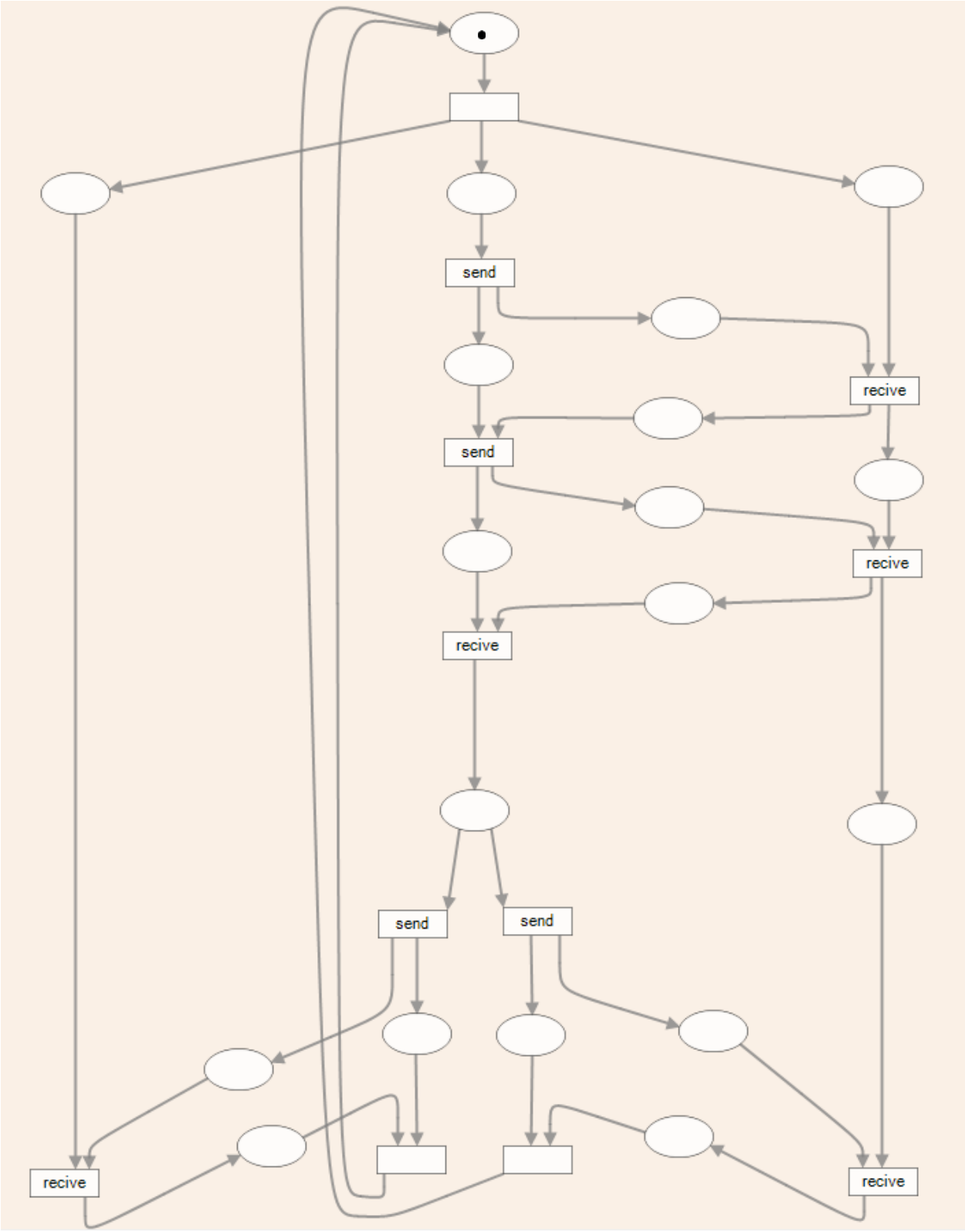
Постановка задачи (вариант 10)

Морской бой. Несколько процессов поочередно обмениваются сообщениями согласно правилам игры в морской бой. (правила игры с числом игроков больше двух – устанавливаются самостоятельно)

Выполнение работы

Программа создает несколько процессов, считывает ранг каждого и общее количество процессов. Запускает основной цикл игры, если количество процессов больше или рано 2. Размещает корабли на игровом поле. Далее генерируются псевдослучайные координаты и отправляются на следующий процесс (по кругу). После принятия координат, процесс проверяет на попадание по кораблю (вывод соответствующего сообщения). Далее проверяется условие выхода из игры: все корабли на карте должны быть уничтожены. Если условие выполнено, то процесс выставляет активный флаг завершения и отправляет его другим процессам. После завершения основного цикла завершается параллельная часть программы, освобождаются ресурсы.

Сеть Петри основной части алгоритма для трех процессов:



Листинг программы:

```
#include <stdio.h>
#include <stdlib.h>
#include <mpi.h>
#include <time.h>
```

```
#define FIELD_SIZE 10
#define EMPTY_CELL 1
#define SHIP_CELL 2
#define MISS_CELL 3
#define HIT_CELL 4
#define GAME_END 5
#define HIT_TARGET 6
#define MISS_TARGET 7

void place_ships(int board[FIELD_SIZE][FIELD_SIZE]) {
    for (int i = 0; i < FIELD_SIZE; ++i) {
        int x = rand() % FIELD_SIZE;
        int y = rand() % FIELD_SIZE;
        board[y][x] = SHIP_CELL;
    }
}

int check_end(int board[FIELD_SIZE][FIELD_SIZE], int rank) {
    for (int i = 0; i < FIELD_SIZE; ++i) {
        for (int j = 0; j < FIELD_SIZE; ++j) {
            if (board[i][j] == SHIP_CELL) {
                return 0;
            }
        }
    }
    printf("Игрок %d выбыл!", rank);
    return 1;
}

void play_game_2(int rank, int size) {
    int board[FIELD_SIZE][FIELD_SIZE];
    place_ships(board);
    int end = 0;

    int target_send_x, target_send_y;
    int target_recv_x, target_recv_y;
    // int next_proc_end;
    int hit_target = 0;
    int result;

    while (1) {
         target_send_x = rand() %FIELD_SIZE;
         target_send_y = rand() %FIELD_SIZE;

         MPI_Send(&target_send_x, 1, MPI_INT, (rank + 1) % size, 0,
MPI_COMM_WORLD);
         MPI_Send(&target_send_y, 1, MPI_INT, (rank + 1) % size, 1,
MPI_COMM_WORLD);
        printf("target:%d %d (from %d to %d)\n",target_send_x,
target_send_y, rank, (rank - 1 + size) % size);

         MPI_Recv(&target_recv_x, 1, MPI_INT, (rank - 1 + size) %
size, 0, MPI_COMM_WORLD, MPI_STATUS_IGNORE);
         MPI_Recv(&target_recv_y, 1, MPI_INT, (rank - 1 + size) %
size, 1, MPI_COMM_WORLD, MPI_STATUS_IGNORE);

         if (board[target_recv_x][target_recv_y] == SHIP_CELL) {
```

```
          hit_target = HIT_TARGET;
          board[target_recv_x][target_recv_y] = HIT_CELL;
         }
        else if(board[target_recv_x][target_recv_y] != SHIP_CELL){
          board[target_recv_x][target_recv_y] = MISS_CELL;
           hit_target = MISS_TARGET;
         }


         if (end != GAME_END)
          MPI_Send(&hit_target, 1, MPI_INT, (rank - 1 + size) % size,
2, MPI_COMM_WORLD);

         else {
             MPI_Send(&end, 1, MPI_INT, (rank - 1 + size) % size, 2,
MPI_COMM_WORLD);
           break;
        }


        MPI_Recv(&result, 1, MPI_INT, (rank + 1) % size, 2,
MPI_COMM_WORLD, MPI_STATUS_IGNORE);

        if(result==HIT_TARGET){
           printf("Hit in proc %d from proc %d!\n", rank, (rank +
1) % size);
        }
        else if (result==MISS_TARGET){
           printf("Miss in proc %d from proc %d!\n", rank, (rank +
1) % size);
        }

         if (check_end(board, rank) || result == GAME_END) {
          end = GAME_END;
           break;
        }
    }
}

int main(int argc,  char *argv[]) {
    int rank, recv, size;
    MPI_Status status;

    MPI_Init(&argc, &argv);
    MPI_Comm_rank(MPI_COMM_WORLD, &rank);
    MPI_Comm_size(MPI_COMM_WORLD, &size);

    if(size < 2){
        printf("to few processes");
    }
    else if(size>=2){
        play_game_2(rank, size);
    }

    MPI_Finalize();
    return 0;
}
```

Полученный вывод при запуске на 2-ух процессах:

```
target:1 8 (from 0 to 1)
Miss in proc 0 from proc 1!
target:7 9 (from 0 to 1)
Miss in proc 0 from proc 1!
target:2 0 (from 0 to 1)
Miss in proc 0 from proc 1!
target:2 3 (from 0 to 1)
Miss in proc 0 from proc 1!
target:7 5 (from 0 to 1)
Miss in proc 0 from proc 1!
target:9 2 (from 0 to 1)
Miss in proc 0 from proc 1!
target:2 8 (from 0 to 1)
target:1 8 (from 1 to 0)
Miss in proc 1 from proc 0!
target:7 9 (from 1 to 0)
Miss in proc 1 from proc 0!
target:2 0 (from 1 to 0)
Miss in proc 1 from proc 0!
target:2 3 (from 1 to 0)
Miss in proc 1 from proc 0!
target:7 5 (from 1 to 0)
Miss in proc 1 from proc 0!
target:9 2 (from 1 to 0)
Miss in proc 1 from proc 0!
target:2 8 (from 1 to 0)
Miss in proc 1 from proc 0!
target:9 7 (from 1 to 0)
Miss in proc 1 from proc 0!
target:3 6 (from 1 to 0)
Miss in proc 1 from proc 0!
target:1 2 (from 1 to 0)
Miss in proc 1 from proc 0!
target:9 3 (from 1 to 0)
Miss in proc 1 from proc 0!
target:1 9 (from 1 to 0)
Hit in proc 1 from proc 0!
target:4 7 (from 1 to 0)
Miss in proc 0 from proc 1!
target:9 7 (from 0 to 1)
Miss in proc 0 from proc 1!
target:3 6 (from 0 to 1)
Miss in proc 0 from proc 1!
target:1 2 (from 0 to 1)
Miss in proc 0 from proc 1!
target:9 3 (from 0 to 1)
Miss in proc 0 from proc 1!
target:1 9 (from 0 to 1)
Hit in proc 0 from proc 1!
target:4 7 (from 0 to 1)
Miss in proc 0 from proc 1!
target:8 4 (from 0 to 1)
Miss in proc 1 from proc 0!
target:8 4 (from 1 to 0)
Miss in proc 0 from proc 1!
target:5 0 (from 0 to 1)
Miss in proc 1 from proc 0!
target:5 0 (from 1 to 0)
Miss in proc 0 from proc 1!
target:3 6 (from 0 to 1)
Miss in proc 1 from proc 0!
target:3 6 (from 1 to 0)
Miss in proc 0 from proc 1!
target:1 0 (from 0 to 1)
Miss in proc 1 from proc 0!
target:1 0 (from 1 to 0)
Miss in proc 0 from proc 1!
target:6 3 (from 0 to 1)
Miss in proc 1 from proc 0!
target:6 3 (from 1 to 0)
Hit in proc 1 from proc 0!
target:2 0 (from 1 to 0)
Hit in proc 0 from proc 1!
target:2 0 (from 0 to 1)
Miss in proc 0 from proc 1!
target:6 1 (from 0 to 1)
Miss in proc 1 from proc 0!
target:6 1 (from 1 to 0)
Miss in proc 0 from proc 1!
Miss in proc 1 from proc 0!
target:5 5 (from 0 to 1)
target:5 5 (from 1 to 0)
Miss in proc 0 from proc 1!
target:4 7 (from 0 to 1)
Miss in proc 0 from proc 1!
target:6 5 (from 0 to 1)
Miss in proc 0 from proc 1!
target:6 9 (from 0 to 1)
Miss in proc 0 from proc 1!
target:3 7 (from 0 to 1)
Miss in proc 0 from proc 1!
target:4 5 (from 0 to 1)
Miss in proc 1 from proc 0!
target:4 7 (from 1 to 0)
Miss in proc 1 from proc 0!
target:6 5 (from 1 to 0)
Miss in proc 1 from proc 0!
target:6 9 (from 1 to 0)
Miss in proc 1 from proc 0!
target:3 7 (from 1 to 0)
Miss in proc 1 from proc 0!
target:4 5 (from 1 to 0)
Miss in proc 1 from proc 0!
target:2 5 (from 1 to 0)
Miss in proc 1 from proc 0!
target:4 7 (from 1 to 0)
Miss in proc 0 from proc 1!
target:2 5 (from 0 to 1)
Miss in proc 0 from proc 1!
target:4 7 (from 0 to 1)
Miss in proc 0 from proc 1!
target:4 4 (from 0 to 1)
Miss in proc 0 from proc 1!
target:3 0 (from 0 to 1)
Miss in proc 1 from proc 0!
target:4 4 (from 1 to 0)
Miss in proc 1 from proc 0!
target:3 0 (from 1 to 0)
Miss in proc 1 from proc 0!
Miss in proc 0 from proc 1!
target:7 8 (from 0 to 1)
Miss in proc 0 from proc 1!
target:6 8 (from 0 to 1)
target:7 8 (from 1 to 0)
Miss in proc 1 from proc 0!
target:6 8 (from 1 to 0)
Miss in proc 0 from proc 1!
target:8 4 (from 0 to 1)
Miss in proc 0 from proc 1!
target:8 4 (from 1 to 0)
Miss in proc 1 from proc 0!
target:3 1 (from 1 to 0)
target:3 1 (from 0 to 1)
Miss in proc 0 from proc 1!
target:4 9 (from 0 to 1)
Miss in proc 1 from proc 0!
target:4 9 (from 1 to 0)
Miss in proc 0 from proc 1!
target:2 8 (from 1 to 0)
Miss in proc 0 from proc 1!
target:9 7 (from 1 to 0)
Miss in proc 0 from proc 1!
target:3 6 (from 1 to 0)
Miss in proc 0 from proc 1!
target:1 2 (from 1 to 0)
Miss in proc 0 from proc 1!
target:9 3 (from 1 to 0)
Miss in proc 0 from proc 1!
target:1 9 (from 1 to 0)
Hit in proc 0 from proc 1!
target:4 7 (from 1 to 0)
Miss in proc 1 from proc 0!
target:9 7 (from 0 to 1)
Miss in proc 1 from proc 0!
target:3 6 (from 0 to 1)
Miss in proc 1 from proc 0!
target:1 2 (from 0 to 1)
Miss in proc 1 from proc 0!
target:9 3 (from 0 to 1)
Miss in proc 1 from proc 0!
target:1 9 (from 0 to 1)
Hit in proc 1 from proc 0!
target:4 7 (from 0 to 1)
Miss in proc 1 from proc 0!
target:8 4 (from 0 to 1)
Miss in proc 0 from proc 1!
target:8 4 (from 1 to 0)
Miss in proc 1 from proc 0!
target:5 0 (from 0 to 1)
Miss in proc 0 from proc 1!
target:5 0 (from 1 to 0)
Miss in proc 1 from proc 0!
target:3 6 (from 0 to 1)
Miss in proc 0 from proc 1!
target:3 6 (from 1 to 0)
Miss in proc 1 from proc 0!
target:1 0 (from 0 to 1)
Miss in proc 0 from proc 1!
target:1 0 (from 1 to 0)
Miss in proc 1 from proc 0!
target:6 3 (from 0 to 1)
Miss in proc 0 from proc 1!
target:6 3 (from 1 to 0)
Hit in proc 1 from proc 0!
target:2 0 (from 1 to 0)
Hit in proc 0 from proc 1!
target:2 0 (from 0 to 1)
Miss in proc 0 from proc 1!
target:6 1 (from 0 to 1)
Miss in proc 1 from proc 0!
target:6 1 (from 1 to 0)
Miss in proc 0 from proc 1!
Miss in proc 1 from proc 0!
target:5 5 (from 0 to 1)
target:5 5 (from 1 to 0)
Miss in proc 0 from proc 1!
target:4 7 (from 0 to 1)
Miss in proc 0 from proc 1!
target:6 5 (from 0 to 1)
Miss in proc 0 from proc 1!
target:6 9 (from 0 to 1)
Miss in proc 0 from proc 1!
target:3 7 (from 0 to 1)
Miss in proc 0 from proc 1!
target:4 5 (from 0 to 1)
Miss in proc 1 from proc 0!
target:4 7 (from 1 to 0)
Miss in proc 1 from proc 0!
target:6 5 (from 1 to 0)
Miss in proc 1 from proc 0!
target:6 9 (from 1 to 0)
Miss in proc 1 from proc 0!
target:3 7 (from 1 to 0)
Miss in proc 1 from proc 0!
target:4 5 (from 1 to 0)
Miss in proc 1 from proc 0!
target:2 5 (from 1 to 0)
Miss in proc 1 from proc 0!
target:4 7 (from 1 to 0)
Miss in proc 0 from proc 1!
target:2 5 (from 0 to 1)
Miss in proc 0 from proc 1!
target:4 7 (from 0 to 1)
Miss in proc 0 from proc 1!
target:4 4 (from 0 to 1)
Miss in proc 0 from proc 1!
target:3 0 (from 0 to 1)
Miss in proc 1 from proc 0!
target:4 4 (from 1 to 0)
Miss in proc 1 from proc 0!
target:3 0 (from 1 to 0)
Miss in proc 1 from proc 0!
Miss in proc 0 from proc 1!
target:7 8 (from 0 to 1)
Miss in proc 0 from proc 1!
target:6 8 (from 0 to 1)
target:7 8 (from 1 to 0)
Miss in proc 1 from proc 0!
target:6 8 (from 1 to 0)
Miss in proc 0 from proc 1!
target:8 4 (from 0 to 1)
Miss in proc 0 from proc 1!
target:8 4 (from 1 to 0)
Miss in proc 1 from proc 0!
target:3 1 (from 1 to 0)
target:3 1 (from 0 to 1)
Miss in proc 0 from proc 1!
target:4 9 (from 0 to 1)
Miss in proc 1 from proc 0!
target:4 9 (from 1 to 0)
Miss in proc 0 from proc 1!
target:4 8 (from 0 to 1)
Miss in proc 1 from proc 0!
target:4 8 (from 1 to 0)
Miss in proc 1 from proc 0!
Miss in proc 0 from proc 1!
target:7 1 (from 0 to 1)
target:7 1 (from 1 to 0)
Miss in proc 1 from proc 0!
target:7 2 (from 1 to 0)
Miss in proc 0 from proc 1!
target:7 2 (from 0 to 1)
Hit in proc 0 from proc 1!
Hit in proc 1 from proc 0!
target:7 2 (from 1 to 0)
target:7 2 (from 0 to 1)
Miss in proc 0 from proc 1!
target:2 6 (from 0 to 1)
Miss in proc 1 from proc 0!
target:2 6 (from 1 to 0)
Hit in proc 1 from proc 0!
target:1 0 (from 1 to 0)
Hit in proc 0 from proc 1!
target:1 0 (from 0 to 1)
Miss in proc 0 from proc 1!
Miss in proc 1 from proc 0!
target:6 1 (from 1 to 0)
target:6 1 (from 0 to 1)
Miss in proc 0 from proc 1!
target:5 9 (from 0 to 1)
Miss in proc 1 from proc 0!
target:5 9 (from 1 to 0)
Miss in proc 1 from proc 0!
Miss in proc 0 from proc 1!
target:4 9 (from 0 to 1)
Miss in proc 0 from proc 1!
target:4 9 (from 1 to 0)
Miss in proc 1 from proc 0!
target:0 9 (from 1 to 0)
target:0 9 (from 0 to 1)
Miss in proc 0 from proc 1!
target:1 7 (from 0 to 1)
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Miss in proc 1 from proc 0!
target:1 7 (from 1 to 0)
Miss in proc 1 from proc 0!
Miss in proc 0 from proc 1!
target:7 1 (from 0 to 1)
Miss in proc 0 from proc 1!
target:7 1 (from 1 to 0)
Miss in proc 1 from proc 0!
target:1 5 (from 1 to 0)
target:1 5 (from 0 to 1)
Miss in proc 0 from proc 1!
Miss in proc 1 from proc 0!
target:9 7 (from 1 to 0)
target:9 7 (from 0 to 1)
Miss in proc 0 from proc 1!
target:7 6 (from 0 to 1)
Miss in proc 1 from proc 0!
target:7 6 (from 1 to 0)
Hit in proc 1 from proc 0!
Miss in proc 0 from proc 1!
target:7 3 (from 0 to 1)
target:7 3 (from 1 to 0)
Miss in proc 1 from proc 0!
target:6 5 (from 1 to 0)
Miss in proc 0 from proc 1!
target:6 5 (from 0 to 1)
Miss in proc 0 from proc 1!
target:6 3 (from 0 to 1)
Miss in proc 1 from proc 0!
target:6 3 (from 1 to 0)
Miss in proc 1 from proc 0!
target:9 4 (from 1 to 0)
Miss in proc 0 from proc 1!
target:9 4 (from 0 to 1)
Miss in proc 0 from proc 1!
Miss in proc 1 from proc 0!
target:8 1 (from 1 to 0)
target:8 1 (from 0 to 1)
Miss in proc 0 from proc 1!
target:2 9 (from 0 to 1)
Miss in proc 1 from proc 0!
target:2 9 (from 1 to 0)
Miss in proc 1 from proc 0!
Miss in proc 0 from proc 1!
target:3 9 (from 0 to 1)
Miss in proc 0 from proc 1!
target:3 9 (from 1 to 0)
Miss in proc 1 from proc 0!
target:0 8 (from 1 to 0)
target:0 8 (from 0 to 1)
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target:8 5 (from 0 to 1)
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target:8 5 (from 1 to 0)
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target:0 9 (from 1 to 0)
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target:0 9 (from 0 to 1)
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target:6 3 (from 0 to 1)
Miss in proc 1 from proc 0!
target:6 3 (from 1 to 0)
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target:8 5 (from 0 to 1)
Miss in proc 1 from proc 0!
target:8 5 (from 1 to 0)
Miss in proc 1 from proc 0!
Miss in proc 0 from proc 1!
target:6 1 (from 0 to 1)
Miss in proc 0 from proc 1!
target:6 1 (from 1 to 0)
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target:1 5 (from 1 to 0)
target:1 5 (from 0 to 1)
Miss in proc 0 from proc 1!
target:9 8 (from 0 to 1)
Miss in proc 1 from proc 0!
target:9 8 (from 1 to 0)
Miss in proc 1 from proc 0!
Miss in proc 0 from proc 1!
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target:4 8 (from 1 to 0)
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target:3 0 (from 0 to 1)
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target:3 0 (from 1 to 0)
Miss in proc 1 from proc 0!
Miss in proc 0 from proc 1!
target:4 4 (from 0 to 1)
Miss in proc 0 from proc 1!
target:4 4 (from 0 to 1)
Miss in proc 0 from proc 1!
target:7 6 (from 0 to 1)
target:4 4 (from 1 to 0)
Miss in proc 1 from proc 0!
target:4 4 (from 1 to 0)
Miss in proc 1 from proc 0!
target:7 6 (from 1 to 0)
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target:3 1 (from 1 to 0)
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target:7 5 (from 1 to 0)
Miss in proc 1 from proc 0!
target:9 6 (from 1 to 0)
target:7 5 (from 0 to 1)
Miss in proc 0 from proc 1!
target:9 6 (from 0 to 1)
Miss in proc 0 from proc 1!
target:2 1 (from 0 to 1)
Miss in proc 1 from proc 0!
target:2 1 (from 1 to 0)
Miss in proc 1 from proc 0!
target:7 8 (from 1 to 0)
Miss in proc 0 from proc 1!
target:7 8 (from 0 to 1)
Miss in proc 0 from proc 1!
target:5 7 (from 0 to 1)
Miss in proc 1 from proc 0!
target:5 7 (from 1 to 0)
Hit in proc 1 from proc 0!
target:4 1 (from 1 to 0)
Hit in proc 0 from proc 1!
target:4 1 (from 0 to 1)
Miss in proc 0 from proc 1!
target:8 5 (from 0 to 1)
Miss in proc 1 from proc 0!
target:8 5 (from 1 to 0)
Miss in proc 1 from proc 0!
Miss in proc 0 from proc 1!
target:9 7 (from 0 to 1)
Miss in proc 0 from proc 1!
target:5 3 (from 0 to 1)
Miss in proc 1 from proc 0!
target:9 7 (from 1 to 0)
Miss in proc 1 from proc 0!
target:5 3 (from 1 to 0)
Hit in proc 0 from proc 1!
target:8 8 (from 0 to 1)
Hit in proc 1 from proc 0!
target:8 8 (from 1 to 0)
Miss in proc 1 from proc 0!
target:3 1 (from 1 to 0)
Miss in proc 0 from proc 1!
target:3 1 (from 0 to 1)
Miss in proc 0 from proc 1!
target:8 9 (from 0 to 1)
Miss in proc 1 from proc 0!
target:8 9 (from 1 to 0)
Miss in proc 1 from proc 0!
target:6 4 (from 1 to 0)
Miss in proc 0 from proc 1!
target:6 4 (from 0 to 1)
Miss in proc 0 from proc 1!
target:3 3 (from 0 to 1)
Miss in proc 0 from proc 1!
Miss in proc 1 from proc 0!
target:3 3 (from 1 to 0)
Miss in proc 1 from proc 0!
target:3 8 (from 1 to 0)
target:3 8 (from 0 to 1)
Miss in proc 0 from proc 1!
target:6 0 (from 0 to 1)
Hit in proc 0 from proc 1!
target:4 8 (from 0 to 1)
Miss in proc 1 from proc 0!
target:6 0 (from 1 to 0)
Hit in proc 1 from proc 0!
target:4 8 (from 1 to 0)
Miss in proc 1 from proc 0!
target:8 8 (from 1 to 0)
Miss in proc 0 from proc 1!
target:8 8 (from 0 to 1)
Miss in proc 0 from proc 1!
target:9 7 (from 0 to 1)
Miss in proc 1 from proc 0!
target:9 7 (from 1 to 0)
Miss in proc 1 from proc 0!
target:7 6 (from 1 to 0)
Miss in proc 0 from proc 1!
target:7 6 (from 0 to 1)
Miss in proc 0 from proc 1!
target:4 3 (from 0 to 1)
Miss in proc 0 from proc 1!
target:0 3 (from 0 to 1)
Miss in proc 1 from proc 0!
target:4 3 (from 1 to 0)
Miss in proc 1 from proc 0!
target:0 3 (from 1 to 0)
Miss in proc 1 from proc 0!
target:0 9 (from 1 to 0)
Miss in proc 0 from proc 1!
target:0 9 (from 0 to 1)
Miss in proc 0 from proc 1!
target:2 5 (from 0 to 1)
Miss in proc 0 from proc 1!
Miss in proc 1 from proc 0!
target:2 5 (from 1 to 0)
Miss in proc 1 from proc 0!
target:4 0 (from 1 to 0)
Miss in proc 1 from proc 0!
target:4 0 (from 0 to 1)
Miss in proc 0 from proc 1!
target:5 9 (from 0 to 1)
Miss in proc 0 from proc 1!
target:5 9 (from 1 to 0)
Miss in proc 1 from proc 0!
target:4 6 (from 1 to 0)
```

```
target:4 6 (from 0 to 1)
Miss in proc 0 from proc 1!
target:9 2 (from 0 to 1)
Miss in proc 1 from proc 0!
target:9 2 (from 1 to 0)
Miss in proc 1 from proc 0!
target:2 4 (from 1 to 0)
Miss in proc 0 from proc 1!
target:2 4 (from 0 to 1)
Miss in proc 0 from proc 1!
Miss in proc 1 from proc 0!
target:7 7 (from 1 to 0)
target:7 7 (from 0 to 1)
Miss in proc 0 from proc 1!
target:5 4 (from 0 to 1)
Miss in proc 1 from proc 0!
target:5 4 (from 1 to 0)
Miss in proc 1 from proc 0!
target:8 1 (from 1 to 0)
Miss in proc 0 from proc 1!
target:8 1 (from 0 to 1)
Miss in proc 0 from proc 1!
target:2 8 (from 0 to 1)
Miss in proc 1 from proc 0!
target:2 8 (from 1 to 0)
Miss in proc 1 from proc 0!
target:9 3 (from 1 to 0)
Miss in proc 0 from proc 1!
target:9 3 (from 0 to 1)
Miss in proc 0 from proc 1!
target:6 8 (from 0 to 1)
Miss in proc 1 from proc 0!
target:6 8 (from 1 to 0)
Miss in proc 1 from proc 0!
Miss in proc 0 from proc 1!
target:0 2 (from 0 to 1)
target:0 2 (from 1 to 0)
Miss in proc 0 from proc 1!
target:1 0 (from 0 to 1)
Miss in proc 1 from proc 0!
target:1 0 (from 1 to 0)
Miss in proc 0 from proc 1!
target:5 1 (from 0 to 1)
Miss in proc 1 from proc 0!
target:5 1 (from 1 to 0)
Miss in proc 0 from proc 1!
target:1 0 (from 0 to 1)
Miss in proc 1 from proc 0!
target:1 0 (from 1 to 0)
Miss in proc 0 from proc 1!
target:8 5 (from 0 to 1)
Miss in proc 1 from proc 0!
target:8 5 (from 1 to 0)
Miss in proc 0 from proc 1!
target:0 6 (from 0 to 1)
Miss in proc 0 from proc 1!
Miss in proc 1 from proc 0!
target:0 6 (from 1 to 0)
Miss in proc 1 from proc 0!
target:4 6 (from 1 to 0)
target:4 6 (from 0 to 1)
Miss in proc 0 from proc 1!
Miss in proc 1 from proc 0!
target:2 5 (from 1 to 0)
Miss in proc 1 from proc 0!
target:2 5 (from 0 to 1)
Miss in proc 0 from proc 1!
target:8 6 (from 0 to 1)
Miss in proc 0 from proc 1!
target:8 6 (from 1 to 0)
Miss in proc 1 from proc 0!
target:2 8 (from 0 to 1)
target:2 8 (from 1 to 0)
Miss in proc 1 from proc 0!
Miss in proc 0 from proc 1!
target:4 7 (from 0 to 1)
Miss in proc 0 from proc 1!
target:4 7 (from 1 to 0)
Miss in proc 1 from proc 0!
target:2 4 (from 0 to 1)
target:2 4 (from 1 to 0)
Miss in proc 1 from proc 0!
Miss in proc 0 from proc 1!
target:0 6 (from 0 to 1)
Miss in proc 0 from proc 1!
target:0 6 (from 1 to 0)
Miss in proc 1 from proc 0!
target:2 9 (from 1 to 0)
Miss in proc 1 from proc 0!
target:9 0 (from 1 to 0)
Hit in proc 1 from proc 0!
target:8 1 (from 1 to 0)
Miss in proc 1 from proc 0!
target:3 1 (from 1 to 0)
Miss in proc 1 from proc 0!
target:1 0 (from 1 to 0)
Miss in proc 1 from proc 0!
target:3 4 (from 1 to 0)
Miss in proc 1 from proc 0!
target:0 3 (from 1 to 0)
Miss in proc 1 from proc 0!
target:9 1 (from 1 to 0)
Miss in proc 1 from proc 0!
target:9 6 (from 1 to 0)
Miss in proc 1 from proc 0!
target:9 3 (from 1 to 0)
Miss in proc 1 from proc 0!
target:3 8 (from 1 to 0)
Miss in proc 1 from proc 0!
target:0 5 (from 1 to 0)
Miss in proc 1 from proc 0!
target:6 6 (from 1 to 0)
Miss in proc 1 from proc 0!
target:4 0 (from 1 to 0)
Miss in proc 1 from proc 0!
target:0 4 (from 1 to 0)
Miss in proc 1 from proc 0!
target:6 2 (from 1 to 0)
Hit in proc 1 from proc 0!
Игрок 1 выбыл!target:2 9
(from 0 to 1)
Miss in proc 0 from proc 1!
target:9 0 (from 0 to 1)
Hit in proc 0 from proc 1!
target:8 1 (from 0 to 1)
Miss in proc 0 from proc 1!
target:3 1 (from 0 to 1)
Miss in proc 0 from proc 1!
target:1 0 (from 0 to 1)
Miss in proc 0 from proc 1!
target:3 4 (from 0 to 1)
Miss in proc 0 from proc 1!
target:0 3 (from 0 to 1)
Miss in proc 0 from proc 1!
target:9 1 (from 0 to 1)
Miss in proc 0 from proc 1!
target:9 6 (from 0 to 1)
Miss in proc 0 from proc 1!
target:9 3 (from 0 to 1)
Miss in proc 0 from proc 1!
target:3 8 (from 0 to 1)
Miss in proc 0 from proc 1!
target:0 5 (from 0 to 1)
Miss in proc 0 from proc 1!
target:6 6 (from 0 to 1)
Miss in proc 0 from proc 1!
target:4 0 (from 0 to 1)
Miss in proc 0 from proc 1!
target:0 4 (from 0 to 1)
Miss in proc 0 from proc 1!
target:6 2 (from 0 to 1)
Hit in proc 0 from proc 1!
Игрок 0 выбыл!
```

Количество процессов (шт)	Среднее затрачиваемое время (мс)
2	0,3115
4	0,4583
8	0,9082
12	1,1001
13	804,4069
14	1009,7896

15	1619,9837
16	2289,4688
24	5419,8323
32	4302,5810

Табл. 1 – Результаты работы программы на разном количестве процессов.

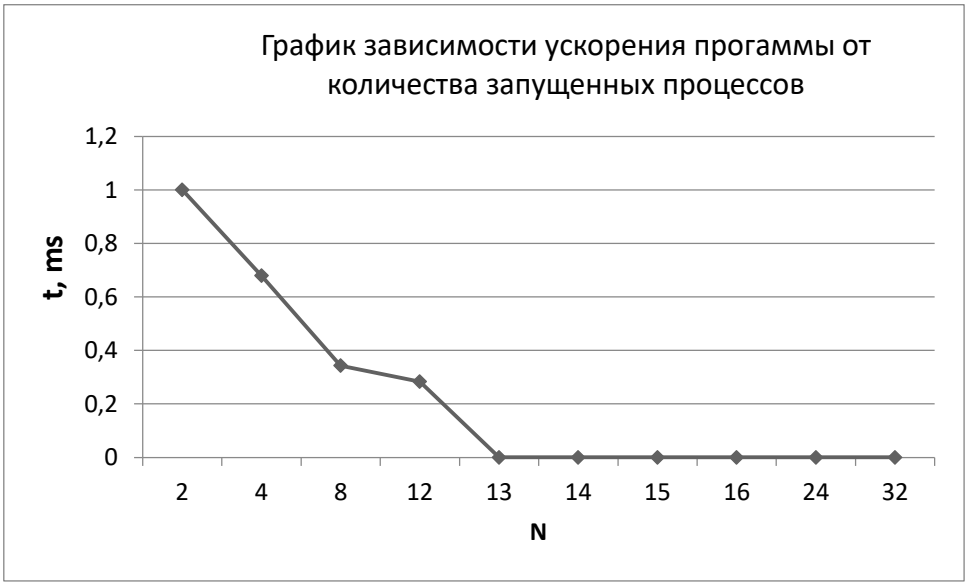
Расчеты ускорения программы выполним по формуле:

$$S_p(n) = T_2(n)/T_p(n)$$

Количество процессов P (шт)	Ускорение S_p
2	1
4	0,679686
8	0,342986
12	0,283156
13	0,000387
14	0,000308
15	0,000192

16	0,000136
24	5,75E-05
32	7,24E-05

Табл. 2 – Результаты расчетов ускорения программы.



Вывод

В ходе выполнения лабораторной работы были изучены основные функции класса точка-точка из библиотеки MPI, способы пересылки и принятия сообщений без использования джокеров. Также были улучшены навыки по построению сетей Петри.

Результатом работы является реализованный алгоритм автономной игры в морской бой, где процессы обмениваются псевдослучайными координатами.

Скорость выполнения программного кода сильно зависит от количества процессов, т.к. при увеличении числа игроков (процессов) увеличивается и количество ходов не более чем на 100 (размеры доски). Следовательно растет трафик пересылаемых сообщений. Таким образом,

время выполнения программы растет с увеличением числа процессов, а ускорение программы падает.

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