



MONASH University

FIT4001
Parallel and distributed systems

Unit guide

Semester 2, 2008

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FIT4001 Parallel and distributed systems - Semester 2 , 2008

Unit leader :

David Abramson

Lecturer(s) :

Clayton

- David Abramson
- Sita Ramakrishnan

Introduction

Welcome to FIT4001 Parallel systems. This 6 point unit comprises two modules - *Parallel architectures* and *Distributed Systems*. Each of these two modules caters for half of the lectures, work and assessment of FIT4001.

Modern computer systems contain parallelism in both hardware and software. This unit covers parallelism in both general purpose and application specific computer architectures and the programming paradigms that allow parallelism to be exploited in software.

Unit synopsis

Modern computer systems contain parallelism in both hardware and software. This unit covers parallelism in both general purpose and application specific computer architectures and the programming paradigms that allow parallelism to be exploited in software.

The unit examines both shared memory and message passing paradigms in both hardware and software; concurrency, multithreading and synchronicity; parallel, clustered and distributed supercomputing models and languages. Students will program in these paradigms.

Learning outcomes

At the completion of this unit, students will have:

Knowledge of:

- A variety of parallel architectures, such as bus-based, massively parallel, cluster, vector.
- A variety of parallel programming paradigms, synchronization and parallelization primitives, message passing, data parallel, tuple space.

Understanding of:

- Concurrency, synchronicity and parallelism.
- The design issues of parallel systems.

Skills in:

- Designing, developing and debugging parallel programs using a variety of paradigms.

Workload

Workload commitments for FIT4001 are:

- two-hour lecture
- one-hour unsupervised tute in the MUSE lab (G.13/Bldg 26, Clayton) to work on assignments, any hurdles etc, and contact lecturer on campus if required
- upto 3 hours / week of preparation/personal study including lecture material
- upto 3 hours / week surveying existing literature in the library, on-line resources etc; hands-on lab exercises
- a minimum of 4 hours / week per 2 hour contact time in order to satisfy the reading and assignment expectations

Unit relationships

Prerequisites

Before attempting this unit you must have satisfactorily completed:

- CSE2302 (Operating systems) and CSE2/3324 (Computer architecture) in the old BSE & BCS degree structure,
- OR
- FIT2022 (Comp system II) and FIT2014 (Theory of computation) in the new BSE & BCS degree structure.

In addition you must have completed 24 points of level 3 core or approved or preferred units in CS or SE or equivalent.

Students joining this unit as part of their masters unit need to consult the Masters coordinator to seek approval.

You should have knowledge of types of parallelism within a computer architecture; processes, scheduling, inter-process communication; and experience with multiple programming languages.

Relationships

FIT4001 is a core unit in the Bachelor of Software Engineering Degree and is an elective unit for BCS and Postgraduate courses in the Faculty of IT.

Continuous improvement

Monash is committed to 'Excellence in education' and strives for the highest possible quality in teaching and learning. To monitor how successful we are in providing quality teaching and learning Monash regularly seeks feedback from students, employers and staff. Two of the formal ways that you are invited to provide feedback are through Unit Evaluations and through Monquest Teaching Evaluations.

One of the key formal ways students have to provide feedback is through Unit Evaluation Surveys. It is Monash policy for every unit offered to be evaluated each year. Students are strongly encouraged to complete the surveys as they are an important avenue for students to "have their say". The feedback is anonymous and provides the Faculty with evidence of aspects that students are satisfied and areas for improvement.

Student Evaluations

The Faculty of IT administers the Unit Evaluation surveys online through the my.monash portal, although for some smaller classes there may be alternative evaluations conducted in class.

If you wish to view how previous students rated this unit, please go to <http://www.monash.edu.au/unit-evaluation-reports/>

Over the past few years the Faculty of Information Technology has made a number of improvements to its courses as a result of unit evaluation feedback. Some of these include systematic analysis and planning of unit improvements, and consistent assignment return guidelines.

Monquest Teaching Evaluation surveys may be used by some of your academic staff this semester. They are administered by the Centre for Higher Education Quality (CHEQ) and may be completed in class with a facilitator or on-line through the my.monash portal. The data provided to lecturers is completely anonymous. Monquest surveys provide academic staff with evidence of the effectiveness of their teaching and identify areas for improvement. Individual Monquest reports are confidential, however, you can see the summary results of Monquest evaluations for 2006 at <http://www.adm.monash.edu.au/cheq/evaluations/monquest/profiles/index.html>

Improvements to this unit

Online MonQuest Evaluation and Online Unit Evaluations will continue to be requested (and encouraged) to be done by as many students as possible as usual in sem 2 2008.

Unit staff - contact details

Unit leader

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Additional communication information

Prof David Abramson - Parallel architectures component

Dr Sita Ramakrishnan and Mr Quazi Mamun - Distributed Systems component

Teaching and learning method

FIT4001 provides students with a comprehensive set of study guides and references to facilitate your learning. The lectures will build on these teaching resources rather than reproduce them, and are an opportunity for you to raise questions.

Lectures: You are advised to read through the study guide prior to the lecture, as two hours is far too short to cover all the important concepts. Emphasis in lectures will be given to providing examples of the concepts and discussing some of the questions that these ideas may provoke.

Students are strongly encouraged to attend the lectures and participate in the discussions.

Some of the assignment work in the Distributed systems component will be team based and peer assessed for some aspects.

Timetable information

For information on timetabling for on-campus classes at all Australian campuses please refer to MUTTS, <http://mutts.monash.edu.au/MUTTS/>

Lecture - Tuesdays 1-3pm, Clayton campus, Bldg. 26, Level 1, Rm 135

Unsupervised tute/lab - 3-4pm, Bldg 26, Grd floor, G.13, MUSE Lab

Communication, participation and feedback

Monash aims to provide a learning environment in which students receive a range of ongoing feedback throughout their studies. You will receive feedback on your work and progress in this unit. This may take the form of group feedback, individual feedback, peer feedback, self-comparison, verbal and written feedback, discussions (on line and in class) as well as more formal feedback related to assignment marks and grades. You are encouraged to draw on a variety of feedback to enhance your learning.

It is essential that you take action immediately if you realise that you have a problem that is affecting your study. Semesters are short, so we can help you best if you let us know as soon as problems arise. Regardless of whether the problem is related directly to your progress in the unit, if it is likely to interfere with your progress you should discuss it with your lecturer or a Community Service counsellor as soon as possible.

Unit Schedule

Week	Topic	Study guide	References/Readings	Key dates
1	Distributed systems - Introduction to Concurrency & parallelism, Java's model of concurrency with built-in model of monitor, Shared memory synchronisation	Topics 1 & 2 on FIT4001/FIT4001 Blackboard site	Topics 1 - Overview from Parallel Programming Languages and Systems by Murray Cole's slides and Concurrent & Distributed computing in Java by Vijay Garg , Ch.2,3 in Magee & Kramer's text	

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	- week 1 - July 15th			
2	Distributed systems - Shared memory synchronisation (contd), Monitors and deadlocks - week 2 - July 22nd	Topic 2 contd & Topic 3 on FIT4001/FIT4001 Blackboard site	Ch.3, 4 & 5 in Magee & Kramer's text	Hurdle for Distributed systems Ass1 - check Blackboard site
3	Distributed systems - concurrent program analysis - Deadlock, Safety & Liveness properties - week 3 - July 29th	Topic 4 on FIT4001/FIT4001 Blackboard site	Ch.8, 6 &7 in Magee & Kramer's text	Hurdle for Distributed systems Ass1 - check Blackboard site
4	Distributed systems - Message passing concepts - week 4 - Aug 5th	Topic 4 on FIT4001/FIT4001 Blackboard site	Ch.6 & 7 in Magee & Kramer's text	Prelim submission for Distributed systems Ass1 due Monday Aug 4th - to be overwritten with the final vers/submission in week 5 - Monday Aug 11th 5pm
5	Distributed systems - Principles and Issues in Message passing programming, Synchronous & asynchronous semantics -Case study - MPI, Java, Linda - week 5 - Aug 12th	Topic 5 on FIT4001/FIT4001 Blackboard site		Distributed systems assignment 1 due Monday Aug 11th 5pm. Hurdle for Distributed systems Ass2- check Blackboard site
6	Distributed systems - Parallel programming libraries - week 6 - Aug 19th	Topic 6 on FIT4001/FIT4001 Blackboard site		Hurdle for Distributed systems Ass2 - check Blackboard site
7	Parallel	Materials on	Refer to Blackboard site	Distributed systems

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	Architectures Lectures - Review of instruction level pipelining - Chapters 4 & 7 - week 7 - Aug 26	FIT4001/FIT4001 Blackboard site	for references to Chapters in the Topic column for Parallel architectures	assignment 2 due Week 7 - Monday Aug 25th 5pm
8	Parallel Architectures Lectures -Review of instruction level pipelining - Chapter 7 - week 8 - Sep 2	Materials on FIT4001/FIT4001 Blackboard site		
9	Introduction to Parallel Architectures - Chapter 10 SIMD Architectures - Chapter 11 Vector Architectures - Chapter 14 VLIW Architectures - Chapter 6 Introduction to MIMD - week 9 - Sep 9	Materials on FIT4001/FIT4001 Blackboard site		
10	Distributed Memory MIMD Architectures - Chapter 17 - week 10 - Sep 16	Materials on FIT4001/FIT4001 Blackboard site		Parallel architectures assignment 3 due Friday 19th September
11	Shared Memory MIMD Architectures - Chapter 18 - week 11 - Sep 23	Materials on FIT4001/FIT4001 Blackboard site		
Mid semester break				
12	Parallel architectures - week 12 - Oct 10	Materials on FIT4001/FIT4001 Blackboard site		
13	Week 13 - Review session - Oct 14			Parallel architectures assignment 4 due Friday 17th October

Unit Resources

Prescribed text(s) and readings

Reading material including research papers, programming manuals and system specifications, will be distributed electronically or in hardcopy.

Reference Material:

G.R. Andrews: Foundations of Multithreaded, Parallel and Distributed Programming, Addison-Wesley, 2000.

J. Magee and J. Kramer: Concurrency: State models & Java Programming; John-Wiley & Sons, 2006.

I.T. Foster: Designing and Building Parallel Programs, Addison-Wesley, 1995.

M. Maekawa, A.E. Oldehoeft, R.R. Oldehoeft: Operating Systems Advanced Concepts, Benjamin/Cummings, 1987.

Text books are available from the [Monash University Book Shops](#). Availability from other suppliers cannot be assured. The Bookshop orders texts in specifically for this unit. You are advised to purchase your text book early.

Recommended text(s) and readings

Reading material including research papers, programming manuals and system specifications, will be distributed electronically or in hardcopy.

Reference Material:

G.R. Andrews: Foundations of Multithreaded, Parallel and Distributed Programming, Addison-Wesley, 2000.

J. Magee and J. Kramer: Concurrency: State models & Java Programming; John-Wiley & Sons, 2006.

I.T. Foster: Designing and Building Parallel Programs, Addison-Wesley, 1995.

M. Maekawa, A.E. Oldehoeft, R.R. Oldehoeft: Operating Systems Advanced Concepts, Benjamin/Cummings, 1987.

Advanced Computer Architectures: A Design Space Approach, Sima, Fountain and Kacsuk , Addison Wesley Publishers

Equipment and consumables required or provided

Students may use the facilities available in the computing labs. Information about computer use for students is available from the ITS Student Resource Guide in the Monash University Handbook. You will need to allocate up to **8** hours per week for use of a computer, including time for newsgroups/discussion groups.

Study resources

Study resources we will provide for your study are:

- Weekly detailed lecture notes outlining the learning objectives, discussion of the content, required readings and exercises;

- Weekly exercises - refer to relevant chapters in Andrews & Magee's Text for Distributed Systems' component ;
- Assignment specifications;
- Discussion groups;
- This Unit Guide outlining the administrative information for the unit;
- The unit web site on MUSO, where resources outlined above will be made available.

Library access

The Monash University Library site contains details about borrowing rights and catalogue searching. To learn more about the library and the various resources available, please go to <http://www.lib.monash.edu.au>. Be sure to obtain a copy of the Library Guide, and if necessary, the instructions for remote access from the library website.

Monash University Studies Online (MUSO)

All unit and lecture materials are available through MUSO (Monash University Studies Online). Blackboard is the primary application used to deliver your unit resources. Some units will be piloted in Moodle. If your unit is piloted in Moodle, you will see a link from your Blackboard unit to Moodle (<http://moodle.monash.edu.au>) and can bookmark this link to access directly. In Moodle, from the Faculty of Information Technology category, click on the link for your unit.

You can access MUSO and Blackboard via the portal: <http://my.monash.edu.au>

Click on the Study and enrolment tab, then Blackboard under the MUSO learning systems.

In order for your Blackboard unit(s) to function correctly, your computer needs to be correctly configured.

For example:

- Blackboard supported browser
- Supported Java runtime environment

For more information, please visit: <http://www.monash.edu.au/muso/support/students/downloadables-student.html>

You can contact the MUSO Support by: Phone: (+61 3) 9903 1268

For further contact information including operational hours, please visit:
<http://www.monash.edu.au/muso/support/students/contact.html>

Further information can be obtained from the MUSO support site:
<http://www.monash.edu.au/muso/support/index.html>

Assessment

Unit assessment policy

The unit is made up of 2 components, distributed and parallel computing, and parallel architectures.

Each component is assessed with two assignments. In addition, the parallel architectures lectures will include a short quiz in each lecture (Weeks 7 - 12).

To pass the unit you must:

- attempt both assignments in each of the 2 components (Parallel architectures & Distributed Systems)
- achieve no less than 40% of the possible marks in each component
- achieve no less than 50% of possible marks.

Marks breakdown:

Distributed systems (Sita Ramakrishnan and Quazi Mamun) - assignment 1 - 25% + assignment 2 - 25%

Parallel architectures (David Abramson) - assignment 3 - 19% + assignment 4 - 19% + six weekly quizzes, each 2%, total - 12%

Assignment tasks

• Assignment Task

Title : Distributed Systems - Programming Assignment 1

Description :

Develop an FSP model and Java implementation for demonstrating concurrent programming mechanisms that use shared variables. Assignment spec on Blackboard site for the unit.

Weighting : 25%

Criteria for assessment :

Demonstrate through your submission,

the theoretical understanding and practical skills in modelling, analysis and realization of multi-process algorithms with shared memory synchronisation.

Due date : Distributed systems assignment 1 due Week 5 - Monday Aug 11th 5pm (note also the prelim vers due date in week 4)

• Assignment Task

Title : Distributed Systems - Programming Assignment 2

Description :

Write parallel programs using message passing. Assignment spec on Blackboard site for the unit.

Weighting : 25%

Criteria for assessment :

Demonstrate through your submission, the theoretical understanding and practical skills in distributed programming in which processes communicate and synchronise by means of messages.

Due date : Distributed systems assignment 2 due - Week 7 - Monday Aug 25th 5pm

• **Assignment Task**

Title : Parallel architectures - Assignment 3

Description :

In this assignment you are asked to write a research paper on how high performance machines are applied to a range of different application areas. You should read sufficient material to give you some understanding of the outcomes for the area, and the underlying computational methods (for example, the numerical methods involved, or the computer science algorithms employed) and how it is solved using a high performance computer.

Weighting : 19%

Criteria for assessment :

Each case study should contain the following sections:

1. A description of the problem.
2. The science or engineering outcomes of the application.
3. How the problem is solved on parallel machines.

Marks will be allocated, roughly equally, against the application areas listed in the assignment specification. Further marks will be allocated for the length of the paper (against the word limit) and the number of references.

Students should see the assignment specification for more detailed description of the requirements.

Due date : Week 10 - 19/9/2008

• **Assignment Task**

Title : Parallel architectures - Assignment 4

Description :

In this assignment you are to write a research paper on various multi-core architectures and discuss the design choices and alternatives available in the current commercial products.

Weighting : 19%

Criteria for assessment :

Marks will be allocated, roughly equally, against the four items discussed in the description. Further marks will be allocated for the length of the paper (against the word limit) and the number of references.

Students should see the assignment specification for more detailed description of the requirements.

Due date : Week 13 - 17/10/2008

• **Assignment Task**

Title : Week 7 Quiz

Description :

Students will be given a short quiz on materials presented in the lecture.

Weighting : 2%

Criteria for assessment :

Demonstration of knowledge (understanding) gained during the week

Due date : Week 7 lecture slot

• **Assignment Task**

Title : Week 8 Quiz

Description :

Students will be given a short quiz on materials presented in the lecture.

Weighting : 2%

Criteria for assessment :

Demonstration of knowledge (understanding) gained during the week

Due date : Week 8 lecture slot

• **Assignment Task**

Title : Week 9 Quiz

Description :

Students will be given a short quiz on materials presented in the lecture.

Weighting : 2%

Criteria for assessment :

Demonstration of knowledge (understanding) gained during the week

Due date : Week 9 lecture slot

• **Assignment Task**

Title : Week 10 Quiz

Description :

Students will be given a short quiz on materials presented in the lecture.

Weighting : 2%

Criteria for assessment :

Demonstration of knowledge (understanding) gained during the week

Due date : Week 10 lecture slot

• **Assignment Task**

Title : Week 11 Quiz

Description :

Students will be given a short quiz on materials presented in the lecture.

Weighting : 2%

Criteria for assessment :

Demonstration of knowledge (understanding) gained during the week

Due date : Week 11 lecture slot

• **Assignment Task**

Title : Week 12 Quiz

Description :

Students will be given a short quiz on materials presented in the lecture.

Weighting : 2%

Criteria for assessment :

Demonstration of knowledge (understanding) gained during the week

Due date : Week 12 lecture slot

Assignment submission

Assignments will be submitted by **electronic** submission to the FIT4001 unit site on MUSO On-campus Students submit the assignment to the MUSO as per the given due dates above, with the appropriate cover sheet correctly filled out.

Assignment coversheets

Electronic cover sheets are provided in MUSO

University and Faculty policy on assessment

Due dates and extensions

The due dates for the submission of assignments are given in the previous section. Please make every effort to submit work by the due dates. It is your responsibility to structure your study program around assignment deadlines, family, work and other commitments. Factors such as normal work pressures, vacations, etc. are seldom regarded as appropriate reasons for granting extensions. Students are advised to NOT assume that granting of an extension is a matter of course.

Procedures and policies on applying for extensions for assignment work:

Requests for extensions must be made to the unit lecturer at your campus at least two days before the due date. You will be asked to forward original medical certificates in cases of illness, and may be asked to provide other forms of documentation where necessary. A copy of the email or other written communication of an extension must be attached to the assignment submission.

Late assignment

Assignments received after the due date will be subject to a penalty **for late submission as described in the MUSO site for cse4333 assignments.**

Return dates

Students can expect assignments to be returned within two weeks of the submission date or after receipt, whichever is later.

Assessment for the unit as a whole is in accordance with the provisions of the Monash University Education Policy at <http://www.policy.monash.edu/policy-bank/academic/education/assessment/>

We will aim to have assignment results made available to you within two weeks after assignment receipt.

Please note that as FIT4001 is composed of 2 components, we suggest that you please check the relevant part of the MUSO site for any specific changes to the above requirement.

Plagiarism, cheating and collusion

Plagiarism and cheating are regarded as very serious offences. In cases where cheating has been confirmed, students have been severely penalised, from losing all marks for an assignment, to facing disciplinary action at the Faculty level. While we would wish that all our students adhere to sound ethical conduct and honesty, I will ask you to acquaint yourself with Student Rights and Responsibilities (<http://www.infotech.monash.edu.au/about/committees-groups/facboard/policies/studrights.html>) and the Faculty regulations that apply to students detected cheating as these will be applied in all detected cases.

In this University, cheating means seeking to obtain an unfair advantage in any examination or any other written or practical work to be submitted or completed by a student for assessment. It includes the use, or attempted use, of any means to gain an unfair advantage for any assessable work in the unit, where the means is contrary to the instructions for such work.

When you submit an individual assessment item, such as a program, a report, an essay, assignment or other piece of work, under your name you are understood to be stating that this is your own work. If a submission is identical with, or similar to, someone else's work, an assumption of cheating may arise. If you are planning on working with

another student, it is acceptable to undertake research together, and discuss problems, but it is not acceptable to jointly develop or share solutions unless this is specified by your lecturer.

Intentionally providing students with your solutions to assignments is classified as "assisting to cheat" and students who do this may be subject to disciplinary action. You should take reasonable care that your solution is not accidentally or deliberately obtained by other students. For example, do not leave copies of your work in progress on the hard drives of shared computers, and do not show your work to other students. If you believe this may have happened, please be sure to contact your lecturer as soon as possible.

Cheating also includes taking into an examination any material contrary to the regulations, including any bilingual dictionary, whether or not with the intention of using it to obtain an advantage.

Plagiarism involves the false representation of another person's ideas, or findings, as your own by either copying material or paraphrasing without citing sources. It is both professional and ethical to reference clearly the ideas and information that you have used from another writer. If the source is not identified, then you have plagiarised work of the other author. Plagiarism is a form of dishonesty that is insulting to the reader and grossly unfair to your student colleagues.

Register of counselling about plagiarism

The university requires faculties to keep a simple and confidential register to record counselling to students about plagiarism (e.g. warnings). The register is accessible to Associate Deans Teaching (or nominees) and, where requested, students concerned have access to their own details in the register. The register is to serve as a record of counselling about the nature of plagiarism, not as a record of allegations; and no provision of appeals in relation to the register is necessary or applicable.

Non-discriminatory language

The Faculty of Information Technology is committed to the use of non-discriminatory language in all forms of communication. Discriminatory language is that which refers in abusive terms to gender, race, age, sexual orientation, citizenship or nationality, ethnic or language background, physical or mental ability, or political or religious views, or which stereotypes groups in an adverse manner. This is not meant to preclude or inhibit legitimate academic debate on any issue; however, the language used in such debate should be non-discriminatory and sensitive to these matters. It is important to avoid the use of discriminatory language in your communications and written work. The most common form of discriminatory language in academic work tends to be in the area of gender inclusiveness. You are, therefore, requested to check for this and to ensure your work and communications are non-discriminatory in all respects.

Students with disabilities

Students with disabilities that may disadvantage them in assessment should seek advice from one of the following before completing assessment tasks and examinations:

- Faculty of Information Technology Student Service staff, and / or
- your Unit Coordinator, or
- [Disabilities Liaison Unit](#)

Deferred assessment and special consideration

Deferred assessment (not to be confused with an extension for submission of an assignment) may be granted in cases of extenuating personal circumstances such as serious personal illness or bereavement. Information and forms for Special Consideration and deferred assessment applications are available at

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<http://www.monash.edu.au/exams/special-consideration.html>. Contact the Faculty's Student Services staff at your campus for further information and advice.