Course Outline

PTR

People, Training, Results

Advanced Programming in Modern Fortran

Course Description:

The course provides an introduction to the rest of the capabilities of modern Fortran, including generic programming, object oriented programming, parameterised derived types, exception handling using the IEEE facilities, C interoperability and parallel programming.

The course is suitable for people who have attended the Introduction to Modern Fortran programming course, or have a basic grounding in Fortran.

The course is also suitable for people wanting to convert from another language and already have a basic grounding in Fortran.

Pre-requisites:

A basic knowledge of Fortran or a good grounding in programming in another language.

Course Content:

- **The Fortran organisational method, equivalent to classes in other languages**
  - Basic module syntax
  - Modules for global data
  - Modules for precision specification and constant definition
  - Modules for globally sharing data
  - Modules for derived data types
  - Implicit and explicit interfaces

- **Data structuring in Fortran**
  - Several examples illustrating the basic syntax

- **Operator overloading**
  - Basic syntax

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- **Generic programming**
  - Basic syntax
  - Generic programming and other languages
  - Generic sorting with support for 4 integer types and 3 real types
  - Generic statistics module with support for three precisions

- **Mathematical examples**
  - Using linked lists for sparse matrix problems
  - Inner product of two sparse vectors
  - Solving 1st order ODE's using RKM
  - Automatic arrays
  - Subroutine as a dummy procedure argument:
  - A subroutine to extract the diagonal elements of a matrix
  - The solution of linear equations using Gaussian elimination

- **Parameterised derived types**
  - Linked list parameterised by real kind kind
  - Ragged array parameterised by real kind type

- **Object Oriented Programming**
  - Basic syntax in Fortran
  - Base class
  - Derived or inherited classes:
  - Derived types and structure constructors
  - Structure constructors and generic names
  - Derived classes and inheritance
  - Polymorphism and dynamic binding

- **Introduction to parallel programming**
  - Basic technical background
  - Amdahl's Law
  - Gustafson's law
  - Fortran and Parallel Programming

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- **MPI (Message Passing Interface)**
  - MPI Implementations
  - Compiler and implementation combination
  - Examples highlighting the basics of MPI Programming

- **OpenMP**
  - The OpenMP Model
  - Examples highlighting the basics of OpenMP programming

- **Coarray Fortran**
  - The Coarray model
  - Examples highlighting the basics of Coarray Fortran

- **C Interop**
  - Basic introduction
  - Examples illustrating:
  - Fortran calling C
  - Fortran calling C++
  - C calling Fortran
  - C++ calling Fortran

- **IEEE Arithmetic**
  - Basic history and background
  - Examples illustrating the use of Fortran's IEEE support for numeric exception handling

- **Third party libraries**
  - Benchmarking user written generic recursive quicksort
  - Benchmarking user written non recursive quicksort
  - The Nag parallel SMP Library
  - Benchmarking one of the Nag parallel sorting routines
  - Comparison of the three sorting methods
  - Graphics Libraries
  - Examples using the Dislin Graphics library

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- **Converting from Fortran 77**
- Deleted language features
- Obsolescent language features
- Third party tools

Course Duration: 5 Days