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Multimedia Education in Computer Science: A Little Bit of Everything Is Not Enough

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Multimedia is everywhere. People use it for entertainment purposes, for example, when storing, accessing, and sharing videos on platforms such as YouTube. However, the use of multimedia becomes increasingly serious in contexts such as VoIP and video conferencing. The quickly growing pervasiveness of multimedia increases the relevance of its knowledge for today's computer science and software engineering students. But its significance for the future of computing generally is not reflected in current curricula. For example, few universities offer dedicated programs; most only teach multimedia as part of other courses such as computer graphics and computer vision, or else not at all. How should the multimedia community deal with this issue? What makes up a good multimedia education? Do we need to rethink and improve the way in which we teach multimedia today?

To answer these and related questions, a panel of experts—Susanne Boll (University of Oldenburg, Germany), Ramesh Jain (University of California, Irvine), Max Mühlhäuser (Darmstadt University of Technology, Germany), and Timothy K. Shih (Tamkang University, Taiwan)—discussed the current status and the future of multimedia education at a workshop held at the 2007 ACM Multimedia conference (see Figure 1). The ''Panel Summary'' sidebar (on page 80) summarizes the main statements of the panelists; further information about the workshop can be found at http://emme2007.informatik.uni-freiburg.de. The panelists' comments and discussion with the audience clearly showed the high relevance of this topic. This topic is of significant importance for the multimedia community because the way in which we teach multimedia not only shapes today's students (who will be tomorrow's multimedia researchers and developers), but also influences the field's general definition, self-conception, and overall acceptance among other disciplines. This is because discussion about the content of good multimedia education almost inevitably forces us to take a closer look at the definition of multimedia as a discipline and the current status and nature of the field.

Current multimedia education resembles the earlier days of computer science, where people were discussing whether the topic required its own interdisciplinary curriculum or whether it should be taught as part of a traditional discipline, such as mathematics or electrical engineering. Because of the relevance and uniqueness of multimedia, we suggest establishing it as its own discipline and getting the subject higher recognition in related fields. In the following sections, we discuss the most critical issues for improving the current status of multimedia education, enforcing the standing of multimedia among other disciplines, and making its relevance for the future of computing more clear.

Editors' Note

Media Impact usually focuses on the practical impact of multimedia research on IT business. Yet given the pervasiveness of multimedia technology in our everyday life, a thorough reflection on the impact of multimedia progress on education and, in particular, multimedia education is overdue. Multimedia teachers at the 2007 ACM Multimedia conference engaged in a panel discussion on the current state and future of multimedia education. In this issue's, Wolfgang Hürst of Utrecht University and his colleagues Gerald Friedland of the International Computer Science Institute, Berkeley, and Lars Knipping of Berlin University of Technology use this panel as an opportunity to argue the need for a dedicated multimedia curriculum in computer science education.

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Figure 1. At the workshop on Educational Multimedia and Multimedia Education, several researchers and educators gathered to discuss new technologies and approaches for multimedia-based education. (Photo courtesy W. Hürst.)

Multimedia curriculum

Following traditional definitions, multimedia combines at least two elements from continuous and discrete media types, such as audio or video and text or images. As a consequence, many successful multimedia researchers and educators actually don't have a degree in multimedia technologies, but often have either a rather broad computer science education or are experts in one particular area with high relevance for multimedia—for example, computer vision, graphics, computer networking, or human–computer interaction. The resulting interdisciplinary characteristic is a key aspect of multimedia. In fact, for many people it's one of the main reasons multimedia is such an exciting research area. However, multimedia not only profits from the contributions of people with various backgrounds, but also sometimes suffers from this interdisciplinary nature by not being seen as a discipline of its own but as a melting pot of different areas.

For example, what is the answer to a student's question about what to study to become a good multimedia researcher? An answer such as ''a little bit of everything'' would be as unsatisfying as the recommendation to concentrate on one particular technology. A generally accepted curriculum for multimedia doesn't exist but is strongly needed. And although such a curriculum would be an important step in the right direction, it isn't enough. In the same way that multimedia research benefits from interdisciplinary contributions, multimedia education should take advantage of courses taught in different disciplines. Hence, we also need some sort of guidelines elaborated by the community. These should harmonize the education of multimedia-related content taught in different courses of related disciplines. Doing so would establish a common basis of multimedia knowledge not only for future multimedia researchers but also for general computer scientists and software engineers.

Such guidelines and a commonly accepted multimedia curriculum will not only improve multimedia education but will certainly be of high relevance for people already working in the field as well. We mentioned the traditional view of multimedia as a combination of a discrete and continuous medium. This definition dates back to the days when PCs could barely manage to render a single video and providing temporal synchronization seemed to be the Holy Grail for multimedia research. Shouldn't more recent issues, such as multimodal artificial intelligence, interactivity, or even social aspects, be reflected in the definition as well?

Learning material

The question of whether multimedia should actually be used to teach multimedia is another highly discussed issue. Many multimedia teachers barely make use of new media in their courses, often instead relying on traditional ways of teaching using chalkboards or slides. On the surface it could seem that there might not be much value in media-supported teaching when even multimedia experts don't use it, but we disagree with this statement. For example, to explain the complex formula or calculation procedure used in a multimedia compression algorithm, the chalkboard might indeed be the most appropriate tool. On the other hand, in foreign language learning, having a textbook with associated audio clips obviously seems to add value. Hence, if and how multimedia can make teaching more exploratory and successful depends on the actual content and subject rather than on the discipline. Nevertheless, examples of really good multimedia teaching

Panel Summary

A panel at the ACM Workshop on Educational Multimedia and Multimedia Education at the 2007 ACM Multimedia conference discussed the current state and future of multimedia education. Panelists included four experienced multimedia researchers and educators. Here, we summarize some of their statements.

Max Mühlhäuser of the Darmstadt University of Technology, Germany, stated that in relation to general computer science, multimedia is not particular with respect to the involved concepts, but with respect to multimedia's interdisciplinary nature. The big challenge related to the content of multimedia education is not the identification of the core algorithms and methods, Mühlhäuser argued, but pushing these approaches into canonical computer science education. Mühlhäuser said that although lots of basic algorithms are indeed taught in introductory classes, harmonization between the different fields is strongly needed to establish a reasonable baseline and get the foundation needed for a solid education in multimedia. Hence, Mühlhäuser said, this problem is a political rather than a technical one. Because of its interdisciplinary nature, multimedia is often considered a soft topic and an application domain not covered in basic computer science classes but later in the curriculum. Mühlhäuser argued that computer science in general should become more interdisciplinary by focusing, for example, on human aspects as well as traditional topics. In that sense, multimedia could serve as a way to introduce an interdisciplinary nature to future computer science.

In relation to learning material, Mühlhäuser mentioned that the lack of a good textbook could just be an artifact and argued that textbooks might not be a timely medium for a quickly changing field such as computer science. Instead, Mühlhäuser suggested that we should work on new and better ways to use educational multimedia material in teaching.

Timothy K. Shih of Tamkang University, Taiwan, analyzed the computer curricula recommendations of the ACM and the IEEE Computer Society for computer science, computer engineering, and software engineering, and concluded that multimedia indeed exists in these curricula but mostly in relation to applications and systems and topics related to human–computer interaction. However, the basic concepts and uses of multimedia technologies can and should be taught in introductory and programming courses. On the other hand, he raised the issue that the field is changing very quickly and new trends, such as ubi-media (ubiquitous multimedia) computing or video game technology, create a constant need to adapt and change course contents. To deal with this issue, Shih argued that the multimedia community should specify some guidelines for basic multimedia technologies taught in introductory classes, thus creating a solid basis so we can teach advanced up-to-date topics that meet the changing demands of industries in elective courses. In this context, Shih also brought up the issue of the community looking into employment opportunities and that the demands from the industries should be better considered in multimedia education.

On the basis of his own experience with using multimedia in his classes, Shih strongly argued for the production of reusable and exchangeable e-learning courseware and mentioned standards such as the Sharable Content Object Reference Model, Content Object Repository Discovery and Registration/Resolution Architecture, and the e-learning specification Common Cartridge. In relation to multimedia textbooks, he said that a perfect one might not exist but mentioned Li and Drew as an example of a reasonable choice for a basic multimedia course.[1]

Susanne Boll of the University of Oldenburg, Germany, identified multimedia as a truly interdisciplinary field that goes beyond single topic areas, such as computer vision and computer graphics, by being multimodal, involving human aspects, and meeting usability and accessibility issues. For these reasons, she argued against teaching multimedia only in advanced courses but said she believes that its basic technologies should be taught in introductory BS and MS classes. However, at many universities multimedia is not considered a relevant basic course on part with subjects such as operating systems or artificial intelligence, and is sometimes not taught at all. To deal with this issue, Boll argued that the multimedia community should elaborate a standard curricula or guidelines. Plans of the recently founded section on media informatics within the German Society for Computer Science as well as related efforts of the new European subchapter of the ACM Special Interest Group on Multimedia illustrate that the community is indeed starting to address such issues. A curriculum certified by the community would help define the field and give individual teachers a stronger standing for implementing related courses. In addition, it might help in collecting and exchanging related material.

In relation to learning material, Boll said that the issue is less about incorporating more multimedia into our courses than it is about practicing multimedia with the students. More multimedia tools could be introduced in lectures to foster experimentation through small practical projects.

Ramesh Jain of the University of California, Irvine, US, argued that multimedia education is not in a good state. In fact, Jain said the whole discipline is often considered by educators outside the field to be a second-class citizen. Jain said this attitude seems surprising if you look at the historic development of computer science. In the early stages, computing was all about data. Then we started dealing with information. Now experience is becoming the main focus, which is, in fact, inherently multimedia-based. Jain said that new trends and technologies, such as powerful mobile phones, will push this last phase even more because people using these phones will not distinguish between video, audio,

or text. The reason multimedia is not getting the respect it deserves might partly be our own fault in that the multimedia community has not clearly identified the fundamentals of its own discipline. The lack of a good textbook is one example supporting this statement. Where there are plenty of research overviews (which are generally written from researchers for researchers) and encyclopedias (which are created by editors), true textbooks (which are written by teachers and look at multimedia purely from a student's perspective) are missing. If we don't have a textbook that synthesizes the fundamentals, how can we expect our colleagues in other computing sciences to consider multimedia as a discipline? In fact, there are many areas such as computer graphics, computer vision, or databases that only gained acceptance as a basic discipline within computer science once appropriate textbooks had been written.

For the creation of such a book, Jain argued against a traditional textbook but for some sort of organic book that is multimodal, created by the community, and continuously developing. The multimedia community keeps claiming that information and knowledge should not be created, distributed, and stored exclusively as text. Hence, a book on multimedia using real multimedia would be a logical approach that gives us the opportunity to keep up with new developments and, more importantly, allows the community to author it, thus helping to define the field.

The statements presented by the panelists resulted in a lively discussion. A mutual agreement among participants was that there is a need for a multimedia curriculum or guidelines for multimedia teaching, especially for boost multimedia education at introductory levels. In addition, there was agreement that better teaching material is necessary. Klara Nahrstedt agreed with Jain's statement about the relevance of a good textbook. She gave an example of some recent developments at her university where course-specific textbooks are created using a mixture of chapters from different books to better fit the needs of a particular class. Although some skepticism about this approach was mentioned in the discussion, it's a clear indication that publishers have started thinking about better and more timely ways for the production of teaching material. In fact, such efforts could even be interpreted as a small but nevertheless important step toward the creation of an organic book as proposed by Jain.

material are rare, and it's somehow surprising that multimedia experts don't come up with more and better multimedia material for their own courses. It's unclear if this is due to a lack of good tools or active media competence (which someone with theoretical background knowledge might not necessarily have), or just an issue of limited time and resources.

The lack of good teaching material is evident not only for multimedia tools but also for traditional media. It's generally understood in the multimedia community that no really good textbook for a basic multimedia course exists—a perspective even shared by Klara Nahrstedt, a co-author of the de facto standard multimedia book (see the ''Panel Summary'' sidebar). There are many possible reasons for this. There are rather pragmatic ones, such as limited time and a lack of reward for writing a good multimedia textbook. Another, more crucial argument might be that the field has become too big to cover in a single book. In addition, the field changes very quickly—a fact that applies to most areas of computer science, but is even more applicable to multimedia.

Because of the long editing cycles, publishers have begun to rethink traditional ways of publishing teaching material and are experimenting with new approaches, such as individual, class-dependent versions of textbooks consisting of selected chapters from different books and exclusively produced for a particular class (see again the ''Panel Summary'' sidebar). Multimedia researchers have long worked on recording lectures and the resulting systems are now used by a growing number of teachers. The produced content certainly will not replace textbooks or printed matter in general, but can complement them and therefore might help solve the problem of insufficient or outdated teaching material.

Other promising approaches exist for the creation of up-to-date teaching material. If implemented successfully, they would not only help today's multimedia students and teachers, but also would act as guides to find ways for better creation of teaching material in general. An organic book, as proposed by Ramesh Jain in the panel (see the ''Panel Summary'' sidebar), that grows out of contributions from different disciplines and keeps evolving over time in response to new developments seems like a good step in the right direction. Students and teachers would benefit from a good textbook about basic multimedia technologies, and, again, so would the community as a whole, because such a book would help define the field and increase its acceptance among other areas of computer science.

Discipline acceptance

Unfortunately, there is not much acceptance of multimedia as a discipline from people not working in a multimedia-related field. Quite often multimedia doesn't get the respect it deserves. We see no problem here with today's students because the current generation already accepts multimedia as a natural part of computer science. For example, current computer science students have grown up with digital music, MP3 players, and so on, and don't typically use analog media, such as tape recorder and LPs or even CDs. However, it's exactly this entertainment aspect of multimedia that hampers multimedia as a discipline from gaining acceptance in some parts of traditional computer science. For some people, multimedia has become such a buzzword that they actually avoid it and use different terms, such as media technology, to attempt to deliver a more scientific connotation.

True multimedia is probably one of the most difficult fields in which to do research because, to do it right, you need significant knowledge of many disciplines. However, because of this interdisciplinary characteristic and focus on users and applications, multimedia is not always acknowledged by some of our colleagues. Similarly, there are many different perceptions of multimedia in the industries. On the one hand, we have the growing multimedia-related industries that acknowledge that developing computer games or entertainment-related media not only is fun but also requires the highest skills in computer science. On the other hand, we have many traditional industries that don't accept that multimedia is becoming ubiquitous and a normal, integrated part of everyday computing, and is not just a field with the main applications related to fun and entertainment.

Again, a general multimedia curriculum as well as some common guidelines on multimedia education would be helpful. In addition, the multimedia community should not think only about how it can better impart media knowledge to students, but should make sure that the industries that hire those students become aware that this knowledge will be an essential requirement for the future of computing. We should work harder on to increase acceptance, describe the job opportunities for students of multimedia more clearly, and improve evaluation of the skills expected of a multimedia engineer.

Consequences

Multimedia research has achieved tremendous results over the last years, which is demonstrated by the increasingly ubiquitous role new media plays in our everyday life. However, it's obvious that multimedia education is not in a perfect state. We as a community should do something about this, first to improve the education of today's students and second to increase the general acceptance of the field. We should develop common guidelines for multimedia education. We should talk to multimedia-related industries and communicate the need for multimedia with people working in traditional areas of computer science. We should better evaluate and specify job opportunities and requirements for our students. And, finally, we should produce better teaching materials and think of timely and more forward-looking ways for their production.

Doing all this is a tremendous challenge because of the interdisciplinary character of the field and its rapid evolution. However, it's exactly because of this dynamic and multimedia's interdisciplinary nature that we have the chance to accomplish these goals. By doing so, we would be contributing to the field and serving as pacemakers and creative directors for others, introducing a more interdisciplinary character to computer science in general and illustrating new and better ways for the production of timely teaching material.

The discussions at our workshop and the related activities show that the community is becoming aware of the importance of multimedia education. We hope that our views presented here can help foster some new momentum. We encourage everyone—those who agree and those who disagree—to participate in this discussion to help improve multimedia education and to make sure that our field gets the recognition it deserves. **MM**

Reference

1. Z.-N. Li and M.S. Drew. *Fundamentals of Multimedia*, Prentice-Hall, 2003.

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