COMPUTER SCIENCE
AND SOFTWARE ENGINEERING
AUBURN UNIVERSITY
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Homework 1 Solution
COMP 3220

(1. 30pts) Write a detailed evaluation of a programming language you know, using and covering the criteria discussed in class (and in Table 1.1 of Chapter 1).

This question involves evaluation of a selected language in terms of the following criteria: Readability, Writability, Reliability. Consider for instance, the **Java** language in comparison to another popular language such as C. Your answer does not have to compare the features of the selected language to another language.

The Java language has small amount of language constructs and is easy to learn. On the other hand, feature multiplicity (e.g., x++, x=x+1, ++x) allows more than one way to accomplish a particular operation. Another problem with respect to readability is the operator overloading. While operator overloading brings dynamic flexibility and context-sensitive use of a construct (e.g., method). An orthogonal language is one in which you can express a lot by combining a small number of operators in a lot of different ways. Java has orthogonal I/O since all I/O is through classes. Further, formatted I/O can be simpler than in C if you use the proper Java class. On the other hand, objects complicate Java in a few ways. First, the treatment of objects versus primitive data types makes Java less orthogonal than C. Second, because some classes have static components, instantiated objects is not orthogonal (in some cases, you pass messages to objects, in some cases you pass messages directly to the class).

The syntax design of Java can be improved by the use of reserved words that can improve readability of compound constructs. Instead of using brackets for starting and terminating compound data and control structures, reserved words such as endfor, endwhile etc. can be used. In C and Java, functions and methods are similar, but it is more complex in Java because of the use of information hiding. On the other hand, C permits passing of functions and Java does not. Additionally, C only has pass by copy making parameter passing more complex than in Java where objects are automatically passed by reference. As for data types and structures, (in comparison to languages such as C), Java is object-oriented and offers more abstraction than structs or unions (e.g., C). In addition to objects, Java also has the Boolean type and the String type. java is an expressive language as it offers numerous short cut operators and a flexible for loop. As for type checking, Java is greatly superior over C because C has mechanisms to avoid type checking, such as by passing optional parameters to a function. Java is closer to a strongly typed language than C. However, Java has polymorphism and other mechanisms, so is not a strongly typed language.

(2. 15pts) Name and explain another criterion by which languages can be judged (in addition to those discussed in the chapter). We can categorize language evaluation criteria into four main areas, each offering specific criteria for evaluation.

- **Language design and implementation criteria** help assess how well a language is designed and how easily compilers and interpreters can be developed for the language.
- **Human factors criteria** help assess the human interface or the user-friendliness of a language. For instance, writability is partly related to this category, because it helps determine the degree to which a language allows a programmer to develop programs easily and correctly. The learnability of a language is also related to this category.
- **Software engineering criteria** are intended to assess those aspects of a language that improve the engineering of quality software. Such criteria help evaluate a language's capacity to support portability, reliability, maintainability, reusability, testability, etc.
- **Application domain criteria** assess how well a language supports programming for specific application domains. Real-time systems that operate under uncertain environments and hence requirements may call for constructs that help the programmers develop self-managing, self-healing, self-monitoring, self-tuning, self-repair, self-configuration etc. Artificial Intelligence application domain may require a program to provide constructs that enable reasoning, learning, and planning.

(3. 10pts) What are the advantages in implementing a language with a pure interpreter? In a pure interpreter, data and program are provided as required. A our interpreter is highly dynamic and allows changing a program on the fly to dynamically update the code. For some application domains, such Artificial Intelligence, run-time generation of plans and actions are often needed. A pure interpreter also allows easy implementation of debugging operations, because error messages can refer to source-level statements instead of the object code. An interpreter does not require sophisticated lexical and syntactic analysis components, which are used predominantly in translation (e.g., compiling) systems.

(4. 10pts) Some programming languages – for example, Pascal – have used semicolon to separate statements, while Java uses it to terminate statements. Which of these, in your opinion, is most natural and least likely to result in syntax errors? Support your answer.

In Pascal, which uses semicolon to separate statements, the last statement in a block of statements does not end with a comma. Presence of such an exception makes the language non-orthogonal. This easily (and often) leads to syntax errors.

(5. 15pts) Describe some design trade-offs between efficiency and safety in some language you know. Java has a built-in garbage collection mechanism that frees a programmer from manually deallocating memory space. Automated garbage collection helps improve safety by eliminating or reducing certain bugs. One example is dangling pointer bugs that occur when a memory is deallocated when there are still references (pointers) to it, and one of these pointers is dereferenced. By then the memory space may have been allocated to another use and dereferencing may cause unpredictable results. Another example is a memory leak, in which a program fails to free the memory space occupied by unreachable objects. This leads to memory exhaustion. While garbage collection improves program safety, it has efficiency issues. it consumes computing resources in deciding which memory to free, which can lead to decreased or uneven performance.

(6. 10pts) Do you think language design by committee is a good idea? Support your opinion. A language designed by a small group of experts may not offer features that are desirable by the users of the programming language. An open, transparent, and participative activity can facilitate taking into account diverse views and requirements, which may not be available to members of a community. This view is analogous to open source software innovations that have been extremely successful in the recent past.

(7. 10pts) Explain two reasons why pure interpretation is an acceptable implementation method for several recent scripting languages. Scripting languages support programs developed for the execution of tasks that can be executed ”on-the-fly”, without explicit compile and link steps; they are typically created or modified by the person executing them. Scripts are expected to be executed in a platform-neutral manner. Therefore, compilation into machine code is not always desirable and/or needed. This makes pure interpretation an acceptable implementation method.