



Muscat College

Programming Language Paradigms

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Ada programming language

A Report

Submitted by

Stirling No: 2840080

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• **Introduction**

In the era of fast technology, robust secure programming is more demand than ever before, with many successive achievements in the huge electronic industries such as missiles, automotive and aviation systems and medical systems. These terms are protected under a strong programming language which called ADA. The ADA 2012 language is considered one of the high-level programming languages and is ideal for large-scale and long-lived applications. In addition, Ada language supports many of the features that were present in Fortan and Pascal language, also to that it contains additional features that make it use by programmers easier and more reliable even in complex engineering programs. We aim in this research paper to follow briefly the status of this language and what distinguishes it from. I will talk about in this topic about Ada from the moment it was adopted until its current performance, and also about developing independent systems for some sectors to determine whether this language corrected the problems of previous programming's languages.

1. Features of ADA

The ADA language was created in 1980s, but it was completed in 2012, it is considered one of the high-level programming languages. The main goal that produced this language was originally justified that other languages which is do not meet the needs of electronic systems.

The life cycle of the ADA language started in the general "Jean Ichbiah" computer lab after the US Department of Defense issued

specific requirements to create a unified language that can work on all operating systems, which is one of the basics of the military project, it is not ceased to serve military projects only, but it is rather it is considered the main artery for global commercial projects such as air control systems, air missiles and satellites.

After the ADA language became real and tangible in our technical life, we noticed that it satisfies most of the needs that programmers previously stumbled upon to solve such:

1.1 Concurrent programming, error detection and handling.

Ada can detect errors, process it, and effectively packaging of data, in addition to providing tools for large programming teams to work together on large projects with a high degree of productivity, and with this ability. Ada achieves its main goal of being a special language for embedded computer systems.^[14] For example, Ada supports a lot of checks (at compile time) to help the programmer avoid errors that can only be discovered (Run time) like what happens in other programming languages.^[17]

One of the most popular software tools in Ada used by programmers that help them to write source code is (GNAT Programming Studio).

"GNAT Studio" it is (IDE) the programmer with GNAT Studio can get sophisticated code, and navigation features and the power to make graphs a lot of awesome projects organization, and class inheritance'.^[18]

1.2 Ada style in programming.

The systems designed in Ada language use a programming way substantially different from traditional programming. To illustrate, let's look at a problem that involves ascertaining the value of the change in one's pocket. The traditional program might say: Take any coin from the bag; if it is a half, add 50 Baiza to the total; if it a Baiza add other 10 Baiza, etc... then take another coin. An Ada solution might say: Take all coins from the bag and divide into like groups of halves, Baiza's, etc.; determine the value of each group simultaneously; and add the subtotals together. The scope and approach of the difference between Ada and traditional programming languages is substantial.^[14]

2. Problems solved by Ada:

2.1. Converting units of measurement.

In October 1999, NASA announced that they had lost a spacecraft bound for Mars, because one team of engineers and programmers works in metric units, and the other team works in English units, and therefore there was an error in translating from system to system, and the spacecraft went in wrong direction. "ROBERT LEE HOTZ, TIMES SCIENCE WRITER".

There were many programming problems at the time, then ADA came to solve these problems and rely on them by the programmers.

In Ada, they have a base type, float, they can sub-type float with, such as distance, mass, then the Ada compiler will complain. Now, also they can subtype distance with imperial and metric and subtype imperial

with miles, yards, feet, and inches and kilometers, meters, centimeters too.

If they try to add a distance to a mass, the ADA compiler will complain. Now, we can subtype distance with imperial and metric. They can subtype imperial with miles, yards, feet, and inches. They can subtype metric with kilometers, meters, centimeters. Note that if they subtype mass with imperial and metric, through the magic of “disambiguation”, they are still different types.

Now, at each level of subtyping, they can define operators. The operators are overloaded, they “know” what types they are supposed to work on. So, for example, under distance we define a “+” operator that adds inches and centimeters: it multiplies inches by 2.54 and adds to centimeters returning centimeters, or it divides centimeters by 2.54, adds to inches and returns inches. [\[4\]\[1\]\[8\]\[9\]](#)

2.2. The Ada impact on today's weapon systems.

Ada it is one of the standards in the military, and in American National Standards Institute, also and became a United State Federal Information Processing Standard since 1985. This language has also been adopted in NATO's command and control systems. The policy of the MODs in the UK now to use either CORAL 66 or Ada and, also in German defense applications, only use two languages are allowed (Ada, PEARL).

In a statement from the "AdaCore" company, it says something like "Ada it is the trusted source for doing reliable and robust software development", and it also announced company that "Airbus Helicopters" have chosen the Ada language to develop unmanned aerial prototype project. It is specifically designed to meet the requirements of global militaries, and navies in the current century.

The F-35 fifth generation fighter jet, among the most complex military podiums until now, this fighter jet suffered many production setbacks due to poor programming languages, the huge volume of software code used. Yet, the airlines and defense companies have since been working to correct this problem, by using Ada language, it is known that the computer program increase in complexity as the size of the program increase so the Ada language provides a lot of facilities to divide the programs into smaller unites, to help the programmer read, modify and write the program easier. [\[14\]\[1\]\[5\]\[8\]\[9\]](#)

2.3. Ada's capabilities in medicine.

According to the US (FDA) report, every year there are many reports that it receives about deaths, serious injuries, and malfunctions that are associated with medical device, therefore the FDA has introduced safer specifications and guarantees to protect medical equipment and programs from potential risks, here the importance of Ada is highlighted, as it has a long history of successful use of many types of security and safety programs.

Ada language support the development of high-quality computer programs, inclusive those that requirement to certified security and safety standards. e.g., powerful typing, means this data meant for one aim will not be accessed via unsuitable operations; errors like treating pointers as (integers) are blocked. Also (array) in Ada, bounds checking blocked buffer overrun vulnerabilities that are frequently common in other languages. [\[11\]\[5\]\[8\]\[9\]](#)

The study looks if Ada corrected the problems of the others languages, and by evaluating the projects that were implemented by the Ada language that they were successful, however, is Ada fast at detecting errors and smoothing storage? here is diagram showing a group of programming languages, including the Ada programming language:

2.4.General comparison between programming languages.

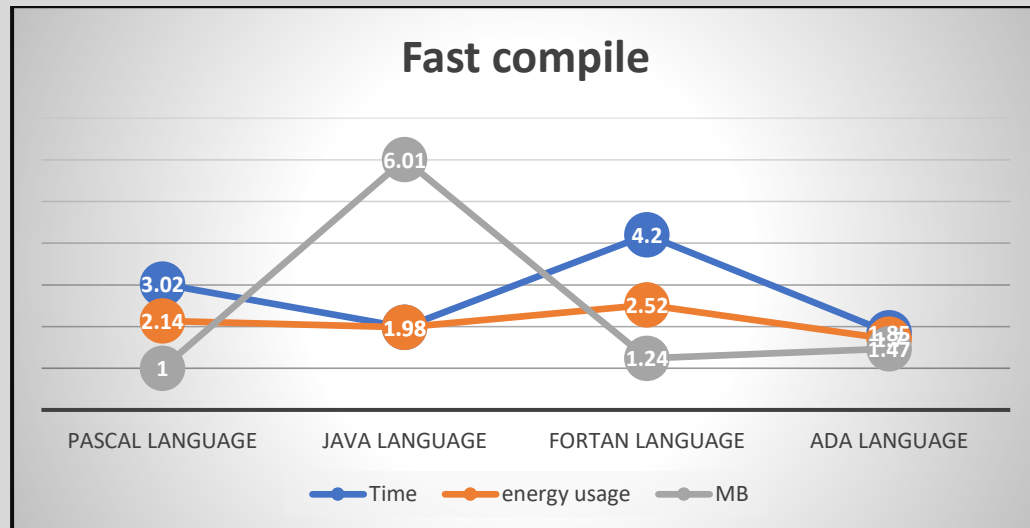


Chart- 1 (Comparison between (Ada, Java, Pascal, Fortan)

The chart gives information about fast compile for 4 different programming languages (Ada, Java, Fortan, Pascal). According the chart, there were upward trends in java regarding its consumption Mb, on both items. Also, as we can see Ada language generally shows the fastest and most energy efficient language among the other 3 languages mentioned in the previous chart, and the slowest programming languages as per chart is pascal.

Overall, the fastest form languages in ascending order are: Ada, Java, Fortan then pascal. But this does not mean that we should use the Ada language and leave the rest of the languages, there is no explicit answer to the question that many people have: "what is the best language?" There is no best language, there is no definitive and definitive answer to this question at all. ^[12]

But some languages may be easier for the beginner to acquire, unlike others, in terms of speed of reading and understanding the codes, and the following table summarizes the differences from another side for these languages:

	Ada	Pascal	Java
For loop	<pre> procedure ADA is M, A : Int := 1; I : Int := 50; H : Int; begin -- Ada uses a regular assignment statement for incrementation. M := M + 1; -- Regular addition H := M + A + I; end ADA;</pre>	<pre> program forLoop; var i: int; begin for i := 10 to 20 do begin writeln('value of i: ', i); end; end; end.</pre>	<pre> Public class Hjava{ Public static void main(String[] argv) { integer O = 1, M = 50, A; O++; A = O + M; } }</pre>
If statement	<pre> if number > 5 then Put_Line (" large "); elsif number < 5 then Put_Line (" small"); else Put_Line (""); end if;</pre>	<pre> if month = 5 then writeln('May') else writeln('Summer season');</pre>	<pre> if (number > 5) System.out.print("pass"); else if (number < 5) System.out.print("failure"); else System.out.print("");</pre>
Understand ability	<p>little hard to understand because it does not contain the same symbols as other language like: { }</p> <p>And because it is high-level-language</p>	<p>Easy to understand, to clarify, consider this example to calculates a factorial n!::</p> <pre> var M, A, fact : integer; begin writeln('Enter any number: '); read(A); fact := 1; for M := 2 to n do fact := fact * M; write(n, '! = ', fact); end.</pre> <p>It is easy to look at the program, and get a sense of what is happening, despite the fact that it has no comments</p>	<p>Quick to understand, because it is relatively high-level, that is means you don't need to dive deep.</p>
Easy to use	<p>Yes, because it is protecting you (to some degree) against a lot of common mistakes.</p>	<p>Pascal is easy to learn. In terms of level of abstraction and lines of code.</p>	<p>Relatively Simple to Use, for example in Java garbage collection, happens without your involvement.</p>
Languages Problems	<p>The maintenance price is very low, because Ada is converting the voltage to create a sound system in the first time.</p>	<p>Need effort arduous, and very expensive.</p>	<p>Need working harder, more expense</p>

Table1 - Ada vs Pascal and Java

Source: [15][2][16]

3. Conclusion:

To conclude, with the great attention by the US Department of defense for ADA Programming language, more attention should be given to this language, for its advantages that distinguished it from other programming languages since the time it was created. I think that Ada is still in its mature stage, it takes some stages of growth for the controversy end. The research focuses on one goal, which is a real demonstration that the Ada language is still a very good programming language, and it is controversial. Several points were discussed, the problems that Ada was able to solve, and adoption of Ada in huge projects, as well as I made a comparison between Ada and other languages. The problem in this research is to determine whether the Ada language has achieved the intended purpose of its creation.

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