# Introduction to Fortran: Problem Sheet

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## 1 Compilation

- Obtain the code examples for this session
  - Download from github: https://github.com/coolernato/Intro-to-Fortran.git
- Find the Compilation directory
- Source.f90 should be compiled as a single file
- Source1.f90 and Source2.f90 should be compiled together
- Compile and run the files by either:
  - Compile it on your own computer and run it
  - Copy and paste it into https://www.onlinegdb.com , select Fortran in the top right and click Run

## 2 My First Code

- Find the My First Code directory
- Compile and "run my_first_code.f90"
- Experiment with:
  - Changing the words in quotation marks following the print statement
  - Adding more print statements
- You will need to recompile between making a change and running your program

## 3 Variables

### 3.1 Mathematical Operators

There are 5 identical cubes, each with a side length of 3.2m. Calculate and print:

- The volume of one cube
- The area of all faces of one cube
- The volume of all cubes
- The area of all cubes
- The surface area to volume ratio of the cubes

100m3 of water is added to these cubes. One cube will be fully filled, before the enxt is filled and so on. Eventually there will be a number of completely filled cubes and a partially filled cube.

- How many cubes are completely or partially filled?
- What volume of the partially filled cube is unfilled?

### 3.2 Order of Operations

- Find the Variables directory
- Compile the order_of_operations file
- Write down what you expect the value of the different cases to be
- Run the file
- Check the results are what you expect

### 3.3 Arrays

A location in 3d Cartesian space may be represented by (x,y,z) coordinates. This may be represnted by a dimension 1 array with size 3.

- Create a 1d array with three elements to represent Position A, which is at (1,2,1)
- Calculate the location of Position B, which has a displacement of (3,-4,1) from Position A
- Calculate the location of Position C, which is twice as far from the origin as Position B
- Calculate the location of position D, which is found by rotating position C $45^o$ around the z axis. To rotate a location around the z axis, it may be multiplied by the matrix:

$$\begin{pmatrix} \cos(\theta) & -\sin(\theta) & 0 \\ \sin(\theta) & \cos(\theta) & 0 \\ 0 & 0 & 1 \end{pmatrix} \tag{1}$$

- Calcualte the straight line distance between Positions A and D

Extension:

- Repeat the above, but with three points, all contained in a single two-dimensional array
- Initial points to use are (1,2,1), (-1,0,1) and (-3, -2, -2.5)