COMP332

Programming Languages

S2 Day 2019

Dept of Computing

Contents

General Information

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Credit points
3

Prerequisites
(39cp at 100 level or above) including (COMP225 or COMP229)

Corequisites
ISYS358 or (3cp COMP units at 300 level) or (ENGG350 and admission to BE or BE(Hons) or BEBA or BE(Hons)BA or BEBBA or BEBCom or BE(Hons)BCom or BEBSc or BE(Hons)BSc)

Co-badged status

Unit description
Formal languages play a central role in modern software development. Programming languages such as Java and C++ allow developers to express their algorithms and data structures. Compilers and interpreters transform programs into running software. Data languages such as XML and JSON are widely used to transfer information between systems. This unit studies software languages by looking at how they are used in software development. Students will study how to formally understand the syntax, semantics and translation of software languages. Practical exercises involve writing software language processors of various kinds such as simple compilers or data transformation tools.

Important Academic Dates

Information about important academic dates including deadlines for withdrawing from units are available at https://www.mq.edu.au/study/calendar-of-dates

Learning Outcomes

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

Explain the role that languages play in software development and describe a spectrum of software languages that are in current use.

Express properties of software languages using formal notations.

Translate formal notations of software language properties into implementations of language processors.

Demonstrate that a language processor is operating correctly by construction and use of appropriate test cases.

General Assessment Information

ASSIGNMENTS

The unit has one assignment that is a programming exercise in Scala and two assignments that together complete the implementation of a small but non-trivial programming language using Scala and the Kiama library.

LATE PENALTY

No extensions will be granted without an approved application for Special Consideration. There will be a deduction of 20% of the total available marks made from the total awarded mark for each 24 hour period or part thereof that the submission is late. For example, 25 hours late in submission for an assignment worth 40 marks – 40% penalty – deducted from the total for an assignment marked out of 100. No submission will be accepted after solutions have been posted.

EXAMINATIONS

The unit has three examinations corresponding to weeks 1-4, 5-8, and 9-12, respectively. Each examination is offered twice: once during the mixed classes in weeks 7, 10 and 13, respectively, and once in the final examination period. The repeat offerings of the examination will not be identical examinations but will be designed to assess the same material.

If a student attempts an examination more than once then the higher of their marks for the two attempts will be used to compute the grade.

If you receive Special Consideration for the final exam, a supplementary exam will be scheduled after the normal exam period, following the release of marks. By making a special consideration application for the final exam you are declaring yourself available for a resit during the supplementary examination period and will not be eligible for a second special consideration approval based on pre-existing commitments. Please ensure you are familiar with the policy prior to submitting an application. Approved applicants will receive an individual notification one week prior to the exam with the exact date and time of their supplementary examination.

MIXED CLASSES

Each week tutorial and practical exercises will be set for the mixed classes. These exercises are not to be submitted and do not attract any marks. They are designed to prepare students for the examinations and the assignments.

Assessment Tasks

Name	Weighting	Hurdle	Due
Assignment 1: Scala	10%	No	Week 6
Examination 1 (Weeks 1-4)	20%	No	Mixed Class Week 7
Assignment 2: Syntax Analysis	15%	No	Week 9
Examination 2 (Weeks 5-8)	20%	No	Mixed Class Week 10
Assignment 3: Translation	15%	No	Week 12
Examination 3 (Weeks 9-12)	20%	No	Mixed Class Week 13
Final Examination	0%	No	Exam Period

Assignment 1: Scala

Due: **Week 6**
Weighting: **10%**

The first assignment focuses on using Scala (particularly its functional features) to develop a small-medium program. The aim is to consolidate and assess Scala programming skills in

preparation for the other two assignments.

On successful completion you will be able to:

- Express properties of software languages using formal notations.
- Translate formal notations of software language properties into implementations of language processors.
- Demonstrate that a language processor is operating correctly by construction and use of appropriate test cases.

Examination 1 (Weeks 1-4)

Due: **Mixed Class Week 7**
Weighting: **20%**

This examination will assess the material from Weeks 1-4 of the semester. The examination will be held in the first hour of the mixed class in this week.

On successful completion you will be able to:

- Explain the role that languages play in software development and describe a spectrum of software languages that are in current use.
- Express properties of software languages using formal notations.

Assignment 2: Syntax Analysis

Due: **Week 9**
Weighting: **15%**

The second assignment focuses on processing the syntax of a language to obtain a representation that the rest of the implementation can use.

On successful completion you will be able to:

- Express properties of software languages using formal notations.
- Translate formal notations of software language properties into implementations of language processors.
- Demonstrate that a language processor is operating correctly by construction and use of appropriate test cases.

Examination 2 (Weeks 5-8)

Due: **Mixed Class Week 10**
Weighting: **20%**

This examination will assess the material from Weeks 5-8 of the semester. The examination will be held in the first hour of the mixed class in this week.

On successful completion you will be able to:

- Explain the role that languages play in software development and describe a spectrum of software languages that are in current use.
- Express properties of software languages using formal notations.

Assignment 3: Translation

Due: **Week 12**
Weighting: **15%**

The third assignment focuses on translating a language into some other form, such as another structured language (e.g., translating a programming language into a lower-level form such as bytecode or assembly language).

On successful completion you will be able to:

- Express properties of software languages using formal notations.
- Translate formal notations of software language properties into implementations of language processors.
- Demonstrate that a language processor is operating correctly by construction and use of appropriate test cases.

Examination 3 (Weeks 9-12)

Due: **Mixed Class Week 13**
Weighting: **20%**

This examination will assess the material from Weeks 9-12 of the semester. The examination will be held in the first hour of the mixed class in this week.

On successful completion you will be able to:

- Explain the role that languages play in software development and describe a spectrum of software languages that are in current use.
- Express properties of software languages using formal notations.

Final Examination

Due: **Exam Period**
Weighting: **0%**

The final examination will be a chance to sit any or all of Examinations 1, 2 and 3 again. The final examinations will not be identical to the earlier examinations but will be designed to assess the same material.

On successful completion you will be able to:

- Explain the role that languages play in software development and describe a spectrum of software languages that are in current use.
- Express properties of software languages using formal notations.

Delivery and Resources

CLASSES

Each week of COMP332 has three hours of lecture and a two-hour mixed class. The mixed classes will require a mixture of tutorial-style and practical work. Mixed classes start in Week 1.

REQUIRED AND RECOMMENDED TEXTS AND/OR MATERIALS

There is no required text. We will provide notes or references to freely available materials where relevant.

The free book Creative Scala (https://www.creativescala.org) is a clear introduction to functional programming in Scala and we will use the Doodle graphics library described in that book to illustrate Scala programming principles.

Students may find it useful to consult one of the many books that are available on the programming languages topic. The following books are among those that are available in the Macquarie University Library:

- Programming Language Pragmatics. Scott.
- Principles of programming languages: design, evaluation, and implementation. MacLennan.
- Programming languages: design and implementation. Pratt and Zelkowitz.
- Concepts of programming languages. Sebesta.
- Programming languages: concepts and constructs. Sethi.
- Introduction to compiler construction. Waite and Carter.
- Compilers: principles, techniques and tools. Aho, Sethi, and Ullman.
- Modern compiler implementation in Java. Appel.

UNIT WEBPAGE AND TECHNOLOGY USED AND REQUIRED

COMP332 uses iLearn for delivery of class materials, discussion boards, online selftests, submission of assessment tasks and access to marks and comments. Students should check the iLearn site regularly for unit updates.

Questions regarding the content of this unit, its tutorials or practicals should be posted to the appropriate discussion board on iLearn. In particular, any questions which are of interest to all students in this unit should be posted to one of these discussion boards, so that everyone can benefit from the answers.

The practical work in this unit involves programming in the Scala language (http://www.scala-lan

g.org) which will give students experience with modern programming language features that we expect to see in mainstream languages in the future.

We will also use the Kiama language processing library (https://bitbucket.org/inkytonik/kiama) that is being developed by our Programming Languages and Verification Research Group. Kiama provides high-level facilities for writing processors such as compilers in Scala and makes it possible for students to implement of a language from scratch within the semester.

Instructions will be provided on how to use Scala and Kiama on the laboratory machines and how to download it for use on your own machines

Unit Schedule

Week	Topic	Lecturer	Assignment Due	Exam
	Introduction: Unit and Scala Basics	Tony Sloane		
	Functional Programming in Scala	Tony Sloane		
	Syntax	Tony Sloane		
	Names	Tony Sloane		
	Semantic analysis	Tony Sloane	One	
	Types	Dom Verity		One
	Lecture Recess - Two Weeks			
	Transformation; compilation	Dom Verity		
	No lectures or practicals on Monday due to public holiday. Tuesday classes are still on for last minute assignment help.	Dom Verity	Two	
	Subroutines and control abstraction	Dom Verity		Two
	Data abstraction and object-oriented programming	Dom Verity		
	Language runtimes; interpretation	Dom Verity	Three	
	Review, Exam Discussion	Dom Verity		Three
				One, Two, Three

Policies and Procedures

Macquarie University policies and procedures are accessible from Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central). Students should be aware of the following policies in particular with regard to Learning and Teaching:

- Academic Appeals Policy
- Academic Integrity Policy
- Academic Progression Policy
- Assessment Policy
- Fitness to Practice Procedure
- Grade Appeal Policy
- Complaint Management Procedure for Students and Members of the Public
- Special Consideration Policy *(**Note:** The Special Consideration Policy is effective from 4 December 2017 and replaces the Disruption to Studies Policy.)*

Undergraduate students seeking more policy resources can visit the Student Policy Gateway (https://students.mq.edu.au/support/study/student-policy-gateway). It is your one-stop-shop for the key policies you need to know about throughout your undergraduate student journey.

If you would like to see all the policies relevant to Learning and Teaching visit Policy Central (https://staff.mq.edu.au/work/strategy-planning-and-governance/university-policies-and-procedures/policy-central).

Student Code of Conduct

Macquarie University students have a responsibility to be familiar with the Student Code of Conduct: https://students.mq.edu.au/study/getting-started/student-conduct

Results

Results published on platform other than eStudent, (eg. iLearn, Coursera etc.) or released directly by your Unit Convenor, are not confirmed as they are subject to final approval by the University. Once approved, final results will be sent to your student email address and will be made available in eStudent. For more information visit ask.mq.edu.au or if you are a Global MBA student contact globalmba.support@mq.edu.au

Student Support

Macquarie University provides a range of support services for students. For details, visit http://students.mq.edu.au/support/

Learning Skills

Learning Skills (mq.edu.au/learningskills) provides academic writing resources and study strategies to improve your marks and take control of your study.

- Workshops
- StudyWise
- Academic Integrity Module for Students
- Ask a Learning Adviser

Student Services and Support

Students with a disability are encouraged to contact the Disability Service who can provide appropriate help with any issues that arise during their studies.

Student Enquiries

For all student enquiries, visit Student Connect at ask.mq.edu.au

If you are a Global MBA student contact globalmba.support@mq.edu.au

IT Help

For help with University computer systems and technology, visit http://www.mq.edu.au/about_us/offices_and_units/information_technology/help/.

When using the University's IT, you must adhere to the Acceptable Use of IT Resources Policy. The policy applies to all who connect to the MQ network including students.

Graduate Capabilities

Creative and Innovative

Our graduates will also be capable of creative thinking and of creating knowledge. They will be imaginative and open to experience and capable of innovation at work and in the community. We want them to be engaged in applying their critical, creative thinking.

This graduate capability is supported by:

Learning outcomes

- Express properties of software languages using formal notations.
- Translate formal notations of software language properties into implementations of language processors.
- Demonstrate that a language processor is operating correctly by construction and use of appropriate test cases.

Assessment tasks

- Assignment 1: Scala
- Examination 1 (Weeks 1-4)
- Assignment 2: Syntax Analysis
- Examination 2 (Weeks 5-8)

- Assignment 3: Translation
- Examination 3 (Weeks 9-12)
- Final Examination

Discipline Specific Knowledge and Skills

Our graduates will take with them the intellectual development, depth and breadth of knowledge, scholarly understanding, and specific subject content in their chosen fields to make them competent and confident in their subject or profession. They will be able to demonstrate, where relevant, professional technical competence and meet professional standards. They will be able to articulate the structure of knowledge of their discipline, be able to adapt discipline-specific knowledge to novel situations, and be able to contribute from their discipline to inter-disciplinary solutions to problems.

This graduate capability is supported by:

Learning outcomes

- Explain the role that languages play in software development and describe a spectrum of software languages that are in current use.
- Express properties of software languages using formal notations.
- Translate formal notations of software language properties into implementations of language processors.
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- Assignment 3: Translation
- Examination 3 (Weeks 9-12)
- Final Examination

Critical, Analytical and Integrative Thinking

We want our graduates to be capable of reasoning, questioning and analysing, and to integrate and synthesise learning and knowledge from a range of sources and environments; to be able to critique constraints, assumptions and limitations; to be able to think independently and systemically in relation to scholarly activity, in the workplace, and in the world. We want them to have a level of scientific and information technology literacy.

This graduate capability is supported by:

Learning outcomes

- Explain the role that languages play in software development and describe a spectrum of software languages that are in current use.
- Express properties of software languages using formal notations.
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- Final Examination

Problem Solving and Research Capability

Our graduates should be capable of researching; of analysing, and interpreting and assessing data and information in various forms; of drawing connections across fields of knowledge; and they should be able to relate their knowledge to complex situations at work or in the world, in order to diagnose and solve problems. We want them to have the confidence to take the initiative in doing so, within an awareness of their own limitations.

This graduate capability is supported by:

Learning outcomes

- Express properties of software languages using formal notations.
- Translate formal notations of software language properties into implementations of language processors.
- Demonstrate that a language processor is operating correctly by construction and use of appropriate test cases.

Assessment tasks

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- Examination 2 (Weeks 5-8)

- Assignment 3: Translation
- Examination 3 (Weeks 9-12)
- Final Examination

Effective Communication

We want to develop in our students the ability to communicate and convey their views in forms effective with different audiences. We want our graduates to take with them the capability to read, listen, question, gather and evaluate information resources in a variety of formats, assess, write clearly, speak effectively, and to use visual communication and communication technologies as appropriate.

This graduate capability is supported by:

Learning outcomes

- Explain the role that languages play in software development and describe a spectrum of software languages that are in current use.
- Express properties of software languages using formal notations.
- Translate formal notations of software language properties into implementations of language processors.
- Demonstrate that a language processor is operating correctly by construction and use of appropriate test cases.

Assessment tasks

- Assignment 1: Scala
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- Examination 2 (Weeks 5-8)
- Assignment 3: Translation
- Examination 3 (Weeks 9-12)
- Final Examination

Changes from Previous Offering

No major changes from 2018 version.

Some of the practical work in the first part of the unit has been made more substantial to better prepare students for the assignments.

The deadline for Assignment One has been moved back a week to give more time between the relevant classes and the deadline. The deadline for Assignment Three is also a week later due to the Labour Day holiday in Week 9 this year compared to Week 8 in 2018.

Assessment Standards

COMP332 will be assessed and graded according to the University assessment and grading policies.

The following general standards of achievement will be used to assess each of the assessment tasks with respect to the letter grades.

Pass: Can correctly reproduce facts and definitions across a breadth of concepts, but lacks depth of understanding. Can use notations to specify familiar language concepts in ways that are close to those discussed in lectures or notes. Can implement and test the basic features of a programming language similar to examples provided. Uses basic standards for code comprehension such as variable naming or documentation. Adheres to basic standards for presentation of written work. Can produce a basic description of the main aspects of a software system. Can describe basic test cases for software under study.

Credit/Distinction: As for Pass plus: Exhibits breadth and depth of understanding of concepts. Can use terminology accurately in new contexts. Can express ideas in their own words and has an understanding of the limits of their understanding. Can apply formal notations to describe language concepts that have not previously been seen. Can use provided general techniques to implement language concepts whose detailed implementation in code has not previously been discussed. Has well-developed skills for writing comprehensible, modular and well-documented code. Able to describe all or relevant aspects of a software system to an appropriate level of detail. Can articulate the principles behind the design of a suite of test cases.

High Distinction: As for Credit/Distinction plus: Is aware of the context in which the concepts are developed and their limitations. Able to generate and justify principles and hypotheses for existing or new concepts. Can recognise the limitations of formal notations for specifying some language concepts and is able to propose alternatives. Can develop new techniques to implement language concepts beyond those provided. Can critically evaluate aspects of the software system under study and the appropriateness of testing as a method for demonstrating software correctness.

ASSESSMENT PROCESS

These assessment standards will be used to give a numeric mark out of 100 to each assessment submission during marking. The mark will correspond to a letter grade for that task according to the University guidelines. The final mark for the unit will be calculated by combining the marks for all assessment tasks according to the percentage weightings shown in the assessment summary.

Changes since First Published

Date	Description
30/07/2019	Fixed an incorrect link to the Creative Scala online book.