BIOL 3V00.501 Topics in Biological Sciences: Introduction to Programming for Biological Sciences

Fall 2016

Classroom FO 2.404, TR 5:30pm-6:45am

Instructor Dr. Faruck Morcos — Office BSB 12.601

email: faruckm@utdallas.edu — Office hours: Friday's 4-5pm

Department of Biological Sciences — TA: Xianli Jiang

University of Texas at Dallas — **TA's email**: xianli.jiang@utdallas.edu

Pre-requisites

BIOL 2281: Introductory Biology Laboratory, BIOL 2311: Introduction to Modern Biology I and BIOL 2312: Introduction to Modern Biology II.

Course Description

This course is an introduction to programming practices using C++ designed specifically for students in the biological sciences. Special emphasis will be put in particular features of C++ like object oriented programming, some data structures as well as applications to process, model and analyze biological data. One goal of this course is to provide a strong background on programming skills on a basic level while leaving more advanced techniques of software development and algorithms for other advanced courses. This course also covers an introduction to data analysis with R, a statistical platform used widely in the biological sciences community.

Outcomes

Students will be able to:

1. Be proficient with programming platforms and environments like Unix/Linux and C++ compilers as well as statistical platforms like R.
2. Identify and use the most important structures needed to develop basic programs. These structures include data types, iterations and control structures.
3. Write programs and algorithms that analyze biological data like nucleotide and amino acid sequence data, expression data and molecular interaction datasets.
4. Build programs to model biological processes using the principles of object oriented programming.
5. Write efficient scripts that can be used to analyze and visualize the large amounts of genomic and molecular data deposited in local and public databases.

Textbook and references

- Deitel & Deitel. *C++ How to Program.* Prentice Hall, 7th Edition, 2010.
- Beckerman & Petchey. Getting started with R: An introduction for Biologists. Oxford University Press. 2012
- Neil Jones & Pavel Pevzner. An introduction to bioinformatics algorithms. MIT Press. 2004. (**reference**)

Class Schedule

Aug. 23: Tue	Computation and Life Sciences
Aug. 25: Th	Linux and data types
Aug. 30: Tue	Control structures
Sept. 1: Th	Control structures & Loops
Sept. 6: Tue	Iterations
Sept. 8: Th	Biological examples: interactive lecture
Sept. 13: Tue	Functions and IDE's
Sept. 15: Th	Parameters & Inline functions
Sept. 20: Tue	Templates & Header files
Sept. 22: Th	Recursion
Sept. 27: Tue	Enumerations & Arrays
Sept. 29: Th	Strings and multidimensional arrays used in Biosciences
Oct. 4: Tue	Recursive functions
Oct. 6: Th	C++ Strings and Input/output
Oct. 11: Tue	Text Interfaces
Oct. 13: Th	Biological simulation
Oct. 18: Tue	Data structures
Oct. 20: Th	Midterm
Oct. 25: Tue	Midterm solutions / Data structures examples in Biology
Oct. 27: Th	Data structures examples in Biology (cont.)
Nov. 1: Tue	In-class exercise: using vectors in sequence analysis
Nov. 3: Th	Standard Template Library
Nov. 8: Tue	Introduction to Classes
Nov. 10: Th	In-class exercise
Nov. 15: Tue	Biomolecule Molecule Class
Nov. 17: Th	Introduction to **R**
Nov. 22: Tue	Analysis of Biological Data with R
Nov. 24: Th	*Thanks giving break*
Nov. 29: Tue	Expression Data and other biological databases
Dec. 1: Th	Scripting with R: in-class exercise
Dec. 6: Tue	A glimpse of Bioinformatics Algorithms
Final Exam	**Date:** TBD, **Time:** TBD , **Place:** TBD

Course Policies

Grading

The grade is composed by a weighted average of the grades in midterm exam (15 %), in-class participation (5 %), a final exam (30 %), homework assignments (50 %).

Homeworks

Programming homeworks will be assigned to be handed in on Fridays. Homework guidelines will be posted on eLearning in a separate hand out.

Collaboration Policy

Collaboration during homeworks and study sessions is highly recommended. Exchange of ideas is part of the learning process and programming is not an exception. However, **there should be a clear line between a healthy collaboration and unethical practices**. Homework problems can be discussed, debugging strategies can be shared as well as general ideas that could improve understanding of a topic or homework. **Writing code must be an individual task** and every submission should be easily reproducible by its author. **Copying code**, from another student or the internet, is against the collaboration policy. *Changing the name of variables* is **not** writing your own code :-). Groups of 2 students can be formed to officially collaborate in assignments, you must put the name of the person in your team in every submission.

Exams

There will be **two exams**, a **midterm** exam and a **final** exam. Exams will have a combination of theory questions and programming problems. Given the nature of the material discussed in class, the final exam will be accumulative and will cover all the topics taught during the semester with an emphasis on the second part of the course.

Attendance and Participation

Lecture **attendance** is an important part of your learning experience. Attending a lecture should be seen as a resource rather than an obligation. Attendance will not be strictly enforced but rather encouraged to improve the exchange of ideas, solve questions and clarify concepts. **Participation**, on the other hand, enriches the class experience and interactivity greatly improves learning connections. Participation also sets the pace of the lecture, an important feature to avoid falling asleep! Attendance, participation as well as in class exercises or quizzes contribute to the final grade.

Academic Honesty

Students are expected to follow the rules and guidelines of academic honesty established by the University of Texas. Basically, be honest about your contributions to homeworks, work on your own during exams and spend enough time reading and trying to understand class materials. This creed was voted on by the UT Dallas student body in 2014. It is a standard that Comets choose to live by and encourage others to do the same:

"As a Comet, I pledge honesty, integrity, and service in all that I do"

Note: The descriptions and timelines contained in this syllabus are subject to change at the discretion of the Professor.