

Problem Solving with Bioinformatics Tools

(CS 490/590 and PBIO 313/693)

Tuesday and Thursday, 9:10am to 11:00am

Stocker 107

CS 490 Call No.: 06333

CS 590 Call No.: 06334

PBIO 313 Call No.: 06623

PBIO 693 Call No.: 06624

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I. Introduction

Computation has become integral and critical to research in the life sciences. Biotechnology researchers produce vast quantities of data that require detailed analysis. In addition, numerous biological data repositories offer an overwhelming amount of information. This course will provide an opportunity to learn about bioinformatics software tools that enable the efficient analysis of biological data. Students will acquire important skills that (1) are required by employers in the growing field of biotechnology, and (2) are necessary for successful research in the life sciences.

The course will provide a unique learning environment. It will bring together students from the life sciences, computer science, engineering, mathematics, and other related fields. It will offer perspectives from faculty in the fields of biology and computer science. Classroom activities will focus on employing state-of-the-art bioinformatics tools to collaboratively solve a set of biological research problems.

II. Course Organization

[Students will](#) become familiar with the capabilities of popular bioinformatics tools, and with the kind of information contained in popular biological databases. Participants will also gain insight into how bioinformatics tools and biological databases are used in multidisciplinary biological research and experimentation processes.

Major units of the course:

- Week 1. Introduction to bioinformatics as a discipline and problem based learning, introduction to the genomic age. Begin Project 1.
- Week 2-3. Continue Project 1 – Students are given the sequence of a gene identified by mutant analysis and asked to analyze it. This project covers the basics of gene expression, the most commonly used computer software/analyses routinely used by biologists and databases available.
- Weeks 3-4. Project 2 – Students will be give several members of a protein family and asked to search the databases for additional members. The biological topics include functional significance of protein structure.
- Weeks 4-5. Project 3 – Students are provided the data from an expression profiling experiment (microarray exp.) and asked to analyze it. This project will focus on the aspects of microarray experiments, both biological and analytical including global gene expression, biological pathways and processes and statistical analysis of the expression data.
- Weeks 6-7. Project 4 - Analysis of regulation of gene expression by transcription factors. These projects include the search for cis elements and analysis of

chromosome immunoprecipitation (ChIP) experiments. Major biology topics covered are the regulation of gene expression by transcription factors and expression modules.

Weeks 8-9. Project 5 – The last project of the course will revolve around proteomics and will include analysis of two dimensional gels, sequence analysis and identification of protein, post translational modification and functional significance.

Week 10. Summary/ discussion of projects and presentations. Discussion of other uses of bioinformatics.

Week 11. Finals week. Wednesday, June 7, 8:00 am, Final oral presentations and discussions.

Instructional strategies:

Problem-based learning will be employed throughout the course. That is, students will be given problems to solve. In the classroom, they will work in teams to identify the learning issues that must be resolved in order to solve specific problems, to resolve the learning issues, and to apply their new knowledge to solve the problems.

Recommended textbook:

The following textbook will be useful as a reference, but is not required for the course.

Bioinformatics: Sequence and Genome Analysis, by David W. Mount, second edition, Cold Spring Harbor Laboratory Press, 2004.

III. Assignments¹

In-Class Activities

The course material will be learned through problem-solving activities and other learning activities that will take place in the classroom. Many of the activities will be performed in teams, while other activities may be performed individually. Some activities will require preparation in advance. **Individual grades for in-class activities will be based on each student's *presence, participation, and preparation*** and based on self, peer and instructor evaluation according to criteria on the attached evaluation sheet.

¹Copies of student work may be included in the Teaching Portfolios of Dr. Welch and Dr. Wyatt. Teaching Portfolios are viewed by other faculty for the purpose of assessing the teaching methods. If you do not wish to have your work included in the portfolio, please notify Dr. Welch and Dr. Wyatt.

Problem Solutions

A detailed understanding of the course concepts will be acquired by solving problems. Most problem solving activities will be performed with a team, but some may be performed individually. Each student will record details of problem solving efforts in a *course notebook*. Results from problem solving efforts of each team will be *presented in class*. Additionally, each student will submit a *written report* for each project. Grades for the problem solutions will be based upon their correctness, completeness, and effectiveness.

The **course notebook** should contain everything you do for this class: project, learning issues, references for all information obtained, your strategy, all web sites, programs, information, and solutions. All data and information presented in the oral or written reports should be validated by material in your notebook. If it is not in your notebook, it will be assumed that you didn't do it. Entries should be made and dated as they occur, and enough care should be taken with the entries so that a colleague could repeat your work if given your notebook.

Oral Reports will be presented and will be graded for each team. The presentation style is up to each individual team. Presentations may be powerpoint shows, chalk talks or done on overheads either by a single or multiple member(s) of the team. However, over the course of the entire quarter, there must be equal participation in the presentations by all members of each team. Ten minutes has been assigned for each oral presentation, with 10 additional minutes allowed for questions. Questions may be directed to any member of the group, whether they are presenting or not. All members of the group are responsible for the oral presentations and will share the grade. The oral report should include the problem presented, the learning issues identified, the approach taken to solve the problem, and the final results in a clear, organized manner.

Written Reports for the projects are to be done individually. Each report should include an introduction, the problem description, the methods used to solve the problem, and the results in a clear, organized manner.

IV. Basis for Evaluation

Grading in the course will be based on performance in the activities listed below. The weight of each activity is shown in parentheses.

- in-class activities (30%)
- course notebook (20%)
- problem solutions:
 - team oral presentation (20%)
 - individual written report (30%)

Letter grades will be assigned as follows:

- A**: demonstrated breadth and depth of understanding of major concepts covered in the course, and performance in required activities was excellent.
- B**: demonstrated breadth and depth of understanding of major concepts covered in the course, and performance in required activities was good.
- C**: did not demonstrate breadth and depth of understanding of major concepts covered in the course, *or* performance in required activities was fair.
- D**: did not demonstrate breadth and depth of understanding of major concepts covered in the course, *and* performance in required activities was fair.
 - E**: did not demonstrate breadth and depth of understanding of major concepts covered in the course, *and* performance in required activities was poor.

Attendance and Makeup Policies: ***Participation in all class sessions is mandatory.*** Each class session will involve activities in which students will learn the course material. Some of the in-class activities will be graded. Makeup activities and project deadline extensions will not be granted, except for legitimate reasons (see student handbook for details).

Academic Misconduct: Individuals performing plagiarism, copying and other forms of academic misconduct (see student handbook for further details) will receive an 'F' in the course and referral to Ohio University Judiciaries.