

**BCB 444/544 INTRODUCTION TO BIOINFORMATICS**  
**Syllabus – Fall 2009** Revised 8/10/09

**BCB 444/544 Introduction to Bioinformatics.** (3-2) Cr. 4.

Broad overview of bioinformatics with a significant problem-solving component, including hands-on practice using computational tools to solve a variety of biological problems. *Topics include:* database searching, sequence alignment, gene prediction, RNA and protein structure prediction, construction of phylogenetic trees, comparative and functional genomics.

**Prereqs:** Math 165 or Stat 401 or equiv. or permission of instructor.

**Co-listings:** BCB/Biol/ComS/CprE/Gen 444 / BCB/ComS/CprE/GDCB 544

**Course Goals:** to convey the importance of bioinformatics and computational biology for solving problems in modern biomedical research and to provide hands-on experience using software, critically evaluating results, and interpreting their biological significance.

Students will understand:

- *fundamental biomedical questions* and how to apply appropriate computational tools to address them
- *basic principles underlying computational approaches*, limitations of available tools and how to critically interpret results

**Intended audience:**

Undergraduate & graduate students interested in a broad introduction to the fundamental biomedical problems & computational approaches in Bioinformatics and Computational Biology research. **Note: this course does not fulfill core course requirements for BCB PhD students**, but can be used to fulfill Bioinformatics course requirements for certain other graduate majors or fellowships (IG, IGERT, etc.). BCBio or BCB majors are welcome to audit the lectures or register for the course (lectures & lab) as an elective.

**Course Website:** <http://dobbslab.gdcb.iastate.edu/BCB544/>

**Instructor:** [Drena Dobbs](#)  
[ddobbs@iastate.edu](mailto:ddobbs@iastate.edu)

*Office Hrs:* Fri 11-12, or by appointment  
in 106 Molecular Biology Building (MBB) 294-4991

**Teaching Assistants:** Ben Lewis                  Deepak Reyon                  Usha Muppirla  
[balewis@iastate.edu](mailto:balewis@iastate.edu)   [dreyon@iastate.edu](mailto:dreyon@iastate.edu)   [usha@iastate.edu](mailto:usha@iastate.edu)

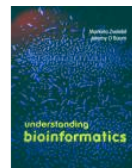
*Office Hrs:* Thurs 1-3 or 3-5 or by appt  
All TA office hours meet in 106 MBB or MBB 1340 (294-4991)

<b>Class Meetings:</b>	Lectures:		MWF	10:00 – 10:50 AM	in MBB 1424	
		<u>BCB 444</u>	<u>BCB 544</u>			
	Labs:	# 8543005	# 8548005	Thurs	1:10 – 3:00 PM	in MBB 1340
		# 8543010	# 8548010	Thurs	3:10 – 5:00 PM	in MBB 1340

**Textbooks: Required:** [Essential Bioinformatics](#)  
J. Xiong, Cambridge, 2006  
ISBN-13: 978052160082



**Optional:** [Understanding Bioinformatics](#)  
M. Zvelebil & J. Baum, Garland, 2007  
ISBN-10: 0815340249



**Required Reading, Homework & Projects:****BCB 444:**

- **Reading:** Assigned chapters in the textbook & supplemental materials provided in class or on the course website should be read *prior to lecture* (see Schedule).
- **Take-home & Lab Assignments:** Weekly assignments to assess comprehension of readings, lecture and laboratory will be required.

**BCB 544:**

- **Reading & Take-home & Lab Assignments:** same as BCB 444  
In addition, BCB 544 students will be required to complete:
- **Additional Reading & Discussion Questions** - BCB 544 students will be required to read assigned journal articles & answer discussion questions that emphasize critical evaluation of experiments & results presented, including fundamental concepts, experimental design, and interpretation of results.
- **Team Semester Research Projects** - BCB 544 students will form 3-4 person teams & complete a 4-week research project. A written summary and a group oral presentation on the term project will be required.

**Exams:** There will be 2 Midterm Exams and a Final Exam. The Final will be cumulative with emphasis on the most recent material and general concepts from earlier material. In addition, there will be Take-home assignments based on material covered in the lectures and laboratory. Details are provided in *Grading Policy* online.

**Grading:**

<b>BCB 444:</b>	200 pts	Midterm Exams = 100 points each
	200	Take-home & Laboratory assignments = 200 points
	<u>100</u>	Final Exam
	<b>500 pts</b>	<b>Total for BCB 444</b>
<b>BCB 544:</b>	200 pts	Midterm Exams = 100 points each
	200	Take-home & Laboratory assignments
	100	Final Exam
	<u>200</u>	Discussion Questions & Team Research Projects
	<b>700 pts</b>	<b>Total for BCB 544</b>

**Intended Learning Outcomes:**

Students are expected to gain an understanding of the importance of bioinformatic approaches in modern biological research. For each of the topics covered, they will understand the fundamental biological questions and be able to apply appropriate computational tools. They will understand basic principles underlying computational approaches, realize the limitations of available tools, and be able to critically interpret results.

**Students with Disabilities:**

If you have a disability and require accommodations, please contact one of the instructors early in the semester so that your learning needs may be appropriately met. You will need to provide documentation of your disability to the Disability Resources (DR) office, located on the main floor of the Student Services Building, Room 1076, 515-294-6624.

[BCB 444/544](#)  
Lecture Schedule - Fall 2009

#	Date		Topic	Reading
1	Aug 24	M	What is Bioinformatics?	Xiong, Ch 1
2	Aug 26	W	Biological Databases	Ch 2
3	Aug 28	F	Brief Biology Review What is Systems Biology? What is Synthetic Biology?	<a href="#">HGP Primer</a> <a href="#">Adventures in Synthetic Biology</a>
4	Aug 31	M	Pairwise Sequence Alignment	Ch 3
5	Sept 2	W	Dynamic Programming (DP)	Ch 3
6	Sept 4	F	Scoring Matrices and Alignment Statistics	Ch 3
-	Sept 7	M	UNIVERSITY HOLIDAY (Labor Day)	
7	Sept 9	W	Database Searching with BLAST	Ch 4
8	Sept 11	F	PSI-BLAST, etc.	Ch 4
9	Sept 14	M	Multiple Sequence Alignment (MSA)	Ch 5
10	Sept 16	W	Scoring MSAs	Ch 5
11	Sept 18	F	Position Specific Scoring Matrices (PSSMs) & <i>VR Tour 1 PM</i>	Ch 5
12	Sept 21	M	CLUSTAL	Ch 5
13	Sept 23	W	"Catchup" & Review	Chps 1-5
-	Sept 25	F	<b>Midterm Exam #1</b>	<b>Chps 1-5</b>
14	Sept 28	M	Hidden Markov Models (HMMs)	Ch 6
15	Sept 30	W	More HMMs	Ch 6
16	Oct 2	F	Protein Families, Domains, and Motifs	Ch 7
17	Oct 5	M	Gene Structure and Prediction	Ch 8
18	Oct 7	W	Promoter & Regulatory Element Prediction	Ch 9
19	Oct 9	F	Phylogenetics - Basics	Ch 10
20	Oct 12	M	Phylogenetics - Distance-based Methods	Ch 11
21	Oct 14	W	Phylogenetics - Character-based Methods	Ch 11
22	Oct 16	F	Protein Motifs & Domain Prediction	Ch 12
23	Oct 19	M	Protein Structure, Visualization, Comparison	Ch 13
24	Oct 21	W	Protein Structure - Classification	Ch 13
25	Oct 23	F	Protein Secondary Structure Prediction	Ch 14
26	Oct 26	M	Protein Tertiary Structure Prediction	Ch 15
27	Oct 28	W	"Catchup" & Review	Chps 6-15
-	Oct 30	F	<b>Midterm Exam #2 (Add/drop deadline)</b>	<b>Chps 6-15</b>
28	Nov 2	M	RNA Structure Prediction	Ch 16
29	Nov 4	W	Predicting Macromolecular Functions & Interactions	TBA
30	Nov 6	F	Machine Learning Algorithms (Weka: NB, SVM)	TBA
31	Nov 9	M	Genomics, Comparative Genomics & Metagenomics	Ch 17
32	Nov 11	W	Functional Genomics	Ch 18
33	Nov 13	F	Microarrays	Ch 18
34	Nov 16	M	Clustering Algorithms	Ch 18
35	Nov 18	W	Proteomics (2-D Gels & MS)	Ch 19
36	Nov 20	F	Regulatory and Developmental Networks	TBA
37	Nov 23 - 27		NO CLASS - Thanksgiving Break	
38	Nov 30	M	Systems Biology	Zvevil & Baum Ch 17 pp 667-694
39	Dec 2	W	Synthetic Biology	<a href="http://openwetware.org/images/f/f9/IGEM_Student_Book.pdf">http://openwetware.org/images/f/f9/IGEM_Student_Book.pdf</a>
40	Dec 4	F	Topic of Students' Choice	TBA
-	Dec 7-11		<b>BCB 544 Team Project Presentations</b>	
-	Dec 17	Th	<b>FINAL EXAM 9:45 - 11:45 AM (Comprehensive; includes lab practical exam)</b>	

**Lab Schedule - Fall 2009**  
Labs Meet in MBB 1340 (unless otherwise noted)

#	Date (Thurs)	Topics	Exercises	Answers	Instructor
1	Aug 27	Literature Resources for Bioinformatics <b>Note: This lab meets in Rm 32 Library</b>	Lab 1		Andrea Dinkelman
2	Sept 3	NCBI - Sequence Databases & Tools ISU Databases, Servers & Software	Lab 2		Ben Lewis
3	Sept 10	Pairwise Sequence Alignment Database Searching (BLAST)	Lab 3		Usha Muppирala
4	Sept 17	Multiple Sequence Alignment (CLUSTAL, MultAlign)	Lab 4		Usha Muppирala
-	Sept 24	<b>Review &amp; Independent Projects</b>	<b>Review Study Guide #1 Answers</b>		
5	Oct 1	Synthetic Biology (SYNBIOS)	Lab 5		Deepak Reyon
6	Oct 8	Gene & Regulatory Element Prediction (UCSC Genome Browser)	Lab 6		Ben Lewis
7	Oct 15	Phylogenetic Analysis (CLUSTAL, PHYLIP)	Lab 7		Ben Lewis
8	Oct 22	Structure Databases & Visualization (PDB, PyMol, KiNG)	Lab 8		Deepak Reyon
-	Oct 29	<b>Review &amp; Independent Projects</b>	<b>Review Study Guide #2 Answers</b>		
9	Nov 5	Protein Structure Prediction RNA Structure Prediction	Lab 9		Ben Lewis
10	Nov 12	Gene Function Prediction (Sequence-based, Structure-based)	Lab 10		Deepak Reyon
11	Nov 19	Microarray Analysis (Clustering Algorithms)	Lab 11		Usha Muppирala
12	Nov 26	Network Analysis Synthetic Biology <i>Redux</i>	Lab 12		Deepak Reyon
	Dec 3	<b>NO LAB – University Thanksgiving Break</b>			
-	<b>Dec 10</b>	<b>BCB 544 Team Project Presentations</b>			