Australian National University

COMP2710: COMP2710 Special Topics in Computer Science
Numerical Computing with Julia
Outline – S2 2023

Mode of Delivery: In Person
Class Meeting Time: Fridays 12:00 pm - 14:00 pm
Class Meeting Location: Room 5.06, Marie Reay Building #155
Lab Meeting Time: Mondays 14:00 pm - 16:00 pm
Lab Meeting Location: CSIT N109
Course Prerequisites:

- COMP1100/1110/1130/1140/1730 or equivalently, some experience in programming.
- Existing knowledge on Julia, calculus, and linear algebra will make the course easier.

Course Website: `https://quanlingdeng.github.io/comp2710.html`

Course Convener and Lecturer: Quanling Deng
Email: COMP2710.convenor@anu.edu.au
Office Location: 4.19 @ Building #145, Hanna Neumann or virtually at Zoom
Consultation Hours : Fridays 14:00 pm - 15:00 pm or by appointment
Tutor: Jipei Chen
Email: Jipei.Chen@anu.edu.au

Course Description: This is an introductory course on numerical computation with a focus on computer program realisation using Julia. This course introduces students to computational topics on roots of non-linear equations, function approximation with series expansions, polynomial interpolation and data fitting, algorithms for solving linear systems of equations, quadrature rules for numerical integration, difference rules for numerical differentiation, and a tentative topic on numerical methods for differential equations. The tentative course weekly schedule is attached at the end of this course outline. Emphasis is made on algorithm development implementation in Julia and the basic mathematical ideas behind the algorithms. Learning to use Julia will be an important part of the course.

Course Learning Outcomes

- Demonstrate a basic knowledge of programming in Julia.
- Demonstrate a basic knowledge of numerical differentiation/integration, interpolation and data fitting.
- Be able to implement numerical computation algorithms on such as root-finding, expansion, interpolation/data fitting, matrix calculation, and numerical integrations.

Recommended References/Resources:

- Bezanson, Jeff, Alan Edelman, Stefan Karpinski, and Viral B. Shah. "Julia: A fresh approach to numerical computing." SIAM review 59, no. 1 (2017): 65-98.
- Tobin A. Driscoll, Richard J. Braun. Fundamentals of Numerical Computation: Julia Edition.

- The official list of Julia's learning resources: https://julialang.org/learning/
- Julia's Youtube channel: https://www.youtube.com/user/JuliaLanguage
- A package on Fundamentals of Numerical Computation: https://github.com/fncbook/FundamentalsNumericalComputation.jl
- A guide: https://github.com/gridap/Gridap.jl/wiki/Start-learning-Julia

Assessment Summary: Your percentage grade is determined by the following:

Quizzes	10%	Six quizzes will be given randomly in class 5 best scores will be used
Assignments 1	20%	Due on 5:00 pm 28/08/2023 No extension
Assignments 2	20%	Due on 5:00 pm 27/10/2023 No extension
Project	20%	Due on 5:00 pm 27/10/2023 No extension
Final Exam	30%	Closed book. Time/venue will be announced later

Notes:

- Each assignment includes two components, Julia coding and theoretic understanding. The deadlines are fixed. No late submission.
- We will randomly select six weeks to give quizzes in the Friday lectures. One of the lowest scores will be dropped. Five scores will be used and each worth 2% towards your final grades. No extension, no make-up.
- The project is to mainly test Julia's coding skills. You will need to submit your Julia codes as well as a report documenting your work and results. No extension, no make-up.
- **Assignment submission:** Assignments are submitted through the course Wattle site. You will be required to electronically sign a declaration as part of the submission of your assignment. Please keep a copy of the assignment for your records. The ANU is using Wattle to enhance student citation and referencing techniques and to assess assignment submissions as a component of the University's approach to managing Academic Integrity. A student in this course is expected to be able to explain and defend any submitted assessment item. The course convener can conduct or initiate an additional interview about any submitted assessment item for any student.
- **Extensions and penalties:** Since it is likely that in the course of the semester, you will either experience a technical difficulty (e.g., missed the deadline, your computer shut down as you were submitting it, internet outage, etc) or a personal emergency, the deadlines are designed in a way such that the assignments/project are given plenty of time for completion. Please take careful note of deadlines and adhere to them. You are encouraged to submit your assignments before the strict deadline. You will be marked on whatever you have submitted at the time of the deadline.
- **Returning assignments:** Quizzes are returned one week after. Assignments, project reports, and final exams are returned two weeks after. Assignments will be marked and returned through Wattle or emails within two weeks of the submission deadlines.
- **Resubmission of assignments:** No resubmission.
- **Referencing requirements:** Students should provide relevant references in their assignments as appropriate and when applicable.

- **Final exam:** The final exam is designed to test the mathematical understanding of the topics covered in lectures. Closed book. The exam date is to be assigned by the central. We will announce the date and details in the lectures. If you are sick and unable to take the final exam, please let me know. In such a case, you will receive an Incomplete in the course and will have the opportunity to take a makeup exam during the first week of the following semester.

Feedback:

- Staff feedback
  - Through comments to the class during briefing and lectures;
  - Through the course Wattle site (students should consult this regularly)
  - In written form on your assignments by the lecturers/tutors;
  - By email, where appropriate;
  - In individual consultation during the one-on-one sessions.
- Student feedback ANU is committed to the demonstration of educational excellence and regularly seeks feedback from students. One of the key formal ways students have to provide feedback is through Student Experience of Learning Support (SELS) surveys. The feedback given in these surveys is anonymous and provides the Colleges, University Education Committee and Academic Board with opportunities to recognise excellent teaching, and opportunities for improvement.

  For more information on student surveys at ANU and reports on the feedback provided on ANU courses, go to
  - `http://unistats.anu.edu.au/surveys/selt/students/`
  - `http://unistats.anu.edu.au/surveys/selt/results/learning/`

Educational Policies: ANU has educational policies, procedures and guidelines, which are designed to ensure that staff and students are aware of the University's academic standards, and implement them. You can find the University's education policies and an explanatory glossary at: `http://policies.anu.edu.au/`

Students are expected to have read the Academic Misconduct Rule before the commencement of their course. Other key policies include: Student Assessment (Coursework) and Student Surveys and Evaluations.

ANU Academic Integrity Policies: Please note that, by ANU Academic Integrity policies (http://academichonesty.anu.edu.au/), **students must not post any hints or solutions to assessment items (e.g., quizzes, assignments, exams, etc) on the course discussion forum before the deadlines.**

Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner.Academic integrity is a basic guiding principle for all academic activity at ANU, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, the University's Code of Conduct states that all students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts.

Academic integrity includes a commitment by all members of the University community not to engage in or tolerate acts of falsification, misrepresentation or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others. In particular, these include: original individual homework submission, individual assessment through quizzes, and individual midterm project and final exam. There are various cheating services online or in-person (Chegg, CourseHero etc). The usage of these services is a violation of the academic integrity, and will be prosecuted. All violations will be reported to the Integrity Office and handled accordingly.

Course policy on communication: To provide efficient, transparent and fair support for our students, the following course policy on communication is applied:

- Students are encouraged to post course-related questions, such as asking for clarification about lectures, labs, tutorials and other course materials, to the course discussion forum on Piazza. The course convener and tutors will be monitoring and answering questions every day. All students are also encouraged to answer questions from other students on Wattle. This will be not only the fastest way of getting your questions answered but also everyone in the class can benefit from the experience of their fellow students.
- Course-related questions that are directly sent to the course convener and tutors may be re-directed to the course discussion forum on Piazza so that the answers can benefit the entire class.
- If you have questions regarding your specific personal circumstances or questions that might be sensitive, please email the course convener (COMP2710.convenor@anu.edu.au) to discuss them via email or arrange an online appointment.

Getting Help:

- **Piazza first:** This term we will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the tutors, and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza. We will answer questions on Piazza regularly. Your questions will be most likely answered within 48 hours in Piazza. If you have any problems or feedback for the developers, email team@piazza.com.
- Email tutor/convenor for appointments or questions.
- The University offers a number of support services for students. Information on these is available online from `http://students.anu.edu.au/studentlife/`

Outline policy: The policies in this course outline are subject to change. Minor changes will be announced in class and substantive changes shall be communicated in writing.

A tentative course schedule is attached below. Depending on the progress of the course, changes may happen along the way.

Week	Lecture	Lab
1	Introduction to limits	Julia installation and hand-on experience
2	Introduction to Derivatives	Evaluating limits
3	Higher-oder derivatives, optima, and Taylor series	Evaluating differences quotients & plots
4	Application of derivatives: root-finding algorithms	Expansion convergence study
5	Introduction to integration	Algorithm implementation
6	Integral approximations, quadratures	Definite integrals as limits of sums
	Teaching break	
7	Piecewise interpolation and error convergence	Implementation of integration methods
8	Polynomial interpolation, linear systems, matrices	Study on approximation errors
9	Various algorithms for solving matrix problems	Matrix form implementations
10	Overdetermined systems and data fitting	Other matrix algorithm implementation
11	Matrix analysis, eigenpairs, decompositions	Implementation of fitting methods
12	Several methods for diferential equations	Numerical study on matrices
	Final exam	