Purdue University  
Department of Biochemistry  
BCHM 495  
R for Molecular Biosciences  
Syllabus  
Fall 2018

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Hours: After class, on Piazza or by appointment.

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Hours: After class, on Piazza or by appointment.

COURSE OBJECTIVES

Students will acquire, clean, explore and analyze biological data sets with R. Lectures and example data sets will show the link between data and complex biological phenomena through human observation or instrumentation. Students will learn how to organize data sets to optimize clarity and analytic possibilities while minimizing errors with examples drawn from the literature or biological databases. R programming will be taught starting with small-scale data such as drug sensitivity assays, qPCR, and metabolomics, moving to genome-scale analyses such as gene expression and pathway analysis later in the course. These skills will be taught in the light of enabling reproducible research through clear documentation of data sets and analyses. Relevant concepts from statistics will be reviewed, but it is assumed that students are familiar with basic statistical analyses.

LEARNING OUTCOMES

- Explain how complex biological phenomena are captured as data.
- Organize data sets by observations and variables using appropriate data types.
- Acquire, clean, and manipulate data sets and files programmatically.
- Develop data analysis workflows in R with clear documentation.
- Use R to manipulate and analyze DNA sequences.
- Use R to perform gene expression and pathway analysis.

TEXTBOOKS

We will use three textbooks that are available for free online. You may also use online forums such as StackOverflow to search for solutions. However, read the forum rules carefully before you post questions! R is very popular, so a well-crafted Google search will often reveal multiple solutions for your problems.
TIME AND PLACE

<table>
<thead>
<tr>
<th>Session</th>
<th>Day</th>
<th>Time</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture-Lab</td>
<td>T</td>
<td>10:30 - 11:45</td>
<td>SC 277</td>
</tr>
<tr>
<td>Lecture-Lab</td>
<td>R</td>
<td>10:30 - 11:45</td>
<td>BRNG B286</td>
</tr>
</tbody>
</table>

PIAZZA COURSE FORUM

I have created a Piazza Forum for this class. Many course materials will be distributed through this site. In addition, you can post questions for the instructor, teaching assistants and fellow students on this forum. All posts can be made anonymously, so there is no reason to be shy. I strongly encourage students to seek help here, and I strongly encourage students to answer questions. If a post was helpful, please take a moment to post a follow-up that indicates that the post was helpful. You can also click good note to provide feedback metrics.

While the posts are anonymous, I can track student usage of the forum on Piazza, so I know who is reading posts, asking questions and/or answering questions. You Piazza statistics will factor into your course participation so take advantage of this resource!

ASSESSMENT

Assessment will be achieved with regular quizzes and exercises, a midterm exam and four projects. The final grade will be determined with the following weighting:

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Grading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quizzes and exercises</td>
<td>20%</td>
</tr>
<tr>
<td>Midterm exam</td>
<td>20%</td>
</tr>
<tr>
<td>Group project 1</td>
<td>10%</td>
</tr>
<tr>
<td>Group project 2</td>
<td>15%</td>
</tr>
<tr>
<td>Group project 3</td>
<td>15%</td>
</tr>
<tr>
<td>Final: Group project 4 and presentation</td>
<td>20%</td>
</tr>
<tr>
<td>Class participation and attendance</td>
<td>0, 2 or 4 bonus points</td>
</tr>
<tr>
<td>Coding Notebook</td>
<td>required but grading optional</td>
</tr>
</tbody>
</table>

Quizzes and exercises will be graded on a scale 0 - 10 with point values clearly indicated. The midterm will have point values for each question listed. Every effort will be made to give students appropriate partial credit. Group projects will be graded with a rubric that will be distributed with the assignment. The Coding Notebook is a required assignment that you will turn in at the end of the semester, but grading is optional. If you choose to
have the Coding Notebook graded, you can substitute that grade for your Midterm exam grade.

Requests for re-grades must be submitted no later than the end of the second class period after the graded test or assignment has been returned.

Perfect attendance is required for 4 bonus points, but one absence is allowed for 2 bonus points. This might seem like a minor reward, but perfect attendance can easily change your letter grade, e.g. 88% (B+) + 4% = 92% (A). Prearranged, excused absences may be allowed at the discretion of the instructor. Requests for excused absences can be discussed with the instructor, but requests must be emailed to, and confirmed by, the instructor. In either case, active participation in class discussions or on the Piazza forum is expected.

**GRADING SCALE**

<table>
<thead>
<tr>
<th>Score</th>
<th>Grade</th>
<th>Score</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>98.00 and above</td>
<td>A+</td>
<td>78.00 to 79.99</td>
<td>C+</td>
</tr>
<tr>
<td>92.00 to 97.99</td>
<td>A</td>
<td>72.00 to 77.99</td>
<td>C</td>
</tr>
<tr>
<td>90.00 to 91.99</td>
<td>A-</td>
<td>70.00 to 71.99</td>
<td>C-</td>
</tr>
<tr>
<td>88.00 to 89.99</td>
<td>B+</td>
<td>68.00 to 69.99</td>
<td>D+</td>
</tr>
<tr>
<td>82.00 to 87.99</td>
<td>B</td>
<td>62.00 to 67.99</td>
<td>D</td>
</tr>
<tr>
<td>80.00 to 81.99</td>
<td>B-</td>
<td>60.00 to 61.99</td>
<td>D-</td>
</tr>
<tr>
<td>59.99 and Below</td>
<td></td>
<td></td>
<td>F</td>
</tr>
</tbody>
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**EXTRA CREDIT**

Class attendance is the only way to achieve extra credit. No exceptions will be made.

**COURSE MANAGEMENT SYSTEM**

We will not use Blackboard for this course. I will distribute course materials through Piazza, or in some cases, Data Depot.

**OBTAINING EXTRA HELP**

Professor Pascuzzi will be available to answer your questions immediately after class, on Piazza, or by appointment (arranged by e-mail). The teaching assistant will be available via Piazza or by appointment. If you are struggling, get help!

**ACADEMIC MISCONDUCT**

Academic misconduct of any kind will not be tolerated in any course offered by the Department of Biochemistry. For specifics, please refer to Purdue’s Regulations Governing Student Conduct.

Any incidence of academic misconduct will be reported to the Office of the Dean of Students. Academic misconduct may result in disciplinary sanctions including expulsion,
suspension, probated suspension, disciplinary probation, and/or educational sanctions. In addition, such misconduct will result in punitive grading such as:

- receiving a lower or failing grade on the assignment, or
- assessing a lower or failing grade for the course

Punitive grading decisions will be made after consultation with the Office of the Dean of Students. Please note reported incidences of academic misconduct go on record for reference by other instructors. Further, a record of academic misconduct is likely to influence how current/future situations are handled.

To provide you with an unambiguous definition of academic misconduct, the following text has been excerpted from “Academic Integrity: A Guide for Students”, written by Stephen Akers, Ph.D., Executive Associate Dean of Students (1995, Revised 1999, 2003), and published by the Office of the Dean of Students in cooperation with Purdue Student Government, Schleman Hall of Student Services, Room 207, 475 Stadium Mall Drive West Lafayette, IN 47907-2050.

Purdue prohibits “dishonesty in connection with any University activity. Cheating, plagiarism, or knowingly furnishing false information to the University are examples of dishonesty.” [Part 5, Section III-B-2-a, Student Regulations] Furthermore, the University Senate has stipulated that “the commitment of acts of cheating, lying, and deceit in any of their diverse forms (such as the use of substitutes for taking examinations, the use of illegal cribs, plagiarism, and copying during examinations) is dishonest and must not be tolerated. Moreover, knowingly to aid and abet, directly or indirectly, other parties in committing dishonest acts is in itself dishonest.” [University Senate Document 72-18, December 15, 1972]

More specifically, the following are a few examples of academic dishonesty which have been discovered at Purdue University.

- substituting on an exam for another student
- substituting in a course for another student
- paying someone else to write a paper and submitting it as one’s own work
- giving or receiving answers by use of signals during an exam
- copying with or without the other person’s knowledge during an exam
- doing class assignments for someone else
- plagiarizing published material, class assignments, or lab reports
- turning in a paper that has been purchased from a commercial research firm or obtained from the internet
- padding items of a bibliography
- obtaining an unauthorized copy of a test in advance of its scheduled administration
- using unauthorized notes during an exam
- collaborating with other students on assignments when it is not allowed
- obtaining a test from the exam site, completing and submitting it later
- altering answers on a scored test and submitting it for a regrade
• accessing and altering grade records
• stealing class assignments from other students and submitting them as one’s own
• fabricating data
• destroying or stealing the work of other students

Plagiarism is a special kind of academic dishonesty in which one person steals another person’s ideas or words and falsely presents them as the plagiarist’s own product. This is most likely to occur in the following ways:

• using the exact language of someone else without the use of quotation marks and without giving proper credit to the author
• presenting the sequence of ideas or arranging the material of someone else even though such is expressed in one’s own words, without giving appropriate acknowledgment
• submitting a document written by someone else but representing it as one’s own

CLASS ATTENDANCE

In accordance with University policy, you are expected to attend every scheduled class. If you have a valid reason for missing class such as a University-sponsored activity, religious observances, illness, or family emergency, the instructor or TA will assist you in obtaining information and materials you may have missed. Students who skip class without a valid excuse should not expect the instructor or TA to supply class notes or provide special help. For more information see the Purdue Regulations Governing Classes and the Class Absence page from the Office of the Dean of Students.

EMERGENCY PREPAREDNESS

In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances. To get information about changes in this course consult the class PURR site or e-mail or phone the instructor.

ON-LINE COURSE EVALUATIONS

During the last two weeks of the semester, you will be provided an opportunity to evaluate this course and your instructor(s). To this end, Purdue has transitioned to online course evaluations. On Monday of the fifteenth week of classes, you will receive an official email from evaluation administrators with a link to the online evaluation site. You will have two weeks to complete this evaluation. Your participation in this evaluation is an integral part of this course. Your feedback is vital to improving education at Purdue University. I strongly urge you to participate in the evaluation system.

NON-DISCRIMINATION POLICY STATEMENT

Purdue University's non-discrimination policy will be upheld in this classroom. Purdue University is committed to maintaining a community which recognizes and values the
inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life.

Purdue University views, evaluates, and treats all persons in any University related activity or circumstance in which they may be involved, solely as individuals on the basis of their own personal abilities, qualifications, and other relevant characteristics.

In this course, each voice in the classroom has something of value to contribute. Please take care to respect the different experiences, beliefs and values expressed by students and staff involved in this course. We support Purdue’s commitment to diversity, and welcome individuals of all ages, backgrounds, citizenships, disability, sex, education, ethnicities, family statuses, genders, gender identities, geographical locations, languages, military experience, political views, races, religions, sexual orientations, socioeconomic statuses, and work experiences.

For more information, see [http://www.purdue.edu/purdue/ea_eou_statement.html](http://www.purdue.edu/purdue/ea_eou_statement.html)

**MENTAL HEALTH**

Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of support, services are available. For help, such individuals should contact Counseling and Psychological Services (CAPS) at (765)494-6995 or [http://www.purdue.edu/caps/](http://www.purdue.edu/caps/) after hours, on weekends and holidays, or by going to the CAPS office of the second floor of the Purdue University Student Health Center (PUSH) during business hours.

**ACCESSIBILITY AND ACCOMMODATIONS**

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: drc@purdue.edu or by phone: 765-494-1247.

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**CLASS SCHEDULE (subject to change)**

**Week 01**

- Course overview and logistics
- Principles of data science: planning, collecting, analyzing and publishing
- Skills: Logging on to Scholar, Linux basics, Navigating RStudio, Writing documents in Rmarkdown, R basics
Week 2

- Sources of biological data: sequences, structures, enzymatic assays, phenotypes, etc.
- Database: National Center for Biotechnology Information
- Skills: R data structures and data types

Week 3

- Acquiring and reusing published biological data
- Skills: Data transformation and data summaries
- Project 1
  - Cancer cell drug sensitivity
  - CellMiner database
- Example data set: Drug resistance in cancer

Week 4

- Data exploration and visualization
- Tools: R
- Project 1 group work
- Database: SGD, FlyBase, WormBase, etc.

Week 5

- Data manipulation and conversion
- Project 1 due
- Example data set: student selected

Week 6

- R programming
- Tools: R
- Database: Ensembl
- Project 2 assigned

Week 7

- Unsupervised clustering
- Tools: R
- Example data set: student selected
- Project 2 group work

Week 8 (Fall Break)

- Data visualization
- Tools: R
- Database: Gene Ontology Consortium
- Project 2 group work
Week 9
- Data acquisition and reuse
- Tools: R
- Example data set: student selected
- Midterm Exam
- Project 2 group work

Week 10
- Biological sequence data
- Tools: R and Bioconductor
- Database: UCSC Genome Browser
- Project 2 due

Week 11
- Biological annotation data
- Tools: R and Bioconductor
- Example data set: student selected
- Project 3 assigned

Week 12
- High performance computing
- Project 3 group work
- Tools: Unix and R
- Database: cBioPortal

Week 13
- High performance computing
- Tools: Unix and R
- Example data set: student selected
- Project 3 due

Week 14 (Thanksgiving)
- Pathway annotation
- Tools: R
- Database: Reactome
- Project 4 assigned

Week 15
- Additional requested topics
- Project 4 group work
Week 16
- Additional requested topics
- Project 4 group work

Finals
- Project 4 presentations

DISCLAIMER
This syllabus is subject to change.