Project guidelines

Bioinformatics is the use of biological databases and programming to ask biological questions. Your project starts by asking a question. The answer to the question is a hypothesis. Your hypothesis drives and directs your approach. Your research seeks to verify, support, prove, or disprove your hypothesis.

Senior thesis may be an independent study project or may be research in a lab. If you are working in a lab under the direction of a professor or graduate student, then you will be less independent. The question (hypothesis) may be decided for you. Your job is to understand the background and follow the direction of your thesis advisor (professor or graduate student). It is not enough to simply act a lab technician and do what you are told. You must ask questions until you fully understand the project and can interpret results. You should discuss future directions in your report. You should meet weekly with your research advisor.

If you are working on an independent study project, you still need a research advisor. However, you take on the additional burden (or creative freedom!) of defining the project. An independent study project is done in two stages, project definition and project execution. Project definition should not take more than one to two weeks. The project definition stage leads to a project proposal which will be approved (or not) by your research advisor. Your research advisor may suggest changes in the definition/execution/direction of the project. (Don’t assume that all will go perfectly as planned!)

Choose your research advisor before starting your project, and ideally before the term in which you take Senior Thesis. You should spend about 8 hours/week on this course. Contact your thesis advisor frequently, especially if you feel “stuck.”

Components required

At least one of the following should be components of the BFMB senior thesis project to qualify for culminating experience credit:

Programming, biological databases, molecular modeling, molecular simulations, phylogenetic analysis, sequence analysis, sequence modeling, genomics, metagenomics, protein design, docking, drug design, GWAS, cloning, high-throughput screening.

If your project contains none of these components or if it is unclear whether it has one of these components, please contact the BFMB program director to approve the project for culminating experience.

Example project titles (invented):

1) SNPs in human COX-2 code for mutations near the binding sites of non-steroidal anti-inflammatory drugs — a molecular modeling study.
2) Analysis of 1 microsecond molecular dynamics simulation of the folding of Protein A reveals order of formation of alpha helices correlates with helix amphipathicity.  
3) Reconciliation of species tree and distance-based gene trees for homeobox proteins in plants suggests a gene duplication event in the early mesozoic era.  
4) Analysis of metagenomic data set using UGENE shows a predominance of spore-forming bacteria in Argentine pampa soils.  
5) A Python program to score alternative phylogenetic trees using quartet puzzling.  
6) Geometric hashing as a way to find potential scaffolds for de novo enzyme design.  
7) Rational design and docking of a cyclic peptide to bind cholera toxin.  
8) A program to simulate action potentials using the Hodgkin-Huxley model.  
9) Cluster analysis of kinase genes in vertebrates.

**Presentation**

Give a 30 minute talk on your research. Include background, methods, results and future directions. Be sure to correctly attribute sources. Schedule your talk well in advance.

**Report**

Write a 5 page paper on your research. Include Introduction, Methods or Experimental Design, Results (and Discussion), Conclusions, References. Include original figures. Use a standard bibliography/citation format.

**Grading**

Your grade depends on  
40% Weekly meetings.  
30% Presentation.  
30% Written report.*  
*Your grade does not depend on the “success” of your research.

**Timeline**

Week 1: Set up time for weekly meetings.  
Week 2 : Propose thesis project.  
Week 3 - 13 : Meet once a week. Show progress towards your goal.  
Week 13 or 14 : Present your thesis project. Turn in written report.

**Contact**

Questions on senior thesis requirements for BFMB should be directed to Prof. Chris Bystroff,  
bystrc@rpi.edu, 518-276-3185, J-Rowl 3C07.

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