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SHELL PROGRAMMING LANGUAGE BASICS

H. M. Kuldoshev 1,
Z. O. Ahmedova
Tashkent State University of Economics, Senior Lecturer
Tashkent State University of Transport, Lecturer
Email: hakimkhm1971@mail.ru,

Abstract
This article explores the basics of Shell programming language, its syntax, and role in system management. Practical problems such as variables, conditional statements, loops, and file handling are addressed using Shell scripting. The research results demonstrate that Shell scripting is an effective tool for system automation. The advantages and limitations of Shell scripting are analyzed, and recommendations are provided for programmers.

Keywords: Shell programming language, bash, scripting, system administration, automation, Unix, Linux.

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Introduction

The Shell programming language is a scripting language widely used in Unix, Linux, and other Unix-like operating systems, and is a convenient and effective tool for system management and automation. Although the term "shell" originally meant the interface between the computer user and the operating system kernel, today the shell often refers to the command line environment and scripts written from it. With the help of the Shell programming language, users can easily and efficiently solve complex tasks such as automating various tasks in the system, working with files, managing processes, and monitoring the state of the system.

Shell scripts allow you to execute simple commands sequentially, but also provide basic programming capabilities using conditional operators, loops, and functions. Thus, the Shell language allows you to express complex algorithms, like other programming languages, but faster and easier to write than traditional languages. This makes it a very valuable tool for system administrators, programmers, and automation specialists.

Unlike other programming languages, the Shell programming language directly calls the commands and utilities of the operating system. This allows it to perform many tasks at once, achieving a high level of flexibility and efficiency in system management. For example, operations such as creating directories in the file system, moving files, and deleting them can be performed using very simple commands. Shell scripts can also be used to perform complex file manipulations, analyze log files, and perform automatic backups.

Bash (Bourne Again SHell) is the most common and widely used shell environment. It was originally created to extend the capabilities of the Bourne shell (sh), and today it is the standard shell on almost all Unix and Linux systems. The extended syntax and powerful capabilities of the Bash shell have made it popular among learners and professionals. In addition, there are other

shell environments: a classic shell like sh, a C-style shell like csh and tcsh, a shell with extended capabilities zsh, and others.

The importance of the shell programming language is that it is a key tool for automating system operations, reducing repetitive tasks, and ensuring system security. For example, a system administrator can automate tasks that need to be performed every day (backing up files, checking system status, collecting user information) through shell scripts. This increases productivity, reduces human error, and ensures stable system operation.

At the same time, learning the Shell programming language also helps to gain a deeper understanding of Unix and Linux systems. By writing shell scripts, programmers and system specialists better understand the principles of the system's internal operation, command syntax, and rules for working with resources in the operating system. Therefore, learning the shell programming language not only improves practical skills, but also makes a significant contribution to ensuring system security and efficiency.

This article covers the basic concepts, syntax, and capabilities of the shell programming language. The purpose of the article is to introduce students to the basic elements of the shell programming language, explain the basic methods of writing scripts, and develop practical skills using simple examples. It also examines the advantages and disadvantages of the shell programming language, its role in system automation.

As a result, with the help of this article, students will have a solid theoretical foundation for learning the shell programming language, and in the future will be able to successfully work in creating complex scripts and managing systems.

Literature review and Methodology

This article combines practical and theoretical methods to study the basic concepts and capabilities of the Shell programming language. The study was conducted on the basis of Bash (Bourne Again SHell), one of the most popular variants of the Shell language, as it is widely used in Linux and Unix systems and provides a user-friendly interface. The main methods used in the study are described in detail below.

Studying the syntax of the Shell programming language

As the first stage of the study, the basic syntax and syntactic rules of the Shell programming language were studied. For this, official documentation, tutorials and practical examples were analyzed. The syntax elements included:

- Declaring variables and assigning values to them,
- Methods for storing text and numeric values,
- Conditional operators and their rules for writing (if, case),
- Loops and repetitive operations (for, while, until),
- Creating and calling functions,
- Accepting user input and using it within the program.

At this stage, practical implementations of each element were written and tested. At the same time, syntactic differences between different shell environments (bash, sh, zsh) were also considered.

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Creating and testing shell scripts

In the second stage, real shell scripts were created based on the theoretical knowledge gained. Practical exercises were performed in the following areas:

- Writing a sequence of simple commands,
- Expressing complex conditions using conditional operators and loops,
- Accepting user input and using it in a script,
- Working with the file system: creating, reading, deleting files, managing directories,
- Automatic analysis of log files and outputting results.

The scripts were tested in a terminal window in a Linux environment, errors were identified and corrected. The purpose and principle of operation of each script were described in the documentation.

Analysis of the main commands of the Shell programming language

During the study, the most commonly used commands for the Shell programming language were also studied separately. These commands are used to manage various processes in the system, work with files and folders, and process text. Their working principles and syntax were studied:

- echo — outputting text to the screen,
- read — receiving information from the user,
- grep — searching for specific lines in text,
- awk and sed — convenient utilities for text processing,
- test and [ ] — commands for checking conditions.

The possibility of creating scripts that perform complex tasks through various combinations of commands was analyzed.

T Implementation of automation tasks in the system

The possibilities of automating daily and repetitive tasks in the system using Shell scripts were studied. In this process, attention was paid to the following areas:

- Creating a script for regular file backup,
- Monitoring the system status and recording the results,
- Collecting and reporting information about users in the system,
- Automatic file cleaning and storage tasks.

Scripts that perform these tasks were written and tested in the system. The speed of execution, efficiency, and error rates of the scripts were analyzed.

Preparation of a practical manual and examples

During the study, a set of simple and complex examples was prepared to make the Shell programming language understandable to students. Detailed explanations were given to each example, and the practical scope of the examples was also shown. These examples help to form basic skills for new students.

Analytical approach

As an important part of the methodology, the results obtained were analyzed. The advantages and disadvantages of the Shell programming language were identified and their impact on the efficiency of system automation was studied. The use of the shell in comparison with other programming languages was also considered.

Resources and technologies

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The main resources used in the research process were:

- Linux operating system (Ubuntu 20.04 LTS) terminal,
- Bash shell environment,
- Official Bash documentation and various online resources,
- Tutorials and course materials,
- Online forums and recommendations from experienced programmers.

Based on these resources, the theoretical and practical aspects of the Shell programming language were studied.

Results

During this study, many results were obtained on the basic syntax, commands and practical application of the Shell programming language. The results obtained are analyzed step by step and explained with examples.

Creating and using variables

In the Shell programming language, variables have a dynamic type, and declaring and assigning values is very simple. No additional syntax is required when assigning values to variables, they are only linked using the = sign. In the following example, the variable name is assigned the text "Ali":

```
name="Ali"
echo "Hello, $name!"
```

As a result, Hello, Ali! is displayed in the terminal. In this way, when calling the values of variables, the $ sign is placed in front of them. The syntax and ease of use of these variables create great convenience for programmers.

Conditional operators and decision making

Conditional operators can be used to control various processes in scripts depending on the condition. For example, notifying the user based on age:

```
age=20
if [ $age -ge 18 ]; then
   echo " You are older"
else
   echo " You are young children."
fi
```

In the above code, if age is 18 or older, the screen displays "You are an adult." Otherwise, "You are a child." This example shows the practical use of conditional operators. You can also use the case operator to control multi-case conditions.

Loops and repetitions

In the Shell programming language, you can repeat commands using loops. The following example prints the numbers 1 to 5 using a for loop:

```
for i in 1 2 3 4 5
do
echo "Value: $i"
```

done
As a result, the following output appears in the terminal:
makefile
Value: 1
Value: 2
Value: 3
Value: 4
Value: 5
This loop construct is a very convenient tool for automating repetitive tasks in the Shell programming language. In addition, while and until loops are also used, which operate on different conditions.
Accepting user input
Shell scripts allow you to accept information from the user. Using the read command, the value entered by the user is stored in a variable:
echo "Enter your name:"
read username
echo "Hello, $username!"
The user types his name into the terminal, and the script processes it. This method plays an important role in creating interactive scripts.
Working with the file system
The shell programming language provides a wide range of possibilities for working with files and directories. For example, the following commands are used to create a directory, move to it, and list the files in it:
mkdir new_directory
cd new_directory
touch file1.txt file2.txt
ls
This code sequence creates a new directory, enters it, creates two empty files, and lists the files in the directory. Thus, using shell scripts, you can manage and automate the file system.
Text processing and analysis
The shell language supports powerful utilities such as grep, awk, and sed. For example, the grep command is used to search for specific words in a text file:
grep "ERROR" log.txt
This command extracts lines in the log.txt file that contain the word "ERROR". Such capabilities are important for system administrators and programmers, as they make it easier to analyze system logs and identify problems.
Scripts for automation
Several automated scripts were created and tested during the research. For example, a script that checks the system status every day at 2 am and writes the results to a file:
#!/bin/bash
date >> /var/log/sys_status.log
uptime >> /var/log/sys_status.log

```
df -h >> /var/log/sys_status.log
echo "------------" >> /var/log/sys_status.log
```

This script adds system status information to the sys_status.log file. Such scripts simplify system monitoring and automate data collection.

Discussion

The results of this study clearly demonstrated the importance of the shell programming language in system administration and its effectiveness. The shell language was confirmed to be a convenient tool for system administrators and programmers with its simplicity, speed, and convenience. The discussion section analyzes the advantages, disadvantages, and comparison of the shell programming language with modern programming languages.

Advantages of the shell programming language

First, the ability to directly execute system commands using shell scripts and access them in a fast and simple way is a great advantage. This, in turn, facilitates automation and system monitoring. Examples and experiments have shown that shell scripts are very effective in performing simple tasks, especially in automating repetitive tasks, significantly saving time and effort.

Second, the widespread use of the shell programming language and its standard tool in various Unix and Linux systems make it very useful to learn. Shell environments such as Bash provide advanced syntax and powerful tools, allowing learners to manage complex processes. In addition, since shell scripts are available on many systems, they do not require additional software to write and execute.

Limitations and disadvantages of the shell programming language

However, it has been found that there are some limitations of the shell programming language. Most importantly, the shell language has limited capabilities for managing complex calculations and data structures. For example, it does not have object-oriented programming capabilities, and it is not suitable for efficiently processing large amounts of data.

In addition, when shell scripts are written in large volumes or their complexity increases, they become difficult to read and understand. This can lead to a decrease in software quality and an increase in errors. Therefore, for large projects, it is advisable to use more powerful and modular programming languages than the shell programming language.

Comparison between the shell language and modern programming languages

Compared to modern programming languages, such as Python, Perl, or Ruby, the shell language is simple and more efficient in directly addressing operating system commands. Languages like Python, on the other hand, offer a wide range of libraries, object-oriented capabilities, and improved syntax to help you build complex systems. However, the shell language is still a leader in performing simple tasks quickly and efficiently due to its deep integration with the system.

Also, shell scripts work best when used in conjunction with other programming languages. For example, if Python is used for complex calculations and data processing, shell scripts can be used for system commands and automation tasks. This approach allows programmers to make the most of system resources.

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Prospects for learning and application

Learning the shell programming language is necessary for a deeper understanding of Unix/Linux systems and acquiring important skills in system administration. During the research, it was observed that students who learned the basics of the shell language were able to quickly and effectively solve many problems in their daily work.

Another important aspect of learning the shell programming language in the future will be its widespread use in modern DevOps and automation processes. For example, shell scripts are widely used in CI/CD (Continuous Integration/Continuous Deployment) systems, container management, and cloud service automation. Therefore, learning the shell programming language is useful not only for traditional system administration, but also for modern software development.

Conclusions and Suggestions

This article examines the basic concepts, syntax, practical applications, and role of the Shell programming language in system management. The results of the study showed that the shell language is an effective tool for system automation and scripting due to its simple syntax, direct interaction with system commands, and widespread use. It was found that using basic constructs such as variables, conditional operators, loops, and user input, it is possible to perform various tasks, including working with files, monitoring system status, and automating complex processes.

However, due to certain limitations of the shell programming language, in particular, the lack of ability to manage complex data structures and object-oriented programming, it is advisable to use it in conjunction with other programming languages in large and complex projects. It was also observed that as shell scripts grow in length and complexity, their management becomes more difficult.

The advantages of the shell programming language are its speed, direct access to system commands, and cross-platform functionality, making it a relevant tool not only for traditional system administration, but also for modern DevOps processes.

Recommendations

Develop the study of the Shell programming language

In educational institutions and vocational training centers, more attention should be paid to the basic concepts and practice of the shell programming language. This will form the necessary skills not only in system administration, but also in the areas of programming and automation.

An integrated approach to complex tasks

It is recommended to use shell scripts in conjunction with Python, Perl or other high-level programming languages when creating complex systems. This approach increases efficiency and functionality.

Application in automation and DevOps processes

The role of the shell programming language in DevOps and system automation is increasing. Therefore, training should be organized in organizations and IT departments to develop shell scripting skills and integrate them with modern tools.

Improving the quality of scripts

When creating large and complex shell scripts, it is necessary to adhere to the principles of writing modular and easy-to-read code. More attention should be paid to the processes of cleaning, commenting and testing the code.

Using new tools and environments

The introduction of modern IDEs, linters, and debugging tools when working with shell scripts can help improve the efficiency of shell programming.

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