

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%)

Coursework

Multithreaded programming using the C++11/14/17 memory model and threading libraries. The programming exercise is an opportunity to experience how theoretical concepts from the lectures translate into actual working code using a state-of-the-art industry standard threading library. Time required: 4-8 hours programming plus 15 minutes demonstrating and discussing your code with an assessor. Please note that coursework assessment is not anonymous.

| Coursework | Format | Due date & marks |
|--|---|---|
| Multithreaded programming <u>Learning objectives:</u> <ul style="list-style-type: none">• To gain practical experience with the C++11/14/17 threading library.• To design and implement thread-safe data structures.• To practice concurrency control so as to avoid race conditions and starvation. | Individual Demonstrating your software Not anonymously marked | Software to be Lent Term or Assessment Term [15/60] |

Booklists

Please see the [Booklist for Group F Courses](#) [3] for references for this module.

Examination Guidelines

Please refer to [Form & conduct of the examinations](#) [4].

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Links

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[3] <https://www.vle.cam.ac.uk/mod/book/view.php?id=364101&chapterid=55871>

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