**Team Members: Siva Shankar Reddy Beeram, Ammy Gwaba, Avipsa Sharma Paudel**

# Abstract:

File systems serve as the backbone of data storage and retrieval in modern computing environments, yet their performance characteristics and forensic capabilities are often overlooked when making critical infrastructure decisions. This project provides a comprehensive comparative analysis of two prominent file systems NTFS (New Technology File System) and EXT4 (Fourth Extended File System) from both performance and digital forensics perspectives.

The study addresses two primary research questions: (1) How do NTFS and EXT4 compare in terms of read/write performance across different file sizes and workloads? and (2) Which file system provides better data recovery capabilities and metadata preservation for forensic investigations?

Our approach involves establishing controlled testing environments using a physical USB/external drive partitioned into separate volumes to ensure isolation and reproducibility. NTFS will be tested natively on a Windows host system, and EXT4 will be tested natively on a Linux host system, with the USB drive mounted as the dedicated target volume. Performance benchmarking will be conducted using standardized tools including dd, fio, and custom Python scripts. The key metrics captured will be throughput (MB/s), latency, and I/O operations per second (IOPS). Testing scenarios will be executed across small file operations (1KB-1MB), large file operations (100MB-1GB), and mixed workloads. For forensic analysis, we will examine metadata storage and conduct recovery testing involving controlled file deletion scenarios on various file types, including documents (.docx, .txt), media (.jpg, .mp4), and system logs. Deleted files will be subjected to data restoration attempts using industry-standard tools such as Autopsy.

Our End Goal is to compare NTFS and EXT4 to observe which one does a better job at restoring deleted files and keeping metadata intact. We will also try and compare how different types of files like documents, photos, videos, and logs hold up during deletion and recovery. In the process, we will point out any problems, like files that only recover partially or lose metadata. At the end, we will give a detail about what file systems to employ if you care about recoverability of data and forensic readiness for enterprise storage, or even just plain old personal usage.