

Assignment 01

Second Year BS (Honours) 2023-2024

Course Title: Math Lab II Course Code: AMTH 250

Department of Applied Mathematics, University of Dhaka

Name:

Group:

[Write a Fortran Program to solve each of the following problems. Use files for input/output unless specified otherwise. Name the files and the code according to the assignment and problem no., e.g., for problem no. Y of assignment X, input and output file names must be 'inXqY.txt' and 'outXqY.txt' respectively.]

1. Write a Fortran program that reads the following matrix from a file and store it as A.

$$A = \begin{bmatrix} 1 & 7 & 3 & 4 \\ 5 & 2 & 6 & 0 \\ 0 & 9 & 3 & 5 \\ 8 & 1 & 7 & 6 \end{bmatrix}$$

In the output file:

- (i) write A in matrix form
(ii) write all the elements of A in a horizontal line traversing row-wise as 1 7 3 4 5 2
6...1 7 6

1
5
0

- (iii) all the elements of A in a vertical line traversing column-wise as .

.
5
6

- (iv) write only the elements of 1st row and 1st column of A as follows:

1 7 3 4
5
0
8

- (v) determine whether $d_3 > d_2$ where d_3 is the sum of the cube the major diagonal elements and d_2 is the sum of the square of the minor diagonal elements

- (vi) find A^T .

2. Use an array to store a list of $n \geq 5$ integers in a file. When the value of n is given, the memory size will be allocated for the elements of the array. Write a program to sort and print the numbers in both ascending and descending orders.

3. Write a Fortran program to generate a square matrix of 36 random numbers between 10 to 20 inclusive. Print the matrix appropriately in three different files named *alq3_F.txt*, *alq3_E.txt*, *alq3_ES.txt*, respectively using:

- (i) The F descriptor, corrected up to 8 decimal places
- (ii) The E descriptor, corrected up to 7 decimal places
- (iii) The ES descriptor, corrected up to 7 decimal places

4. For any two positive integers a and b the GCD satisfies the following recurrence relationship:

$$\gcd(a, b) = \begin{cases} b; & a \pmod{b} = 0 \\ \gcd(b, a \pmod{b}); & a \pmod{b} \neq 0 \end{cases}$$

Write a program using **recursive function** that takes a and b as input from the keyboard and gives their GCD as output on the terminal.

5. It was once claimed that the formula of numbers found by Pierre de Fermat (1607–1665) of the form $F_n = 2^{2^n} + 1$, where n is a non-negative integer, generates only prime numbers. It's for you to check whether the claim is valid. For this reason, you may want to follow the instructions as follows:

- i) Generate Fermat's number as many as you can.
- ii) Use a function to check whether the numbers are prime or not.
- iii) Finally, show your judgement about the claim

6. Write a **function** that checks if the multiplication of two matrices is possible from the number of rows and columns. Write a **subroutine** that takes the two matrices A and B as input and return the multiplication $C = AB$. Now write a program that takes the input of number of rows and columns of two matrices (say r_1, c_1, r_2, c_2) from the keyboard and matrices A and B from file; then print the multiplication of matrices $C = AB$ on the terminal. Also show that your result is correct by verifying using built in **matmul** command.

7. The philosopher Iamblichus of Chalcis (ca. 250-330 A.D.) writes that the Pythagoreans knew of these numbers: They call certain numbers **amicable numbers**, adopting virtues and social qualities to numbers, such as 284 and 220; for the parts of each have the power to generate the other. Pythagoras is reported to have said that a friend is "one who is the other I, such as are 220 and 284." In the sense that the sum of the proper positive divisors of each, sum to the other.

220	1+2+4+5+10+11+20+22+44+55+110 =284
284	1+2+4+71+142 =220

Now using **function** to determine the divisors, write a program that prints the first 10 pairs of **amicable numbers**.