National University of Computer & Emerging Sciences, Karachi

Fall-2023 FAST School of Computing
Final Exam Solution
18th December 2023, 9:00 am – 12:00 pm

Course Code:CS1002	**Course Name:** Programming Fundamentals
Instructor Name: Mr. M. Shahzad, Dr. Farooque, Dr. Abdul Aziz, Mr. Zain, Mr. Basit, Ms. Sobia, Mr. Farooq Zaidi, Mr. M. Kariz	
Student Roll No:	**Section:**

Instructions:

- Return the question paper and make sure to keep it inside your answer sheet.
- Read each question completely before answering it. There are 6 questions and 5 pages.
- In case of any ambiguity, you may make assumptions. However, your assumption should not contradict any statement in the question paper.
- Do not write anything on the question paper (except your ID and group).

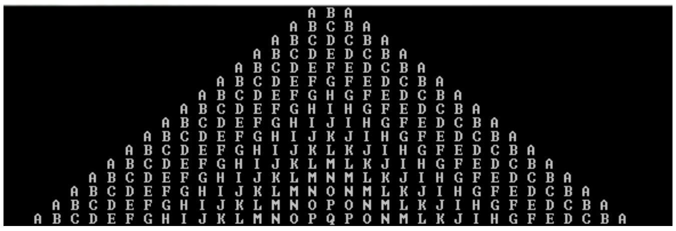
Total Time: 170 minutes **Max Points**: 100

Q1: [20 min, 15 Points (5 each), CLO 1]

a. Write on the answer sheet the output of the following programs, when they are executed. There are no compilation errors in the programs.

```
1, 2, 3
4, 5, 6
```

```
{3, 2, 1};
{6, 5, 4};
{9, 8, 7};
```



```
                              A B A
                            A B C B A
                          A B C D C B A
                        A B C D E D C B A
                      A B C D E F E D C B A
                    A B C D E F G F E D C B A
                  A B C D E F G H G F E D C B A
                A B C D E F G H I H G F E D C B A
              A B C D E F G H I J I H G F E D C B A
            A B C D E F G H I J K J I H G F E D C B A
          A B C D E F G H I J K L K J I H G F E D C B A
        A B C D E F G H I J K L M L K J I H G F E D C B A
      A B C D E F G H I J K L M N M L K J I H G F E D C B A
    A B C D E F G H I J K L M N O N M L K J I H G F E D C B A
  A B C D E F G H I J K L M N O P O N M L K J I H G F E D C B A
A B C D E F G H I J K L M N O P Q P O N M L K J I H G F E D C B A
```

Q2: [30 min, 18 Points (6 each), CLO 2] Considering the output given, complete the following code snippets. [Attempt on answer script]

```
struct student {
    char fname[30];
    char lname[30];
    int rollno;
    float percentage;
};

void writeStudentToFile(const char
*filename) {
    FILE *fp;
    struct student input;

    // open student file for writing
    fp = fopen(filename, "w");
    if (fp == NULL) {
        printf("\nFile opening
error..\n\n");
        exit(1);
    }

    printf("Enter \"exit\" as First Name to
stop reading user input.");

    while (1) {
        printf("\nFirst Name: ");
        scanf("%s", input.fname);

        if (strcmp(input.fname, "exit") ==
0)
            break;

        printf("Last Name : ");
        scanf("%s", input.lname);
        printf("Roll Number  : ");
        scanf("%d", &input.rollno);
        printf("Percentage : ");
        scanf("%f", &input.percentage);

        // write student data to file
        fwrite(&input, sizeof(struct
student), 1, fp);
    }

    fclose(fp);
}
```

```
Output:
Enter "exit" as First Name to stop
reading user input.
First Name: Ali
Last Name : Iqbal
Roll Number  : 101
Percentage : 90.50

First Name: Naima
Last Name : Ali
Roll Number  : 102
Percentage : 95.50

First Name: exit
```

```
int* getMinMax(int *numbers, const int size) {
    int i;
    int min = *numbers;
    int max = *numbers;
    for (i = 1; i < size; i++) {
        if (*(numbers + i) < min)
            min = *(numbers + i);
        if (*(numbers + i) > max)
            max = *(numbers + i); }
    int *resultArray = (int*)malloc(2 *
sizeof(int));
    resultArray[0] = min;
    resultArray[1] = max;
    return resultArray;
}
```

```
Output:
Enter size of array: 5
Enter 5 elements in array: 1 -2 3 -1 9
Minimum value in array : -2
Maximum value in array : 9
```

```
  void removeWordFromString(char str[], char
word[], char neww[]) {
          int i, j = 0, k = 0, n = 0;
          int flag = 0;

          for (i = 0; str[i] != '\0'; i++) {
              k = i;

              while (str[i] == word[j]) {
                  i++, j++;
                  if (j == strlen(word)) {
                      flag = 1;
                      break;
                  }
              }
              j = 0;

              if (flag == 0)
                  i = k;
              else
                  flag = 0;

              neww[n++] = str[i];
          }

          neww[n] = '\0';
      }
```

```
Output:
Enter any string to remove a word
from it:
Programming Fundamental

Enter the word you want to remove:
gram

After removing the word from the
string: Proming Fundamental
```

Q3: [25 min, 12 Points, CLO 3]

```
#include <stdio.h>
#define N 10000
#define inf 1e9
int arr[N], n, x;

int foo(int sum)
{
      if (sum == 0)
      return 0;
      int mini = inf;
      for (int i = 0; i < n; i++)
      {
      if (sum - arr[i] >= 0)
      {
            int m = foo(sum - arr[i]) + 1;
            if (mini > m)
            mini = m;
      }
      }
      return mini;
}

int main(void)
{
      scanf("%d %d", &n, &x);
      for (int i = 0; i < n; i++)
      scanf("%d", &arr[i]);
      printf("%d\n", foo(x));
}
```

Q4: [30 min, 20 Points, CLO 2

You need to write two functions for user authentication with encryption in C Language:

Part A. void encrypt(*usernames, *passwords): This function takes two pointer arrays as arguments: usernames: An array of 100 strings containing user names, and passwords: An array of 100 strings containing passwords. Strings are null ('\0') terminated.

For each username and password pair, the function encrypts them using the below method:

- Each character in the string is replaced by another character that is i positions ahead in the alphabet.
- i is determined by the index of the string in the usernames array (e.g., first string element uses i=0, second element uses i=1, etc.).

Part B. int find(*usernames, *passwords, *search_username, *search_password): This function takes four arguments. The function searches in the encrypted usernames and passwords arrays for a matching pair corresponding to the provided search_username and search_password (un-encrypted). Function returns 1 if a matching username and password pair are found, 0 otherwise.

-----------------------RUBRICS------------------------

10 Points: Function prototype, definition uses nested loop to access characters and each character is updated using index position.

10 Points: Function prototype, definition uses nested loop to access characters and
Encrypt the input strings and compare with encrypted data.

OR

decrypt the data in database, each decrypted entry is compared with input strings.
The function flag should be updated if the entry matches.

---------------------SOLUTION----------------------

PART 1:

```
void encrypt(char *usernames[], char *passwords[]) {
    for (int i = 0; i < 100; ++i) {

          char user[100];
          strcpy (user, usernames[i]);
        for (int j = 0; user[j] != '\0'; ++j) {
            user[j] = user[j] + i;
        }
          usernames[i] = user;

          char pw[100];
          strcpy (pw, passwords[i]);
        for (int j = 0; pw[j] != '\0'; ++j) {
            pw[j] = pw[j] + i;
        }
          passwords[i] = pw;
    }
}
```

PART 2:

```
int find(char *usernames[], char *passwords[], char *search_username, char
*search_password)
{
    int userFlag = 0;
    for (int i = 0; i < 100 && userFlag != 1; i++)
    {
        char user[100];
          strcpy (user, search_username);
        for (int j = 0; user[j] != '\0'; ++j) {
            user[j] = user[j] + i;
        }
          char pw[100];
          strcpy (pw, passwords[i]);
        for (int j = 0; pw[j] != '\0'; ++j) {
            pw[j] = pw[j] + i;
        }
        if (strcmp(user, usernames[i]) && strcmp(pw, passwords[i]))
            userFlag = 1;
    }

    return userFlag;
}
```

Q5: [35 min, 15 Points, CLO 2]

```
Part A

// Structure Definitions
struct DailyConsumption {
    int day;
    double unitsConsumed;
};

struct BillingTier {
    double rate;
    double upperLimit;
};

struct ElectricityBill {
    char customerName[50];
    int customerID;
    struct DailyConsumption dailyConsumptions[30];
};

Part B

void calculateTotalConsumption(struct ElectricityBill *bill)
{
    double totalConsumption = 0.0;
    for (int i = 0; i < 30; i++)
      {
        totalConsumption += bill->dailyConsumptions[i].unitsConsumed;
    }

    // Calculate and print the total bill based on billing tiers
    double totalBill = 0.0;
    int tierIndex = 0;

    while (totalConsumption > billingTiers[tierIndex].upperLimit &&
billingTiers[tierIndex].upperLimit != -1.0)
      {
            totalBill += billingTiers[tierIndex].upperLimit *
billingTiers[tierIndex].rate;
            totalConsumption -= billingTiers[tierIndex].upperLimit;
            tierIndex++;
    }

    totalBill += totalConsumption * billingTiers[tierIndex].rate;


    printf("Total Bill: $%.2f\n", totalBill);
}

void findUnitFrequency(struct ElectricityBill bill)
{
    int frequency[30] = {0};
      double units;

    for (int i = 0; i < 30; i++)
      {
        units = bill.dailyConsumptions[i].unitsConsumed;
        frequency[i] = 1;

        for (int j = i + 1; j < 30; j++)
            {
            if (bill.dailyConsumptions[j].unitsConsumed == units)
                  {
                frequency[i]++;
                frequency[j] = -1;
            }
        }

        if (frequency[i] != -1) {
            printf("%.2lf units frequency is %d\n", units, frequency[i]);
        }
    }
}

void Analysis(const struct ElectricityBill *bill) {
    // Find the second highest and third lowest electricity consumption
    double highestConsumption = -1.0;
    double secondHighestConsumption = -1.0;
    double lowestConsumption = 1.0e9;
    double secondLowestConsumption = 1.0e9;
    double thirdLowestConsumption = 1.0e9;
```

```
        for (int i = 0; i < 30; ++i) {
            double consumption = bill->dailyConsumptions[i].unitsConsumed;

            // Update highest and second highest
            if (consumption > highestConsumption) {
                secondHighestConsumption = highestConsumption;
                highestConsumption = consumption;
            } else if (consumption > secondHighestConsumption && consumption <
    highestConsumption) {
                secondHighestConsumption = consumption;
            }

            // Update lowest and second lowest and third lowest
            if (consumption < lowestConsumption) {
                thirdLowestConsumption = secondLowestConsumption;
                secondLowestConsumption = lowestConsumption;
                lowestConsumption = consumption;
            } else if (consumption < secondLowestConsumption) {
                thirdLowestConsumption = secondLowestConsumption;
                secondLowestConsumption = consumption;
            } else if (consumption < thirdLowestConsumption)
             {
                thirdLowestConsumption = consumption;
                 }

        }

        // Display the results
        printf("Days with the second highest and third lowest electricity
    consumption:\n");
        printf("Second Highest Consumption (%.2lf units):\n",
    secondHighestConsumption);
        for (int i = 0; i < 30; ++i) {
            if (bill->dailyConsumptions[i].unitsConsumed == secondHighestConsumption)
    {
                printf("Day %d\n", bill->dailyConsumptions[i].day);
            }
        }

        printf("Third Lowest Consumption (%.2lf units):\n", thirdLowestConsumption);
        for (int i = 0; i < 30; ++i) {
            if (bill->dailyConsumptions[i].unitsConsumed == thirdLowestConsumption) {
                printf("Day %d\n", bill->dailyConsumptions[i].day);
            }
        }
    }}
```

Q6: [30 min, 20 Points, CLO 4]

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

char *result = NULL;

// Function to concatenate two strings dynamically
char* concatenateStrings(char* str1, char* str2) {
    int len1 = strlen(str1);
    int len2 = strlen(str2);
    int totalLen = len1 + len2 + 1;

    // Check if this is the first concatenation
    if (result == NULL) {
        result = (char *)malloc(totalLen * sizeof(char));
        if (result == NULL) {
            perror("Memory allocation failed. Exiting...");
            exit(EXIT_FAILURE);
        }
        strcpy(result, str1);
    } else {
        // Reallocate memory for the concatenated result
        result = (char *)realloc(result, strlen(result) + totalLen * sizeof(char) + 1);
        if (result == NULL) {
            perror("Memory reallocation failed. Exiting...");
            exit(EXIT_FAILURE);
        }
        strcat(result, str1);
    }

    // Concatenate the second string
    strcat(result, str2);

    return result;
}

int main() {
    char temp[50];
    char* input1 = NULL;
    char* input2 = NULL;
    char* concatenated = NULL;
    char choice;

    do {
        // Input two strings of varying lengths
        printf("Enter the first string: ");
        fgets(temp, sizeof(temp), stdin);
        temp[strcspn(temp, "\n")] = '\0';  // Remove trailing newline
        input1 = (char *)malloc(strlen(temp) + 1);
        strcpy(input1, temp);

        printf("Enter the second string: ");
        fgets(temp, sizeof(temp), stdin);
        temp[strcspn(temp, "\n")] = '\0';  // Remove trailing newline
        input2 = (char *)malloc(strlen(temp) + 1);
        strcpy(input2, temp);

        // Concatenate the strings
        concatenated = concatenateStrings(input1, input2);

        // Display the original input strings and the concatenated result
        printf("\nOriginal Strings:\n");
        printf("String 1: %s\n", input1);
        printf("String 2: %s\n", input2);

        printf("\nConcatenated Result with Previous Strings:\n");
        printf("%s\n", concatenated);

        // Prompt user to continue or quit
        printf("Enter 'Q' to quit or any other key to continue: ");
        scanf(" %c", &choice);

        // Free memory for the previous inputs
        free(input1);
        free(input2);

        // Clear input buffer
        while ((getchar()) != '\n');

    } while (choice != 'Q' && choice != 'q');

    // Free remaining memory
    free(result);

    return 0;
}
```