Report of the External Review Committee for the Graduate Program in Biological and Medical Informatics
University of California, San Francisco

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Overview

The External Review Committee was invited by the Dean of Graduate Programs at the University of San Francisco to perform a peer evaluation of the Biological and Medical Informatics (BMI) Program. The BMI program is comprised of two tracks currently, a Computational Biology Informatics (Bioinfo) track and a Clinical and Translation Informatics (CTI) track. The program has an interesting history. It was formed in the early 1980s under Marsden Scott Blois, MD. That program had a strong focus on clinical informatics and information sciences. It was suspended in 1987 after the passing of Dr. Blois. Revived in 1997 with the support of University funds, the two tracks evolved along very different lines. The Bioinfo track thrived, owing to a strong and visionary faculty who pursued training funds aggressively for sustainability. The CTI track languished, for a variety of reasons; in the main these were structural realities at the Medical Center. The CTI program was suspended for several years, and was revived in 2007.

Our review included analysis of the self-study documents provided by the program, followed by a day and a half of intensive interviews and discussions. We interviewed students (pre-qualifying exams, post-qualifying exams, and recent graduates); current post-doctoral fellows; faculty (junior and senior faculty); and program administrators. We also reviewed the standard UCSF anonymous student survey.

Our report is broken down into two parts. The first covers the Bioinfo track, the second covers the CTI track. For Bioinfo, we start by highlighting the strengths of, and challenges confronting, the program. That is followed by a brief review of the specific guideline points suggested by the University.
The Computational Biology and Bioinformatics Track

Strengths.

Community building amongst students and faculty
Over the past several years, the program has developed highly innovative components of the curriculum that foster community building among the students from the day they arrive. These include the following. (i) A 2-week boot camp for incoming first-year students, taught and organized by senior students. This program is well received as not only building community for all students, but in communicating to each incoming student what it takes to succeed in the graduate program, and what knowledge gaps s/he may have that need to be addressed. (ii) Team challenges in the fall-winter and winter-spring quarter gaps for the first years, TAed by senior students. These activities encourage students to work together and become familiar with techniques and analytical tools they would otherwise not be exposed to. (iii) A mandatory Journal Club that has developed into an important component of the student’s experience. This program hones students’ presentation and critical thinking skills and provides students with the opportunity to critique and review presentations by others. Each of the two annual presentations by each student is a sort of rite of passage, taking the place of a pre-candidacy exam often found in other programs. (iv) An annual retreat at which all fourth year students make a formal presentation. Importantly, these activities appear to be inclusive of all students in the three emphasis areas: Biophysics, Bioinformatics, and Systems Biology. Given the synergies between each of these small programs, this benefits all students and the program as a whole. (v) The ‘mini courses’ – 2 or 3 week intensive courses on a particular topic.

Faculty engagement in teaching/mentoring
Faculty engagement is incredibly strong - at least for the core faculty we met with - and clearly is vital to the success of the program. There is a palpable 'esprit de corps' that stretches from the most senior faculty, through junior faculty and all levels of students. Junior faculty feel well-supported by the senior faculty, and likewise the students feel that they have ample opportunity for support by all faculty.

Curriculum and training innovations
The curriculum has innovative components that serve both 'social engineering'/bonding functions and have a strong teaching effect. According to the students training other students in the context of the bootcamp and team challenges, it's not just about what they teach, but that 'they show students what they don't know'. In so doing they foster the collaborative approach to problem solving. The Journal Club teaches students not only critical thinking and analysis but also presentation skills. The mini-courses are another fine adaptation that permits flexibility in the first year (and often beyond) for students wishing to explore a brief but concentrated exposure to specific topics not otherwise available in a core course. All in all, these initiatives are a terrific combination and represent real 'graduate level' teaching. The core lecture courses seem to be evolving to keep pace with the evolving interests of students and the expertise and interests of new faculty. The review committee, along with the students and professors, supports the idea of introducing 'a real statistics course'. Assistant professor Jun Song indicated that he is ready to teach such a course.

Recruiting, Admissions, and Progress tracking/evaluation of students
The integrated, collaborative effort of faculty and students in the admissions process is novel and successful. The practice of student participation on the Admissions Committee, including review of applications, interviews, and selection, is another example of the level of professional maturity that is expected of UCSF BMI students. The admissions process is supported by robust IT infrastructure (including online applications, committee review and ranking of
applications, reporting for NIH training grant tables) that was developed by a faculty member. This system also supports the academic progress tracking/evaluation, publications, and reporting requirements for active students.

**Challenges.**

*Striking right balance in core curriculum*

Over the past years the program faculty has added strengths in genomics and systems biology, an area of interest reflected in the student applicant pool and increasingly in the enrolled student body. The program has responded by appropriately beefing up the genomics component of the Fall quarter Core course. However, the core curriculum would still benefit from a statistics core course. This is reflected by comments by current students, past students, and some faculty. The Review Committee recognizes that the BMI program grew out of Biophysics, but as Biophysics is evolving into just one of three emphases within the combined program, consideration should be given to the notion that one of the biophysics oriented core classes be morphed into a specialization, in place of general statistics, an essential component of all quantitative biological research comprised within iPQB. Core classes need not be restricted to the Fall quarter. The program should resist the urge to swing too far away from the breadth of biophysics – one of the former students related how something he had learned in statistical mechanics proved to be exactly the solution to a completely different problem he was posed in his current career.

*Tuning the admissions process to maximize training funds (e.g., consider insurance)*

The program is so successful that we encourage the faculty in charge to be less conservative in the admission process! We recognize that there is no institutional 'insurance' for slots offered, but there appears to be an 'operational insurance' in asking faculty to support second year students on R01 grants. Some type of institutional insurance regarding over-runs would be nice, even if not practical in the current budget year. Also, although some of the participating faculty have many students from the program - 7 in one instance - others have none. Therefore, more students in the incoming class would not be a bad thing. We do not recommend increasing the class size per year to more than 20 - because the 'year of 19' appeared to some to be the limit that could be accommodated. We recommend keeping classes to an intimate size and allowing students their desired choices in rotations. We also recommend that the program recruit to the areas of interest of the breadth of faculty involved in the program.

*Team Challenges are a major component in the curriculum, playing an important role both in building the esprit de corps of the students and in fostering their intellectual development in future research in an interdisciplinary environment. These are so special that the committee views it as priority that necessitates planning for long term space and staff support.***

The Team Challenge exercises held twice annually in the first year are a novel, exciting way to engage graduate students in team science and creative critical thinking about real problems. The Team Challenges currently utilize vacant lab space and borrowed instrumentation. As the Mission Bay campus continues to fill up, vacant space will have a tendency to disappear. We recommend that current efforts to secure, plan for, and develop an environment that is suitable for the Team Challenge, as well as other educational activities of a periodic nature, be financially supported. A flexible learning environment of this type will provide the necessary infrastructure to facilitate existing and future educational opportunities, including iGEM, SRTP, etc.
The criticality of the Program Coordinator
The Program administrators must acknowledge the critical logistical role played by the Program Coordinator, and invest in helping him/her advertise lab rotations, related UCSF/UCB/Stanford courses across campuses, travel funding opportunities, and grant opportunities. Students at all levels stressed how important the coordinator is, and we want to ensure that this is foregrounded in the eyes of Administration.

Professional career development.
We advocate making a concerted effort to improve organized professional career development mentoring. This should include counseling on the major career options of industrial and academic pathways. We also were struck that none of the current graduate students were considering a career in public service or non-profit science. We advise injecting systematic exposure to public service and non-profit careers into the curriculum and team-building exercises.

Buy-in from other groups on campus.
The program still has work to do to keep abreast of relevant research by other faculty on campus not affiliated with the program, to get the word out and to reach out to them to create a larger network of opportunities for collaborative research and training. Some faculty in other programs at UCSF are starting genomics and informatics projects within their own groups without fostering interactions with the BMI program. Effort should be made to ascertain why outside faculty do this, and what is their perception of the BMI program. Their perceptions may be outdated. A tendency for different faculty groups at UCSF to reinvent the bioinformatics wheel, if confirmed, would not be beneficial to UCSF.

At the very least, there could be something like a campus-wide ‘genomics & informatics’ seminar series, to bring faculty and students together, and to avoid different groups ‘reinventing the wheel’. Students mentioned in their general comments that there was a wealth of resources available to them, but that it was not always easy to find them.

UCSF Suggested Academic Review Points
I. Program

A. Goals: The primary goal articulated by the Program is one of creating and fostering a successful multi-disciplinary graduate program in computational biology and bioinformatics. As suggested by our enthusiasm for the creative and dynamic program innovations noted above under Strengths, we see this goal as being met, and met exceedingly well. The current students, recent graduates, and faculty demonstrate real excitement and engagement in this graduate program. Needs of all these groups are generally well met, with the exceptions that we noted above under Challenges.

B. Curriculum: see Strengths above.

C. Research and scientific integrity: There is a required ethics course, NS 114, but we feel that stressing the principles of sound ethical conduct could be emphasized more systematically throughout the innovative components of the program as well, such as during the bootcamp or during the Team Challenges. Perhaps they already are, but if so it was not apparent to the committee.

D. Overall program resources: See Challenges above
II. Students

A. Ability of applicant pool: No concerns. The Program has been able to recruit consistently high-quality and academically diverse students. The program makes a special effort to recruit students who are highly independent, self-motivated, and ready to tackle anything that is thrown at them. This kind of student thrives at UCSF. The existing students participate in this recruitment effort with excellent positive effects. Inclusion of students so completely in the admission process is unique and clearly a success.

B. Diversity of students: Recruiting female graduate students and under-represented minority graduate students remains a challenge for the Program, although there has been some recent improvement on this score. We urge the Program to continue its recruitment efforts at the appropriate venues like SACNAS. You should consider debriefing qualified candidates in these groups to whom you offer admission but who go elsewhere, to determine if there is some systematic reason why these students elect not to attend UCSF. We recognize that recruiting qualified URM is a challenge for all institutions, but the San Francisco location is clearly stated as a key factor in the decision of students to attend UCSF in the anonymous survey results.

C. Regular evaluation of students: See Strengths above.

D. Opportunities for faculty-student interchange: See Strengths above.

E. Financial support: There was no systematic problem identified with financial support; on the whole students seemed satisfied with funding opportunities.

F. Student completion interval/quality of published work: the program has a very high completion rate, and there we identified no trend in excessive or unusual time-to-completion intervals. The student and recent graduate publications listed in the self-study appeared to be of high quality and were generally placed in respectable journals. At least one reviewer (JFH) thought that the number of first-authored papers by students was, in general, on the lower side of the norm for senior students and recent graduates. One way that could happen is if faculty fail to provide enough manuscript encouragement, which is something the Program might wish to examine.

G. Student outplacement: All of the graduates of the Program have found relevant positions in industry (mainly) and academe (as post-docs). The track record in this regard is superb.

H. Morale of the students: Nothing in our interviews or in our evaluation of the student survey suggests that there is any problem with student morale. Quite the opposite, the positive esprit de corps here among the students is palpable.

III. Faculty

A. Quality of scholarship/adequate faculty diversity: The faculty has several well-known senior leaders, and the recently recruited faculty are very high caliber.

B. Adequate support for teaching and mentoring of students: A lab space is needed as discussed above for the team challenges and as a shared instrumentation resource.

C. Successful high-quality faculty recruitment: see above.
D. Morale of the faculty: The morale of the faculty is uniformly high, based on our several sessions with faculty from all ranks. The junior faculty in particular are exceptionally pleased with access to resources and senior faculty, both formally and informally.

IV. Facilities/Resources
A. Adequacy of the physical plant: The new Byers and adjoining buildings comprise a remarkable physical plant. The instructional, classroom, and office environment are completely up-to-date, with one exception. There was a consistent motif heard throughout our visit that network IT support was sub par. Given the critical importance of network resources in the field of Bioinformatics, this is should be serious addressed to ensure continued productivity by students and by faculty.

B. Adequacy of research instrumentation and program support: We were impressed by the openness and willingness of faculty to share instrument access with their colleagues. Do note the point we made in Challenges above about the need to ensure support for the team Challenges’ space. The current Program Coordinator is held in extremely high regard. She is clearly a critical resource for the Program.
Review of Clinical and Translational Informatics Track of the Biological and Medical Informatics Graduate Program and Recommendations.

The Clinical and Translational Informatics track of the BMI graduate program has not been successful. After several years of dormancy it was recently revived and three students recruited. However, these students were already working at UCSF before transferring into the graduate program. They were not recruited from outside. The CTI track will surely succumb to the same problems that led to its earlier demise unless it finds a new home as part of a much larger mission. The program needs to be reinvented in a new form, as part of a much bigger initiative in electronic medicine.

We are entering a new decade in which medicine will become much more information-based. This is based on intrinsic changes in medical understanding and technology, and is not just a temporary trend or fad. The restructuring of health insurance and the development of increasingly complex diagnostic and prognostic measurements based on new technologies has created a unique need and opportunity for a new electronic infrastructure for medical records and decision making. The current administration in Washington, and its scientific leaders (including Harold Varmus and Eric Lander on PCAST and Francis Collins heading the NIH) are powerful advocates for this transformation. From the people we interviewed, we found a consensus view that UCSF is in great danger of missing the boat on this, which would put it at a significant disadvantage compared to its peer institutions. The only silver lining is that it is possible that UCSF’s underdevelopment in this area may actually present an opportunity to build something entirely new, based on the latest models in this rapidly changing landscape. This issue is vastly broader and more important to UCSF’s core mission as an academic medical center than the fate of this specific graduate program, and must be addressed at a much larger scale.

**Recommendation:**

We recommend that a task force be created by the Chancellor to explore the idea of a UCSF initiative in information-intensive medicine. Three components would need to be assembled for such an initiative to be successful. (1) An external donor would need to be identified, e.g. a bay area person who made their fortune in high-tech and is frustrated with the current relatively primitive use of informatics in medicine. (2) An external collaborator who is developing a large-scale next-generation platform for medical informatics, such as Google Health, Microsoft Health Vault, or Dossia, and (3) an academic leader in this field who could be recruited to UCSF if given sufficient resources by the external donor to build something world class on this campus, working with the external collaborator. Although the faculty currently involved running this program are good, they are clearly spread too thin and have too many other commitments to provide the level of leadership that is required. Hiring of a new leader would articulate the importance UCSF places on such a program. The extraordinary state-of-the-art clinical enterprise at UCSF, and its outstanding reputation, will be an enormous asset in these negotiations. The recruitment package would need to include multiple faculty lines and facilities, including cooperation from the hospitals to collaborate on deployment as well as training. We recommend that the University consider a pan-academic home for this program that spans across existing schools. This would leverage support from multiple Deans and to reflect the cross-disciplinary nature of the field. If this is not possible, a less desirable alternative would be to obtain buy-in from an appropriate school, e.g. the School of Medicine, which would absorb most of these new faculty lines and prosecute the mission entailed by this initiative.
The current Clinical and Translational Informatics Track would then be reborn (and probably renamed) as a new degree-granting program under the school that houses this larger initiative. Newly hired faculty would teach alongside the existing faculty for this track. To be viable, it is recommended that this new, reinvented program grow to support a professional Masters program as well as a research-oriented Ph.D.

We do not recommend a middle course on this. Half-hearted attempts to perpetuate or slightly enhance the current efforts will not be successful. This requires a decision whether to launch a serious initiative, perhaps along the lines outlined above, or to walk away from this and focus efforts in other areas. The solution for the Clinical and Translational Informatics track is definitely not to stay where it is under BMI. The BMI program is thriving and must remain fully engaged in developing itself into a top-ranked program in bioinformatics, bioengineering and systems biology under the Integrated Program in Quantitative Biology (iPQB) umbrella. The BMI program should perhaps be renamed to reflect the necessary split between clinical informatics and the quite distinct programs in iPQB.