Telephone Book

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FUNCTIONS DESCRIPTION

1) Load File

loadFile() function is the first function to be called in our programme.

The user is asked to enter file's name, if file is found it will be opened automatically, and if not, two choices will be available to the user either to enter filename again or create a new file in the same directory with the same name.

For both cases, a validation will take a place to check whether this entry is an integer or not. If not, the user will be prompted to enter his choice again.

```
46  void loadFile()
47  {
48      printf("Please enter the name of the file you want to load: "); //User is prompted to enter the file name and extension
49      scanf("%s",fileName);
50      strcat(fileName,".txt");
51      FILE*f=fopen(fileName,"r"); //Open the file in a read mode.
52      if(!f)
53      { //If the file can not be opened, the user will be asked whether he would like to re-enter its name or create a new one
54          printf("\nFILE CANNOT BE OPENED!  Please choose one of the following options:\n\
55                 t(1)\tRe-enter file name\n\t(2)\tCreate a file with this name\nYour choice: ");
56          int z;
57          do{
58              char x[4];
59              z = input(x); //Prompt the user for his choice and check whether it is an integer or not.
60              if (z!=1&&z!=2)
61                  printf("NOT FOUND!\nPlease re-enter your choice: ");
62          }while (z!=1&&z!=2);
```

Opposingly, 3 cases are to happen:-

First: if he chooses 1, loadFile() function will be called again.

Second: if he chooses 2, a message will be displayed informing the user about a successful creation of the file and saveFile() function will be called.

Third: if he enters any other number an error message will be displayed to let the user re-enter his choice.

To make sure that we are loading a non-empty file, 2 variables containing the starting and ending positions of the file are compared to each other. If found equal, that means the file is empty as a result, the user will be asked to add a contact and main menu will be displayed.

Else, cursor will be moved using rewind() function to the beginning of the file. while loop is used till reaching the end of file to access and read all contacts using the fscanf() functions. The second argument in the fscanf() function "format" is specific for each data type. The "%[^,]," format is used in the strings: First name, Last name, Address, Phone number to scan all the data till reaching the first comma and skips it. The global variable n would be incremented by 1 in each loop to reach the final value (Total number of contacts in the text document). After that, the file is to be closed.

```
63          switch(z)
64          {
65              case 1: loadFile(); break;  //Function will be recalled so the user can re-enter his choice.
66              case 2: printf("A new file with the name %s is created in your directory\n",fileName);saveFile(); break;
67              //User will be asked to add a contact.
68              default: break;
69          }
70      }
71      else //If the file exists and can be opened.
72      {
73          int stPos,edPos; //Variables storing start and end position of the cursor in file
74          stPos=ftell(f);
75          fseek(f,0,SEEK_END);
76          edPos=ftell(f);
77          if(stPos!=edPos){ //If the beginning of the file is the same as its end(File is empty), scanning will not be made.
78              rewind(f); //Return cursor to the beginning of the file
79              while(!feof(f)) //Loop until the end of the file, for each contact get all its data and put the contact in the array.
80              {
81                  fscanf(f,"%[^,],",c[n].l_name);
82                  fscanf(f,"%[^,],",c[n].f_name);
83                  fscanf(f,"%d-%d-%d,",&c[n].DoB.day,&c[n].DoB.month,&c[n].DoB.year);
84                  fscanf(f,"%[^,],",c[n].address);
85                  fscanf(f,"%[^,],",c[n].num);
86                  fscanf(f,"%s\n",c[n].mail);
87                  n++; //n is a global variable starting with 0, is incremented by 1 after each loop,
88                  //so after reaching the end of the file n will be equal to the number of contacts in the file.
89              }}
90          else printf("FILE IS EMPTY!\nYou have to add a contact!\n");
91          fclose(f); //Close the file.
92      }
93  }
```

2) Phonebook Options

a) Input validation

input(char *x) function is used to validate the integer input of the user to avoid character input. Validation is implemented using atoi() function that returns 0 if no validation conversion takes place. Character input in certain parts may result in an infinite loop that will crack the programme.

```
94   int input(char *x)
95   {
96       int i;
97       do{
98       scanf("%s", x); //scan the number entered by the user in a string.
99       i=atoi(x); //Convert the string to a integer.
100      if (i==0) //i will be equal to 0 if no valid conversion takes place.
101          printf("INVALID CHARACTER INPUT!\nPlease re-enter your choice: ");
102      }while(i==0);
103      return i; //The integer is returned
104  }
```

b) Function selector

funcselect(int opt) is the function that will direct the programme according to the user's selection which is saved in the integer variable opt.
switch case condition is used accordingly. For instance, if the user enters '1', searchFile() function would be called. If the user enters none of the valid options, default case would be applied that will print to the user an error message and ask him to re-enter his choice.

```
105  void funcSelect(int opt)
106  {
107      switch(opt) //Variable "opt" is the choice made by the user, and according to it the function will be called.
108      {
109          case 1: searchFile(); break;
110          case 2: add_contact(); break;
111          case 3: delete_contact(); break;
112          case 4: modify_contact(); break;
113          case 5: printFile(); break;
114          case 6: saveFile(); break;
115          case 7: quit(); break;
116          default: //If the user chooses a number which is not from the options, he will be asked to re-enter the number.
117              printf("INVALID CHOICE!\nPlease re-enter your choice: ");
118              char x[4];
119              opt=input(x);
120              funcSelect(opt);
121              break;
122      }
123  }
```

phonebookOpts() function is used to print the menu and calls both functions input(char *x) to scan and validate the user's entry and funcselect(int opt) to direct the programme according to the user's choice.

```
124  void phonebookOpts()
125  {
126      char x[4];
127      printf("\t\tPhonebook options\n\t(1)\t\tSearch for a contact\n\t(2)\t\tAdd a contact\n\t(3)\t\tDelete a contact\n\
128             t(4)\t\tModify a contact\n\t(5)\t\tPrint phonebook\n\t(6)\t\
129             tSave to file\n\t(7)\t\tExit programme\n\tSelect an option from the menu:\t");
130      int opt=input(x); //Prompt the user for his choice, check whether it is an integer.
131      funcSelect(opt); //Call the function selected.
132  }
```

3) Back

back() function asks the user either he wants to go back to menu or not. User would be prompted to enter either 'Y' or 'N'(Not case-sensitive). If he chose 'Y', phonebookOpts() function would be called. Else the programme will terminate. Validation was used to assure that the input is either 'Y' or 'N' (Not case-sensitive).

```
133  void back()
134  {
135      printf("\nDo you want to go back to menu(Y or N)? "); //The user is asked if he wants to go back to the main menu.
136      char ch;
137      scanf(" %c",&ch);
138      while((ch!='Y'&&ch!='y')&&(ch!='N'&&ch!='n'))
139      {
140          printf("\nINVALID INPUT!\nPlease re-enter your choice: ");
141          scanf(" %c",&ch);
142      }
143      if(ch=='Y'||ch=='y')
144          phonebookOpts(); //If the user said YES, the menu is displayed.
145      else if(ch=='N'||ch=='n')
146      {
147          printf("\nTHANK YOU!\n"); //If the user said NO, he will exit the programme.
148          exit(0);
149      }
150  }
```

4) Deciding Functions

a) Save File

saveFile() function is used to open the file in write only mode, to copy the data in the array to it. If the file was not opened by any means, an error message would be displayed. fprintf() function is used to copy the data to the file in a comma separated format. After that, the file is to be closed. Finally, back() function is to be called.

```
151  void saveFile()
152  {
153      int i;
154      FILE*f=fopen(fileName,"w"); //Open the file in write mode to re-enter the contacts.
155      if(!f)
156      {
157          printf("FILE CANNOT BE SAVED!");
158          exit(1);
159      } //Exit if the file can not be opened.
160      for(i=0;i<n;i++) // Loop until the end of the array.
161      {
162          fprintf(f,"%s,%s,%d-%d-%d,%s,%s,%s\n",c[i].l_name,c[i].f_name,c[i].DoB.day,c[i].DoB.month,c[i].DoB.year,c[i].address,c[i].num,c[i].mail);
163          //Print all contacts in the file.
164      }
165      fclose(f);
166      if(n)
167          printf("\nDATA SAVED SUCCESSFULLY TO FILE!");
168      back();
169  }
```

b) Decide

decide() function asks the user whether he would like to save the file using saveFile() function or go back to menu using the phonebookOpts() function, and displays an error message if the user entered an invalid input.

```
170  void decide()
171  {
172      printf("\n\t\tDo you want to save or go back to menu\n\t(1)\t\tSave to file\n\t(2)\t\tGo back to menu\nSelect an option from the menu: ");
173      //Ask the user if he wants to save or quit.
174      int z;
175      do{
176          char x[4];
177          z = input(x); //Prompt the user for his choice and check whether it is an integer or not.
178          if (z!=1&&z!=2)
179              printf("INVALID CHOICE!\nPlease re-enter your choice: ");
180      }while (z!=1&&z!=2);
181      switch(z)
182      {
183          case 1: saveFile(); break; //Changes will be saved in the file.
184          case 2: phonebookOpts(); break; //Main menu will be displayed.
185          default: break;
186      }
187  }
```

5) Search for a contact

searchFile() function asks the user to enter the last name for the contact he wants to search for.

ALGORITHM (Linear search): User's entry would be compared to each last name stored in the array using a for loop. If a match is found, the contact's record would be displayed for all matches. Otherwise, a message would be displayed to the user informing him/her that no matches were found.

```
205  void searchFile()
206  {//Linear Search
207      char cname[20];
208      printf("\nSEARCH FOR A CONTACT\nPlease enter contact last name:\t");
209      scanf("%s",cname); //The last name the user wants to search is stored in variable cname.
210      int i,cnt=0;
211      for(i=0; i<n; i++) //Loop on all the contacts of file.
212      {
213          if(strcmp(c[i].l_name,cname)==0) //When the contact the user searched is found, the data of this contact will be printed.
214          {
215              printf("\nContact %d\nFirst name: %s\tAddress: %s\tEmail: %s\tPhone number: %s\n",cnt+1,c[i].f_name,c[i].address,c[i].mail,c[i].num);
216              cnt++; //When a contact with this last name is found, this variable is incremented by 1.
217          }
218      }
219      if(cnt==0) //If this variable equals to 0, that means that it has not been incremented, so no contacts are found.
220          printf("\nNO MATCHES FOUND!\n");
221      back(); //The user is asked if he wants to go back to menu.
222  }
```

6) Adding a contact

a) Enter data

- Phone number validation: checkNum(char nmb[16], int except) function is used to validate the phone numbers entered by the user. 3 types of validations are used:
  - First: we check that the phone number length is between 6 and 15 (Standard Length).
  - Second: we check that the phone number entered is not of another existing contact. Variable (except) is the index for the contact that is being added or modified, we must not compare it with itself.
  - Third: the programme checks for the user entry to assure that the input is only digits (No special characters or letters are allowed). That check is made using the ASCII digits boundaries.

For any wrong entry, and error message would be displayed to the user and he would be prompted for re-entry.

```
223  int checkNum(char nmb[16], int except) //the input of this function is the phone number to check,
224  //and except which is the position of the contact to check.
225  {
226      int i,nl=strlen(nmb);
227      if(nl<6||nl>15)
228      {
229          printf("INVALID PHONE NUMBER LENGTH!\n");
230          return 1;
231      }
232      for(i=0; i<nl; i++) //Check that the phone number consists only of digits (0-9).
233      {
234          if(nmb[i]<48||nmb[i]>57) //According to the ASCII table, a digit is between 48 and 57,
235              //so any character in the phone number out of this range is incorrect.
236          {
237              printf("INVALID CHARACTER INPUT!\n");
238              return 1;
239          }
240      }
241      for(i=0;i<n&&i!=except;i++) //Check whether another contact has the same phone number.
242      {
243          if(strcmp(c[i].num,nmb)==0){
244              printf("NUMBER ALREADY EXISTS!\n");
245              return 1;}
246      }
247      return 0; //Returns 0 if the phone number is valid.
248  }
```

- Date validation: checkDate(int d, int m, int y) function validates the date entered by the user by checking the year to be smaller than 2021, month to be from 1 to 12 inclusive and finally day to be from 1 to 31 except for months (4-6-9-11) in which they have 30 days only.

  It checks also if months was February so it has a maximum of 29 days unless it was a leap year where maximum number of days will be 28.

```
249  int checkDate(int d,int m,int y) //d, m and y are the day, month and year entered by the user respectively.
250  {
251      if (y>2021) //Check that the year has passed.
252      {
253          printf("INVALID YEAR\n");
254          return 1;
255      }
256      if (m<1 || m>12) //Check that the month is between 1 and 12.
257      {
258          printf("INVALID MONTH\n");
259          return 1;
260      }
261      if (d<1 || d>31) //Check that the day is between 1 and 31.
262      {
263          printf("INVALID DAY\n");
264          return 1;
265      }
266      if (d==31 && (m==4 || m==6 || m==9 || m==11)) //Check that there is 31 days in this month.
267      {
268          printf("THIS MONTH DOES NOT HAVE 31 DAYS\n");
269          return 1;
270      }
271      if (m==2 && d>29) //Check that February has not more than 29 days.
272      {
273          printf("FEBRUARY DOES NOT HAVE MORE THAN 29 DAYS\n");
274          return 1;
275      }
276      if (m==2 && d==29 && (y%400 != 0 && (y%4!=0 || y%100==0))) //Check if it is a leap year and February has 29 days.
277      {
278          printf("FEBRUARY ONLY HAS 28 DAYS IN THIS YEAR\n");
279          return 1;
280      }
281      return 0; //It is valid date when all the previous conditions were false.
282  }
```

- Email validation: check_mail(char x[], int except) function validates the email entered by the user. 3 types of validations are used:
  - First: we check that the email entered is not of another existing contact. Variable (except) is the index for the contact that is being added or modified, we must not compare it with itself.

- Second: we check that the username and domain do contain only ‘_’ , ’ - ‘ , ’ . ’,’ A to Z ’,’ a to z ’,’0 to 9’.
- Third: we check that the domain ends with .com and it consists of more than 4 characters.

For any wrong entry, and error message would be displayed to the user and he would be prompted for re-entry.

```
int check_mail(char x[], int except) //x is the mail entered by the user, except is the position of the contact to check.
{
    int i,length=strlen(x),j,found=0;
    char domain[15]; //Checking that the domain is valid.
    for (i=0;i<n;i++) //Check whether another contact has the same email.
    {
        if(!strcmp(x,c[i].mail)&&i!=except)
        {
            printf("EMAIL ALREADY EXISTS!\n");
            return 1; //Invalid email.
        }
    }
    for(i=0;i<length;i++) //Find the position of '@' in the email address.
    {
        if(x[i]=='@')
            {
                j=i; //j is the index of '@'
                found=1;
                break;
            }
    }
    if(!found)
    {
        printf("INVALID INPUT\n");
        return 1;
    }
    for(i=0;i<length;i++) //Checking that the email address before only consists of digits, characters (a-z) or (A-Z), underscore or '.' or '-'.
    {
        if((i!=j) && !(x[i]=='_'||x[i]=='.'||x[i]=='-'||(x[i]>47&&x[i]<58)||(x[i]>64&&x[i]<91)||(x[i]>96&&x[i]<123)))
        {
            printf("INVALID INPUT!\n");
            return 1;
        }
    }
    strcpy(domain, x+j+1); //Copy the part of the email address after the '@'.
    if(strcmp(x+length-4,".com")!= 0 || (strlen(domain)<6)) //Checking that the email ends with ".com" and that the domain length is bigger than 4.
    {
        printf("INVALID DOMAIN!\n");
        return 1;
    }
    return 0; //Email is valid.
}
```

enter_data(int x) function prompts the user to enter all required fields for the contact. It copies the entered data to the array at index 'x' which is the first empty field in the array. The function uses all validation functions mentioned above.

```
325  void enter_data(int x) //x is the position the contact added or modified
326  {
327      //User is prompted field by field for the data of the new contact.
328      printf("First name: ");
329      scanf("%s", c[x].f_name);
330      printf("Last name: ");
331      scanf("%s", c[x].l_name);
332      printf("Birth date(day-month-year): ");
333      scanf("%d-%d-%d", &c[x].DoB.day, &c[x].DoB.month, &c[x].DoB.year);
334      int w=checkDate(c[x].DoB.day,c[x].DoB.month,c[x].DoB.year); //Validation of the date.
335      while(w) //While is true when "w" != 0, that means that the date entered was incorrect.
336      {
337          printf("Please re-enter birth date(day-month-year): ");
338          scanf("%d-%d-%d", &c[x].DoB.day, &c[x].DoB.month, &c[x].DoB.year);
339          w=checkDate(c[x].DoB.day,c[x].DoB.month,c[x].DoB.year);
340      }
341      printf("Address: ");
342      scanf(" %[^\n]", c[x].address);
343      printf("Phone number: ");
344      scanf("%s", c[x].num);
345      w=checkNum(c[x].num,x);
346      while(w) //While is true when "w" != 0, that means that the phone number entered was incorrect.
347      {
348          printf("Please re-enter phone number: ");
349          scanf("%s",c[x].num);
350          w=checkNum(c[x].num,x);
351      }
352      printf("Email: ");
353      scanf("%s", c[x].mail);
354      w=check_mail(c[x].mail, x);
355      while(w) //While is true when "w" != 0, that means that the email entered was incorrect.
356      {
357          printf("Please re-enter the email: ");
358          scanf("%s", c[x].mail);
359          w=check_mail(c[x].mail, x);
360      }
361  }
```

addcontact() function calls the enter_data(int x) function and increments the total number of contacts by 1. decide() function is to be called.

```
362  void add_contact()
363  {
364      printf("\nADD CONTACT\nPlease enter data of the new contact: \n");
365      enter_data(n); //Here the user will be asked to enter all data of the new contact.
366      n++; //Global variable n is incremented by 1, because a new contact was added.
367      decide(); //Ask the user if he wants to save or go back to menu.
368  }
```

7) Deleting a contact

delete_contact() function prompts the user to enter first and last names, all records associated with the names should be deleted. User's entry would be compared to each contact stored in the array using a for loop. If a match is found, the contact's index number would be stored in the array "index[n]" and his/her data would be displayed on the screen. Variable 'k' will have the number of matches. If no matches were found, a message will appear to the user stating so and back() function will be called .

A for loop is used to shift all the contacts after the one to be deleted replacing each contact by the one after it resulting in contact deletion. Consequently, all indices in the "index[n]" array should be decremented by 1.

The shifting will happen according to the number of matches (Variable 'k') and (Variable 'n') is to be decremented by k. decide() function is to be called thereafter.

```
369  void delete_contact()
370  {
371      int i,j,k=0,index[n],m=0,z=0;
372      char cfname[20],clname[20];
373      printf("\nDELETE CONTACT\nPlease enter contact first name: ");  //Prompt the user for the first and last name of the contact he wants to delete.
374      scanf("%s",cfname);
375      printf("Please enter contact last name: ");
376      scanf("%s",clname);
377      for (i=0;i<n;i++) //Looping on all contacts, searching for contacts with these first and last name.
378      {
379          if (strcmp(c[i].l_name,clname)==0&&strcmp(c[i].f_name,cfname)==0) //When a contact is found, it will be displayed to the user.
380          {
381              printf("\nContact to be deleted:\nDate of Birth: %d-%d-%d\tPhone number: %s\n",c[i].DoB.day,c[i].DoB.month,c[i].DoB.year,c[i].num);
382              index[k] = i; //index is an array of integers that will contain the index of each contact to be deleted.
383              k++; //k starting by 0, incremented by 1 each time a contact is found, so will finally represent the number of contacts to be deleted.
384          }
385      }
386      if (!k) //if k=0, that means that no contacts were found.
387      {
388          printf("\nNO CONTACTS FOUND!\n");
389          back(); //Ask the user if he wants to go back to menu.
390      }
391      else
392      {
393          for(i=0;i<k;i++) //Looping a number of time equals the number of contacts to be deleted.
394          {
395              for(j=index[m]-z;j<n-1;j++) //Start from the first contact to be deleted, replace each contact by the one after it.
396              {
397                  c[j]=c[j+1];
398              }
399              z++; //z is incremented by 1 because all the contacts were shifted to the left,
400              //so the next time in the loop we want to start from the index of the next contact to be deleted but decremented by 1.
401              n--;m++; //n is decremented by 1 because a contact was deleted, m is incremented to get the index of the next contact to be deleted.
402          }
403          decide();//Decide to save or go back to menu.
404      }
405  }
```

8) Modifying a contact

modify_contact() function prompts the user to enter the last name, all records associated with the name will be displayed. If no contacts are found a message will be displayed informing the user that no contacts were found and back() function is to be called .

The user is asked to choose the contact he wants to modify and his choice is going to be validated using input(char *x) function, after that function enter_data() is called to allow the user entering his new details regarding that contact. decide() function is to be called thereafter.

```
406  void modify_contact()
407  {
408      int i,index[n],k=0,x,j;
409      char cname[20];
410      printf("\nMODIFY CONTACT\nPlease enter contact last name:\t"); //Prompt the user for the last name of the contact he wants to modify.
411      scanf("%s",cname);
412      for(i=0;i<n;i++) //Looping on all contacts, searching for contacts with this last name.
413      {
414          if (strcmp(c[i].l_name,cname)==0)
415          {
416              index[k]=i; //index is an array of integers that will contain the index of each contact to be modified.
417              k++; //k starting by 0, incremented by 1 each time a contact is found, so will finally represent the number of contacts to be modified.
418          }
419      }
420      if(!k) //if k=0, that means that no contacts were found.
421      {
422          printf("\nNO CONTACTS FOUND!\n");
423          back(); //Ask the user if he wants to go back to menu.
424      }
425      else
426      {
427          if(k>1) //If there is more than one contact with this last name, display these contacts and let the user choose which one does he want to modify.
428          {
429              for(i=0;i<k;i++)
430                  {
431                      printf("\n(%d) %s %s\tEmail: %s\tPhone Number: %s\n", i+1, c[index[i]].f_name, c[index[i]].l_name, c[index[i]].mail, c[index[i]].num);
432                      //Data of contacts with this last name.
433                  }
434              printf("\nPlease choose which contact do you want to modify: ");
435              char p[4];
436              do{
437                  j=input(p); //The user is prompted for his choice.
438                  if (j>k) //If the user entered a number higher than the possible ones.
439                      printf("INVALID CHOICE!\nPlease re-enter your choice: ");
440              }while(j>k); //Loop until he choose a valid number.
441              x=index[j-1]; //x represents the index of the contact to be modified.
442          }
443          else
444          {
445              x=index[0]; //If only one contact was found with this last name, x will be equal to the first and only element in the array.
446          }
447          printf("\nContact to be modified: \n%s %s\tDate of Birth: %d-%d-%d\tEmail: %s\tAddress: %s\
448                 tPhone Number: %s\n", c[x].f_name,c[x].l_name,c[x].DoB.day,c[x].DoB.month,c[x].DoB.year,c[x].mail,c[x].address,c[x].num);
449          printf("\nModify the data: \n");
450          enter_data(x); //Prompting the user field by field for the data of the contact he wants  to modify.
451          decide();//Ask the user if he wants to save or go back to menu.
452      }
453  }
```

9) Printing the directory

a) Swapping

swap (Contact *x, Contact *y) function has the argument for the addresses of 2 contacts to swap them. The function initializes another variable of struct type "Contact" to aid in swapping.

The function has a return value of '0'.

```
454  int swap (Contact *x, Contact *y)
455  {
456      //Swap function takes as input the addresses of 2 contacts and returns 0.
457      Contact temp;
458      temp = *x;
459      *x = *y;
460      *y = temp;
461      return 0;
462  }
```

b) Sorting by last name

sortByLname() function sorts the directory in an ascending order of last name.

ALGORITHM (Bubble sort): starts by comparing the first contact "last name" with the second contact "last name", if the first element is greater than the second element, it will swap both elements using the swap() function, and then move on to compare the second and the third element, and so on. In case that 2 contacts have the same last name, they will be sorted according to their first names.

Comparison for the 2 strings is made using strcmp() function. sorted variable acts as a flag to reduce execution time if the array was sorted. If sorted remained 1 in any loop, the loop would be terminated, else the variable sorted will have the return value of swap() function '0'.

```
463  void sortByLname()
464  {//Bubble Sort
465      int pass,i,sorted=0;
466      for (pass=1;!sorted&&pass<n;pass++) //Loop until you reach the end of the array or when sorted = 1.
467      {
468          sorted=1; //When the array is sorted, 'sorted' will remain = 1, and the loop will end.
469          for (i=0;i<n-pass;i++)
470          {
471              if (strcmp(c[i].l_name, c[i+1].l_name)==1) //When contact 2 is less than contact 1, they will be swapped.
472                  sorted=swap(&c[i],&c[i+1]); //Swap function returns 0 when executed.
473              if (strcmp(c[i].l_name, c[i+1].l_name)==0) //When two contacts have the same last name, they will be sorted by first name.
474                  if (strcmp(c[i].f_name, c[i+1].f_name)==1)
475                      sorted=swap(&c[i],&c[i+1]);
476          } //After this loop, the higher contact in order will be the last one.
477      }
478  }
```

c) Sorting by Date of Birth

sortByDoB() function sorts the directory in an ascending order of the date of birth. It uses bubble sorting as well to execute so. The function compares the year of birth of the first 2 contacts, swapping will take place if contact 1 is higher than contact 2. If the birth year is the same, it checks and compares the month of birth, contacts will be swapped if the month of the first contact is higher than that of the second. If the birth month is the same, it checks and compares the day of birth to swap if the day of birth of contact 1 is higher than that of contact 2. Loops are used to access all contacts if found not sorted, while if sorted variable remained to be 1 the loops will terminate.

```
479  void sortByDoB()
480  {//Bubble Sort
481      int i,j,sorted=0;
482      for(i=1;!sorted&&i<n;i++) //Loop until you reach the end of the array or when sorted = 1.
483      {
484          sorted = 1; //When the array is sorted, 'sorted' will remain = 1, and the loop will end.
485          for(j=0;j<n-i;j++)
486          {
487              if(c[j].DoB.year>c[j+1].DoB.year) //Check year, if contact 1 higher than contact 2, they will be swapped.
488                  sorted=swap(&c[j],&c[j+1]);
489              else if(c[j].DoB.year==c[j+1].DoB.year)
490              {
491                  if(c[j].DoB.month>c[j+1].DoB.month) //If they have the same year, but contact 1 month higher than contact 2, they will be swapped.
492                      sorted=swap(&c[j],&c[j+1]);
493                  else if(c[j].DoB.month==c[j+1].DoB.month)
494                       if(c[j].DoB.day>c[j+1].DoB.day) //If the have the same year and month, but contact 1 day higher than contact 2, they will be swapped.
495                          sorted=swap(&c[j],&c[j+1]);
496              }
497          } //After this loop, the higher contact in order will be the last one.
498      }
499  }
```

d) Printing

printFile() function firstly asks the user to enter his choice of sorting either by last name or date of birth. User will input either '1' to sort by last name (calling sortByLname() function) or '2' to sort by date of birth (calling sortByDoB() function) .

The input will be validated using the input(char *x) to assure that it is an integer. The value would be compared to '1' and '2' if it was not one of those cases, the user would be asked to re-enter his sorting choice. A loop would then be made to pass by all the contacts in the array in which they are sorted according to the user preference to print them. Finally, decide() function would then be called.

```
500  void printFile()
501  {
502      if (n==0) //If the file is empty.
503      {
504          printf("\nNO CONTACTS FOUND.\n");
505          back();
506      }
507      else
508      {
509          //Ask the user if he wants to print the contacts sorted by last name or date of birth.
510          printf("\nPRINTING FILE\n\t\tPrinting options\n\t(1)\t\tSorted by last name\n\t(2)\t\tSorted by date of birth\n\tSelect an option from the menu: ");
511          int z;
512          do{
513              char x[4];
514              z = input(x); //Prompt the user for his choice.
515              if (z!=1&&z!=2)
516                  printf("INVALID CHOICE!\nPlease re-enter printing option: ");
517          }while (z!=1&&z!=2); //Loop if the user entered invalid number.
518          switch(z)
519          {
520              case 1: sortByLname(); break; //Sort them by last name.
521              case 2: sortByDoB(); break; //Sort them by date of birth.
522              default: break;
523          }
524          int i;
525          for(i=0; i<n; i++) //After sorting contacts, print them.
526          {
527              printf("Contact %d\nFirst name: %s  Last name: %s  Birth date: %d-%d-%d  Address: %s  Phone: %s  Email: %s\
528                     n",i+1,c[i].f_name,c[i].l_name,c[i].DoB.day,c[i].DoB.month,c[i].DoB.year,c[i].address,c[i].num,c[i].mail);
529          }
530          decide(); //Ask the user if he wants to save or go back to menu.
531      }
532  }
```

10) Quit

quit() function is used to exit the programme without saving the data. A warning message is displayed to the user to let him/her confirm that the changes would be discarded.

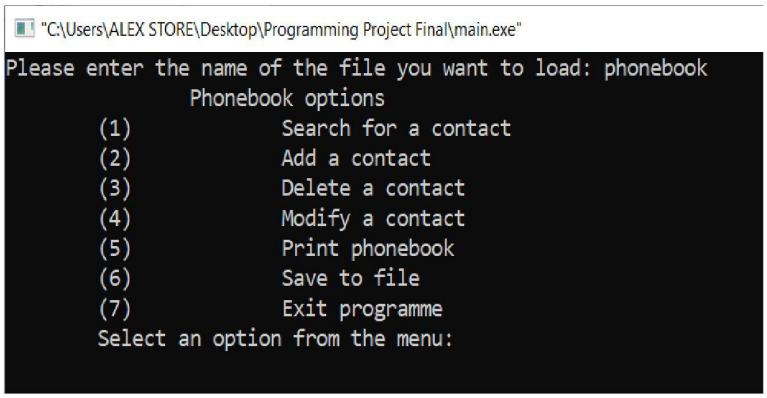
The user is prompted to enter his choice whether he would like to quit by entering 'Y' or not by entering 'N' (Not case-sensitive). If he chose 'N', back() function is to be called. Validation was used to assure that the input is either 'Y' or 'N' (Not case-sensitive).

```
188  void quit()
189  {
190      char ch;
191      printf("\nAll changes will be discarded unless you saved it before\nAre you sure you want to quit(Y or N)? ");
192      scanf(" %c",&ch);
193      while((ch!='Y'&&ch!='y')&&(ch!='N'&&ch!='n')) //If the user wants to quit he is only allowed to type 'Y'or 'y', if not he can type 'N' or 'n'.
194      {
195          printf("INVALID INPUT!\nPlease re-enter your choice: ");
196          scanf(" %c",&ch);
197      }
198      if(ch=='Y'||ch=='y'){ //If the user said YES, changes will not be saved.
199          printf("\nTHANK YOU!\n");
200          exit(0);
201          }
202      else //If the user said NO, he will be asked whether he would like to go back to menu or not.
203          back();
204  }
```

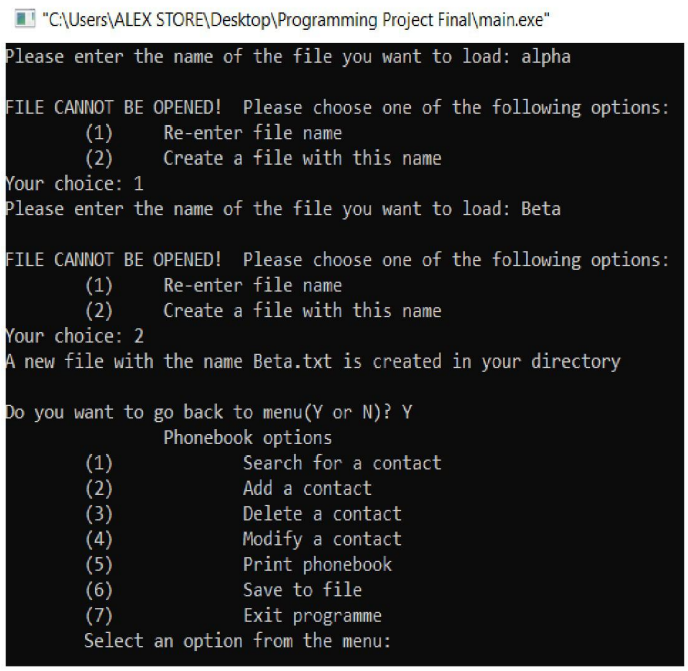
USER MANUAL AND SAMPLE RUNS

How to load a file

When you open the programme you are prompted to enter the name of the text file you want to load. If there exists a file with the same name in your directory, the main menu will be displayed where you can (Search, add, delete, modify a contact print your phonebook, save your file, or quit the programme).



Else if the file does not exist, you will be asked either to re-enter the file name or to create a new file with the same name. This choice is made by typing either '1' or '2' respectively.

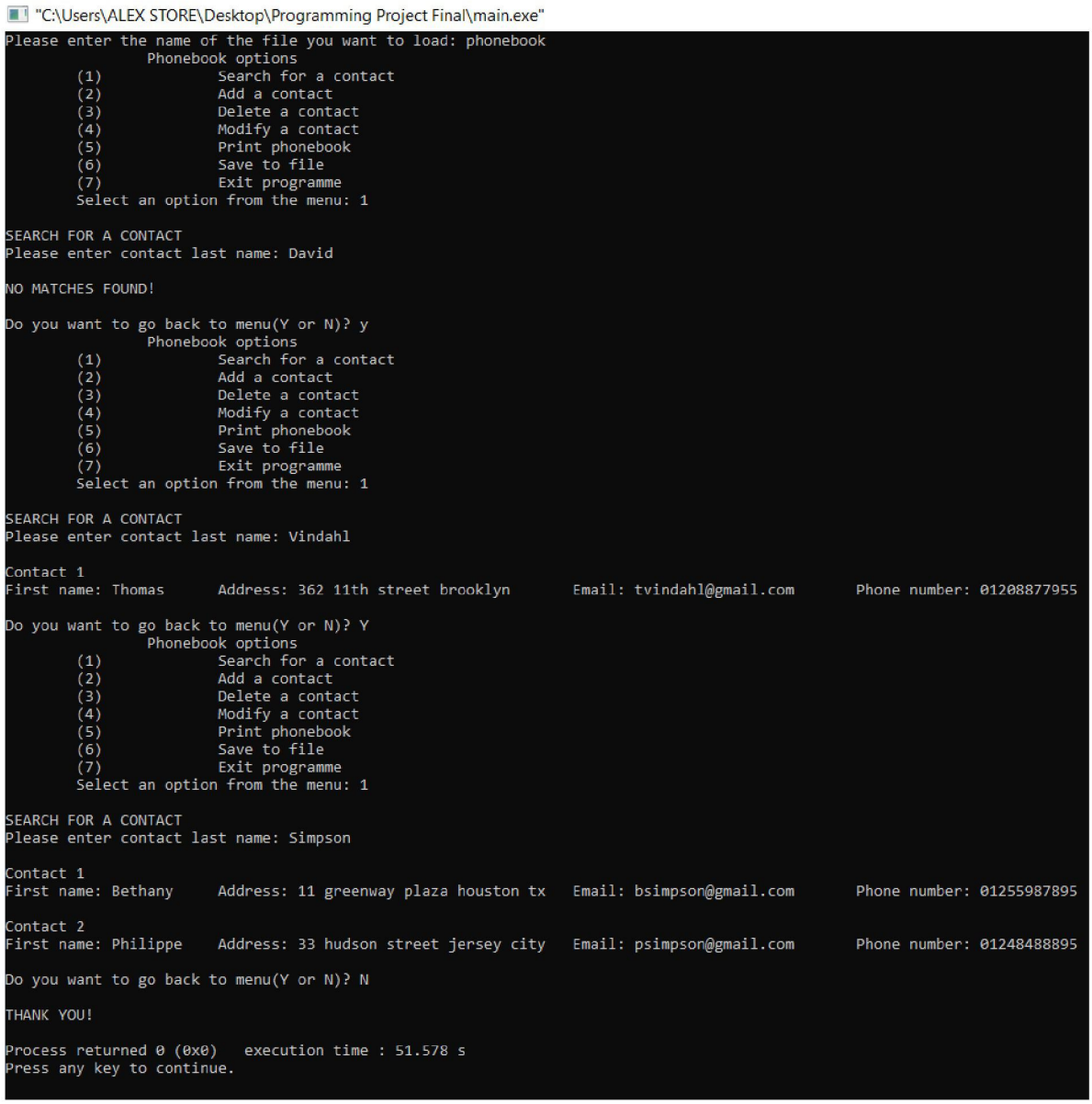


In case you create a new file, the file will be created in the same directory and will be empty, so it is recommended to add a contact.

How to search for a contact

Choose searching option by typing 1, then you have to write the last name of the contact you want to search for. The first name, address, email, phone number will be displayed for all matches.

After searching, you will be asked either to go back to menu by entering 'Y' or to exit by entering 'N'.



How to add a contact

Choose adding option by typing 2, then you have to write first name, last name, date of birth in the format DD -MM-YYYY, address, phone number, email.

After that, you have to choose either to save the file by entering '1' or to go back to menu by entering '2'.

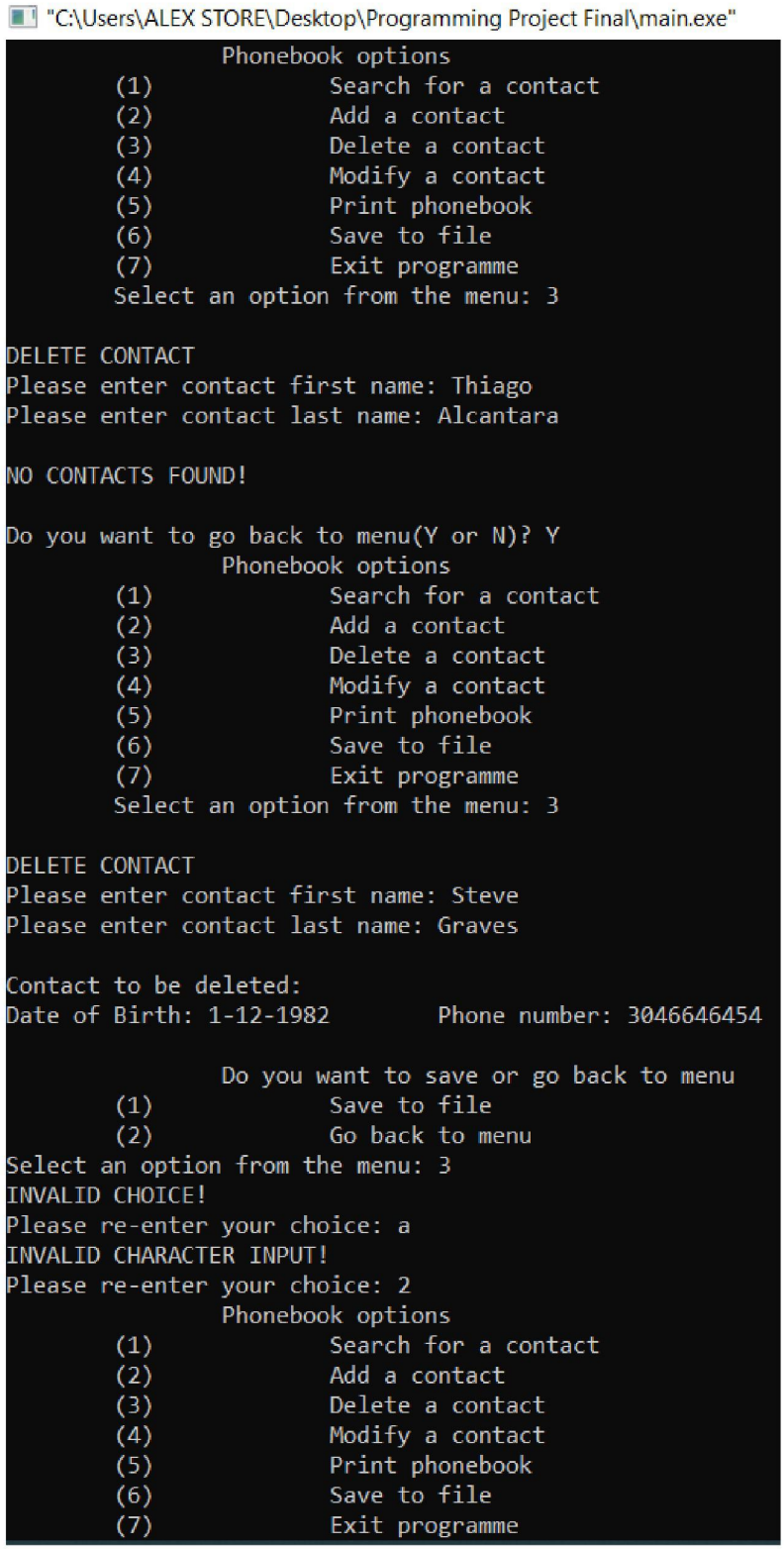
"C:\Users\ALEX STORE\Desktop\Programming Project Final\main.exe"

```
Please enter the name of the file you want to load: phonebook
                Phonebook options
        (1)             Search for a contact
        (2)             Add a contact
        (3)             Delete a contact
        (4)             Modify a contact
        (5)             Print phonebook
        (6)             Save to file
        (7)             Exit programme
        Select an option from the menu: 2

ADD CONTACT
Please enter data of the new contact:
First name: John
Last name: Henderson
Birth date(day-month-year): 2-2-2022
INVALID YEAR
Please re-enter birth date(day-month-year): 2-13-2020
INVALID MONTH
Please re-enter birth date(day-month-year): 32-12-2020
INVALID DAY
Please re-enter birth date(day-month-year): 31-4-2020
THIS MONTH DOES NOT HAVE 31 DAYS
Please re-enter birth date(day-month-year): 30-2-2020
FEBRUARY DOES NOT HAVE MORE THAN 29 DAYS
Please re-enter birth date(day-month-year): 29-2-2019
FEBRUARY ONLY HAS 28 DAYS IN THIS YEAR
Please re-enter birth date(day-month-year): 29-2-2020
Address: 318 W Alameda Avenue
Phone number: 30345566
NUMBER ALREADY EXISTS!
Please re-enter phone number: 333
INVALID PHONE NUMBER LENGTH!
Please re-enter phone number: 313abc567
INVALID CHARACTER INPUT!
Please re-enter phone number: 313567891
Email: mcanfield@icloud.com
EMAIL ALREADY EXISTS!
Please re-enter the email: mcan$fiend@gmail.com
INVALID INPUT!
Please re-enter the email: mcanfield@hotmail.net
INVALID DOMAIN!
Please re-enter the email: mcanfieldoutlook.com
INVALID INPUT
Please re-enter the email: mcanfield@a.com
INVALID DOMAIN!
Please re-enter the email: john.Hendy@yahoo.com

                Do you want to save or go back to menu
        (1)             Save to file
        (2)             Go back to menu
Select an option from the menu: 1

DATA SAVED SUCCESSFULLY TO FILE!
Do you want to go back to menu(Y or N)? n

THANK YOU!

Process returned 0 (0x0)   execution time : 320.718 s
Press any key to continue.
```

How to delete a contact

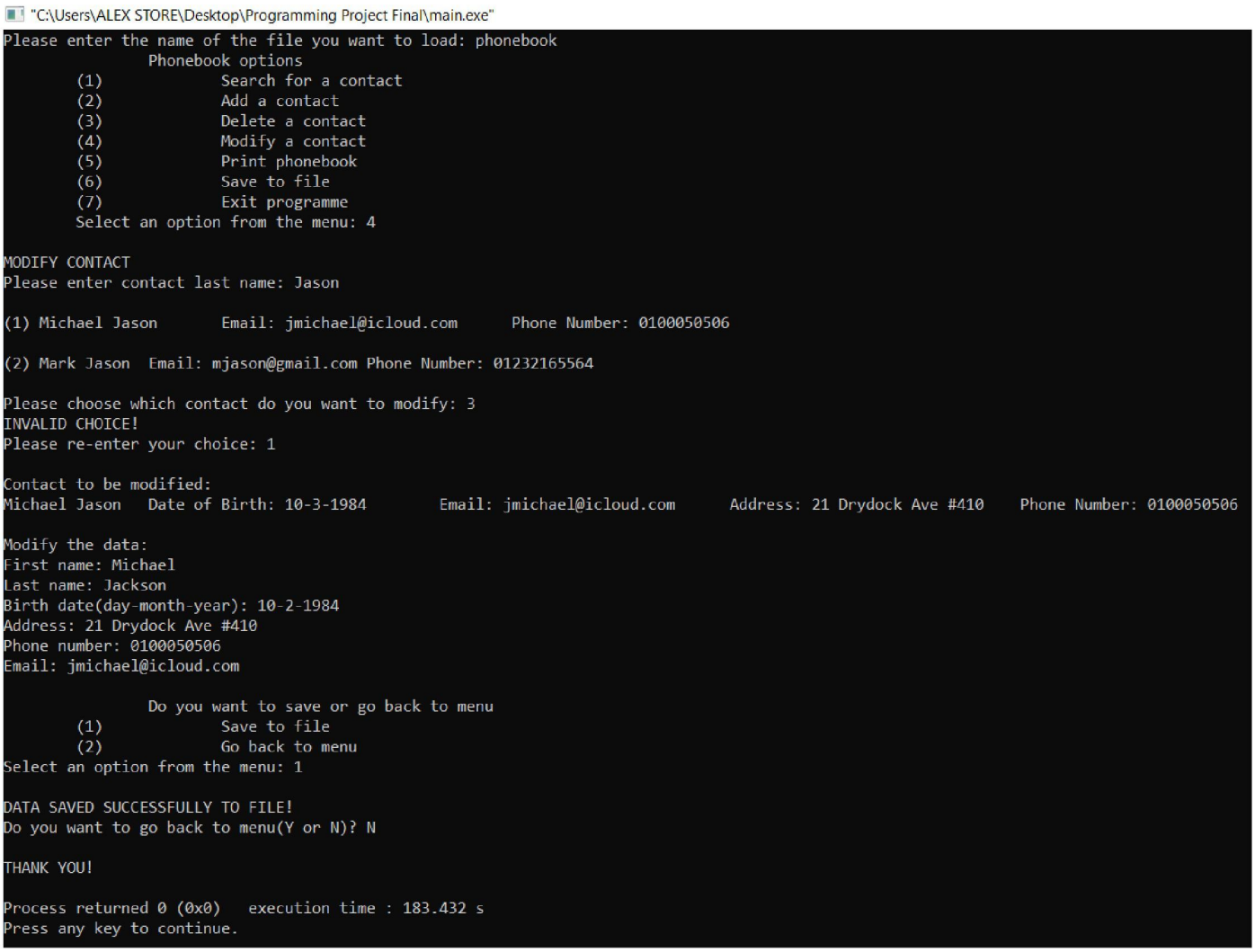
Choose the deleting option by typing '3' and then type first name and last name for the contact you want to delete.

After that, you have to choose either to save the file by entering '1' or to go back to menu by entering '2'.



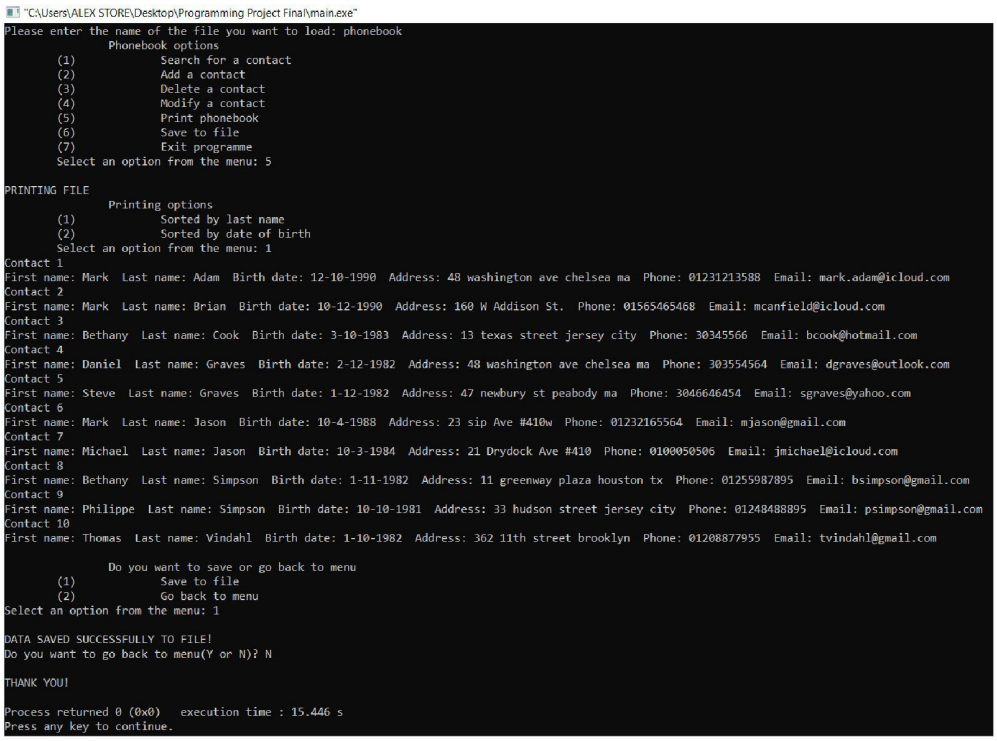
How to modify a contact

Choose modifying option by typing '4' and then, type the last name of the contact you want to modify. If there is more than one match, these contacts will be displayed, and you will be asked to enter your preference by typing its number. After that, you will be prompted field by field to modify the information. Finally, choose whether you want to save or back to menu.



How to print the file

Choose printing option by typing '5', then you have to choose either to print it sorted by last name or by date of birth by typing '1' or '2' respectively.



```
"C:\Users\ALEX STORE\Desktop\Programming Project Final\main.exe"
Please enter the name of the file you want to load: phonebook
                Phonebook options
        (1)             Search for a contact
        (2)             Add a contact
        (3)             Delete a contact
        (4)             Modify a contact
        (5)             Print phonebook
        (6)             Save to file
        (7)             Exit programme
        Select an option from the menu: 5

PRINTING FILE
                Printing options
        (1)             Sorted by last name
        (2)             Sorted by date of birth
        Select an option from the menu: 1
Contact 1
First name: Mark  Last name: Adam  Birth date: 12-10-1990  Address: 48 washington ave chelsea ma  Phone: 01231213588  Email: mark.adam@icloud.com
Contact 2
First name: Mark  Last name: Brian  Birth date: 10-12-1990  Address: 160 W Addison St.  Phone: 01565465468  Email: mcanfield@icloud.com
Contact 3
First name: Bethany  Last name: Cook  Birth date: 3-10-1983  Address: 13 texas street jersey city  Phone: 30345566  Email: bcook@hotmail.com
Contact 4
First name: Daniel  Last name: Graves  Birth date: 2-12-1982  Address: 48 washington ave chelsea ma  Phone: 303554564  Email: dgraves@outlook.com
Contact 5
First name: Steve  Last name: Graves  Birth date: 1-12-1982  Address: 47 newbury st peabody ma  Phone: 3046646454  Email: sgraves@yahoo.com
Contact 6
First name: Mark  Last name: Jason  Birth date: 10-4-1988  Address: 23 sip Ave #410w  Phone: 01232165564  Email: mjason@gmail.com
Contact 7
First name: Michael  Last name: Jason  Birth date: 10-3-1984  Address: 21 Drydock Ave #410  Phone: 0100050506  Email: jmichael@icloud.com
Contact 8
First name: Bethany  Last name: Simpson  Birth date: 1-11-1982  Address: 11 greenway plaza houston tx  Phone: 01255987895  Email: bsimpson@gmail.com
Contact 9
First name: Philippe  Last name: Simpson  Birth date: 10-10-1981  Address: 33 hudson street jersey city  Phone: 01248488895  Email: psimpson@gmail.com
Contact 10
First name: Thomas  Last name: Vindahl  Birth date: 1-10-1982  Address: 362 11th street brooklyn  Phone: 01208877955  Email: tvindahl@gmail.com

                Do you want to save or go back to menu
        (1)             Save to file
        (2)             Go back to menu
Select an option from the menu: 1

DATA SAVED SUCCESSFULLY TO FILE!
Do you want to go back to menu(Y or N)? N

THANK YOU!

Process returned 0 (0x0)   execution time : 15.446 s
Press any key to continue.
```

After that, you can either save the file in a sorted form according to your choice in printing or go back to menu.

```
PRINTING FILE
                Printing options
        (1)             Sorted by last name
        (2)             Sorted by date of birth
        Select an option from the menu: 2
Contact 1
First name: Philippe  Last name: Simpson  Birth date: 10-10-1981  Address: 33 hudson street jersey city  Phone: 01248488895  Email: psimpson@gmail.com
Contact 2
First name: Thomas  Last name: Vindahl  Birth date: 1-10-1982  Address: 362 11th street brooklyn  Phone: 01208877955  Email: tvindahl@gmail.com
Contact 3
First name: Bethany  Last name: Simpson  Birth date: 1-11-1982  Address: 11 greenway plaza houston tx  Phone: 01255987895  Email: bsimpson@gmail.com
Contact 4
First name: Steve  Last name: Graves  Birth date: 1-12-1982  Address: 47 newbury st peabody ma  Phone: 3046646454  Email: sgraves@yahoo.com
Contact 5
First name: Daniel  Last name: Graves  Birth date: 2-12-1982  Address: 48 washington ave chelsea ma  Phone: 303554564  Email: dgraves@outlook.com
Contact 6
First name: Bethany  Last name: Cook  Birth date: 3-10-1983  Address: 13 texas street jersey city  Phone: 30345566  Email: bcook@hotmail.com
Contact 7
First name: Michael  Last name: Jason  Birth date: 10-3-1984  Address: 21 Drydock Ave #410  Phone: 0100050506  Email: jmichael@icloud.com
Contact 8
First name: Mark  Last name: Jason  Birth date: 10-4-1988  Address: 23 sip Ave #410w  Phone: 01232165564  Email: mjason@gmail.com
Contact 9
First name: Mark  Last name: Adam  Birth date: 12-10-1990  Address: 48 washington ave chelsea ma  Phone: 01231213588  Email: mark.adam@icloud.com
Contact 10
First name: Mark  Last name: Brian  Birth date: 10-12-1990  Address: 160 W Addison St.  Phone: 01565465468  Email: mcanfield@icloud.com
```

Saving and quitting from the main menu

After doing any of the previous processes you always had the ability to go back to main menu and choose either save or quit by typing '6' or '7' respectively.

TAKE CARE: If you did not save your work and you chose to quit from the main menu, all the changes you made will be discarded.