Engineering Tripos Part IIB, 4F14: Computer Systems, 2019-20

Module Leader
Dr AH Gee [1]

Lecturers
Dr AH Gee and Prof PO Kristensson [2]

Timing and Structure
Lent Term. 75% exam / 25% coursework

Prerequisites
Part 1 Digital Circuits and Computing assumed

Aims
The aims of the course are to:

- Describe the computer hardware that underlies modern information processing systems.
- Explain how to write multithreaded software that runs on such hardware.

Objectives
As specific objectives, by the end of the course students should be able to:

- Appreciate the basic components needed to construct a computer and the different ways to interconnect these components, including the various ways of exploiting parallelism.
- Compare the instruction sets, implementation issues and performance of CISC and RISC architectures.
- Design efficient hardware for computer arithmetic.
- Understand the operation of pipelined datapaths.
- Describe memory organisation, addressing schemes and the use of caches; and their effects on performance.
- Compare the various ways of handling input and output in a computer system.
- Understand the concept of a memory model.
- Understand basic concurrency concepts.
- Design and implement thread-safe algorithms in C++.

Content
Computer Systems (8L + 2 examples classes, Dr Andrew Gee)

- Computer architecture, historical perspectives.
- Instruction set architectures, RISC vs CISC.
- ALU design, datapaths and control, pipelining.
- Memory hierarchy, caches, virtual memory.
- Input/output, bus organization, polling and interrupt-driven I/O, DMA.
Parallel processing, SIMD and MIMD architectures.

**Assessment:** examination (75%), candidates to attempt two questions from a choice of three

**Parallel Programming (4L, Prof Per Ola Kristensson)**

- C++11/14/17 memory model.
- Race conditions, mutual exclusion, synchronization, starvation.
- Thread-safe data structures.
- C++11/14/17 threading library.

**Assessment:** coursework (25%)