**Федеральное государственное бюджетное образовательное учреждение высшего образования**

**«Московский Авиационный Институт»**

**(Национальный Исследовательский Университет)**

**Институт №8 «Компьютерные науки и прикладная математика»**

# **Кафедра 806 «Вычислительная математика и программирование»**

**Курсовой проект 9**

**Автор работы:**

студент 1 курса, группа М8О-102Б-21

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**Руководитель проекта:**

Доцент кафедры 806 Никулин С.П.

**Дата сдачи:**

**Цель работы:**

Составить программу на языке Си с использованием процедур и функций для сортировки таблицы заданным методом и двоичного поиска по ключу в таблице

**Вариант преобразований:**

Метод сортировки № 8: Турнирная сортировка

Тип ключа № 9: комплексный

Хранение данных и ключей: вместе

**Программа:**

#include <stdio.h>

#include <stdlib.h>

#include <stdbool.h>

#define abs(a) (a < 0) ? (-a) : a

typedef struct complex { long double re, im; } key\_type;

typedef struct { key\_type key; char data[75]; } table\_type;

bool gt(key\_type a, key\_type b) {

if (a.re == b.re) return a.im > b.im;

return a.re > b.re;

}

void Heapify(table\_type A[], int i, int size) {

int left = 2 \* i + 1, right = 2 \* i + 2, new = i;

if (left < size && gt(A[left].key, A[new].key)) new = left;

if (right < size && gt(A[right].key, A[new].key)) new = right;

if (new != i) {

table\_type t = A[new]; A[new] = A[i]; A[i] = t;

Heapify(A, new, size);

}

}

void HeapBuilder(table\_type A[], int size) { for (int i = size / 2; i >= 0; i--) Heapify(A, i, size); }

void heapSort(table\_type A[], int size) {

HeapBuilder(A, size);

for (int j = size - 1; j > 0; j--) {

table\_type t = A[0]; A[0] = A[j]; A[j] = t;

Heapify(A, 0, j);

}

}

void show\_table(table\_type A[], int size) {

printf("\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n");

printf("|num| key |\t\t\t\t\tdata\t\t\t |\n");

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

printf("|%3d|%.2Lf%c%.2Lfi|%70s|\n", i, A[i].key.re, (A[i].key.im < 0) ? '-' : '+', abs(A[i].key.im), A[i].data);

}

printf("---------------------------------------------------------------------------------------\n");

}

int binary\_search(table\_type A[], int size, key\_type x) {

int left = 0, right = size, mid = size / 2;

while (right - left > 1) {

if (gt(A[mid].key, x)) right = mid;

else if (gt(x, A[mid].key)) left = mid;

else return mid;

mid = (right + left) / 2;

}

return (A[mid].key.re != x.re || A[mid].key.im != x.im) ? -1 : mid;

}

int main(int n, char\* arr[]) {

table\_type table[10];

key\_type x;

int size = -1, i;

FILE\* file = fopen(arr[1], "r");

if (!file) {

printf("Can't open file\n");

return 2;

}

while (++size < 10 && fscanf(file, "%Lf %Lf ", &table[size].key.re, &table[size].key.im) && fgets(table[size].data, 75, file)) {

for (i = 0; table[size].data[i] != '\n'; i++) {}

table[size].data[i] = table[size].data[i + 1];

}

int state = -1;

while (state != 4) {

printf("Select: 1 - sort; 2 - find; 3 - print; 4 - ext;\n>");

scanf("%d", &state);

switch (state) {

case 1:

show\_table(table, size);

printf("Sorting...\n");

heapSort(table, size);

printf("Table sorted\n");

show\_table(table, size);

break;

case 2:

printf("input the complex key:");

scanf("%Lf %Lf", &x.re, &x.im);

i = binary\_search(table, size, x);

if (i == -1) printf("element not in table\n");

else printf("|%3d|%.2Lf%c%.2Lfi|%70s|\n", i, table[i].key.re, (table[i].key.im < 0) ? '-' : '+', abs(table[i].key.im), table[i].data);

break;

case 3: show\_table(table, size); break;

}

}

}

**Работа программы:**

[root@fedora ~]# cat data1.txt

1 -2 To the town of Agua Fria rode a stranger one fine day

2 0 Hardly spoke to folks around him, didn't have too much to say

2 1 No one dared to ask his business, no one dared to make a slip

3 8 For the stranger there among them had a big iron on his hip

4 -9 Big iron on his hip

5 6 It was early in the morning when he rode into the town

7 1 He came riding from the south side, slowly looking all around

8 -1 He's an outlaw loose and running, came the whisper from each lip

9 -3 And he's here to do some business with the big iron on his hip

9 5 Big iron on his hip

[root@fedora ~]# gcc main.c -o run

[root@fedora ~]# ./run data1.txt

Select: 1 - sort; 2 - find; 3 - print; 4 - ext;

>3

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|num| key | data |

| 0|1.00-2.00i| To the town of Agua Fria rode a stranger one fine day|

| 1|2.00+0.00i| Hardly spoke to folks around him, didn't have too much to say|

| 2|2.00+1.00i| No one dared to ask his business, no one dared to make a slip|

| 3|3.00+8.00i| For the stranger there among them had a big iron on his hip|

| 4|4.00-9.00i| Big iron on his hip|

| 5|5.00+6.00i| It was early in the morning when he rode into the town|

| 6|7.00+1.00i| He came riding from the south side, slowly looking all around|

| 7|8.00-1.00i| He's an outlaw loose and running, came the whisper from each lip|

| 8|9.00-3.00i| And he's here to do some business with the big iron on his hip|

| 9|9.00+5.00i| Big iron on his hip|

---------------------------------------------------------------------------------------

Select: 1 - sort; 2 - find; 3 - print; 4 - ext;

>2

input the complex key:7+1

| 6|7.00+1.00i| He came riding from the south side, slowly looking all around|

Select: 1 - sort; 2 - find; 3 - print; 4 - ext;

>2

input the complex key:7+0

element not in table

Select: 1 - sort; 2 - find; 3 - print; 4 - ext;

>1

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|num| key | data |

| 0|1.00-2.00i| To the town of Agua Fria rode a stranger one fine day|

| 1|2.00+0.00i| Hardly spoke to folks around him, didn't have too much to say|

| 2|2.00+1.00i| No one dared to ask his business, no one dared to make a slip|

| 3|3.00+8.00i| For the stranger there among them had a big iron on his hip|

| 4|4.00-9.00i| Big iron on his hip|

| 5|5.00+6.00i| It was early in the morning when he rode into the town|

| 6|7.00+1.00i| He came riding from the south side, slowly looking all around|

| 7|8.00-1.00i| He's an outlaw loose and running, came the whisper from each lip|

| 8|9.00-3.00i| And he's here to do some business with the big iron on his hip|

| 9|9.00+5.00i| Big iron on his hip|

---------------------------------------------------------------------------------------

Sorting...

Table sorted

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|num| key | data |

| 0|1.00-2.00i| To the town of Agua Fria rode a stranger one fine day|

| 1|2.00+0.00i| Hardly spoke to folks around him, didn't have too much to say|

| 2|2.00+1.00i| No one dared to ask his business, no one dared to make a slip|

| 3|3.00+8.00i| For the stranger there among them had a big iron on his hip|

| 4|4.00-9.00i| Big iron on his hip|

| 5|5.00+6.00i| It was early in the morning when he rode into the town|

| 6|7.00+1.00i| He came riding from the south side, slowly looking all around|

| 7|8.00-1.00i| He's an outlaw loose and running, came the whisper from each lip|

| 8|9.00-3.00i| And he's here to do some business with the big iron on his hip|

| 9|9.00+5.00i| Big iron on his hip|

---------------------------------------------------------------------------------------

Select: 1 - sort; 2 - find; 3 - print; 4 - ext;

>4

[root@fedora ~]# cat data2.txt

7 -8 In this town, there lived an outlaw by the name of Texas Red

6 5 Many men had tried to take him and that many men were dead

5 9 He was vicious and a killer though a youth of twenty-four

5 -2 And the notches on his pistol numbered one and nineteen more

4 5 One and nineteen more

3 8 Now the stranger started talking, made it plain to folks around

3 3 He was an Arizona Ranger, wouldn't be too long in town

1 6 He came here to take an outlaw back alive or maybe dead

1 -9 And he said it didn't matter, he was after Texas Red

0 9 After Texas Red

[root@fedora ~]# ./run data2.txt

Select: 1 - sort; 2 - find; 3 - print; 4 - ext;

>3

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|num| key | data |

| 0|7.00-8.00i| In this town, there lived an outlaw by the name of Texas Red|

| 1|6.00+5.00i| Many men had tried to take him and that many men were dead|

| 2|5.00+9.00i| He was vicious and a killer though a youth of twenty-four|

| 3|5.00-2.00i| And the notches on his pistol numbered one and nineteen more|

| 4|4.00+5.00i| One and nineteen more|

| 5|3.00+8.00i| Now the stranger started talking, made it plain to folks around|

| 6|3.00+3.00i| He was an Arizona Ranger, wouldn't be too long in town|

| 7|1.00+6.00i| He came here to take an outlaw back alive or maybe dead|

| 8|1.00-9.00i| And he said it didn't matter, he was after Texas Red|

| 9|0.00+9.00i| After Texas Red|

---------------------------------------------------------------------------------------

Select: 1 - sort; 2 - find; 3 - print; 4 - ext;

>2

input the complex key:-1-1

element not in table

Select: 1 - sort; 2 - find; 3 - print; 4 - ext;

>1

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|num| key | data |

| 0|7.00-8.00i| In this town, there lived an outlaw by the name of Texas Red|

| 1|6.00+5.00i| Many men had tried to take him and that many men were dead|

| 2|5.00+9.00i| He was vicious and a killer though a youth of twenty-four|

| 3|5.00-2.00i| And the notches on his pistol numbered one and nineteen more|

| 4|4.00+5.00i| One and nineteen more|

| 5|3.00+8.00i| Now the stranger started talking, made it plain to folks around|

| 6|3.00+3.00i| He was an Arizona Ranger, wouldn't be too long in town|

| 7|1.00+6.00i| He came here to take an outlaw back alive or maybe dead|

| 8|1.00-9.00i| And he said it didn't matter, he was after Texas Red|

| 9|0.00+9.00i| After Texas Red|

---------------------------------------------------------------------------------------

Sorting...

Table sorted

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|num| key | data |

| 0|0.00+9.00i| After Texas Red|

| 1|1.00-9.00i| And he said it didn't matter, he was after Texas Red|

| 2|1.00+6.00i| He came here to take an outlaw back alive or maybe dead|

| 3|3.00+3.00i| He was an Arizona Ranger, wouldn't be too long in town|

| 4|3.00+8.00i| Now the stranger started talking, made it plain to folks around|

| 5|4.00+5.00i| One and nineteen more|

| 6|5.00-2.00i| And the notches on his pistol numbered one and nineteen more|

| 7|5.00+9.00i| He was vicious and a killer though a youth of twenty-four|

| 8|6.00+5.00i| Many men had tried to take him and that many men were dead|

| 9|7.00-8.00i| In this town, there lived an outlaw by the name of Texas Red|

---------------------------------------------------------------------------------------

Select: 1 - sort; 2 - find; 3 - print; 4 - ext;

>4

[root@fedora ~]# cat data3.txt

7 -8 The morning passed so quickly, it was time for them to meet

9 4 It was twenty past eleven when they walked out in the street

4 2 Folks were watching from their windows, everybody held their breath

1 -7 They knew this handsome ranger was about to meet his death

7 1 Was about to meet his death

9 -5 There was forty feet between them when they stopped to make their play

4 6 And the swiftness of the ranger is still talked about today

2 2 Texas Red had not cleared leather when a bullet fairly ripped

6 -6 And the ranger's aim was deadly with the big iron on his hip

2 -4 The big iron on his hip

[root@fedora ~]# ./run data3.txt

Select: 1 - sort; 2 - find; 3 - print; 4 - ext;

>3

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|num| key | data |

| 0|7.00-8.00i| The morning passed so quickly, it was time for them to meet|

| 1|9.00+4.00i| It was twenty past eleven when they walked out in the street|

| 2|4.00+2.00i| Folks were watching from their windows, everybody held their breath|

| 3|1.00-7.00i| They knew this handsome ranger was about to meet his death|

| 4|7.00+1.00i| Was about to meet his death|

| 5|9.00-5.00i|There was forty feet between them when they stopped to make their play|

| 6|4.00+6.00i| And the swiftness of the ranger is still talked about today|

| 7|2.00+2.00i| Texas Red had not cleared leather when a bullet fairly ripped|

| 8|6.00-6.00i| And the ranger's aim was deadly with the big iron on his hip|

| 9|2.00-4.00i| The big iron on his hip|

---------------------------------------------------------------------------------------

Select: 1 - sort; 2 - find; 3 - print; 4 - ext;

>1

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|num| key | data |

| 0|7.00-8.00i| The morning passed so quickly, it was time for them to meet|

| 1|9.00+4.00i| It was twenty past eleven when they walked out in the street|

| 2|4.00+2.00i| Folks were watching from their windows, everybody held their breath|

| 3|1.00-7.00i| They knew this handsome ranger was about to meet his death|

| 4|7.00+1.00i| Was about to meet his death|

| 5|9.00-5.00i|There was forty feet between them when they stopped to make their play|

| 6|4.00+6.00i| And the swiftness of the ranger is still talked about today|

| 7|2.00+2.00i| Texas Red had not cleared leather when a bullet fairly ripped|

| 8|6.00-6.00i| And the ranger's aim was deadly with the big iron on his hip|

| 9|2.00-4.00i| The big iron on his hip|

---------------------------------------------------------------------------------------

Sorting...

Table sorted

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|num| key | data |

| 0|1.00-7.00i| They knew this handsome ranger was about to meet his death|

| 1|2.00-4.00i| The big iron on his hip|

| 2|2.00+2.00i| Texas Red had not cleared leather when a bullet fairly ripped|

| 3|4.00+2.00i| Folks were watching from their windows, everybody held their breath|

| 4|4.00+6.00i| And the swiftness of the ranger is still talked about today|

| 5|6.00-6.00i| And the ranger's aim was deadly with the big iron on his hip|

| 6|7.00-8.00i| The morning passed so quickly, it was time for them to meet|

| 7|7.00+1.00i| Was about to meet his death|

| 8|9.00-5.00i|There was forty feet between them when they stopped to make their play|

| 9|9.00+4.00i| It was twenty past eleven when they walked out in the street|

---------------------------------------------------------------------------------------

Select: 1 - sort; 2 - find; 3 - print; 4 - ext;

>3

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|num| key | data |

| 0|1.00-7.00i| They knew this handsome ranger was about to meet his death|

| 1|2.00-4.00i| The big iron on his hip|

| 2|2.00+2.00i| Texas Red had not cleared leather when a bullet fairly ripped|

| 3|4.00+2.00i| Folks were watching from their windows, everybody held their breath|

| 4|4.00+6.00i| And the swiftness of the ranger is still talked about today|

| 5|6.00-6.00i| And the ranger's aim was deadly with the big iron on his hip|

| 6|7.00-8.00i| The morning passed so quickly, it was time for them to meet|

| 7|7.00+1.00i| Was about to meet his death|

| 8|9.00-5.00i|There was forty feet between them when they stopped to make their play|

| 9|9.00+4.00i| It was twenty past eleven when they walked out in the street|

---------------------------------------------------------------------------------------

Select: 1 - sort; 2 - find; 3 - print; 4 - ext;

>4

[root@fedora ~]#

**Заключение:**

Мне удалось составить программу на языке Си с использованием процедур и функций для сортировки таблицы заданным методом и двоичного поиска по ключу в таблице