Ada Language in Computer Education in Ukraine

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Abstract

The paper presents a proposal for introducing Ada 95 as the major teaching language for courses in computer engineering education in Ukraine.

1 Background

Ukraine is a country situated in eastern Europe. It has a population of about 52 million people. The country is probably best known now for the football club Dynamo Kiev and, less fortunately, for Chernobyl. However the country has a large potential for economic and scientific growth.

Both the development of computer science and the computer industry have a long tradition in the Ukraine. In 1951 the MESM computer was developed in Kiev by Professor S. Lebedev's group. This computer was the second in Europe and the first in continental Europe. In 1963 the world-renowned Academic Glushkov Cybernetic Center (Institute of Cybernetic of Academy of Science of Ukraine) was created. The Ukraine has since developed and manufactured many indigenous computers including Mir-1, Mir-2, Dnipro, PS-2000, PS-3000, SM-2, SM-4 and many special computers, which were used in military, industrial and space applications.

The computer industry in Ukraine is currently not a world player, but it is developing rapidly. Today there are more than one million computers of different kinds in use: PC, workstations, servers and multi-processors systems. More than 250,000 computers were sold in 1998. Companies such as IBM, DEC, Hewlett-Packard, Siemens and others have divisions in the Ukraine. In Kiev alone there are more then 70 companies involved in the manufacture and sale of computers. The country is a huge prospective market for modern hardware and software and consequently needs many specialists in computer science and computer engineering.

2 The Computer Engineering Education in Ukraine

Since 1957, computer education in Ukraine was provided by Kiev Polytechnical Institute. When Ukraine became independent in 1991, education was reformed and bachelor, specialist and magistr degrees were created. After this reform, computer education was divided into computer science and computer engineering. In 1994 the first standard of computer engineering education was created. This standard prescribes the structure, list and contents of major courses in computer engineering education for bachelor of computer engineering only. By 2002, a new full standard of computer engineering education will be created through the national program called "Education - 21st century".

Today Ukrainian Computer Engineering Education is offered by more then 25 technical universities in Kiev, Lvov, Charkov, Donetsk, Odessa, and Dnepropetrovsk. The degrees available in computer engineering in Ukraine are:
The standard list of courses in the bachelor program include Mathematics, Physics, Economics and Social Issues, Computer Electronics, Computer Logic, Computer Arithmetic, Theory of Circuits, Digital Computers, Computer Networks, Computer Systems Architecture, Real-Time Systems and a block of software courses. There are also elective courses.

The graduate programs of Specialist and Magistr are provided in three different areas:

1. Computer Systems and Networks
2. System Programming

Currently, there are no standard curriculums for the specialist and magistr degrees. Every university has its own set of courses. Standards will be created by the year 2002.

The computer engineering curriculum in Ukraine is a combination of computer science and computer engineering that provides the education and training necessary to design, implement, test and utilize the hardware and software of digital computer systems. Within the curriculum students study all aspects of computer systems from electronic design through logic design, VLSI concepts and device utilization, machine language design, implementation and programming, operating system concepts, system programming, networking fundamentals and application of these systems. As a result of historical developments, students in the computer engineering department take many of their courses in the departments of computer science and electrical engineering.

Education in software development includes Programming, Object-Oriented Programming, Modeling, System Programming, Parallel Programming, Operating System, Programming Real Time and Embedded Systems, Programming Distributed Systems and so on. Programming languages currently used in these courses are summarized in a table in a later section of this paper.

3 Ada in Ukraine

Ada is becoming more popular in Ukraine. There are many perspective areas of the Ada using: Avionics (Antonov - "Mria AN-124", AN-140, AN-70), Space (Yuzhmash - "Zenit"), Banking Systems, Medicine, Metallurgy, Metro and Railways.

Ukrainian teachers and researchers are looking at Ada 95 materials outside of Ukraine. They are active participants of Ada-Europe and next year they will begin participation in ACM/SIGAda activities. The Ukrainian Ada users are currently creating a society - "Ada in Ukraine". We believe that Ada has a bright future in Ukraine.

4 Ada 95 in Computer Engineering

We now have experience of using and teaching Ada in Ukrainian classrooms. Ada is taught by several universities in Ukraine. The Department of Computer Systems at the National Technical University of Ukraine - "Kiev Polytechnical Institute" has used Ada since 1986. Ada is also taught at Charkov, Odessa, Kremenchug, and Kirovograd. The main problems with teaching Ada in Ukraine are the absence of a good textbooks with Ada 95 and knowledge of modern pedagogy for teaching and using Ada 95 in the classroom. While there is a Ukrainian Ada 95 textbook for beginning programmers [3], there are no Ada 95 based books for the remainder of the curriculum.

There are many academic and financial arguments for using one core language in software education [1, 2]. They are equally valid in Ukrainian education. Until the arrival of Ada 95 there was no programming language which supports the concepts taught in the majority of software courses offered in Ukraine. I am proposing that we use Ada 95 as the core language of Ukrainian computer engineering.
The table given below presents computer engineering software courses and the use of programming languages in these in Kiev National Technical University. It is typical for Ukrainian universities.

<table>
<thead>
<tr>
<th>Courses</th>
<th>Languages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Programming</td>
<td>Pascal, C</td>
</tr>
<tr>
<td>System Programming</td>
<td>Assembler, C</td>
</tr>
<tr>
<td>Modeling</td>
<td>Pascal</td>
</tr>
<tr>
<td>Parallel Programming</td>
<td>Ada</td>
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<tr>
<td>Object-Oriented Programming</td>
<td>C++</td>
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<tr>
<td>Numerical Methods</td>
<td>Pascal</td>
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<tr>
<td>Real-Time Systems</td>
<td>Pascal</td>
</tr>
<tr>
<td>Embedded Systems</td>
<td>Assembler, Pascal</td>
</tr>
<tr>
<td>Security</td>
<td>Pascal</td>
</tr>
<tr>
<td>Distributed Computing</td>
<td>Ada, Java</td>
</tr>
</tbody>
</table>

As can be seen from the table above, Ukrainian students have experience with a variety of languages. Currently, Ada is used only in the parallel and distributed computing courses. How can we add "Ada" to other lines of the language column of the table? The course "Programming" is the first programming course taken by computer engineering students. A successful choice of programming language is very important here. As demonstrated by studies at U.S. military academies [4], using Ada in this course will allow us to improve our students' foundation in computer science so they will be better prepared to understand modern software concepts such as abstractions of different kinds, modules and libraries, object oriented, exceptions, separate compilations and so forth.

Ada will be a good vehicle in "System Programming". The "Modeling" and "Numerical Methods" courses will also benefit from the power of Ada. Finally Ada is an excellent choice in such course as "Parallel Programming".

5 Ada in courses Real-Time Systems and Distributed Computing

Courses “Real-Time Systems” and “Distributed Computing” are new in computer engineering curriculum. Benefit of Ada in embedded and real-time systems is well-known.

In course “Distributed Computing” are studied and used PVM and MPI libraries, CORBA and Java technologies. Annex E of Ada 95 Standard for distributed applications is supported by GLAD system. This course is studied on level of master (year 5th) after course “Parallel Programming” based on Ada. GLADE system allows students easy to develop the distributed applications and to research them on local computer networks.

In NTUU-KPI both course is supported by advanced theory of parallel and distributed systems load balancing which is successfully developed at Department of Computer Systems.

6 Main goals of project

The goals of our project "Ada 95 as a Foundation Language in Computer Engineering Education in Ukraine" include:
- the study of experience in European and American universities using the Ada language in teaching
- adaptation of Ada in the Ukrainian universities
- development of methods of Ada 95 teaching in Computer Engineering curriculum
- writing (in collaboration) and publishing in the Ukraine new Ada 95 textbooks.

We are developing this project as a part of the national curriculum project “Education - 21st century”. The schedule for completing this major education system reform is
1998 – new list of education directions
1999 - 2000 – full Standard for bachelor
2000 - 2001 – full Standard for specialist

The full Standards prescribe the qualification characteristic of graduates, the structure, list and contents of major and elective courses and the tests.

A Working Group in the Ministry of education of Ukraine, is creating the full Standard in Computer Engineering. The author of this paper is a member of the group and also the secretary of the committee “Computer Engineering”. The National Technical University - KPI is the basic university in charge of the creation of this new Standard.

The use of Ada in Computer Engineering Education is planned in two steps. The first step is to include Ada in the new Standard as compulsory programming language for beginning students. The second step is using Ada in most other courses. The major obstacles we face are that many of our teachers 1) don’t know Ada 2) believe that Ada is a very complicated language and 3) don’t know of the latest Ada standard: Ada’95.

The work of adopting Ada in Ukrainian universities is now underway. Teachers from Ukrainian universities have learned Ada at the National Technical University – KPI. Therefore we will plan Ada classes and seminars in several universities in Ukraine. (In April and May we will have such classes in Odessa and Kirovograd ).

7 Center of Ada-Technologies

The Ukraine is prospective market for modern software. The struggle for this market is begun. So in November 1998 Sun Microsystems opened in Kiev the Center of Java-Technologies. The goal of Center is development of projects, consulting in Java-technologies, integration existing systems in common information distributed area and an advance Java-technologies in computer education in Ukraine.

If Ada related companies (ACT, Aonix, Rational) and organizations (ACM SIGAda, Ada – Europe, NATO Science Programs) will be out of this process then Ada language will be supplanted from software area in Ukraine. And problem of safety in software engineering in country where there are a few nuclear stations and there are space, aviation and military industries will be opened.

A creation in Ukraine such Center of Ada-Technologies could promote to advance Ada in industry, science and education in Ukraine. In this case our project “Ada 95 as a Foundation Language in Computer Engineering Education in Ukraine” will be one function of Ada Center linked with education.

8 Summary

This project is one more step in bringing Ukrainian education up to that of the best education systems in the World. Using the Ada 95 programming language as a foundation language in computer engineering education in Ukraine will allow us:

- to study modern outstanding programming language
- to enter in the world of modern information technologies
- to use international experience of teaching and using Ada
- to participation in joint projects
- to exchange students and teachers

We guess if only Ada was used at the Ukrainian nuclear stations we did not have the tragedy in Chernobyl.
Acknowledgements

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