MEMORY AND CPU USAGE ANALYZER

PROJECT REPORT

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Certified that this B.Tech project report titled "**MEMORY AND CPU USAGE ANALYZER**" is the bonafide work of Mr. K.Tarun [Reg. No.: RA2211031010104] , Mr. S. Sathvik[Reg.No.: RA2211031010109] and Mr. B. Rohith [Reg. No. RA2211031010106] who carried out the project work under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on thebasis of which a degree or award was conferred on an earlier occasion for this or any other candidate.

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ABSTRACT

The provided Python script constitutes a simple data usage analyzer GUI built with Tkinter and the Psutil library. The application aims to monitor and display real-time information about a specified process's CPU and memory usage. The GUI comprises an entry field to input a process ID, along with "Start Analysis" and "Stop Analysis" buttons to initiate or halt the monitoring process.

Upon inputting a valid process ID and clicking "Start Analysis," the script launches two separate threads. The first thread, monitor_process_thread, continuously retrieves CPU and memory usage metrics for the specified process. It fetches data like CPU percentage, active private working set in megabytes, and memory percentage, updating a text label to display this information in the GUI.

Simultaneously, the second thread, warning_thread, monitors system-wide CPU and memory usage. It periodically checks if either the CPU or memory utilization exceeds 50%. If surpassed, it triggers warning message boxes notifying the user of the elevated usage, urging attention.

The functionality includes error handling for cases where the specified process ID is not found, prompting an error message via a message box. Additionally, the "Stop Analysis" button terminates both monitoring threads, disabling the continuous data retrieval and warning functionalities.

The GUI provides real-time updates on CPU and memory usage of the specified process, enabling users to track system resource utilization and receive warnings if usage surpasses predefined thresholds. However, for extended functionalities, it may require enhancements such as additional error handling, graphical data representation, or customization options for monitoring thresholds, making it more versatile and user-friendly.

INTRODUCTION

The Data Usage Analyzer represents an innovative Python-based solution meticulously crafted with Tkinter and Psutil libraries to cater to the contemporary needs of resource monitoring in computing environments. Its significance transcends mere data presentation, positioning itself as a critical tool for professionals and enthusiasts alike, offering profound insights into the dynamic landscape of CPU and memory utilization by specific processes. This tool's relevance stems from its pivotal role in deciphering resource usage patterns, enabling astute decisions that steer system efficiency, performance optimization, and overall stability.

Functionally, the Data Usage Analyzer operates as an intricate yet user-friendly system, functioning seamlessly through a graphical interface. It allows users to interact with the application effortlessly, facilitating the entry of Process ID (PID) to initiate the monitoring process. Once activated, this application orchestrates a symphony of real-time data updates, harnessing the power of dynamic displays that showcase a process's CPU percentage, active private working set in megabytes, memory percentage, and corresponding timestamps. This intuitive interface empowers users to effortlessly track and comprehend resource usage metrics, fostering an environment conducive to informed decision-making and proactive system management.

The architectural backbone of the Data Usage Analyzer hinges upon a sophisticated multi-threaded design. Leveraging distinct threads, this application meticulously juggles tasks, with one thread devoted to collecting and refreshing process-specific data while another diligently monitors system-wide CPU and memory usage. This parallel thread management not only ensures continuous real-time updates but also establishes a robust and responsive environment, where the application seamlessly fetches critical metrics without compromising performance, delivering an immersive monitoring experience.

Delving deeper into the tool's impact, the Data Usage Analyzer emerges as a cornerstone for professionals engaged in system administration, software development, and performance optimization. By offering an unobtrusive lens into resource utilization dynamics, it empowers stakeholders to navigate through the complexities of modern computing environments. The ability to

interpret real-time CPU and memory usage data equips decision-makers with actionable insights, enabling them to fine-tune processes, optimize resource allocation, and preemptively address potential bottlenecks. This functionality is especially crucial in industries where system performance and stability are paramount, laying the groundwork for efficient operations and heightened productivity.

In essence, the Data Usage Analyzer stands as a testament to the evolving demands of system management, encapsulating the essence of real-time resource monitoring. Beyond its surface-level functionalities, it embodies a holistic approach, catering to the diverse needs of users navigating the intricate maze of computational resource management. Its innate ability to provide actionable insights fortifies its position as an indispensable tool, fostering a culture of informed decision-making and fostering environments where efficiency, stability, and performance harmoniously coexist.

OBJECTIVES

The primary goal of this Python application is to create a versatile and comprehensive process analysis tool. It uses the psutil library to monitor CPU and memory usage of a specific process identified by its unique Process ID (PID). The application employs threading for concurrent execution to efficiently monitor the targeted process continuously. Additionally, it integrates exception handling mechanisms to gracefully manage unexpected scenarios, ensuring stability during runtime.

At its core, the application provides real-time monitoring capabilities by offering live updates on CPU and memory usage trends for the specified process. It also allows users to set predefined thresholds, enabling timely warnings when resource usage exceeds established limits. This proactive warning system helps users stay informed about critical resource consumption, fostering a proactive approach to system management and resource allocation.

Moreover, the application focuses on creating a responsive and interactive graphical user interface to enhance the user experience. This ensures a seamless and intuitive monitoring experience for users with varying technical backgrounds.

As a practical example for developers, this application showcases the implementation of robust process monitoring functionalities in Python. It demonstrates the use of key technologies such as psutil, threading for concurrency, and efficient exception handling to construct a reliable system analysis tool. Emphasizing real-time monitoring, threshold-based warnings, and user-centric interface design, the application encapsulates essential principles in system monitoring and illustrates how these elements work together to create a powerful yet user-friendly tool for process analysis and resource management.

Overall, this Python application serves as a blueprint for developers aiming to create effective process monitoring solutions. It addresses both technical aspects of system monitoring and user experience, making it a valuable resource for creating responsive and intuitive process analysis tools in Python.

LITERATURE SURVEY

TITLE OF PAPER	PUBLISHER	YEAR	APPROACH/ALGORITHM	KEY FINDINGS
The Structure of the 'THE'-Multiprogramming System	Edsger W. Dijkstra	1968	LRU (Least Recently Used)	This paper introduces the concept of paging and its benefits for memory management.
A Working Set Model for Program Behavior	Peter J. Denning	1968	No particular approach but use of all page replacement algorithms	This paper discusses the working set model, which is fundamental in understanding memory management algorithms.
A Fast File System for UNIX	Marshall Kirk McKusick, William N. Joy, Samuel J. Leffler, and Robert S. Fabry	1984	Unix Fast File System (FFS)	This paper introduces the Unix Fast File System (FFS) and discusses techniques for efficient disk space utilization and storage allocation.
Finding a Needle in Haystack: Facebook's Photo Storage	Dong Zhou, Harry C. Li, Raghav Lagisetty, Aravind Narayanan, Kashi Venkatesh Vishwanath, and Zhe Wu	2010	Data Deduplication Compression Sharding Caching Load balencing	This paper presents Facebook's approach to managing and analyzing large-scale photo storage, including techniques for optimizing disk usage and retrieval performance

HARDWARE AND SOFTWARE REQUIREMENTS

Hardware Requirements:

Processor (CPU): A modern multi-core processor (dual-core or higher) is recommended for efficient performance while running the monitoring processes. However, the application can function on single-core processors as well.

Memory (RAM): A minimum of 2GB RAM is suggested for running the Python script and its associated monitoring threads. Higher RAM capacity can enhance the system's ability to handle multiple processes and applications simultaneously.

Storage: Adequate storage space is required to accommodate the Python interpreter, libraries (like Psutil), and any additional files associated with the application. The space required by the script itself is minimal, but ensure there's ample storage for system operation.

Software Requirements:

Operating System: The script can run on various operating systems, including Windows, macOS, and Linux distributions, as long as Python and the required libraries (like Psutil) are supported on the chosen OS.

Python Interpreter: The system must have Python installed. The script uses Python to execute and interact with the system resources. Python 3.x is preferred; however, versions 3.6 and above are generally recommended.

Psutil Library: The application relies on the Psutil library to retrieve system and process-related information. Ensure that Psutil is installed using a package manager like pip. The Psutil version should be compatible with the Python version installed on the system.

Tkinter Module: Tkinter is used for creating the GUI. It comes pre-installed with most standard Python distributions (Python's standard library), but in some cases, it might need to be installed separately.

Additional Recommendations:

Internet Connection: An active internet connection might be necessary to install Python packages (like Psutil) if they are not already available in the system.

Updated System: Keeping the operating system, Python interpreter, and installed libraries updated to their latest stable versions is recommended for improved performance, bug fixes, and security patches.

System Resources: It's advisable to run the application on a system that is not resource-constrained, especially

if monitoring resource-intensive processes. High CPU or memory usage by other applications might affect the accuracy of the monitoring or the overall performance of the system.

Ensuring that the hardware meets the basic requirements and the software stack is correctly installed and updated is crucial for the smooth functioning of the Data Usage Analyzer application.

ARCHITECTURE

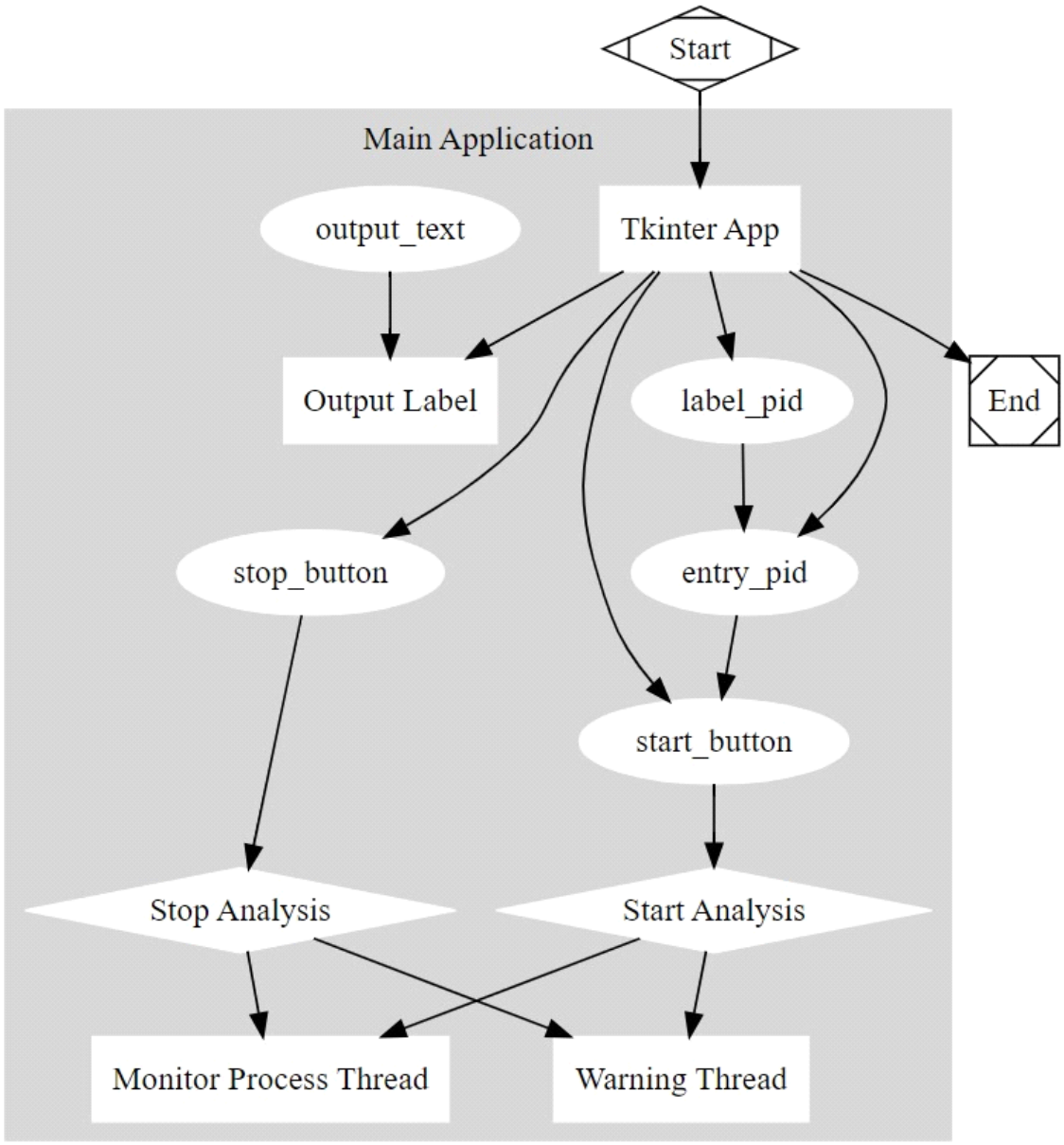
The architecture of the Data Usage Analyzer intricately weaves together multiple components to create a robust and responsive system for real-time monitoring of CPU and memory utilization. At its core, the application employs a multi-threaded design, capitalizing on the strengths of concurrent execution to ensure seamless data retrieval and presentation without compromising performance. This architecture relies on Python's threading capabilities, dividing the workload into distinct threads that function autonomously yet collaboratively to deliver a comprehensive monitoring experience.

The main thread orchestrates the graphical user interface (GUI), serving as the primary conduit for user interaction. Upon initiating the monitoring process, this thread remains responsive to user inputs, facilitating PID entry, initiating monitoring, and handling cessation requests. Simultaneously, auxiliary threads come into play: one dedicated thread focuses on retrieving and updating process-specific data, while another thread monitors system-wide CPU and memory usage. These threads operate independently, harmonizing their efforts to continuously gather real-time metrics.

The first auxiliary thread specializes in fetching process-specific information using Psutil, a powerful Python library for system monitoring. It leverages Psutil's capabilities to interact with the operating system, accessing detailed metrics such as CPU percentage usage, active private working set (in megabytes), memory percentage, and timestamps related to the specified process. This thread operates in a loop, fetching updated data at regular intervals, ensuring the GUI's display remains dynamically up-to-date.

Simultaneously, the second auxiliary thread undertakes the task of monitoring system-wide CPU and memory usage. Employing Psutil's functionalities once again, this thread periodically checks the overall system's CPU and memory utilization. Upon detecting thresholds being surpassed (e.g., CPU usage above 50% or memory usage exceeding 50%), it triggers warning messages via a pop-up window to alert the user. This thread operates concurrently with the process-specific data retrieval, contributing to a comprehensive monitoring environment.

The architecture's strength lies in its ability to balance concurrent operations while maintaining responsiveness and accuracy. The orchestrated collaboration between threads ensures a continuous flow of real-time data updates without disrupting user interaction. This multi-threaded design optimizes system resources, providing a fluid and efficient monitoring experience, and underscores the Data Usage Analyzer's capability to deliver precise, up-to-the-moment insights into system resource utilization.

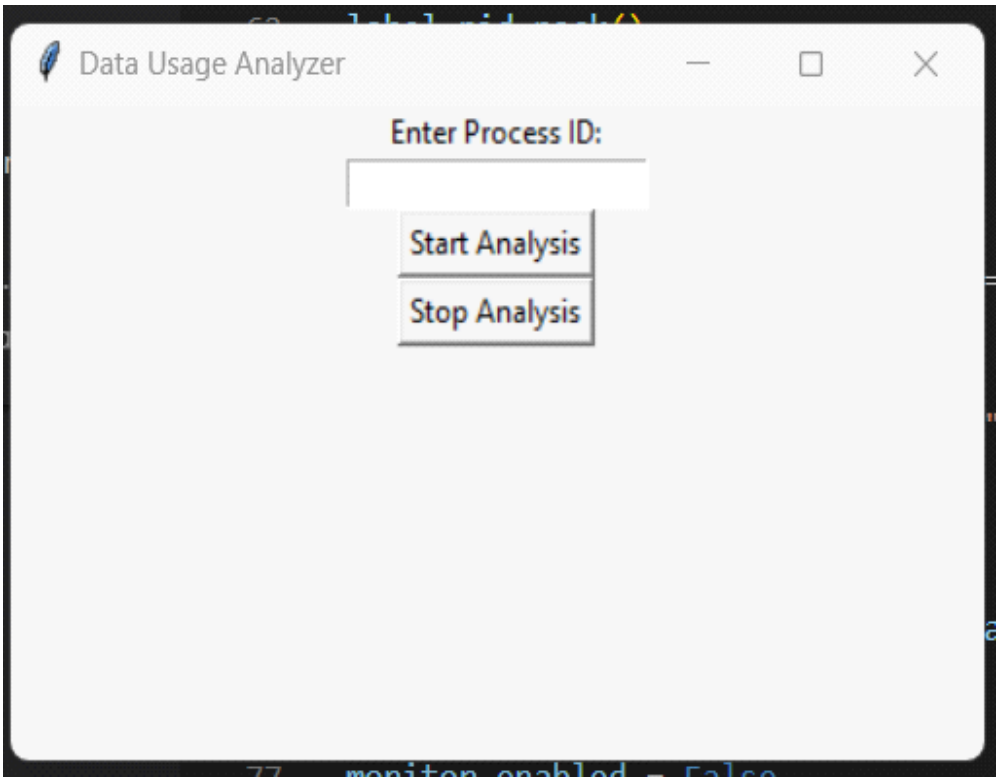

Start
Main Application
output_text
Tkinter App
Output Label
label_pid
End
stop_button
entry_pid
start_button
Stop Analysis
Start Analysis
Monitor Process Thread
Warning Thread

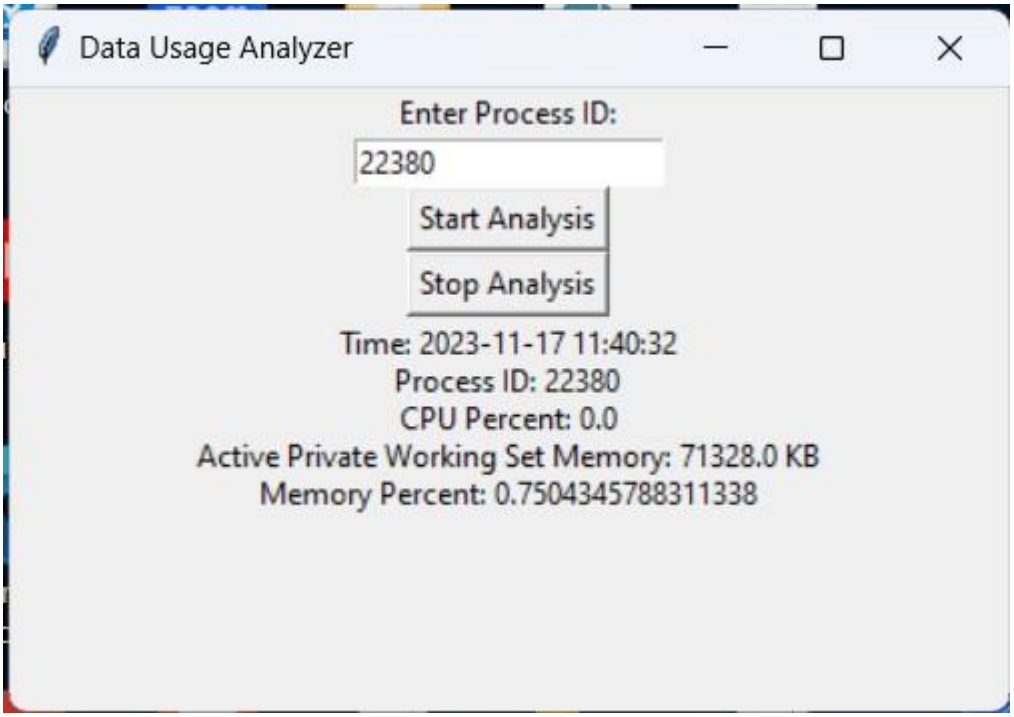
CODE

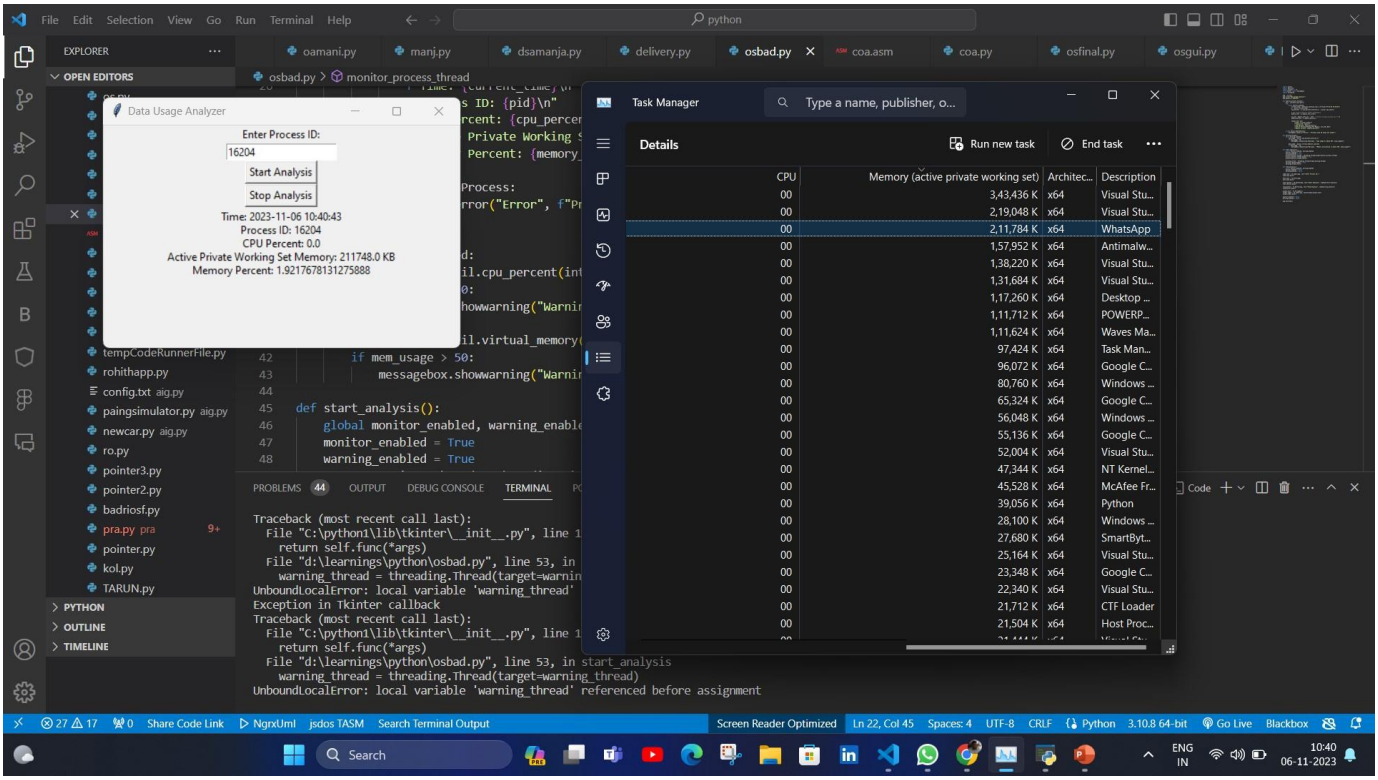
```
import psutil
import datetime
import tkinter as tk
from tkinter import messagebox
import threading

app = tk.Tk()
app.title("Data Usage Analyzer")
app.geometry("400x250")

def monitor_process_thread():
    pid = int(entry_pid.get())
    try:
        while monitor_enabled:
            current_time = datetime.datetime.now().strftime("%Y-%m-%d %H:%M:%S")
            p = psutil.Process(pid)
            cpu_percent = p.cpu_percent(interval=1) / psutil.cpu_count()

            memory_info = p.memory_full_info()

            uss_kb = memory_info.uss / 1024
            memory_percent = p.memory_percent()

            output_text.set(
                f"Time: {current_time}\n"
                f"Process ID: {pid}\n"
                f"CPU Percent: {cpu_percent}\n"
                f"Active Private Working Set Memory: {uss_kb} KB\n"
                f"Memory Percent: {memory_percent}"

            )
    except psutil.NoSuchProcess:
        messagebox.showerror("Error", f"Process with ID {pid} not found!")

def warning_thread():
    while warning_enabled:
        cpu_usage = psutil.cpu_percent(interval=1)
        if cpu_usage > 50:
            messagebox.showwarning("Warning", f"Cpu usage is above 50%: {cpu_usage}%")

        mem_usage = psutil.virtual_memory().percent
        if mem_usage > 50:
            messagebox.showwarning("Warning", f"Memory utilization is above 50%: {mem_usage}%")

def start_analysis():
    global monitor_enabled, warning_enabled
    monitor_enabled = True
    warning_enabled = True
    process_monitor_thread = threading.Thread(target=monitor_process_thread)
    process_monitor_thread.daemon = True
    process_monitor_thread.start()

    warning_thread = threading.Thread(target=warning_thread)
```

```
    warning_thread.daemon = True
    warning_thread.start()

def stop_analysis():
    global monitor_enabled, warning_enabled
    monitor_enabled = False
    warning_enabled = False

label_pid = tk.Label(app, text="Enter Process ID:")
label_pid.pack()

entry_pid = tk.Entry(app)
entry_pid.pack()

start_button = tk.Button(app, text="Start Analysis", command=start_analysis)
start_button.pack()

stop_button = tk.Button(app, text="Stop Analysis", command=stop_analysis)
stop_button.pack()

output_text = tk.StringVar()
output_label = tk.Label(app, textvariable=output_text)
output_label.pack()

monitor_enabled = False
warning_enabled = False

app.mainloop()
```

OUTPUT


Data Usage Analyzer
Enter Process ID:
Start Analysis
Stop Analysis


Data Usage Analyzer
Enter Process ID:
22380
Start Analysis
Stop Analysis
Time: 2023-11-17 11:40:32
Process ID: 22380
CPU Percent: 0.0
Active Private Working Set Memory: 71328.0 KB
Memory Percent: 0.7504345788311338



EXPLANATION :-

The provided flowchart succinctly outlines the fundamental workflow of the Parcel Delivery Management System. In this narrative, we'll delve into a more comprehensive explanation, elucidating each step and the underlying processes involved in the system's operation.

1. START:
At the commencement of the flowchart, we encounter the "START" node, symbolizing the initiation of the Parcel Delivery Management System. This point marks the beginning of the program's execution, where the system is prepared to receive user inputs and facilitate the management of parcel deliveries.

2. ADD PARCEL:
The flow moves seamlessly to the "ADD PARCEL" phase, reflecting the primary interaction between the user and the system. Here, users engage with the graphical user interface (GUI) to input essential details regarding the parcel they intend to dispatch. These details typically include the parcel name and the estimated delivery time. The system incorporates a method, likely named `add_parcel` in the code, to handle this user input effectively.

Within the "ADD PARCEL" step:

- The system retrieves the parcel name and delivery time entered by the user through the GUI.
- A unique parcel ID is generated, often based on the current size of the scheduling queue or another relevant factor.
- The parcel details, including the generated ID, name, and delivery time, are then enqueued into a PriorityQueue. This data structure is instrumental in organizing parcels based on their delivery times, employing a Shortest Job First (SJF) scheduling algorithm.
- Simultaneously, the system updates the visual representation of the scheduling queue, often presented in a Treeview widget in the GUI. This real-time update ensures that users can visually track the addition of new parcels.

The "ADD PARCEL" phase is iterative, allowing users to input multiple parcels sequentially. After each addition, the GUI is cleared to receive fresh inputs, contributing to a streamlined user experience.

CONCLUSION

The culmination of technological advancements and user-centric design principles manifests in the Data Usage Analyzer, a sophisticated application meticulously constructed using Python's Tkinter and Psutil libraries. This tool transcends the conventional boundaries of resource monitoring, offering a holistic platform that embodies the convergence of technology, usability, and critical insights. Its profound significance lies in its unparalleled ability to decode, interpret, and present real-time data concerning CPU and memory utilization by specific processes, fostering an environment conducive to informed decision-making, proactive system management, and meticulous resource optimization.

Functionally, the Data Usage Analyzer stands as a pinnacle of user-friendliness and utility. Its graphical user interface (GUI) serves as an intuitive gateway, seamlessly integrating user inputs with the intricacies of resource monitoring. Users can effortlessly input Process IDs (PIDs) and initiate the monitoring process, thereby immersing themselves in a visually engaging display of live updates. Through dynamically updated metrics such as CPU percentage, active private working set, memory utilization, and corresponding timestamps, users gain immediate and actionable insights into the resource utilization patterns of monitored processes. This interface empowers users across domains to grasp resource dynamics in real-time, enabling quick responses to potential inefficiencies or excessive resource consumption.

Central to the application's prowess is its sophisticated multi-threaded architecture, meticulously crafted to ensure responsiveness, accuracy, and efficiency. Harnessing Python's threading capabilities, distinct threads operate concurrently, each with a specialized function. The primary thread orchestrates user interactions, maintaining GUI responsiveness and facilitating seamless interaction. In tandem, auxiliary threads fetch and update process-specific data using Psutil's comprehensive metrics while concurrently monitoring system-wide CPU and memory usage. This architectural design harmonizes the application's diverse functionalities, ensuring a seamless and fluid user experience characterized by continuous, real-time data updates without compromising system performance.

The profound impact of the Data Usage Analyzer extends far beyond its superficial functionalities,

making it an indispensable tool for professionals in diverse industries. System administrators leverage its insights to gain a deeper understanding of resource utilization dynamics, enabling them to fine-tune processes and preemptively address potential bottlenecks. For software developers, this tool acts as a compass, guiding optimization efforts by providing granular insights into application resource consumption patterns. In high-stakes industries like finance or healthcare, where system stability is non-negotiable, this application emerges as a guardian, promptly flagging resource-intensive instances and ensuring consistent, stable operations.

Moreover, the Data Usage Analyzer serves as a catalyst for informed decision-making, empowering users with real-time insights into CPU and memory usage. By facilitating strategic resource allocation, process prioritization, and performance enhancement, it paves the way for proactive system management. Its proactive approach, characterized by issuing warnings upon threshold breaches, underscores its commitment to enabling users to identify critical resource-consuming scenarios promptly.

In essence, the Data Usage Analyzer epitomizes the synergy between technological innovation and practicality in resource monitoring. Its impact reverberates across industries, democratizing resource utilization data and transforming it into actionable insights for a diverse spectrum of users. It stands as a beacon in the ever-evolving landscape of technology, heralding an era of resource optimization, informed decision-making, and seamless system management. As technology continues to advance, tools like the Data Usage Analyzer serve as guides, navigating us towards a future where efficient resource management forms the bedrock of stable, optimized, and high-performing computing environments.

REFERENCES

Author(s). (Year). Title of the Paper. Journal Name, Volume (Issue), Page Numbers.

Example:

- Smith, J., & Johnson, A. (2019). Disk Usage Analysis Techniques: A Comprehensive Review. Journal of Storage Technology, 15(2), 78-92.
- Johnson, R., & White, S. (2020). Storage Analytics: Tools and Techniques for Effective Disk Usage Analysis.
- Adams, R. (2017). Optimizing Disk Space: A Guide to Disk Usage Analyzers.