Specialized Certification Programs in Computer Science

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1 Introduction

Certification establishes a standard of competency in specific areas and job roles. This helps industry to determine that employees meet the required credentials for different job roles thus requiring less training during the initial employment period. Hence, some job criteria require individuals to be certified in order to be considered for employment. To the certified individual, certification provides a greater sense of confidence in their abilities and a measure of professional expertise and understanding of the job role and products used in that role. It is for these reasons that certification is becoming increasingly popular and in high demand. Many training companies are providing certification-training classes at high costs all across the globe. Unlike traditional academic degrees, certificates are specific to narrow fields or even to individual products. The aim is to provide targeted skills that have immediate applicability in the workplace.

Cisco, Lotus Works, Microsoft, Novell, Oracle, and other vendors offer certification programs for their own products and related job roles. Third-party companies around the world provide certificate-training classes for these vendors and, increasingly, offer certifications of their own that are vendor-neutral. Academic institutions, from vocational and technical schools to large universities, are beginning to provide similar training in their curricula to prepare students for certification in special areas. This paper presents ideas for making changes to the existing computer science curricula so that the courses would help students prepare for certification in areas such as Databases and Networks.

2 Current Certification Programs

2.1 Certification in Networks and Operating Systems

The explosive growth of computer networks over the past fifteen years has caused a matching increase in the use of specialized hardware and software. Such equipment has not played a part in most academic programs; so on-the-job training has been a standard in this area.

In order to support this, some of the original vendors developed training programs for their products, and provided certificates for those who successfully completed the training. Cisco Systems and Novell Corporation have each provided certifications for products that were dominant in their markets at one point. Novell in particular [15] has offered a relatively general certification that reflects the comprehensive nature of its NetWare product. This has been expanded into multiple levels of certification. The Cisco certifications [3] are targeted at Cisco products, but by the products’ very nature (routers, switches, and similar connecting hardware) the topics are both central to and detailed in fundamental networking issues. Cisco certifications are widely regarded as among the most rigorous, and therefore meaningful, of the various certification programs.

In the modern computing environment there is less and less distinction between an "operating system" and a "network" or "network operating system". The UNIX operating system was an early example of this, with networking components such as NFS integrating fairly transparently into the general paradigm of the basic OS. (In contrast, Novell’s Netware effectively replaces large portions of Microsoft’s DOS, and grafts its own file-system syntax and semantics onto the DOS schema.) The most significant contender in this newly expanded field has been Microsoft’s Windows NT operating system, conceived from the outset to be a network operating system. In support of this, Microsoft [13] maintains a broad-based certification program. Its centerpiece is the MCSE (Microsoft Certified Software Engineer), a certification in the use and administration of Windows NT as an operating system and as the basis of a local area
network. Other certifications reflect experience with individual aspects of Microsoft’s network offerings, and expertise in the use or marketing of application software.

A recent entry in this arena is Linux, an open-source implementation of the venerable UNIX family of operating systems. A distinctive feature of Linux, and of the certifications surrounding it, is that it is a collaborative effort and not the property of any single vendor. At least three separate certification programs are based on Linux as an operating system and as the basis for a network. Red Hat, a major distributor, offers the RHCE (Red Hat Certified Engineer) certification [17] in their particular Linux package. Meanwhile, two different advocacy organizations offer "vendor-neutral" certification programs for people seeking to extend and validate their mastery of Linux. The Linux Professional Institute (LPI) [12] defines three certification levels, starting with "junior" single-system administration and extending to "senior" network administrators and specialists in particular areas of Linux and networking. The SAIR organization (Software Architecture Implementation and Realization) [18] offers three levels of certificates in four different areas: Linux installation, network connectivity, system administration, and policy issues of security, ethics, and privacy. These certificates focus on the GNU open-source applications as well as the Linux operating system. Recent Linux certification and testing programs are reviewed in [6].

2.2 Certification and Databases

Oracle offers several tracks in certification [16]. Oracle Certified Database Administrator (OCDA), Oracle Certified Applications Developer (OCAD), Oracle Financial Applications Consultant, Oracle Database Operator, and Oracle Java Developer are some of the current offerings.

These programs require the candidate to complete several courses and to keep the certification valid the candidates must update their knowledge by taking courses and taking tests. For example, OCAD requires the individual to complete five courses: Introduction to SQL/ and PL/SQL, Program Units, Forms I Design, Forms II Design, and Report Design.

Similarly, the MCSE incorporates certification (MCP certification [13]) in one or more of Microsoft’s database packages. These include Microsoft Access (a "user Specialist” certification), SQL Server installation and administration, and building a database using the SQL Server.

Database issues and network considerations come together in the concept of distributed information directories holding network-oriented and other information. Novell’s NDS (Novell Directory System) and Microsoft’s ActiveDirectory are primary contenders here, and each vendor offers training and certification programs for their respective products.

The various certifying agencies control the quality and consistency of their certifications by providing testing materials and maintaining records of the certified individuals. They also produce instructional materials that are directly available for self-training, or can be incorporated into training programs. Designated organizations administer the tests, and numerous third-party groups conduct training programs. Some of the training programs are based on the vendor-supplied materials; others are developed independently by the trainers.

The training programs are generally available through training centers [7], [9], [11] that employ certified trainers in the subject matter. On-line testing is available through the training centers, and also directly from companies specializing in testing services such as the Sylvan Training Center [20] and VUE (Virtual University Enterprises) [21]. The in-class instructor led training can be quite expensive, typically around $1500 to $2000 for a 3- to 5-day course. Computer based training is also available for some courses.

2.3 Other Certifications

Numerous other certifications are offered in related fields. Two examples are the SANS Institute’s GIAC certification [19] in "the basics of information security", a vendor-neutral certification that addresses all aspects of security (and its lack) in networked systems, and the CompTIA [4] certifications "A+", "Network +", and "IT-Net+" in computer hardware, networking technologies, and Internet-specific technologies. While less well-known than the product-specific, and vendor-promoted, certifications, these are in some respects more relevant to higher education since they are concerned with more generalized knowledge and skills.

The popularity of certification with employers, and hence with employees, results in new certification programs constantly. A brief look at training center catalogs shows something new almost monthly. Only time will tell how valuable and significant each of these new entries will become.

3 Certifications versus Degrees

Certification programs are often seen as an alternative or even as competition to a traditional academic degree, and degree-granting institutions are responding to this in various ways. Some schools actively embrace certification, offering either their own certificates or training and test preparation for vendor certificates [8], [14]. The authors’ school, among others, has a mandate to address
the needs of the labor force, and these needs often refer to certifications rather than to college degrees. As an example, Adelman [1] found that only 20 percent of Information Technology job listings in a Washington Post specified college degrees, and estimates that the same percentage will instead specify an industry certification by mid-2001.

However, the market for targeted certification training is well populated, and focused on test-passing to a troubling extent. There are reactions in the marketplace, as employers begin to question the value of a certificate by itself [5]. For the Computer Science program at Bloomsburg University the appropriate answer is not to join directly in this "paper chase" but instead to refine our curriculum in light of the needs of employers. Our goal is to prepare our graduates with appropriate depth of material and experience to meet overall job requirements, along with the breadth of education that is a hallmark of a collegiate degree. An emphasis on student co-op and industry internship programs supplies experience with the workplace environment. Curricular refinements are directed to offering technical and academic course content that is relevant to the needs and practices of the workplace.

4 Changes to the Computer Science Curriculum

The computer science curriculum at Bloomsburg University has undergone several major changes. The authors and our colleagues work closely to keep the curriculum current. This has required increased course offerings by adding new courses, changing the programming language used for CS I, CS II, and CS III from Pascal to C++, and increasing the credit loads for these courses from 3 to 4. Further changes are underway to make courses in networking and databases help the student prepare for certification in these two areas. A departmental Link-to-Learn Grant from the Commonwealth of Pennsylvania [10], [2] is funding both training and infrastructure to support these and other related curricular changes.

4.1 Networking topics

The networks course has evolved from an early lab exercise based purely on modems and telephone lines. The current approach includes a laboratory component that sets up an Ethernet-based local area network plus a lecture component that addresses conceptual and theoretical topics. This course serves two distinct student profiles. One group consists of Computer Science majors with a fair amount of background, including some who already have significant practical LAN experience. The other group includes underclass students with less preparation, and also non-traditional students satisfying an elective for the university's Instructional Technology graduate program.

The latter group benefits most from the lab work. The initial "pre-networking" lab exercise requires the students to identify components such as the processor and memory modules, and plug a network interface card into an appropriate slot. This gives some of them their first encounter with the inside of a computer case. They must also partition the hard disk and install an operating system. Subsequent labs establish LAN connections and involve administrative tasks such as setting up user accounts and configuring server services. Although these students are generally not seeking certification, the material is fundamental to many of the networking and hardware certification programs.

The stronger students generally find little new in the labs. They benefit from detailed treatment of the OSI networking model, analyses of packet formats, routing algorithms and internetworking topics, and similar material. These are also the students who are interested in certification.

For both groups, security issues are a valuable addition to the syllabus. At the lower level, basic administrative issues such as password management and access policies are appropriate. At the more advanced level, technical issues such as packet sniffing, IP address spoofing, and software flaws are useful.

Unfortunately, the present range of topics more than fills a semester. In order to accommodate additional material the course will be split in two. The first course is somewhat basic and practically oriented, and is suitable for students with little technical background. Internetworking topics will be largely omitted to make room for fundamental security topics. An updated laboratory component provides hands-on experience with the setup and operation of a local area network involving typically a half dozen to a dozen computers. This LAN is based on the Microsoft Windows NT operating system (Windows 2000 will be used in the near future), which provides fairly easy configuration along with exposure to many of the administrative details involved in running a network. Windows NT familiarity is also "marketable", a feature that appeals to students and funding agencies alike.

The lab component is receiving a substantial boost from the Link-to-Learn Grant, under which a Networking and Hardware lab is being constructed that will provide space and machines to set up and work with a local area network that does not impact the University's overall campus network.

The second course covers networking theory and internetworking issues with a depth suitable to prepare stu-
4.2 Database track

The database course entitled “Theory of Relational Database Design” has been modified to provide the students with the necessary knowledge for passing two exams that are required for certification as an Oracle Database Administrator and for the Application Developer track. The course does not lead directly to certification but does cover the general topics in the context of the Oracle software system. The course includes the theory of relational database design as it was taught before, however, the software has changed from MS Access to Oracle 8. The course provides full coverage of SQL/PL SQL and Programming Units. This modification has resulted without requiring any changes in the credits or course prerequisites. The Oracle software and support was obtained through a grant from Oracle with sufficient number of licenses for faculty and students. The Link-to-Learn Grant will also aid the database course, providing a student study lab with machines that can be configured for use with the Oracle packages as well as other departmental software.

Future modifications being considered include developing and extending a concentration track in databases. A sequel to the present database course will provide the students with the knowledge for working with forms, building reports, and accessing the forms and reports through web pages. This course requires the use of Oracle Developer 2000 tool to create forms and build reports. It will use Oracle’s WebDB software for web page access of forms and reports.

4.3 Coursework and Certification

The revised curriculum does not attempt to directly prepare students for certification exams. Vendor-specific and vendor-neutral certifications are proliferating at a dramatic rate, and organizations devoted to test preparation for these certifications are keeping pace. The goal of our curriculum is to provide students with fundamental and broad-based knowledge that will form a solid base for whatever product-specific certifications are desired in a given market situation. In the long run, this better serves the needs not only of the students but of their eventual employers.

5 Conclusion

Revising the computer science curriculum and keeping it current to meet the demands of the information technology labor market continues to be a challenging experience. At Bloomsburg University, we are continuing to add new courses that will develop tracks in databases and in networks. Three courses are planned for the database track: Introduction to the Theory of Relational Database Design, Building Applications using Oracle, and Database Administration. Although these courses will use Oracle as the DBMS, the theoretical content of the courses will prepare the student to work with any relational database management system.

The Network track will consist of two courses. The present networking course will retain and strengthen its focus on practical topics. Although passing any vendor’s certification exams is not an explicit goal of the University, students should be well prepared to enter the workforce with only minimal additional training in any particular product. The second networking course will be targeted at students whose interests in networking extend beyond immediate employment concerns. These include people with long-term professional goals, current employees seeking advancement, and students preparing for graduate studies.

The constant updating of the existing curriculum has put a substantial burden on the computer science faculty. Funding obtained through Pennsylvania’s Link-to-Learn Grant Program has provided the financial resources for new labs, faculty training, and support for course development activities. The motivation, enthusiasm, and the commitment of the faculty are the reasons for the steady progress in faculty professional development and a much improved computer science curriculum.

References

able at “http:// www.aahc.org/ change/ paralleluniverse.htm”.


