The Creation of a Partnership to Guide the CIS Curriculum

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Abstract

The computing industry is in a constant state of evolution. Technological changes are slow to be merged into the college curriculum. In many cases, faculty members at universities suffer from a lack of industry contact, which hinders this integration of new technology. In addition, to be effective, the curriculum must focus on core computer science concepts and not simply be at the mercy of current trends. To achieve an adequate balance there must be a cooperation and understanding between academia and industry. The theory of the core concepts must be reinforced by concrete experiences that support the learning environment. To this end, an industrial advisory council has been in place for many years at the School of Computer and Information Sciences (CIS) at the University of South Alabama. These leaders from local and regional industry consult on a regular basis with the School's administration and faculty. Recently, this has led to the creation of a partnership to support several targeted courses in the curriculum. Accelerated Technology (AT), a division of Mentor Graphics, is an international company based in Mobile and is focused on embedded real-time processing. It was recognized that a partnership would be mutually beneficial to both parties by providing much needed equipment, resources and expertise to the university as well as giving students - potentially future AT employees - practical experiences using state of the art equipment to supplement their course concepts. It was understood and planned that no theoretical changes would be made to the courses but that practical laboratory experiences would be integrated in order to reinforce the core concepts. The following courses were targeted for this joint venture: operating systems, networks, real-time systems and advanced networks. It was also anticipated that after students completed those courses that later in the curriculum during senior projects, directed studies or theses they might continue to develop projects that were initially started in those courses. The basic attributes of this partnership included: funding of two graduate fellowships, providing a substantial equipment grant, training the graduate fellows at AT and providing support and expertise throughout the year. The paper will report on the creation of the partnership and the observed impact on the CIS curriculum.

Introduction

In order to evaluate our educational program, we have a Dean's Student Council made up of undergraduate and graduate students from all three of our program's disciplines (computer science, information science, and information technology) and an advisory council made up of industrial leaders from technology oriented companies from across our local region. When asked how they would improve their education, the members of the Student Council consistently mentioned that they would like to see more demonstrations and have more hands-on labs where they could explore the various theoretical topics discussed in class. The members of the advisory council also noted that it would be beneficial if our graduates had some more in-depth projects so that they would be better prepared when they entered the work force.

At the time, our University was experiencing major funding cutbacks from the state government. Due to this lack of funding, the entire University enforced a hiring freeze. Since we were unable to purchase new equipment or hire additional faculty, we had no way to make these demonstrations and labs a reality.

Despite these bleak economic conditions our university and the School of CIS continued to attract many new students. Our industrial advisers continued to be impressed with the quality of our graduates and found them to be valuable assets to their own economic growth. Since these industrial advisers had often been consulted on curriculum issues, they were well award of the core topics included in the curriculum and found in our courses. Since all of the advisers attended and met each other during the Advisory Council meetings, each member realized that the School of CIS services a wide and diverse industrial base and thus that the demands of any one industry could not drive any curriculum decisions. With this in mind, more in-depth discussion continued with several industrial advisers.

The Birth of a Partnership

One of these industry leaders, Neil Henderson is an alumnus from our University and was the CEO for Accelerated Technologies, Inc. (AT), which was later acquired as a division of Mentor Graphics. While attending the advisory council meetings, Neil Henderson saw an opportunity for his corporation to participate more actively in the development and growth of the university. Seeing the problems that the school was having with funding, he proposed a mutually beneficial partnership which would allow the school to enrich the students' learning experiences by making the addition of new demonstrations and labs possible. Many of the employees at AT were themselves graduates of the School of CIS and were well acquainted with the courses of the curriculum. Likewise Neil Henderson had become well aware of the relevant courses through his work with the industrial advisory council.

Initial high level discussions identified certain targeted courses that AT felt they could assist with through equipment and technical expertise. Since AT develops software for the embedded real-time market, the obvious target courses would include: operating systems, networks, architecture/organization, and real-time systems. Several employees were invited to deliver guest lectures in some of those courses which were in progress at the time. This was met with great excitement by the students in those courses. At the same time several recent graduates of

our Computer Science program started work with faculty to define enhancements to the curriculum, targeting the specified courses. These graduates were able to provide valuable insight from both a student perspective and industrial expectation.

The resulting document was used as a proposal for the funding of this partnership between AT and the university. Priority was established to enhance the above mentioned courses in which AT had interest and expertise. However, due to the broader knowledge of the AT employees (former CS students) they were able to also envision a farther reaching impact of this effort. The proposal extended beyond the limited courses to include many courses related to those courses. For example, prerequisite courses could anticipate the use of certain concepts or equipment and be given a preview. Likewise follow-up courses could build on prior efforts. The most likely follow-up courses would be the senior projects capstone or individual research projects (directed study, MS theses). For the sake of the proposal document many technical details were not enumerated. However, even at this initial stage of planning, additional working documents were created for each course which detailed projects and how topical coverage could be enhanced. It is certainly the case that most of this could not have been accomplished without the in-depth knowledge provided by the recent graduates of the CS program. These graduates were able to balance the needs of a specific industry with the overall demands of the broader curriculum. They were also able to blend and merge those needs into the curriculum in such a way as they maintain the larger curriculum goals. This effort was an example of the benefits of a participatory design effort by those with expert knowledge.

Details of the Partnership

The partnership between AT and the University consisted of donated equipment, software, and funds that were expressly to be used by the University to give students practical hands-on experience at various stages of their education. Seventy-three thousand dollars in equipment and software were given to the university. The equipment consisted of various evaluation boards and the accompanying hardware to give them more diversity in use. The software consists of the various off-shoots of the Nucleus operating system and the code|lab debugging tool, both of which were created and developed at AT. In addition, AT donated twenty thousand dollars with which to fund two graduate assistants and to pay for any extra equipment expenses or travel expenses that may be warranted from this partnership.

Equipment

The equipment donated by AT included ten SH-2 Evaluation Boards and ten code|lab Partner Solution Mother Boards. Each of the mother boards were accompanied by an SH-4 Daughter Board and a Partner-J hardware debugging device. The SH-2 and SH-4 boards were manufactured by Hitachi and are mainly used in embedded systems.

Software

The software donated by AT includes various offshoots of the Nucleus operating system and the code|lab debugging tool. The Nucleus operating system is a real-time operating system that offers many useful services that allow systems programmers to easily accomplish a variety of

common tasks. The code|lab debugging tool allows programmers to debug the applications that they create for the donated hardware. This tool allows programmers to download their programs onto the boards and to view various operating system statistics while the program is running. code|lab was used extensively in almost all of the created demonstrations.

Graduate Assistants

As part of the contractual agreement, AT gave the university $18,000 to cover the cost of two graduate assistants who would be in charge of creating much needed the demonstrations and labs. Each graduate assistant was given a stipend of nine thousand dollars that was paid biweekly over the nine month period spanning the fall and spring semesters. They were also each granted a four thousand dollar tuition waiver by the University.

The graduate assistants were expected to work with the donated equipment and software for twenty hours per week during the semesters. In order to become familiar with the donated equipment, the graduate assistants spent the first eight weeks of the fall semester commuting to AT. During this time, the assistants were mentored by several AT employees, some of which were university alumni. The employees showed the assistants how to set up the hardware and software. They also gave the assistants some tasks that helped to guide them to delve a bit deeper into the implementation of the Nucleus operating system so that they could better understand the various system calls and functions. This experience allowed the assistants to get a feel for how the equipment is used by AT's customers and thus helped to expand on their ideas on how to integrate the equipment back into the curriculum.

After becoming acquainted with the technology, the assistants began working in an on-campus lab environment. They were expected to produce demonstrations and hands-on laboratory exercises for various courses in the curriculum. In order to accomplish this, the assistants met with several instructors of the targeted courses to find out which topics they would like their students to see concrete examples of. The assistants were also expected to oversee and partially mentor any projects that dealt with the AT equipment. They were basically to act as the AT experts on campus. Since they too only had limited experience with the equipment and software, they kept in regular contact with their mentors from AT.

Additional Funding

In accordance with the partnership contract, AT gave the University one thousand dollars for any additional supplies or materials that might be needed for the lab. Some of this money was used for the purchase of tools, wires, and sensors that were used for several class projects using the AT equipment.

In order to help finance any travel that might be necessary in conjunction with the partnership, AT also gave one thousand dollars for travel money. This would be used to help offset the cost of travel to conferences such as this one.

In total, this partnership required $101,000 in funds and equipment less than eight percent of which was paid for by the university.

University Curriculum Benefits

The School of CIS benefits immensely from this partnership with AT. Not only do the students benefit from a more enriched curriculum, the professors also have an enhanced research experience by having a wider selection of equipment on hand for various research projects.

Even in just this first year of the partnership, the curriculum has been greatly enhanced by the addition of more concrete demonstrations and labs. In particular, the courses of real time systems, operating systems, and networking have greatly benefited thus far. In the real time systems course, students were able to use the donated equipment to create more realistic real time systems than they have been able to in previous years. In the operating systems course, demonstrations using the donated equipment and code|lab were developed to help students better understand the concepts of process priorities, scheduling, and semaphores. The students also had a hands-on laboratory experience in which they created counting semaphores. In the networking course, a demonstration on wireless communication was developed using the donated equipment in conjunction with a pair of wireless transceivers.

Operating Systems

For the operating systems course, the graduate assistants developed several demonstrations to concretely illustrate some of the concepts from the course. The concepts demonstrated were chosen by the assistants with input from the instructor of the course. These concepts were multiprocessing, scheduling, process priorities, preemptive and non-preemptive processes, and semaphores. The assistants also created a hands-on lab that allowed the students to create their own counting semaphore. During this lab, the students had a chance to further explore the other concepts demonstrated to them. Data was collected in order to ascertain the effectiveness of these demonstrations and labs in reinforcing the concepts. According to this data which will be further discussed and evaluated in a future paper, the students showed enthusiastic acceptance of the demonstrations and illustrated an increased understanding of the demonstrated concepts.

Real-time Systems

For the real-time systems class, the graduate assistants developed several ideas for projects that the students in that course could create using the donated AT equipment. These projects not only allowed the students to create an actual example of a real-time system that utilizes many of the concepts that they learned in class but also forced the students to deal with many issues from their previous courses, such as dealing with memory management, interfacing between hardware and software, and creating a good user interface so that the user has some visualization of what is happening inside the system. At the end of the semester, the employees of AT were invited to watch the demonstrations of the completed real-time projects. By seeing that the students were intelligently using the donated equipment in class projects less than a year after the partnership began, AT was able to see an effective use of the technology in the classroom.

AT Perceived Benefits

As seen by Accelerated Technologies, there are several benefits of implementing this program. The first benefit deals with the local employee pool. Generally training for a new hire lasts three months, but by supplying the same learning materials to the university, this training can be cut down to just a few weeks. This saves the time of both the new hire and the engineer left to manage the new hire.

The second benefit arises from research projects that the students may do using the donated equipment. As the students become more adept with the donated software and equipment, they may choose to do advanced research such as senior projects or theses utilizing the donated equipment. As such, the results from these research projects could serve AT by giving their own research and development department ideas on how to improve the existing technology or what areas to focus on to stay on the cutting edge of technology.

The third benefit is a bit broader than the other two. By gaining experience with embedded programming in a university environment, students gain a better understanding of the embedded world. This understanding may help them to find jobs in the embedded systems field from companies other than AT. When they are hired, they will take the experience gained with AT software with them to this new job. This experience may influence the software purchasing decisions made by that company, in such a way that they may be more interested in purchasing AT software since their employees are already experienced and familiar with it. Even if the student never works with AT software again, our hope is that the knowledge gained should help them to better their field of employment and thereby improve the field of software engineering as a whole.

Biographical Information

MICHAEL DORAN received BS, M Engr, and PhD degrees from Tulane University. He is currently a professor and CIS/CSC coordinator at the University of South Alabama (USA) and is in charge of overseeing the AT graduate assistants.

JERROLYN HEBERT received BS and MS degrees in CIS from USA and served as an AT graduate assistant during the academic year of 2001 to 2002. She is currently an instructor in the CIS department at USA.

HAUKUR RAGNARSSON received BS and MS degrees in CIS from USA and was an AT graduate assistant during the academic year of 2001 to 2002. He is currently working at Kögun Ltd, a systems and software engineering company in Iceland.

GENE SIMMONS received a BS from the Louisiana State University and MS and PhD degrees from the University of Louisiana in Lafayette He is currently an assistant professor in the CIS department at USA and is active in several student projects dealing with the donated AT equipment.

JOSHUA HARRISON received a BS in CIS from USA and is currently a software engineer at AT.

NEIL HENDERSON received an MS in CIS from USA. He was the founder and CEO of AT until the merger with Mentor Graphics. He is now the general manager of the AT division of Mentor Graphics.

DOUGLAS PHILLIPS received a BS in CIS from USA and is currently a software engineer at AT.

MIKE TRIPPI received a BS from the University of New Orleans and is currently the Engineering Manager of the AT division of Mentor Graphics.