University of Kent
Module specification

1. Title: CO891 Parallel Architectures

2. Department responsible: School of Computing

3. Start date: September 2010

4. Cohort of students (onwards) to which module will be applicable: 2010-11

5. Number of students: 20

6. Modules to be withdrawn: None

7. Level: M

8. Credits: 15 (7.5 ECTS)

9. Period taught: Autumn

10. Prerequisite and co-requisite modules

None, but some experience of programming is necessary.

11. Programmes of study to which the module contributes

Portfolio of Taught Postgraduate Programmes in Computing
(compulsory for MSc Advanced Programming for Multi-core Systems)

12. Subject-specific learning outcomes

On successful completion of this module, students will:

a. have a systematic understanding of modern multi-core processor micro-architectures and interconnect technologies, and be able to explain their evolution and be able to critically evaluate their design decisions; [A2, A4]
b. understand the memory hierarchy, be familiar with the parameters that characterise its performance and be able to calculate performance from those parameters; [A2, A3, A4]
c. understand the need for atomic operations and be familiar with a variety of locking mechanisms; [A1, A3, A17, C1, C3]
d. be familiar with the architecture of general purpose graphics processing units and their common programming models; [A1, A2, A4, A17, B2, C1, C3]
e. be familiar with a variety of parallel architectures including high performance computing architectures, heterogeneous multi-core architectures, etc. [A2, A4, A17]

13. Generic learning outcomes

On successful completion of this module, students will be able to:

f communicate with other professionals using appropriate technical vocabulary; [D6]
g. deal with complex issues systematically and make sound judgement in the presence of only partial data; [B4, B6]
h. identify and evaluate possible solutions to common design problems; [B1, B2, B3]
i. critically evaluate commercial software products; [B3]
j. understand and engage with relevant research. [B7]

k. plan, work and study independently and to use relevant resources in a manner that reflects good practice; [D1]
l. make effective use of general IT facilities including information retrieval skills; [D2]
m. apply time management and organisational skills including the ability to manage their own learning and development; [D3]
n. appreciate of the importance of continued professional development as part of lifelong learning; [D4]
o. present ideas, arguments and results in the form of a well structured written report [D7]

14. Synopsis of the curriculum

- The micro-architecture of modern, multi-core processors.
- Inter-connect technologies, including shared bus and point-to-point designs.
- The memory hierarchy, including cache architectures and banked memory; quantitative analysis; cache coherency.
- Hardware support for concurrency; processor atomic instructions; locks and their implementation; support for transactional memory.
- General purpose graphics processing architectures and programming models.
- Architectures for high performance computing.
- Novel architectures; heterogeneous multi-core.

15. Indicative reading list

- Jon Stokes, "Inside the machine : an illustrated introduction to microprocessors and computer architecture", No Starch Press, 2006
- Maurice Herlihy and Nir Shavit, "The Art of Multiprocessor Programming", Morgan Kaufman, 2008
- Relevant industrial and academic research papers

16. Learning and teaching methods

All learning outcomes will be achieved through a combination of lectures and private study, with further assistance provided electronically via newsgroups and the web. All subject-specific learning outcomes will be supported by a number of pieces of compulsory coursework. This module represents a total of 150 study hours, including:

22 hours of lectures
10 hours of classes

Seminars will support the lectures by reinforcing key ideas in an environment where students can discuss both lecture and coursework material.

17. Assessment methods

Students are graded on a percentage scale with 40% as the pass mark.

All learning outcomes are assessed both by coursework and an unseen written examination. The weightings are as follows:

50% written examination (tests outcomes a-o)
50% coursework (tests outcomes a-o)

18. Implications for learning resources, including staff, library, IT and space

Teaching will be undertaken by existing academic staff from the School of Computing using timetabled university lecture/seminar rooms and existing teaching space within the School.
Students will require normal access to university library and IT resources. A small number of core texts may need to be purchased.
Assessments will be based on freely-available software. A small number of shared multi-core and

GPGPU-equipped computers will be needed for coursework. Sufficient provision will be made in an existing School of Computing laboratory.

19. A statement confirming that, as far as can be reasonably anticipated, the curriculum, learning and teaching methods and forms of assessment do not present any non-justifiable disadvantage to students with disabilities.

The School of Computing recognises and has embedded the expectations of SENDA, and supports students with a declared disability or special (educational) need in its teaching, through the establishment of Inclusive Learning Plans agreed between student, department and the Disability Support Unit. We will liaise with the Disability Support Unit in order to provide specialist support where needed.

Statement by the Director of Learning and Teaching: "I confirm I have been consulted on the above module proposal and have given advice on the correct procedures and required content of module proposals"

Director of Learning and Teaching Date

Statement by the Head of Department: "I confirm that the Department has approved the introduction of the module and will be responsible for its resourcing

Head of Department	Date

Last updated – 22 March 2010