Introduction

Computer Organization and Abstraction

Model of a computer
Stored program
Von Neumann Machine, Turing Machine
Instructions

Measuring Program Performance
Complexity and Statistical Characterization
SPECmarks, INTmarks, TOP 500 etc.
Amdahl's Law

Error Analysis

Representation of Numbers
IEEE Floating Point Representation
Floating point exceptions and exception handling
Machine epsilon, and representation errors

Programming languages
Instruction sets and assembler
Higher level programming languages
F77, F90, F2003, C, C++
MATLAB

Memory
Register, Cache, Main memory, Disk
Memory Organization
Memory aware programming
Instruction level parallelism, MMX, SSE

Compilers and Program optimization
Loop unrolling
Pipelining
Debugging, Profiling

Scientific computing libraries: BLAS, LAPACK etc.
Automatic tuning libraries: ATLAS, FFTW, Goto BLAS
Optimization strategies: block-based approaches

Computer Networks. IP. Programming models.
Sockets
Client-Server

Parallel computing
Architectures
SIMD, MIMD; exotic architectures from the 90s
Clusters, multi-core processors
MPI, OMP

MPI programming

DSP/embedded computers, FPGAs, Cell Processors, GPUs
Scientific computing on GPUs
Heterogeneous architectures