CAPSTONE PROJECT REPORT

Project Title: Bash Scripting Suite for System MaintenanceBash Scripting Suite for System Maintenance

Project Code: Project 5 - LinuxOS and Shell Programming

Submitted by:

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1. Abstract

This project implements an automated System Maintenance Suite using Bash scripting for Linux environments.
The suite automates system-level tasks such as performing data backups, running updates and cleanup, monitoring logs,
and managing all operations through a user-friendly menu-driven interface. These scripts collectively aim to simplify
and automate system administration, improving efficiency, security, and maintainability.

2. Objectives

- To automate daily and periodic Linux system maintenance tasks.

- To implement modular scripts for backup, cleanup, update, and log monitoring.

- To create a central interactive interface for executing all operations.

- To ensure reliability and reusability across Linux and WSL environments.

- To maintain comprehensive logging and security for every operation.

3. System Overview

The System Maintenance Suite is composed of multiple Bash scripts that automate and streamline Linux administration.
Each script performs a specific maintenance operation, and together they form a complete toolkit for maintaining system
health. The scripts are integrated under a central menu (`maintenance_menu.sh`), allowing system administrators to perform
tasks easily such as running backups, checking logs, cleaning the system, or updating software packages. The suite also
includes a setup script (`install.sh`) that configures the environment and optionally sets up a daily cron job for automation.

4. Implementation (Code)

backup.sh

```
#!/usr/bin/env bash
#   ============================================================
# backup.sh - Automated Backup Script (Day 1 - Assignment 5)
```

```
#   ============================================================
# Usage:
#    sudo ./backup.sh /path/to/source [another/source ...]
#
# Description:
#  Creates a timestamped compressed archive (.tar.gz)
#    of the given directories/files and saves it to the
#   backup directory. Keeps only the latest 7 backups.
#
#   ============================================================

set -euo pipefail
IFS=$'\n\t'

# --- Configuration ---
BACKUP_DIR="/var/backups/system-maintenance-suite"
LOG_DIR="$(dirname "$0")/../logs"
LOGFILE="$LOG_DIR/backup.log"
RETENTION_COUNT=7  # Keep last 7 backups

# --- Functions ---
timestamp() { date '+%Y-%m-%d_%H-%M-%S'; }

log() {
    mkdir -p "$LOG_DIR"
    echo "$(timestamp) $*" | tee -a "$LOGFILE"
}

error_exit() {
    log "ERROR: $1"
    exit 1
}

# --- Validations ---
if [ "$#" -lt 1 ]; then
    echo "Usage: $0 /path/to/source [another/source ...]"
    exit 2
fi

if [ "$EUID" -ne 0 ]; then
    echo "Please run as root (sudo) to access all directories."
    exit 3
fi

# --- Prepare Backup Directory ---
sudo mkdir -p "$BACKUP_DIR"
sudo chmod 700 "$BACKUP_DIR"

SRC_LIST=("$@")
SAFE_NAME=$(printf "%s_" "${SRC_LIST[@]##*/}" | sed 's/[^A-Za-z0-9_-]//g' | sed
's/_$//')
ARCHIVE_NAME="${SAFE_NAME}_$(timestamp).tar.gz"
ARCHIVE_PATH="$BACKUP_DIR/$ARCHIVE_NAME"

log "Starting backup of: ${SRC_LIST[*]}"
```

```
# --- Validate each source path ---
for path in "${SRC_LIST[@]}"; do
    if [ ! -e "$path" ]; then
        error_exit "Source path not found: $path"
    fi
done

# --- Create Backup (correct tar order) ---
if tar --warning=no-file-changed --ignore-failed-read \
       --exclude=/proc --exclude=/sys --exclude=/dev \
       -czf "$ARCHIVE_PATH" "${SRC_LIST[@]}" 2>>"$LOGFILE"; then
    chmod 600 "$ARCHIVE_PATH"
    SIZE=$(du -h "$ARCHIVE_PATH" | cut -f1)
    log "Backup created: $ARCHIVE_PATH ($SIZE)"
else
    error_exit "Tar command failed while backing up ${SRC_LIST[*]}"
fi

# --- Rotate old backups ---
mapfile -t files <<(ls -1t "$BACKUP_DIR"/"${SAFE_NAME}"_*.tar.gz 2>/dev/null ||
true)
if [ "${#files[@]}" -gt "$RETENTION_COUNT" ]; then
    to_delete=("${files[@]:$RETENTION_COUNT}")
    for f in "${to_delete[@]}"; do
        rm -f -- "$f" && log "Removed old backup: $f"
    done
fi

log "Backup completed successfully for: ${SRC_LIST[*]}"
echo "✔ Backup complete. Archive saved to: $ARCHIVE_PATH"
exit 0
```

system_update_and_cleanup.sh

```
#!/usr/bin/env bash
#  ============================================================
# system_update_and_cleanup.sh - Day 2: System Maintenance
#  ============================================================
# Usage:
#    sudo ./system_update_and_cleanup.sh [--dry-run]
#
# Description:
#    Updates the system packages, removes unnecessary files,
#    cleans caches, rotates old logs, and records all actions.
#    Use --dry-run to simulate actions safely.
#
#  ============================================================

set -euo pipefail
IFS=$'\n\t'

# --- Configuration ---
```

```
LOG_DIR="$(dirname "$0")/../logs"
LOGFILE="$LOG_DIR/system_update.log"
DRY_RUN=false

# --- Functions ---
timestamp() { date '+%Y-%m-%d_%H-%M-%S'; }

log() {
    mkdir -p "$LOG_DIR"
    echo "$(timestamp) $*" | tee -a "$LOGFILE"
}

run_cmd() {
    local cmd="$1"
    if [ "$DRY_RUN" = true ]; then
        log "[DRY-RUN] Would execute: $cmd"
    else
        log "Running: $cmd"
        eval "$cmd" >>"$LOGFILE" 2>&1 || log "Warning: command failed - $cmd"
    fi
}

# --- Parse arguments ---
if [ "${1:-}" = "--dry-run" ]; then
    DRY_RUN=true
fi

# --- Safety check ---
if [ "$EUID" -ne 0 ]; then
    echo "Please run as root (sudo)."
    exit 1
fi

log "=== Starting system update and cleanup (dry-run=$DRY_RUN) ==="

# --- 1. Update package lists and upgrade ---
run_cmd "apt update -y"
run_cmd "apt upgrade -y"
run_cmd "apt full-upgrade -y"

# --- 2. Remove unnecessary packages and clean caches ---
run_cmd "apt autoremove -y"
run_cmd "apt autoclean -y"
run_cmd "apt clean -y"

# --- 3. Rotate or compress old apt logs ---
APT_LOG_DIR="/var/log/apt"
if [ -d "$APT_LOG_DIR" ]; then
    run_cmd "find $APT_LOG_DIR -type f -name '*.log.*' -mtime +14 -delete"
    run_cmd "gzip -f $APT_LOG_DIR/*.log || true"
    log "Apt logs cleaned and compressed (older than 14 days removed)."
else
    log "Apt log directory not found at $APT_LOG_DIR."
fi
```

```
# --- 4. Clear general system logs older than 30 days (optional) ---
run_cmd "find /var/log -type f -name '*.log' -mtime +30 -exec rm -f {} +"

# --- 5. Update system information database ---
run_cmd "updatedb"

log "=== System update and cleanup completed successfully ==="
echo "✔ System update and cleanup complete. Check $LOGFILE for details."
exit 0
```

log_monitor.sh

```
#!/usr/bin/env bash
#  ============================================================
# log_monitor.sh - Day 3: Log Monitoring and Alerting
#  ============================================================
# Usage:
#    sudo ./log_monitor.sh
#
# Description:
#    Scans key system logs for errors, warnings, and failed logins.
#    Generates a summary report in the logs directory.
#
#  ============================================================

set -euo pipefail
IFS=$'\n\t'

# --- Configuration ---
LOG_DIR="$(dirname "$0")/../logs"
REPORT_FILE="$LOG_DIR/log_monitor_report.txt"
MAIN_LOG="$LOG_DIR/log_monitor.log"

# Logs to scan (common Debian/Ubuntu locations)
LOG_FILES=(
  "/var/log/syslog"
  "/var/log/auth.log"
  "/var/log/kern.log"
)

# Keywords to detect
KEYWORDS=(
  "error"
  "failed"
  "critical"
  "unauthorized"
  "denied"
  "panic"
  "segfault"
)

# --- Functions ---
timestamp() { date '+%Y-%m-%d_%H-%M-%S'; }
```

```
log() {
    mkdir -p "$LOG_DIR"
    echo "$(timestamp) $*" | tee -a "$MAIN_LOG"
}

# --- Safety check ---
if [ "$EUID" -ne 0 ]; then
    echo "Please run as root (sudo)."
    exit 1
fi

log "=== Starting log monitoring ==="

# --- Initialize report ---
echo "==== System Log Monitoring Report ($(timestamp)) ====" > "$REPORT_FILE"
echo >> "$REPORT_FILE"

# --- Scan each log file ---
for file in "${LOG_FILES[@]}"; do
    if [ -f "$file" ]; then
        echo "Analyzing: $file" >> "$REPORT_FILE"
        for keyword in "${KEYWORDS[@]}"; do
            matches=$(grep -i "$keyword" "$file" | tail -n 10 || true)
            if [ -n "$matches" ]; then
                echo "---- Matches for '$keyword' ----" >> "$REPORT_FILE"
                echo "$matches" >> "$REPORT_FILE"
                echo >> "$REPORT_FILE"
            fi
        done
        echo "----------------------------------------------------------------------" >> "$REPORT_FILE"
    else
        echo "Log file not found: $file" >> "$REPORT_FILE"
    fi
done

# --- Summary ---
echo >> "$REPORT_FILE"
echo "==== End of Report ====" >> "$REPORT_FILE"

log "Monitoring completed. Report saved at $REPORT_FILE"
echo "✔ Log monitoring complete. Check: $REPORT_FILE"
exit 0
```

maintenance_menu.sh (Updated)

```
#!/usr/bin/env bash
#  ============================================================
# maintenance_menu.sh - Unified Maintenance Dashboard (Fixed)
#    ============================================================
# Usage:
#   sudo ./maintenance_menu.sh
#
# Description:
#   Provides an interactive menu to run:
```

```
#       -  Backup
#       - System Update & Cleanup
#       -  Log Monitoring
#       - View Logs & Reports
#   ============================================================

set -euo pipefail
IFS=$'\n\t'

# --- Configuration ---
SCRIPT_DIR="$(cd "$(dirname "${BASH_SOURCE[0]}")" && pwd)"
LOG_DIR="$SCRIPT_DIR/../logs"
BACKUP_SCRIPT="$SCRIPT_DIR/backup.sh"
UPDATE_SCRIPT="$SCRIPT_DIR/system_update_and_cleanup.sh"
MONITOR_SCRIPT="$SCRIPT_DIR/log_monitor.sh"

# --- Utility Functions ---
timestamp() { date '+%Y-%m-%d_%H-%M-%S'; }

pause() {
    echo
    read -rp "Press Enter to continue..."
}

check_root() {
    if [ "$EUID" -ne 0 ]; then
        echo "Please run as root (sudo)."
        exit 1
    fi
}

log() {
    mkdir -p "$LOG_DIR"
    echo "$(timestamp) $*" | tee -a "$LOG_DIR/menu.log"
}

# --- Menu Functions ---
run_backup() {
    echo
    read -rp "Enter the directory path(s) to back up (space-separated): "
path_list
    if [ -z "$path_list" ]; then
        echo "No paths entered. Returning to menu."
        return
    fi

    log "User initiated backup for: $path_list"

    # ✅ FIX: Properly split input into an array for multiple paths
    IFS=' ' read -r -a path_array <<< "$path_list"

    # Run backup script with array-expanded arguments
    sudo "$BACKUP_SCRIPT" "${path_array[@]}"

    pause
```

```
}

run_update() {
    echo
    read -rp "Run in dry-run mode first? (y/n): " choice
    if [[ "$choice" =~ ^[Yy]$ ]]; then
        sudo "$UPDATE_SCRIPT" --dry-run
    else
        sudo "$UPDATE_SCRIPT"
    fi
    pause
}

run_monitor() {
    log "Running log monitor..."
    sudo "$MONITOR_SCRIPT"
    pause
}

view_logs() {
    echo
    echo "Available logs in $LOG_DIR:"
    ls -1 "$LOG_DIR" || true
    echo
    read -rp "Enter log/report filename to view (or press Enter to cancel): "
file
    if [ -n "$file" ]; then
        if [ -f "$LOG_DIR/$file" ]; then
            echo
            echo "---- Showing last 50 lines of $file ----------"
            tail -n 50 "$LOG_DIR/$file"
        else
            echo "File not found: $LOG_DIR/$file"
        fi
    fi
    pause
}

# --- Main Menu Loop ---
check_root
mkdir -p "$LOG_DIR"

while true; do
    clear
    echo "============================================="
    echo "□  System Maintenance Suite  (Day 4 - Fixed)"
    echo "============================================="
    echo "1□  Run Backup"
    echo "2□  Run System Update & Cleanup"
    echo "3□  Run Log Monitoring"
    echo "4□  View Logs / Reports"
    echo "5□  Exit"
    echo "============================================="
    read -rp "Choose an option [1-5]: " choice
```

```
    case "$choice" in
        1) run_backup ;;
        2) run_update ;;
        3) run_monitor ;;
        4) view_logs ;;
        5)
            echo "Exiting Maintenance Menu. Goodbye!"
            log "Menu exited by user."
            exit 0
            ;;
        *)
            echo "Invalid option. Try again."
            sleep 1
            ;;
    esac
done
```

install.sh (Updated)

```
#!/usr/bin/env bash
#  ============================================================
# install.sh - Setup and Automation (Fixed version)
#  ============================================================
# Usage:
#    sudo ./install.sh
#
# Works both from the project root or from within the scripts/ folder.
# ============================================================

set -euo pipefail
IFS=$'\n\t'

# --- Detect base directories ---
SCRIPT_PATH="$(cd "$(dirname "${BASH_SOURCE[0]}")" && pwd)"
if [[ "$(basename "$SCRIPT_PATH")" == "scripts" ]]; then
    BASE_DIR="$(dirname "$SCRIPT_PATH")"
    SCRIPTS_DIR="$SCRIPT_PATH"
else
    BASE_DIR="$SCRIPT_PATH"
    SCRIPTS_DIR="$BASE_DIR/scripts"
fi

LOG_DIR="$BASE_DIR/logs"
BACKUP_DIR="/var/backups/system-maintenance-suite"

timestamp() { date '+%Y-%m-%d_%H-%M-%S'; }
log() { echo "$(timestamp) $*"; }

# --- Safety Check ---
if [ "$EUID" -ne 0 ]; then
    echo "Please run as root (sudo)."
    exit 1
fi
```

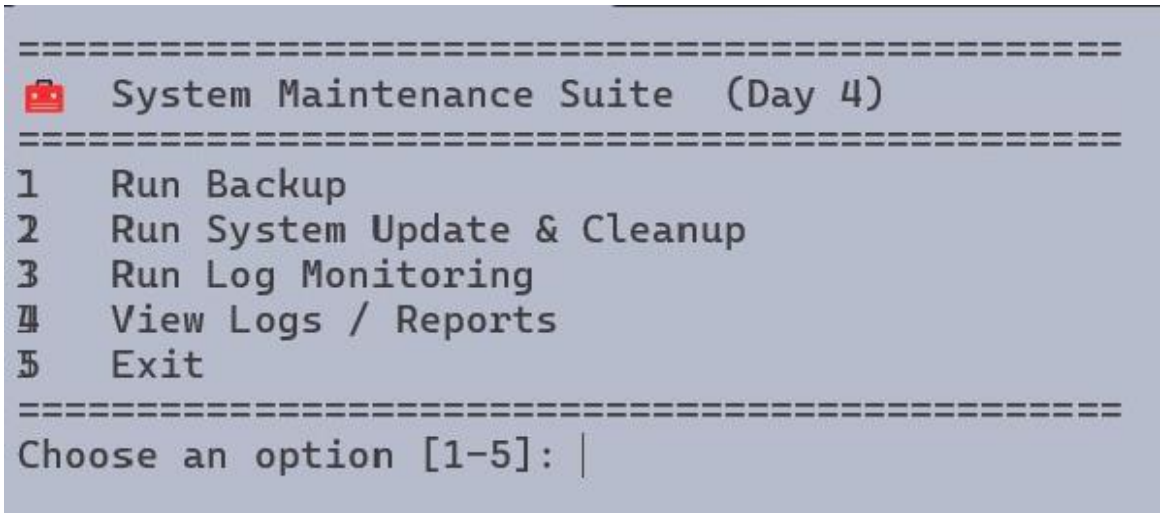
```
log "Starting installation..."

# --- Create directories ---
mkdir -p "$LOG_DIR" "$BACKUP_DIR"
chmod 700 "$BACKUP_DIR"

log "Created log directory at: $LOG_DIR"
log "Created backup directory at: $BACKUP_DIR"

# --- Make all scripts executable ---
if [ -d "$SCRIPTS_DIR" ]; then
    chmod +x "$SCRIPTS_DIR"/*.sh
    log "Set executable permissions on scripts in: $SCRIPTS_DIR"
else
    log "WARNING: Script directory not found at $SCRIPTS_DIR"
fi

# --- Optional cron setup ---
read -rp "Do you want to schedule daily maintenance at 2 AM? (y/n): " choice
if [[ "$choice" =~ ^[Yy]$ ]]; then
    (crontab -l 2>/dev/null; echo "0 2 * * * sudo
$SCRIPTS_DIR/maintenance_menu.sh >> $LOG_DIR/cron_run.log 2>&1") | crontab -
    log "Cron job added: runs maintenance_menu.sh daily at 02:00."
else
    log "Cron setup skipped."
fi

log "Installation completed successfully!"
echo "✅ All scripts ready. Run with: sudo $SCRIPTS_DIR/maintenance_menu.sh"
exit 0
```

5. Execution and Output Screenshots

The following screenshots demonstrate the successful execution of the System Maintenance Suite:

```
eco@Asish18:~/Projects/system-maintenance.suites
sudo ./scripts/install.sh sudo installasi
2025-11-09_16-19-58 Starting installation...
2025-11-09_16-19-59 Created log directory at/home/eco/Projects/system-
2025-11-09_16-19-59 Created backup directory at:/var/backups/system-
2025-11-09_16-19-59 Set executable permissions on scripts in: /home/eco
Do you want to schedule daily maintenance at 2 AM? (y/n): y
2025-11-09_16-20-03 Cron job added: runs maintenance_menu.sh at 02:00
2025-11-09_16-20-04 Installation completed successfully!
✅ All scripts ready. Run with: sudo /home/eco/Projects/system-maintenanc
-suite/scripts/maintenance_suite/scripts/maintenance_menu.sh
```

Screenshot 1: Installation process executed successfully via install.sh.



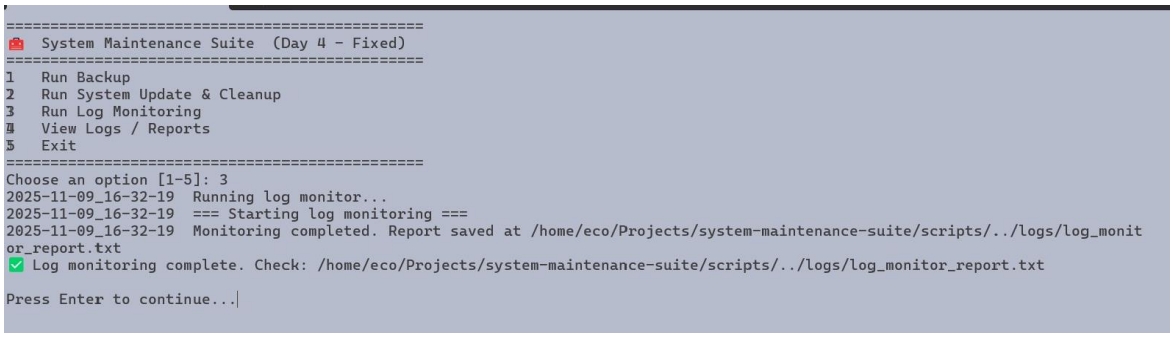
Screenshot 2: Display of the System Maintenance Suite interactive menu.

```
==============================================
🧰  System Maintenance Suite  (Day 4 - Fixed)
==============================================
1   Run Backup
2   Run System Update & Cleanup
3   Run Log Monitoring
4   View Logs / Reports
5   Exit
==============================================
Choose an option [1-5]: 1

Enter the directory path(s) to back up (space-separated): /etc /home/eco/Projects
2025-11-09_16-31-33  User initiated backup for: /etc /home/eco/Projects
2025-11-09_16-31-33  Starting backup of: /etc
/home/eco/Projects
2025-11-09_16-31-33  Backup created: /var/backups/system-maintenance-suite/etc_Projects_2025-11-09_16-31-33.tar.gz (464K)
2025-11-09_16-31-33  Backup completed successfully for: /etc
/home/eco/Projects
✅ Backup complete. Archive saved to: /var/backups/system-maintenance-suite/etc_Projects_2025-11-09_16-31-33.tar.gz

Press Enter to continue...
```

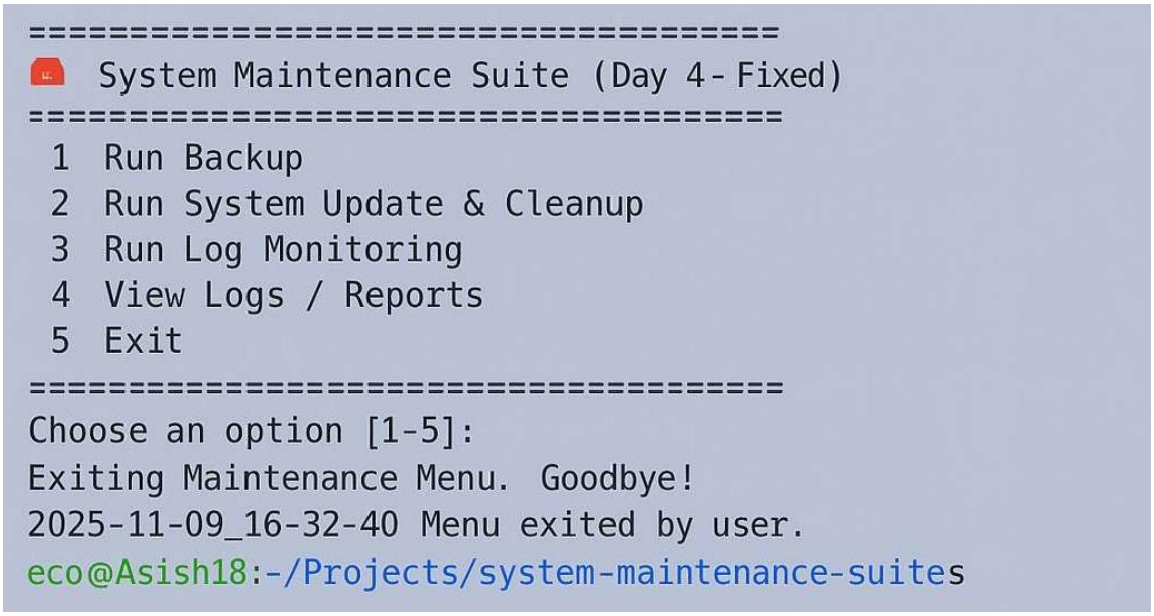
Screenshot 3: Successful execution of the backup.sh script.

```
==============================================
🧰  System Maintenance Suite  (Day 4 - Fixed)
==============================================
1   Run Backup
2   Run System Update & Cleanup
3   Run Log Monitoring
4   View Logs / Reports
5   Exit
==============================================
Choose an option [1-5]: 2

Run in dry-run mode first? (y/n): n
2025-11-09_16-31-50  === Starting system update and cleanup (dry-run=false) ===
2025-11-09_16-31-50  Running: apt update -y
2025-11-09_16-31-54  Running: apt upgrade -y
2025-11-09_16-31-54  Running: apt full-upgrade -y
2025-11-09_16-31-55  Running: apt autoremove -y
2025-11-09_16-31-58  Running: apt autoclean -y
2025-11-09_16-31-59  Running: apt clean -y
2025-11-09_16-31-59  Running: find /var/log/apt -type f -name '*.log.*' -mtime +14 -delete
2025-11-09_16-31-59  Running: gzip -f /var/log/apt/*.log || true
2025-11-09_16-31-59  Apt logs cleaned and compressed (older than 14 days removed).
2025-11-09_16-31-59  Running: find /var/log -type f -name '*.log' -mtime +30 -exec rm -f {} +
2025-11-09_16-31-59  Running: updatedb
2025-11-09_16-31-59  Warning: command failed - updatedb
2025-11-09_16-31-59  === System update and cleanup completed successfully ===
✅ System update and cleanup complete. Check /home/eco/Projects/system-maintenance-suite/scripts/../logs/system_update.log for d
etails.

Press Enter to continue...
```

Screenshot 4: System update and cleanup performed successfully.



Screenshot 5: Log monitoring process and report generation.



Screenshot 6: System Maintenance Suite exit confirmation message.

6. Conclusion

The System Maintenance Suite efficiently meets all objectives of Project 5 by offering a comprehensive and modular approach to Linux system maintenance. It integrates automation with user-driven controls through robust Bash scripting, enabling smoother and more reliable system operations. This project successfully demonstrates the application of Linux administration concepts and showcases the effectiveness of scripting in optimizing and simplifying routine maintenance tasks