

# Preparing Undergraduate Students for Java Certification

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## ABSTRACT

Java certification promises to make our students more marketable once they graduate. The truth is that certifications in general offer significant advantages, but it is important not to overestimate their benefits. In this paper, we describe our experiences on teaching a workshop aimed at preparing undergraduate students for the Sun Certified Java Programmer exam. But first, we layout the real value of IT certifications and explain the different certification options available for Java technology.

## Categories and Subject Descriptors

K.7.3 [The Computing Profession]: Testing, Certification, and Licensing.

## General Terms

Measurement, Human Factors, Languages.

## Keywords

Java, Certification, SCJP.

## 1. BACKGROUND

Back in 1996 and 1997, our university's Computer Science department started teaching Java in two elective courses: Advanced Computer Graphics and Object Oriented Software Construction. Both of these courses were offered to undergraduate Computer Science and Computer Engineering senior students. We didn't take too long to realize that Java was in many cases more convenient than other languages we had been using so far. Thus, we started to promote the use of Java in other Computer Science courses.

By the year 2000, we had adopted the Java language as the official CS1 programming language in our Computer Science, Computer Engineering, Electronic Engineering and Information Systems undergraduate programs. In that same year, our department was already engaged teaching certification-related courses with Cisco [3] and Carnegie Technology Education [7] (currently known as iCarnegie). Given the thrust we had with Java, it only seemed reasonable to extend our certification offerings in order to include Java as well.

In 2002, we offered for the first time an elective course called "Java Certification Workshop". The rest of this paper describes how we got about this course and our experiences teaching it.

## 2. VALUE OF IT CERTIFICATIONS

There are important discrepancies on the industry's perceived value regarding Information Technology certifications. Some recruiters and hiring managers have stated that they see Java certification as an unimpressive credential, and that they consider hands-on experience a much more valuable asset [15]. Others claim that getting certified virtually guarantees a substantial salary raise. For example, according to a survey conducted by CRN on 2002, a Sun certified Java developer was earning annually 22,550 USD more than a non-certified developer [11].

An adequate balance has to be found between these opposite points of view. Some sources, such as [9], state that certification is a tool that people successfully use to challenge themselves. Additionally, it serves as evidence that a person is self-motivated and actively working to stay current. And, indeed, most experts agree that certification is definitely no substitute for extensive hands-on experience.

Certification serves as a proof for qualification and suitability for a certain kind of task. This can be very important in order to gain the customers' confidence, or it may even be mandatory in some cases. For example, the Mexican company PROSA, regional leader in the interconnection and information interchange industry, relies on outsourcing for all their software development projects, which are currently based on J2EE technology. One thing they expect from all of their IT suppliers is that their staff members be Java certified [1]. For entry-level IT positions or roles that involve mostly technical knowledge, IT certifications are a useful way to measure knowledge, screen applicants and assist in promotion decisions [6].

Certification programs generate product and company recognition. This means that people who get certified also get the benefits of the marketing power of corporations and professional organizations. This is why vendor participation is one of the major forces driving certification growth. Industry vendors understand that the more people who master their product, the more often people will use it.

From an academic point of view, Computer Science departments should be *educating* students on how to adapt to changing technologies, and not *training* them on how to use particular tools. Preparing undergraduate students for certification may seem like a shift from this premise. On the other hand, employers commonly assert that recently graduated students are lacking

some of the practical skills required in “real world” situations. We believe that a reasonable balance can be found between the industry’s requirements and what the academia considers to be the right thing. The certification workshop described in section 4 is an elective course which complements our university’s undergraduate Computer Science program and does in no way seek to substitute its core essence.

### 3. JAVA CERTIFICATION OPTIONS

There seems to be an ongoing discussion on how Java testing should be carried out [12]. Is the objective to test whether the candidate knows all about the Java language, including those seldom used features? Or is it to test the programmer’s knowledge of writing “applied Java”? Or should the candidate take the Java test in the context of the larger set of tools that have grown up around the Java platform? Currently, three organizations respond to these questions in their own specific ways: Sun Microsystems, ProsoftTraining, and the jCert Initiative. The following sections review what each of these has to offer.

#### 3.1 Sun’s Java Technology Certification Path

Sun offers these Java technology certifications [13]:

- *Sun Certified Programmer for the Java 2 Platform*. This certification is for programmers experienced in using the basic syntax and structure of the Java programming language. Certification consists of one exam. It has no prerequisites.
- *Sun Certified Developer for the Java 2 Platform*. This certification is for programmers who are already familiar with the basic structure and syntax of the Java programming language, and who have a need to further apply this knowledge to developing complex, production-level applications. Certification consists of two elements: a programming assignment and an essay exam. Candidates must be Sun Certified Java Programmers.
- *Sun Certified Web Component Developer for the J2EE Platform*. This certification is for programmers who are using the Java technology servlet and JavaServer Pages APIs to develop Web applications. The certification consists of one exam. Candidates must be Sun Certified Java Programmers.
- *Sun Certified Enterprise Architect for J2EE Technology*. This certification is for enterprise architects responsible for architecting and designing J2EE compliant applications, which are scalable, flexible and highly secure. Certification consists of three elements: a knowledge-based multiple-choice exam, an assignment and essay exam. It has no prerequisites.

#### 3.2 ProsoftTraining CIW Certifications

The CIW certification program validates job-role skills competency for entry-level job seekers and seasoned professionals alike. Candidates can earn CIW certificates in various information technology job roles, from the foundational CIW Associate certification, continuing to CIW Professional and specialization certifications, and up to advanced-level Master CIW certifications [4]. CIW spans various IT disciplines, including Web site design, enterprise development, network administration and security, as well as cross-functional areas that combine other disciplines, such

as Web site management and Web development. The choices offered by the CIW program allow individuals to focus on pursuing personal interests and talents.

The CIW program has three Java related certifications and paths:

- *CIW Web Develop Certification* A certified Web Developer has the skills and knowledge required to assemble and maintain Java based Web applications. Web Developers are familiar with Java, but do not necessarily write Java program code. Instead, they may use advanced Java development tools that perform basic Java programming, allowing Web Developers to focus on the business-requirements aspect of the application development cycle. Certification consists of one exam. It has no prerequisites, although the Associate Certification (CIW Foundations) is recommended before attempting the Web Developer Certification. This certification corresponds to jCert’s Web Developer job role.
- *CIW Professional Certification (CIW Enterprise Specialist)*. A CIW Enterprise Specialist builds n-tier database business solutions using Java in conjunction with distributed application architecture technologies such as Enterprise JavaBeans and CORBA. The Enterprise Specialist designs, develops and deploys complete software solutions tailored to a given business domain. Certification consists of one exam. Prerequisite: Associate Certification (CIW Foundations).
- *Master CIW Enterprise Developer*. This certification prepares skilled professionals to develop enterprise-wide Web-enabled applications and implement complex e-business solutions. Master CIW Enterprise Developers have advanced skills in database management, distributed object computing, scripting and programming languages, and language theory. Certification consists of eight exams; one of them is the *Sun Certified Java Programmer*.

#### 3.3 jCert Job Role Certification Tracks

The jCert Initiative Inc., established in November 1999, is a nonprofit organization sponsored by leading software, training and certification companies: BEA Systems, CGS, IBM, ProsoftTraining, SkillSoft, Sun Microsystems, and Thomson Prometric. jCert’s motto summarizes its purpose: “Certified Once, Recognized Everywhere”.

jCert aims to establish and promote standards for the certification of enterprise developers who use Java. The objective is to provide a ready supply of trained Java technology developers to meet the increasing demand for enterprise applications in the e-commerce marketplace [12]. As an organization, jCert does not own exams or curricula. Instead, it promotes a certification standard composed of industry-tested exams and curricula for generic Java and related technology skills.

The jCert program recognizes four job roles [8]: Web Developer, Java Programmer, Solution Developer and Enterprise Developer. A job role is an industry-recognized job title that details the knowledge and practical skills required to perform specific job tasks. Each job role includes a series of certification exams owned and managed by various jCert member organizations. Candidates can qualify for jCert job roles by passing the specified certification exams.

Two of the job roles, Web Developer and Java Programmer, are defined as core technology certifications, meaning these exams validate vendor-neutral and Java-based technology (non-tool) skills. Currently three member organizations offer jCert core exams: CIW, IBM and Sun. Solution Developer and Enterprise Developer job-role certifications consist of core and vendor-specific exams. The vendor exams build upon the vendor-neutral or "common" skills obtained in the core exams and require the certification candidate to validate competency in a tool-specific environment. Currently, BEA, IBM and Sun develop, manage and deliver vendor exams included in the jCert Solution Developer and Enterprise Developer job roles.

### 3.4 SCJP: Sun Certified Java Programmer

As seen in previous sections, there are several options to choose from when considering Java certification. We decided to go for Sun's programmer certification because of its wide industry recognition, and also because it offers the most flexible certification start path for our students: they can later continue in whatever avenue they choose from Sun, ProsoftTraining or jCert (see figure 1).

The current edition of the SCJP exam is based on the Java 2 platform, version 1.4. In general, this exam is a fairly comprehensive examination of one's knowledge of the latest version of the Java programming language and of few key packages that belong to the Java standard library [14]. It covers concepts, reserved words and language structures and capabilities as well as elements of the standard Java programming environment. Some basic understanding of object-oriented design, development, testing and implementation is absolutely essential for prospective exam candidates. Specifically, these are the nine topics evaluated in this exam [13]:

- Declarations and access control.
- Flow control, assertions, and exception handling.
- Garbage collection.
- Language fundamentals.
- Operators and assignments.

- Overloading, overriding, runtime type and object orientation.
- Threads.
- Fundamental classes in the java.lang package.
- The collections framework.

The previous version of the test (CX-310-025) is significantly different from the current one (CX-310-035). The former is focused on the Java 2 platform, version 1.2, while the later is based in version 1.4. It's worthwhile highlighting the differences between both these exams because many of the currently available resources (books, web sites, mock exams, etc.) are still focused on the CX-310-025 exam. In the new exam, all AWT objectives have been removed. This means that there are no questions on GUI programming. Also, all I/O objectives have been removed, and there is a new objective on assertions. Lastly, a few of the previous objectives have been strengthened, including those related to the hashcode and equals methods, the collection framework, and wrapper classes.

The CX-310-035 SCJP exam may be taken in any authorized Prometric testing center. It's a multiple choice and short answer exam, comprised of 61 questions that must be answered in 120 minutes or less. In order to pass, candidates must correctly answer at least 32 of the 61 questions (52%). It has a cost of 150 US dollars.

## 4. JAVA CERTIFICATION WORKSHOP

In the fall semester of 2002, our department offered a new course entitled "Java Certification Workshop". The course was offered as an elective subject for senior Computer Science undergraduate students. The purpose was to prepare them to take the SCJP exam once the semester concluded. At that time, we didn't know what to expect. We hoped that every enrolled student got certified, but we weren't sure if this was realistic expectation.

### 4.1 Previous Student Experience

A typical Computer Science senior student at our university usually arrives to our certification workshop with a reasonable amount of previous Java experience. Aside from the CS1 course, most students have taken at least a couple of courses in which important software projects are developed using Java. These courses might include, but are not limited to: Software Design,

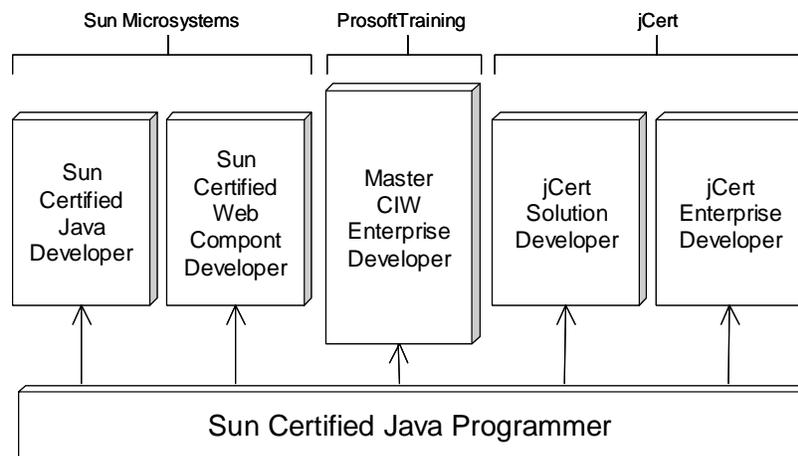


Figure 1: Certification options starting with SCJP

Programming Languages, Component-Based Computing, Compiler Construction, Net-centric Computing, Advanced Operating Systems, Advanced Database Systems, Computer Graphics, and Intelligent Systems. Furthermore, some students might have used Java in a capstone project or in a community service project. The important thing to note here is that at the beginning of the workshop, students already know how to program with Java. Thus, in the workshop we are able to spend more time in those topics in which we know our students are usually weak.

At first, it might seem unnecessary to have a one semester workshop for students who already have a significant amount of on-hands Java experience. But as many experts point out, even the best Java gurus can fail this exam if they don't have an appropriate preparation. As Awe [2] affirms: "Failing to prepare equals preparing to fail".

## 4.2 Grades

One of the main distinctive features of this workshop, at least compared to other courses offered by our department, is that in order to pass the course the student must pass the certification exam. 70 out of 100 points of the final course grade are awarded to students who obtain a passing score in the SCJP exam. The other 30 points are attained from other preparation exams and activities. Because the passing grade is 70 in our university, they have no alternatives but to get a passing score in the SCJP exam.

Every student enrolled in the workshop is required to pay for her or his exam. We give some assistance to our students so as to simplify their exam registration process (i.e. obtaining the exam voucher from Sun Educational Services and contacting a Prometric testing center).

## 4.3 Activities

We have devised several course activities for the entire semester in order to prepare our students for the certification process:

- *Weekly tests.* From the start of the semester, we schedule a 15 to 20 minute written test at the end of every week, covering the content of a specific chapter of the textbook [10]. The test has basically the same format as the SCJP exam. After the test has been taken, we go through the exam with all the class in order to solve any questions.
- *Summary Notes.* Although this exam preparation technique might sound pretty obvious, a surprisingly large number of senior students do not have the discipline to carry it out unless explicitly requested. Before the weekly test, they are required to read the corresponding textbook chapter and make "awesome summary notes" as described in [5]. Having students make these kinds of notes has several advantages. First, it helps them organize and group the study material so as to understand better the relationships between different concepts. Furthermore, writing out and organizing the material on paper creates a visual cue, which makes it much easier to remember. At the end of the semester they have a compilation of the most important concepts of the textbook. These notes can then be used for doing a quick recap the day before taking the SCJP exam, instead of having to skim through the whole textbook again.

- *Monthly exam.* Our students take a 50-minute written exam at the end of every month. These exams have the same format as the SCJP exam, and they include all the material covered so far in the semester. We only have three monthly exams in one semester. Because of its extent, the last monthly exam can be considered a close simulation of the real exam.
- *Lectures.* The most difficult topics are reviewed in lecture sessions. As instructors we know which areas are typically challenging to our students. We also use the results of the weekly and monthly exams to adjust the content of our lectures. The workshop is carried out in a classroom that allows hands-on demonstrations on the topics being dealt with. The instructor has a projector connected to his laptop computer, and most students bring their own laptops as well. This allows testing and dissecting pieces of code in an interactive manner.
- *Virtual forum.* Every week or two, students are required to read a course related Web article. The article themes have to do with certification and specific Java technology issues. After that, every student must post a message to the course's newsgroup with a comment or critique regarding the article. We use this space to encourage group discussions on the positive and negative aspects of Java and certifications, according to different authors. We believe that this activity is important, because it allows students to have a better thought perception of the virtues and limitations of Java certification. This is the moment in which they should realize that a certification is no substitute for experience.
- *Programming exercises.* The textbook includes some programming exercises at the end of every chapter, so that concepts can be tried out in practice. Students are encouraged to do those and some other exercises provided by the instructor.
- *Programming contests.* During the semester we have three or four short programming contests. The objective is let students apply some recently discussed material in order to solve small yet interesting programming problems. For this activity, students work in pairs.
- *Java Jeopardy.* Five or six times during the semester we organize a question and answer game similar to the Jeopardy!™ TV game. Students compete in teams of three or four people. There is a board with six columns and four rows (see figure 2). Every column represents a question category,

Garbage Collection	Threads	Expressions	Anonymous Classes	Reserved Words	Data Types
200	200	200	200	200	200
400	400	400	400	400	400
600	600	600	600	600	600
800	800	800	800	800	800

Figure 2: Example of Java Jeopardy

for example declarations, expressions, control sequences, etc. The rows contain numbers that represent game points. Each team in turn selects a category and the number of points they wish to play (higher points means higher difficulty level). Given an answer statement, the team has to formulate what the corresponding question should be. If the team makes a correct formulation, they win those points. The winning team is the one that gets the largest amount of points at the end of the game. This is probably the student's favorite activity. In a very fun and dynamic way, it allows quick reviews of the most important concepts on any given topic. We can always take a couple of minutes from the game to explain a certain concept if we see that most of the group is struggling with it.

## 5. CURRENT OUTCOME

Our first workshop generation had twenty-two students. All of them took their SCJP exam during the months of November and December of 2002. Twenty-one of them obtained a passing score on their first try. Only one required a second chance to pass the exam.

The second generation had twenty-eight students. They took the exam during the months of May and June of 2003. Twenty-two of them passed the exam in their first try, four of them needed a re-take in order to pass, and two desisted after failing their first attempt.

Considering the two generations into account, 48 students have become certified Java programmers at the end of the course; that's 96% of the students enrolled in the workshop.

Immediately after a candidate completes the exam, a report sheet is generated that includes the global result and an analysis for each section (topic). Although this information is intended as a feedback mechanism specifically for the exam candidate, it's actually more useful for us as instructors. Here are the results of both generations together (the right column is the group average):

	<b>SCJP Score</b>	<b>70%</b>
Declarations and access control		<b>70%</b>
Flow control, assertions, and exception handling		<b>70%</b>
Garbage collection		<b>56%</b>
Language fundamentals		<b>77%</b>
Operators and assignments		<b>71%</b>
Overloading, overriding, runtime type and obj. orientation		<b>78%</b>
Threads		<b>65%</b>
Fundamental classes in the java.lang package		<b>66%</b>
The collections framework		<b>64%</b>

The four main sections in which we can improve are quite clear from this table: garbage collection, the collections framework, fundamental classes in the java.lang package, and threads.

In the semester in progress (autumn 2003), we have twenty-four students enrolled in the Java Certification Workshop. With the experience we gained from the last two semesters, we have some high expectations for this third generation. Our goal is to certify every single student, and we hope to increase the average score.

## 6. CONCLUSIONS

We have clearly seen that Java certification allows students to get a deeper understanding of the Java language, in a way that otherwise just wouldn't happen. Although some students have a lot of experience using Java in other courses, there is always a subset of the language that they ignore and therefore never use.

The SCJP exam is not easy. It requires an economical investment, an important amount of time for preparation, and a great deal of personal motivation. Indeed it is a challenge to offer this certification in a regular university class environment with two-dozen students with dissimilar skills and experience. However, the series of activities that we have used in our workshop have given positive results. In a 16-week time frame, we can review every single section of the exam. At the end of the semester, there's no need for cramming, because our students have had time to adequately digest all the material, so they can confidently go and take the exam.

At the end, the most rewarding moment is when you see a proud student's face filled with relief and satisfaction after taking and passing the SCJP exam.

Given the success and popularity of the Java certification workshop among students, our Computer Science department started offering this semester (autumn 2003) an other new elective course entitled "Web Component Developer Workshop", focused on preparing students for the SCWCD (Java Servlets and JSP) exam. Furthermore, our university has just joined the Sun Academic Initiative (SAI), which is a program designed by Sun Microsystems to bring technology education to the academic marketplace. We are confident that these two initiatives will have an additional positive effect complementing our student's professional development.

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