Class Project

Matrix Library (Part One)

Inside your 'fortran' directory create a new directory called 'class_project'. Inside your 'class_project' directory create a new directory called 'part1'. In your 'part1' directory write a program that can read in two matrices from the keyboard and calculate their matrix product in the order they were read. The first matrix 'mat1' with **m** rows and **n** columns (**m** by **n** matrix). The second matrix 'mat2' with **n** rows and **k** columns (**n** by **k** matrix). The matrix product, 'mat3' will be an **m** by **k** matrix, the result of pre-multiplying 'mat2' by 'mat1'. Your program should then output to the screen 'mat1', 'mat2', 'mat3' and 'mat4'. The matrix 'mat4' should be set to the result of Fortran's own 'MATMUL()' function which will multiply together its matrix arguments in the order they are given ie. 'mat4=MATMUL(mat1,mat2)'.

The Program

- In the specification part of your program declare 'm,n & k' as integer parameters and then use these parameters to declare the dimensions of the four real two dimensional arrays that will serve as your matrices. Hint, initially choose small values of 'm,n & k' so as to minimise typing in the matrix elements while testing and debugging your code. You will, of course, need to declare other entities that you will need for this program.
- Use two 'DO' loops nested together to read in the two matricies 'mat1' and 'mat2'. The 'outer loop' loops over the number of matricies to be read (i.e. 'DO matno=1,2'), where 'matno' is the 'INTEGER' loop variable. The 'inner loop' loops over the number rows in the matrix corresponding to 'matno' (i.e. currently being read in from the keyboard). You can read in, from the keyboard, an arbitrary row of a matrix with the following statement

  ```
  READ*,mat1(i,:)
  ```

  Where 'i' is the 'inner loop' 'INTEGER' variable and denotes the current row to be read in. The the colon references each column element for the given row 'i'. You will need to work out how to code the 'inner loop' 'DO' header statement so it loops over the correct number of rows in the matrix currently needing to be read in (corresponding to 'matno'). Hint, you can store the number of rows, for each matrix, in a one dimensional array of two elements. The first element of the array stores the number of rows in 'mat1' the second element stores the number of rows in 'mat2'. You can declare and initialise this array on the same line with the following declaration statement.

  ```
  INTEGER, DIMENSION(2) ::  row=(/m,n/)
  ```

  Note that the above declaration of 'row' must appear after the declaration of the integer parameters 'm' and 'n'. Storing the number of rows in an array will make it easy for you to loop over the correct number of rows for the required matrix.

  You will cover this sort of declaration in more detail later in the course. In a similar fashion, to create an array of 'REAL' type with five elements, containing the values one to five, in numerical order, we would use the declaration statement.

  ```
  REAL, DIMENSION(5) ::  row=(/1,2,3,4,5/)
  ```

- Structure your program in five parts. First the specification part where you declare all your variables, next a section where you read in the arrays. A section to calculate the matrix product using three 'DO' loops nested together. Finally a section where you make use of the fortran 'MATMUL' function to calculate the matrix product and print the result matrices to the screen. When printing the result matrices to the screen print them out row by row in a similar fashion to how you read them in.

This is the first part of the ‘Class Project’ of which there will be many parts. Do not rush through the handout and please make sure that you complete and fully understand the work in this part of the class project. Each part of the class project will directly build on the code from the previous parts. Note that it will not be ‘directly’ assessed, so it does not count towards the course work contribution to your final mark. However, it will in the end be a significant part of the course so it is likely find its way onto the exam.