Отчёт по лабораторной работе №

по курсу «Языки и методы программирования».

Выполнил студент группы М8О-111Б-23: Воробьев Глеб Янович № по списку 5.

Контакты: koshastet13@gmail.com

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Преподаватель: каф. 806 Никулин Сергей Петрович

Входной контроль знаний с оценкой: _____

Отчет сдан «29» февраля 2024 г.

Итоговая оценка: _____

Подпись преподавателя: _____

1. **Тема:**
Абстрактные типы данных, рекурсия, модульное программирование на ЯП Си. Автоматизация сборки программ модульной структуры с использованием утилиты make.

2. Цель работы:
Применение различных сортировок к различным типам данных и обучение по работе с утилитой make.

3. Задание:
АТД - дек, процедура - поиск и удаление максимального и минимального элемента, метод - сортировка линейным выбором

4. Оборудование:
Процессор AMD Ryzen 5 7640HS.
ОП 16 ГБ.
SSD 512 ГБ.
Монитор 2560x1600~165Hz.

5. Программное обеспечение:
Операционная система семейства Unix.
Наименование Ubuntu версия 22.04.3.
Интерпретатор команд GNU bash версия 6.2.0.
Система программирования -.
Редактор текстов Visual Studio Code.

6. Идея, метод, алгоритм решения задачи:
Код реализует поиск максимального и минимального элемента в деке, который представлен как кольцевой буфер. Реализация дека представлена в файлах udt.c и udt.h. RemoveMin для удаления минимального элемента из дека и selectionSort для сортировки дека методом сортировки выбором.которая представлена в файле main.c
содержание main.c:

1. RemoveMin(deque *d): Начинается с сохранения первого элемента дека как текущего минимального. Проходит через все элементы дека, перемещая их с "головы" на "хвост" и сравнивая их с текущим минимальным значением. Если новый элемент меньше текущего минимального, обновляет минимальное значение и индекс минимального элемента. После прохода по всему деку, проходит по деку второй раз, удаляя минимальный элемент (не добавляя его обратно). Возвращает значение минимального элемента.
2. selectionSort(deque *d): Создает новый пустой дек, который будет использоваться для хранения отсортированных элементов. Пока исходный дек не пуст, вызывает RemoveMin для нахождения и удаления минимального элемента и добавляет этот элемент в конец нового отсортированного дека. После того как все элементы перемещены в отсортированный дек, перекладывает их обратно в исходный дек (этот шаг на самом деле не нужен, если мы хотим сохранить отсортированный дек). Возвращает новый отсортированный дек.
3. printDeque(deque *d): Функция печати элементов дека на экран. Выводит все элементы дека с начала до конца, учитывая кольцевую структуру дека и начальный индекс head.
4. main(): Главная функция, которая предоставляет пользователю меню для взаимодействия с деком. В меню есть опции для добавления элементов в голову или хвост дека, печати минимального и максимального элемента, удаления минимального и максимального элемента, проверки размера и пустоты дека, а также для печати всех элементов дека.

Для компиляции используется утилита make

7. Сценарий выполнения работы:

makefile

```
all:
	gcc main.c udt.c
```

udt.h

```
#ifndef _UDT_H_
#define _UDT_H_

#define POOL_SIZE 100

typedef struct {
	int head;
	int tail;
	int size;
	int data[POOL_SIZE];
} deque;

void PushHeadDeque(deque *d, int key);
void PushTailDeque(deque *d, int key);
void PopHeadDeque(deque *d);
void PopTailDeque(deque *d);
int TopHeadDeque(deque *d);
int TopTailDeque(deque *d);
void CreateDeque(deque *d);
void deleteDeque(deque *d);
int getSizeDeque(deque *d);
int isEmptyDeque(deque *d);

#endif
```

udt.c

```
#include <stdio.h>

#include "udt.h"

void CreateDeque(deque *d)
{
	d->head = 0;
	d->tail = 0;
	d->size = 0;
}

int isEmptyDeque(deque *d)
{
	return d->size == 0;
}
```

```c
int getSizeDeque(deque *d)
{
    return d->size;
}

void PushHeadDeque(deque *d, int key)
{
    if (d->size == POOL_SIZE) // Проверяем, не заполнен ли дек.
        return; // Если дек полон, мы не можем добавить новый элемент.

    // Если дек пуст, добавляем элемент в начало, не меняем индекс head.
    if (d->size == 0) {
        d->data[d->head] = key; // Вставляем элемент в текущую позицию
head, которая равна 0.
    } else {
        // Уменьшаем head на 1 с учетом кольцевой структуры.
        d->head = (d->head - 1 + POOL_SIZE) % POOL_SIZE;
        d->data[d->head] = key; // Вставляем элемент в позицию перед
текущим head.
    }
    d->size++; // Увеличиваем размер дека.
}


void PushTailDeque(deque *d, int key)
{
    if (d->size == POOL_SIZE) // Проверяем, не заполнен ли дек.
        return; // Если дек полон, мы не можем добавить новый элемент.

    // Вычисляем индекс для вставки элемента в конец дека.
    int index = (d->head + d->size) % POOL_SIZE;
    d->data[index] = key; // Вставляем элемент.
    d->size++; // Увеличиваем размер дека.
    d->tail = index; // Обновляем индекс tail.
}


void PopHeadDeque(deque *d)
{
    if (!d->size)
        return;
    d->head++;
    d->head %= POOL_SIZE;
    d->size--;
}

void PopTailDeque(deque *d)
{
```

```
    if (!d->size)
        return;
    d->tail = (d->tail - 1 + POOL_SIZE) % POOL_SIZE;
    d->size--;
}

int TopHeadDeque(deque *d)
{
    if (d->size)
        return d->data[d->head];
    else
        return '\0';
}

int TopTailDeque(deque *d)
{
    if (d->size)
        return d->data[d->tail];
    else
        return '\0';
}

void deleteDeque(deque *d)
{
    d->head = 0;
    d->tail = 0;
    d->size = 0;
}
```

main.c

```
#include <stdio.h>
#include "udt.h"


int RemoveMin(deque *d)
{
    int min_el = TopHeadDeque(d);
    int cur_el;
    int min_ind = 0;

    for (int i=0; i < d->size; ++i) {
        cur_el = TopHeadDeque(d);
        PopHeadDeque(d);
        PushTailDeque(d, cur_el);

        if (cur_el < min_el) {
            min_el = cur_el;
            min_ind = i;
```

```
        }
    }

    for (int i=0; i < d->size; ++i) {
        cur_el = TopHeadDeque(d);
        PopHeadDeque(d);

        if (min_ind != i)
            PushTailDeque(d, cur_el);
    }

    return min_el;
}


deque selectionSort(deque *d)
{
    deque sorted_d;
    CreateDeque(&sorted_d);
    int min_el;

    while (!isEmptyDeque(d))
    {
        min_el = RemoveMin(d);
        PushTailDeque(&sorted_d, min_el);
    }

    while (!isEmptyDeque(&sorted_d)) {
        min_el = TopHeadDeque(&sorted_d);
        PopHeadDeque(&sorted_d);
        PushTailDeque(d, min_el);
    }

    return sorted_d;
}


void printDeque(deque *d)
{
    int i, index;
    for (i = 0; i < d->size; i++) {
        index = (d->head + i) % POOL_SIZE;
        printf("%d ", d->data[index]);
    }
    printf("\n");
}
```

```c
int main()
{
   deque deck;

   CreateDeque(&deck);

   int state, key;

   do {
       printf("Choose the option: 1-push to head, 2-push to tail, 3-delete
and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print
deque\n");
       scanf("%d", &state);
       if (state == 1) {
           printf("Type value: ");
           scanf(" %d", &key);
           PushHeadDeque(&deck, key);
           printf("%d added to head\n", key);
       } else if (state == 2) {
           printf("Type value: ");
           scanf(" %d", &key);
           PushTailDeque(&deck, key);
           printf("%d added to tail\n", key);
       } else if (state == 3) {
           if (!isEmptyDeque(&deck)) {
               int mini = RemoveMin(&deck);
               printf("Min is %d\n", mini);
           } else {
               printf("Deque is empty\n");
           }
       } else if (state == 4) {
           if (!isEmptyDeque(&deck)) {
               deque sorted = selectionSort(&deck);
               printDeque(&deck);
           } else {
               printf("Deque is empty\n");
           }
       } else if (state == 5) {
           int size = getSizeDeque(&deck);
           printf("Size is %d\n", size);
       } else if (state == 6) {
           int empty = isEmptyDeque(&deck);
           printf("Deque is %s\n", empty ? "empty" : "not empty");
       } else if (state == 7) {
           printf("Deque:\n");
           printDeque(&deck);
       }
   } while(state);
```

```
    deleteDeque(&deck);

    return 0;
}
```

Допущен к выполнению работы. **Подпись преподавателя _____**

8. **Распечатка протокола:**

```
xxxkoshaster@YES-MAN:~/Documents/Zayks/lb6$ make
gcc main.c udt.c
xxxkoshaster@YES-MAN:~/Documents/Zayks/lb6$ ./a.out
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
1
Type value: 10
10 added to head
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
5
Size is 1
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
6
Deque is not empty
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
7
Deque:
10
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
3
Min is 10
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
5
Size is 0
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
6
Deque is empty
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
7
Deque:

Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
4
Deque is empty
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
3
Deque is empty
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
2
Type value: 10
10 added to tail
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
2
Type value: 20
20 added to tail
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
2
Type value: 30
```

30 added to tail
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
7
Deque:
10 20 30
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
5
Size is 3
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
3
Min is 10
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
4
20 30
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
7
Deque:
20 30
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
5
Size is 2
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
3
Min is 20
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
4
30
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
5
Size is 1
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
1
Type value: 10
10 added to head
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
1
Type value: 20
20 added to head
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
7
Deque:
20 10 30
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
3
Min is 10
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
4
20 30
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
1
Type value: 10
10 added to head
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
2
Type value: 20
20 added to tail
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque

2
Type value: 10
10 added to tail
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
7
Deque:
10 20 30 20 10
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
3
Min is 10
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
4
10 20 20 30
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
3
Min is 10
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
4
20 20 30
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
1
Type value: -10
-10 added to head
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
7
Deque:
-10 20 20 30
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
3
Min is -10
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
4
20 20 30
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
3
Min is 20
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
3
Min is 20
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
3
Min is 30
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
6
Deque is empty
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
1
Type value: -10
-10 added to head
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
2
Type value: -5
-5 added to tail
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
7
Deque:
-10 -5

Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
3
Min is -10
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
3
Min is -5
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
6
Deque is empty
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
1
Type value: -10
-10 added to head
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
2
Type value: 20
20 added to tail
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
2
Type value: -30
-30 added to tail
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
2
Type value: 40
40 added to tail
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
7
Deque:
-10 20 -30 40
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
3
Min is -30
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
4
-10 20 40
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
3
Min is -10
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
4
20 40
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
3
Min is 20
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
4
40
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
3
Min is 40
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
4
Deque is empty
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
5
Size is 0

Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
6
Deque is empty
Choose the option: 1-push to head, 2-push to tail, 3-delete and print min, 4- sorte deque, 5-size, 6-check if empty, 7-print deque
0

9. Дневник отладки

№	Лаб. или дом.	Дата	Время	Событие	Действие по исправлению	Примечание

10. Замечания автора:
По существу работы: замечания отсутствуют.

11. Выводы:

Подпись студента _____