

Report on Project-Based Learning: Telephone Directory Management System

Submitted by: Sahil Bhardwaj(24bcd10111)

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1. Introduction to Telephone Directory Using Linked List

A **Telephone Directory** is a fundamental application that serves as a repository of contact information, including names and phone numbers of individuals or entities. With the increasing need for efficient data management systems, implementing a telephone directory using data structures such as **Linked Lists** provides a practical and effective solution.

The **Linked List** is a dynamic data structure that consists of a sequence of nodes, where each node contains two parts: the data (e.g., name and phone number) and a pointer to the next node in the sequence. This structure is particularly advantageous for applications like a telephone directory because of its flexibility and efficiency in handling frequent insertions, deletions, and updates.

In a telephone directory implemented using a linked list, each contact is stored as a node. The linked list allows for seamless addition of new contacts, deletion of outdated entries, and efficient traversal to search for specific details. Unlike arrays, linked lists do not require allocating a fixed amount of memory at the beginning, making them ideal for applications where the number of entries can vary significantly.

The project demonstrates the practical application of linked lists by providing functionalities such as:

- Adding a new contact to the directory.
- Searching for a contact by name or phone number.
- Deleting a contact when it is no longer needed.
- Displaying all contacts in the directory in a sequential manner.

2. Objective

The primary objective of the **Telephone Directory Management System** project is to design and implement a user-friendly system for managing contact information efficiently. This system leverages the **Linked List** data structure to dynamically handle operations such as adding, searching, updating, deleting, and displaying contacts without the need for a fixed memory allocation.

Key goals of the project include:

1. **Dynamic Data Management:** Utilize the flexibility of a linked list to dynamically allocate memory for storing contact details, ensuring efficient memory utilization and adaptability to varying data sizes.
2. **Real-World Application of Data Structures:** Demonstrate practical usage of the linked list data structure to solve a real-world problem, bridging the gap between theoretical learning and practical implementation.
3. **Feature-Rich Functionality:** Provide essential features for managing a telephone directory, such as:
 - a. Adding new contacts
 - b. Searching for existing contacts
 - c. Updating contact details
 - d. Deleting outdated or unnecessary contacts
 - e. Displaying the entire contact list in a user-friendly format
4. **Scalability:** Ensure the system can handle a growing number of contacts efficiently without performance degradation.
5. **Ease of Use:** Develop a simple and intuitive interface that allows users to interact with the system seamlessly, catering to both technical and non-technical users.
6. **Learning Outcome:** Enhance understanding of linked lists and their advantages over other data structures like arrays, particularly in handling dynamic data and performing insertion and deletion operations.

Through this project, the aim is not only to build a functional telephone directory management system but also to gain deeper insights into the practical challenges and benefits of using linked lists in software development.

3. Modules Chosen

In the development of the Telephone Directory Management System, selecting the appropriate data structure was critical to ensure the system's efficiency and reliability. After careful consideration, the **Linked List** was chosen as the core data structure for this project due to its inherent advantages in handling dynamic data and performing operations such as insertion and deletion efficiently.

a. Linked List

The **Linked List** is a linear data structure where elements (referred to as nodes) are linked together in a sequential manner using pointers. Each node in the linked list consists of two main parts:

1. **Data Field:** Stores the actual information, which in this project includes the name, phone number, and email address of a contact.
2. **Pointer Field:** Contains the address of the next node in the sequence, creating a dynamic chain of nodes.

Why Linked List Was Chosen:

1. **Dynamic Nature:** Unlike arrays, linked lists do not require a predefined size. This dynamic allocation of memory is particularly useful for a telephone directory where the number of contacts may grow or shrink at runtime.
2. **Efficient Insertion and Deletion:** Operations such as adding new contacts, updating existing ones, or removing outdated entries can be performed efficiently without the need to shift elements, as is required in arrays.
3. **Memory Utilization:** Linked lists allocate memory as needed, avoiding the wastage of memory that may occur in arrays with predefined sizes.
4. **No Contiguous Memory Requirement:** Since nodes in a linked list are scattered in memory and linked via pointers, there is no requirement for contiguous memory blocks, making it easier to store and manage data.

4. Methodology (Features)

The **Telephone Directory Management System** is designed to efficiently manage contact information using a dynamic and modular approach. The system incorporates a set of core features, each implemented to handle specific operations related to contact management. By leveraging the **Linked List** data structure, the project ensures flexibility, scalability, and efficient memory utilization. Below is a detailed explanation of the features and their implementation.

Features of the System

1. Add Contact

The "Add Contact" feature allows users to include new contact details in the directory. When a contact is added:

- The system prompts the user to input the following details:
 - **Name:** The name of the contact.
 - **Phone Number:** A unique identifier for the contact.
 - **Email Address:** Additional information associated with the contact.
- A new node is dynamically created in the linked list to store this data.
- The newly created node is linked to the existing list by updating the pointer of the last node, ensuring seamless integration.

This feature enables the directory to grow dynamically without any predefined size limitations, making it highly scalable.

2. Search Contact

The "Search Contact" feature allows users to locate specific contacts based on either the contact's name or phone number. The implementation involves:

- Traversing the linked list sequentially, starting from the head node.

- Comparing the search query (name or phone number) with the data in each node.
- If a match is found, the system displays the contact details.
- If no match is found after traversing the entire list, the system notifies the user that the contact does not exist.

This feature ensures quick and efficient retrieval of information, even as the directory size increases.

3. Update Contact

The "Update Contact" feature enables users to modify the details of an existing contact. The process includes:

- Searching the linked list to locate the contact using the name or phone number.
- Once the desired node is found, the system prompts the user to input updated details such as a new name, phone number, or email address.
- The data fields in the corresponding node are modified based on the user's input.

This feature ensures that the directory remains up-to-date, reflecting any changes in contact information.

4. Delete Contact

The "Delete Contact" feature provides users with the ability to remove a contact from the directory. The steps involved are:

- Searching the linked list to locate the node corresponding to the contact to be deleted.
- Adjusting the pointers of the preceding and succeeding nodes to bypass the node being removed.

- Releasing the memory allocated to the deleted node to prevent memory leaks.

This feature helps maintain a clean and relevant directory by enabling the removal of old or unnecessary entries.

5. Display Directory

The "Display Directory" feature allows users to view the entire list of contacts in the system. When this feature is invoked:

- The system traverses the linked list from the head node to the last node.
- For each node, the stored contact details (name, phone number, email) are extracted and displayed in a user-friendly format.

This feature provides a comprehensive overview of all stored contacts, making it easy for users to review and verify the information in their directory.

Implementation Using Linked List

The **Linked List** data structure is central to the functionality of the Telephone Directory Management System. Each contact is represented as a node in the list, with the following structure:

- **Name:** A string to store the contact's name.
- **Phone Number:** A string or numeric value to store the unique identifier of the contact.
- **Email Address:** A string to store additional information about the contact.
- **Pointer:** A pointer to the next node in the list.

The use of a linked list allows for:

- **Dynamic Memory Allocation:** Memory is allocated only when a new contact is added, optimizing resource utilization.

- **Ease of Insertion and Deletion:** Adding or removing contacts requires minimal pointer manipulation, without the need for shifting data.
- **Scalability:** The directory can grow as needed without restrictions, making it suitable for dynamic applications.

Each feature is carefully designed to utilize the linked list's capabilities, ensuring efficient and effective contact management.

5. Working of Project Source Code

The **Telephone Directory Management System** is implemented in the C programming language and is designed to manage contact details dynamically using a linked list. The project is structured to provide efficient operations for adding, searching, updating, deleting, and displaying contact information. Below is a concise breakdown of the source code's functionality:

Code Breakdown

1. **Structure Definition:** The `struct contact` defines the structure of a node in the linked list. Each node contains fields for storing:
 - a. **Name**
 - b. **Phone Number**
 - c. **Email Address**
 - d. A **pointer** to the next node in the list.
2. **Dynamic Memory Allocation:** The `malloc` function is used to dynamically allocate memory for each new node, ensuring efficient memory utilization.
3. **Functions:**
 - a. **createEntry:** Creates and initializes a new contact node with user-provided details.
 - b. **inserting:** Adds new contacts to the linked list by linking the new node to the existing list.
 - c. **displayDirectory:** Traverses the linked list and displays all stored contacts sequentially.
 - d. **searchContact:** Searches for a specific contact by name and retrieves the corresponding details.
 - e. **deleteContact:** Locates a contact node and adjusts the pointers to remove it from the linked list while freeing its memory.
4. **Main Function:** The main function provides a menu-driven interface, allowing users to interact with the system and perform various operations. It continuously prompts the user with options until the "Exit" option is selected.

Program Flow

1. **Initialization:** An empty linked list is created to store contact nodes.
2. **User Interaction:**
 - a. The user is presented with a menu of options:
 - i. Add a contact
 - ii. Search for a contact
 - iii. Update a contact
 - iv. Delete a contact
 - v. Display the directory
 - vi. Exit
 - b. Based on the user's selection, the corresponding function is executed.
3. **Execution of Operations:**
 - a. **Adding a Contact:** A new node is created using `createEntry` and added to the linked list using `inserting`.
 - b. **Searching:** The list is traversed sequentially by `searchContact` to match the query with stored data.
 - c. **Updating:** The user modifies details of an existing contact by locating and updating its node.
 - d. **Deleting:** The node is located and removed using `deleteContact`, with pointers adjusted to maintain the list's structure.
 - e. **Displaying Contacts:** The `displayDirectory` function traverses the list and prints all nodes in a readable format.
4. **Termination:** The program continues to operate until the user selects the "Exit" option, at which point the program terminates.

This modular and dynamic approach ensures flexibility, scalability, and efficient memory management, making the system robust and user-friendly.

Source Code:

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

// Define the structure for a directory entry
struct contact {
    char name[50];
    char phone[15];
    char address[100];
    char relation[30];
    char company[50];
    struct contact* next;
};

// Function to create a new directory entry
struct contact* createEntry(char* name, char* phone,
char* address, char* relation, char* company) {
    struct contact* newEntry = (struct
contact*)malloc(sizeof(struct contact));
    if (!newEntry) {
        printf("Memory allocation failed!\n");
        exit(EXIT_FAILURE);
    }
    strcpy(newEntry->name, name);
    strcpy(newEntry->phone, phone);
    strcpy(newEntry->address, address);
    strcpy(newEntry->relation, relation);
    strcpy(newEntry->company, company);
    newEntry->next = NULL;
    return newEntry;
}

// Modified Function to add multiple entries to the
directory
struct contact* inserting(struct contact* head) {
    char choice;
    do {
```

```

        char name[50], phone[15], address[100],
relation[30], company[50];
        printf("Enter Name: ");
        scanf(" %[^\\n]", name);
        printf("Enter Phone Number: ");
        scanf(" %[^\\n]", phone);
        printf("Enter Address: ");
        scanf(" %[^\\n]", address);
        printf("Enter Relation: ");
        scanf(" %[^\\n]", relation);
        printf("Enter Company Name: ");
        scanf(" %[^\\n]", company);

        struct contact* newEntry = createEntry(name,
phone, address, relation, company);
        newEntry->next = head;
        head = newEntry; // Update the head of the list

        printf("New contact added successfully!\\n");
        printf("Do you want to add another contact? (y/Y
for yes, any other key for no): ");
        scanf(" %c", &choice); // Ask user for choice
    } while (choice == 'y' || choice == 'Y');

    return head; // Return the updated head of the list
}

// Function to display all contacts
void displayDirectory(struct contact* head) {
    if (head == NULL) {
        printf("The directory is empty.\\n");
        return;
    }
    struct contact* current = head;
    while (current != NULL) {
        printf("\\nName: %s\\n", current->name);
        printf("Phone: %s\\n", current->phone);
        printf("Address: %s\\n", current->address);
        printf("Relation: %s\\n", current->relation);
    }
}

```

```

        printf("Company: %s\n", current->company);
        printf("-----\n");
        current = current->next;
    }
}

// Function to search a contact by name
void searchContact(struct contact* head, char*
searchName) {
    struct contact* current = head;
    while (current != NULL) {
        if (strcmp(current->name, searchName) == 0) {
            printf("\nContact Found:\n");
            printf("Name: %s\n", current->name);
            printf("Phone: %s\n", current->phone);
            printf("Address: %s\n", current->address);
            printf("Relation: %s\n", current->relation);
            printf("Company: %s\n", current->company);
            return;
        }
        current = current->next;
    }
    printf("Contact with name '%s' not found.\n",
searchName);
}

// Function to delete a contact by name
struct contact* deleteContact(struct contact* head, char*
deleteName) {
    struct contact *current = head, *prev = NULL;
    while (current != NULL && strcmp(current->name,
deleteName) != 0) {
        prev = current;
        current = current->next;
    }

    if (current == NULL) {
        printf("Contact '%s' not found.\n", deleteName);
        return head;
    }
}

```

```

    }

    if (prev == NULL) {
        // Deleting the head node
        head = current->next;
    } else {
        prev->next = current->next;
    }

    free(current);
    printf("Contact '%s' deleted successfully.\n",
deleteName);
    return head;
}

// Main function
int main() {
    struct contact* directory = NULL;
    int choice;
    char searchName[50];

    do {
        printf("\n--- Telephone Directory Menu ---\n");
        printf("1. Add Contact\n");
        printf("2. View Contacts\n");
        printf("3. Search Contact\n");
        printf("4. Delete Contact\n");
        printf("5. Exit\n");
        printf("Enter your choice: ");
        scanf("%d", &choice);
        getchar(); // Clear buffer

        switch (choice) {
            case 1:
                directory = inserting(directory);
                break;
            case 2:
                displayDirectory(directory);
                break;

```

```

        case 3:
            printf("Enter name to search: ");
            scanf(" %[^\\n]", searchName);
            searchContact(directory, searchName);
            break;
        case 4:
            printf("Enter name to delete: ");
            scanf(" %[^\\n]", searchName);
            directory = deleteContact(directory,
searchName);
            break;
        case 5:
            printf("Exiting program.\\n");
            break;
        default:
            printf("Invalid choice! Please try
again.\\n");
    }
} while (choice != 5);

return 0;
}

```

6. Limitations

The **Telephone Directory Management System** has certain limitations that stem from both the choice of data structure and the overall implementation. These limitations are outlined below:

a. Linked List Limitations

1. **Sequential Access:**
2. Accessing a specific contact requires traversing the linked list from the beginning, which can be time-consuming for large datasets.
3. **Memory Overhead:**

Each node in the linked list requires additional memory to store the pointer to the next node, increasing memory usage compared to arrays.

4. **No Backward Traversal:**

The implementation uses a singly linked list, which restricts traversal to one direction. This makes operations like reverse traversal or bidirectional searches impossible.

b. General Project Limitations

1. **No Persistent Storage:** The contact data is only stored in memory and is lost when the program terminates. There is no mechanism to save or retrieve data from a file or database.
2. **Limited Search Capability:**

The search functionality is limited to exact name matching and does not support partial matches or advanced search queries.

3. **No Sorting:**

Contacts are not stored or displayed in any particular order (e.g., alphabetically), which can make navigation cumbersome.

4. Command-Line Interface (CLI):

The project uses a basic CLI, which may not be user-friendly for non-technical users. A graphical user interface (GUI) would make it more accessible.

5. No Input Validation:

The program does not validate user input thoroughly, which can lead to issues like duplicate entries, invalid phone numbers, or incorrect formats.

6. No Backup or Recovery:

There is no feature to back up the directory or recover deleted contacts, increasing the risk of data loss.

- These limitations provide opportunities for future improvements, such as introducing persistent storage, advanced search capabilities, and a more user-friendly interface.

7. My Role in This Project

As a contributor to the **Telephone Directory Management System** project, my role was multifaceted and included the following responsibilities:

Code Editing and Optimization

- Carefully reviewed the existing codebase and implemented significant modifications to improve its efficiency and precision.
- Focused on optimizing memory allocation by ensuring effective use of dynamic memory for the linked list nodes.
- Enhanced the logical flow of the program to make it more structured and maintainable.

Enhancing Functionality

- Added new features to make the program more user-friendly and robust.
- Ensured seamless integration of the menu-driven interface, allowing users to interact with the system intuitively.
- Improved functionalities such as adding, searching, updating, and deleting contacts to enhance usability.

Project Report Preparation

- Took responsibility for creating a comprehensive and detailed project report.
- Analyzed and structured content for each section of the report, ensuring it effectively communicates:
 - The project's objectives
 - Methodology
 - Source code functionality
 - Limitations and outcomes
- Ensured that the report was clear, concise, and aligned with the project's goals.

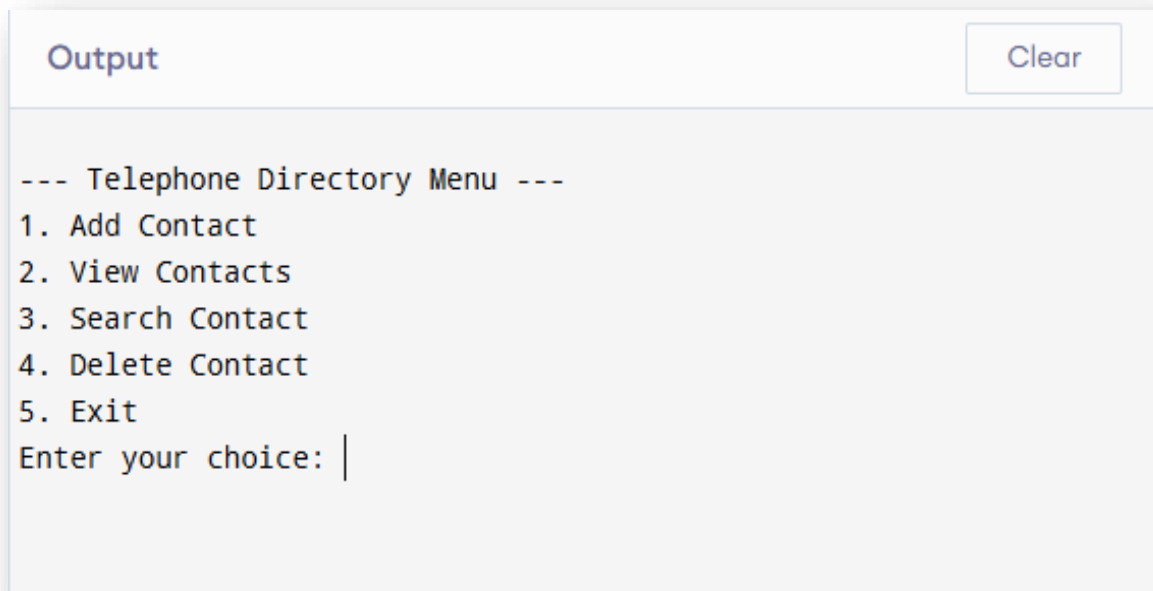
Debugging and Testing

- Debugged the program thoroughly to resolve logical and runtime errors.
- Conducted rigorous testing to account for edge cases, ensuring the program's stability and reliability.
- Verified that all features worked as intended and that the system could handle unexpected inputs gracefully.

Through these contributions, I played a pivotal role in ensuring the success of the project and its effective demonstration of dynamic data structures in real-world applications.

8. Screenshots (Outputs)

1. Main Menu:



The screenshot shows a terminal window with a title bar that says "Output" and a "Clear" button on the right. The terminal content displays a menu for a telephone directory application. The menu is titled "--- Telephone Directory Menu ---" and lists five options: "1. Add Contact", "2. View Contacts", "3. Search Contact", "4. Delete Contact", and "5. Exit". Below the list, it prompts the user with "Enter your choice: |", where the vertical bar indicates the current cursor position.

```
Output Clear  
--- Telephone Directory Menu ---  
1. Add Contact  
2. View Contacts  
3. Search Contact  
4. Delete Contact  
5. Exit  
Enter your choice: |
```

2. Adding a Contact:

```
Output Clear

--- Telephone Directory Menu ---
1. Add Contact
2. View Contacts
3. Search Contact
4. Delete Contact
5. Exit
Enter your choice: 1
Enter Name: sahil
Enter Phone Number: 8493953450
Enter Address: jammu
Enter Relation: myself
Enter Company Name: xyzltd
New contact added successfully!
Do you want to add another contact? (y/Y for yes, any other key for no)

--- Telephone Directory Menu ---
1. Add Contact
2. View Contacts
3. Search Contact
4. Delete Contact
5. Exit
Enter your choice: |
```

3. Viewing All Contacts:

```
Output Clear
Enter Name: john
Enter Phone Number: 9878456380
Enter Address: usa
Enter Relation: friend
Enter Company Name: abcltd.
New contact added successfully!
Do you want to add another contact? (y/Y for yes, any other key for no):
    n

--- Telephone Directory Menu ---
1. Add Contact
2. View Contacts
3. Search Contact
4. Delete Contact
5. Exit
Enter your choice: 2

Name: john
Phone: 9878456380
Address: usa
Relation: friend
Company: abcltd.
-----

Name: sahil
Phone: 8493952450
Address: jammu
Relation: myself
Company: xyzltd
```

4. Searching a Contact:

```
--- Telephone Directory Menu ---
```

1. Add Contact
2. View Contacts
3. Search Contact
4. Delete Contact
5. Exit

```
Enter your choice: 3
```

```
Enter name to search: john
```

```
Contact Found:
```

```
Name: john
```

```
Phone: 9878456380
```

```
Address: usa
```

```
Relation: friend
```

```
Company: abcltd.
```

```
--- Telephone Directory Menu ---
```

1. Add Contact
2. View Contacts
3. Search Contact
4. Delete Contact
5. Exit

```
Enter your choice: |
```

5. Deleting a Contact:

```
--- Telephone Directory Menu ---  
1. Add Contact  
2. View Contacts  
3. Search Contact  
4. Delete Contact  
5. Exit  
Enter your choice: 4  
Enter name to delete: john  
Contact 'john' deleted successfully.
```

```
--- Telephone Directory Menu ---  
1. Add Contact  
2. View Contacts  
3. Search Contact  
4. Delete Contact  
5. Exit  
Enter your choice: 5  
Exiting program.
```

```
=== Code Execution Successful ===
```


9. Conclusion (Summary)

The Telephone Directory Management System project demonstrates the practical application of Data Structures and Algorithms (DSA) in creating a dynamic and user-friendly solution for managing contact information. Below are the key points of conclusion:

• Successful Implementation:

- The project successfully implements a Linked List data structure to handle dynamic memory allocation.
- Core operations such as adding, searching, deleting, and displaying contacts were implemented and tested effectively.

• Learning Outcomes:

- Enhanced understanding of Linked Lists and their applications in real-world scenarios.
- Gained hands-on experience with dynamic memory allocation using C programming.
- Developed logical thinking and problem-solving skills through iterative testing and debugging.

• Project Features:

- A menu-driven interface was created, ensuring a smooth user experience.
- The project supports critical functionalities such as:
 - Adding contacts.
 - Searching for contacts by name.
 - Deleting existing contacts.
 - Viewing all stored contacts.
- The program was tested for edge cases, ensuring robustness.

• **Practical Applications:**

- Demonstrates how a Linked List can be used in real-world applications like contact management, scheduling, or inventory tracking.
- Provides a base for further enhancements, such as persistent storage or advanced search functionalities.

• **Limitations Identified:**

- The project lacks persistent storage, meaning data is lost when the program is terminated.
- Searching and deletion operations are performed in $O(n)$ time complexity, which can be inefficient for large datasets.
- No sorting mechanism for maintaining an ordered directory.

• **Future Scope:**

- Adding persistent storage to retain contact data across sessions.
- Implementing a sorting algorithm to maintain an ordered list of contacts.
- Optimizing the search functionality using more efficient data structures.

• **Personal Contributions:**

- The project provided an opportunity to contribute through code optimization, testing, and debugging.
- Creating a detailed project report and showcasing the program's outputs helped refine documentation and analytical skills.

In conclusion, the project serves as an excellent example of project-based learning by combining theoretical knowledge with practical implementation. It provides a foundation for further exploration and development, enhancing both technical and analytical competencies.