Εργασία 5: Πίνακες - Δείκτες - Αρχεία

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Περιεχόμενα

1 Δομή προγραμμάτων και οδηγίες εκτέλεσης

1.1 Εκτέλεση από Linux

```
$ cd path-to-program
$ make
$ make run
$ make run ARGS=txt/data.txt #fcombinations ONLY
$ make clean #optional
```

1.2 Δομή φακέλων

Το κάθε πρόγραμμα, είναι δομημένο ως εξής: Υπάρχουν πέντε φάκελοι, καθώς και ένα Makefile στο top directory. Στον φάκελο src βρίσκονται οι πηγαίοι κώδικες, στον include τα header files, στον obj τα object files και στον bin το εκτελέσιμο αρχείο. Στον φάκελο txt υπάρχουν τα text files που διαβάζονται οι γράφονται από το κάθε πρόγραμμα. Το Makefile είναι υπεύθυνο για την μεταγλώττιση όλων των αρχείων μαζί, και την τοποθέτησή τους στους κατάλληλους φακέλους, την εκτέλεση των προγραμμάτων, καθώς και τον καθαρισμό των φακέλων (διαγράφει τα object files και το εκτελέσιμο με την εντολή make clean).

2 combinations - συνδυασμοί

2.1 main.c

```
#include "combinations.h"

int main(int argc, char **argv)
{
    int *arr, N, x1, x2, y1, y2;

    N = get_n();

    arr = fill_array(N);
    quicksort(arr, 0, N-1);
    x_pair(&x1, &x2);
    y_pair(&y1, &y2);
    print_combs(arr, N, x1, x2, y1, y2);

```

```
15      free(arr);
16
17      return 0;
18  }
```

2.2 combinations.c

```
1   #include "combinations.h"
2
3   int get_n()
4   {
5       int N;
6
7       do
8       {
9           system("clear||cls");
10          printf("N (6 < N <= 49): ");
11          scanf("%d", &N);
12      } while (N <= 6 || N > 49);
13
14      system("clear||cls");
15
16      return N;
17  }
18
19
20  void x_pair(int *x1, int *x2)
21  {
22      do
23      {
24          printf("x1: ");
25          scanf("%d", x1);
26          printf("x2: ");
27          scanf("%d", x2);
28      } while (*x1 < 0 || *x1 > *x2 || *x2 > 6);
29  }
30
31
32  void y_pair(int *y1, int *y2)
33  {
34      do
35      {
36          printf("y1: ");
37          scanf("%d", y1);
38          printf("y2: ");
39          scanf("%d", y2);
40      } while (*y1 < 21 || *y1 > *y2 || *y2 > 279);
41  }
42
43
```

```
44 void print_combs(int *arr, int N, int x1, int x2, int y1,
       int y2)
45 {
46     int *currComb = (int *)malloc(N * sizeof(int));
47     int *freqArr = (int *)malloc(N *sizeof(int));
48     int unFrstCond = 0, unScndCondOnly = 0, printed = 0;
49 
50     if (currComb == NULL)
51     {
52         set_color(BOLD_RED);
53         printf("Error! Not enough memory, exiting...\n");
54         exit(EXIT_FAILURE);
55         set_color(STANDARD);
56     }
57     else
58     {
59         combinations(arr, currComb, freqArr, 0, N-1, 0, &
       printed, &unFrstCond, &unScndCondOnly, x1, x2, y1, y2, N)
       ;
60         print_other(N, unFrstCond, unScndCondOnly, printed,
       arr, freqArr);
61     }
62 
63     free(currComb);
64     free(freqArr);
65 }
66 
67 
68 void combinations(int *arr, int *currComb, int *freqArr, int
        start, int end, int index, int *printed, int *unFrstCond
       , int *unScndCondOnly, int x1, int x2, int y1, int y2,
       int N)
69 {
70     int i, j;
71 
72     if (index == COMBSN)
73     {
74         for (j = 0; j < COMBSN; j++)
75         {
76             if (even_calc(currComb, x1, x2) && sum_comb_calc
       (currComb, y1, y2))
77             {
78                 printf("%d ", *(currComb + j));
79                 if (j == COMBSN - 1)
80                 {
81                     frequency(freqArr, currComb, arr, N);
82                     (*printed)++;
83                     printf("\n");
84                 }
85             }
```

```
86          }
87          if (!even_calc(currComb, x1, x2) && sum_comb_calc(
    currComb, y1, y2)) (*unFrstCond)++;
88          if (!sum_comb_calc(currComb, y1, y2)) (*
    unScndCondOnly)++;
89          return;
90      }
91
92      for (i = start; i <= end && end-i+1 >= COMBSN-index; i++
    )
93      {
94          *(currComb + index) = *(arr + i);
95          combinations(arr, currComb, freqArr, i+1, end, index
    +1, printed, unFrstCond, unScndCondOnly, x1, x2, y1, y2,
    N);
96      }
97
98  }
99
100
101 bool even_calc(int *arr, int x1, int x2)
102 {
103     int numEven = 0, i;
104
105     for (i = 0; i < COMBSN; i++)
106         if (*(arr + i) % 2 == 0) numEven++;
107
108     return (numEven >= x1 && numEven <= x2) ? true : false;
109 }
110
111
112 bool sum_comb_calc(int *arr, int y1, int y2)
113 {
114     int sumNums = 0, i;
115
116     for (i = 0; i < COMBSN; i++)
117         sumNums += *(arr + i);
118
119     return (sumNums >= y1 && sumNums <= y2) ? true : false;
120 }
121
122
123 void frequency(int *freqArr, int *currComb, int *arr, int N)
124 {
125     int pos, i;
126
127     for (i = 0; i < COMBSN; i++)
128     {
129         pos = find_pos(arr, N, *(currComb + i));
130         (*(freqArr + pos))++;
```

```
131     }
132 }
133 
134 
135 long int combinations_count(int N)
136 {
137     return (factorial(N) / (factorial(COMBSN) * factorial(N
    - COMBSN)));
138 }
139 
140 
141 long double factorial(int num)
142 {
143     int i;
144     long double fac;
145     if (num == 0) return -1;
146     else for (i = 1, fac = 1; i <= num; i++) fac *= i;
147     return fac;
148 }
149 
150 
151 void print_other(int N, int unFrstCond, int unScndCondOnly,
    int printed,int *arr, int *freqArr)
152 {
153     int i;
154 
155     printf("\nTotal number of combinations %d to %d: %ld\n",
     N, COMBSN, combinations_count(N));
156     printf("Number of combinations not satisfying the first
    condition: %d\n", unFrstCond);
157     printf("Number of combinations not satisfying the second
     condition only: %d\n", unScndCondOnly);
158     printf("Printed combinations: %d\n\n", printed);
159 
160     for (i = 0; i < N; i++)
161         printf("%d appeared %d times\n", *(arr + i), *(
    freqArr + i));
162 
163 }
```

2.3 combinations.h

```
1 #ifndef COMBINATIONS_H
2 #define COMBINATIONS_H
3 
4 #include <stdio.h>
5 #include <stdlib.h>
6 #include <stdbool.h>
7 
8 #include "arrhandler.h"
```

```
9  #include "ccolors.h"
10
11 #define COMBSN 6
12
13 void x_pair(int *, int *);
14 void y_pair(int *, int *);
15
16 void print_combs(int *, int, int, int, int, int);
17 void combinations(int *, int *, int *, int, int, int, int *,
       int *, int *, int, int, int, int, int);
18
19 bool even_calc(int *, int, int);
20 bool sum_comb_calc(int *, int, int);
21
22 void frequency(int *, int *, int *, int);
23 long int combinations_count(int);
24 long double factorial(int);
25 void print_other(int, int, int, int, int *, int *);
26
27 #endif
```

2.4 arrhandler.c

```
1  #include "arrhandler.h"
2
3  int *fill_array(int N)
4  {
5      int num, i = 0;
6      int *arr = (int *)malloc(N * sizeof(int));
7
8      if (arr == NULL)
9      {
10         set_color(BOLD_RED);
11         printf("Error! Not enough memory, exiting...\n");
12         exit(EXIT_FAILURE);
13         set_color(STANDARD);
14     }
15     else
16     {
17         do
18         {
19             printf("arr[%d]: ", i);
20             scanf("%d", &num);
21
22             if (num >= 1 && num <= 49)
23             {
24                 if (i == 0) { *(arr + i) = num; i++; }
25                 else
26                 {
27                     if (!exists_in_array(arr, N, num)) { *(
```

```
    arr + i) = num; i++; }
28                      else printf("Give a different number.\n"
    );
29                  }
30              }
31              else printf("Give a number in [1, 49].\n");
32          } while (i < N);
33      }
34
35      return arr;
36  }
37
38
39  bool exists_in_array(int *arr, int N, int num)
40  {
41      int *arrEnd = arr + (N - 1);
42      while (arr <= arrEnd && *arr != num) arr++;
43      return (arr <= arrEnd) ? true : false;
44  }
45
46
47  void quicksort(int *arr, int low, int high)
48  {
49      if (low < high)
50      {
51          int partIndex = partition(arr, low, high);
52          quicksort(arr, low, partIndex - 1);
53          quicksort(arr, partIndex + 1, high);
54      }
55  }
56
57
58  int partition(int *arr, int low, int high)
59  {
60      int pivot = *(arr + high);
61      int i = (low - 1), j;
62
63      for (j = low; j <= high - 1; j++)
64          if (*(arr + j) < pivot)
65              swap(arr + ++i, arr + j);
66
67      swap(arr + (i + 1), arr + high);
68      return (i + 1);
69  }
70
71
72  void swap(int *a, int *b)
73  {
74      int temp = *a;
75      *a = *b;
```

```
76      *b = temp;
77  }
78
79
80  int find_pos(int *arr, int numIter, int val)
81  {
82      int pos, i;
83
84      for (i = 0; i < numIter; i++)
85          if (val == *(arr + i))
86              pos = i;
87
88      return pos;
89  }
```

2.5 arrhandler.h

```
1  #ifndef ARRHANDLER_H
2  #define ARRHANDLER_H
3
4  #include "combinations.h"
5
6  int *fill_array(int);
7  bool exists_in_array(int *, int, int);
8
9  void quicksort(int *, int, int);
10 int partition(int *, int, int);
11 void swap(int *, int *);
12
13 int find_pos(int *, int, int);
14
15 #endif
```

2.6 Διάγραμμα ροής

2.7 Περιγραφή υλοποιήσης

3 kcombinations - συνδυασμοί με K

3.1 main.c

```
1  #include "kcombinations.h"
2
3  int main(int argc, char **argv)
4  {
5      int *arr, N, K, x1, x2, y1, y2;
6
7      N = get_n();
8      K = get_k(N);
9
```

```
    arr = fill_array(N);
    quicksort(arr, 0, N-1);
    x_pair(&x1, &x2);
    y_pair(&y1, &y2);
    print_combs(arr, N, K, x1, x2, y1, y2);

    free(arr);

    return 0;
}
```

3.2 kcombinations.c

```
#include "kcombinations.h"

int get_n()
{
    int N;

    do
    {
        system("clear||cls");
        printf("N (6 < N <= 49): ");
        scanf("%d", &N);
    } while (N <= 6 || N > 49);

    return N;
}


int get_k(int N)
{
    int K;

    do
    {
        printf("K (K < N <= 49): ");
        scanf("%d", &K);
    } while (K >= N || K > 49);

    system("clear||cls");

    return K;
}


void x_pair(int *x1, int *x2)
{
    do
    {
```

```
38          printf("x1: ");
39          scanf("%d", x1);
40          printf("x2: ");
41          scanf("%d", x2);
42      } while (*x1 < 0 || *x1 > *x2 || *x2 > 6);
43  }
44
45
46  void y_pair(int *y1, int *y2)
47  {
48      do
49      {
50          printf("y1: ");
51          scanf("%d", y1);
52          printf("y2: ");
53          scanf("%d", y2);
54      } while (*y1 < 21 || *y1 > *y2 || *y2 > 279);
55  }
56
57
58  void print_combs(int *arr, int N, int K, int x1, int x2, int
        y1, int y2)
59  {
60      int *currComb = (int *)malloc(N * sizeof(int));
61      int *freqArr = (int *)malloc(N * sizeof(int));
62      int unFrstCond = 0, unScndCondOnly = 0, printed = 0;
63
64      if (currComb == NULL)
65      {
66          set_color(BOLD_RED);
67          printf("Error! Not enough memory, exiting...\n");
68          exit(EXIT_FAILURE);
69          set_color(STANDARD);
70      }
71      else
72      {
73          combinations(arr, currComb, freqArr, 0, N-1, 0, N, K
        , &printed, &unFrstCond, &unScndCondOnly, x1, x2, y1, y2)
        ;
74          print_other(N, K, unFrstCond, unScndCondOnly,
        printed, arr, freqArr);
75      }
76
77      free(currComb);
78      free(freqArr);
79  }
80
81
82  void combinations(int *arr, int *currComb, int *freqArr, int
        start, int end, int index, int N, int K, int *printed,
```

```
    int *unFrstCond, int *unScndCondOnly, int x1, int x2, int
     y1, int y2)
{
    int i, j;

    if (index == K)
    {
        for (j = 0; j < K; j++)
        {
            if (even_calc(currComb, K, x1, x2) &&
    sum_comb_calc(currComb, K, y1, y2))
            {
                printf("%d ", *(currComb + j));
                if (j == K - 1)
                {
                    frequency(freqArr, currComb, arr, N);
                    (*printed)++;
                    printf("\n");
                }
            }
        }
        if (!even_calc(currComb, K, x1, x2) && sum_comb_calc
    (currComb, K, y1, y2)) (*unFrstCond)++;
        if (!sum_comb_calc(currComb, K, y1, y2)) (*
    unScndCondOnly)++;
        return;
    }

    for (i = start; i <= end && end-i+1 >= K-index; i++)
    {
        *(currComb + index) = *(arr + i);
        combinations(arr, currComb, freqArr, i+1, end, index
    +1, N, K, printed, unFrstCond, unScndCondOnly, x1, x2, y1
    , y2);
    }
}


bool even_calc(int *arr, int K, int x1, int x2)
{
    int numEven = 0, i;

    for (i = 0; i < K; i++)
        if (*(arr + i) % 2 == 0) numEven++;

    return (numEven >= x1 && numEven <= x2) ? true : false;
}


bool sum_comb_calc(int *arr, int K, int y1, int y2)
```

```
126 {
127     int sumNums = 0, i;
128 
129     for (i = 0; i < K; i++)
130         sumNums += *(arr + i);
131 
132     return (sumNums >= y1 && sumNums <= y2) ? true : false;
133 }
134 
135 
136 int frequency(int *freqArr, int *currComb, int *arr, int N)
137 {
138     int pos, i;
139 
140     for (i = 0; i < N; i++)
141     {
142         pos = find_pos(arr, N, *(currComb + i));
143         (*(freqArr + pos))++;
144     }
145 }
146 
147 
148 long int combinations_count(int N, int K)
149 {
150     return (factorial(N) / (factorial(K) * factorial(N - K))
    );
151 }
152 
153 
154 long double factorial(int num)
155 {
156     int i;
157     long double fac;
158     if (num == 0) return -1;
159     else for (i = 1, fac = 1; i <= num; i++) fac *= i;
160     return fac;
161 }
162 
163 
164 void print_other(int N, int K, int unFrstCond, int
    unScndCondOnly, int printed, int *arr, int *freqArr)
165 {
166     int i;
167 
168     printf("\nTotal number of combinations %d to %d: %ld\n",
     N, K, combinations_count(N, K));
169     printf("Number of combinations not satisfying the first
    condition: %d\n", unFrstCond);
170     printf("Number of combinations not satisfying the second
     condition only: %d\n", unScndCondOnly);
```

```
171     printf("Printed combinations: %d\n\n", printed);
172
173     for (i = 0; i < N; i++)
174         printf("%d appeared %d times\n", *(arr + i), *(
    freqArr + i));
175 }
```

3.3 kcombinations.h

```
1  #ifndef COMBINATIONS_H
2  #define COMBINATIONS_H
3
4  #include <stdio.h>
5  #include <stdlib.h>
6  #include <stdbool.h>
7
8  #include "arrhandler.h"
9  #include "ccolors.h"
10
11 void x_pair(int *, int *);
12 void y_pair(int *, int *);
13
14 void print_combs(int *, int, int, int, int, int, int);
15 void combinations(int *, int *, int *, int, int, int, int,
       int, int *, int *, int *, int, int, int, int);
16
17 bool even_calc(int *, int, int, int);
18 bool sum_comb_calc(int *, int, int, int);
19
20 int frequency(int *, int *, int *, int);
21 long int combinations_count(int, int);
22 long double factorial(int);
23 void print_other(int, int, int, int, int, int *, int *);
24
25 #endif
```

3.4 arrhandler.c

```
1  #include "arrhandler.h"
2
3  int *fill_array(int N)
4  {
5      int num, i = 0;
6      int *arr = (int *)malloc(N * sizeof(int));
7
8      if (arr == NULL)
9      {
10         set_color(BOLD_RED);
11         printf("Error! Not enough memory, exiting...\n");
12         exit(EXIT_FAILURE);
```

```
13          set_color(STANDARD);
14      }
15      else
16      {
17          do
18          {
19              printf("arr[%d]: ", i);
20              scanf("%d", &num);
21
22              if (num >= 1 && num <= 49)
23              {
24                  if (i == 0) { *(arr + i) = num; i++; }
25                  else
26                  {
27                      if (!exists_in_array(arr, N, num)) { *(
    arr + i) = num; i++; }
28                      else printf("Give a different number.\n"
    );
29                  }
30              }
31              else printf("Give a number in [1, 49].\n");
32          } while (i < N);
33      }
34
35      return arr;
36  }
37
38
39  bool exists_in_array(int *arr, int N, int num)
40  {
41      int *arrEnd = arr + (N - 1);
42      while (arr <= arrEnd && *arr != num) arr++;
43      return (arr <= arrEnd) ? true : false;
44  }
45
46
47  void quicksort(int *arr, int low, int high)
48  {
49      if (low < high)
50      {
51          int partIndex = partition(arr, low, high);
52          quicksort(arr, low, partIndex - 1);
53          quicksort(arr, partIndex + 1, high);
54      }
55  }
56
57
58  int partition(int *arr, int low, int high)
59  {
60      int pivot = *(arr + high);
```

```
61      int i = (low - 1), j;
62
63      for (j = low; j <= high - 1; j++)
64          if (*(arr + j) < pivot)
65              swap(arr + ++i, arr + j);
66
67      swap(arr + (i + 1), arr + high);
68      return (i + 1);
69  }
70
71
72  void swap(int *a, int *b)
73  {
74      int temp = *a;
75      *a = *b;
76      *b = temp;
77  }
78
79
80  int find_pos(int *arr, int numIter, int val)
81  {
82      int pos, i;
83
84      for (i = 0; i < numIter; i++)
85          if (val == *(arr + i))
86              pos = i;
87
88      return pos;
89  }
```

3.5 arrhandler.h

```
1  #ifndef ARRHANDLER_H
2  #define ARRHANDLER_H
3
4  #include "kcombinations.h"
5
6  int *fill_array(int);
7  bool exists_in_array(int *, int, int);
8
9  void quicksort(int *, int, int);
10 int partition(int *, int, int);
11 void swap(int *, int *);
12
13 #endif
```

3.6 Διάγραμμα ροής

3.7 Περιγραφή υλοποιήσης

4 fcombinations - συνδυασμοί από αρχείο

4.1 main.c

```c
#include "fcombinations.h"

int main(int argc, char **argv)
{
    int N, K;
    int *arr;
    int x1, x2, y1, y2;

    read_file(argv);

    return 0;
}
```

4.2 fcombinations.c

```c
#include "fcombinations.h"

void read_file(char **argv)
{
    FILE *dataFile = fopen(argv[1], "r");

    if (dataFile == NULL)
    {
        set_color(BOLD_RED);
        printf("Error! Not enough memory, exiting...\n");
        exit(EXIT_FAILURE);
        set_color(STANDARD);
    }
    else
    {
        printf("Cool\n");
        // fscanf();
    }

    fclose(dataFile);
}


void x_pair(int *x1, int *x2)
{
    do
    {
```

```
28          printf("x1: ");
29          scanf("%d", x1);
30          printf("x2: ");
31          scanf("%d", x2);
32      } while (*x1 < 0 || *x1 > *x2 || *x2 > 6);
33  }
34
35
36  void y_pair(int *y1, int *y2)
37  {
38      do
39      {
40          printf("y1: ");
41          scanf("%d", y1);
42          printf("y2: ");
43          scanf("%d", y2);
44      } while (*y1 < 21 || *y1 > *y2 || *y2 > 279);
45  }
46
47
48  void print_combs(int *arr, int N, int x1, int x2, int y1,
        int y2)
49  {
50      int *currComb = (int *)malloc(N * sizeof(int));
51      int unFrstCond = 0, unScndCondOnly = 0, printed = 0;
52
53      if (currComb == NULL)
54      {
55          set_color(BOLD_RED);
56          printf("Error! Not enough memory, exiting...\n");
57          exit(EXIT_FAILURE);
58          set_color(STANDARD);
59      }
60      else
61      {
62          combinations(arr, currComb, 0, N-1, 0, &printed, &
        unFrstCond, &unScndCondOnly, x1, x2, y1, y2);
63          print_other(N, unFrstCond, unScndCondOnly, printed);
64      }
65
66      free(currComb);
67  }
68
69
70  void combinations(int *arr, int *currComb, int start, int
        end, int index, int *printed, int *unFrstCond, int *
        unScndCondOnly, int x1, int x2, int y1, int y2)
71  {
72      int i, j;
73
```

```
74      if (index == COMBSN)
75      {
76          for (j = 0; j < COMBSN; j++)
77          {
78              if (even_calc(currComb, x1, x2) && sum_comb_calc
    (currComb, y1, y2))
79              {
80                  printf("%d ", *(currComb + j));
81                  if (j == COMBSN - 1) { (*printed)++; printf(
    "\n"); }
82              } // add freq
83          }
84          if (!even_calc(currComb, x1, x2) && sum_comb_calc(
    currComb, y1, y2)) (*unFrstCond)++;
85          if (!sum_comb_calc(currComb, y1, y2)) (*
    unScndCondOnly)++;
86          return;
87      }
88
89      for (i = start; i <= end && end-i+1 >= COMBSN-index; i++
    )
90      {
91          *(currComb + index) = *(arr + i);
92          combinations(arr, currComb, i+1, end, index+1,
    printed, unFrstCond, unScndCondOnly, x1, x2, y1, y2);
93      }
94  }
95
96
97  bool even_calc(int *arr, int x1, int x2)
98  {
99      int numEven = 0, i;
100
101     for (i = 0; i < COMBSN; i++)
102         if (*(arr + i) % 2 == 0) numEven++;
103
104     return (numEven >= x1 && numEven <= x2) ? true : false;
105 }
106
107
108 bool sum_comb_calc(int *arr, int y1, int y2)
109 {
110     int sumNums = 0, i;
111
112     for (i = 0; i < COMBSN; i++)
113         sumNums += *(arr + i);
114
115     return (sumNums >= y1 && sumNums <= y2) ? true : false;
116 }
117
```

```
118
119 int frequency()
120 {
121
122 }
123
124
125 long int combinations_count(int N) // wtf ???????
126 {
127     return (factorial(N) / (factorial(COMBSN) * factorial(N
    - COMBSN)));
128 }
129
130
131 long double factorial(int num)
132 {
133     int i;
134     long double fac;
135     if (num == 0) return -1;
136     else for (i = 1, fac = 1; i <= num; i++) fac *= i;
137     return fac;
138 }
139
140
141 void print_other(int N, int unFrstCond, int unScndCondOnly,
    int printed)
142 {
143     printf("\nTotal number of combinations %d to %d: %ld\n",
     N, COMBSN, combinations_count(N));
144     printf("Number of combinations not satisfying the first
    condition: %d\n", unFrstCond);
145     printf("Number of combinations not satisfying the second
     condition only: %d\n", unScndCondOnly);
146     printf("Printed combinations: %d\n", printed);
147 }
```

4.3 fcombinations.h

```
1 #ifndef COMBINATIONS_H
2 #define COMBINATIONS_H
3
4 #include <stdio.h>
5 #include <stdlib.h>
6 #include <stdbool.h>
7 #include <string.h>
8
9 #include "arrhandler.h"
10 #include "ccolors.h"
11
12 #define COMBSN 6
```

```
13
14 void read_file();
15
16 void x_pair(int *, int *);
17 void y_pair(int *, int *);
18
19 void print_combs(int *, int, int, int, int, int);
20 void combinations(int *, int *, int, int, int, int *, int *,
       int *, int, int, int, int);
21
22 bool even_calc(int *, int, int);
23 bool sum_comb_calc(int *, int, int);
24
25 int frequency();
26 long int combinations_count(int);
27 long double factorial(int);
28 void print_other(int, int, int, int); // add freq
29
30 #endif
```

4.4 arrhandler.c

```
1  #include "arrhandler.h"
2
3  int *fill_array(int N)
4  {
5      int num, i = 0;
6      int *arr = (int *)malloc(N * sizeof(int));
7
8      if (arr == NULL)
9      {
10         set_color(BOLD_RED);
11         printf("Error! Not enough memory, exiting...\n");
12         exit(EXIT_FAILURE);
13         set_color(STANDARD);
14     }
15     else
16     {
17         do
18         {
19             printf("arr[%d]: ", i);
20             scanf("%d", &num);
21
22             if (num >= 1 && num <= 49)
23             {
24                 if (i == 0) { *(arr + i) = num; i++; }
25                 else
26                 {
27                     if (!exists_in_array(arr, N, num)) { *(
       arr + i) = num; i++; }
```

```
28                      else printf("Give a different number.\n"
    );
29                  }
30              }
31              else printf("Give a number in [1, 49].\n");
32          } while (i < N);
33      }
34
35      return arr;
36  }
37
38
39  bool exists_in_array(int *arr, int N, int num)
40  {
41      int *arrEnd = arr + (N - 1);
42      while (arr <= arrEnd && *arr != num) arr++;
43      return (arr <= arrEnd) ? true : false;
44  }
45
46
47  void quicksort(int *arr, int low, int high)
48  {
49      if (low < high)
50      {
51          int partIndex = partition(arr, low, high);
52          quicksort(arr, low, partIndex - 1);
53          quicksort(arr, partIndex + 1, high);
54      }
55  }
56
57
58  int partition(int *arr, int low, int high)
59  {
60      int pivot = *(arr + high);
61      int i = (low - 1), j;
62
63      for (j = low; j <= high - 1; j++)
64          if (*(arr + j) < pivot)
65              swap(arr + ++i, arr + j);
66
67      swap(arr + (i + 1), arr + high);
68      return (i + 1);
69  }
70
71
72  void swap(int *a, int *b)
73  {
74      int temp = *a;
75      *a = *b;
76      *b = temp;
```

```
77 }
```

4.5 arrhandler.h

```
1  #ifndef ARRHANDLER_H
2  #define ARRHANDLER_H
3
4  #include "fcombinations.h"
5
6  int *fill_array(int);
7  bool exists_in_array(int *, int, int);
8
9  void quicksort(int *, int, int);
10 int partition(int *, int, int);
11 void swap(int *, int *);
12
13 #endif
```

4.6 Διάγραμμα ροής

4.7 Περιγραφή υλοποιήσης

5 minesweeper - ναρκαλιευτής

5.1 main.c

```
1  #include "minesweeper.h"
2
3  int main(int argc, char **argv)
4  {
5
6      main_win();
7      options_menu();
8      int yMax, xMax;
9      WINDOW *menuWin = menu_win(&yMax, &xMax);
10
11     int COLS = set_cols(menuWin, xMax);
12     int ROWS = set_rows(menuWin, yMax);
13     int NMINES = set_nmines(menuWin, COLS*ROWS);
14
15     WINDOW *gameWin = game_win(COLS, ROWS, NMINES);
16     char **dispboard = init_dispboard(gameWin, COLS, ROWS);
17     char **mineboard = init_mineboard(gameWin, COLS, ROWS,
       NMINES);
18     play_minesweeper(gameWin, dispboard, mineboard, COLS,
       ROWS, NMINES);
19
20     free(dispboard);
21     free(mineboard);
22
```

```
23      endwin();
24
25      return 0;
26  }
```

5.2 minesweeper.c

```
1   #include "minesweeper.h"
2
3   char **init_dispboard(WINDOW *gameWin, int COLS, int ROWS)
4   {
5       int i;
6       char **dispboard = (char **)malloc(COLS * sizeof(char *)
        );
7       for (i = 0; i < COLS; i++)
8           dispboard[i] = (char *)malloc(ROWS);
9
10      if (dispboard == NULL)
11      {
12          mvprintw(1, 1, "Error, not enough memory, exiting...
        ");
13          exit(EXIT_FAILURE);
14      }
15      else
16      {
17          fill_dispboard(dispboard, COLS, ROWS);
18          print_board(gameWin, dispboard, COLS, ROWS);
19      }
20
21      return dispboard;
22  }
23
24
25  void fill_dispboard(char **dispboard, int COLS, int ROWS)
26  {
27      int i, j;
28
29      for (i = 0; i < COLS; i++)
30          for (j = 0; j < ROWS; j++)
31              dispboard[i][j] = BLANK;
32  }
33
34
35  char **init_mineboard(WINDOW *gameWin, int COLS, int ROWS,
        int NMINES)
36  {
37      int i;
38      char **mineboard = (char **)malloc(COLS * sizeof(char *)
        );
39      for (i = 0; i < COLS; i++)
```

```
40          mineboard[i] = (char *)malloc(ROWS);
41
42      if (mineboard == NULL)
43      {
44          mvprintw(1, 1, "Error, not enough memory, exiting...
    ");
45          exit(EXIT_FAILURE);
46      }
47      else
48      {
49          place_mines(mineboard, COLS, ROWS, NMINES);
50          add_adj(mineboard, COLS, ROWS);
51          fill_spaces(mineboard, COLS, ROWS, NMINES);
52          //print_board(gameWin, mineboard, COLS, ROWS);
53          //filewrite(mineboard, COLS, ROWS, 1, 2);
54      }
55
56      return mineboard;
57  }
58
59
60  void place_mines(char **mineboard, int COLS, int ROWS, int
        NMINES)
61  {
62      int i, wRand, hRand;
63
64      srand(time(NULL));
65
66      for (i = 0; i < NMINES; i++)
67      {
68          wRand = rand() % ROWS;
69          hRand = rand() % COLS;
70          mineboard[wRand][hRand] = MINE;
71      }
72  }
73
74
75  void add_adj(char **mineboard, int COLS, int ROWS)
76  {
77      int i, j;
78
79      for (i = 0; i < COLS; i++)
80          for (j = 0; j < ROWS; j++)
81              if (!is_mine(mineboard, i, j))
82                  mineboard[i][j] = adj_mines(mineboard, i, j,
        COLS, ROWS) + '0';
83  }
84
85
86  bool is_mine(char **mineboard, int row, int col)
```

```
87 {
88     return (mineboard[row][col] == MINE) ? true : false;
89 }
90
91 bool outof_bounds(int row, int col, int COLS, int ROWS)
92 {
93     return (row < 0 || row > COLS-1 || col < 0 || col > ROWS
       -1) ? true : false;
94 }
95
96
97
98 int8_t adj_mines(char **mineboard, int row, int col, int
       COLS, int ROWS)
99 {
100     int8_t numAdj = 0;
101
102     if (!outof_bounds(row, col - 1, COLS, ROWS)      &&
       mineboard[row][col-1]    == MINE) numAdj++; // North
103     if (!outof_bounds(row, col + 1, COLS, ROWS)      &&
       mineboard[row][col+1]    == MINE) numAdj++; // South
104     if (!outof_bounds(row + 1, col, COLS, ROWS)      &&
       mineboard[row+1][col]    == MINE) numAdj++; // East
105     if (!outof_bounds(row - 1, col, COLS, ROWS)      &&
       mineboard[row-1][col]    == MINE) numAdj++; // West
106     if (!outof_bounds(row + 1, col - 1, COLS, ROWS)  &&
       mineboard[row+1][col-1]  == MINE) numAdj++; // North-East
107     if (!outof_bounds(row - 1, col - 1, COLS, ROWS)  &&
       mineboard[row-1][col-1]  == MINE) numAdj++; // North-West
108     if (!outof_bounds(row + 1, col + 1, COLS, ROWS)  &&
       mineboard[row+1][col+1]  == MINE) numAdj++; // South-East
109     if (!outof_bounds(row - 1, col + 1, COLS, ROWS)  &&
       mineboard[row-1][col+1]  == MINE) numAdj++; // South-West
110
111     return numAdj;
112 }
113
114
115 void fill_spaces(char **mineboard, int COLS, int ROWS, int
       NMINES)
116 {
117     int i, j;
118
119     for (i = 0; i < COLS; i++)
120         for (j = 0; j < ROWS; j++)
121             if (mineboard[i][j] != MINE && mineboard[i][j] =
       = '0')
122                 mineboard[i][j] = '-';
123 }
```

5.3 minesweeper.h

```
#ifndef MINESWEEPER_H
#define MINESWEEPER_H

#if defined linux || defined __unix__
#include <ncurses.h>
#elif defined _WIN32 || defined _WIN64
#include <pdcurses.h>
#include <stdint.h>
#endif

#include <stdlib.h>
#include <string.h>
#include <time.h>

#include "settings.h"
#include "gameplay.h"
#include "navigation.h"
#include "outputs.h"
#include "wins.h"

#define BLANK ' '
#define MINE '*'
#define CLEAR "
                        "

char **init_dispboard(struct _win_st*, int, int);
void fill_dispboard(char **, int, int);
char **init_mineboard(struct _win_st*, int, int, int);

void place_mines(char **, int, int, int);
void add_adj(char **, int, int);
bool is_mine(char **, int, int);
bool outof_bounds(int, int, int, int);
int8_t adj_mines(char **, int, int, int, int);
void fill_spaces(char **, int, int, int);

#endif
```

5.4 gameplay.c

```
#include "minesweeper.h"

char **init_dispboard(WINDOW *gameWin, int COLS, int ROWS)
{
    int i;
    char **dispboard = (char **)malloc(COLS * sizeof(char *)
    );
    for (i = 0; i < COLS; i++)
```

```
8           dispboard[i] = (char *)malloc(ROWS);
9
10      if (dispboard == NULL)
11      {
12          mvprintw(1, 1, "Error, not enough memory, exiting...
        ");
13          exit(EXIT_FAILURE);
14      }
15      else
16      {
17          fill_dispboard(dispboard, COLS, ROWS);
18          print_board(gameWin, dispboard, COLS, ROWS);
19      }
20
21      return dispboard;
22  }
23
24
25  void fill_dispboard(char **dispboard, int COLS, int ROWS)
26  {
27      int i, j;
28
29      for (i = 0; i < COLS; i++)
30          for (j = 0; j < ROWS; j++)
31              dispboard[i][j] = BLANK;
32  }
33
34
35  char **init_mineboard(WINDOW *gameWin, int COLS, int ROWS,
        int NMINES)
36  {
37      int i;
38      char **mineboard = (char **)malloc(COLS * sizeof(char *)
        );
39      for (i = 0; i < COLS; i++)
40          mineboard[i] = (char *)malloc(ROWS);
41
42      if (mineboard == NULL)
43      {
44          mvprintw(1, 1, "Error, not enough memory, exiting...
        ");
45          exit(EXIT_FAILURE);
46      }
47      else
48      {
49          place_mines(mineboard, COLS, ROWS, NMINES);
50          add_adj(mineboard, COLS, ROWS);
51          fill_spaces(mineboard, COLS, ROWS, NMINES);
52          //print_board(gameWin, mineboard, COLS, ROWS);
53          //filewrite(mineboard, COLS, ROWS, 1, 2);
```

```
54      }
55
56      return mineboard;
57  }
58
59
60  void place_mines(char **mineboard, int COLS, int ROWS, int
        NMINES)
61  {
62      int i, wRand, hRand;
63
64      srand(time(NULL));
65
66      for (i = 0; i < NMINES; i++)
67      {
68          wRand = rand() % ROWS;
69          hRand = rand() % COLS;
70          mineboard[wRand][hRand] = MINE;
71      }
72  }
73
74
75  void add_adj(char **mineboard, int COLS, int ROWS)
76  {
77      int i, j;
78
79      for (i = 0; i < COLS; i++)
80          for (j = 0; j < ROWS; j++)
81              if (!is_mine(mineboard, i, j))
82                  mineboard[i][j] = adj_mines(mineboard, i, j,
         COLS, ROWS) + '0';
83  }
84
85
86  bool is_mine(char **mineboard, int row, int col)
87  {
88      return (mineboard[row][col] == MINE) ? true : false;
89  }
90
91  bool outof_bounds(int row, int col, int COLS, int ROWS)
92  {
93      return (row < 0 || row > COLS-1 || col < 0 || col > ROWS
        -1) ? true : false;
94  }
95
96
97
98  int8_t adj_mines(char **mineboard, int row, int col, int
        COLS, int ROWS)
99  {
```

```
100     int8_t numAdj = 0;
101
102     if (!outof_bounds(row, col - 1, COLS, ROWS)      &&
        mineboard[row][col-1]    == MINE) numAdj++; // North
103     if (!outof_bounds(row, col + 1, COLS, ROWS)      &&
        mineboard[row][col+1]    == MINE) numAdj++; // South
104     if (!outof_bounds(row + 1, col, COLS, ROWS)      &&
        mineboard[row+1][col]    == MINE) numAdj++; // East
105     if (!outof_bounds(row - 1, col, COLS, ROWS)      &&
        mineboard[row-1][col]    == MINE) numAdj++; // West
106     if (!outof_bounds(row + 1, col - 1, COLS, ROWS)  &&
        mineboard[row+1][col-1]  == MINE) numAdj++; // North-East
107     if (!outof_bounds(row - 1, col - 1, COLS, ROWS)  &&
        mineboard[row-1][col-1]  == MINE) numAdj++; // North-West
108     if (!outof_bounds(row + 1, col + 1, COLS, ROWS)  &&
        mineboard[row+1][col+1]  == MINE) numAdj++; // South-East
109     if (!outof_bounds(row - 1, col + 1, COLS, ROWS)  &&
        mineboard[row-1][col+1]  == MINE) numAdj++; // South-West
110
111     return numAdj;
112 }
113
114
115 void fill_spaces(char **mineboard, int COLS, int ROWS, int
        NMINES)
116 {
117     int i, j;
118
119     for (i = 0; i < COLS; i++)
120         for (j = 0; j < ROWS; j++)
121             if (mineboard[i][j] != MINE && mineboard[i][j] =
        = '0')
122                 mineboard[i][j] = '-';
123 }
```

5.5 gameplay.h

```
1  #ifndef GAMEPLAY_H
2  #define GAMEPLAY_H
3
4  #include "minesweeper.h"
5
6  void play_minesweeper(struct _win_st*, char **, char **, int
       , int, int);
7  void transfer(char **, char **, int, int);
8  void reveal(struct _win_st*, char **, int, int, int, int);
9  void flag_handler();
10 bool is_flagged();
11 bool is_defused(char **, char **, int, int);
12
```

```
13 #endif
```

5.6 navigation.c

```
1  #include "navigation.h"
2
3  void navigate(WINDOW *gameWin, char **mineboard, char *move,
       int *mboardXLoc, int *mboardYLoc)
4  {
5      int yMax, xMax;
6      static int yLoc = 1, xLoc = 2;
7      getmaxyx(gameWin, yMax, xMax);
8      wmove(gameWin, yLoc-1, xLoc);
9
10     update_curs(gameWin, yLoc, xLoc);
11     *mboardYLoc = yLoc-1;
12     *mboardXLoc = (xLoc-2)/3;
13     mvprintw(1, 1, "Current position: (%d, %d) ", *
       mboardXLoc+1, *mboardYLoc+1);
14     refresh();
15     getmv(gameWin, move, &yLoc, &xLoc, yMax, xMax);
16 }
17
18
19 void getmv(WINDOW *gameWin, char *move, int *yLoc, int *xLoc
       , int yMax, int xMax)
20 {
21     *move = wgetch(gameWin);
22     switch (*move) // vim keys support!!
23     {
24         case 'k': case 'K':
25         case 'w': case 'W':
26             mvup(yLoc, xLoc);
27             break;
28         case 'j': case 'J':
29         case 's': case 'S':
30             mvdown(yLoc, xLoc, yMax, xMax);
31             break;
32         case 'h': case 'H':
33         case 'a': case 'A':
34             mvleft(yLoc, xLoc);
35             break;
36         case 'l': case 'L':
37         case 'd': case 'D':
38             mvright(yLoc, xLoc, yMax, xMax);
39             break;
40         default: break;
41     }
42 }
43
```

```
44
45 void mvup(int *yLoc, int *xLoc)
46 {
47     (*yLoc)--;
48     if (*yLoc < 1) *yLoc = 1;
49 }
50
51
52 void mvdown(int *yLoc, int *xLoc, int yMax, int xMax)
53 {
54     (*yLoc)++;
55     if (*yLoc > yMax-2) *yLoc = yMax-2;
56 }
57
58
59 void mvleft(int *yLoc, int *xLoc)
60 {
61     *xLoc -= 3;
62     if (*xLoc < 2) *xLoc = 2;
63 }
64
65
66 void mvright(int *yLoc, int *xLoc, int yMax, int xMax)
67 {
68     *xLoc += 3;
69     if (*xLoc > xMax-3) *xLoc = xMax-3;
70 }
71
72
73 void update_curs(WINDOW *gameWin, int yLoc, int xLoc)
74 {
75     wmove(gameWin, yLoc, xLoc);
76 }
```

5.7 navigation.h

```
1 #ifndef NAVIGATION_H
2 #define NAVIGATION_H
3
4 #include "minesweeper.h"
5
6 void navigate(struct _win_st*, char **, char *, int *, int *
      );
7 void getmv(struct _win_st*, char *, int *, int *, int, int);
8 void mvup(int *, int *);
9 void mvdown(int *, int *, int, int);
10 void mvleft(int *, int *);
11 void mvright(int *, int *, int, int);
12 void update_curs(struct _win_st*, int, int);
13
```

```
14 #endif
```

5.8 settings.c

```
1  #include "settings.h"
2
3  int set_cols(WINDOW *menuWin, int xMax)
4  {
5      int COLS;
6
7      do
8      {
9          mvwprintw(menuWin, 1, 1, "Columns (Max = %d): ", (
       xMax-2)/3 - 2);
10         wrefresh(menuWin);
11         scanw("%d", &COLS);
12         mvwprintw(menuWin, 1, COLS_CHAR_LENGTH, "%d", COLS);
13         wrefresh(menuWin);
14     } while (COLS < 5 || COLS > (xMax-2)/3 - 2);
15
16     return COLS;
17 }
18
19
20 int set_rows(WINDOW *menuWin, int yMax)
21 {
22     int ROWS;
23
24     do
25     {
26         mvwprintw(menuWin, 2, 1, "Rows (Max = %d): ", yMax-1
       4);
27         wrefresh(menuWin);
28         scanw("%d", &ROWS);
29         mvwprintw(menuWin, 2, ROWS_CHAR_LENGTH, "%d", ROWS);
30         wrefresh(menuWin);
31     } while (ROWS < 5 || ROWS > yMax - 14);
32
33     return ROWS;
34 }
35
36
37 int set_nmines(WINDOW *menuWin, int DIMENSIONS)
38 {
39     int NMINES;
40
41     do
42     {
43         mvwprintw(menuWin, 3, 1, "Mines (Max = %d): ",
       DIMENSIONS-10); // -10 so the player has a chance to win
```

```
44          wrefresh(menuWin);
45          scanw("%d", &NMINES);
46          mvwprintw(menuWin, 3, NMINES_CHAR_LENGTH, "%d",
        NMINES);
47          wrefresh(menuWin);
48      } while (NMINES < 1 || NMINES > DIMENSIONS-10);
49
50      return NMINES;
51  }
```

5.9 settings.h

```
1  #ifndef SETTINGS_H
2  #define SETTINGS_H
3
4  #include "minesweeper.h"
5
6  #define COLS_CHAR_LENGTH strlen("Columns (Max = XXX): ") + 1
7  #define ROWS_CHAR_LENGTH strlen("Rows (Max = YYY): ") + 1
8  #define NMINES_CHAR_LENGTH strlen("Mines (Max = MMMM): ") +
       1
9
10 int set_cols(struct _win_st*, int);
11 int set_rows(struct _win_st*, int);
12 int set_nmines(struct _win_st*, int);
13 void init_colors();
14
15 #endif
```

5.10 outputs.c

```
1  #include "outputs.h"
2
3  void print_board(WINDOW *gameWin, char **board, int COLS,
       int ROWS)
4  {
5      int i, j, x, y = 1;
6
7      print_grid(gameWin, ROWS, COLS);
8
9      for (i = 0; i < ROWS; i++)
10     {
11         x = 2;
12         for (j = 0; j < COLS; j++)
13         {
14             wattron(gameWin, A_BOLD);
15             mvwaddch(gameWin, y, x, board[i][j]);
16             x += 3;
17         }
18         y++;
```

```
19      }
20
21      wrefresh(gameWin);
22      wattron(gameWin, A_BOLD);
23  }
24
25
26  void print_grid(WINDOW *gameWin, int ROWS, int COLS)
27  {
28      int i, j;
29
30      for (i = 1; i <= ROWS; i++)
31      {
32          wmove(gameWin, i, 1);
33          for (j = 0; j < COLS; j++)
34              wprintw(gameWin, "[ ]");
35      }
36
37      wrefresh(gameWin);
38  }
39
40
41  void filewrite(char **mineboard, int COLS, int ROWS, int
        hitRow, int hitCol, const char *status)
42  {
43      int i, j;
44      FILE *mnsOut = fopen("txt/mnsout.txt", "w");
45
46      if (mnsOut == NULL)
47      {
48          mvprintw(1, 1, "Error opening file, exiting...");
49          exit(EXIT_FAILURE);
50      }
51      else
52      {
53          strcmp(status, "won")
54              ? fprintf(mnsOut, "Mine hit at position (%d, %d)
        \n\n", hitRow+1, hitCol+1)
55              : fprintf(mnsOut, "Last mine defused at position
         (%d, %d)\n\n", hitRow+1, hitCol+1);
56          fprintf(mnsOut, "Board overview\n\n");
57
58          for (i = 0; i < ROWS; i++)
59          {
60              for (j = 0; j < COLS; j++)
61                  fprintf(mnsOut, "%c ", mineboard[i][j]);
62              fprintf(mnsOut, "\n");
63          }
64
65          mvprintw(1, 1, "Session written to file %s", CLEAR);
```

```
66          refresh();
67          getchar();
68      }
69
70      fclose(mnsOut);
71  }
72
73
74  void game_won(WINDOW *gameWin, int yMiddle, int xMiddle)
75  {
76      wclear(gameWin);
77      wrefresh(gameWin);
78      wattron(stdscr, A_BOLD);
79      mvwprintw(stdscr, yMiddle-2, xMiddle-11, "You defused
        all the mines!");
80      mvwprintw(stdscr, yMiddle-1, xMiddle-3, "You won :)");
81      mvwprintw(stdscr, yMiddle, xMiddle-11, "Press any key to
         continue");
82      refresh();
83      wattroff(stdscr, A_BOLD);
84  }
85
86
87  void game_over(WINDOW *gameWin, char **mineboard, int
        yMiddle, int xMiddle)
88  {
89      wclear(gameWin);
90      wrefresh(gameWin);
91      wattron(stdscr, A_BOLD);
92      mvwprintw(stdscr, yMiddle-2, xMiddle-24, "You hit a mine
        ! (or tried to defuse the wrong cell)");
93      mvwprintw(stdscr, yMiddle-1, xMiddle-4, "Game over :(");
94      mvwprintw(stdscr, yMiddle, xMiddle-11, "Press any key to
         continue");
95      refresh();
96      wattroff(stdscr, A_BOLD);
97  }
```

5.11 outputs.h

```
1  #ifndef OUTPUTS_H
2  #define OUTPUTS_H
3
4  #include "minesweeper.h"
5
6  void print_grid(struct _win_st*, int, int);
7  void print_board(struct _win_st*, char **, int, int);
8  void game_won(struct _win_st*, int, int);
9  void game_over(struct _win_st*, char **, int, int);
10 void filewrite(char **, int, int, int, int, const char *);
```

```

#endif
```

5.12 wins.c

```
#include "wins.h"

void main_win()
{
    initscr();
    noecho();
    cbreak();

    WINDOW *mainWin = newwin(0, 0, 0, 0);
    wattron(mainWin, A_BOLD);
    box(mainWin, 0, 0);
    refresh();
    wrefresh(mainWin);
    wattroff(mainWin, A_BOLD);
}


WINDOW *menu_win(int *yMax, int *xMax)
{
    int numSettings = 3;
    getmaxyx(stdscr, *yMax, *xMax);
    WINDOW *menuWin = newwin(numSettings+2, *xMax-8, *yMax-8
    , 4);
    wattron(menuWin, A_BOLD);
    box(menuWin, 0, 0);
    wrefresh(menuWin);
    wattroff(menuWin, A_BOLD);
    return menuWin;
}


WINDOW *game_win(int COLS, int ROWS, int NMINES)
{
    int winRows = ROWS + 2;
    int winCols = COLS*3 + 2;
    WINDOW *gameWin = newwin(winRows, winCols, 2, 4);
    wattron(gameWin, A_BOLD);
    box(gameWin, 0, 0);
    wrefresh(gameWin);
    wattroff(gameWin, A_BOLD);
    return gameWin;
}


void options_menu()
```

```
45 {
46     int yMax = getmaxy(stdscr);
47     mvprintw(yMax-3, 5, "q Quit      w/k Move up      s/j Move
        down        a/h Move Left        d/l Move Right       [
       ENTER]/o Open cell");
48     mvprintw(yMax-2, 5, "f Flag cell      g Defuse (if
       flagged only)");
49     refresh();
50 }
```

5.13 wins.h

```
1  #ifndef WINS_H
2  #define WINS_H
3
4  #include "minesweeper.h"
5
6  void main_win();
7  WINDOW *menu_win(int *, int *);
8  WINDOW *game_win(int, int, int);
9  void options_menu();
10 void options_win();
11
12 #endif
```

5.14 Διάγραμμα ροής

5.15 Περιγραφή υλοποιήσης

Ο ναρκαλιευτής αυτός χρησιμοποιεί την βιβλιοθήκη ncurses και είναι δομημένος ως εξής: Από το main.c καλούνται αρχικά οι συναρτήσεις δημιουργίας των παραθύρων που θα εμφανιστούν στην οθόνη και στην συνέχεια καλούνται οι συναρτήσεις δημιουργίας των πινάκων $M \times N$, για το ναρκοπέδιο και για τον πίνακα που έχει "κρυμμένα" τα κελιά αντίστοιχα. Τέλος από την main καλείται η συνάρτηση που θα ξεκινήσει το παιχνίδι.

Οι συναρτήσεις για τις στήλες, γραμμές, και αριθμό των ναρκών βρίσκονται στο settings.h

Στο minesweeper.c εκτελούνται όλες οι συναρτήσεις δημιουργίας πινάκων, τοποθέτησεις ναρκών, μέτρημα των βομβών στα γειτονικά κελιά, καθώς και γέμισμα των κενών θέσεων τους.

Έπειτα, στο gameplay.c εκτελείται το παιχνίδι - αρχικά τυπώνεται ο πίνακας και το περίγραμμα που υπάρχει ανάμεσα σε κάθε κελί ώστε να είναι πιο εμφανίσιμο και πιο εύχρηστο το παιχνίδι. Προκειμένου τα κελιά να τοποθετηθούν στις κατάλληλες θέσεις στον πίνακα, δηλαδή να είναι ανάμεσα στα [ ], τα στοιχεία των πινάκων τοποθετούνται κάθε φορά με απόσταση 2 στον κάθετο άξονα και 3 στον οριζόντιο το ένα από το άλλο. Με αυτά τα 2 νούμερα προκύπτουν και 2 τύποι, οι οποίοι βοηθάνε στην σωστή προσπέλαση των στοιχείων των πινάκων κατά την διάρκεια του παιχνιδιού, και στον υπολογισμό των διαστάσεων του παραθύρου που εμφανίζεται το πεδίο. Οι τύποι είναι οι εξής

$$x = rows + 2 \tag{1}$$

$$y = columns \times 3 + 2 \tag{2}$$

Αφού τυπωθεί στην οθόνη ο πίνακας με κρυμμένα τα στοιχεία του, το οποίο είναι στην ουσία ένας $M \times N$ πίνακας γεμισμένος με κενά, ξεκινάει το βασικό loop του παιχνιδιού, στο οποίο ο χρήστης μετακινείται από κελί σε κελί, επιλέγει την κίνηση που θέλει να κάνει πάνω σε κάθε κελί, και είτε χάνει ή νικάει. Προκειμένου να λειτουργήσει κάτι τέτοιο, μέσα στο loop γίνονται οι εξής λειτουργίες: Αρχικά ο κέρσορας μετακίνεται κάθε φορά που ο και χρήστης μετακινείται ώστε να μπορεί να δει σε ποιο κελί βρίσκεται και ο χρήστης πρέπει έχει

Λόγω του ότι το πρόγραμμα περιέχει πολλές μεταβλητές θεώρησα καλύτερο να εστιάσω στην λειτουργία του προγράμματος και όχι τόσο στο τι συμβολίζει η κάθε μεταβλητή.

6 Διευκρινήσεις

7 Εργαλεία

- Editors: Visual Studio Code, NVim
- Compiler: gcc
- Shell: zsh
- OS: Arch Linux
- Συγγραφή: LaTeX