KAIROS PROJECT PROGRESS

Data Analysis and Visualization

TEAM

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OUR OBJECTIVE

To optimize the process of analysis and visualization of data and create a better system for such task.

RECORD EXAMPLE OF OUR DATASET

This is raw data we will process and there are 20 column records to manage

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
anxiety_le	self_esteer	mental_he	depression	headache	blood_pres	sleep_qual	breathing_	noise_level	living_con	safety	basic_neec	academic_	study_load	teacher_st	future_care	social_sup	peer_press	extracurric	bullying	stress_level
14	20	0	11	2	1	2	4	2	3	3	2	3	2	3	3	2	3	3	2	1
15	8	1	15	5	3	1	4	3	1	2	2	1	4	1	5	1	4	5	5	2
12	18	1	14	2	1	2	2	2	2	3	2	2	3	3	2	2	3	2	2	1
16	12	1	15	4	3	1	3	4	2	2	2	2	4	1	4	1	4	4	5	2
16	28	0	7	2	3	5	1	3	2	4	3	4	3	1	2	1	5	0	5	1
20	13	1	21	3	3	1	4	3	2	2	1	2	5	2	5	1	4	4	5	2
4	26	0	6	1	2	4	1	1	4	4	4	5	1	4	1	3	2	2	1	0
17	3	1	22	4	3	1	5	3	1	1	1	1	3	2	4	1	4	4	5	2
13	22	1	12	3	1	2	4	3	3	3	3	3	3	2	3	3	3	2	2	1
6	8	0	27	4	3	1	2	0	5	2	2	2	2	1	5	1	5	3	4	1
17	12	1	25	4	3	1	3	4	2	1	1	1	3	1	4	1	4	4	5	2
17	15	1	22	3	3	1	5	5	2	1	1	1	3	1	4	1	5	5	4	2
5	28	0	8	1	2	4	2	2	3	5	5	5	2	4	1	3	1	1	1	0
9	23	1	24	4	3	1	0	1	2	4	3	1	2	3	3	0	1	0	1	2
2	28	0	3	1	2	4	2	1	3	4	4	4	2	5	1	3	1	2	1	0
11	21	0	14	3	1	2	4	2	2	2	2	3	3	3	3	2	3	2	2	1
6	28	0	1	1	2	4	2	1	4	5	4	5	1	5	1	3	2	2	1	0

THE PROGRESS SO FAR....

We’ve separated our work into 3 files

01_data_cleaning.ipynb ⏳

02_feature_importance.ipynb

03_exploratory&statistical_analysis.ipynb

THE OVERVIEW OF OUR CODE

1ST FILE

This file does 3 things

Memory Management

Files I/O

Process Scheduling

OS CONCEPT WE APPLY TO THE FIRST FILE

1. Simulate Process Scheduling

Break tasks into separate multiprocessing jobs

2.Optimize File I/O

test and compare file reading speeds to simulate OS-level file handling.

3.Improve Memory Management

Track how much memory each step uses — simulate what an OS does.

MEMORY MANAGEMENT

We use psutil to monitor the memory and CPU usage.

```python
# ✅ Utility: Memory and CPU usage logger
def log_memory_cpu(tag, output_queue):
    process = psutil.Process(os.getpid())
    mem_mb = process.memory_info().rss / 1024 ** 2
    cpu_percent = process.cpu_percent(interval=0.1)
    output_queue.put(f"[{tag}] Memory: {mem_mb:.2f} MB | CPU: {cpu_percent:.2f}%")
```

```python
# ✅ Resource monitoring (3 seconds)
def monitor_resources(output_queue, duration=3):
    process = psutil.Process(os.getpid())
    for i in range(duration):
        mem = process.memory_info().rss / 1024 ** 2
        cpu = process.cpu_percent(interval=1)
        output_queue.put(f"[Monitor {i+1}] Memory: {mem:.2f} MB | CPU: {cpu:.2f}%")
```

FILES I/O

Instead of downloading our file with panda, we use mmap instead. We also track the time it takes.

```python
# ✅ Process 1: Load CSV with pandas and monitor resources
def load_data(output_queue, timing_queue):
    try:
        monitor_thread = threading.Thread(target=monitor_resources, args=(output_queue, 3))
        monitor_thread.start()

        log_memory_cpu("Before reading CSV", output_queue)
        start = time.time()

        if not os.path.exists("raw_data.csv"):
            output_queue.put("[ERROR] raw_data.csv not found.")
            return

        df = pd.read_csv("raw_data.csv")

        elapsed = time.time() - start
        log_memory_cpu("After reading CSV", output_queue)
        output_queue.put(f"[Pandas] CSV loaded in {elapsed:.4f} seconds")
        timing_queue.put(("pandas", elapsed))

        monitor_thread.join()

    except Exception as e:
        output_queue.put(f"[ERROR] Pandas read failed: {str(e)}")
```

Load CSV file with panda

```python
# ✅ Process 2: mmap reading (full file)
def mmap_read(output_queue, timing_queue):
    try:
        start = time.time()
        if not os.path.exists("raw_data.csv"):
            output_queue.put("[ERROR] raw_data.csv not found.")
            return

        with open("raw_data.csv", 'r') as f:
            with mmap.mmap(f.fileno(), length=0, access=mmap.ACCESS_READ) as mm:
                content = mm.read()  # ✅ Read entire file content
                text = content.decode(errors='ignore')  # decode bytes to string

                output_queue.put("[mmap] Full file read successfully.")
                output_queue.put(f"[mmap] Total bytes read: {len(content)}")

        elapsed = time.time() - start
        output_queue.put(f"[mmap] Read completed in {elapsed:.4f} seconds")
        timing_queue.put(("mmap", elapsed))

    except Exception as e:
        output_queue.put(f"[ERROR] mmap read failed: {str(e)}")
```

Load CSV file with mmap

PROCESS SCHEDULING

Lastly, while running these processes, we use multiprocessing to schedule each process.

```python
# ✅ Main execution
if __name__ == '__main__':
    output_queue1 = multiprocessing.Queue()
    output_queue2 = multiprocessing.Queue()
    timing_queue = multiprocessing.Queue()

    print("\n[PROCESS SCHEDULING] Starting subprocesses...")

    p1 = multiprocessing.Process(target=load_data, args=(output_queue1, timing_queue))
    p2 = multiprocessing.Process(target=mmap_read, args=(output_queue2, timing_queue))
    p1.start()
    p2.start()
    p1.join()
    p2.join()

    print("\n--- Pandas CSV Load Outputs ---")
    while not output_queue1.empty():
        print(output_queue1.get())

    print("\n--- mmap File Read Outputs ---")
    while not output_queue2.empty():
        print(output_queue2.get())

    # Collect timings for plotting
    timings = []
    while not timing_queue.empty():
        timings.append(timing_queue.get())

    # ✅ Plot the comparison
    plot_results(timings)

    print("\n[DONE] All subprocesses completed with visualization.")
```

PROCESS SCHEDULING

The result of the run, including the memory usage and the time used for each process

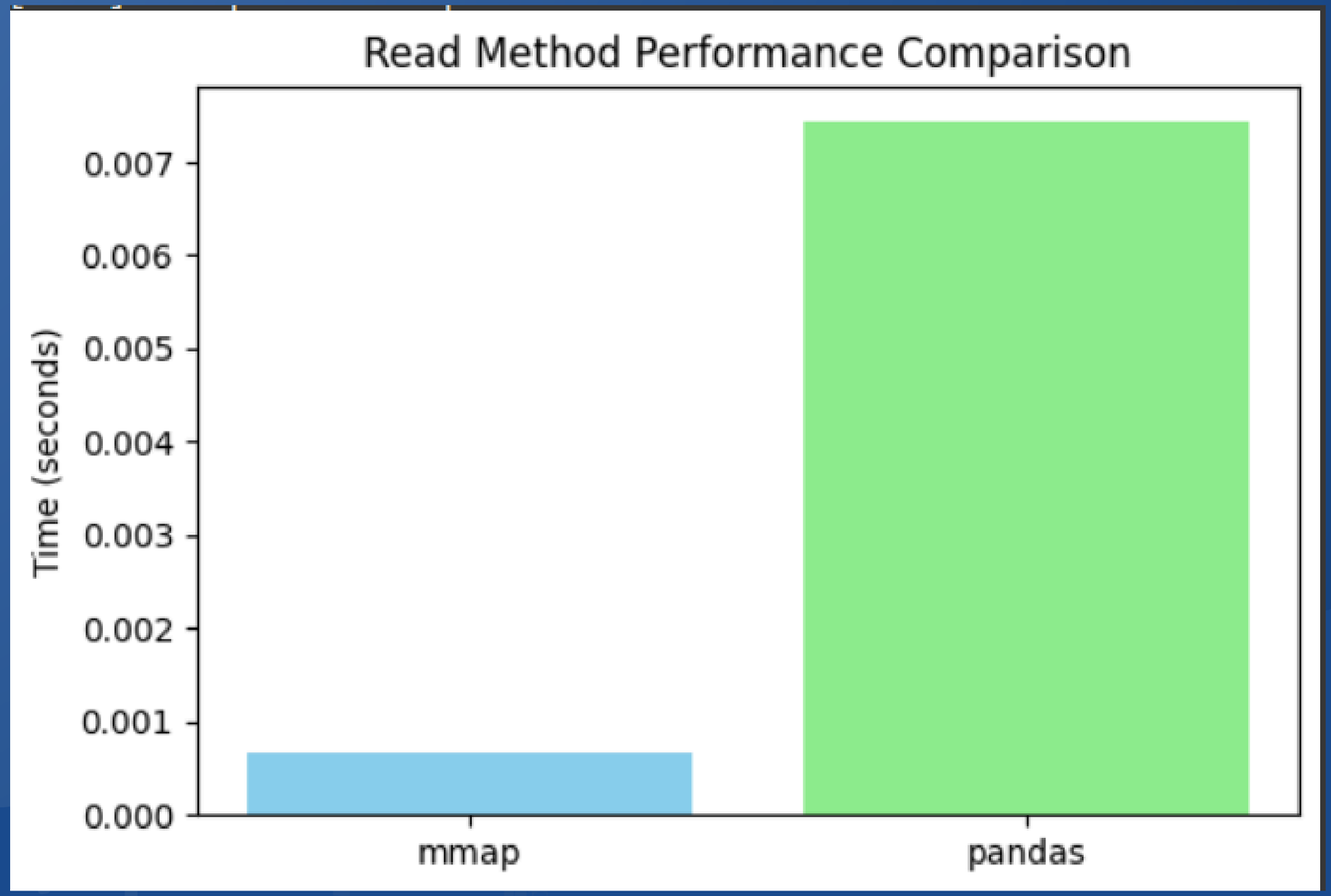
```
[PROCESS SCHEDULING] Starting subprocesses...

--- Pandas CSV Load Outputs ---
[Before reading CSV] Memory: 116.70 MB | CPU: 0.00%
[After reading CSV] Memory: 122.23 MB | CPU: 0.00%
[Pandas] CSV loaded in 0.0074 seconds
[Monitor 1] Memory: 116.70 MB | CPU: 0.00%
[Monitor 2] Memory: 122.23 MB | CPU: 0.00%
[Monitor 3] Memory: 122.23 MB | CPU: 0.00%

--- mmap File Read Outputs ---
[mmap] Full file read successfully.
[mmap] Total bytes read: 48717
[mmap] Read completed in 0.0007 seconds
[ 📊 ] Plot saved as performance_comparison.png
```

RESULT BENCHMARK

Performance different between these two methods.



STAY TUNED!!!