Bioinformatics and Systems Biology Graduate Program

Student Handbook
2012
Department Directors:

Alexander Hoffmann
Professor, Chemistry and Biochemistry
Vineet Bafna
Professor, Computer Science & Engineering

**Bioengineering** is consistently ranked among the top three programs nationally and is a key pioneer in the area of bioinformatics and systems biology.

- Xiaohua Huang, Associate Professor
- Andrew McCulloch, Professor
- Christian Metallo, Assistant Professor
- Bernhard Palsson, Professor
- Shankar Subramaniam, Professor/Chair
- Kun Zhang, Assistant Professor

**Biological Sciences** is a premier division at UCSD that provides the anchor for the vibrant biomedical research community across departments and institutions.

- Steven Briggs, Professor, Cell and Developmental Biology
- Joseph Ecker, Adjunct Professor (SALK) Molecular Biology and Genetics
- Jeffrey Hasty, Professor, Molecular Biology
- Amy Kiger, Associate Professor, Genomics, Cellular Morphogenesis, Rnai
- Scott Rifkin, Assistant Professor, Ecology, Behavior and Evolution
- Julian Schroeder, Professor, Cell and Developmental Biology
- Inder Verma, Adjunct Professor (Salk) Proto-oncogenes, Tumor-Suppressor Genes, Gene Therapy

**Chemistry and Biochemistry** is a focal point of systems biology and mathematical modeling of biological circuits, as well as computational biophysics.

- Pieter Dorrestein, Associate Professor
- Alexander Hoffmann, Professor, Program Director
- Simpson Joseph, Professor
- Andrew McCammon, Professor
- Susan Taylor, Professor
- Wei Wang, Associate Professor

**Cellular & Molecular Medicine** is a program emphasizes an interdisciplinary and interdepartmental approach for studying the molecular, cellular and genetic pathways of cell function and their relationship to human disease.

- Christopher Glass, Professor
- Lawrence Goldstein, Professor
- Bing Ren, Professor
- Gene Yeo, Assistant Professor
Computer Science & Engineering is unique in having a critical mass of faculty whose research interests focus on biology. These faculty have very strong collaborative research interactions with biology, chemistry and engineering.

- Vineet Bafna, Professor
- Charles Elkan, Professor
- Pavel Pevzner, Professor
- Yoav Freund, Professor

Marine Biology Research Division consists of specialist marine research laboratories in the fields of cell and developmental biology, ecology and evolutionary biology, microbiology and physiology.

- Terry Gaasterland, Professor, Director, Genomics

Mathematics has built increasing expertise in the area of bioinformatics with emphasis on statistics and probability. This focus is one of fundamental importance for the future of bioinformatics.

- Michael Holst, Professor
- Glenn Tesler, Professor
- Ruth Williams, Professor

School of Medicine

- Ruben Abagyan, Professor, School of Pharmacy/Pharmaceutical Science
- Nuno Bandeira, Asst. Professor, School of Pharmacy/Pharmaceutical Science
- Philip Bourne, Professor, School of Pharmacy/Pharmaceutical Science
- Pieter Dorrestein, Assoc. Professor, School of Pharmacy/Pharmaceutical Science
- Michael Gilson, Professor, School of Pharmacy/Pharmaceutical Science
- Joseph Gleeson, Professor, Neuroscience
- Olivier Harismendy, Asst. Adjunct Professor, Pediatrics
- Nate Heintzman, Asst. Clinical Professor, Medicine
- Vivian Hook, Professor, School of Pharmacy/Pharmaceutical Science
- Trey Ideker, Professor, Medicine
- Richard Kolodner, Professor, Medicine
- Andrew McCulloch, Professor, School of Pharmacy/Pharmaceutical Science
- Lucila Ohno-Machado, Professor, Medicine
- Sergei Pond, Asst. Adjunct Professor, Medicine
- Doug Richman, Professor, Medicine
- Geoff Rosenfeld, Professor, Pathology
- Dorothy Sears, Associate Professor, Medicine
- Palmer Taylor, Professor/Dean, School of Pharmacy/Pharmaceutical Science
- Roger Tsien, Professor, Pharmacology
- Christopher Woelk, Professor, Medicine
- Ronghui Xu, Professor, Family & Preventive Medicine

Physics is home to leaders in the field of computational statistical mechanics applied to biology and provides the foundation for sophisticated modeling of complex biological systems and information/theory-based models of biological systems.

- Terrence Hwa, Professor
Admissions Requirements

Admissions criteria are in accordance with the general requirements of the Office of Graduate Studies (OGS). Candidates ought to have an interdisciplinary track record and persuasion to work across biology, medicine, computational sciences, and engineering. The most competitive applicants have an undergraduate degree majoring in any of the disciplines in the biological sciences, the physical sciences, computer science, mathematics, or engineering with a strong background in the complementary disciplines.

Admission review will be on a competitive basis based on applicants’ undergraduate track record, Graduate Record Examination General Test (GRE) scores, and other scholastic achievements. Special attention will be given to the quantitative and analytical section scores of the GRE. Attention will also be given to the motivation and career plans of the applicant candidates. The applications will be screened and evaluated by the Admissions Committee with input from all program faculty. In addition, applicants must submit a completed UCSD Application for Graduate Admission (use major code BF76), official transcripts (English translation must accompany official transcript written in other languages), TOEFL scores (required ONLY for all international applicants whose native language is not English and who have not studied full-time for one uninterrupted year at a university-level institution in a country where English is the official language), and three letters of recommendation from individuals who can attest to the academic competence and to the depth of the candidates’ interest in pursuing graduate study.

UC San Diego Graduate Application website: https://graduateapp.ucsd.edu
Bioinformatics and Systems Biology Ph.D. students are required to complete four core courses (Bioinformatics I-IV), four courses to be chosen from a list of electives approved by the Curriculum Committee, three quarters of research rotations (BNFO 298), four quarters of the Seminar in Bioinformatics and Systems Biology (BNFO 281), one ethics course (SOMI 226 or BIOM 219) and two quarters of Teaching Assistantship experience (BNFO 500) as outlined below. The electives are intended to maximize the flexibility of the program, but at least one course must be chosen from the biology field (elective fields 1-3) and at least one from the computer science and engineering field (electives 4-6). The faculty advisor(s) will pay particular attention to deficits in the background of each student and will assist in making appropriate course choices from the elective fields. Students electing to take any of the undergraduate courses listed in these fields will receive an additional course component in order to make it equivalent to a graduate level course. Students have the option to test out of a course by passing an exam designed by the course instructor and curriculum committee. This exam will fulfill one of the breadth requirements of the program. It is the general policy of the program to be as adaptable as possible to the needs of the individual student. The faculty advisory committee will work closely with students to identify what might be lacking in a particular curriculum program.

Core Requirements

Each student must take the four courses below.

**Bioinformatics I** (PHAR 201). Biological Data & Analysis
**Bioinformatics II** (BENG 202/CSE 282). Introduction to Bioinformatics Algorithms
**Bioinformatics III** (BENG 203/CSE 283). Genomics, Proteomics, and Network Biology
**Bioinformatics IV** (MATH 283). Statistical Methods in Bioinformatics

All students in years 1-2 must take **BNFO 281**. This class consists of Faculty Seminars (Frontiers in Bioinformatics and Systems Biology Colloquium) as well Student Research Talks.

All students must take one of the two ethics courses SOMI 226 or BIOM 219. (Offered in Spring quarter) SOMI 226. Scientific Ethics
BIOM 219. Ethics in Scientific Research

Biomedical Informatics Track students will follow recommendations outlined by their faculty advisors.

Program Electives

Each student will select from four of the nine elective fields below. One must be from the biology field (electives 1-3) and one from the computer science field. (electives 4-6)

**Elective 1: Biochemistry**
BENG 230A. Biochemistry
CHEM 209. Macromolecular Recognition
CHEM 213. Physical Chemistry of Biological Macromolecules
CHEM 216. Chemical Biology

**Elective 2: Molecular Genetics**
BICD 100. Genetics
BGGN 220. Graduate Molecular Biology
BGGN 223. Graduate Genetics

**Elective 3: Cell Biology**
BICD 110. Cell Biology
BICD 130. Embryos, Genes, and Development
BGGN 222. Graduate Cell Biology
BGGN 230/CHEM 221. Graduate Signal Transduction

**Elective 4: Algorithms**
CSE 101. Design and Analysis of Algorithms
CSE 200. Computability and Complexity
CSE 202. Algorithm Design and Analysis
CSE 280A. Algorithms in Computational Biology
MATH 261A. Probabilistic Combinatorics and Algorithms

**Elective 5: Machine Learning and Data Mining**
CSE 250A. Artificial Intelligence: Search and Reasoning
CSE 250B. Artificial Intelligence: Learning
CSE 254. Statistical Learning

**Elective 6: Bioinformatics and Systems Biology**
BENG 211. Systems Biology I: Biological Components
BENG 212. Systems Biology II: Network Reconstruction
BENG 227. Biomedical Transport Phenomena

**Elective 7: Mathematics and Statistics**
MATH 274. Numerical Methods for Physical Modeling
MATH 280A. Probability Theory
MATH 281A. Mathematical Statistics
MATH 281B. Mathematical Statistics
PHYS 210A. Equilibrium Statistical Mechanics
PHYS 210B. Nonequilibrium Statistical Mechanics

**Elective 8: Kinetic Modeling**
BENG 125. Modeling and Computation in Bioengineering
PHYS 239. Special Topics: Quantitative Molecular Biology
BENG 213. Systems Biology and Bioengineering III: Building and Simulating Large-Scale In Silico Models
CHEM 220. Regulatory Circuits in Cells

**Elective 9: Medical Informatics**
MED 263. Bioinformatics Applications to Human Disease
MED 264. Principles of Biomedical Informatics
MED 265. Healthcare Systems: A Quantitative Perspective
MED 266. Machine Learning in Biomedicine
MED 269. Clinical Decision Support Systems at the point of Care
Sample (Year 1) Schedule

*Students are required to complete three research rotations by the end of their first year (fall-spring). Students must be enrolled in at least 12 units every quarter to maintain their full time student status. Students must find a rotation faculty mentor before the quarter begins and enroll in BNFO 298 Research Rotation section for 4 units.

<table>
<thead>
<tr>
<th>FALL</th>
<th>WINTER</th>
<th>SPRING</th>
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<tbody>
<tr>
<td>Bioinformatics I:</td>
<td>Bioinformatics II:</td>
<td>Bioinformatics III:</td>
</tr>
<tr>
<td>(PHAR 201)</td>
<td>(BENG 202/CSE 282)</td>
<td>(BENG 203/CSE 283)</td>
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<tr>
<td>BNFO 281</td>
<td>BNFO 281</td>
<td>Bioinformatics IV:</td>
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<tr>
<td>BNFO 298</td>
<td>BNFO 298</td>
<td>(MATH 283)</td>
</tr>
<tr>
<td>Elective(s)</td>
<td>Elective(s)</td>
<td>Elective(s)</td>
</tr>
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Research Rotations

The Research Rotation Program is an integral component of the first year in our curriculum. The purpose of the research rotation is to train students in specific research methodologies and identify a laboratory in which to pursue doctoral thesis research. Each first year student in the Program is required to undertake and pass three, quarter-long (ten week) Research Rotations, one in the Fall, Winter and Spring quarters. (BNFO298)

For each rotation project, a one-page proposal, signed by the student and rotation mentor must be submitted to the Program Coordinator by the first day of the quarter. At the completion of the ten-week rotation, a five-page report, signed by the student and rotation mentor, summarizing the work, results, and conclusions, is to be submitted to the Program Coordinator by the last day of instruction of the quarter.

All students, regardless of their background and elective track, are expected to identify a thesis research laboratory and join that laboratory by the beginning (fall quarter) of their second year. However, all students may petition the Research and Rotation Committee to undertake additional rotations. When choosing a thesis lab, it is important to remember that not all laboratories are in the same financial position to take on new graduate students. Actively pursue sources of outside funding during your first year to improve your ability to join the lab of your choice. Also, be sure to discuss your intentions to join a lab with your perspective mentor as soon as possible, as this helps him/her prepare for the financial obligation and other administrative responsibilities.

Seminars, Informal Courses, Group Meetings, and Symposia

First and second year students are required to enroll in BNFO 281 during fall and winter quarters which includes Seminars in Bioinformatics and Systems Biology, hosted by the program, and Student Research Talks, given by students.

In addition to formally structured courses, graduate students are encouraged to attend seminars, group meetings, as well as informal sessions during which they have the opportunities to interact closely with faculty mentors and to present their research plans, problems, and findings.
Teaching Requirement
Each graduate student admitted to the Ph.D. Program in Bioinformatics and Systems Biology is mandated to serve as a teaching assistant (TA) for at least two quarters. Most students complete this requirement during their second year; however, are required to complete it prior to Advancing to Candidacy. Students enroll in BNFO 500 to receive credit for completing their TA requirement. This will aid in preparing the students for careers in which teaching plays an important role. In addition, each student will have opportunities to make research presentations to the graduate program students/faculty during their Student Research Talks. Students will also discuss their progress at the annual program meeting to be held each year. It is anticipated these formal presentations will serve as valuable training in preparing the student for a teaching career.

Bioinformatics graduate students will also participate in additional TA training provided by the Office of Graduate Studies and Research through the Center for Teaching Development (CTD).

Second-Year Qualifying Examination
The Bioinformatics and Systems Biology Second-Year Qualifying Examination (BQE), to be taken before the completion of a student’s second year, is designed to test the ability of students to think analytically and independently about their research project, and to determine whether the student is sufficiently familiar with the literature to develop a meaningful research project. The subject of the exam is the student’s current research project- essentially, it is a “minor proposition” exam that precedes the “major proposition” or Senate/Advancement to Candidacy Exam described below.

The Qualifying Exam chair will appoint three faculty to each student’s exam committee. The exam must be held before the end of the spring quarter of the second year. It consists of two components; a ten-page project proposal and an oral exam. Two weeks prior to the exam date the student will submit the ten-page proposal including introduction, hypotheses, preliminary results, and proposed studies to the Qualifying Exam Committee. The oral exam is intended to probe the student’s ability to defend the project proposal.

Once the student passes the oral and written qualifying examination, the student is qualified to advance to their chosen Ph.D. thesis research in Bioinformatics and Systems Biology.

Advancement to Ph.D. Candidacy
Upon completion of formal course requirements, each student will be required to take a written and oral qualifying examination that will admit the student to the candidacy of the Ph.D. Program. It is often known as a “major proposition” or “Senate Qualifying” or “Advancement to Candidacy” exam. Prior to this examination, each student, in consultation with his or her faculty advisor(s), will establish a dissertation committee of five faculty members. One advisor should have a primarily computational research focus, the other a primarily experimental research focus. One of the two advisors will function as chair of the committee. The committee will consist of three faculty who are affiliated with the Bioinformatics and Systems Biology Program. At least two of the five committee members must be from a department other than the committee chair’s department and at least one of these two must be tenured. The thesis advisors will have the major responsibility for the student’s research and dissertation
Thesis or Dissertation

Each graduate student in the program will work on a bioinformatics thesis project under dual mentorship of their program faculty advisors. It is mandatory that the student will meet at least once annually, before the end of Spring quarter, with their thesis committee to update members on his or her progress.

Final Examination

Bioinformatics graduate students will defend their thesis in a final oral examination. The exam will consist of (1) a presentation of the thesis by the graduate student, (2) questioning by the general audience, and (3) closed door questioning by the thesis committee. The student will be informed of the exam result at the completion of all three parts of the oral examination. The final report of the doctoral committee will be signed by all members of the committee and the final version of the dissertation will conform to the procedures outlined in the publication, *Instructions for the Preparation and Submission of Doctoral and Master’s Theses*.

Good academic standing and satisfactory progress will be established by: (a) maintaining a GPA of at least 3.0; (b) having a research advisor by the end of the first year; (c) satisfying the program teaching (TA) obligations on time; (d) passing qualifying and Senate exams within the prescribed schedule; (e) receiving satisfactory annual progress reports; (f) meeting the standards of scholarship of the program-see UCSD Catalog; and (g) meeting program standards that include obtaining a “B” or better in core and elective courses taken for the degree. Failure to meet one of these standards will not, however, mean the automatic loss of financial support. These cases will be reviewed individually by the program director in consultation with the faculty advisor, the curriculum committee and the Steering Committee.

Financial Support

All US Citizen students admitted into the Ph.D. program in Bioinformatics and Systems Biology will receive a stipend that covers living expenses and tuition, as long as they are in good academic standing with university and program requirements. The financial support for the first year is provided from (1) departmental financial commitments, (2) university financial commitments, and (3) NIH-funded graduate training grant. Second year forward the financial support will come from your Faculty Advisor (PI). Individual scholarships and fellowship are encouraged and opportunities can be found on the OGS website.
To Do – After Orientation

• Read the Bioinformatics Graduate Program Student handbook to be aware of my academic requirements.

• Work on my schedule of Fall courses. Contact my Faculty Advisor to discuss my academic and research plans and refer to the Bioinformatics and Systems Biology Graduate Student Handbook. Enroll in at least 12 units.

• Double-check for any change in course schedules and finalize my Fall courses. I can check course schedules via Student link at: http://students.ucsd.edu/

• Register for Fall courses via Student Link at: http://blink.ucsd.edu/technology/help-desk/applications/link-family/list.html

• Arrange for my Fall Rotation. Check Bioinformatics and Systems Biology webpage for Rotation Openings. Speak to faculty and speak to advisors. I must have a 1 page Rotation Proposal signed by my Rotation Advisor in to Kathy by the end of the first week (Sept 28th).

• Check my mailbox. All graduate students have mailboxes in Room 228 located in Powell-Focht Bioengineering Hall. (It is essential that students check mailboxes regularly as important correspondence is placed in them).

• Update my address information and local phone number via Student link.

• If I am not a California Resident, I must begin to establish California ties now in order to change residency. The program does not pay for out of state tuition after the first year of study. Make sure I look out for a letter on change of classification that will be send to me from the residency office. Change of Residency is not applicable for international students. See information on the Residency website at: http://students.ucsd.edu/finances/fees/residence/status-change.html

• All information in this handbook is also available on the program website is will have the most up-to-date information. http://bioinformatics.ucsd.edu.
# Enrollment and Registration Calendar 2012-2013

<table>
<thead>
<tr>
<th>Description</th>
<th>Fall 12</th>
<th>Winter 13</th>
<th>Spring 13</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Schedule of Classes available</strong></td>
<td>5/4</td>
<td>11/2</td>
<td>2/8</td>
</tr>
<tr>
<td>Effective date for enrollment holds</td>
<td>5/8</td>
<td>11/6</td>
<td>2/12</td>
</tr>
<tr>
<td>Enrollment begins</td>
<td>5/9</td>
<td>11/7</td>
<td>2/13</td>
</tr>
<tr>
<td>Effective date for fee payment holds</td>
<td>8/27</td>
<td>TBA</td>
<td>TBA</td>
</tr>
<tr>
<td>New student enrollment begins</td>
<td>8/27</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Billing statement available on <a href="#">TritonLink</a></td>
<td>9/1</td>
<td>TBA</td>
<td>TBA</td>
</tr>
<tr>
<td>Registration fee payment deadline (after this date, late fees apply)</td>
<td>9/21</td>
<td>12/19</td>
<td>3/15</td>
</tr>
<tr>
<td>Deadline for mandatory insurance health waiver - all students (after this date, $50 late waiver fee will apply until late waiver deadline, see below.)</td>
<td>9/21</td>
<td>12/19</td>
<td>3/15</td>
</tr>
<tr>
<td>Deadline for students not attending (who are receiving financial aid, full-fee waivers or graduate fellowships/ scholarships) to notify university that they will not attend. See the schedule of refunds for more information.</td>
<td>9/21</td>
<td>12/19</td>
<td>3/15</td>
</tr>
<tr>
<td>Quarter begins</td>
<td>9/24</td>
<td>1/2</td>
<td>3/28</td>
</tr>
<tr>
<td>Classes dropped if registration payment not received</td>
<td>9/26</td>
<td>1/2</td>
<td>4/1</td>
</tr>
<tr>
<td>First day of classes</td>
<td>9/27</td>
<td>1/2</td>
<td>4/1</td>
</tr>
<tr>
<td>Late health insurance fee waiver deadline (no waivers will be accepted beyond this date)</td>
<td>9/28</td>
<td>1/2</td>
<td>4/1</td>
</tr>
<tr>
<td>Automatic wait-lists officially end</td>
<td>10/11</td>
<td>1/17</td>
<td>4/11</td>
</tr>
<tr>
<td>Deadline for all students to add or re-enroll in classes if canceled for non-payment via WebReg.</td>
<td>10/12</td>
<td>1/18</td>
<td>4/12</td>
</tr>
<tr>
<td>Deadline for graduate students to file for leave of absence</td>
<td>10/12</td>
<td>1/18</td>
<td>4/12</td>
</tr>
<tr>
<td>Deadline to change grading option, change units, and drop classes without &quot;W&quot; on transcript</td>
<td>10/26</td>
<td>2/1</td>
<td>4/26</td>
</tr>
<tr>
<td>Deadline for students receiving financial aid to withdraw and retain 100% of federal aid</td>
<td>11/14</td>
<td>2/21</td>
<td>5/16</td>
</tr>
<tr>
<td>Drop without penalty of &quot;F&quot; grade — end of 9th week (undergraduates)</td>
<td>11/30</td>
<td>3/8</td>
<td>5/31</td>
</tr>
<tr>
<td>Last day of classes before finals</td>
<td>12/7</td>
<td>3/15</td>
<td>6/7</td>
</tr>
<tr>
<td>Deadline to file for &quot;Removal of Grade Incomplete&quot; from previous quarter</td>
<td>12/15</td>
<td>3/23</td>
<td>6/14</td>
</tr>
<tr>
<td>Quarter ends</td>
<td>12/15</td>
<td>3/23</td>
<td>6/14</td>
</tr>
<tr>
<td>Deadline to file for a Request to receive a grade of &quot;Incomplete&quot;</td>
<td>12/17</td>
<td>3/25</td>
<td>6/17</td>
</tr>
<tr>
<td>Grades available on TritonLink</td>
<td>12/20</td>
<td>3/28</td>
<td>6/20</td>
</tr>
</tbody>
</table>

## Fee Deadlines and Late Fee Waivers

**LATE ENROLLMENT OR LATE REGISTRATION IS COSTLY!!**

The cost of missing either of these deadlines is $50. Forgetting or being too busy to meet the deadline has proven to be a costly lesson ($50 or $100) for some students. Graduate students are responsible for meeting deadlines as published in the quarterly Schedule of Classes. Late fee waivers are granted only with proof of the following: University Responsibility, Verified Illness, Verified Family Responsibility. Students who qualify for cancellation of penalty fees should inquire with their graduate coordinator.

Please note that students who have fees paid for them, but who miss the enrollment deadline will be assessed $100 in late fees.
Bioinformatics and Systems Biology Deadlines

**Spring Evaluations**: Due before Friday, June 14, 2013 (Meet with advisor(s) end of May)

**Second-Year Qualifying Examination**: to be taken before June 14, 2013

**Selection of Thesis Committee**: To be completed by May 31, 2014.

**Senate Exam**: to be taken before June 14, 2014.

**Rotations**: See Table below

<table>
<thead>
<tr>
<th>Academic year 2012-13</th>
<th>Proposal</th>
<th>5 page report</th>
<th>Student evaluation</th>
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<tbody>
<tr>
<td>Fall</td>
<td>Thu Sep 27, 2012</td>
<td>Fri Dec 7, 2012</td>
<td>Fri Dec 14, 2012</td>
</tr>
<tr>
<td>Advisor-Student Match Up</td>
<td>June 10-14, 2013</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2nd Summer</td>
<td>Mon Jul 29, 2013</td>
<td>Fri Sep 6, 2013</td>
<td>Fri Sep 13, 2013</td>
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