School of Computing and Information Systems

Unit Outline

KXA437 Multi-core Architecture and Programming

Semester 2, 2012
Sandy Bay Campus, Hobart

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UNIT OVERVIEW

Introduction

This unit will introduce pipelined, superscalar, and multi-core processor architectures. Students will explore the current and future trends of hardware design and the associated programming techniques necessary for such architectures. The practical work will focus on a particular high-performance architecture - the PlayStation 3. Students will learn generic high-performance programming concepts such as threading, single-instruction multiple-data (SIMD) instructions, direct memory access (DMA), and synchronisation primitives. Additionally, students will learn low-level optimisation techniques such as assembly programming, instruction scheduling, and loop unrolling.

Prerequisites

KXT201

Unit Weight

12.5% of one academic year

Teaching Pattern

Weeks 1-4:
Lectures: 4 hr/wk

Weeks 5-9
Lectures: 2 hr/wk
Tutorials: 2 hr/wk

Weeks 10-13
Tutorials: 4 hr/wk

Unit Content

- basic computer architectures
- pipelined architectures
- superscalar architectures
- multicore architectures
- Cell architecture
- Cell's PPE in detail
- Cell's SPEs in detail
- Threading
- DMA
- SIMD instructions
- low-level optimisation

For more information see the section titled 'Content' on the unit website.

Prior Knowledge and/or Skills

Students are assumed to have a working understanding of basic computer architecture a good understanding of C programming concepts.

Learning Outcomes

On successful completion of this unit, you will be able to:

1. Understand past and present hardware designs.
2. Understand programming techniques for multi-core processors.
3. Create programs using the PlayStation 3's Cell processor.
4. Understand and know when to apply low-level programming optimisations.

Generic graduate attributes

The university has defined a set of generic graduate attributes expected in its graduates. http://www.utas.edu.au/__data/assets/pdf_file/0003/214662/Generic-Attributes-of-Graduates.pdf Your course is designed to enable you to develop generic skills that are valued in, and expected of, graduates. These are skills that you will need to develop over time. Hence you are encouraged to look for opportunities, as you study each unit, to reflect on and improve these skills.
UNIT ASSESSMENT

Assessment Pattern

Internal (40%), Exam (60%)

Assessment Summary

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tutorial Quizzes</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>Assignment 1</td>
<td>15%</td>
<td>Thursday 3:00pm, September 20th (Week 22)</td>
</tr>
<tr>
<td>Assignment 2</td>
<td>15%</td>
<td>Thursday 3:00pm, October 18th (Week 26)</td>
</tr>
<tr>
<td>Exam</td>
<td>60%</td>
<td>University Examination Period</td>
</tr>
</tbody>
</table>

Assessment Items

**Item 1**  
**Title:** Tutorial Quizzes  
**Type:** In-Semester - test  
**Task Length:** not applicable  
**Weighting:** 10%  
**Links to Learning Outcomes:** 1,2,3,4  
**Due:**  
**Description:** These quizzes will test aspects of the lectures and tutorials throughout the semester.

**Item 2**  
**Title:** Assignment 1  
**Type:** In-Semester - individual assignment  
**Task Length:** not applicable  
**Weighting:** 15%  
**Links to Learning Outcomes:** 2, 3, 4  
**Due:** Thursday 3:00pm, September 20th (Week 22)  
**Description:** This will be a programming assignment.

**Item 3**  
**Title:** Assignment 2  
**Type:** In-Semester - individual assignment  
**Task Length:** not applicable  
**Weighting:** 15%  
**Links to Learning Outcomes:** 2, 3, 4  
**Due:** Thursday 3:00pm, October 18th (Week 26)  
**Description:** This will be a programming assignment.

**Item 4**  
**Title:** Exam  
**Type:** Formal Examination  
**Task Length:** 2 hours  
**Weighting:** 60%  
**Links to Learning Outcomes:** 1, 2, 3, 4  
**Due:** University Examination Period  
**Description:** This exam is closed book.

See the 'Assessment' section in unit website for more detailed information about assessment items.

**How your Final Grade will be determined**

Overall assessment will be based on the student's performance throughout the semester as well as in a formal examination. In order to achieve a pass (or better) result, a student must obtain:

1. at least 45% of the total mark for in-semester assessment items
2. at least 45% of the mark for the formal examination
3. at least 50% of the overall mark
UNIT RESOURCES

Unit Web Site

This unit is Web Dependent: content. This means that you will need to use the Web for this unit. The unit website contains unit information and resources.

The unit website is accessed from http://www.utas.edu.au/coursesonline/. You will need to use your university email pop account username and password to log on to the MyLO system. Once authenticated by the system your personalised MyLO Learning Online area will be displayed. It contains links to the websites that you have permission to access - including the website for this unit.

If you are not able to access the unit website, please contact the University IT help desk:
  Entrance Level, Morris Miller Library, Sandy Bay Campus;
  Entrance Level, Launceston Campus Library, Newnham Campus.
  Telephone: 6226 1818 and 1300 304 903.
  The 1300 number is a local call from within Tas, with the exception of mobiles.
  Email: servicedesk@utas.edu.au
  Website: http://www.utas.edu.au/servicedesk/student/index.html

Prescribed Text

None

Readings


Software

The software that you will need to access the unit website and to study this unit, including general purpose software such as word processors, is provided on the computers in the School's computing labs. If you intend to use software on other computers please check that the versions are compatible.
GENERAL RESOURCES

School Website

School of Computing and Information Systems - Faculty of Science, Engineering, and Technology.
http://www.utas.edu.au/cis

Faculty Website

Information and Resources for Faculty of Science, Engineering and Technology students are available on the faculty website at: http://www.utas.edu.au/scieng

University Website

Information and Resources for 'Current Students' are available on the university website at:
http://www.utas.edu.au/students/

School Help Desk

Contact the School Help Desk if you have any queries or problems with accessing, using, or printing from the computers in the School of Computing and Information Systems labs.

In Hobart the Help Desk is located on level 3 in the Centenary Building, and is open from 10:00am-12:00pm, and 2:00pm-4:00pm Monday-Friday. The phone number is 6226 2929.

In Launceston the Help Desk is located near the entrance to the computing labs and is open from 10:00am-12:00pm, and 2:00pm-4:00pm Monday-Friday. The phone number is 6324 3447.

Both help desks will accept queries over the phone outside the standard opening hours.

The computer labs at the Cradle Coast Campus are maintained by ITR - please contact the University Help Desk for assistance with these computers.

Computing Facilities

The School has PC labs (running Windows 7), Mac labs (running Mac OS X 10.6), and special purpose Networking labs at the Newnham and Sandy Bay campuses. All students are provided with logins for Windows, Macintosh and Unix environments. If you have not used these facilities before please contact the School Help Desk to collect your account details. If you would like to access these facilities after hours please contact the School Help Desk.

In Hobart, there are 4 PC Labs, 2 Mac Labs, and 1 Networks Lab in the Centenary Building. In Launceston, there are 2 PC Labs, 1 Mac Lab, 1 Networks Lab, and one Multipurpose Lab in Building V.

Use of Facilities

Use of computing facilities provided by the School is subject to the School's Ethics Guidelines, details of which are posted at http://www.utas.edu.au/computing-information-systems/resources/ethics-guidelines. Copies of the guidelines are also available in all School labs. The School's facilities may only be used for study-related purposes, and may not be used for personal gain. Anti-social behaviour in labs such as game playing, viewing pornography, loud discussion, audio without the use of head-phones, etc is strictly prohibited in all labs at all times. Eating, drinking, and smoking is not permitted in the labs. Before being granted access to the School's facilities, you will be required to sign a declaration that you have read and understand these guidelines, and that you will abide by them. Disciplinary action may be taken against students who violate the guidelines.
Learning Strategies

If you need assistance in preparing for study please refer to your tutor or lecturer. For additional information refer to the Learning Development website: [http://www.utas.edu.au/learndev/](http://www.utas.edu.au/learndev/)

If you will be using MyLO for the first time and would like some information on how to use MyLO refer to the following website: [http://www.utas.edu.au/coursesonline/mylo-support.htm](http://www.utas.edu.au/coursesonline/mylo-support.htm)

Some of the units you will study use videoconferencing to deliver lectures and tutorials. To enable you to get the best out of a videoconference please refer to the following guide: [http://www.its.utas.edu.au/videoconf/vcstudentguide.pdf](http://www.its.utas.edu.au/videoconf/vcstudentguide.pdf)

Help resolving concerns about this unit

In the first instance you should contact your lecturer. If the matter is not resolved then you should contact the Head of School. If the matter is still unresolved and you would like to know who to contact or the procedures for resolving your concern refer to the following website: [http://acserv.admin.utas.edu.au/complaints_info.html](http://acserv.admin.utas.edu.au/complaints_info.html)

The Tasmanian University Union (TUU) may also be able to assist.

The School reserves the right to alter the details contained in this Unit Outline. Students will be advised of changes to the outline via their University email account and it remains the responsibility of the student to check their email for such changes.

Occupational Health and Safety

The university is committed to providing a safe and secure teaching and learning environment. For more information see [http://www.admin.utas.edu.au/hr/ohs/pol_proc/](http://www.admin.utas.edu.au/hr/ohs/pol_proc/)

University Services and Support

If you are experiencing difficulties with your studies or assignments, have personal or life planning issues, disability or illness which may affect your course of study, you are advised to raise these with your lecturer in the first instance.

The University has staff available to assist you, such as the:

- Learning Development Advisor
- Student Counselor
- Careers Advisor
- Disability Officer

For more information and contact details see the Services and Support section on the University 'Current Students' web page: [http://www.utas.edu.au/students/](http://www.utas.edu.au/students/)
**GENERAL ASSESSMENT**

**Approach to Learning**

The University is committed to high standards of professional conduct in all activities, and holds its commitment and responsibilities to its students as being of paramount importance. Likewise, it holds expectations about the responsibilities students have as they pursue their studies within the special environment the University offers.

The University's Code of Conduct for Teaching and Learning states:

Students are expected to participate actively and positively in the teaching/learning environment. They must attend classes when and as required, strive to maintain steady progress within the subject or unit framework, comply with workload expectations, and submit required work on time.

You are expected to spend about 130 hrs studying in this unit - this includes attendance at scheduled teaching sessions. (For a 13 week semester this is, on average, 10 hr/wk.) This is the amount of study time that the 'typical' student will need to reach the level of competence and understanding required to fulfil the unit objectives. You are expected to:

- attend all scheduled teaching sessions, unless otherwise notified by the unit coordinator
- prepare for, and actively participate in all scheduled teaching sessions
- complete the assigned learning tasks
- review what has been learnt
- complete assessment items and submit them on time
- access and be familiar with the information and resources available on the unit website
- seek help from teaching staff if you have any questions or difficulties in studying this unit

You are encouraged to read the university's Code of Conduct for Teaching and Learning. Part A describes the 'Responsibility of the University to Students' and part B describes the 'Responsibilities of Students to the University'.


It is expected that students will familiarise themselves with access and use of the MyLO system operated by the University for the electronic delivery of course materials, and for various forms of communication.

It is expected that students will consult email sent to their University email address at least twice a week for notices relating to the administration of the unit, and for notification of the results of assignments.

It is expected that students will read the background material specified in the course curriculum, will actively attend and participate in tutorials, and be prepared to discuss relevant issues arising with tutors, lecturers and fellow students.

**Student Expectations of the Unit**

Students enrolled in this Unit may reasonably expect the following:

1. To be able to contact a lecturer or tutor by electronic mail, to raise issues arising in the unit, either relating to content or student performance within the unit.
2. Subject to availability, to be able to discuss such issues in person with the lecturer or tutor.
3. That assignments will be marked and the marks will normally be returned within 3 weeks of due dates.
4. That all relevant notices regarding the administration of the unit, including any necessary changes, will be communicated to all students enrolled in the unit via email.

*These expectations are in addition to those specified in relevant University regulations.*
Plagiarism

Unless specifically stated in the specification of the assessment item provided on the unit website, it is required that:

- work submitted by a student is the work of that student alone OR
- where the assessment item is to be completed by a group of students, the work submitted by the group of students is the work of that group of students alone.

While students are encouraged to discuss the assignments in this unit and to engage in active learning from each other, it is important that they are also aware of the University's policy on plagiarism. Plagiarism is taking and using someone else's thoughts, writings or inventions and representing them as your own; for example downloading an essay wholly or in part from the internet, copying another student's work or using an author's words or ideas without citing the source.

"Plagiarism is a form of cheating. It is taking and using someone else's thoughts, writings or inventions and representing them as your own; for example, using an author's words without putting them in quotation marks and citing the source, using an author's ideas without proper acknowledgment and citation, copying another student's work.

If you have any doubts about how to refer to the work of others in your assignments, please consult your lecturer or tutor for relevant referencing guidelines, and the academic integrity resources on the web at [http://www.academicintegrity.utas.edu.au](http://www.academicintegrity.utas.edu.au).

The intentional copying of someone else's work as one's own is a serious offence punishable by penalties that may range from a fine or deduction/cancellation of marks and, in the most serious of cases, to exclusion from a unit, a course or the University. Details of penalties that can be imposed are available in the Ordinance of Student Discipline - Part 3 Academic Misconduct, see [http://www.utas.edu.au/__data/assets/pdf_file/0006/23991/ord91.pdf](http://www.utas.edu.au/__data/assets/pdf_file/0006/23991/ord91.pdf).

The University and any persons authorised by the University may submit your assessable works to a plagiarism checking service, to obtain a report on possible instances of plagiarism. Assessable works may also be included in a reference database. It is a condition of this arrangement that the original author's permission is required before a work within the database can be viewed."

It is important that you understand this statement on plagiarism. Should you require clarification please see your unit coordinator or lecturer. Useful resources on academic integrity, including what it is and how to maintain it, are also available at: [http://www.academicintegrity.utas.edu.au](http://www.academicintegrity.utas.edu.au)

Referencing

The preferred text referencing systems for the School is the Harvard system (also referred to as the author-date system). In your written work you will need to support your ideas by referring to scholarly literature, works of art and/or inventions. For information on presentation of assignments, including referencing styles: [http://utas.libguides.com/referencing](http://utas.libguides.com/referencing)

It is important that you understand how to correctly refer to the work of others and maintain academic integrity. Failure to appropriately acknowledge the ideas of others constitutes academic dishonesty (plagiarism), a matter considered by the University of Tasmania as a serious offence. The university document on plagiarism contains information about referencing the work or ideas of others (see [http://www.utas.edu.au/plagiarism/](http://www.utas.edu.au/plagiarism/)).
Submissions
The details of the submission method (paper, electronic or other) for each assignment will be supplied in a separate assignment specification sheet. All in-semester assignment submissions (including electronic submissions) are to include an Assignment Cover Sheet which includes a statement confirming that the submission is your own work. The Assignment Cover Sheet is available from the School Help Desk in Launceston and Hobart, and on the School’s web site: http://www.utas.edu.au/computing-information-systems/resources.

Students must take responsibility for the correct submission of their assignments. Students are expected to adhere to the following procedure for submission:

- Submitted files MUST be checked by the student to ensure that correct submission of the file has been undertaken.
- Students are expected to notify the Lecturer WITHIN TWO HOURS of submission if their files have not been submitted correctly.
- Students must take responsibility for safely backing up of their own files during the academic year to ensure that no files are permanently lost.

Extensions
Assessment items will not be accepted after the due date except under the conditions stated in the School policy on late assessment. http://www.utas.edu.au/__data/assets/pdf_file/0003/231960/ExtensionPolicy.pdf (PDF - 100KB).

Review of Assessment and Appeals
1. It is expected that students will adhere to the following policy for review of any piece of continuous assessment.
   a. Within 5 days of the release of the assessment result, the student should request an appointment with the Lecturer. The student should be prepared to discuss specifically which section of the marking criteria they are disputing and why they consider the mark is inappropriate.
   b. Following this discussion, students may request a formal remark of the original submission (in accordance with Rule of Academic Assessment 111, clause 22.1). This remark will be undertaken, where practicable, by an alternative assessor.
2. Students may also request a review of the final result in a unit. The request and payment must be made within 10 days from the date of the result notification. Students are referred to Rule of Academic Assessment 111, clause 23 at http://www.utas.edu.au/university-council/university-governance/rules and http://www.studentcentre.utas.edu.au/examinations_and_results/results/result_review_results.htm.

Complaints Procedure
It is expected that students will adhere to the following policy for making any complaint or grievance directly related to a Unit:

a. In the first instance, students are to approach the Lecturer or Unit Coordinator concerned and arrange a time to speak with them about their concern.

b. If an issue remains unresolved, the student should approach the Head of School and arrange a time to speak with them about their concern.

If the School’s internal policy of complaints is unable to resolve an issue, students should consult Ordinance 8 Student Complaints for further direction, see http://acserv.admin.utas.edu.au/complaints_info.html

Formal Examination
The formal examination is conducted by the University Registrar. The 'Current Students' section on the university website contains information about the conduct of, and timetable for, formal examinations.

Final Grade
Passing grades will be awarded based on the AVCC guidelines:

- PP at least 50% of the overall mark but less than 60%
- CR at least 60% of the overall mark but less than 70%
- DN at least 70% of the overall mark but less than 80%
- HD at least 80% of the overall mark

In order to comply with the benchmarks set by the Faculty of Science, Engineering & Technology for distribution of grades in units, both the in-semester and examination marks that students obtain may be adjusted either upwards or downwards. See http://fcms.its.utas.edu.au/scieng/scieng/policies.asp for details of the Faculty Assessment Guidelines.