Journal of Cellular Biochemistry 80:208–209 (2000)

VIEWPOINTS

The Accidental Bioinformaticist

Parag Mallick

The twentieth century has observed several revolutions within biology and medicine. We are now able to dissect complex biological phenomena into specific molecules and their functions. The development of tools to rapidly determine macromolecular structures has further refined our view of the living organism, enabling us to develop precise mechanistic models that help explain fundamental biological processes. High-throughput genomics technologies such as genome sequencing and whole-genome expression analysis are now transforming the biological sciences again and engendering the next revolution; the bioinformatics revolution. Without intending to, I inadvertently joined this revolution, and am now one of its strong proponents.

The Accidental Bioinformaticist

I can honestly say that I never planned to become a bioinformaticist. Five years ago, if you had mentioned the word bioinformatics I most likely would have just stared at you and looked puzzled. I only recently became a champion of bioinformatics when I realized that bioinformaticists explore the interface between the many fields I adore. It is now exciting to be part of a nascent field, where the boundaries and even the fundamental problems have yet to be defined. However, it is not the newness or novelty of bioinformatics that draws me to it now. Instead, my interest in the field is completely accidental and was developed through separate interests in the diverse fields that comprise the interdisciplinary field of bioinformatics. The recent emergence of bioinformatics has enabled me to meld long-standing, disparate interests into a cohesive, coherent, clear path. I did not study to become a bioinformaticist. I took an interdisciplinary course load to avoid neglecting a field I enjoyed. In retrospect, I have spent my entire life preparing for and getting excited about bioinformatics. I can think of few other fields where one can actively exercise an interest in mathematics, statistics, chemistry, biochemistry, molecular biology, and computer science.

Developing a Passion for Bioinformatics

My path to becoming a bioinformaticist actually began in fifth grade under the instruction of Mr. Baumgärtner. It was there I first learned algebra and began to appreciate mathematics. Without the rigor of mathematical principles, it would be nearly impossible to categorize and glean information from the vast stores of biological data now available. My research colleagues & mentors have always encouraged me to continue expanding my mathematical horizons. In addition to providing a wealth of tools, mathematics helps develop a clarity of thought that enables one to translate a biological question into an analytical approach.

My passion for math was supplemented in high school with passions for chemistry, biochemistry, molecular biology, and computer science. Diane Sweeny inspired our class to think about biology, to aspire to understand the nuances of complex biological systems, and to realize that biology was fun, interesting, and exiting. It was primarily because of her that I went to college to be a molecular biologist, and to her that I attribute my current fascination with the way the biological world works.

My interest in bioinformatics would not be complete were it not for Mark Lawton. My senior year of high school Mark developed a course in Advanced Placement Computer Science. I had been tinkering around and "programming" since I was a kid, but it was in this class that I had my first exposure to real computing, to algorithms and design.

My Collegiate Training

High school gave me a passion for chemistry, biology, math, and computing. In college, I refined these interests and developed the core

skills that I use today. As a freshman I arrived on campus a molecular biology and biochemistry major. Within hours I realized that this degree would satisfy my desire to learn more biology and chemistry but would force me to completely abandon my interests in math and computing. A bioengineering option existed, but at the time I felt it was neither enough biology nor enough engineering. I decided instead to pursue a dual program in computer science and biochemistry. To expand my curriculum further, I would often audit or sit in on non-major classes that interested me. In hindsight I wish I had taken more classes in pure and applied mathematics as well.

In addition to classwork, I was given the opportunity to participate in two research projects. One project was with the Department of Computer Science and the other with Department of Biochemistry and Molecular Biophysics. My undergraduate research helped me both focus and expand my collegiate experience. My research forced me to explore areas I had only briefly discovered in coursework. Classes usually provided questions or problems and forced me to find answers. Research forced me to find both the questions and the answers. It forced me to translate problems between fields and gave me experience with the application of diverse disciplines in the real world. In addition, the people I worked with helped me design a curriculum so that I would be equipped to approach problems set before me.

Suggestions for Beginning Bioinformaticists

To operate at the interface between many disciplines, one must have the language and familiarity to converse with those in each discipline. If I could give any advice to those considering this path, I would say "do not take shortcuts, they will only get you in trouble later." Take all the classes you can, and if you cannot handle the load, at least sit in and listen so you will be able to learn it on your own later. Also, do not overextend yourself. If you do, you will have a lot of knowledge, but no real core expertise. A friend of mine used to say "If you find that it is impossible to know a lot about a lot, then be great at one thing and try to know enough about everything else to make yourself useful." I took from that the importance of having at least one very strong discipline and the ability to communicate with those who are expert in other areas.

Also, remember that there is often value in things that don't seem immediately useful. Often a course will help you broaden your perspective or think about things differently without actually giving you a concrete skill. Bioinformatics is constantly changing and will continue to do so. The best training you can give yourself will involve developing strong fundamentals, the ability to problem solve, and the ability to change your perspective on a particular problem at the drop of a hat. Some of the computing classes I enjoyed most, like computer communications, have not directly helped me with my day-to-day research. However, these courses have allowed me to think about data transfer, distributed database synchronization, message passing, abstract design, and coding theory, which are all highly relevant to my studies. Above all, give yourself the ability to translate problems between disciplines and the ability to learn what you need to address a particular problem. There is no set of skills that will make you "ready" to study bioinformatics. There is also no recipe I can give that will make you ready. There is no such thing as ready. Every problem I work on requires me to expand my knowledge base before beginning. Be prepared for diverse problems. Give yourself the ability to learn for each problem. Make sure the learning overhead, for each problem, is not insurmountable. Learn to think in different perspectives. Practice turning biological problems into computing or mathematical problems. Ask yourself random questions and try translating them; for example, "How might one express the protein folding problem as a graph theory problem?" Once you have (1) an area of expertise, (2) a large enough breadth and vocabulary to talk to others in different fields, (3) the ability to translate problems between disciplines, and (4) the ability to learn whatever you will need to solve a particular problem, then you are as ready as you will ever be to study bioinformatics.