Discrete Math & Computing with Python

William Chau

Computing Wisdom

Course Sequence Description
Prerequisites
Topic Coverage
Course Materials
Classroom Delivery Methods
Expectation of Students
Grading Policy

Course Sequence Description

- This is a four-course sequence Discrete Math & Computing with Python for gifted/high-achieving 8th-12th graders and beyond, i.e. including college students and adult learners.

- Each course in the sequence lasts for one term, which consists of 18 sessions with 2.5 hours in each session.

- Discrete Math serves as the math foundation for computing. Python is a popular, general-purpose, and user-friendly language for software programming. It makes great sense to incorporate Discrete Math, Computing, and Python together into a course sequence offering a comprehensive introduction to the world of computing.

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- This course sequence is another option besides the standard high school AP/IB courses and first year university STEM courses for students to take. Together with other upper-level courses in our *Competitive STEM* program, it builds a solid foundation for students to succeed in math competitions, top universities, and competitive careers.

- It is proof-intensive throughout, making it as an alternative math olympiad course sequence for proof-based math competitions such as the USA Mathematical Talent Search.

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Prerequisites

- A comprehensive and rigorous Algebra course sequence such as *Algebra* offered in our *Competitive STEM* program
- Little or no prior programming experience

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Topic Coverage

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   - The study of discrete structures and techniques including Logic and Proofs, Set Theory, Number Theory, Induction and Recursion, Combinatorics and Discrete Probability, Functions and Relations, Graph Theory, Trees, and Formal Languages and Grammars
   - Mathematical foundations for computing disciplines such as Computer Science, Computer Engineering, Data Science, and Information Technology

2. Computing

   - Algorithms such as searching algorithms, sorting algorithms, greedy algorithms, dynamic programming, and graph algorithms
   - Time complexity of algorithms
   - Data Structures such as lists, stacks, queues, linked lists, hash tables, trees, and graphs

3. The Python 3 Standard Library

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Course Materials

- Lecture slides and notes
- Jupyter notebooks
- [R] Kenneth H. Rosen, Discrete Mathematics and its Applications, Eight Edition, McGraw-Hill Education, 2018
- [RM] Paul Resnick and Brad Miller, Foundations of Python Programming, Runestone Interactive

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- The Python standard library will be taught through a flipped classroom approach using the interactive textbook [RM].
  - Python reading and problems sets are assigned from the textbook. Students work directly in the interactive environment integrated with the textbook.

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- Discrete math and computing topics will be taught in a traditional classroom approach through Zoom.
  - Instructions are presented in slides and notes, which based primarily on [R], but also other textbooks, articles, and videos, and are available in Google classroom.
  - Algorithms written in Python for instructions, Python assignments and their solutions, Python problem set solutions, and Python projects are available in Vocareum[1]. Students can work directly in Vocareum for Python assignments and Python projects or work locally on their computing device and then upload their completed work to Vocareum.

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[1]Vocareum is a cloud-based lab environment for programming classes.

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- This is a very demanding course sequence. Besides the 2.5 class hours per session, each course requires approximately 4-6 hours between sessions to review class materials and to complete homework assignments and Python projects.

- But at the end, after exposing to many challenging and interesting real-world mathematics, knowing many important and useful algorithms and data structures, and gaining experience in developing many fun and practical projects using Python, you will have great satisfaction what you accomplish. You would most definite want to list what you learned on your resume and your LinkedIn profile.

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- Below is a table summaries the breakdown of the different components of this course sequence.

Part	A	B	C	D
Lessons	14×2.5 h	14×2.5 h	14×2.5 h	14×2.5 h
Written problem sets	13	14	14	14
Python reading sets	12	8	N/A	N/A
Python problem sets	12	8	N/A	N/A
Python assignments	N/A	TBD	TBD	TBD
Python projects	2	2	2	2
Review sessions	2×2.5 h	2×2.5 h	2×2.5 h	2×2.5 h
Exams	2×2.5-3 h	2×2.5-3 h	2×2.5-3 h	2×2.5-3 h

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Each course has 2 marking periods for a total of 8 in the course sequence. Below is the grading policy per marking period:

- Homework assignments: 40%
    - Written assignments:
        - One assignment with the lowest grade will be dropped
    - Python assignments (assignments for Python reading & problem sets and other assignments):
        - One assignment with the lowest grade will be dropped
- Python Projects: 30%
- Exams: 30%