SECTION I
The Bioinformatics Graduate Program

Doctoral Degree Program

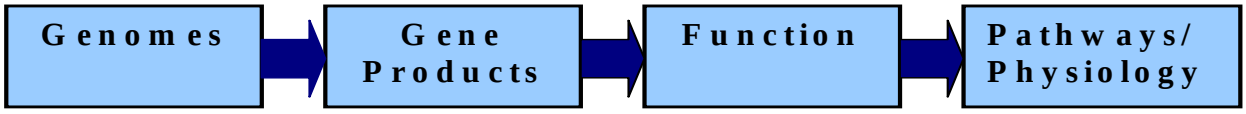
The Bioinformatics graduate program draws upon the interdisciplinary expertise of affiliated faculty from participating departments and graduate programs– Bioengineering, Division of Biological Sciences, Biomedical Sciences, Chemistry and Biochemistry, Computer Science and Engineering, Mathematics, and Physics.

The University of California at San Diego is a premier research institution that has fostered interdisciplinary research since its inception. Specifically, Bioengineering (at the interface of biology, medicine and engineering), Neuroscience (at the interface of biology and medicine), Biophysics (at the interface of chemistry, biology and physics), and Cognitive science (at the interface of medicine and computer science) are all nationally ranked interdisciplinary graduate research programs. This has led to growth and innovation in many new areas of science and engineering research and the training of an exceptionally high caliber of graduate and postdoctoral students.

In recent years, Bioinformatics has been identified by the UCSD administration as one of the most important growth areas for the campus. Several recent new faculty hires have been targeted in bioinformatics-related fields. UCSD has also seen a significant increase in the research activity associated with Bioinformatics across the traditional disciplines.

Development of the Field and Departmental Strength in the Field
We are witnessing the birth of a new era in biology. The ability to decipher the genetic code of living organisms is dramatically changing our understanding of the natural world and promises to improve substantially the quality of human life. Recent advances in technology have led to the creation of a new interdisciplinary science – *Genomics*. In simple terms, genomics is the reading and understanding of the blueprints for life. Understanding how genomes work requires sophisticated computer-based information handling tools (*Bioinformatics)*, and new high throughput technologies for understanding the function of genes on a genome-wide scale (*functional genomics*).

Bioinformatics characterizes the flow of information in living systems and can be schematically represented by the following.



The most pressing problem in the post-genome sequencing era will be to understand the integrated functions of thousands of genes. Dealing with this problem will require an interdisciplinary research structure dedicated to developing intellectual and human capital in bioinformatics and genome science. Due to the complexity of this new paradigm in biology, i.e., understanding the organization, evolution and function of whole genomes rather than single genes, entirely new sets of tools and human resources will be necessary. Thus, future developments in genomics, and the applications that derive from genomics, will be dependent upon the scientific progress at the interface of three major disciplines; biology, engineering, and computer science. In addition to the scientific advances required to understand the functions of genomes, the accelerated growth of modern biology warrants revolutionary changes in academic curricula.

Each department represented in this program participates in various interdisciplinary graduate programs in addition to providing very strong intradisciplinary graduate training. One example is the La Jolla Interfaces in

Science program (LJIS), a campus- and mesa-wide fellowship opportunity sponsored by the Burroughs Wellcome Fund. LJIS supports exploration of interfaces between the biological and biomedical sciences and the physical, computer, and mathematical sciences at UCSD, The Scripps Research Institute (TSRI), The Salk Institute, and the San Diego Supercomputer Center.

Bioengineering, ranked number three nationally by U.S. News and World Report, has several new faculty hires in the area of Bioinformatics and Computational Biology and has identified Bioinformatics as a major area of focus.

Division of Biological Sciences, a premier division at UCSD, will spearhead the interdisciplinary, undergraduate specialization in Bioinformatics and is planning to hire new faculty in Bioinformatics fields.

Biomedical Sciences is an interdisciplinary Ph.D. program, based in the School of Medicine, with tracks in Pharmacology, Physiology, and Cellular and Molecular Medicine. It will be closely linked to the planned new School of Pharmacy. In addition to a strong computational biology presence amongst its faculty, there are plans to hire more faculty whose main interests are in computational pharmacogenomics and bioinformatics.

Chemistry and Biochemistry, the home of the Molecular Biophysics Training Grant, is highly recognized for its strong computational biology program with plans to further expand in chemo and bioinformatics areas.

Computer Science and 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 researchers. CSE is currently recruiting for a senior faculty member with computational biology expertise.

Mathematics has expressed strong interest in building in the area of bioinformatics with emphasis on statistics and probability. This focus is one of fundamental importance for the future of bioinformatics and the department is committed to both hiring new faculty and launching new courses in statistics pertinent to bioinformatics.

Physics is the home of leaders in the field of computational statistical mechanics applied to biology, and provides the foundation for sophisticated modeling of complex biological systems. Physics also plans to recruit new faculty members whose research focus will be on development of information/theory-based models of biological systems.

Admissions Requirements

Admission is in accordance with the general requirements of the Graduate Division. Candidates will have an interdisciplinary persuasion to work across computers, biology, medicine, and engineering; with an undergraduate degree majoring in any of the disciplines in biological science, physical science, computer science, mathematics, or engineering with a strong background in quantitative sciences and biology.

Admission review will be on a competitive basis based on the applicants' undergraduate track record, Graduate Record Examination General Test (GRE) scores and other scholastic achievements. Attention will also be given to the motivation and career plans of the applicant candidates. Special attention will be given to the quantitative and analytical section scores of the GRE. 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 BF75), 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 whose undergraduate education was conducted in a language other than English), and three letters of recommendation from individuals who can attest to the academic competence and to the depth of their interest in pursuing graduate study.

Acceptance letters to incoming students will indicate academic areas in which the Admissions Committee believe the individual is deficient and suggestions for remedial materials to be examined prior to the Fall Quarter may be provided.

For further admission information and/or to request an application packet, students should contact the Bioinformatics Student Affairs Office via e-mail at *bioinfo@ucsd.edu* or at (858) 822-4948. You may also visit the following website at *www.bioinformatics.ucsd.edu*.

Foreign Language requirement
Competence in one or more foreign languages is encouraged but not required.

Ph.D. Curriculum

Specific fields of emphasis:

- Biological Data & Analysis Tools
- Sequence Analysis
- Genomic Analysis
- Statistical Methods for Bioinformatics

The Bioinformatics graduate program is organized around a formal course requirement consisting of 3 quarters of course work, with enrollment in 4 four-unit courses each quarter. One four-unit course in each quarter will be a research rotation in the laboratory of a Program faculty mentor. Research rotations in the first year may begin during Winter quarter of the first year. The remaining 9 courses will include 4 compulsory core courses and 5 courses to be chosen from a list of electives approved by the Advising Committee. All required or recommended courses for the degree must be taken for a letter grade; students must obtain a "B" or better. Any non-program courses need program consent. *Refer to the section on good academic standing and satisfactory progress in this handbook.*

The electives are intended to maximize the flexibility of the program, but at least one course must be chosen from the Biology field and one from the Computer Science and Engineering field. 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 field by passing an exam designed by the faculty 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 Training Courses

- **Bioinformatics I: Biological Data & Analysis Tools**
  Pharmacology (Pharm 201)
  Prerequisites: Perp & Java programming, CSE 100 Advanced Data Structures
  FALL: WF 12:30 p.m. - 1:50 p.m., Location: CSB 004 (section ID# = 540478)
  Course description: Presentation of types of biological data, organization of data and use of analysis tools. Extensive use of web-based bioinformatics environments for investigation and analysis of biological data.
- **Bioinformatics II: Sequence and Structure Analysis – Methods and Applications**
  Bioengineering (BENG 202/CSE 257A)
  Prerequisites: Pharm 201 or consent of instructor
  (WINTER: To be scheduled.)
  Course Description: Introduction to methods for sequence analysis. Applications to genome and proteome sequences. Protein Structure, sequence-structure analysis.
- **Bioinformatics III: Genetic Circuits and Modeling Pathways**
  Bioengineering (BENG 203)
  Prerequisites: Pharm 201, BENG 202/CSE257A or consent of instructor
  (SPRING: To be scheduled.)
  Course description: Annotating genomes, characterizing functional genes, profiling, reconstructing pathways.
- **Bioinformatics IV: Statistical Methods for Bioinformatics**
  Mathematics (Math 283)
  Prerequisites: 1 year of calculus, 1 statistics course

(SPRING: To be scheduled.)
Course description: This course will cover material related to the analysis of modern genomic data; sequence analysis, gene expression/functional genomics analysis, and gene mapping/applied population genetics. This course will focus on statistical modeling and inference issues and not on database mining techniques

Program Electives

(Each student will select from 5 of the 8 elective fields below. 1 must be from Biology field and 1 from Computer Science field. For each elective, multiple course options currently available are listed).

	Field & Course #	Course Title
Elective 1	**Biochemistry**	
	BENG 230A	Biochemistry
	CHEM213	Chemistry of Macromolecules
	CHEM218	Macromolecular Biochemistry
Elective 2	**Data Structures**	
	CSE 204A	Combinatorial Optimization
Elective 3	**Algorithms**	
	CSE 202	Algorithm Design and Analysis
Elective 4	**Information Retrieval, Databases & Data Mining**	
	CSE 254	Machine Learning
Elective 5	**Molecular Genetics**	
	BGGN 220	Graduate Molecular Biology
	BGGN 223	Graduate Genetics
Elective 6	**Cell Biology**	
	BIOMED 210	Cellular Biology
	BIOMED 212	Cellular and Molecular Pharmacology
	BGGN 222	Graduate Cell Biology
	BIEB 204	Phylogenetics
Elective 7	**Physics and Engineering**	
	BENG 253	Biomedical Transport Phenomena
	BENG275	Computational Biomechanics
	PHYS 210A or higher	Equilibrium Statistical Mechanics
	BENG 211	Systems Biology and Bioengineering I: Biolog Components
	BENG 212	Systems Biology and Bioengineering II: Netwo Reconstruction
	BENG 213	Systems Biology and Bioengineering III: Build and Simulating Large-scale In Silico Models
Elective 8	**Mathematics and Statistics**	
	Math 280A	Probability Theory

Example 1 – Sample Program (1st year)
A student with an undergraduate background in Biology might make the following course selections:

Year 1

Fall	Winter	Spring
Bioinformatics I	Bioinformatics II	Bioinformatics III
Test out – Elective	Elective	Bioinformatics IV
Elective	BENG 275	Elective
BGGN 220 (Elective)	Elective	Test out – Elective
CSE 202 (Elective)	Research Rotation	Elective
		Research Rotation

Example 2 – Sample Program (1st year)
A sample program for a student with an undergraduate degree in Computer Science and Engineering might be structured as follows:

Year 1

Fall	Winter	Spring
Bioinformatics I	Bioinformatics II	Bioinformatics III

Test out – Elective	BIOMED 210	Bioinformatics IV
Elective	Math 280A	CHEM 213
BGGN 220 (Elective)	Elective	Elective
CSE 202 (Elective)	Research Rotation	Test out - Elective
		Research Rotation

Year 2

All students, regardless of their background and elective track, will be expected to begin working in the laboratory of their choice by the second year. Additionally in Year 2, students will begin preparing for their qualifying examination and will participate in advanced seminar courses and journal clubs identified by program faculty.

End of Year 2 through 5

Spring of 2nd year – Qualifying Examination
Spring of 3rd year – Advance to Candidacy
End of 5th year – Ph.D.

In summary, in addition to 3 quarters of research rotations, students must complete the 4 compulsory Bioinformatics core courses; and, either test out of, or select at least 5 courses from the 8 elective areas.

Research Rotations

Each student in the graduate program will participate in three research rotations, at least two of which will be in the laboratory of mentors other than the thesis directors. The purpose of the research rotation will be to train the students in research methodology in specific bioinformatics areas. At the end of the research rotation period, the student will submit a written report that will be evaluated by the faculty mentor in whose laboratory the project was carried out. The report will also be sent to the Qualifying Examination Committee who will take this into consideration in the assessment of the student for admission to candidacy.

Seminars, Informal Courses, Group Meetings and Symposia

As well as formally structured courses and research rotations, graduate students will have access to seminars, group meetings and informal sessions during which they will have frequent opportunities to interact closely with faculty mentors and to present their research plans, problems, and findings. In addition to weekly Bioinformatics seminars, the graduate program will launch monthly student/faculty meetings at which students can present their research findings and discuss their progress. Graduate students will also be expected organize an annual symposium where they will invite leading researchers to UCSD for one-day talks and discussions.

Besides the activities noted above, UCSD as a premier research institution, has many excellent seminar programs sponsored by every research department and organized research group. Several interdisciplinary programs facilitate research meetings. Notable ones include, the La Jolla Interfaces in Sciences (LJIS) Program, the Neurosciences Program, the Molecular Biophysics Program, the Whitaker Institute for Biomedical Engineering, the San Diego Supercomputer Center and the Structural Genomics Program. LJIS, for example, is an extremely successful interdisciplinary program sponsoring stimulating and state-of-the-art seminars. LJIS recently sponsored a well-received symposium on *Post-Genomic Bioinformatics*. The San Diego Supercomputer Center is host to the upcoming Intelligent Systems for Molecular Biology Annual Symposium. Many program faculty are involved in several of the areas mentioned above and we anticipate the Bioinformatics graduate program will benefit from all of these additional programs and symposia.

Research Training

Students, upon completion of the appropriate course work, will be given research orientation lectures by the Bioinformatics program faculty. Each graduate student will participate in a research experience in the laboratory they select to carry out their research rotation. During this period students will become acquainted with scientific methodology for designing experiments, analyzing the results, organizing the data, conducting research in a responsible manner, preparing oral and poster presentations of research results, and writing scientific papers.

Upon successful completion of the Qualifying Examination, graduate students will choose his/her research project from the many possibilities offered in the program and begin to work on a research problem with their faculty advisors. In consultation with their mentors, students will formulate the research activity that will lead to their dissertation. Graduate students will have the opportunity to do internships in the local bioinformatics/biotechnology industry if the thesis project is of mutual interest to a corporate sponsor and the thesis advisors. The research program is designed with two key objectives in mind, a) first to provide a truly interdisciplinary research training at the interface area between biology and computer science and engineering and b) to address fundamentally strong research problems that will lead to the advancement of the field of bioinformatics. We anticipate that every graduating student will emerge as a highly trained Bioinformatician who can either pursue an academic career by choosing optimal postdoctoral research positions or enter the next generation biotechnology/biopharmaceutical industry.

It is our belief that active research under proper tutelage is the best means of training and that the foundations of a good graduate training program rest on an outstanding faculty group, an excellent student body and a strong and well-coordinated research program. Each of the faculty members in this program have expertise and interests that will contribute importantly to the Bioinformatics graduate program. Participating faculty have pooled their resources in terms of laboratories, and the knowledge and experience to ensure the success of the program. Through daily contact with faculty and other research colleagues, the students will learn to develop critical and creative thinking skills, scientific methodology and a sound knowledge of research problems.

Second Year Qualifying Examination

The Bioinformatics Second Year Qualifying Examination is designed in an innovative manner to test the ability of students to think analytically and in an interdisciplinary manner. This method was suggested by students of the Program during the first two years after inception.

Students are expected to come up with a research problem different from the one she/he may have been working on with a Faculty Advisor and write a proposal that can be defended at the Oral Examination to a faculty committee appointed by the Chair of BQE. The written document is expected to be in the form of a Proposal to NSF or NIH, where the student provides the specific aims of the project, the background for and significance of the problem chosen, some preliminary results and/or observations and specific details on the design of the research. The student is tested on his/her ability to formulate and design the problem as well as on the interdisciplinary nature of the approach. Once the student passes the oral portion of the examination, the student is deemed to be qualified for advancing into Ph.D. thesis research in Bioinformatics. The student can schedule this examination at any time of the year, but with two provisions. First, the student should have completed all the required and most of the elective courses assigned and second, the examination should be taken before the student completes his/her second year in the Program. At the time of BQE, the student should have decided on her/his two mentors/research advisors, and should have discussed with them about joining their laboratories and obtaining guaranteed funding for the duration of research as long as he/she is in good academic standing. The BQE Oral Examination Committee will discuss these specifics and other Program requirements with the student at the Oral Examination.

Advancement to Ph.D. Candidacy

Upon completion of formal course requirements, each student will be required to take a written and oral University Qualifying "Candidacy/Senate" Examination that will admit the student to the candidacy of the Ph.D. program. In advance of the qualifying examination each student, in consultation with his/her faculty advisor(s), will establish a dissertation committee of 5 faculty members. The committee will consist of 3 faculty from the Bioinformatics program and two others who may or may not be part of the program. At least two of the 5 must be from a department other than the committee chair's and at least one of these two must be tenured.

At UCSD, the University Qualifying "Candidacy/Senate" Examination is a requirement for a Graduate Student to complete satisfactorily, once a thesis project has been decided upon and the student has established a thesis Committee in consultation with his/her faculty research advisors. It is deemed after this examination that the student is formally advanced to PhD candidacy and eligible to graduate provided he/she completes his/her dissertation. It is strongly recommended except in special circumstances that the student

complete this examination prior to the end of the first 3 years in the Program. The format for this examination is consistent with the highest standards held by peer Universities. The Student should write a detailed Candidacy report in the format of NIH proposals where it is expected that each Specific Aim will approximately form a Chapter in the dissertation. The Student should ensure that there is initial progress and the research design and methods are spelled out unambiguously. While the size of this document may vary, it is expected to be at least around 25-30 pages. Any publications/supplementary material may be attached. The Student should form the Examination Committee in consultation with his/her faculty research advisors and the Committee should be in a position to advise the student on his/her dissertation topic. The Committee constitution should be in accordance with the rules of the Program and UCSD. The student is advised to choose a Committee whose members will be in the best position to advise and will serve arguably as the toughest, albeit constructive critics of the research so as to maximize the quality of the dissertation. The report should be interdisciplinary and should have input from both thesis advisors. The format for the report should conform to the Bioinformatics Program requirements and not those of the parent Department(s) of the mentor(s)/faculty research advisor(s). It is expected that the student will meet at least annually with the Committee to update the members on his/her progress.

Thesis and/or Dissertation

Each graduate student in the program will work on a bioinformatics thesis project under dual mentorship of the program faculty. As a partial fulfillment for the Ph.D. degree, the student will submit a complete dissertation to be evaluated by a doctoral committee chosen by his/her mentors in consultation with the Bioinformatics Steering Committee. The doctoral dissertation will be submitted to each member of the doctoral committee at least four weeks before the final examination. The student will defend his/her final thesis after the committee's evaluation and will pass or fail depending on the committee's decision. The entire graduate program is expected to be completed within the proposed timeline of the program.

Final Examination

Bioinformatics graduate students will defend their thesis in a final oral examination. The exam will consist of a) a presentation of the thesis by the graduate student, b) questioning by the general audience, and c) 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 Masters' Theses.

Teaching Requirement

Each graduate student admitted to the Ph.D. program in Bioinformatics is mandated to serve as a Teaching Assistant (TA) for at least 2 quarters. This will aid in preparing the students for a teaching career. In addition, each student will make periodic research presentations to the graduate program students/faculty. 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).

Financial Support

It is expected that all students admitted into the Ph.D. program in Bioinformatics will receive financial assistance subject to their continuance and performance (good academic standing) in the Program. The assistance will be provided from a) departmental financial commitments, b) university financial commitments, c) Teaching Assistantships, d) Research Assistantships, and e) training grants.

It is expected that the Program will fund the student for the first 2 years and the research advisors will carry forward the funding during the remaining period of the students research tenure. If the student is funded by the NIH or other Training Grants, the faculty research advisors are expected to reimburse the Program after the customary first two years of Program funding. Students should discuss such funding commitment with the chosen faculty research advisor(s) early in the second year of study.

Good academic standing and satisfactory progress will be established by: (a) maintaining a GPA of at least 3.0; (b) satisfying all program teaching obligations on time; (c) passing program and qualifying exams within

the prescribed schedule; (d) receiving satisfactory annual progress reports; (e) meeting the standards of scholarship of the program-see UCSD Catalog; and (f) meeting program standards that include obtaining a "B" or better in courses taken for the degree/recommended courses-consult with the Student Affairs Office. 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 and the Steering Committee.

Additional support eligibility requirements (refer to information on Graduate Student Support at UCSD published by the Office of Graduate Studies and Research, http://www-ogsr.ucsd.edu): To be eligible for UCSD support (campus appointments, fellowships, traineeships, tuition/fee scholarships) graduate students must meet the following basic eligibility requirements: 1) **be enrolled full-time** (**12 units** of graduate course work or more per quarter) 2) be in good academic standing, i.e., meet program standards including a satisfactory spring evaluation, must not have accumulated more than a total of eight units of F and/or U grades overall 3) be within program support time limit (refer to the UCSD catalog, Bioinformatics section on Ph.D. time limits).

POLICY ON OUTSIDE STUDENT EMPLOYMENT

Program Policy: Graduate students who receive financial support for their graduate studies whether from a research grant, departmental sources including graduate student instructorships, or an extramural fellowship in an amount equal to or exceeding the departmental guidelines for full-time graduate study (see General Principles and Goals under Section 5) are expected to devote full-time effort to graduate studies and research. Therefore, paid employment outside the Bioinformatics Graduate Program is not generally permitted for supported graduate students and must be approved by both the students' faculty advisor and the Steering Committee. This condition does not apply to unsupported students, and exceptions will generally be regarded to students receiving less than the guideline for full-time study.

University Policy: At its October 11, 1996 meeting the Graduate Council approved the following policy regarding a graduate students employment outside UCSD in a company in which his/her research advisor has an interest: If a graduate student is employed by a company outside UC, San Diego in which a faculty member has a fiduciary interest (e.g. owns, consults), then that faculty member may not be the thesis/dissertation advisor of the graduate student. The faculty member may be on the thesis/dissertation committee. Further, if the faculty member is on the thesis/dissertation committee then he/she must inform the University, through the appropriate offices, of the situation and any possible conflict of interest.
Upon review, exceptions may be granted by the dean of Graduate Studies. Questions regarding this policy may be referred to Mary Allen, Director, Graduate Academic Affairs, (858) 534-3552, mallen@ucsd.edu, or to Dean Richard Attiyeh.

Conflict of Interest

There are many potential situations where the academic interests of a student might come into conflict with the financial or other interests of an advisor, sponsor or collaborator. It is the responsibility of the advisor to protect the student from any adverse effects of these non-academic forces. Where the advisor has a real or perceived conflict, the Office of Graduate Studies & Research has procedures on conflict of interest and more information can be found at: http://ogsr.ucsd.edu/. Moreover, regardless of the situation, the student is always free to share any confidential concerns with an appropriate program official, normally the program director. Such discussions will be kept in strict confidence and not disclosed without the permission of the student in accordance with university regulations.

Employment Prospects

There is enormous demand from industry for trained professionals in Bioinformatics. The pharmaceutical industry, agro business, and biotechnology companies often raid academia for people with the appropriate interdisciplinary skills. There is also a great need for academic faculty who have broad, interdisciplinary training, because much of the success of the next generation of undergraduate and graduate students will depend on their ability to master materials in several disciplines. Competition for people skilled in bioinformatics is so intense that salary offers are being driven sky-high and there is concern that the universities--few of which are training students in the field--are rapidly being depleted of the best researchers.

A report from the Working Group of Biomedical Computing of the NIH recognized the shortage of biologists with appropriate computing expertise and called for strong NIH support of cross-disciplinary education and training.

Currently, UCSD offers Ph.D. degrees with a Specialization in Bioinformatics from the 7 participating departments listed in this handout. Students will be admitted into one of the seven departmental graduate programs and will satisfy the requirements of both the departmental and the interdisciplinary Bioinformatics graduate programs. If you are interested in the Ph.D. degree with a Specialization in Bioinformatics, please consult with the Bioinformatics Student Affairs Office to obtain further information on admission and individual program requirements.

SECTION II

General Information on UCSD and San Diego

The University of California, San Diego was established in 1960 by the Regents of the University of California as an outgrowth of the Scripps Institution of Oceanography. During the last three decades, UCSD has steadily grown in size and excellence and risen to national prominence in education and research. It has about 19,000 undergraduate students and over 2,000 graduate students. Starting with a strong nucleus of outstanding faculty in biology, chemistry and physics, UCSD established its School of Medicine in 1964. UCSD was established with the principle that faculty work easily across departmental boundaries. The academic and intellectual environments are most conducive to interdisciplinary interactions in fields such as bioinformatics.

UCSD has excellent facilities and resources in its libraries, Office of Animal Research, Office of Learning Resources, Office of Environmental Health and Safety, and Office of Development. UCSD is the site of the NSF-funded San Diego Supercomputer Center (SDSC), which provides superb computational support for bioengineering research.

THE REGION

The University of California, San Diego, is located in the town of La Jolla. The twelve-hundred-acre picturesque campus extends along the Pacific seashore of San Diego. The diverse ethnic background of San Diego (population slightly over one million) provides a dynamic cultural environment with many museums and theaters. San Diego and its vicinity has world-famous tourist attractions such as Sea World, the San Diego Zoo, the Wild Animal Park, the Stephen Birch Aquarium of the Scripps Institute of Oceanography at UCSD, and beautiful beaches. The San Diego Convention Center was completed in 1990. While being a part of a big city with all of its available facilities, La Jolla is tranquil and serene as a university town. The climate is almost ideal, with a daytime temperature usually in the range of 60° to 80°F throughout the year, which lends itself well to numerous outdoor activities.

The marvelous weather in La Jolla is matched by the superb academic climate of UCSD and its neighboring institutions. There is an outstanding collection of talent in bioengineering, molecular and cell biology, and clinical investigations. The strong research programs at the La Jolla Cancer Research Foundation, the Salk Institute, and the Scripps Research Institute provide excellent resources and strengths for bioengineering. Scientists at these institutions collaborate effectively with their colleagues at UCSD, and many of them are members of the Institute for Biomedical Engineering. La Jolla also features vibrant biotechnological and pharmaceutical industries that have close interactions with the scientists in local academic institutions.

STUDENT LIFE AT UCSD

The diverse ethnic background in San Diego provides a dynamic cultural environment with many museums and theaters. In addition to the tourist attractions mentioned earlier, San Diego has many other cultural and recreational activities throughout the year. The Old Globe Theater in Balboa Park is the site of the annual

National Shakespeare Festival, and the Cassius Carter Center Stage offers year-round plays of classical and contemporary nature. The UCSD campus has its own La Jolla Playhouse, Mandell Weiss Theatre, and Price Center Movie Theater. While being a part of a big city with all of its available facilities, La Jolla is a tranquil and serene University town.

Many of the students' social and recreational activities involve those on the waterfront, such as surfing, scuba diving, and beach parties. Fishing, sailing and diving opportunities are plentiful offshore surrounding the Coronado Islands in Mexican waters, and the Channel Islands off the coast of California. Local lakes provide fishing and other water sports. The Laguna Mountains, located an hour to the east, provide opportunities for hiking, camping, and mountain biking. Beyond the Lagunas lies the vast Anza-Borrego Desert with its breathtaking display of wild flowers every spring. Snow skiing is available in both the local mountains and the San Bernardino Mountains located about two hours by car from UCSD. The peninsula of Baja California, one of the world's last great wilderness areas, stretches for 900 miles southward from the international gateway at Tijuana. Visitors to the Mexico coastline will enjoy miles of undeveloped beaches, mountains and deserts.

The best sources of information regarding life at UCSD and in La Jolla are fellow students. In order to bring new students and continuing students together, an orientation meeting is held early in Fall quarter.

SECTION III

Important Information for New Graduate Students

Teaching Requirement

Each graduate student admitted to the Ph.D. program in Bioinformatics is mandated to serve as a Teaching Assistant (TA) for at least 2 quarters. This will aid in preparing the students for a teaching career. In addition, each student will make periodic research presentations to the graduate program students/faculty. 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.

The role of *Graduate Student Instructors* (GSI) in the Bioinformatics Graduate Program is to assist in the instruction of undergraduate courses. The Bioinformatics faculty regard this as an essential academic experience and a valuable opportunity for professional development. Accordingly, the performance of every GSI in every course is separately evaluated by the faculty instructor before credit for satisfying the teaching requirement is granted. Formal participation as a GSI is by enrollment in the graduate course 501. Service as a Teaching Assistant or Reader in another department will not satisfy the departmental teaching requirement.

Under faculty supervision, the duties of a GSI include holding regularly scheduled tutorial discussion sessions, assisting in laboratory instruction, holding office hours, conducting review sessions, assisting instructors in designing courses, preparing materials and tests, proctoring exams, grading students' papers, homework and exams, and maintaining records of grades for assignments. A GSI is not responsible for the instructional content of a course, the course policy, the selection of student assignments, writing examinations, or assigning grades.

GSIs are required to comply with all relevant University regulations. These prohibit sexual harassment, misuse of University property, substance abuse, and any violations of the law. (For details, refer to the UCSD Policies and Procedures Manual.)

It is both program and University policy that all GSIs must complete a training course prior to the first quarter of assigned teaching. GSI training workshops are offered by the department at the beginning of every quarter, refer to the information on training under this section.

Ethical Principles

It is the responsibility of a GSI to behave in a professional manner, and to follow the ethical principles which all university instructors must adhere to. This clearly prohibits the following:

- Discrimination against any student on political grounds, or for reasons of race, religion, sex, sexual orientation or ethnic origin, or for other arbitrary or personal reasons.
- Refusal to follow instructions of a faculty member in charge of the course.
- Discussion of the academic work of a student with people other than the faculty member and the other GSIs involved in the course.
- Criticism of the course, instructor or other GSIs in the presence of the students.
- Exploitation of students for private advantage.

Decisions made by GSIs have a significant effect on their students' grades. GSIs should be especially careful not to abuse their authority. GSIs should evaluate student work as objectively and as fairly as possible. In particular:

- GSIs may not serve as paid tutors for students in their class.
- GSIs must avoid romantic involvement with students in their class. Such involvement makes objective evaluation difficult and also raises questions of sexual harassment. These prohibitions may generate problems for a GSI who is normally a friend or coworker of a student. Such situations must be dealt with on an individual basis in consultation with the instructor or Student Affairs Coordinator. If any real or perceived conflict of interest arises, notify the instructor, Student Affairs Coordinator or Department Chair immediately.

Responsibilities

Prior to the beginning of the quarter in which you are a GSI, you must meet with the course instructor to agree on your role in the course.

The course instructor will have specific information on what is expected of a GSI for that particular class. Some examples of duties you may be asked to perform and some guidelines are given below.

- **Running tutorial sections:**

In addition to being fully prepared for scheduled meetings, GSIs should arrive punctually and be available to the students during the entire period, which is normally 50 minutes. A GSI may not cancel a section. There are occasions when it is unavoidable for a GSI to miss a section meeting due to a conflict with a planned event, such as a conference or trip. It is always the responsibility of the GSI to notify the instructor in this event and to arrange for another GSI to cover the class.

- **Lecture attendance:**

GSIs are expected to attend all lectures unless the instructor gives specific permission for an absence, or explicitly states that lecture attendance is not required.

- **Office Hours:**

GSIs are required to hold office hours every week to assist students in understanding the subject matter of the course. Office hours have to be held in an area that assures that course related concerns of a student, such as grades, can be privately discussed.

- **GSI meetings:**

GSI meetings serve several important functions: they provide time for the GSI to give the instructor comments concerning the course; in meeting with the instructor, the GSI learns more about the course philosophy and structure; the GSI can clarify questions on the course material. Attendance at GSI meetings scheduled by the instructor is mandatory. Since part of the purpose of these meetings is to educate the GSI, it is important that GSIs use this opportunity to ask questions about the course material or any matters of instruction.

- **Review sessions:**

Prior to midterm and final examination times, GSIs are often asked by the instructor to hold review sessions in addition to regular sections and office hours. Room reservations for these sessions must be scheduled by the GSI.

- **Homework:**

In some classes the GSIs must participate in the preparation of solutions to homework assignments and may be requested to post these solutions or take them to Soft Reserves.

- **Experimental labs:**

Effective teaching of a lab class mandates that GSIs are able to perform all assigned lab experiments and understand them completely. They must also be fully versed and trained in all relevant laboratory safety procedures and regulations. To assure this, instructors may require the GSIs to practice the experiment in a pre-lab session before the beginning of the class. The GSI normally participates in lab set up, and grading lab reports. Effective laboratory instruction is among the most challenging but also rewarding of teaching experiences.

- **Computer lab sections:**

Effective teaching of computer lab requires that the GSI understand the programming assignment completely. To assure this, instructors may require the GSIs to write sample programs before the beginning of the lab. The GSI may also participate in grading computer programs. At present the bioengineering department does not hold any programming labs.

- **Exams:**

Two of the most important duties of a GSI are proctoring and scoring examinations. A GSI must be available for both the administration and scoring of exams (including the final). Discuss any time conflicts with the instructor. A GSI must do the utmost to discourage cheating by vigilant proctoring, and by reporting any suspected incidents to the instructor. University policies and procedures on academic integrity are summarized in an instructor's guide published by Student Policies and Judicial Affairs, Student Center Building B (534-6225).

- **Keeping Records:**

The GSI is responsible for maintaining the records for all students in the class. The GSI is responsible for keeping those records in a secure place, and if kept on a computer, for keeping a current backup. Keeping all student records secure and confidential is a major responsibility of the GSI that should be treated with the utmost care. All completed assignments, exams, grades, correspondence, and other information about individual students in the class shall be kept confidential except when the student has given written consent. Papers and examinations have to be returned to the students in a way that protects the privacy of the student. Grade records are kept for one year.

- **Assignment of grades:**

While the faculty member in charge of the course is responsible for assigning students' grades, GSIs play an important role in the evaluation of students' work. If a student complains about a final grade, the GSI should refer the student to the instructor because the instructor has final responsibility for the conduct of the course. Only the instructor has the authority to change a grade. The instructor should announce the policy regarding late homeworks, etc. at the beginning of the quarter. If the GSI is unclear on any of these policies, they are to be discussed with the instructor.

- **Academic dishonesty:**

A GSI who suspects cheating on assignments or exams must report suspected incidents to the instructor.

- **Difficulties:**

Problems that cannot be resolved informally with the instructor should be brought to the attention of the Department Chair or the Chair of the Graduate Affairs Committee.

Training

New Graduate Student Instructors are required to attend training sessions sponsored by the Center for Teaching Development and/or training sessions organized by the program and/or participating programs/departments before beginning their assignment. Attendance is mandatory and is a condition of the appointment.

Students for whom English is not a first language are generally required to pass an English test.

As part of the training process, every new GSI is observed by a representative from CTD, and given a critique of his or her performance. This process involves observation of the GSI during office hours or during a problem session. During the session, the students in the class are invited to give feedback to the GSI by filling out a

Student Feedback Form. The GSI then meets with the CTD representative to review his/her performance, go over the student comments, and, if appropriate, discuss strategies for improvement. Information from these observation sessions is NOT available to the Department, and is used only to provide constructive feedback to the new GSI.

SECTION IV
Other Information

"SURVIVAL SKILLS" FOR GRADUATE STUDENTS

In recent years, increasing attention has been paid to identifying the core skills needed in order to be a successful graduate student and scientist in the highly competitive environment that today's research students and junior scientists face. The UCSD faculty are also involved in this process and at the time of writing, the Office of Graduate Studies and Research is compiling resource material for students and faculty.

Some important skills that have been identified include:

- Study and work skills.
- General technical writing and presentation skills.
- How to write a scientific paper and respond to reviews.
- Making posters and slide presentations. Answering questions in public.
- Accurate data recording.
- The appropriate use of statistical analysis.
- Identifying an advisor and a research project.
- Searching the literature. Using the library effectively.
- Handling problems in the workplace.
- Relationships with faculty, students and staff.
- Writing grant applications. Getting financial support.
- Obtaining permission to use animal and human subjects.
- Creativity, management of time and stress.
- Teaching skills.
- Preparing for life after graduate school. Career management. Negotiation. Preparing a CV.
- Social responsibility of research.
- Communicating with the public.

Of course this list is incomplete but it gives you an idea of the many new skills that you will need to develop as a successful graduate student. It is also easy to see that many of these matters include considerations of scientific and professional ethics, which are discussed in the following section.

While most of these skills are acquired informally in the process of obtaining a graduate degree, there are many advocates, especially students themselves, of some optional formal training in these areas. At present UCSD does not have a program or course that covers all these areas, but some courses cover some of them. In particular, faculty from the Scripps Institution of Oceanography offer a course entitled "Scientific Communication" (SIO 292) in the Spring quarter. It is highly recommended by those students who have taken it. The Cognitive Science Department also includes discussion of these skills in their courses 204 A-B.

Another useful resource is the internet. The following site on the world wide web has a wealth of references on these and other survival skills: http://www.pitt.edu/~survival/homepg.html

RESEARCH ETHICS FOR GRADUATE STUDENTS

As scientists are exposed to closer public scrutiny and demands for greater accountability, the importance of more formal training in the many complex ethical issues that surround scientific research is growing. In

particular, Ph.D. students in the Bioinformatics Program should be aware that the National Institutes of Health requires some training and discussion in ethical issues as a condition of financial support.

One excellent course is offered by the **UCSD Research Ethics Program**. This course, entitle *Scientific Ethics*, is conducted as a weekly discussion forum. Topics include scientific misconduct, government regulation, use of genetic information, whistle blowing, animal and human subject trials, and other subjects related to authorship and plagiarism. Additional resources on ethics, such as course listings, workshops, rules, etc, can be obtained from the UCSD Research Ethics Program. All students are encouraged to enroll in the Scientific Ethics course. ***Students that are funded by the Bioinformatics NIH Training Grant should enroll in this course,*** please visit the UCSD Research Ethics Program website at visit http://ethics.ucsd.edu/ for course offerings and schedules.

An excellent resource is the National Academy of Sciences publication "On Being a Scientist", which is distributed with this handbook. The hypothetical case studies it contains are an excellent starting point for discussion of important and frequently complex topics such as assigning credit and priorities, determining authorship, the integrity of scientific data, recognizing and responding to ethical violations, ethics and grant writing. Graduate students are encouraged to read this booklet and discuss it with faculty and students.

References and Other Sources:

On Being a Scientist, 2nd Ed., National Academy Press, Washington, DC, 1995.
Ethics Center for Engineering and Science Ethics (MIT): Engineering Ethics, Research, http://web.mit.edu/ethics/www
Science Conduct On-Line (American Association for the Advancement of Science), http://sci.aaas.org/aaas/
Ethics in Science (Virginia Polytechnic and State University) http://www.chem.vt.edu/ethics/ethics.html

OCCUPATIONAL HEALTH AND SAFETY

Laboratory research can involve significant exposure to significant hazards to your personal health and safety. It is important to receive thorough safety training before you begin working in a laboratory. State and Federal regulations as well as University policy require that your safety training be documented and that evidence of your training be available for inspection.

Every laboratory has a safety contact person, a copy of the UCSD Laboratory Safety Guide, a First Aid kit and a fire extinguisher. Each lab or Principal Investigator also maintains lab-specific safety information including the "material safety data sheets" (MSDS) for chemicals used in the lab, a laboratory "Chemical Hygiene Plan", and a file that records the training of all students and personnel.

Extensive safety and injury prevention material is available from the Office of Environmental Health and Safety (EH&S) on campus (534-4172). Much of this information is also available on-line via "Infopath".

EH&S offers regular classes on general safety through its Injury and Illness Prevention Program. These classes are very useful and cover basic topics including safety orientation, hazard communication, safe computer use, earthquake preparedness, fire, and preventing back injuries.

Consult your lab safety contact person, EH&S or the Bioinformatics Student Affairs Office at bioinfo@ucsd.edu or (858) 822-4948 for more information.

COMPUTING

Every student enrolled at UCSD is eligible for a free Unix computer account at the Academic Computing Center. Please see their homepage (http://www-acs.ucsd.edu/student) for a more complete description of these services. You can drop by their Accounts Office (see below contact information). These accounts will give you access to on-line class material, the internet, email, programming languages and computing facilities.

ACS Accounts Office
Room 2113, Applied Physics and Math

10:00 a.m. - 3:30 p.m., Monday - Friday
(858) 534-4060
Web: www-acs.ucsd.edu
E-mail: acs-consult@ucsd.edu

Students have access to the **Bioinformatics Laboratory**, located in the Science and Engineering Library of the Geisel Library.

The program has available laptops for student use. To "check-out" program laptops, consult with Linh Vu (lvu@ucsd.edu).

More information

Within the Bioinformatics Graduate Program there are a number of people who you may contact with questions about being a GSI, for help with particular job related problems, or for the resolution of conflicts. The first person to contact is the instructor or your faculty advisor.

Program Contacts:

Student Affairs Office:

Stephanie De La Torre, Graduate Advisor and Coordinator
822-4948, 228 PFBH • sdelator@ ucsd.edu

Irene H. Jacobo, Director of Student Affairs
822-0006, 141 PFBH • ijacobo@bioeng.ucsd.edu

Bioinformatics Program Director:

Professor Shankar Subramaniam, 822-3228
shankar@sdsc.edu

For advice on who might best advise you, consult with the Program Director.

Other Campus Resources:

Center for Teaching Development (CTD): 534-6767, 307 Center Hall
Office of Graduate Studies and Research (OGSR): 544-3555, 520 Roosevelt College
Psychological/Counseling Services: appointments, information 534-3755, 1003 Galbraith Hall
Student Safety Awareness Program: 534-5793

The following handbooks may also be of use to you:

Job Opportunities for Graduate Students (OGSR)
A Guide for Teaching Assistants (OGSR)
A Handbook for Teaching Assistants (CTD)
Grading Information (Office of the Registrar)
UCSD Instructors Guide for Preventing and Processing Incidents of Academic Dishonesty (Student Policies and Judicial Affairs)