Physics 410: Computational Physics: Course Topics

Unix: 3 lectures

- Unix fundamentals
- Basic shell programming

Maple: 3 lectures

- Use of a modern "symbolic manipulation" language for routine computations
- Maple as a powerful environment for exploratory scientific programming

Scientific Programming in Fortran: 4 lectures

- Fortran 77 programming of simple scientific applications
- Numerical computation concerns: error analysis and bug-proofing strategies
- Integration and interaction of Fortran programs with other tools ("make", graphing programs, maple, etc.)
- Porting code to different architectures, portability.

Solution of Linear Systems: 2 lectures

- The LU decomposition algorithm
- Using "canned" software for solving linear systems
- Solution of tridiagonal and banded-systems

Solution of ODEs: 4 lectures

- Review of ODE theory
- Canonicalizing systems of ODEs
- Using "canned" software to solve systems of ODEs
- Applications

Non-linear Equations (Root Finding): 2 lectures

- Bisection (binary search)
- Newton's method
- Newton's method for systems of non-linear equations

Finite Difference (FD) Methods: 7 lectures

- The nature of discrete equations derived from continuum systems
- Expected behaviour of FD approximations (convergence & accuracy)
- Polynomial Interpolation

- Numerical differentiation and numerical integration