MATH 210 Introduction to Mathematical Computing
Course Outline 2019W1

Learning Goals

MATH 210 is an introduction to mathematical computing with Python and Jupyter. By the end of the course, students should be able to:

○ Write scientific documents in Jupyter notebooks using markdown and LaTeX including text, links, images, mathematical notation and Python code.

○ Write and execute Python code to evaluate mathematical expressions.

○ Write basic Python programs including branching with logic and iteration with loops.

○ Write Python functions based on a given design specification.

○ Import Python packages for scientific computing such as:

  ○ NumPy: arrays and vectorization
  ○ SciPy: mathematical functions and algorithms
  ○ Matplotlib: 2D plotting

○ Write Python code to implement a numerical algorithm.

○ Approximate roots and extreme values of functions by the bisection method, secant method and Newton's method.

○ Approximate definite integrals by Riemann sums, the trapezoid rule and Simpson's rule, and estimate the error.

○ Approximate derivatives of functions by finite differences and estimate the error.

○ Derive and solve linear systems of equations.

○ Compute eigenvalues and eigenvectors of a matrix.

○ Approximate solutions of first order differential equations by Euler's method.

○ Write a system of higher order differential equations as a first order system of equations.

○ Approximate solutions of first order systems of differential equations using an ODE solver such as `scipy.integrate.odeint`.

Prerequisites

One of MATH 101, MATH 103, MATH 105, MATH 121, SCIE 001

Corequisites

One of MATH 215, MATH 255, MATH 256 and one of MATH 152, MATH 221, MATH 223

Contacts

Name	Role	Email	Office
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Course Structure

Item	Time	Location
Lectures	MWF 4–5pm	IBLC 182
Lab L2A	T 3–4pm	LSK 121
Lab L2B	Th 2–3pm	LSK 121
Lab L2C	Th 9–10am	LSK 121

- **Lectures**: We write Python code in Jupyter notebooks during lectures. Students are strongly encouraged to bring a laptop (or any device with a keyboard, browser and WiFi).

- **Labs**: Every student must be registered in a lab section. Lab activities include discussions, coding and quizzes. Students must bring a laptop or tablet.

Assessments

Item	Weight	Description
Lab Activities	10%	Each lab is worth 2%. Cumulative up to 10% maximum.
Assignments	25%	In Jupyter notebooks. 5 assignments $\times$ 5%/assignment.
Midterm Exam	25%	In class, only plain scientific calculators allowed
Final Exam	40%	Exam period: 12/3–12/18. Only plain scientific calculators allowed.

Learning Materials

Item	Description
Mathematical Python	Free open source online textbook written in Jupyter notebooks
Canvas	All course information is posted on Canvas
Syzygy	Syzygy is a web application which hosts Jupyter notebooks. All UBC students have an account on ubc.syzygy.ca. Login with your CWL.
Laptops/tablets	Students are expected to create and edit Jupyter notebooks on Syzygy using their own device in labs and lectures. Laptops are available on loan from UBC Library if necessary.

Schedule of Topics

Week	Start	End	Topics
1	9/4	9/6	Jupyter notebooks, markdown and LaTeX
2	9/9	9/13	Basic Python: numbers, variables, sequences and functions
3	9/16	9/20	Basic Python: functions, logic and loops
4	9/23	9/27	Roots and optimization: bisection, secant and Newton's method
5	9/30	10/4	NumPy arrays and functions, and plotting with Matplotlib
6	10/7	10/11	Numerical integration: Riemann sums, trapezoid rule, error formulas
7	10/16	10/18	Numerical integration: Simpson's rule and error formula
8	10/21	10/25	Numerical differentiation and finite differences
9	10/28	11/1	Linear systems of equations, interpolation and linear regression
10	11/4	11/8	Eigenvalues and eigenvectors, applications to graph theory
11	11/13	11/15	Numerical methods for ordinary differential equations
12	11/18	11/22	Numerical methods for systems of ODEs
13	11/25	11/29	Review

Lab Schedule

Week	L2A	L2B & L2C	Description
1	-	-	-
2	9/10	9/12	**Lab activities (2%)**
3	9/17	9/19	Open office hours
4	9/24	9/26	**Lab activities (2%)**
5	10/1	10/3	Open office hours
6	10/8	10/10	**Lab activities (2%)**
7	10/15	10/17	Open office hours
8	10/22	10/24	Open office hours
9	10/29	10/31	**Lab activities (2%)**
10	11/5	11/7	Open office hours
11	11/12	11/14	**Lab activities (2%)**
12	11/19	11/21	Open office hours
13	11/26	11/28	**Lab activities (2%)**

Important Dates

Dates	Description
10/14	Thanksgiving Day (University closed)
10/23	Midterm exam. In class. Only plain scientific calculators allowed.
11/11	Remembrance Day (University closed)
11/29	Last day of class
12/3–12/18	Final Exam Period

Course Policies

Missed Midterm Exam

There are no make-up midterms in this course. Missing the midterm for a valid reason normally results in the weight of the midterm being transferred to the final exam. Examples of valid reasons include illness and travel to play a scheduled game for a varsity team. Examples of reasons that are not valid include conflicts with personal travel schedules or conflicts with work schedules. Any student who misses the midterm is to present to their instructor the Department of Mathematics self-declaration form for reporting a missed assessment to their instructor within 72 hours of the midterm date. This policy conforms with the UBC Vancouver Senate's Academic Concession Policy V-135 and students are advised to read this policy carefully.

Missed Final Exam

You will need to present your situation to the Dean's Office of your Faculty to be considered for a deferred exam. See the UBC Academic Calendar for detailed regulations. Your performance in a course up to the exam is taken into consideration in granting a deferred exam status (e.g. failing badly generally means you will not be granted a deferred exam). In Mathematics, generally students sit the next available exam for the course they are taking, which could be several months after the original exam was scheduled. **Note that your personal travel schedule is NOT a valid reason for missing a final exam and students who miss the MATH 210 exam for this reason will receive a grade of 0 on the exam and fail the course**.

Academic Misconduct

1. UBC takes cheating incidents very seriously. After due investigation, students found guilty of cheating on tests and examinations are usually given a final grade of 0 in the course and suspended from UBC for one year. See UBC Academic Calendar: Discipline for Academic Misconduct for more information.

2. While students are encouraged to study together, they should be aware that blatant copying of another student's work is a serious breach of academic integrity. Please discuss with your instructors their expectations for acceptable collaboration on any assigned coursework. Cases of suspected cheating will be investigated thoroughly.

3. Note that academic misconduct includes misrepresenting a medical excuse or other personal situation for the purposes of postponing an examination or quiz or otherwise obtaining an academic concession.

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.