Lab 9: Binary vs. Linear Search Analysis
Course: Data Structures and Algorithms (CST3108)

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1. Why Binary Search is Faster

Binary search operates with **O(log n)** time complexity, while linear search uses **O(n)**.

- **Reason**: Binary search halves the dataset with each step, while linear search checks elements one-by-one.

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2. Iterative vs. Recursive Binary Search

Both methods have the same **O(log n)** time complexity but differ in implementation:

Aspect	Iterative	Recursive
Approach	Uses loops (`while`/`for`).	Uses function recursion.
Memory Efficiency	Constant space (**O(1)**).	Stack space (**O(log n)**).
Speed	Slightly faster (no function calls).	Marginally slower (recursion overhead).

Key Takeaway:

- Both require the **same number of guesses** (e.g., 21 steps for 2M elements).
- Iterative is more memory-efficient and marginally faster due to avoiding recursion overhead.

Conclusion
Binary search's **logarithmic efficiency** makes it vastly superior for large datasets. Iterative and recursive implementations perform similarly, but iterative is preferred for minimal overhead.