BIOC-6237 Proteomics (BIOC_6237)

2 Credits, Tuesday, 4:00 - 6:00 PM
1st class: Jan 12th.
Location: Online
Office hours: 3:30-4:00PM Tues (please email to schedule)

Course Directors:
Raja Mazumder, PhD, mazumder@gwu.edu
Jonathon Keeney, PhD, keeneyjg@gwu.edu

TA: Nikhita Gogate, nikigogate@gwmail.gwu.edu

Academic Preparation for Learning: Two – Credit Hour Course. According to the Middle States Commission on Higher Education (MSCHE), students enrolled in a three-credit hour course are expected to engage in a minimum of 75 hours of learning during the period of the course. These hours may include the following: attendance and participation, readings and reflections, working with peers and completing all required assignments for the course.

Academic Integrity: Students are expected to conduct themselves with high ethical standards and comply with the GW’s “Code of Academic Integrity” (see http://www.gwu.edu/~ntegrity/about.html)

Disability: If you have a disability that will require accommodations in this class, register with GW’s Disability Support Services (see https://disabilitysupport.gwu.edu/) and inform the professor. Please allow a reasonable length of time for the necessary accommodations to be arranged.

Course Description:
This course will introduce students to application of proteome and proteomics concepts and methods through the use of databases and tools, covering proteomic technologies, proteomes relation to transcriptomics and deep-sequencing, comparative proteome analysis, pathway analysis, structural bioinformatics, structural genomics, biomarker discovery, homology modeling and systems biology. The course will include lectures, demonstrations, and practice sessions in the computer laboratory. Several lectures are followed by hands-on tutorials and some also with take-home assignments.

Course Objectives:
By the end of the course, students will be able to
- understand current proteome and proteomic data
- identify which tools and/or resources to use to perform proteome/proteomic analysis (including comparative proteome analysis);
- perform basic protein structure analysis
- perform basic systems level analysis of proteomic data
Grading:
Grades for the course will be based on take-home assignments and an exam and/or term project:
Assignments/quiz (25%), midterm exam (35%), term project (35%), class participation and attendance (5%)

<table>
<thead>
<tr>
<th>Score Range</th>
<th>Grade</th>
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<tbody>
<tr>
<td>100-94</td>
<td>A</td>
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<tr>
<td>93-90</td>
<td>A-</td>
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<td>89-86</td>
<td>B+</td>
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<td>85-80</td>
<td>B</td>
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<td>79-75</td>
<td>B-</td>
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<td>74-70</td>
<td>C</td>
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<td>69-60</td>
<td>D</td>
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<td>59-below</td>
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Expected background: Students should have general knowledge of how to use a computer, common software such as Microsoft Office, and a web browser. One bioinformatics or computer science-related course would be useful but not essential.

Use of computers: Computer workstations are provided; bring your own wireless enabled laptop. The GU Blackboard system will be used.
Course Syllabus (there will be homework/quiz for every lecture)

<table>
<thead>
<tr>
<th>Lecture</th>
<th>Date</th>
<th>Topics</th>
<th>Lecturer</th>
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<tbody>
<tr>
<td>1</td>
<td>12-Jan</td>
<td>Genomics and Proteomics</td>
<td>Raja Mazumder</td>
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<tr>
<td>2</td>
<td>19-Jan</td>
<td>Proteomics of protein modifications (data in GlyGen). <strong>Mid-term discussions.</strong></td>
<td>Raja Mazumder</td>
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<tr>
<td>3</td>
<td>26-Jan</td>
<td>Command line tools</td>
<td>Raja Mazumder</td>
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<tr>
<td>4</td>
<td>02-Feb</td>
<td>Neuroproteomics and biomarkers</td>
<td>Jonathon Keeney</td>
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<tr>
<td>5</td>
<td>09-Feb</td>
<td>Homology modeling</td>
<td>Brian Fochtman and Jonathon Keeney</td>
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<tr>
<td>6</td>
<td>16-Feb</td>
<td>Mass-spec techniques and analysis I (HIVE glycoproteomics tools)</td>
<td>Jonathon Keeney</td>
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<tr>
<td>7</td>
<td>23-Feb</td>
<td>Mass-spec techniques and analysis II (HIVE glycoproteomics tools)</td>
<td>Jonathon Keeney</td>
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<tr>
<td>8</td>
<td>02-March</td>
<td>Clinical proteomics and biomarkers</td>
<td>Harry Burke</td>
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<tr>
<td>9</td>
<td>09-March</td>
<td>Mass-spec for proteomics</td>
<td>Aswini Panigrahi</td>
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<td>-</td>
<td>16-March</td>
<td>Spring Break</td>
<td>Raja Mazumder</td>
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<tr>
<td>10</td>
<td>23-March</td>
<td>Proteome evolution and comparative proteomics. Proteomics and Systems Biology. <strong>Mid-term due.</strong></td>
<td>Raja Mazumder</td>
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<tr>
<td>11</td>
<td>30-March</td>
<td>Image analysis. Proteomics of protein-protein interactions (interactome) (data in OncoMX).</td>
<td>Raja Mazumder</td>
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<tr>
<td>12</td>
<td>06-April</td>
<td>Protein structural analysis I (Structure-guided alignments (Cn3D); Structure-guided evolutionary analysis (CDD)</td>
<td>Raja Mazumder</td>
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<tr>
<td>13</td>
<td>13-April</td>
<td>Protein structural analysis II (Structure-guided alignments (Cn3D); Structure-guided evolutionary analysis (CDD)</td>
<td>Raja Mazumder</td>
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<td>14</td>
<td>20-April</td>
<td>Biomarker ontology</td>
<td>Dan Lyman and Raja Mazumder</td>
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<td>15</td>
<td>27-April</td>
<td><strong>Review &amp; Final Q&amp;A</strong></td>
<td>Raja Mazumder</td>
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<td>04-May</td>
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<td><strong>Term project due</strong></td>
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Lecture topics

Genomics and Proteomics
Introduction to Genomics and Proteomics and key protein and proteome resources.
How is genomics and proteomics connected? How can we use public resources to
develop research hypothesis

Proteomics of protein modifications
Post-translational modifications and proteomics. How does genomics influence PTMs
and how PTM data is generated? Explore data.glygen.org for PTM data that can be used
in midterm.

Command line tools.
Command line tools are critical in proteomics data analysis. This lecture will show how
to download and start using some of these tools.

Homology modeling.
How to model structures based on homology. How structures are used in drug and
drug discovery

Neuroproteomics and biomarkers II.
Neurogenomics and neuroproteomics biomarkers.

Mass-spec techniques and analysis I (HIVE glycoproteomics tools).
Using HIVE to analyze proteomics data.

Mass-spec techniques and analysis II (HIVE glycoproteomics tools).
Using HIVE to analyze proteomics data and recording the steps as BioCompute Objects.

Clinical proteomics and biomarkers.
Application of biomarkers in the clinic and clinical trials.

Proteomics of protein-protein interactions
Protein-protein interactions. Techniques and databases and how to use them. Analysis
of protein interactions in vivo, in vitro and in silico. Interactomes and the complexity of

Proteome evolution and comparative proteomics ; Proteomics and Systems Biology.
Redefining current taxonomy through comparative proteomics. Application of
proteomics in studying human disease and medicine. Data analysis using proteomics
resources and tools. Pathway analysis.

Mass-spec for proteomics.
Mass-spec technology current status.

Protein structural analysis I
Structure-guided alignments (Cn3D); Structure-guided evolutionary analysis (CDD)
How to create high quality alignments using protein structure information. Structure-
guided evolutionary analysis (CDD). How to use structural information for evolutionary
analysis.

Protein structural analysis II
Structure-guided alignments (Cn3D); Structure-guided evolutionary analysis (CDD)
How to create high quality alignments using protein structure information. Structure-guided evolutionary analysis (CDD). How to use structural information for evolutionary analysis.

Biomarker ontology
In depth analysis of specific biomarkers and how to model biomarker data.
Development of biomarker ontology and need for such an ontology will be discussed.

ADDITIONAL INFORMATION

**University policy on observance of religious holidays**
In accordance with University policy, students should notify faculty during the first week of the semester of their intention to be absent from class on their day(s) of religious observance. For details and policy, see “Religious Holidays” at provost.gwu.edu/policies-procedures-and-guidelines
Support for students outside the classroom

Virtual academic support
A full range of academic support is offered virtually in fall 2020. See coronavirus.gwu.edu/top-faqs for updates.

Tutoring and course review sessions are offered through Academic Commons in an online format. See academiccommons.gwu.edu/tutoring

Writing and research consultations are available online. See academiccommons.gwu.edu/writing-research-help

Coaching, offered through the Office of Student Success, is available in a virtual format. See studentsuccess.gwu.edu/academic-program-support

Academic Commons offers several short videos addressing different virtual learning strategies for the unique circumstances of the fall 2020 semester. See academiccommons.gwu.edu/study-skills. They also offer a variety of live virtual workshops to equip students with the tools they need to succeed in a virtual environment. See tinyurl.com/gw-virtual-learning

Writing Center
GW’s Writing Center cultivates confident writers in the University community by facilitating collaborative, critical, and inclusive conversations at all stages of the writing process. Working alongside peer mentors, writers develop strategies to write independently in academic and public settings. Appointments can be booked online. See gwu.mywconline.

Academic Commons
Academic Commons provides tutoring and other academic support resources to students in many courses. Students can schedule virtual one-on-one appointments or attend virtual drop-in sessions. Students may schedule an appointment, review the tutoring schedule, access other academic support resources, or obtain assistance at academiccommons.gwu.edu.

Disability Support Services (DSS) 202-994-8250
Any student who may need an accommodation based on the potential impact of a disability should contact Disability Support Services to establish eligibility and to coordinate reasonable accommodations. disabilitysupport.gwu.edu
Counseling and Psychological Services 202-994-5300
GW’s Colonial Health Center offers counseling and psychological services, supporting mental health and personal development by collaborating directly with students to overcome challenges and difficulties that may interfere with academic, emotional, and personal success. healthcenter.gwu.edu/counseling-and-psychological-services

Safety and Security
- In an emergency: call GWPD 202-994-6111 or 911
- For situation-specific actions: review the Emergency Response Handbook at safety.gwu.edu/emergency-response-handbook
- In an active violence situation: Get Out, Hide Out, or Take Out. See go.gwu.edu/shooterpret
- Stay informed: safety.gwu.edu/stay-informed