BT 3051 — Data Structures and Algorithms for Biology
Jul–Nov 2024
Course Plan

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Lectures

Lectures:	**G Slot**, Thursdays (09:00), Fridays (10:00)
Labs:	**T Slot**, Fridays (14:00)*
Tutorial:	**G Slot**, need-based, on Mondays (13:00)
Venue:	**CRC 102**
E-mail:	–
Office:	–
Office hours:	–
TAs:	Shradha, Srikrishnan, Madhuvanti, Keshav Krishna

Objectives

- Introduce you to basic algorithms (methods for problem solving)
- Introduce elementary data structures (methods for storing information)
- Study algorithms and data structures of particular importance in biology
- Improve your programming skills (learn good programming practices)

At the end of the course, it is expected that you will

- have a good understanding of basic algorithms/data structures
- understand and apply general computational techniques such as dynamic programming/randomisation/…
- be able to understand and use standard libraries to solve biological problems
- be able to develop algorithms and data structures to solve biological problems
- … and write and test correct and readable programs!
- inculcate professionalism

Course contents

1. Introduction + Basics of Python/Programming
2. Introduction to Algorithms and Data Structures
3. Sorting algorithms, Dynamic Programming
4. String algorithms
5. Graph algorithms

6. Random numbers, sampling
7. Direct search algorithms / Evolutionary algorithms

Pre-requisites

There are no formal pre-requisites for the course, other than a keen interest in programming, problem-solving (and biology)!

Coursework and grading

- Attendance to the lectures is required; *late-comers will be marked absent*
- You must bring your laptops to the lab; you will not be allowed to attend the lab without a laptop
- Weightage (minor changes may happen):

  - Quizzes I/II/Pop: 30%
  - Homework: 30%
  - End-semester exam: 40%

- Some homework may be assigned in pairs
- Class participation (incl. on Piazza online) will also carry weightage ($\approx$bonus)
- Grading will be absolute

For every hour spent in class, I expect you to spend at the least <u>3 hours outside of class</u> on reading relevant and additional material/programming to understand the concepts. I also expect you to inculcate professionalism and maintain the highest level of integrity.

Important Dates

Date	Day	Time	Event
09-Aug-24	Fri	17:00	**Assignment 1 posted**
16-Aug-24	Fri	17:00	**Assignment 1 due**
16-Aug-24	Fri	17:00	**Assignment 2 posted**
23-Aug-24	Fri	08:00	**Quiz I**
06-Sep-24	Fri	17:00	**Assignment 2 due**
06-Sep-24	Fri	17:00	**Assignment 3 posted**; **Assignment 1 grades posted by TAs**
13-Sep-24	Fri	17:00	**Assignment 3 due**
13-Sep-24	Fri	17:00	**Assignment 4 posted**; **Assignment 2 grades posted by TAs**; **Mid-term course feedback**
20-Sep-24	Fri	17:00	**Assignment 4 due**
20-Sep-24	Fri	17:00	**Assignment 5 posted**; **Assignment 3 grades posted by TAs**
04-Oct-24	Fri	08:00	**Quiz II**
11-Oct-24	Fri	17:00	**Assignment 5 due**
11-Oct-24	Fri	17:00	**Assignment 6 posted**; **Assignment 4 grades posted by TAs**
25-Oct-24	Fri	17:00	**TCF / Final course feedback**
01-Nov-24	Fri	17:00	**Assignment 6 due**
01-Nov-24	Fri	17:00	**Assignment 5 grades posted by TAs**
08-Nov-24	Fri	17:00	**Assignment 6 grades posted by TAs**
12-Nov-24	Tue	09:30	**End Semester Examination**

Exams

The exams will be as per Institute timetable, as indicated above.

Homework

There will be 6 assignments during the course. They will mostly involve programming in Python. Credit will be given for correctness, and importantly, also for coding style, comments, test cases, readability. Please have a look at this page (from Cosma Shalizi's blog), on minimal advice to under-graduates on programming: http://cscs.umich.edu/~crshalizi/weblog/593.html.

All homework will be due at 5 pm on the day mentioned in the problem handout, via a Dropbox upload at http://tinyurl.com/bt3051-submit. Late submissions will incur penalties as follows:

- 1 second – 24 h: 20%
- 24–48 h: 40%
- > 48h: 60%

Academic integrity

While you can take help from your colleagues on homework, *copying* is not permitted. Copying from anywhere, including the Web is not allowed. Offenders will be penalised letter grades. For example, you can ask your friends for hints if you are stuck, but at no point should you take a look at their code itself. I would much rather that you come to me if you are stuck. Note that I take copying extremely seriously, and will not show any mercy (ask your seniors!). Many students have failed this course in the past owing to copying of assignments.

The Institute guidelines (which I consider lenient) may be found here: http://academic.iitm.ac.in/sites/default/files/Graded_punishments.pdf. You must not carry your mobile phone/e-book reader to the exam desk, even if they have been switched off.

Feedback

Any suggestions for improvement are welcome at any time. A mid-term feedback will happen before 15th September. The final feedback will happen before 31st October.

Reading

There are many nice books on algorithms, but none ideally suited to our course, to discuss biologically relevant algorithms. Some of the books below are excellent:

Books

- Gries P, Campbell J, and Montojo J (2013) *Practical Programming: An Introduction to Computer Science Using Python 3 (Pragmatic Programmers)*. Pragmatic Bookshelf, third edition/e. ISBN 9789351104698
- Goodrich MT, Tamassia R, and Goldwasser MH (2013) *Data Structures and Algorithms in Python*. Wiley, 1/e. ISBN 1118290275
- Compeau P and Pevzner P (2014) *Bioinformatics Algorithms: An Active Learning Approach*. Active Learning Publishers, 1st/e. ISBN 0990374602

- Guttag JV (2013) *Introduction to Computation and Programming Using Python.* The MIT Press, revised and expanded edition/e. ISBN 0262525003

- Skiena SS (2010) *The Algorithm Design Manual.* Springer, softcover reprint of hardcover 2nd ed. 2008/e. ISBN 1849967202

- Cormen TH (2010) *Introduction to algorithms.* PHI Learning. ISBN 9788120340077

- Sedgewick R, Wayne K, and Dondero R (2015) *Introduction to Programming in Python: An Interdisciplinary Approach.* Addison-Wesley Professional, 1/e. ISBN 0134076435

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