



# Teaching Fortran 90/95

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# Teaching Fortran 90 at the University of Manchester

- Started in 1992? with 3 day course for Department of Mathematics.
- Developed MAN T&EC materials (JISC funded project) based on the above – conversion course from Fortran 77.
- 3 day course has been given regularly at Manchester Computing since 1994.
- Also given externally, notably to the University of Trondheim, the Aircraft Research Association and a brief version at the University of Sao Paulo.





# Current Situation

- Manchester Computing teaches Fortran 90 as 3 day course, open to anybody (but most attendees now from University of Manchester).
- MC teaches students in Department of Mathematics, both as 3 day course for Applied Maths, and as a 10 week series of lectures for an MSc in Numerical Analysis (prior to another module on High Performance Computing).
- School of Engineering teaches Fortran 90 to first year undergraduates.
  - Students changed – expect to use packages not to do explicit programming.





# Takeup of Courses

- Initially good from many academic institutions when our course was one of very few, and many f77 programmers wanted to convert to f90.
- Now more limited and mostly from 'traditional' scientific departments at the University of Manchester, whose students need either basic programming skills or need to work with existing Fortran codes.





# Course Content

- Describe all new features of f90, but diminishing emphasis on more advanced features such as pointers, and operator overloading etc., as experience of attendees has gone down.
- Main emphasis on:
  - Program structure using modules/internal procedures
  - Dynamic memory
  - Array syntax
- Currently adapting course to include introductory f90 material, rather than targeting existing f77 programmers.





# Major Users

- **University of Manchester departments who have been major users of Fortran 77:**
  - Mathematics
  - Engineering
  - And to a lesser extent: Physics, Chemistry
- **CSAR National Supercomputer users – performance is of great importance.**
  - Cray T3E has good implementation of f90 with access to highly optimised Fortran libraries.





# Features Used

- Essentially Fortran 77 features with dynamic memory and (to a lesser extent) array syntax/intrinsics.
- Other features used at least a little:
  - Modules
  - Parameterised data types





# Inhibitors to Using Fortran 90

- Efficiency of array syntax and intrinsics.
- Many libraries still f77 based – BLAS, LAPACK
- make command does not handle f90 modules very well.
- Lack of binding for MPI-1.
  - Must use MPI\_DOUBLE\_PRECISION as no facility for parameterised data types (although some implementations of MPI permit MPI\_REAL8 and MPI-2 will be OK).
- Unclear implementation on shared memory parallel systems. For example on SGI Origin 2000:
  - Array syntax does parallelise.
  - Array intrinsics (MATMUL and DOT\_PRODUCT) do not.







# Other Languages

- **C for scientific programming (using Unix systems)**
  - Losing popularity - similar takeup to Fortran
- **C for PCs**
  - Very popular
- **Java (including Java for HPC)**
  - Can't get enough of it



# The Future

- Do not see significant change in Fortran usage in the near future.
  - Neither in numbers of users, although probably gradually diminishing.
  - Nor in features used, although probably greater use as f90 bindings/interfaces/libraries become more widespread.
- Some transfer to C/C++
- Java may have significant influence as limitations are addressed, particularly at the highest level of programming, although expect underlying routines/libraries to use Fortran for some time.
- Demand for scientific programming decreasing.