Informatics and Biology: What Do They Have in Common

Viera K. Proulx, Associate Professor
College of Computer Science, Northeastern University, Boston, MA 02115, USA
Internet: vkp@ccs.neu.edu

Abstract

By comparing informatics with biology we make an argument for including the study of informatics in a standard secondary school curriculum. Both sciences examine the world we live in, from the smallest components (cells or bytes) to large complex organisms (living animals or computer systems), all the way to the global view of the world around us (world ecology or international system of computer networks). The advances of informatics affect profoundly how we live, work, communicate, and play. By learning to understand the underlying principles of informatics, our students will be better prepared to function in the information world.

Keywords:
Informatics as Study Topic, Curriculum Policies, National Policies, Equity Issues, Social Issues

Introduction

Biology has been a part of standard secondary school curriculum for years. Nobody questions the need for understanding the world of living organisms from the smallest one cell creatures all the way to the complex system that is our human body. We are surrounded by living organisms. Our actions affect the living world around us and the living world around us affects our lives. Over the past fifty years, a new fast growing environment of information technology evolved and became a part of the world we live in. Computer chips control our cars, appliances, factories, they change the world of medicine, banking, transportation, and above all communication. Informatics changes the way we work, play, interact with each other; introduces new problems of computer crime, privacy and security intrusions, new way of dealing with property rights, create new social classes of empowered or disenfranchised people.

Informatics Curriculum and Its Importance

In 1993 Association for Computing Machinery published a Model High School Computer Science Curriculum [1], with the recommendation, that a course in computer science

(informatics) become a regular part of secondary education. Unfortunately, the road to full implementation of these recommendations is a long one. While some states already include some form of informatics in their secondary curriculum, others do not even permit teachers to be certified in computer science. That means that teacher interested in introducing computer science curriculum into her high school must first be certified and hired in another discipline. Many argue that it is sufficient for students to learn how to use computers, not how they work. While nobody expects all students that take a course in biology in high school to become biologists, the argument against studying computer science is that only a few students want to become computer scientists. Let's look at some topics students should learn about.

Bits and Bytes:

Just like cells are the basic building block of all living creatures, so are bits and bytes the basic components of informatics, The way they are stored, manipulated, combined into words, records, files, databases, and large information systems resembles the increasing complexity of living organisms. The information flow in a computer system - with input, processing, and output parallels the processes that cause plants to use water with minerals as their food, and produce fruits and generate oxygen as a result of their growth. We can cultivate the plants - just as we are in charge of organizing and manipulating the information in a computer system.

Algorithms:

Anybody who played a card game or a board game knows what an algorithm is. By looking at basic components of algorithms - repetition, decision, decomposition into simpler parts, we are giving students tools for understanding the nature of controlled processes in general. Simple examples allow us to illustrate how fast a solution can grow, or how easy it is to divide and conquer a difficult problem. They also learn about accumulation of round-off errors, or potential failures due to the poor design of an algorithm.

Computer Architecture:

The number of different computers and calculating devices available today is mind boggling. yet it is easy to show students that just as all living organisms have some similarities, so are all computer systems built out of the same basic building blocks that interact in standard ways. By learning these principles, students will be able to adopt to new systems and use effectively what each has to offer.

Programming Languages:

All students typically learn some method for programming a computer. By learning more about programming languages students see the similarities between the different ways of communicating with computer, they understand the need to follow the syntax carefully. They learn to 'say what they mean and mean what they say'.

Operating Systems:

In biology students learn about the functioning of human body. It is a complex system with several subsystems that interact to support normal functioning. Operating system is similar. There is a memory manager, the process manager, the I/O supervisor, the file manager, the accounting system, the protection mechanisms, the different levels of user interface. While user interfaces differ from one system to another, the underlying management functions carried out by the operating systems remain the same. By understanding these principles, students are ready to learn about new systems and are able to compare the different options available.

Telecommunications:

Computer networks change the way we communicate, exchange information, conduct business. The advantages of having access to the global network, the resources available there, the potential for future growth, are all important to address in every secondary school.

Applications:

Students see many applications of computers in their courses throughout the curriculum. But they do not study the impact of these applications, what are the main threads, nor what are the trends for the future. Some applications are outside the scope of subjects studied in high school, yet affect our lives in a profound way. A course in informatics should look at some of these, to provide a perspective and inspiration.

Societal Issues:

Computer technology gave rise to new types of crimes, property rights, introduced new types of privacy and security problems. It is changing the way we work, play, and communicate. Students should take the time to assess the social and environmental implications of new advances in informatics, reflect on the new societal classes created by the growth of computing, and think about their place in the information world.

Conclusion

The study of informatics stands apart from simple uses of computers throughout the curriculum. It gives the student a solid foundation for understanding the new complex world of computing and communications. It prepares students to adopt to new computer systems and applications and find ways of employing them effectively in their work and daily life. We should look for ways to make study of informatics a part of secondary school curriculum in all states and countries.

References

1. ACM Task Force, "ACM Model High School Computer Science Curriculum", Report of the Task Force on High School Curriculum of the ACM Pre-College Committee", ACM Press, 1993.
2. Viera K. Proulx, "Computer Science/Informatics: The Study of Information World", submitted to the Sixth World Conference on Computers in Education, WCCE '95.
3. Viera K. Proulx, "Computer Science in Elementary and Secondary Schools", in Informatics and Changes in Learning, Proceedings of the IFIP TC3/WG3.1/WG3.5 Open Conference on Informatics and Changes in Learning, Gmunden, Austria, 7-11 June 1993, D. C. Johnson, B. Samways, eds., North Holland, 1993, pp. 95-101.