

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



Introduction

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Course Detail



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Course: Theory of Programming Languages

Course Code: CS IT 507

Lecture: 3 (13-09-2024)

Outline Lecture 3



- Revision of Lecture 2
- Programming Domains and Associated Languages
- Language Evaluation Criteria

Programming Domains and Associated Languages



- **Scientific Applications**
 - Fortran, ALGOL 60
- **Business Applications**
 - COBOL,
- **Artificial Intelligence**
 - LISP, Prolog
- **Systems Programming**
 - most system software is now written in more general programming languages, such as C and C++.
- **Web Software**
 - HTML, PHP, PYTHON

Basic Language Evaluation Criteria



Language evaluation criteria in programming languages are sets of standards and principles used to assess the quality and effectiveness of programming languages.

Some of the most important criteria are

- **Base Criteria:**
 - Readability
 - Writability
 - Reliability
- **Others Criteria**
 - Cost
 - Portability
 - Generality



Readability

- One of the most important criteria for judging a programming language is the ease with which programs can be read and understood
- Before 1970, software development was largely thought of in terms of writing code.
- The different factors that impact readability are:
 - Simplicity
 - Orthogonality
 - Control Statements
 - Data types and data structures
 - Syntax Considerations

Readability - Simplicity



A simple language will be easy to learn and hence understand. There are a number of factors that account for simplicity.

- Number of basic components
- Feature multiplicity
- Operator overloading
- How much simple should it be?

Readability-Simplicity

Number of Basic Components



- Learning curve is directly proportional to the number of basic components. If a language has more basic components, it will be difficult to learn and vice-versa. It is important to note that one can learn a subset of a programming language for writing but for reading you must know everything.

Readability - Simplicity



Feature multiplicity

– more than one way to accomplish the same task.

```
i = i + 1;
```

```
i++;
```

```
++i;
```

```
i += 1;
```

If a programmer has used all these different constructs to increment a variable at different locations, the reader may get confused. It is simpler to adopt one structure and use it consistently.

Readability - Simplicity



Operator overloading

- problematic if inconsistent or unconventional
- **How much simple should it be?**
 - If a language is very simple then its level may also be decreased as it may lose abstraction. In that case, it will be difficult to write and read algorithms in that language.

Readability-Orthogonality



- how relatively small number of components that can be combined in a relatively small number of ways to get the desired results.
- the more orthogonal the designs the fewer exceptions and it make it easier to learn, read, and write programs in a programming language.

Control Statements



Control statements also play an important role in readability. We are all aware of the hazards of goto statement. If a language relies on goto statements for control flow, the logic becomes difficult to follow and hence understand and maintain. Restricted use of goto in extreme was needed and useful as well but with the emergence of new language constructs to handle those situations, it probably not an issue any more.

Data types and data structures



- Data types and data structures also play an important role in improving the abstraction level of a programming language, hence making it more readable. For example, a simple omission of Boolean type in C resulted in many problems as integers were instead of Boolean which made the program difficult to follow and debug in many cases

Syntax Consideration



- Variable names
- signaling the start and end of key words

Let us first consider the following C if statement.

```
if (some condition)
//
```

- Now observe the following code

```
if (some condition) then
    -- do this
end if
    -- now do this
```

Now it can be easily seen that a reader of this program will not be confused by the indentation.



Writability

A way of writing programs in computer languages.

Writability is a measure of how easily a language can be used to create programs for a chosen problem domain.

Writability



It is simply not reasonable to compare the writability of two languages in the realm of a particular application when one was designed for that application and the other was not. For example, the writabilities of Visual BASIC (VB) and C are dramatically different for creating a program that has a graphical user interface, for which VB is ideal. Their writabilities are also quite different for writing systems programs, such as an operation system, for which C was designed.



Reliability

- A programming language should enable the programmers to write reliable code. The important attributes that play an important role in this respect are listed below:
- Type Checking
- Exception handling

Cost



- Training
- Cost of writing programs in the language – productivity
- Programming environment
- Compiling
- Execution
- optimization versus compilation speed
- Cost of language implementation
- Cost of poor reliability
- Maintenance – a function of readability

Other Criterion



- Portability

- Standardization

Portability deals with how easy it is to port a system written in a given programming language to a different environment which may include the hardware and the operating system. In today's heterogeneous environment, portability is a huge issue. C is more standardization as compare to COBOL.

Other Criterion



- **Generality**

- Applicability to a range of domains

Generality is also an important factor and deals with the applicability of the language to a range of different domains. For example, C is more general purpose than LISP or FORTRAN and hence can be used in more domains than these two languages.

Issues and trade-offs



- It would be nice if one could assign weights to different criteria and then compare the different options. Unfortunately, this kind of help is not available and hence the balancing act, as usual, is a very difficult job.

THANKS