Zoology 604 Computer-based gene and disease/disorder research lab

Learning objectives:

In recent years, a large number of open access biological and biomedical databases have become available for on-line, computer based research. Within these sites is a wealth of information regarding genes, gene expression, gene pathways, behavioral characteristics, and disorders or diseases, such as autism, arthritis, bipolar disorder, and schizophrenia. Learning to navigate the various sites to take advantage of the information and push scientific discovery forward is a valuable skill to develop for any student interested in a career in science or medicine.

In this course students will:

1) Learn to navigate through a range of databases and extract information to develop new ideas on how genes are linked to diseases, disorders, or traits. A key part of the course is that each student will pick a disease or disorder of interest (e.g., autism, arthritis, epilepsy, schizophrenia) and use multiple databases to develop new ideas on which genes may be playing important, but previously underappreciated or unknown roles. Alternatively, the student could focus on a gene of interest to understand how it intersects with different disorders.

2) Learn how to combine knowledge from existing publications with that obtained using on-line database research.

3) Learn to create a novel hypothesis about how genes may be linked to a disorder or disease.

4) Learn how to synthesize novel findings in the form of class presentation and final paper

5) Learn how to work cooperatively by contributing to research performed by class partner.

Instructor: Stephen C. Gammie, Ph.D.
Office: Room 412 Birge Hall
Office hours: By appointment.
E-mail: scgammie@ wisc.edu
Phone: 262-3457 (office)

Times: Monday, 1:20-5 p.m. (Room to be determined)

Schedule

Wk1: Introduction to computer based research and discussion of individual interests
Wk2: Introduction to National Center for Biotechnology Information, including the use of the gene expression omnibus; students begin projects
Wk3: GeneNetwork, WebQTL, and the linking of chromosome loci, traits, and gene expression; refresher on the uses of PubMed, Web of Science, and Google Scholar
Wk4: NIH DAVID, gene pathways, and different methods for linking disorders to genes and gene expression
Wk5: Student presentations on progress to date
Wk6: Allen brain atlas and the linking of brain regions to gene expression
Wk7: Genemania and the understanding of gene networks
Wk8: Interactive session with class on projects
Wk9: Spring break
Wk10: Tutorial on bringing together data and developing hypotheses
Wk11: Continue projects and in class feedback
Wk12: Continue projects and in class feedback
Wk13: Synthesis of findings and preparation for presentations
Wk14: Formal presentations
Wk15: Formal presentations

Papers due to professor 1 week after presentations

Homework:

For **six** of the weeks, students are expected to provide an approximately 2+ page progress report on their research. The report can include web screenshots showing how analysis was run and results. Students can be creative in terms of how they demonstrate their progress, but reports should include a combination of text and graphics to make it clear what you tried to do and what you found. The report should end by briefly describing possible next steps. Students can pick any six weeks prior to Wk14 to submit the homework. Only one report can be submitted per week. The idea of allowing 6 reports over 11 weeks is that it provides each student useful flexibility. A report can be emailed to the professor at any time during the week prior to each lab.

Final Paper:

Final Paper will be ~15 pages long, including references. Paper will include: Abstract; Title, Introduction, Methods, Results, Discussion, and Figures and/or Tables. More details on preparing papers will be provided during the course.

Presentation:

Powerpoint presentations of the research should be 15 minutes long and there will be 5 min for questions at the end. Students should have an introduction that provides a background of the study performed. Please remember that this a general audience, so one should assume they know little of the genes or disorders you will be discussing and plan to provide sufficient details for them to follow your logic. For results, focus on the key results and how you got there. It is much better to highlight key findings (make your

graphs and lettering fill the slide) than to show everything and have the audience get confused. You can put additional results in the paper, but here you want to make your main points from your findings. For your discussion, focus on interpretations of data and where this might lead you next. If one of your research partners played a key role in helping you down a successful track of research, you should acknowledge that insight in the talk. Please thank your research partners at the end of the talk.

Grading:

Final grade: 30% = homework assignments; 50% = final research paper; 10% = oral presentation of final paper; 10% = class participation, effort.

Homework: 30 points
Final research paper: 50 points
Oral presentation: 10 points
Class participation/effort: 10 points
Total = 100 points

Letter Grades:
92-100% = A; 88-91% = AB; 82-87% = B; 78-81% = BC; 70-77% = C; 60-69% = D; 0-59% = F

Research structure:

Each student is responsible for his/her own research project and is graded individually. However, each student will also have a primary and secondary research partner with whom they share their findings throughout the semester and gain feedback. By having research partners and being the partner for others, the students will gain additional insights from one another and share in the enthusiasm of discovery.

Representative list of readings:

No formal textbook will be used.

Grisham W, et al (2010) Teaching bioinformatics and neuroinformatics by using free web-based tools. CBE--Life Sciences Education 9: 98-107

Andreux PA et al (2012) Systems genetics of metabolism: the use of the BXD murine reference panel for multiscalar integration of traits. Cell 150:1287-1299

Talishinsky A, Rosen GD (2012) Systems genetics of the lateral septal nucleus in mouse: heritability, genetic control, and covariation with behavioral and morphological traits. PLoS One 7(8): e44236

Barrett T, et. al. (2013). NCBI GEO: archive for functional genomics data sets--update. Nucleic Acids Res. 2013 Jan;41(Database issue):D991-5

Sunkin SM et al (2013) Nucleic Acids Res. 2013 Allen Brain Atlas: an integrated spatio-temporal portal for exploring the central nervous system. Jan;41(Database issue):D996-D1008.

Systematic and integrative analysis of large gene lists using DAVID Bioinformatics Resources. (2009) Nat Protoc. 4(1):44 -57.

Gene set enrichment analysis: GSEA user guide (2012) Broad Institute.