**ESE5023 Assignment 06**

**12132206**

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1. **Matrix multiplication**
   1. **[5 points]** Write a program Main.f90 to read fortran\_demo1/M.dat as the matrix M, and fortran\_demo1/N.dat as the matrix N.
   2. **[5 points]** Write a subroutine Matrix\_multip.f90 to do matrix multiplication.
   3. **[5 points]** Call the subroutine Matrix\_multip() from Main.f90 to compute M\*N; write the output to a new file MN.dat, values are in formats of f9.2

First write two programs **createM.f90** and **createN.f90** to generate two matrices filled with random numbers, for example here: M is a 5×3 matrix, N is a 3×4 matrix.

After run the **createM.f90** and **createN.f90**, two matrices are stored in M.dat and N.dat, respectively.

Matrix multiplication can be done by looping the elements in matrices, multiplying and summing. Whereas, Fortran provides a direct function **matmul(A, B)** to calculate the results of matrix A and B multiplication. Notice that the dimensions of A, B must be suitable for this calculation. Please see the **Matrix\_multip.f90** and **Main.f90** for the details of the matrix multiplication.

1. **Calculate the Solar Elevation Angle**
   1. **[5 points]** Write a module Declination\_angle that calculates the declination angle on a given date.
   2. **[10 points]** Write a module Solar\_hour\_angle that calculates the solar hour angle in a given location for a given date and time.
   3. **[5 points]** Write a main program (Solar\_elevation\_angle.f90) that uses module Declination\_angle and Solar\_hour\_angle to calculate and print the SEA in a given location for a given date and time.
   4. **[5 points]** Create a library (libsea.a) that contains Declination\_angle.o and Solar\_hour\_angle.o. Compile Solar\_elevation\_angle.f90 using libsolar.a. Print the SEA for Shenzhen (22.542883N, 114.062996E) at 10:32 (Beijing time; UTC+8) on 2021-12-31.

To calculate the solar elevation angle:

α: solar elevation angle

δ: declination angle

φ: latitude

h: solar hour angle

d: days of the year

LST: local solar time in 24-hour format

More details are presented in **Declination\_angle.f90** and **Solarhour\_angle.f90.**

Create and link the library:

[ese-liangsj@login02 fortran\_demo4]$ ifort SEA\_main.f90 -o SEA\_main.x -L. -lsea

[ese-liangsj@login02 fortran\_demo4]$ ./SEA\_main.x

2021-12-31

day of the year 365.0000

Declination angle is (degree): 23.35037

Solar hour angle (degree) is : -22.05000

The solar elevation angle for Shenzhen at 10:32 2021-12-31 will be (degree):

21.62326

program finished