

MATH 210 Section 20M

Introduction to Mathematical Computing

Course Outline 2023W2

Introduction to mathematical software and numerical methods. Basic Python programming including numbers, arrays, functions, vectorization and iteration. Sequences and series, root finding, numerical integration, numerical methods for differential equations, systems of linear equations, eigenvalues and mathematical graphics.

Note: MATH 210 Section 20M is coordinated with MATH 215 Section 20M. This section includes a project which combines key concepts from mathematical computing and differential equations.

Learning Goals

- Create scientific documents with [Jupyter notebook](#) using [markdown](#), [LaTeX](#) and [Python](#)
- Solve problems using mathematical software [NumPy](#), [SciPy](#) and [Matplotlib](#)
- Approximate solutions of nonlinear equations
- Approximate definite integrals and estimate error
- Approximate solutions of ordinary differential equations
- Compute solutions of linear systems of equations

Instructors

Instructor	Patrick Walls	pwalls@math.ubc.ca
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Lectures

Section 20M	Monday/Wednesday/Friday 1–2pm	LSK 121
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Learning Resources

Mathematical Python	Online textbook on mathematical computing with Python
Syzygy	Jupyter notebooks for UBC students
Canvas	All course information posted on Canvas

Assessments

Assignments	$5 \times 1\%$ each = 5%	Jupyter notebooks submitted to Canvas
Midterm Exams	$2 \times 20\%$ each = 40%	In class February 14 and March 27
Project	5%	Joint with MATH 215 Section 20M
Final Exam	50%	Exam period April 16–27

Lecture Schedule

Week	Description
1	Jupyter notebooks, markdown and LaTeX
2	Basic Python: numbers, variables and sequences
3	Basic Python: functions, logic and loops
4	Sequences and series, fixed point iteration
5	Root finding: bisection, secant and Newton's method
6	Vectorization, NumPy arrays and functions, plotting with Matplotlib
7	Numerical integration: Riemann sums, trapezoid rule, Simpson's rule, error formulas
8	Numerical methods for differential equations, accuracy and stability
9	Numerical methods for systems of differential equations
10	Solutions of linear systems of equations, eigenvalues and eigenvectors
11	Numerical methods for nonlinear equations, Newton's method, gradient descent
12	Advanced topics and review

Prerequisites/Corequisites

Integral Calculus	One of MATH 101, MATH 103, MATH 105, MATH 121, SCIE 001
Differential Equations	One of MATH 215, MATH 255, MATH 256, MATH 258
Linear Algebra	One of MATH 152, MATH 221, MATH 223
Multivariable Calculus	One of MATH 200, MATH 217, MATH 226, MATH 253, MATH 254

- See the [UBC Course Schedule](#)

Important Dates

January 8	First lecture
February 14	Midterm Exam 1
February 19–23	Reading break (no lectures)
March 27	Midterm Exam 2
March 29	Good Friday (University closed, no lecture)
April 1	Easter Monday (University closed, no lecture)
April 12	Last lecture
April 16–27	Final exam period

- See the [UBC Academic Calendar 2023/2024](#)

Student Resources

Science Advising	Health and Wellbeing	Centre for Accessibility
Academic Concession	Academic Integrity	Counselling Services

University Policies

UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence. UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. UBC provides appropriate accommodation for students with disabilities and for religious observances. UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions. Details of the policies and how to access support are available on the [UBC Senate website](#).