

Evolving Curricula in LIS-focused Bioinformatics Programs

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Introduction

At the 2002 ASIS&T annual meeting a special session co-sponsored by SIG/ED and SIG/BIO explored nascent bioinformatics activities in library and information science (LIS), including in the area of master's curricula (Harmon, et al., 2002). At that time, very little had been presented within the ASIS&T community on roles for library and information science (LIS) in bioinformatics (Denn & MacMullen, 2002). Several bioinformatics-oriented publications followed in subsequent years, including a special issues of JASIS&T (Hemminger, 2005), but this work tended to be focused on situating bioinformatics in an LIS research context (e.g., MacMullen & Denn, 2005), and on specific research projects (e.g., Brown, 2003; Bartlett & Toms, 2005), rather than taking an educational perspective.

Now, seven years later, this panel provides an update on the progress of LIS- and iSchool-based bioinformatics education, with a focus on how programs have evolved, how they are increasing enrollment and developing richer curricula, and how they are differentiating themselves from other programs in disciplines such as computer science and the biological sciences. In addition to the panelists, other faculty who teach in the biomedical informatics area will be encouraged to share their experiences during the Q&A session.

Bioinformatics Education Context

While the bioinformatics curricula of each LIS program and iSchool vary widely, as described below, they are also situated within a diverse landscape of education and training paradigms that span multiple disciplines, ranging across departments of biology, biochemistry, genetics, molecular biology in the natural sciences, as well as biomedical engineering, computer science, statistics, and mathematics. Programs are offered at levels ranging from undergraduate to post-doctoral, and via administrative models ranging from single-discipline perspectives within an academic department, to multi-disciplinary shared-curricula models that include several academic units.

Hemminger, Losi, & Bauers (2005) described the scope of program offerings, and their records have been regularly updated.¹ Their latest survey of bioinformatics programs (January 2009) will be presented during the panel, and the different types of programs and program settings will be discussed. The bioinformatics programs will also be contrasted with closely related programs such as medical informatics programs and public health informatics programs.

The most prominent programs are the 20 university-based biomedical informatics research training programs that the National Library of Medicine (NLM) funds through its extramural funding program.² These programs have pre- and post-doctoral components only, although some of the units also offer master's-level degrees that are not NLM funded. The programs tend to be cross-disciplinary, drawing students from a variety of bio-, computational-, and information sciences. Each program is characterized by NLM as having curricula that emphasize one or more of four areas: health care informatics; bioinformatics or computational biology; clinical research translational informatics; and public health informatics.

In contrast to this research-focused model, with its emphasis on doctoral education, is the Professional Science Master's (PSM) concept. Created by the Sloan Foundation in 1997, the PSM model is focused on training students for careers in industry, government, or nonprofit organizations through a combination of science education and business training, with some similarities to executive MBA programs. There are currently 17 institutions that offer a PSM in "Computational Molecular Biology / Bioinformatics"³, and they vary from being housed in large research universities (e.g., Georgia Tech) to smaller schools such as Northeastern University. The specific focus and coursework required vary significantly across the institutions, but many programs seem focused on placing graduates in the pharmaceutical and biotechnology industries.

Some bioinformatics programs fall under several of the categories described above. For instance, the biomedical informatics program at Stanford⁴ is multidisciplinary, and has a PSM track in addition to being an NLM training site. Other established stand-alone multidisciplinary programs include the University of Pittsburgh,⁵ and Columbia University.⁶

Current LIS/iSchool Programs & Curricula

There are several models for bioinformatics-focused program offerings in LIS programs and iSchools. Differences exist in program structure and credentials conferred.

¹ http://ils.unc.edu/informatics_programs/

² <http://www.nlm.nih.gov/ep/GrantTrainInstitute.html>

³ <http://www.sciencemasters.com/PSMProgramList/ProgramsbyField/tabid/81/Default.aspx#CMB>

⁴ <http://bmi.stanford.edu/>

⁵ <http://www.dbmi.pitt.edu/trainingprogram/>

⁶ <http://www.dbmi.columbia.edu/educ/degreeprograms/>

The Graduate School of Library and Information Science (GSLIS) at the University of Illinois is currently the only LIS program or iSchool to have a separate master's degree in bioinformatics.⁷ The GSLIS program is one of five at the University of Illinois. Each is associated with a campus unit, but they coordinate activities and have a shared core curriculum,⁸ under the rubric of the Illinois Informatics Institute (I³).⁹

The GSLIS M.S. in Biological Informatics is a 36 credit-hour degree, with an optional thesis. Required and elective courses are drawn from the GSLIS curriculum and the four other campus units. The required campus core curriculum includes courses in the areas of biology, bioinformatics, and computer science. Within the GSLIS curriculum, there is an LIS-oriented bioinformatics course, and courses on biodiversity informatics, ontologies in natural science, and scientific communication. Other cognate courses include those for the data curation and health sciences librarianship curricula for the M.S. in LIS degree, as well as courses for the Certificate of Advanced Study (CAS) in Digital Libraries. The program's philosophy is to more broadly construe 'bioinformatics' than the typical constraint to the molecular biology area, with the goal of educating "a new generation of information specialists who are skilled in the many aspects of information management and integration across scale and across fields of biology" (Heidorn, Palmer & Wright, 2007).

The School of Information and Library Science at the University of North Carolina offers a certificate of specialization in bioinformatics¹⁰ which is awarded in conjunction with either the master of science in library science (MSLS) or master of science in information science (MSIS) degree, both of which are ALA-accredited. This program requires additional graduate-level coursework in LIS, biostatistics, and biological sciences in addition to the regular master's degree courses, as well as completion of a substantive research project or internship. This program is aimed to produce LIS graduates who can work in environments requiring some knowledge of biological science research. UNC also offers a standalone Ph.D in bioinformatics. This program's aim is to develop top level researchers who have in depth skills spanning biological sciences, and information and computer sciences.

The School of Information Studies (SIS) at McGill University currently offers a bioinformatics course as part of the MLIS program.¹¹ The course parallels other specialized reference courses (e.g., law information, government information) in the librarianship stream, but is also open to students in both the archival studies and knowledge management streams. The focus shifts slightly in response to the interests of the students, but the aim of the course is to provide MLIS graduates with the knowledge and expertise to respond to bioinformatics and molecular biology related information and training needs in a biomedical or sci/tech library or information center context (Bartlett, 2005). Introduced in 2005, it was the first such course in a Canadian LIS program, and among the few in North America.

The McGill Centre for Bioinformatics (MCB), currently offers a bioinformatics option to Masters and Doctoral students in participating departments.¹² Students complete the degree requirements of their home unit, but also complete a core set of interdisciplinary bioinformatics

⁷ <http://lis.illinois.edu/programs/ms-bioinformatics.html>

⁸ <http://bioinformatics.uiuc.edu/>

⁹ <http://www.informatics.uiuc.edu/>

¹⁰ <http://sil.unc.edu/programs/certificates/bioinformatics.html>

¹¹ <http://www.mcgill.ca/sis/programs/mlis/>

¹² <http://www.mcgill.ca/mcb/academic/graduate/>

courses (e.g., structural bioinformatics, systems biology) and attend a bi-weekly seminar series. This provides students the opportunity to not only maintain their disciplinary focus (e.g., biology, computer science, statistics), but to also gain a common, broader perspective to the multidisciplinary nature of bioinformatics. SIS is currently in the initial stages of having both the MLIS and Ph.D programs become part of the Bioinformatics Option. MLIS students (and post-graduate certificate students) would gain the advanced skills and knowledge in biology to be able to provide specialized bioinformatics information services. Ph.D graduates would be ideally poised to pursue a research and teaching career focused on the information science aspects of bioinformatics.

Clearly, each institution has its own objectives for program development, and there are similarities and differences among the three programs described above, on which the panel will elaborate during the session. Some of the key decisions and concepts facing any LIS or iSchool bioinformatics program include:

- How to define, in programmatic and curricular terms, what the scope of ‘bioinformatics’ includes, within the institution’s particular context.
- Which local units provide possible intellectual synergies and opportunities for partnerships? These decisions are often related to the preceding question: focusing on molecular-level bioinformatics may lead to partnerships with units such as genetics, molecular biology, and biochemistry. The presence of an academic medical campus may lead to a focus on translational bioinformatics or clinical informatics.
- What types and degree of pre-existing scientific domain knowledge is expected of students, and how much will the program help students develop over the course of their study?
- Are there specific types of career paths for which students are being targeted?

Current Demand for Graduates

The diversity of training and education programs described earlier results in similarly diverse pools of graduates who assume different roles in a variety of settings. The NLM programs are focused on training doctoral-level researchers and faculty. PSM programs seem focused on the pharmaceutical and biotech industries. Many jobs are focused on technical skills such as software development. (For more details on the current bioinformatics job environment, see Hill, MacMullen, and Palmer, in press.)

The main market segments where current demand for LIS-focused bioinformatics professionals is observed are as librarians in academic health sciences libraries, in bioinformatics units in universities, and in industry.

The most mature environment for bioinformatics information professionals (as well as the closest to the LIS career path) is for librarians in academic health sciences libraries. There is substantial evidence in the HSL literature of maturation and uptake in that setting over this time period, from early planning efforts and service offerings (e.g., Yarfitz & Ketchell, 2000; MacMullen, Vaughan, & Moore, 2004) to program development (e.g., Chattopadhyay, et al., 2006; Minie, et al., 2006; Rein, 2006) and the evolution of established programs (e.g., Lyon, et al., 2006; Osterbur, et al., 2006; Whitmore, et al., 2008). Helms, et al. (2004) identified six areas where librarians could move beyond established roles to provide services to bioscience

researchers: “communication, collection development, knowledge management, education and training, writing or publishing, and intranet systems development.”

Given the demand for bioinformatics-centered service offerings and trained information professionals, and the relative lack of bioinformatics-focused LIS programs, some libraries have established in-house training programs (e.g., Lyon, 2003) to develop the knowledge and skills of existing library staff. CE courses at the U. S. Medical Library Association (MLA) and the Canadian Health Libraries Association (CHLA) annual meetings often supplement in-house training for working professionals. There appear to be possibilities for partnerships between LIS programs and health sciences libraries to offer training for practicing professionals that leverages existing educational offerings.

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