

Learning challenges faced by computer science students: A qualitative study

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ABSTRACT

Programming language is one of the fundamental courses that are edified to every computer science students. The courses include sundry aspects of language such as basics of fundamentals operations and architecture of computers as well as sharpen the quandary solving skills of students. Other advantage of programming language include fundamental implement for analyzing, studying and understanding advanced concepts of computer science which are edified to the student in later semesters of their undergraduate studies. Thereby, edifying computer science and the cull of a programming language to the computer science students is of utmost consequentiality. In recent past few years numerous programming languages have been evolved such as COBOL, FORTRAN, Algol, Miranda, Oberon, Ada and Java etc. With the time lapse, some of these languages have lost their consequentiality whereas sundry incipient languages have emerged. Consequently, edifying and cull of a programming language always remained a consequential research question for academicians. In this paper, keeping in mind examination of current curriculum and market demands, C/C++, C#, Java, Pascal, GW Rudimentary and JavaScript are culled for comparison.

Keywords: Programming language, C/C++, C#, Java, Pascal

1. INTRODUCTION

Which programming languages should be taught to computer science students? This question is always raised during the development of curriculum for computer science and software engineering students. In recent years programming languages have witnessed the highest drop rate (Robin's et.al, 2003). According to several reports, students have problems in perceiving what is happening in memory, instruction cycle, and overall picture of the execution of program (MILNE, I. and G. ROWE, 2002). As computer science is a rapidly evolving field, the answer to this question varies with the passage of time. Several surveys have been done for the selection of the programming language based on various introductory level programming courses taught at college/undergraduate level (Davies, et.al, 2012). This paper compares C/C++, C#, Java, Pascal, GW Basic and JavaScript based on different criteria and provide recommendations (Schulte, C. and J. Bennedsen, 2006).

2. LITERATURE REVIEW

Literature survey has shown the merits and demerits of several programming languages and the problems involved in selection of a programming language for teaching. Researchers have gathered information from teacher's regarding which topics should be taught in programming courses (Schulte, C. and J. Bennedsen, 2006). Milne and Rowe analysis showed difficult topics in introductory level courses difficult to be comprehended by undergraduate students. Davies et al. gathered a nationwide survey of various languages and techniques being taught in introductory level programming courses. Authors have revealed that Java is the most widely used language for programming teaching Mason et al. (Mason et.al, 2012) determined various introductory level programming courses in Australian Universities to determine the trends in programming language, Integrated Development Environment (IDE), paradigm and topics coverage. Robins et al. provided a review on programming languages and identify topics related

to teaching novice users (Sebesta, et.al, 2014). In a number of studies different programming languages have been analyzed based on their features for novice programmers. (Lisa Eadicicco, 2014) has provided a brief study on the various programming language of choices for beginners.

(Rebecca Hiscott, 2014) has provided an overview of several programming language as per modern day requirement. In some of the studies, specific tools have been designed for more effective learning of programming language to computer science. In recent years a tool named SAUCE has been developed for students and educators for learning parallel programming (Moritz Schlarb, et.al, 2015).

3. A COMPARISON OF MAJOR PROGRAMMING LANGUAGES

3.1 Simplicity

A language should have a simple, easy to use syntax that is closer to natural language. Pascal and GW Basic have a very simple syntax and it uses self-explanatory keywords such as begin, end, to write blocks of code. The programming language such as JavaScript, C++, C# and Java has almost similar syntaxes which have been accepted globally for general purpose programming language.

3.2 Writability

The writability of a language is meant for the availability of different types of constructs to easily write different types of programs. The programming languages provide elementary constructs for looping, conditional statements, procedures etc. Although, programming language such as GW Basic, Pascal, C and JavaScript don't provide sufficient support for data types. Moreover, language C stings for are difficult to operate. Similarly, Boolean data support is not available.

3.3 Reliability

The availability of pointers in Pascal and C impacts its reliability as this can engender dangling references. C# additionally sanctions the utilization of pointers but in unsafe region. An unsafe region provides the flexibility to the program to perform sundry restricted operations, put it puts supplemental burden on programmer to handle sundry low caliber issues (such as recollection leakages, dangling pointers and type safety). C#, Java and JavaScript support exception handling. Figure 2 shows exception handling code for Java. However,

JavaScript is not type safe language. The same can be verbally expressed for language. C language doesn't provide support for exception handling; however, assertions can be utilized. In integration, the ecumenical variable `errno` can be habituated to track the error. The utilization of `goto` in GW Rudimentary withal integrates to unreliability in program.

3.4 Data Structures

Java provides eight fundamental data types i.e. byte, short, int, long, char, float, double and Boolean. In integration, there is support for String and long range integers and authentic numbers in the form of available classes. Utilizer defined data types can be engendered utilizing classes. C language has support for int, long, float, char and double, but doesn't provide Boolean data type. String variables are manipulated utilizing character array or character pointer where the cessation of the string is delimited by null character ('\0'). Utilizer defined data types can be engendered utilizing structure, type def, enumerations etc. C# provides support for sundry data types such as byte, short, and integer, long, single and double precision authentic numbers, decimal, Boolean, date, char and string. Utilizer defined data types can be engendered utilizing structure, enumeration and classes. Pascal has support for string, integer and authentic, Boolean and character data types. Utilizer defined data types in Pascal can be engendered utilizing enumerations, sub-ranges, records and set. GW Fundamental provides support for string, integer, and single precision and double precision authentic numbers. In JavaScript, variables are not explicitly declared to be of any type, but their types are tenacious predicated on the value they hold. A variable can hold numeric, string or Boolean value.

3.5 Availability/ Cost to Students

Java Development Kit is available free of cost. Different integrated development environment such as Eclipse and Net Beans are available free of cost. However, some development toolkits such as J-Builder are available with licensing fee. The IDE and compiler for C, Pascal and GW Rudimental are available free of cost. The most widely used development platform for C# is Visual Studio which is available free of cost for developers. The .Net framework required to run C# program is additionally available free of cost. JavaScript can be facilely run on any standard browser. The most widely environment utilized for development for JavaScript is Web Storm which is available with some licensing fee.

3.6 Market Demand

According to a survey by Business Insider, Java is amongst the highly paid jobs in the market. JavaScript developer gets less salary than Java but more than C while C# is at the bottom of the developer's salary. According to another survey, Java has the maximum job market followed by JavaScript and C#. However, we don't find any details about job market for GW Rudimental and Pascal.

3.7 Community Support

The community support for each of the above language is available. Comprehensive documentation for Java is available in the form of java docs. The community support for Java is available at. Similarly support for C# is available at. JavaScript is an emerging language and support for AJAX, j-Query, Angular Js is available at

different forums such as. Even though, support for Pascal, GW Rudimental and C language is available in the forms of books, online courses, and some forums, but their fortification is not comprehensive.

3.8 OS/Machine Limitations

The IDE for GW Rudimental, C and Pascal can facilely be run with low configuration requisites such as on Pentium IV. JavaScript doesn't require any categorical platform to run as it can be facilely run on a browser. Java Development Kit (JDK) can be run on minuscule configuration, however, its IDE requires Core 2 Duo machine to run. The latest version of Microsoft Visual Studio requires Windows 8 to run.

3.9 Extensions/ Library available

The extensions for Java and C# are facilely available for general purport task such as web programming, Bluetooth communication, hardware interfacing and Graphical Utilizer Interface (GUI). This includes Servlets, Java Server Pages (JSP), Asynchronous JavaScript and XML (AJAX) toolkit etc. JavaScript is an emerging language and asizably voluminous number of extensions for it is available such as Angular-JS, Expres-Js, Socket.IO, Node-Js, D3, Fire Base and Web-GL etc. C language has been utilized for many years; hence, extensions for it are yarely available such as OpenGL, NS2 extensions etc.

3.10 Coverage

For a primary language to be edified to students, it is essential that it extensively covers sundry notions such as OOP, multithreading, databases, networking and mobile computing etc. An exordial programming language once learnt by student can be used primarily for demonstrating these advanced notions of computer science. This section discusses how the major programming languages provide support for these concepts.

3.10.1 Object Oriented Programming

The languages like C, GW Rudimentary and Pascal don't provide support for object oriented programming. C++, an extension of C language can be utilized for object oriented programming. Both Java and C# are 100% object oriented programming languages. It has support for implementing concepts such as encapsulation, inheritance, polymorphism, aggregation and composition. JavaScript can be regarded as an object based programming language as it has support for rudimental concepts of object oriented programming such as classes, sodality, and inheritance. However, concepts such as encapsulation and polymorphism are not fortified. Inheritance can be implemented utilizing prototypes.

3.11 Databases

The concepts of database can be implemented in C# and Java utilizing ADO .NET and JDBC. In integration, database connectivity can be provided for document databases such as MongoDB. JavaScript can be acclimated to connect to any type of databases such as MySQL, SQL Server, MongoDB etc. In C language, database connection can be made utilizing ODBC API. Interfacing with databases is a very picayune task in GW Rudimental and Pascal language.

3.12 Operating System

C, C# and Java provide support for implementing different operating system concepts such as multithreading, I/O, monitor, semaphores, recollection management and process management. In JavaScript, the concept of threads is remotely different. Worker threads are acclimated to implement multithreading. Figure 6 shows the example. File I/O can be performed but in a sandboxed environment. Performing multithreading in Pascal and GW Rudimental is not possible.

3.13 Low Level Programming

In Pascal, C language low caliber programming task can be facilely performed such as utilizing interrupts, process management, inter-process communication, bulwarked operating system calls etc. In C#, these operations can be performed in unsafe region. In Java, system level programming can be done utilizing native methods. GW Rudimentary can interface with assembly language by utilizing USR function and CALL verbalization.

3.14 Network programming

Pascal, C, Java and C# provide support for network programming utilizing Transmission Control Protocol (TCP) and Utilizer Datagram Protocol (UDP) sockets. Figure 8 shows an example of TCP sockets in Java. In JavaScript, socket communication can be performed utilizing Socket.IO API. Socket programming in Pascal and GW Fundamental is not a frivolous task.

3.15 Web programming

In Java, web programming can be done utilizing Servlets, Java Server Pague (JSP), Struts and Java Server Faces (JSF). In C#, Active Server Pages (ASP) .NET can be utilized for web programming. JavaScript can be utilized for both client side and server side programming. At server side, this can be done utilizing Express-Js. At client side different APIs such as j-Query, Angular-Js, Bootstrap etc. In C and Pascal language, web programming can be done utilizing Prevalent Gateway Interface (CGI) programming. Having verbally expressed that, it should be noted that programming in CGI is a very cumbersome job and that makes web programming in C and Pascal very arduous job.

3.16 Mobile Computing

Java provides support for mobile computing utilizing Android and J2ME etc. In C#, XARMIN can be utilized for cross platform mobile application development. In JavaScript, mobile application development can be done utilizing Phone Gap API or Win Js platform. Pascal and GW Rudimentary is not popular for mobile application development.

4. RESULTS & DISCUSSIONS

Predicated on the above discussion, it can be concluded that Java is the best general purport programming languages to be utilized for edifying computer science concepts. It has good writability, reliability, market demand and can be acclimated to edify any computer science concept such as operating system, mobile computing etc. Besides Java, C# can withal be acclimated to edify computer programming. Languages such as Pascal and GW Rudimentary had been used widely to edify exordial level course, but are no longer in demand

in market, nor can they be habituated to implement modern concepts of computer science such as delegates, design patterns and object oriented programming etc.

CONCLUSION

In this paper, an analysis of major programming languages of computer science is done. The paper compares the culled languages predicated on different factors such as their readability, writability, support, market demand and coverage. It has been concluded that Java is the most congruous language to be utilized for edifying computer science concepts.

REFERENCES

- ❖ Robins, A., J. Rountree, and N. Roofree (2003) Learning and Teaching Programming: A Review and Discussion. Computer Science Education, vol. 13(2), Springer, p. 137-172.
- ❖ MILNE, I. and G. ROWE.(2002) Difficulties in Learning and Teaching Programming—Views of Students and Tutors. Education and Information Technologies, vol.7(1), China, p. 55-60.
- ❖ Davies, S., J.A. PolackWahl, and K. Anewalt (2011) A Snapshot of Current Practices in Teaching the Introductory Programming Sequence Beligin, pp.23.
- ❖ Schulte, C. and J. Bennedsen (2009), What do teachers teach in introductory programming?, IEEE conference proceeing,pp.58-65.
- ❖ Mason, R., G. Cooper, and M.D. Raadt (2012) Trends in Introductory Programming Courses in Australian Universities – Languages, Environments and Pedagogy.
- ❖ in Proceedings of the Fourteenth Australasian Computing Education Conference (ACE2012), Melbourne, Australia.pp.89.
- ❖ Sebesta, R.W. (2014) Concepts of Programming Languages, USA, pp.60. Moritz Schlarb ,Christian Hundt and Bertil Schmidt.(2015) SAUCE: A Web- Based Automated Assessment Tool for Teaching Parallel Programming”, Euro-Par 2015: Parallel Processing Workshops.
- ❖ Nikolai Tillmann, Michal Moskal, Jonathan de Halleux, Manuel Fahndrich, Judith Bishop, Arjmand Samuel, Tao Xie, July 3.(2012) The Future of Teaching Programming is on Mobile Devices, ITiCSE12 , Haifa, Israel,pp.25.
- ❖ Lisa Eadicicco. Dec 6 (2014) The Best Programming Languages Every Beginner Should Learn, Business Insider, pp.82-85.
- ❖ Rebecca Hiscott. Jan 21(2014) Programming Languages You Should Learn Right Now, Mashable, USA, pp.57.34