

Winter 2018

## Contacts

### Assignment 2

Assignment 2 uses assignment 1 and focuses on a “Contact Management System”. This assignment continues to emphasize modularization by compartmentalizing highly cohesive and tightly coupled tasks into modules (\*.h and \*.c files). This strategy will reduce redundant coding throughout all parts of the application.

### Deadlines

This assignment is broken into four (4) parts:

Milestone	Due Date
1	In-lab the week it is assigned
2	2 Days before the next Lab class
3	In-lab the week it is assigned
4	2 Days before the next Lab class

### Milestone 1 (10%)

(Due in your Lab Class the week it is assigned)

Download or clone Assignment 2 (**A2**) from <https://github.com/Seneca-144100/IPC-Project>

Open the project file **A2MS1** and look inside (expand “Header Files” and “Source Files” folders – see figure 2.1.1). You will find two modules:

Module	Header File	Source File
Contacts	contacts.h	contacts.c
Contact Helpers	contactHelpers.h	contactHelpers.c

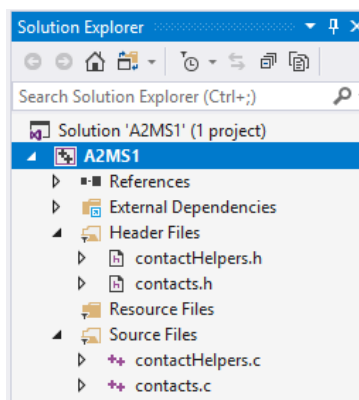


Figure: 2.1.1 – Visual Studio Project Contents

## Contacts Header File (.h)

### Structures

Open the **contacts.h** file and copy the structures (**Name**, **Address**, **Numbers**, and **Contact**) from the file **contacts.h** in *Assignment 1*. Be careful not to paste over the helpful comments in the provided **contacts.h** file!

### Numbers

Modify the **Numbers** structure so that each **C string** member (**cell**, **home**, and **business**) accommodates a 10-digit phone number (ex: **"4163331111"**).

### Function Prototypes

1. Copy the function prototypes (**getName**, **getAddress**, and **getNumbers**) from the file **contacts.h** in *Assignment 1 (Milestone 4)*. Again, be careful not to paste over the helpful comments in the provided **contacts.h** file!
2. Declare an additional function prototype:

```
void getContact(struct Contact *);
```

- This function has one parameter that receives a pointer to a **Contact**.
- The details on how this function should work is described in Milestone 2.

## Contacts Source File (.c)

Open the **contacts.c** source code file.

### Libraries

In order to define the functions that were declared as prototypes in the **contacts.h** file, this source file needs visibility of their existence. This is accomplished by including the required header library file. Include the **contacts.h** header file (see source code comments).

### Function Definitions

1. Copy the function definitions (**getName**, **getAddress**, and **getNumbers**) from the file **contacts.c** in *Assignment 1 (Milestone 4)*.
2. Add an **empty** definition for the new function **getContact** (see the prototype declared in the **contacts.h** file) – refer to the source comments for placement. For this milestone you don't have to define the details for this function (this will be done in Milestone 2) so for now, specify an empty code block:

```
getContact function header goes here...  
{  
    // Use an open and close curly brace with a blank line  
}
```

## Contact Helper Header File (.h)

The contact helper module contains a group of common functions for use in other source code modules in the application. Other modules will be able to access these functions (without having to recode them) by including this header file.

### Function Prototypes

Open the **contactHelpers.h** file. To help you get started, you will notice the prototype for the **clearKeyboard** function is already done for you.

**void clearKeyboard(void);**

- **clearKeyboard** does not return a value and has no parameters.
- The details on how this function should work is described in Milestone 2.

Add the following additional helper function prototypes:

**void pause(void);**

- **pause** does not return a value and has no parameters.
- The details on how this function should work is described in Milestone 2.

**int getInt(void);**

- **getInt** returns an integer value and has no parameters.
- The details on how this function should work is described in Milestone 2.

**int getIntInRange(int, int);**

- **getIntInRange** returns an integer value and receives two (2) integer parameters.
- The details on how this function should work is described in Milestone 2.

**int yes(void);**

- **yes** returns an integer value and has no parameters.
- The details on how this function should work is described in Milestone 2.

**int menu(void);**

- **menu** returns an integer value and has no parameters.
- The details on how this function should work is described in Milestone 2.

**void ContactManagerSystem(void);**

- **ContactManagerSystem** does not return a value and has no parameters.
- The details on how this function should work is described in Milestone 2.

## Contact Helper Source File (.c)

Open the **contactHelpers.c** source code file.

### Libraries

Just as the **contacts.c** source code file included the **contacts.h** header file, the **contactHelpers.c** source code file should include the **contactHelpers.h** header file. Including the header file exposes the prototyped functions before they are defined (see source code comments).

### Function Definitions

Add an empty definition for each function prototyped in the **contactHelpers.h**. You will notice the **clearKeyboard** function has been done for you. Follow this example for the remaining functions (refer to the source code comments for placement).

For this milestone, you don't have to define the details for the functions (the details are described in Milestone 2).

### Milestone 1 Submission

Milestone 1 is to be done in the lab and shown to your instructor, there is no need to submit on matrix.

## Milestone 2 (20%)

**Due 2 days before your next Lab Class.**

Open the project file **A2MS2** and look inside (expand "Header Files" and "Source Files" folders – see figure 2.2.1). You will notice an additional source code file **a2ms2.c** (do not modify this file). This is the main file used to assess your functions to determine if they work to this milestone's specifications.



Figure: 2.2.1 – Visual Studio Project Contents

## Header Files

### **contact.h and contactHelpers.h**

There are no changes required to these files for this milestone. Consult the comments provided in the header files (.h) for these modules and copy the appropriate contents from Milestone 1.

## Contact Helper Source File (.c)

1. Open the **contactHelpers.c** source code file.

**Reminder:** Be sure to include the contactHelpers.h header file!

To help you get started, notice that the **clearKeyboard** function is done for you.

2. For the remaining functions, copy the empty functions from the **contactHelpers.c** file in *Milestone 1* (consult the source code comments for placement – be careful not to replace the **clearKeyboard** function that is already provided for you).
3. Complete the full function definition for each function using the descriptions below:

**void clearKeyboard(void);**

- **clearKeyboard** does not return a value and has no parameters.
- This function makes sure the keyboard input buffer is clear of any residual character by reading from the input buffer character by character until it reads a new line character.
- This function is provided for you – please consult the IPC144 course notes in the section “Input Functions” to learn about the standard input output library (stdio) getchar() function.

**void pause(void);**

- **pause** does not return a value and has no parameters.
- This function pauses the execution of the application by displaying a message and waiting for the user to press the <ENTER> key.
- Display the following line and DO NOT include a newline character:

```
>(Press Enter to continue)<
```

- After displaying the above message, call the **clearKeyboard** function.

**Note:** The **clearKeyboard** function is used for a foolproof <ENTER> key entry

**int** getInt(**void**);

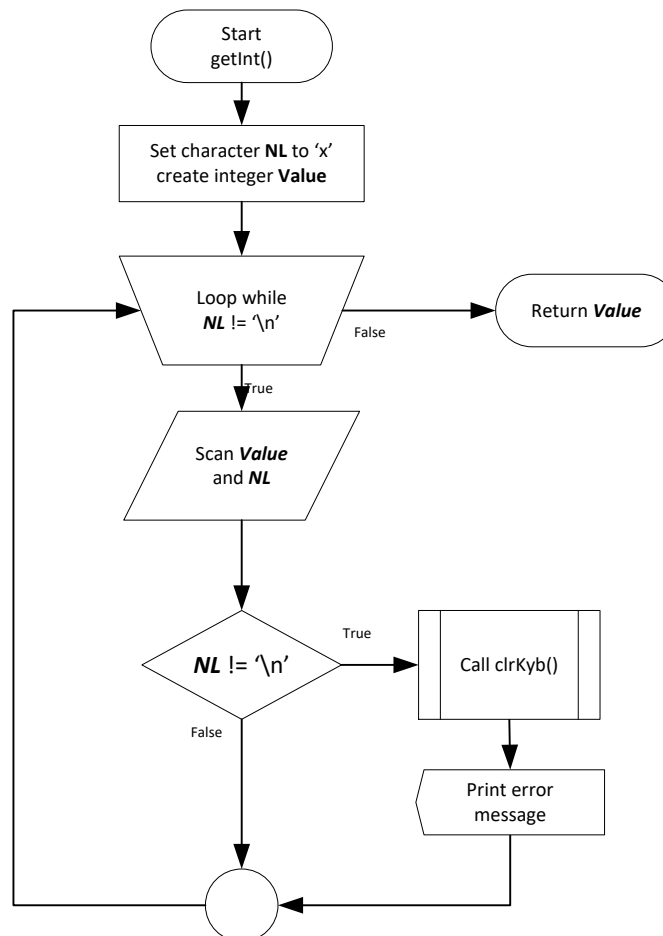
- **getInt** returns an integer value and has no parameters.
- This function gets a valid integer from the keyboard and returns it. If the value entered is not a valid integer an error message should be displayed:  

```
>*** INVALID INTEGER *** <Please enter an integer>: <
```
- This function should continue to prompt the user for a valid integer.
- This function must be foolproof and guarantee an integer value is entered and returned.

### Hint

You can use `scanf` to read an integer and a character ("`%d%c`") in one call and then assess if the second value is a newline character. If the second character is a newline (the result of an <ENTER> key press), `scanf` read the first value successfully as an integer.

If the second value (character) is not a newline, the value entered was not an integer or included additional non-integer characters. If any invalid entry occurs, your function should call the `clearKeyboard` function, followed by displaying the error message described above and continue to prompt for a valid integer. Review the following flowchart that describes this process:



**int getIntInRange(int, int);**

- **getIntInRange** returns an integer value and receives two (2) integer parameters.
- This function uses **getInt** to receive a valid integer and returns it only if the value entered is within the lower-bound (first parameter) and upper-bound (second parameter) range (**inclusive**).
- If the integer entered is not within the valid range, the following error message should be displayed:

```
>*** OUT OF RANGE *** <Enter a number between [param-1] and [param-2]>: <
```

**Note:** Substitute the “[param-1]” and “[param-2]” with the function parameter values

- This function should be a foolproof call to ensure an integer is entered within a given range. Therefore, it should continue to prompt the user for an entry until a valid integer is within the specified range.

**int yes(void);**

- **yes** returns an integer value and has no parameters.
- This function prompts the user for a **single character** entry
- The character entered is only valid if it is a “Y”, “y”, “N”, or “n”. Any other value entered (including more than one character) is an error and should display the following message:

```
>*** INVALID ENTRY *** <Only (Y)es or (N)o are acceptable>: <
```

#### Hint

This function is very similar to the **getInt** function only this function looks for a character as the first value. If the second value is not a newline character it is definitely an error as it won't be a single character entry (be sure to call the **clearKeyboard** function to clear the input buffer). If the second value is a newline character, then assess if the first value is one of the four (4) valid characters. If it isn't one of the valid four (4) characters, then it is an error.

- This function should continue to prompt the user for an entry until one of the four (4) valid characters is entered.
- When a valid value is entered, the function should return an integer value of 1 when the value is “Y” or “y”. Otherwise it should return 0.

**int menu(void);**

- **menu** returns an integer value and has no parameters.
- This function should display the following menu:

```
>Contact Management System<
>-----< (there are 25 dashes)
>1. Display contacts<
>2. Add a contact<
>3. Update a contact<
>4. Delete a contact<
>5. Search contacts by cell phone number<
>6. Sort contacts by cell phone number<
>0. Exit<
><
>Select an option:> <
```

- Prompt for user entry an integer value between the values 0-6 inclusive
- Any other value entered or an integer that is not within the 0-6 range is an error
- The function should continue to prompt for an integer value within the 0-6 range until a valid value is entered.
- When a valid integer value is entered, this value is returned.

#### Hint

This logic sounds familiar... perhaps there is already a function that can help you get an integer value within a specified range...

**void ContactManagerSystem(void);**

- **ContactManagerSystem** does not return a value and has no parameters.
- This function is the heart of the application and will run the whole program.
- This function starts by showing the menu for the system and receives the user's selection
- If the user enters 1, it displays:  
><<< Feature 1 is unavailable >>>< (followed by two (2) newlines)  
If the user enters 2, it displays:  
><<< Feature 2 is unavailable >>>< (followed by two (2) newlines)  
If the user enters 3, it displays:  
><<< Feature 3 is unavailable >>>< (followed by two (2) newlines)  
If the user enters 4, it displays:  
><<< Feature 4 is unavailable >>>< (followed by two (2) newlines)  
If the user enters 5, it displays:  
><<< Feature 5 is unavailable >>>< (followed by two (2) newlines)  
If the user enters 6, it displays:  
><<< Feature 6 is unavailable >>>< (followed by two (2) newlines)  
For selections between 1 and 6, the application should **pause** and then return to displaying the menu.
- If the user enters 0, prompt to exit the application. Display the following:  
>Exit the program? (Y)es/(N)o: <



Wait for the user to enter “Y”, “y”, “N” or “n” (for Yes or No).

If the user replies Yes (“Y”, “y”), it will end the program displaying the following message:

```
>Contact Management System: terminated< (followed by a newline)
```

Otherwise, if the user entered No (“N”, “n”), the application continues to display the menu.

- The following is a general pseudo code for a menu driven user interface. Using this pseudo code is optional. You can use any other logic if you like.

```
Menu driver pseudo code:
while it is not done
    display menu
    get selected option from user
    check selection:
        option one selected
            act accordingly
        end option one
        option two selected
            act accordingly
        end option two
        .
        .
        Exit is selected
            program is done
        end exit
    end check
end while
```

## **Contacts Source File (.c)**

Open the **contacts.c** source code file.

1. Open the **contacts.c** source code file.

**Reminder:** Be sure to include the **contacts.h** header file!

The contact helpers module contains additional functions that can be used to streamline some functions previously coded for getting the **Name**, **Address**, and **Numbers** parts of a **Contact**. To make these helper functions available for use in this source file include the **contactHelpers.h** header file (see the source code comments for placement).

2. Copy the functions from the **contacts.c** file in *Milestone 1* (see the source code comments for placement – be careful not to replace any additional helpful comments)

3. Update the functions `getName`, `getAddress`, and `getNumbers` to use any of the new functions created in the `contactHelpers.h` library (wherever applicable). See source code comments for some suggestions.
4. Update function `getNumbers` so that the cell phone number entry is **mandatory** (don't ask if the user wants to enter this value)
5. Define the new function prototyped in *Milestone 1* `getContact` using the following description:

```
void getContact(struct Contact *);
```

- This function does not return a value but has one parameter that receives a pointer to a `Contact`.
- The purpose of this function is to set the values for a `Contact` using the pointer parameter variable (set the `Contact` it points to).
- Use the pointer parameter received to this function to supply the appropriate `Contact` member to the "get" functions (`getName`, `getAddress`, and `getNumbers`) to set the values for the `Contact`.

## Sample Output

Below is a sample output. User input values are identified in **RED**. Your output should match exactly:

```
-----
Testing: Yes()
-----
Please enter 'Y' > Y
Result: 1
Please enter 'y' > y
Result: 1
Please enter 'N' > N
Result: 0
Please enter 'yes', then 'no', then 'n' > yes
*** INVALID ENTRY *** <Only (Y)es or (N)o are acceptable>: no
*** INVALID ENTRY *** <Only (Y)es or (N)o are acceptable>: n
Result: 0

-----
Testing: pause()
-----
(Press Enter to Continue)   <Enter>

-----
Testing: getInt()
-----
Enter 'ipc', then '144' > ipc
*** INVALID INTEGER *** <Please enter an integer>: 144
Integer entered: 144

-----
Testing: getIntInRange(int,int)
```

```
-----
Enter 'seneca', then '99', then '501', then '250' > seneca
*** INVALID INTEGER *** <Please enter an integer>: 99
*** OUT OF RANGE *** <Enter a number between 100 and 500>: 501
*** OUT OF RANGE *** <Enter a number between 100 and 500>: 250
Integer entered: 250
```

```
-----
Testing: getContact(struct Contact *)
-----
```

```
Please enter the contact's first name: Tom
Do you want to enter a middle initial(s)? (y or n): yes
*** INVALID ENTRY *** <Only (Y)es or (N)o are acceptable>: y
Please enter the contact's middle initial(s): Wong
Please enter the contact's last name: Song
Please enter the contact's street number: one two
*** INVALID INTEGER *** <Please enter an integer>: 99
Please enter the contact's street name: Keele Street
Do you want to enter an apartment number? (y or n): no
*** INVALID ENTRY *** <Only (Y)es or (N)o are acceptable>: n
Please enter the contact's postal code: A8A 3J3
Please enter the contact's city: Toronto
Please enter the contact's cell phone number: 9051116666
Do you want to enter a home phone number? (y or n): n
Do you want to enter a business phone number? (y or n): n
```

Values Entered:

Name: Tom Wong Song

Address: 99|Keele Street|0|A8A 3J3|Toronto

Numbers: 9051116666||

```
-----
Testing: ContactManagerSystem()
-----
```

Contact Management System

- ```
-----
1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit
```

Select an option:> **9**

\*\*\* OUT OF RANGE \*\*\* <Enter a number between 0 and 6>: **1**

<<< Feature 1 is unavailable >>>

(Press Enter to Continue) **<Enter>**

Contact Management System

- ```
-----
1. Display contacts
2. Add a contact
```

3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 4

<<< Feature 4 is unavailable >>>

(Press Enter to Continue) <Enter>

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 6

<<< Feature 6 is unavailable >>>

(Press Enter to Continue) <Enter>

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 0

Exit the program? (Y)es/(N)o: n

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 0

Exit the program? (Y)es/(N)o: y

Contact Management System: terminated

-----  
Testing: Assign#2 - MS #2 test completed  
-----

## Milestone 2 Reflection (20%)

Please provide brief answers to the following questions in a file named [reflect.txt](#).

1. In 3 or 4 sentences explain the term “function” and briefly discuss the need for functions in any language?
2. Briefly explain why you think the "helper" functions are in a different module and why those functions were not included in the "contacts" module?

**Note:** When completing the reflections it is a violation of academic policy to cut and paste content from the course notes or any other published source, or to copy the work of another

## Milestone 2 Submission

If not on matrix already, upload your [contacts.h](#), [contacts.c](#), [contactHelpers.h](#), [contactHelpers.c](#), [a2ms2.c](#), and [reflect.txt](#) files to your matrix account. Compile your code as follows:

```
> gcc -Wall -o ms2 contacts.c contactHelpers.c a2ms2.c <ENTER>
```

This command will compile your code and name your executable “[ms2](#)”. Execute [ms2](#) and make sure everything works properly.

Finally run the following script from your account: (replace profname.proflastname with your professors Seneca userid)

```
~profname.proflastname/submit 144_a2ms2 <ENTER>
```

and follow the instructions.

**Please note that a successful submission does not guarantee full credit for this submission. If the professor is not satisfied with your implementation, your professor may ask you to resubmit. Resubmissions will attract a penalty.**

## Milestone 3 (10%)

(Due in your Lab Class the week it is assigned)

Download or clone Assignment 2 (A2) from <https://github.com/Seneca-144100/IPC-Project>

Open the project file **A2MS3** and look inside (expand “Header Files” and “Source Files” folders).

This milestone introduces the remaining function prototypes required to complete the contacts management system. You have three tasks to perform for this milestone:

1. Declare new function prototypes in **contactHelpers.h**
2. Define the new functions with empty code blocks in **contactHelpers.c**
3. Update **contacts.h** with safeguard and **contact.c** to use new function `getTenDigitPhone`

### Contact Helper Header File (.h)

Open the **contactHelpers.h** file. Refer to the comments in the file and copy/paste your code from MS2 where directed.

You will need to include the **contacts.h** header file so the new functions (parameters) will be able to use the structures defined in that module (see source comments for placement).

### Function Prototypes

You will notice there are two (2) prototypes already prepared:

```
void getTenDigitPhone(char[]);
```

- **getTenDigitPhone** does not return a value and expects a character array sized for 10 characters plus the null terminator.
- The next section describing the **contactHelpers.c** source file explains this function and its use.

```
int findContactIndex(const struct Contact[], int, const char[]);
```

- **findContactIndex** returns an integer and expects a **Contact** array (marked constant so changes can't be made to it), an integer, and a character array.
- The details on how this function should work is described in Milestone 4.

Add the following additional function prototypes:

```
void displayContactHeader(void);
```

- **displayContactHeader** does not return a value and has no parameters.
- The details on how this function should work is described in Milestone 4.

**void displayContactFooter(int);**

- **displayContactFooter** does not return a value and receives one integer parameter.
- The details on how this function should work is described in Milestone 4.

**void displayContact(const struct Contact\*);**

- **displayContact** does not return a value and receives a constant **Contact** pointer (cannot be updated) parameter.
- The details on how this function should work is described in Milestone 4.

**void displayContacts(const struct Contact[], int);**

- **displayContacts** does not return a value and receives a constant **Contact** array (cannot be updated), and an integer for parameters.
- The details on how this function should work is described in Milestone 4.

**void searchContacts(const struct Contact[], int);**

- **searchContacts** does not return a value and receives a constant **Contact** array (cannot be updated), and an integer for parameters.
- The details on how this function should work is described in Milestone 4.

**void addContact(struct Contact[], int);**

- **addContact** does not return a value and receives a **Contact** array, and an integer for parameters.
- The details on how this function should work is described in Milestone 4.

**void updateContact(struct Contact[], int);**

- **updateContact** does not return a value and receives a **Contact** array, and an integer for parameters.
- The details on how this function should work is described in Milestone 4.

**void deleteContact(struct Contact[], int);**

- **deleteContact** does not return a value and receives a **Contact** array, and an integer for parameters.
- The details on how this function should work is described in Milestone 4.

**void sortContacts(struct Contact[], int);**

- **sortContacts** does not return a value and receives a **Contact** array, and an integer for parameters.
- The details on how this function should work is described in Milestone 4.

## Contact Helper Source File (.c)

Open the **contactHelpers.c** source code file.

### Libraries

Include the system library **<string.h>** (refer to the source comments for placement). This library contains the needed string related functions you will use in some of the new functions. Be sure to also include the **contactHelpers.h** header file.

### Function Definitions

Function **getTenDigitPhone** is defined for you (see below for the details):

**void** getTenDigitPhone(**char** telNum[]);

- **getTenDigitPhone** does not return a value and expects a C string character array sized for 10 characters (plus the null terminator).
- This function receives user input for a 10-digit phone number and stores the value to the parameter **telNum**.



#### **Reminder**

*Arrays by variable name (ex: telNum) is a pointer type (points to the 1<sup>st</sup> element). This means any changes made using this variable will directly update the source it points to.*

- If the entered value is not 10 characters in length, a message is displayed and continues to prompt until a 10 character C string is entered:

```
>Enter a 10-digit phone number: <
```

- This function provides a failsafe method in receiving a 10-character C string array.
- **Optional:** Enhance this function to ensure all values entered are **numerical digits**

Just as you did in MS1, add an empty function definition for all the new functions prototyped in the **contactHelpers.h** header file. To help you get going, **findContactIndex** is done for you. Use the provided source code comments for placement.



## Contacts Header File (.h)

Open the header file **contacts.h**. There are a few additional lines of code added to the top and bottom areas of the file:

```
#ifndef CONTACTS_H_
#define CONTACTS_H_

// Header file contents...

#endif // !CONTACTS_H_
```

### **Brief Explanation**

*These lines of code “**safeguard**” the header file to ensure it is only included once when the application is compiled (when it is included multiple times by other files). This is an advanced topic not covered in this course but will be covered in the next level course C++ (OOP244/BTP200).*

Refer to the comments in the **contacts.h** file and carefully insert your code from MS2 where directed.

There are no further modifications to make to this file for this milestone.

## Contacts Source File (.c)

The addition of the new helper function **getTenDigitPhone**, would benefit the **getNumbers** function in this module.

Copy your MS2 code where the comments indicate. Update the **getNumbers** function to use the new function **getTenDigitPhone** where appropriate to ensure a 10-character value is stored for the numbers.

**Hint:** The **getTenDigitPhone** function **does not display an initial prompt message**. The function will display a generic prompt only when and if an invalid number of characters is entered. You should first display the prompt message specific to the case, then call the **getTenDigitPhone** function:

```
char examplePhone[11];
printf("Enter example phone number: ");
getTenDigitPhone(examplePhone);
```

## **Milestone 3 Submission**

Milestone 3 is to be done in the lab and shown to your instructor, there is no need to submit on matrix.

## Milestone 4 (20%)

**Due 2 Days before the next Lab Class.**

Open the project file **A2MS4** and look inside (expand “Header Files” and “Source Files” folders – see figure 2.4.1). Do not modify the source code file: **a2ms4.c**. This is the main file used to assess your functions to determine if they work to this milestone’s specifications.

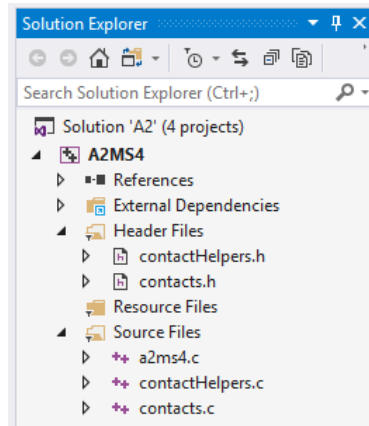


Figure: 2.4.1 – Visual Studio Project Contents

### Unchanged Files

**contacts.h**  
**contacts.c**  
**contactHelpers.h**

Open each of these files in the provided project. Consult the comments provided and copy the appropriate contents from Milestone 3.

### Contact Helper Source File (.c)

1. Open the **contactHelpers.c** source code file.
2. Define **MAXCONTACTS 5** where the comments indicate (under the include section). This will be used for sizing the contacts array later in the program
3. Copy the contents from MS3 where the comments indicate.
4. Complete the full function definitions for each function using the descriptions below:

## Function Definitions

**int findContactIndex(const struct Contact[], int, const char[]);**

- **findContactIndex** returns an integer and expects a **Contact** array (marked constant so changes can't be made to it), and integer (intended for representing the size of the Contact array), and a character array (expecting a C string representing a cell phone number).
- This function's purpose is to find a contact based on the provided cell phone number (parameter 3) and return the index (position in the array) otherwise, if the contact is not found, the function should return -1

### Hints

- Iterate the Contact array (up to the size specified in parameter-2) and compare the current iteration contact's cell phone number to the parameter-3 cell phone number to determine equality
- Use a **string library function** for string compare

**void displayContactHeader(void);**

- **displayContactHeader** does not return a value and has no parameters.
- This function display's a centered title "Contacts Listing" header that is surrounded in a border:

```
+-----+ [line-1]
|               | [line-2]
+-----+ [line-3]
```

#### **Line-1 and Line-3:**

'+' one (1) plus symbol  
'-' seventy-seven (77) minus symbols  
'+' one (1) plus symbol  
Followed by a newline '\n'

#### **Line-2:**

'|' one (1) vertical pipe symbol (usually located above the enter key)  
' ' thirty (30) spaces  
'Contacts Listing' (the title)  
' ' thirty (31) spaces  
'|' one plus symbol  
Followed by a newline '\n'

**void displayContactFooter(int);**

- **displayContactFooter** does not return a value and receives one integer parameter.
- This function display's a line and a total contact summary
- The function parameter is the total number of contacts value to display

+-----+ [line-1]  
Total contacts: 99 [line-2]

#### Line-1:

'+' one (1) plus symbol  
'-' seventy-seven (77) minus symbols  
'+' one (1) plus symbol  
Followed by a newline '\n'

#### Line-2:

'Total contacts: ' Note: one (1) space after the colon  
Followed by the integer parameter value  
Followed by TWO (2) newlines ('\n')

**void displayContact(const struct Contact\*);**

- **displayContact** does not return a value and receives a constant **Contact** pointer (cannot be updated) parameter.
- This function displays the details for a single contact (see example below):

*Example: With middle initial and an apartment number:*

Maggie R. Greene [line-1]  
C: 9051112222 H: 9052223333 B: 9053334444 [line-2]  
55 Hightop House, Apt# 201, Bolton, A9A 3K3 [line-3]

*Example: No middle initial and no apartment number:*

Maggie Greene [line-1]  
C: 9051112222 H: 9052223333 B: 9053334444 [line-2]  
55 Hightop House, Bolton, A9A 3K3 [line-3]

#### Line-1 (contact full name):

' ' one (1) blank space followed by...  
'Contact full name' (See below for details) followed by...  
One (1) newline '\n'

##### Contact Full Name:

- Consists of all the name parts put together separated by a space
- If there is no middle initial then there should only be one (1) space separating the first name and the last name

#### Line-2 (contact numbers):

Use the following format string:

" C: %-10s H: %-10s B: %-10s\n" (Note: 4 spaces at the beginning)

- The 1<sup>st</sup> specifier is for the cell phone number
- The 2<sup>nd</sup> specifier is for the home phone number
- The 3<sup>rd</sup> specifier is for the business phone number

#### Line-3 (contact address):

Use the following format string to get started:

" %d %s, " (Note: 7 spaces at the beginning and 1 after the comma)

- The 1<sup>st</sup> specifier is for the street number
- The 2<sup>nd</sup> specifier is for the street name

**IF** the apartment field has a value (will be > 0) then include on the same line:

"Apt# %d, " (Note: 1 space after the comma)

- The specifier is for the apartment number

Followed by the city and postal code comma separated:

"%s, %s\n"

- The 1<sup>st</sup> specifier is for the city
- The 2<sup>nd</sup> specifier is for the postal code

**void displayContacts(const struct Contact[], int);**

- **displayContacts** does not return a value and receives a constant **Contact** array (cannot be updated), and an integer (intended for representing the size of the Contact array).
- This function needs to display a title header, a detail listing of each **VALID** contact in the array and a footer section showing the total number of contacts.
- To produce the title header, call the **displayHeader** function described earlier in this milestone
- You will need to iterate all items in the **Contact** array (parameter 1) up to the number of items it holds (parameter 2).
- **IF** the current iterator **Contact** is **VALID** (will have a cell number > 0), display the details (call the **displayContact** function described earlier in this milestone).
- After iterating all the contacts, finish with displaying the footer summary section by calling the **displayContactFooter** function.

**Hint:** Keep track of the number of valid contacts displayed and pass this count to the **displayContactFooter** function

**void searchContacts(const struct Contact[], int);**

- **searchContacts** does not return a value and receives a constant **Contact** array (cannot be updated), and an integer (intended for representing the size of the Contact array).
- This function should prompt the user to search the contact listings based on a cell phone number. If there is a match, display the details for the contact.
- Prompt the user for a cell phone number to search:  
>Enter the cell number for the contact: <
  - Do not allow the application to continue until a 10-digit phone is entered.  
(**Hint:** call the **getTenDigitPhone** function to get the value)
- Search the contact array to find a contact with the cell phone number previously entered (**Hint:** call function **findContactIndex**)
- If the contact is found, display the details (**Hint:** call function **displayContact**)  
**Note:** follow with one (1) newline ('\n')
- Otherwise, show the following message:  
>\*\*\* Contact NOT FOUND \*\*\*< (add a newline '\n')

**void addContact(struct Contact[], int);**

- **addContact** does not return a value and receives a **Contact** array, and an integer (intended for representing the size of the Contact array).
- This function should first determine if there is an available slot (empty index) in the contact array. This requires iterating the contact array and looking for the first available element having a cell number string length equal to zero (0). **Hint:** use the string library's string length function.
- If there are no available slots, the contact listing is full. Notify the user displaying the following message:  
>\*\*\* ERROR: The contact list is full! \*\*\*< (add a newline '\n')
- Otherwise, prompt the user to enter the details for the new contact (store to the contact array at the determined empty slot index). **Hint:** use the **getContact** function
- After adding the new contact, display the following message:  
>--- New contact added! ---< (add a newline '\n')

**void updateContact(struct Contact[], int);**

- **updateContact** does not return a value and receives a **Contact** array, and an integer (intended for representing the size of the Contact array).
- This function should prompt the user for the cell phone number of the contact to update.
- Search the contact array to find a contact with the cell phone number previously entered. **Hint:** call the **findContactIndex** function
- If the contact could NOT be located, display the following message:  
>\*\*\* Contact NOT FOUND \*\*\*< (add a newline '\n')
- Otherwise, if the contact is located, display the following message:  
Print a newline ('\n') followed by:  
>Contact found:<  
Follow with another newline ('\n')
- Then display the details for the contact. **Hint:** call the **displayContact** function – followed by a newline ('\n')
- Prompt the user with the following message:  
>Do you want to update the name? (y or n): < **Hint:** call the **yes** function  
- If the user responds yes ('y'|'Y') call the function **getName** to update the name member of the contact
- Follow with a prompt displaying the following message:  
>Do you want to update the address? (y or n): < **Hint:** call the **yes** function  
- If the user responds yes ('y'|'Y') call the function **getAddress** to update the address member of the contact
- Follow with a prompt displaying the following message:  
>Do you want to update the numbers? (y or n): < **Hint:** call the **yes** function  
- If the user responds yes ('y'|'Y') call the function **getNumbers** to update the numbers member of the contact

- Lastly display a confirmation message to indicate the contact information was updated:

```
>--- Contact Updated! ---< (add a newline '\n')
```

**void deleteContact(struct Contact[], int);**

- **deleteContact** does not return a value and receives a **Contact** array, and an integer (intended for representing the size of the Contact array).
- This function should prompt the user for the cell phone number of the contact to delete from the list.
- Search the contact array to find a contact with the cell phone number previously entered. **Hint:** call the **findContactIndex** function
- If the contact could NOT be located, display the following message:  

```
>*** Contact NOT FOUND ***< (add a newline '\n')
```
- Otherwise, if the contact is located, display the following message:  
 Print a newline ('\n') followed by:  

```
>Contact found:<
```

 Follow with another newline ('\n')
- Then display the details for the contact. **Hint:** call the **displayContact** function – followed by a newline ('\n')
- Prompt the user with the following message:  

```
>CONFIRM: Delete this contact? (y or n): <
```

**Hint:** call the **yes** function  
 - If the user responds yes, set the contact's cell number to an empty string (**Hint:** assign a null terminator character to the first element)
- Lastly display a confirmation message to indicate the contact was deleted:  

```
>--- Contact deleted! ---< (add a newline '\n')
```

#### **NOTE**

The **sortContacts** function is **OPTIONAL** (unless otherwise specified by your instructor)

- If you successfully define this function (and if your instructor does not require you to do this function), bonus marks will be given to compensate your extra effort.

If you chose NOT to do this function, display the following message:

```
><<< Feature to sort is unavailable >>>< (add a newline '\n')
```

**void sortContacts(struct Contact[], int);**

- **sortContacts** does not return a value and receives a **Contact** array, and an integer (intended for representing the size of the Contact array).
- This function reorders the elements in the contacts array from lowest to highest based on the cell phone numbers.
- After sorting is done (the array is reordered), display the following message:  

```
>--- Contacts sorted! ---< (add a newline '\n')
```
- **Hint:** Review the course notes on Algorithms (specifically the sections on “**Sorting**”)

5. Lastly, revise the `ContactManagementSystem` function.

- Create a `Contact` array sized to `MAXCONTACTS` and provide it a meaningful name.

- Initialize the array to hold the following:

```
{ { { "Rick", {'\0'}, "Grimes" },
  { 11, "Trailer Park", 0, "A7A 2J2", "King City" },
  { "4161112222", "4162223333", "4163334444" } },
{
  { "Maggie", "R.", "Greene" },
  { 55, "Hightop House", 0, "A9A 3K3", "Bolton" },
  { "9051112222", "9052223333", "9053334444" } },
{
  { "Morgan", "A.", "Jones" },
  { 77, "Cottage Lane", 0, "C7C 9Q9", "Peterborough" },
  { "7051112222", "7052223333", "7053334444" } },
{
  { "Sasha", {'\0'}, "Williams" },
  { 55, "Hightop House", 0, "A9A 3K3", "Bolton" },
  { "9052223333", "9052223333", "9054445555" } },
};
```

- Next, refer to the below for what function should be called for each menu selection:

Contact Management System

-----

1. Display contacts	Call function: <i>displayContacts</i>
2. Add a contact	Call function: <i>addContact</i>
3. Update a contact	Call function: <i>updateContact</i>
4. Delete a contact	Call function: <i>deleteContact</i>
5. Search contacts by cell phone number	Call function: <i>searchContacts</i>
6. Sort contacts by cell phone number	Call function: <i>sortContacts</i>
0. Exit	

Select an option:>

## Sample Output (**NO** Sorting Option)

Below is a sample output. User input values are identified in **RED**. Your output should match exactly:

-----  
Testing: Final A#2-Milestone #4  
-----

Contact Management System

-----

```
1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit
```

Select an option:> **1**



+-----+  
| Contacts Listing |  
+-----+

Rick Grimes  
C: 4161112222 H: 4162223333 B: 4163334444  
11 Trailer Park, King City, A7A 2J2

11 Trailer Park, King City, A7A 2J2

Maggie R. Greene  
C: 9051112222 H: 9052223333 B: 9053334444  
55 Hightop House, Bolton, A9A 3K3

55 Hightop House, Bolton, A9A 3K3

Morgan A. Jones  
C: 7051112222 H: 7052223333 B: 7053334444  
77 Cottage Lane, Peterborough, C7C 9Q9

77 Cottage Lane, Peterborough, C7C 9Q9

Sasha Williams  
C: 9052223333 H: 9052223333 B: 9054445555  
55 Hightop House, Bolton, A9A 3K3

55 Hightop House, Bolton, A9A 3K3

```
+-----+
Total contacts: 4
```

(Press Enter to Continue)

## Contact Management System

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 2

Please enter the contact's first name: **I Should**

Do you want to enter a middle initial(s)? (y or n): **y**

Please enter the contact's middle initial(s): **B.**

Please enter the contact's last name: **Gone**

Please enter the contact's street number: 99

Please enter the contact's street name: No Name Rd.

Do you want to enter an apartment number? (y or n): **y**

Please enter the contact's apartment number: **11**

Please enter the contact's postal code: **A1A J9J**

Please enter the contact's city: **Nowhere City**

Please enter the contact's cell phone number: 1112223333

Do you want to enter a home phone number? (y or n): **y**

Please enter the contact's home phone number: **9991112222**

```
Do you want to enter a business phone number? (y or n): n
```

```

--- New contact added! ---

```

(Press Enter to Continue)

## Contact Management System

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact

5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> **1**

```
+-----+
|                               |
|                               |
+-----+
Rick Grimes
  C: 4161112222   H: 4162223333   B: 4163334444
    11 Trailer Park, King City, A7A 2J2
Maggie R. Greene
  C: 9051112222   H: 9052223333   B: 9053334444
    55 Hightop House, Bolton, A9A 3K3
Morgan A. Jones
  C: 7051112222   H: 7052223333   B: 7053334444
    77 Cottage Lane, Peterborough, C7C 9Q9
Sasha Williams
  C: 9052223333   H: 9052223333   B: 9054445555
    55 Hightop House, Bolton, A9A 3K3
I Should B. Gone
  C: 1112223333   H: 9991112222   B:
    99 No Name Rd., Apt# 11, Nowhere City, A1A J9J
+-----+
```

Total contacts: 5

(Press Enter to Continue)

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> **2**

\*\*\* ERROR: The contact list is full! \*\*\*

(Press Enter to Continue)

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> **3**

Enter the cell number for the contact: 6665555

Enter a 10-digit phone number: 6665551111

\*\*\* Contact NOT FOUND \*\*\*

(Press Enter to Continue)

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 3

Enter the cell number for the contact: 9051112222

Contact found:

Maggie R. Greene

C: 9051112222 H: 9052223333 B: 9053334444

55 Hightop House, Bolton, A9A 3K3

Do you want to update the name? (y or n): y

Please enter the contact's first name: Maggie

Do you want to enter a middle initial(s)? (y or n): y

Please enter the contact's middle initial(s): R.

Please enter the contact's last name: Greene-Grimes

Do you want to update the address? (y or n): y

Please enter the contact's street number: 55

Please enter the contact's street name: Hightop House

Do you want to enter an apartment number? (y or n): y

Please enter the contact's apartment number: 201

Please enter the contact's postal code: A9A 3K3

Please enter the contact's city: Bolton

Do you want to update the numbers? (y or n): y

Please enter the contact's cell phone number: 905

Enter a 10-digit phone number: 9051112222

Do you want to enter a home phone number? (y or n): n

Do you want to enter a business phone number? (y or n): n

--- Contact Updated! ---

(Press Enter to Continue)

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 1

```
+-----+
|                               |
|                               |
+-----+
Rick Grimes
  C: 4161112222   H: 4162223333   B: 4163334444
    11 Trailer Park, King City, A7A 2J2
Maggie R. Greene-Grimes
  C: 9051112222   H:                B:
    55 Hightop House, Apt# 201, Bolton, A9A 3K3
Morgan A. Jones
  C: 7051112222   H: 7052223333   B: 7053334444
    77 Cottage Lane, Peterborough, C7C 9Q9
Sasha Williams
  C: 9052223333   H: 9052223333   B: 9054445555
    55 Hightop House, Bolton, A9A 3K3
I Should B. Gone
  C: 1112223333   H: 9991112222   B:
    99 No Name Rd., Apt# 11, Nowhere City, A1A J9J
+-----+
```

Total contacts: 5

(Press Enter to Continue)

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 4

Enter the cell number for the contact: 9051112222

Contact found:

Maggie R. Greene-Grimes  
 C: 9051112222 H: B:  
 55 Hightop House, Apt# 201, Bolton, A9A 3K3

CONFIRM: Delete this contact? (y or n): n

(Press Enter to Continue)

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number

0. Exit

Select an option:> 4

Enter the cell number for the contact: 9051112222

Contact found:

Maggie R. Greene-Grimes

C: 9051112222 H: B:

55 Hightop House, Apt# 201, Bolton, A9A 3K3

CONFIRM: Delete this contact? (y or n): y

--- Contact deleted! ---

(Press Enter to Continue)

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 1

```
+-----+
|                               |
|                               |
+-----+
Rick Grimes
  C: 4161112222  H: 4162223333  B: 4163334444
    11 Trailer Park, King City, A7A 2J2
Morgan A. Jones
  C: 7051112222  H: 7052223333  B: 7053334444
    77 Cottage Lane, Peterborough, C7C 9Q9
Sasha Williams
  C: 9052223333  H: 9052223333  B: 9054445555
    55 Hightop House, Bolton, A9A 3K3
I Should B. Gone
  C: 1112223333  H: 9991112222  B:
    99 No Name Rd., Apt# 11, Nowhere City, A1A J9J
+-----+
```

Total contacts: 4

(Press Enter to Continue)

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number

0. Exit

Select an option:> 2

Please enter the contact's first name: **Where**  
Do you want to enter a middle initial(s)? (y or n): **y**  
Please enter the contact's middle initial(s): **Do**  
Please enter the contact's last name: **I Belong**  
Please enter the contact's street number: **22**  
Please enter the contact's street name: **Somewhere Lane**  
Do you want to enter an apartment number? (y or n): **n**  
Please enter the contact's postal code: **A1A J9J**  
Please enter the contact's city: **Unknown**  
Please enter the contact's cell phone number: **8883337777**  
Do you want to enter a home phone number? (y or n): **n**  
Do you want to enter a business phone number? (y or n): **y**  
Please enter the contact's business phone number: **7771115555**  
--- New contact added! ---  
(Press Enter to Continue)

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 1

```
+-----+
|                               |
|                               |
+-----+
Rick Grimes
  C: 4161112222   H: 4162223333   B: 4163334444
    11 Trailer Park, King City, A7A 2J2
Where Do I Belong
  C: 8883337777   H:                B: 7771115555
    22 Somewhere Lane, Unknown, A1A J9J
Morgan A. Jones
  C: 7051112222   H: 7052223333   B: 7053334444
    77 Cottage Lane, Peterborough, C7C 9Q9
Sasha Williams
  C: 9052223333   H: 9052223333   B: 9054445555
    55 Hightop House, Bolton, A9A 3K3
I Should B. Gone
  C: 1112223333   H: 9991112222   B:
    99 No Name Rd., Apt# 11, Nowhere City, A1A J9J
+-----+
```

Total contacts: 5

(Press Enter to Continue)

# Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 5

Enter the cell number for the contact: 9052223333

Sasha Williams

C: 9052223333 H: 9052223333 B: 9054445555

55 Hightop House, Bolton, A9A 3K3

(Press Enter to Continue)

# Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 0

Exit the program? (Y)es/(N)o: n

# Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 0

Exit the program? (Y)es/(N)o: y

Contact Management System: terminated

---

## Sample Output (With Sorting Option)

Below is a sample output. User input values are identified in **RED**. Your output should match exactly:

```
-----
Testing: Final A#2-Milestone #4 (Sort)
-----
Contact Management System
-----
1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 1

+-----+
|                               |
|               Contacts Listing               |
|                               |
+-----+
Rick Grimes
  C: 4161112222   H: 4162223333   B: 4163334444
    11 Trailer Park, King City, A7A 2J2
Maggie R. Greene
  C: 9051112222   H: 9052223333   B: 9053334444
    55 Hightop House, Bolton, A9A 3K3
Morgan A. Jones
  C: 7051112222   H: 7052223333   B: 7053334444
    77 Cottage Lane, Peterborough, C7C 9Q9
Sasha Williams
  C: 9052223333   H: 9052223333   B: 9054445555
    55 Hightop House, Bolton, A9A 3K3
+-----+
Total contacts: 4

(Press Enter to Continue)

Contact Management System
-----
1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 2

Please enter the contact's first name: I Should
Do you want to enter a middle initial(s)? (y or n): y
Please enter the contact's middle initial(s): B.
Please enter the contact's last name: Gone
```



Please enter the contact's street number: 99  
Please enter the contact's street name: No Name Rd.  
Do you want to enter an apartment number? (y or n): y  
Please enter the contact's apartment number: 11  
Please enter the contact's postal code: A1A J9J  
Please enter the contact's city: Nowhere City  
Please enter the contact's cell phone number: 1112223333  
Do you want to enter a home phone number? (y or n): y  
Please enter the contact's home phone number: 9991112222  
Do you want to enter a business phone number? (y or n): n  
--- New contact added! ---  
(Press Enter to Continue)

#### Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 1

```
+-----+
|                               |
|                               |
+-----+
Rick Grimes
  C: 4161112222   H: 4162223333   B: 4163334444
    11 Trailer Park, King City, A7A 2J2
Maggie R. Greene
  C: 9051112222   H: 9052223333   B: 9053334444
    55 Hightop House, Bolton, A9A 3K3
Morgan A. Jones
  C: 7051112222   H: 7052223333   B: 7053334444
    77 Cottage Lane, Peterborough, C7C 9Q9
Sasha Williams
  C: 9052223333   H: 9052223333   B: 9054445555
    55 Hightop House, Bolton, A9A 3K3
I Should B. Gone
  C: 1112223333   H: 9991112222   B:
    99 No Name Rd., Apt# 11, Nowhere City, A1A J9J
+-----+
```

Total contacts: 5

(Press Enter to Continue)

#### Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number

6. Sort contacts by cell phone number
0. Exit

Select an option:> **2**

\*\*\* ERROR: The contact list is full! \*\*\*  
(Press Enter to Continue)

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> **3**

Enter the cell number for the contact: **6665555**  
Enter a 10-digit phone number: **6665551111**  
\*\*\* Contact NOT FOUND \*\*\*  
(Press Enter to Continue)

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> **3**

Enter the cell number for the contact: **9051112222**

Contact found:

Maggie R. Greene

C: 9051112222 H: 9052223333 B: 9053334444  
55 Hightop House, Bolton, A9A 3K3

Do you want to update the name? (y or n): **y**  
Please enter the contact's first name: **Maggie**  
Do you want to enter a middle initial(s)? (y or n): **y**  
Please enter the contact's middle initial(s): **R.**  
Please enter the contact's last name: **Greene-Grimes**  
Do you want to update the address? (y or n): **y**  
Please enter the contact's street number: **55**  
Please enter the contact's street name: **Hightop House**  
Do you want to enter an apartment number? (y or n): **y**  
Please enter the contact's apartment number: **201**  
Please enter the contact's postal code: **A9A 3K3**

Please enter the contact's city: **Bolton**  
Do you want to update the numbers? (y or n): **y**  
Please enter the contact's cell phone number: **905**  
Enter a 10-digit phone number: **9051112222**  
Do you want to enter a home phone number? (y or n): **n**  
Do you want to enter a business phone number? (y or n): **n**  
--- Contact Updated! ---  
(Press Enter to Continue)

# Contact Management System

- 1. Display contacts
- 2. Add a contact
- 3. Update a contact
- 4. Delete a contact
- 5. Search contacts by cell phone number
- 6. Sort contacts by cell phone number
- 0. Exit

Select an option:> **1**

```
+-----+
|                               |
|                               |
+-----+
Rick Grimes
  C: 4161112222   H: 4162223333   B: 4163334444
    11 Trailer Park, King City, A7A 2J2
Maggie R. Greene-Grimes
  C: 9051112222   H:                B:
    55 Hightop House, Apt# 201, Bolton, A9A 3K3
Morgan A. Jones
  C: 7051112222   H: 7052223333   B: 7053334444
    77 Cottage Lane, Peterborough, C7C 9Q9
Sasha Williams
  C: 9052223333   H: 9052223333   B: 9054445555
    55 Hightop House, Bolton, A9A 3K3
I Should B. Gone
  C: 1112223333   H: 9991112222   B:
    99 No Name Rd., Apt# 11, Nowhere City, A1A J9J
+-----+
```

Total contacts: 5

(Press Enter to Continue)

# Contact Management System

- 1. Display contacts
- 2. Add a contact
- 3. Update a contact
- 4. Delete a contact
- 5. Search contacts by cell phone number
- 6. Sort contacts by cell phone number
- 0. Exit

Select an option:> **4**

Enter the cell number for the contact: 9051112222

Contact found:

Maggie R. Greene-Grimes

C: 9051112222 H: B:  
55 Hightop House, Apt# 201, Bolton, A9A 3K3

CONFIRM: Delete this contact? (y or n): n  
(Press Enter to Continue)

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 4

Enter the cell number for the contact: 9051112222

Contact found:

Maggie R. Greene-Grimes

C: 9051112222 H: B:  
55 Hightop House, Apt# 201, Bolton, A9A 3K3

CONFIRM: Delete this contact? (y or n): y  
--- Contact deleted! ---  
(Press Enter to Continue)

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 1

+-----+  
| Contacts Listing |  
+-----+

Rick Grimes

C: 4161112222 H: 4162223333 B: 4163334444  
11 Trailer Park, King City, A7A 2J2

Morgan A. Jones

C: 7051112222 H: 7052223333 B: 7053334444  
77 Cottage Lane, Peterborough, C7C 9Q9

Sasha Williams  
C: 9052223333 H: 9052223333 B: 9054445555  
55 Hightop House, Bolton, A9A 3K3  
I Should B. Gone  
C: 1112223333 H: 9991112222 B:  
99 No Name Rd., Apt# 11, Nowhere City, A1A J9J

+-----+  
Total contacts: 4

(Press Enter to Continue)

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 2

Please enter the contact's first name: Where  
Do you want to enter a middle initial(s)? (y or n): y  
Please enter the contact's middle initial(s): Do  
Please enter the contact's last name: I Belong  
Please enter the contact's street number: 22  
Please enter the contact's street name: Somewhere Lane  
Do you want to enter an apartment number? (y or n): n  
Please enter the contact's postal code: A1A J9J  
Please enter the contact's city: Unknown  
Please enter the contact's cell phone number: 8883337777  
Do you want to enter a home phone number? (y or n): n  
Do you want to enter a business phone number? (y or n): y  
Please enter the contact's business phone number: 7771115555  
--- New contact added! ---  
(Press Enter to Continue)

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 1

+-----+  
| Contacts Listing |  
+-----+  
Rick Grimes

C: 4161112222 H: 4162223333 B: 4163334444  
11 Trailer Park, King City, A7A 2J2  
Where Do I Belong  
C: 8883337777 H: B: 7771115555  
22 Somewhere Lane, Unknown, A1A J9J  
Morgan A. Jones  
C: 7051112222 H: 7052223333 B: 7053334444  
77 Cottage Lane, Peterborough, C7C 9Q9  
Sasha Williams  
C: 9052223333 H: 9052223333 B: 9054445555  
55 Hightop House, Bolton, A9A 3K3  
I Should B. Gone  
C: 1112223333 H: 9991112222 B:  
99 No Name Rd., Apt# 11, Nowhere City, A1A J9J

+-----+  
Total contacts: 5

(Press Enter to Continue)

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 5

Enter the cell number for the contact: 9052223333

Sasha Williams  
C: 9052223333 H: 9052223333 B: 9054445555  
55 Hightop House, Bolton, A9A 3K3

(Press Enter to Continue)

Contact Management System

-----

1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit

Select an option:> 6

--- Contacts sorted! ---

(Press Enter to Continue)

Contact Management System

- ```
-----
1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit
```

Select an option:> **1**

```
+-----+
|                               |
|                               |
+-----+
I Should B. Gone
  C: 1112223333   H: 9991112222   B:
    99 No Name Rd., Apt# 11, Nowhere City, A1A J9J
Rick Grimes
  C: 4161112222   H: 4162223333   B: 4163334444
    11 Trailer Park, King City, A7A 2J2
Morgan A. Jones
  C: 7051112222   H: 7052223333   B: 7053334444
    77 Cottage Lane, Peterborough, C7C 9Q9
Where Do I Belong
  C: 8883337777   H:                B: 7771115555
    22 Somewhere Lane, Unknown, A1A J9J
Sasha Williams
  C: 9052223333   H: 9052223333   B: 9054445555
    55 Hightop House, Bolton, A9A 3K3
+-----+
Total contacts: 5
```

(Press Enter to Continue)

Contact Management System

- ```
-----
1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
6. Sort contacts by cell phone number
0. Exit
```

Select an option:> **0**

Exit the program? (Y)es/(N)o: **n**

Contact Management System

- ```
-----
1. Display contacts
2. Add a contact
3. Update a contact
4. Delete a contact
5. Search contacts by cell phone number
```

6. Sort contacts by cell phone number  
0. Exit

Select an option:> 0

Exit the program? (Y)es/(N)o: y

Contact Management System: terminated

## Milestone 4 Reflection (20%)

Please provide brief answers to the following questions in a file named [reflect.txt](#).

3. Briefly explain how the two functions [findContactIndex](#) and [getTenDigitPhone](#) benefit your source code with respect to overall maintenance and readability.
4. What did you learn most from doing Assignment 2?

**Note:** When completing the reflections it is a violation of academic policy to cut and paste content from the course notes or any other published source, or to copy the work of another

## Milestone 4 Submission

If not on matrix already, upload your [contacts.h](#), [contacts.c](#), [contactHelpers.h](#), [contactHelpers.c](#), [a2ms2.c](#), and [reflect.txt](#) files to your matrix account. Compile your code as follows:

```
> gcc -Wall -o ms4 contacts.c contactHelpers.c a2ms4.c <ENTER>
```

This command will compile your code and name your executable “[ms4](#)”. Execute [ms4](#) and make sure everything works properly.

Finally run the appropriate script from your account: (replace profname.proflastname with your professors Seneca userid):

**[NO Sorting Option]**

```
~profname.proflastname/submit 144_a2ms4 <ENTER>
```

**<<< OR >>>**

**[WITH Sorting Option]**

```
~profname.proflastname/submit 144_a2ms4Sort <ENTER>
```

and follow the instructions.

**Please note that a successful submission does not guarantee full credit for this submission. If the professor is not satisfied with your implementation, your professor may ask you to resubmit. Resubmissions will attract a penalty.**