Prototype of Optimization in High-Performance Computing

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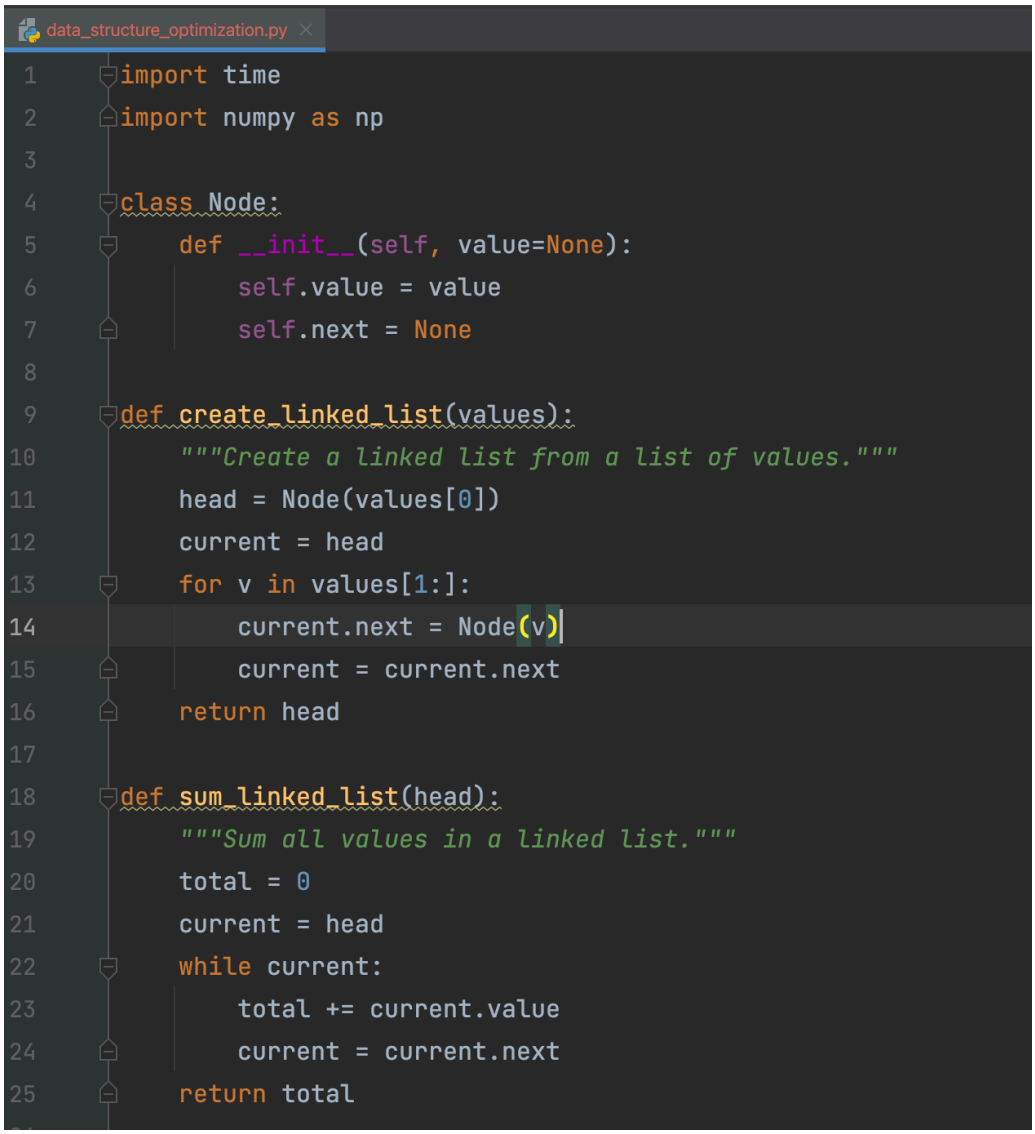
Python Prototype depicting Optimization in High-Performance Computing

Github Link of Source code

https://github.com/ndhinaharan36295/MSCS-532_Final-Project

Screenshot of Source code

Linked list structure:-

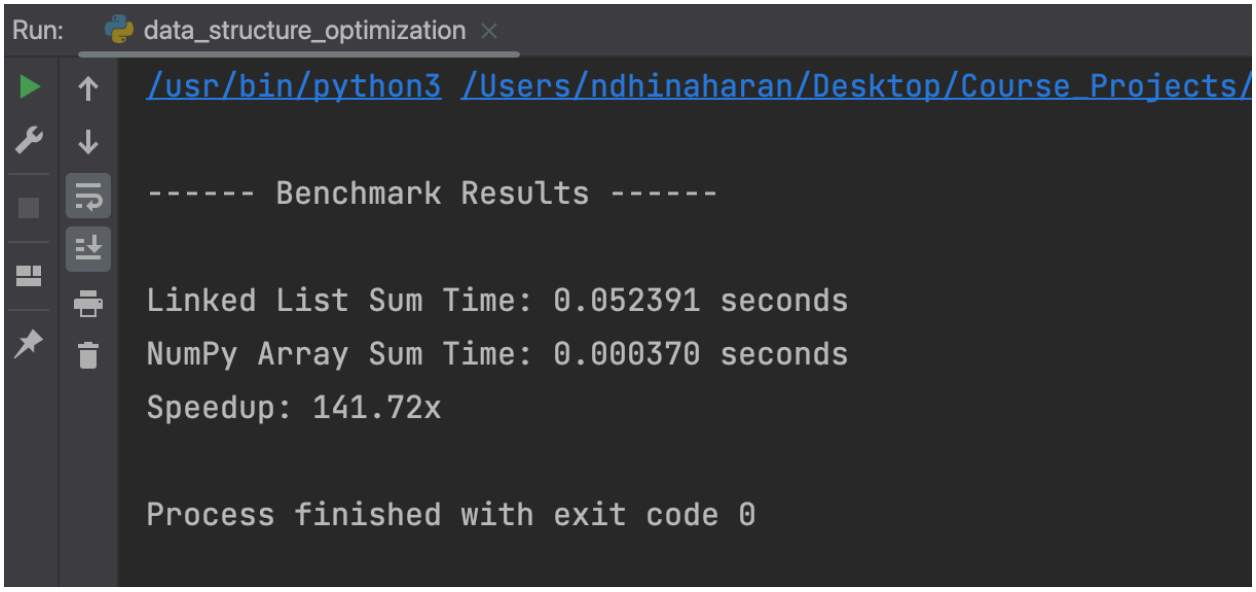


Benchmark implementation to compare Linked list and NumPy array:-

data_structure_optimization.py

```python
def benchmark(N=1_000_000):
    """Benchmark linked list vs NumPy array summation."""
    data = list(range(N))

    # Linked list benchmark
    linked_head = create_linked_list(data)
    start = time.perf_counter()
    sum_linked_list(linked_head)
    linked_time = time.perf_counter() - start

    # NumPy array benchmark
    arr = np.array(data, dtype=np.int32)
    start = time.perf_counter()
    np.sum(arr)
    numpy_time = time.perf_counter() - start

    print("\n------ Benchmark Results ------\n")
    print(f"Linked List Sum Time: {linked_time:.6f} seconds")
    print(f"NumPy Array Sum Time: {numpy_time:.6f} seconds")
    print(f"Speedup: {linked_time / numpy_time:.2f}x")

if __name__ == "__main__":
    benchmark()
```

Screenshot of Benchmarking results to show optimization



From the above screenshot, it can been seen that the performance improves massively.