

SM-2302: Software for Mathematicians

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Module Description

Welcome to SM-2302! In many areas of mathematics, solutions to problems cannot be calculated explicitly and require the aid of computers. This module teaches students the programming skills required to solve such problems, namely in the area of differential equations, statistics, operational research, and other such areas of applied mathematics. Lectures will focus on teaching programming skills that are efficient and numerically stable, as well as how best to visualize problems. Students will appreciate the skills learned in this module when it comes to doing mathematical research during their final year projects and beyond.

Module Contents

- Learning MATLAB and R languages for mathematical applications.
- MATLAB specific learning outcomes:
 - Basic operations
 - Programming
 - Numerical techniques
 - Root finding
- R specific learning outcomes:
 - Logic and types
 - Data frames and matrices
 - Data wrangling using packages from the `tidyverse`
 - Visualisation using `ggplot`
- Preparation of report-style documents using \LaTeX .
- Version control and social coding using Git and GitHub.

Readings

MATLAB

- Peter Issa Kattan. *Matlab for Beginners: A gentle approach*. Petra books, 2008

R

- Hadley Wickham. *Advanced R*. CRC press, 2019. URL: <https://adv-r.hadley.nz/>
- Hadley Wickham and Garrett Grolemund. *R for data science: import, tidy, transform, visualize, and model data*. O'Reilly Media, Inc., 2016. URL: <http://r4ds.had.co.nz/>

Git and GitHub

- Tobias Günther. *Learn Version Control With Git: A Step-by-step Course for the Complete Beginner*. CreateSpace Independent Publishing Platform, 2017. ISBN: 9781548942465
- Ferdinando Santacroce. *Git Essentials: Create, merge, and distribute code with Git, the most powerful and flexible versioning system available*. Packt Publishing Ltd, 2017

L^AT_EX

- Stefan Kottwitz. *LaTeX Beginner's Guide: Create visually appealing texts, articles, and books for business and science using LaTeX*. Packt Publishing Ltd, 2021
- George Grätzer. *More Math Into LaTeX*. Springer International, 2016
- <https://en.wikibooks.org/wiki/LaTeX>

Class Format

See the end of the document for the full schedule

There are two timetabled slots that are for this module:

1. Tuesday 2.10pm–4.00pm
2. Saturday 2.10pm–4.00pm

Unless otherwise specified, classes will be in-person at UTH, ICTC Lab 7. The Thursday sessions will normally be reserved for lectures, while Saturday sessions are lab-based tutorials. You are expected to attend both classes every week.

Assessment

Take note that this module is wholly (100%) by coursework.

Formative assessment

- Lab-based tutorials

Summative assessment

- **20% online quizzes:** 5% each on these topics
 - i. MATLAB (due week 4)
 - ii. Git (due week 5)
 - iii. R (due week 9)
 - iv. L^AT_EX (due week 13)
- **20% individual assignments:** Two individual assignments in the form of programming and debugging exercises. One assignment is MATLAB based (due week 6) and the other is R based (due week 11).

- **30% group assignments:** Two group assignments (one for MATLAB and one for R). Here, students work together to solve a given problem. GitHub will be used so students can experience a collaborative development environment. Assignments will be peer-reviewed and discussed in class.
- **30% final project:** For this individual final project, students will work on an interesting topic in mathematics. Topics may be selected from a suggested list, or students may propose their own topics. The goal is to produce a short written report describing the (mathematical) problem, and how a solution is obtained using software.

Class Schedule

Week	Topic	Instructor	Assessment
W01: 01/08 – 07/08	Introduction & Getting Started	NHR & HJ	
W02: 08/08 – 14/08	[MATLAB] Basic operations	NHR	
W03: 15/08 – 21/08	[MATLAB] Programming	NHR	
W04: 22/08 – 28/08	[R] Introduction to R and Rstudio	HJ	Quiz 1
	[Git] Git and GitHub	HJ	
W05: 29/08 – 04/09	[MATLAB] Numerical techniques	NHR	Quiz 2
W06: 05/09 – 11/09	[MATLAB] Root-finding	NHR	Individual 1
W07: 12/09 – 18/09	[R] Logic and types	HJ	
19/09 – 25/09	Mid-semester Break		
W08: 26/09 – 02/10	[MATLAB] Peer review / presentations	NHR	Group 1
W09: 03/10 – 09/10	[R] Matrices and data frames	HJ	Quiz 3
W10: 10/10 – 16/10	[R] The tidyverse	HJ	
W11: 17/10 – 23/10	[R] Visualisations using ggplot	HJ	Individual 2
W12: 24/10 – 30/10	[LaTeX] Typesetting reports	HJ	
W13: 31/10 – 06/11	[LaTeX] Beyond reports	NHR	Quiz 4
W14: 07/11 – 13/11	[R] Peer review	HJ	Group 2
14/11 – 20/11	Revision week		
21/11 – 27/11	Exam week		Final Report