EEE6207 ADVANCED COMPUTER SYSTEMS

Credits: 15

Course Description including Aims

This module looks at modern computer systems from operating systems down to the underlying computer architectures to provide a coherent view of how such systems work and how their performance can be improved, looking, in particular, at parallelism

1. To provide students with an understanding of the structure of modern multi-tasking operating systems.
2. To identify the links between systems and the underlying architectures.
3. To equip the student with an understanding of high-performance processing system architectures.
4. To introduce the concepts of parallelism as a means of enhancing system performance.

Outline Syllabus

System Organisation. Historic introduction and origins of the operating system. Elements of the multi-user operating system - Hardware considerations, memory protection, system mode operation, time slicing. **Processes:** Scheduling, process synchronisation, inter-process communication. **Threads:** Comparison with heavyweight processes. **Deadlocks:** detection, avoidance and recovery. **File systems. Memory Systems :** virtual memory, memory hierarchies, locality, coherence, address translation, paging/segmentation, memory management. **Processor Classifications**. **Pipelining:** speed-up constraints, static/dynamic pipelines, reservation tables and collision vectors. **Pipelined Processors:** architecture, constraints, interlock and register forwarding/scoreboarding, stalling, branching, superscalar, VLIW. **Parallel Processors:** array processors, loosely-coupled processors, tightly-coupled processors, vector processors. **Connection Networks :** structures, complexity, performance, limitations, memory organisation and interleaving, multi-processing caches. **Task partitioning :** compute/IO bounds.

Time Allocation

36 lectures plus 18 hours of additional support material.

Recommended Previous Courses

EEE336 “Digital Design”

Assessment

3 hour examination, answer 4 out of 6

Recommended Books

Silberschatz, Galvin & Gagne	*Operating System Concepts*	Addison-Wesley
Hennessy & Patterson	*Computer Architecture - A Quantitative Approach*	Morgan Kaufmann
Hwang & Briggs	*Computer Architecture and Parallel Processing*	McGraw-Hill

Stone, H.S.	*High Performance Computer Architectures*	Addison-Wesley
Van de Goor, A.J.	*Computer Architecture and Design*	Addison-Wesley

Objectives

On successful completion of this module students will be able to

1. Describe the key elements and functionality of a modern computer operating system.
2. Demonstrate an understanding of computational processes and their interaction, particular process interactions and synchronisation.
3. Demonstrate an appreciation of the issues surrounding the management of resources such as: memory, disk space and the CPU.
4. Understand the interaction between an operating system and the underlying hardware, and the hardware extensions which facilitate key functionality in a modern operating system.
5. Identify the crucial importance of memory system design in high performance computer systems,
6. Analyse/estimate the performance of a given memory system and to evaluate the design options and alternatives.
7. Identify appropriate forms of parallelism (temporal and spatial) for particular problems/application, to analyse the effect on system performance and evaluate the costs/benefit.
8. Describe various structures and issues which are important to the design of parallel processors, identifying their strengths and weaknesses and to analyse the likely performance of key components.