COMP 6411 – Comparative Study Of Programming Language

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Submitted to:

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Introduction

Designed by James Gosling in 1991 at Sun Microsystems

Evolved from JDK 1.0 to JDK 18

Python was created in the late 1990s by Guido van Rossum at Centrum Wiskunde & Informatica

Evolved from Python 1 to Python 3.10.5

Real World Application

Java

Desktop GUI

Web Application

Mobile Application

Enterprise Application

Python

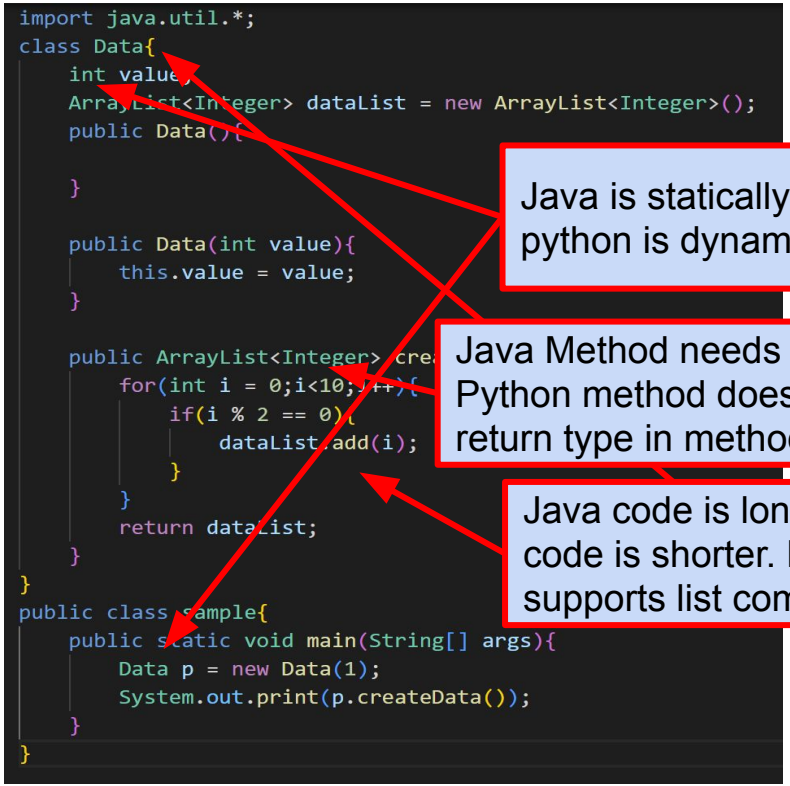
Web Application

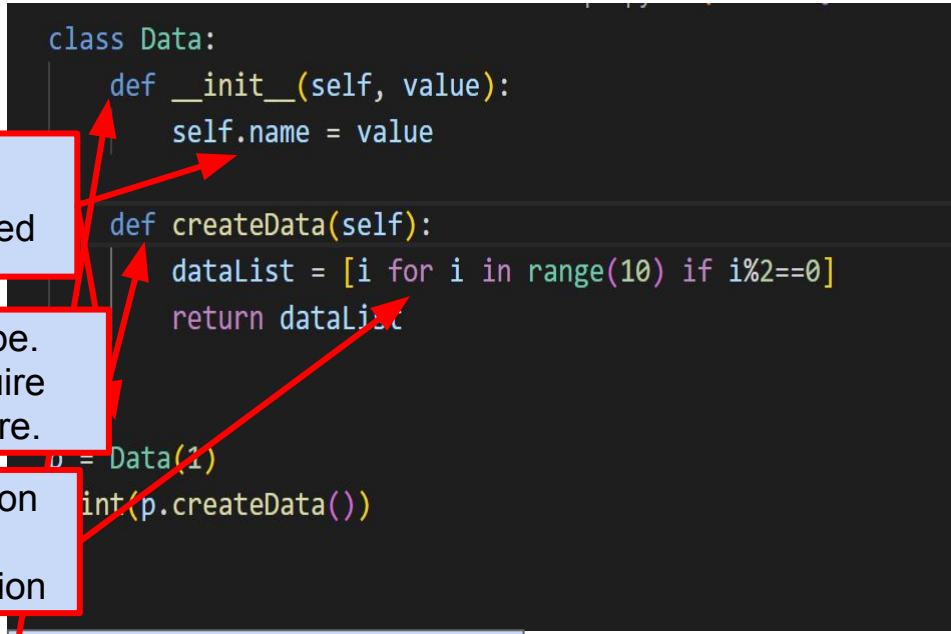
Artificial Intelligence

Data Science

Game Development

Language Constructs





Java is statically typed
python is dynamically typed

Java Method needs return type.
Python method does not require
return type in method signature.

Java code is longer. Python
code is shorter. Python
supports list comprehension

Java uses curly braces,
python uses indentation

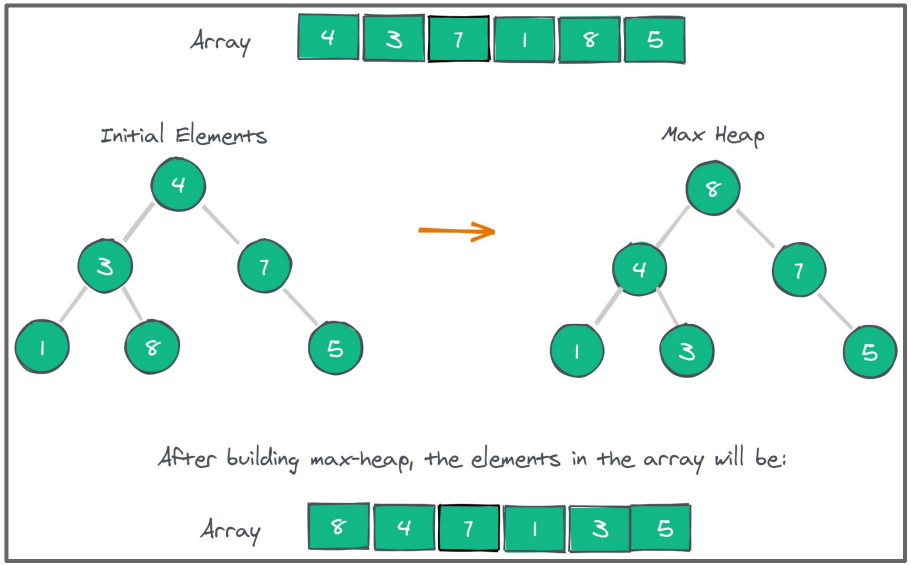
Java vs Python

Parameter		

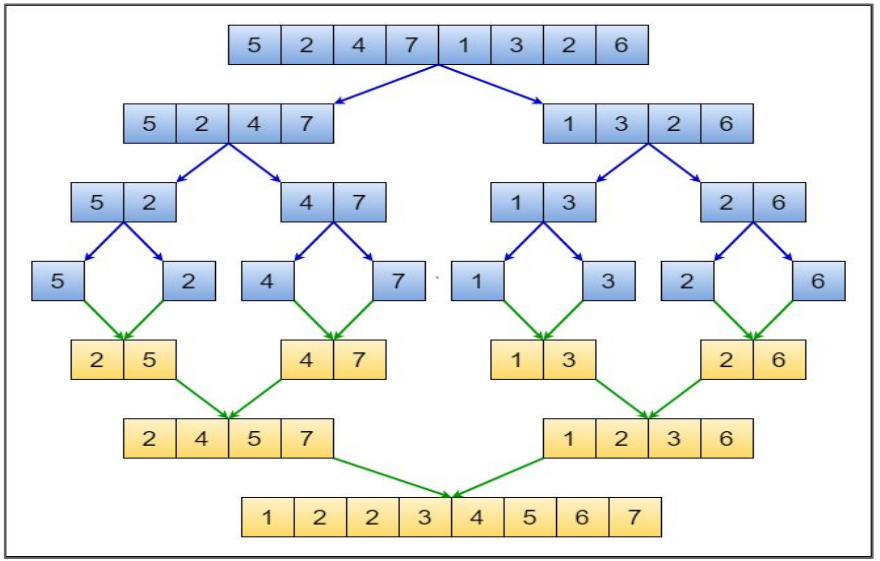
Problem Statement - Sorting Algorithms

Goal : To implement Heap and Merge sort in Java and Python

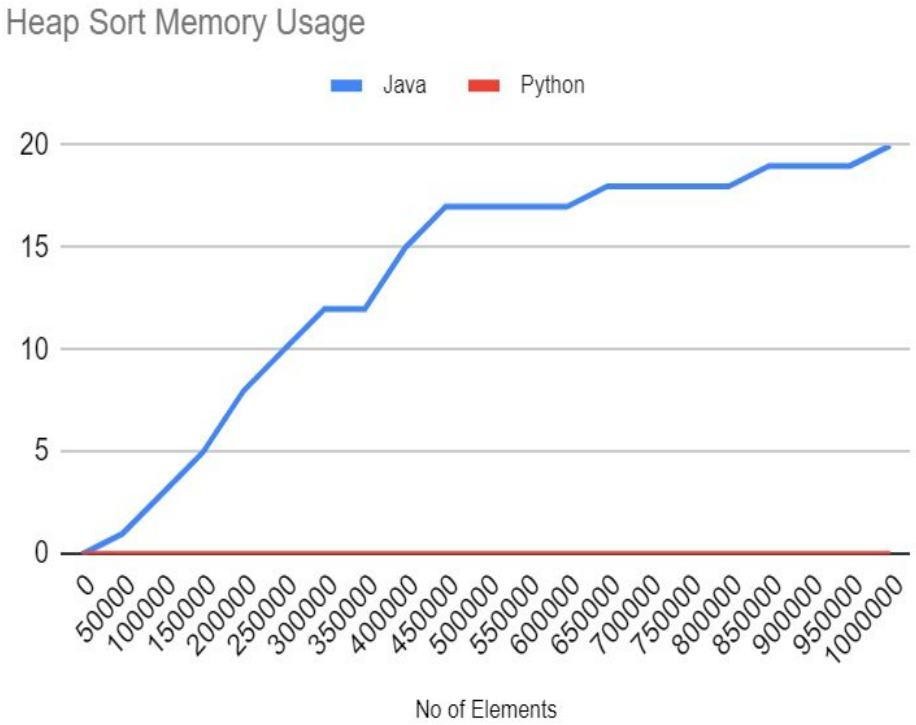
Heap Sort



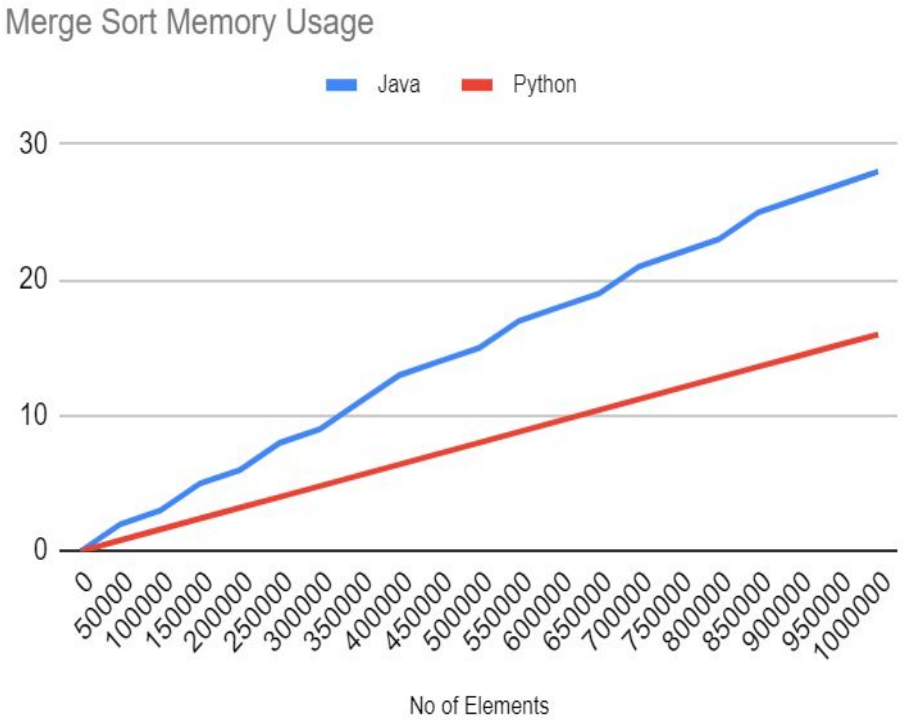
Merge Sort

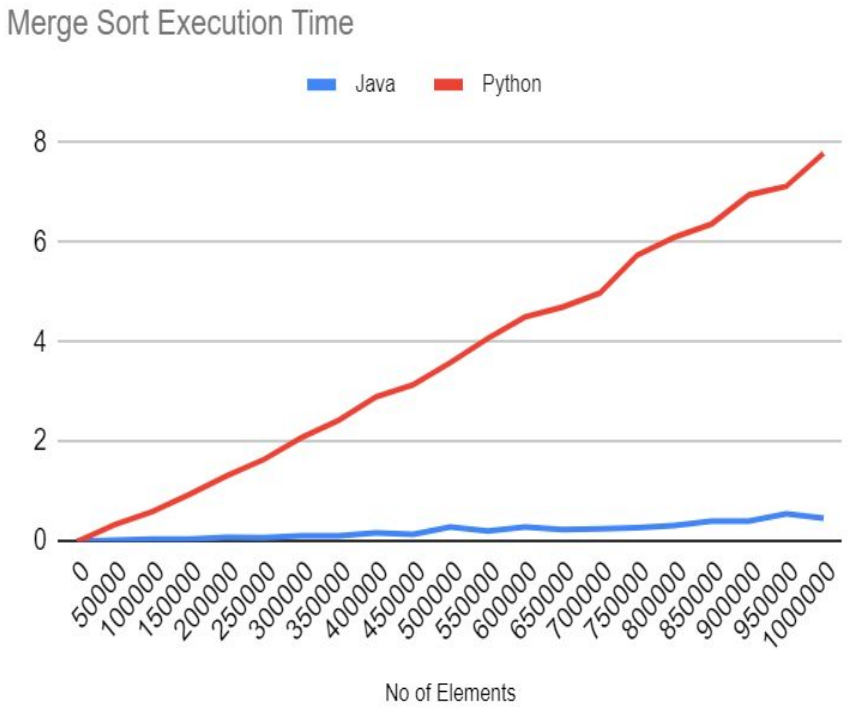


Evaluation - Heap Sort



Evaluation - Merge Sort





Interpretation

Java uses more memory than python.

Garbage Collector

- **Java is a garbage-collected language. In order for the garbage collector to know which objects are eligible for collection, it needs to keep track of the object graphs.**

JIT Optimization

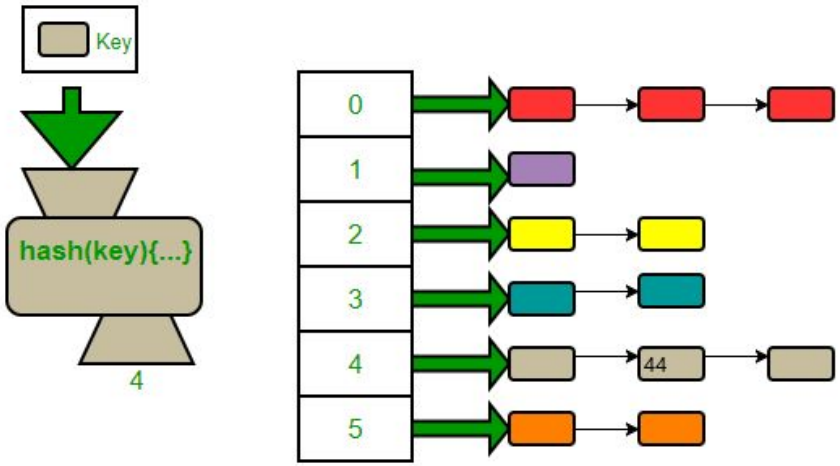
- **Java Virtual Machine optimizes the code during runtime. Again, to know which parts to optimize it needs to keep track of the execution of certain code parts**

- **Unlike Java, Python manages objects by using reference counting. This means that the memory manager keeps track of the number of references to each object in the program**

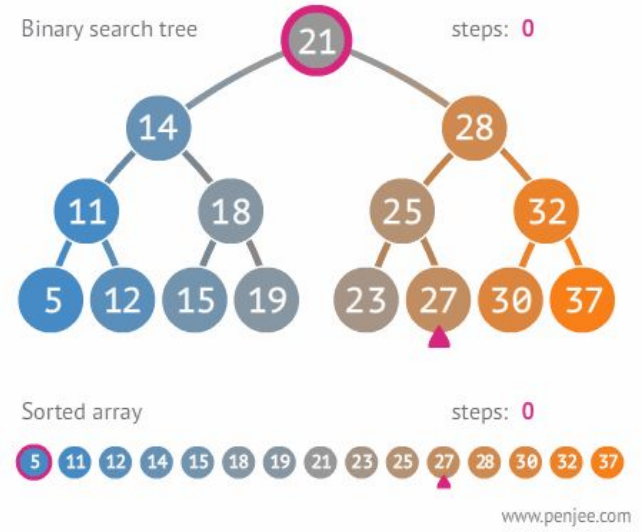
Problem Statement - Searching Data Structures

Goal : To implement Binary Search Tree and Hashing for searching in Java and Python

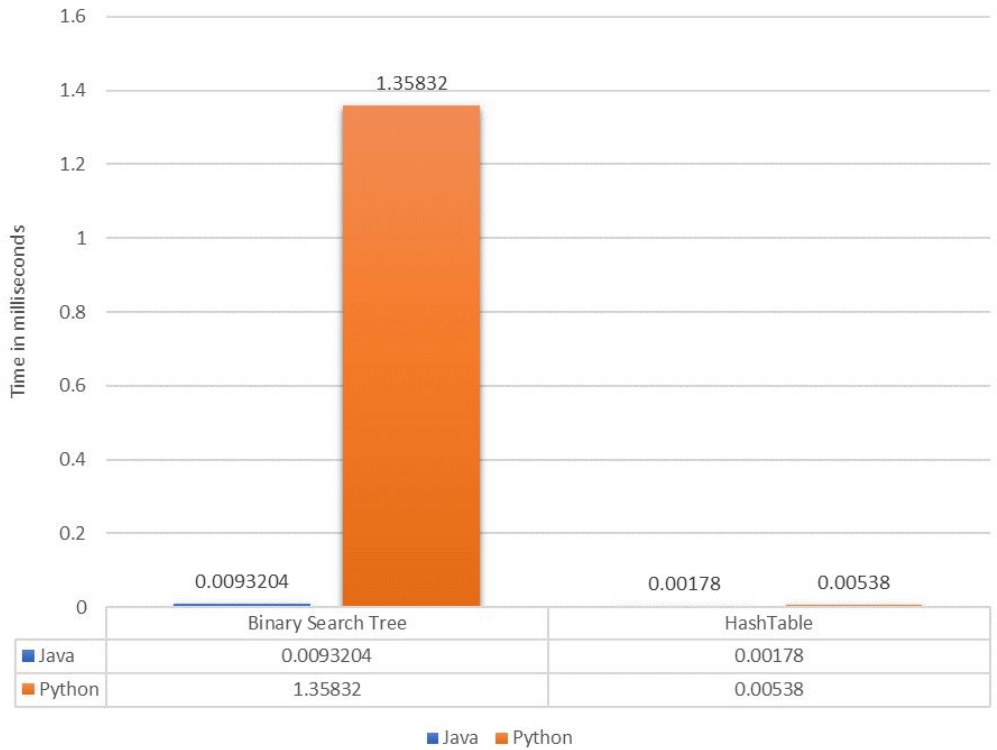
Hashing



Binary Search Tree



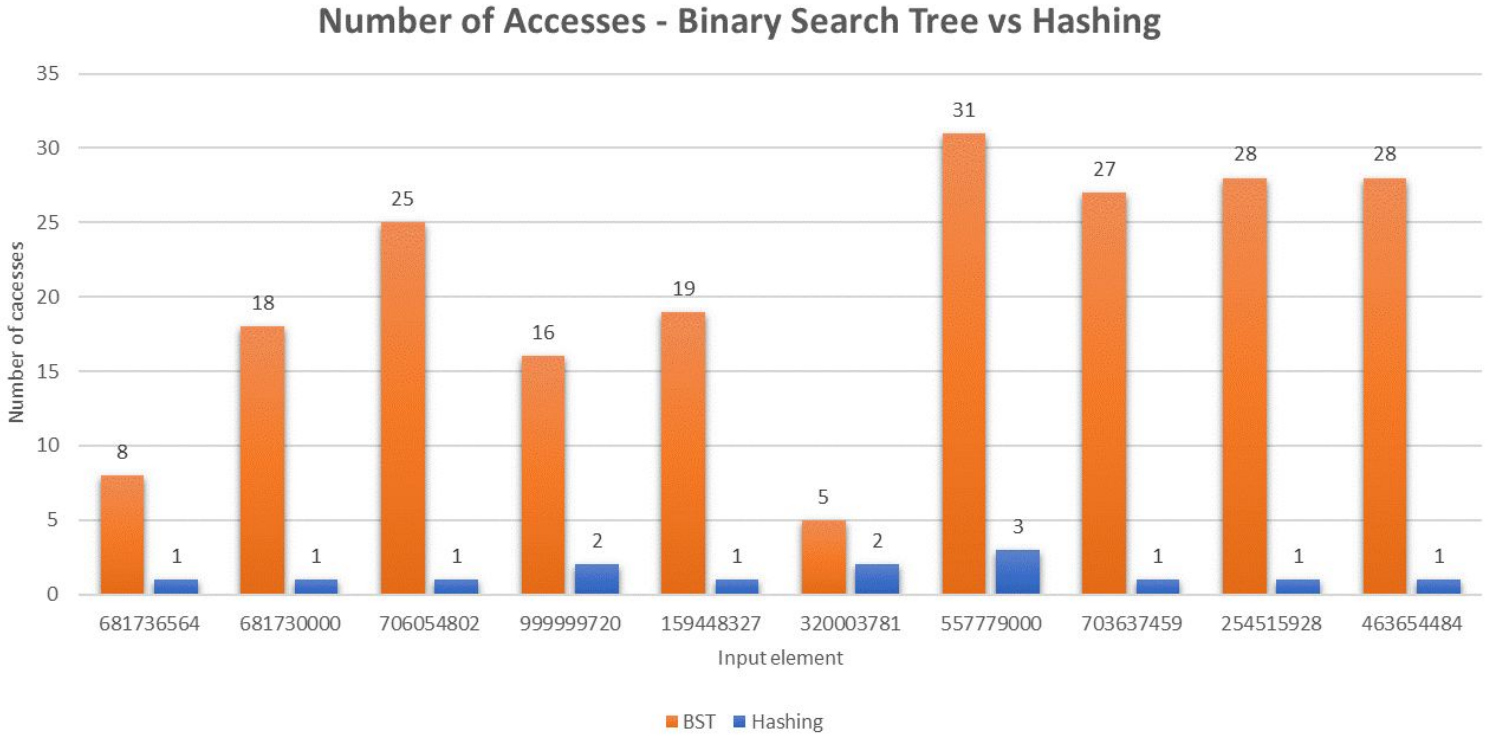
Evaluation – Creating Data Structures



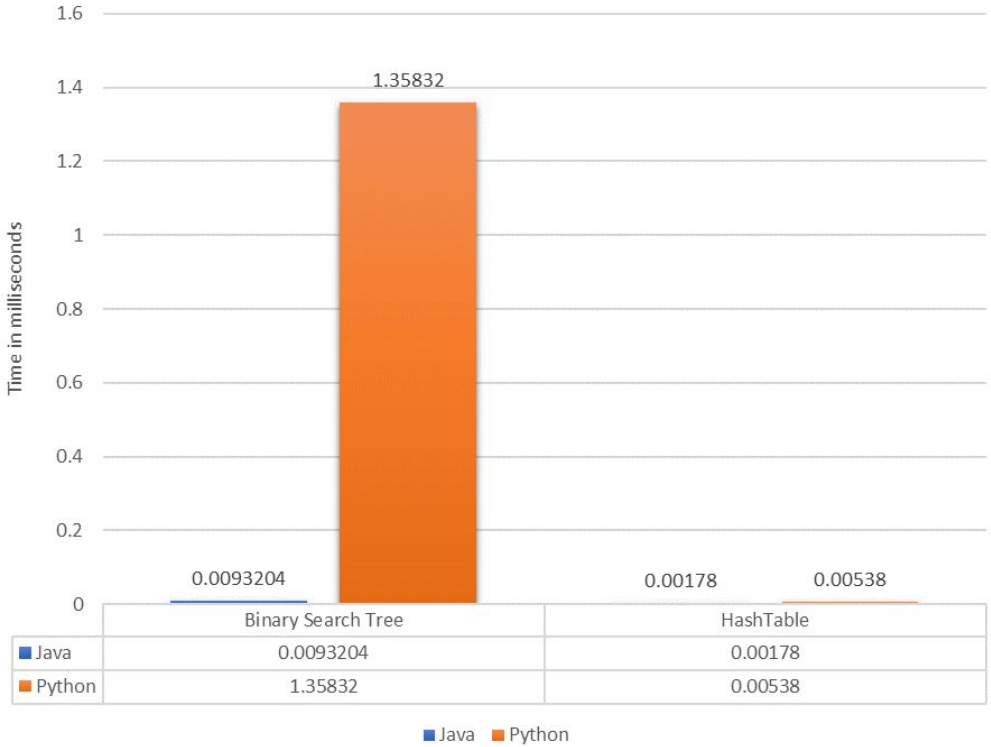
Populating takes longer time in Python than Java

- **Java is a compiled language and comes with concurrency**
- **Compiling does not require processor time and memory usage.**
- **Python is interpreted which slows down programs during runtime.**
- **Determining the variable type which occurs during runtime increases the workload of the interpreter**

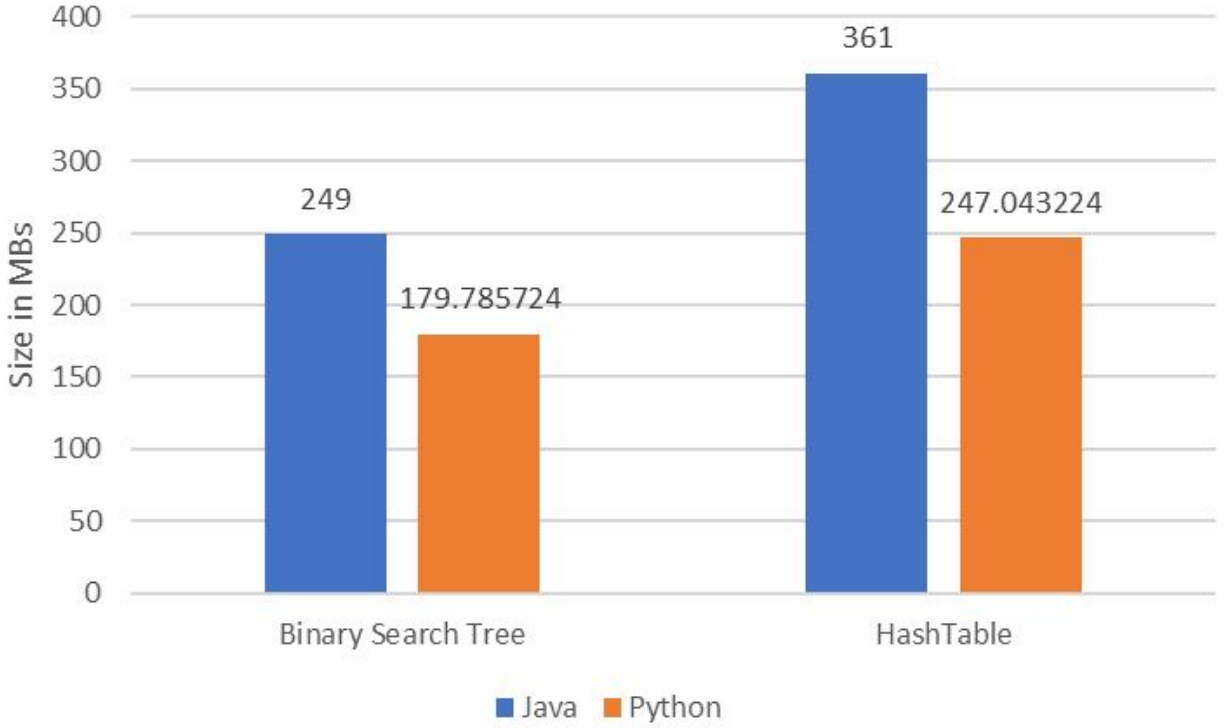
Evaluation – Number of Accesses



Evaluation – Time spent for Searching

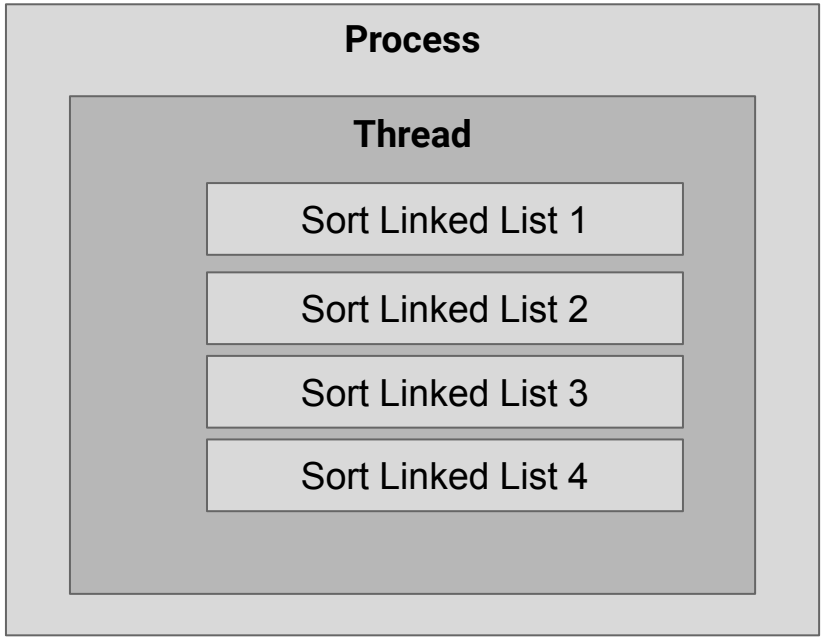


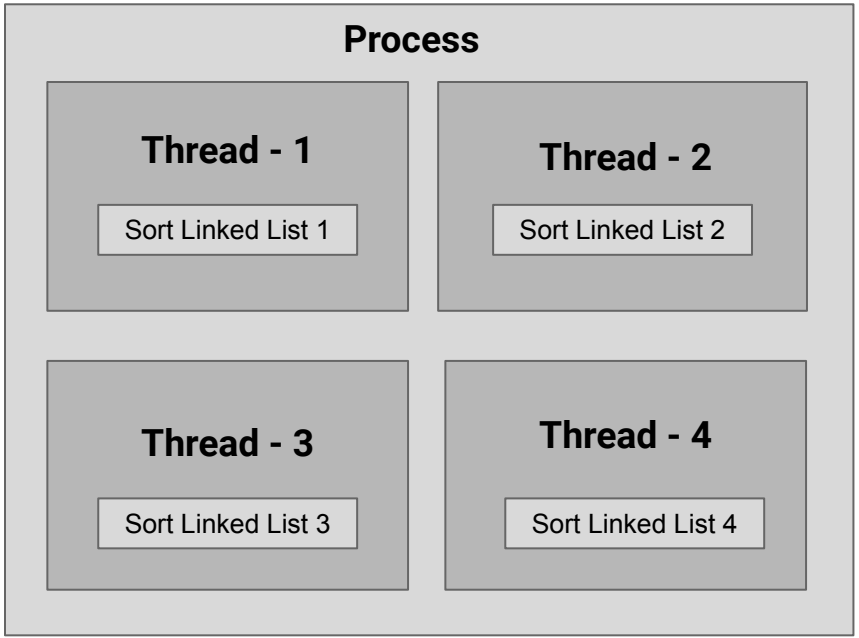
Evaluation – Memory used for creating Data Structure



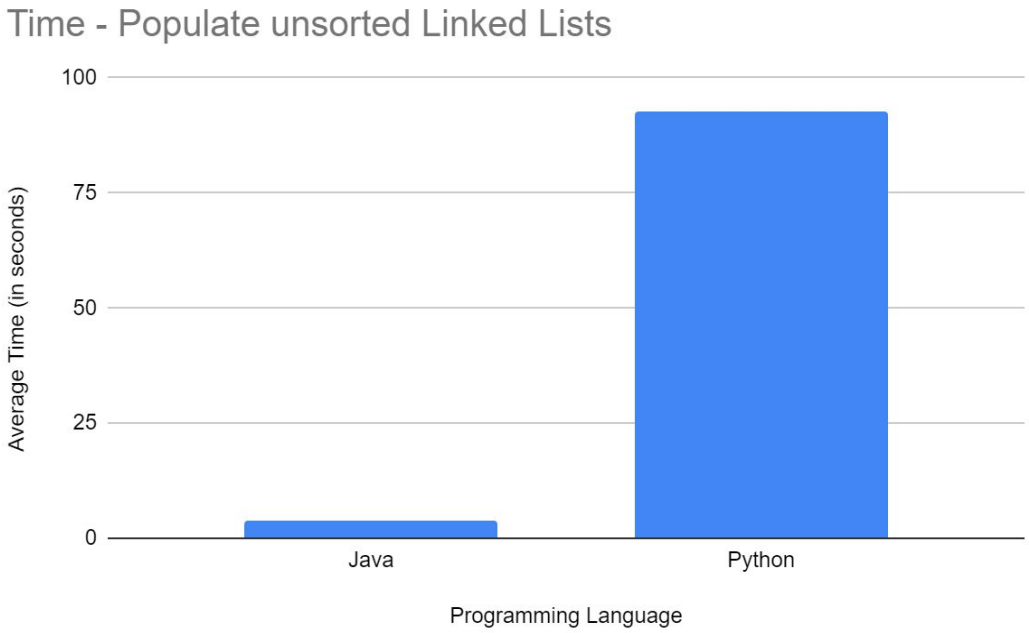
Problem Statement – Concurrency

Goal : Sort 4 distinct single linked list using merge sort in a single threaded and multithreaded program.





Evaluation – Populating Linked List

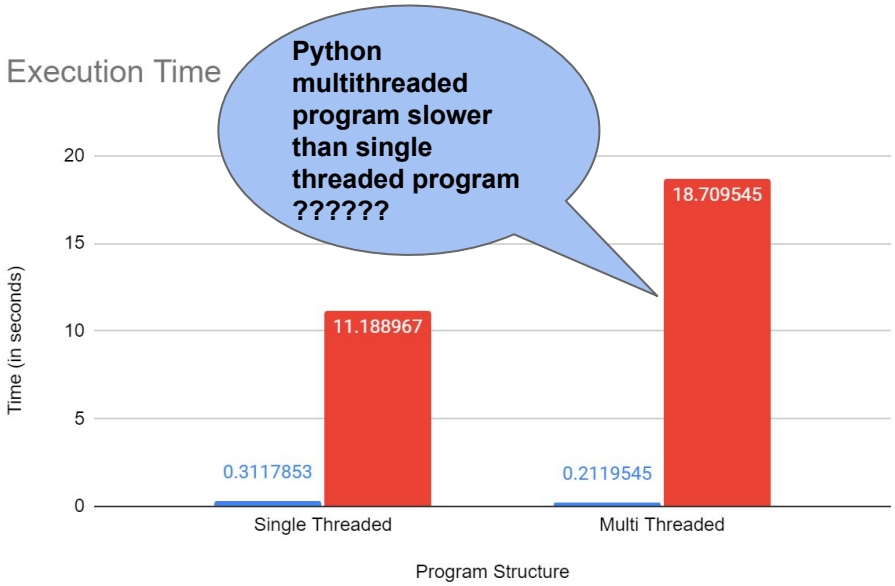


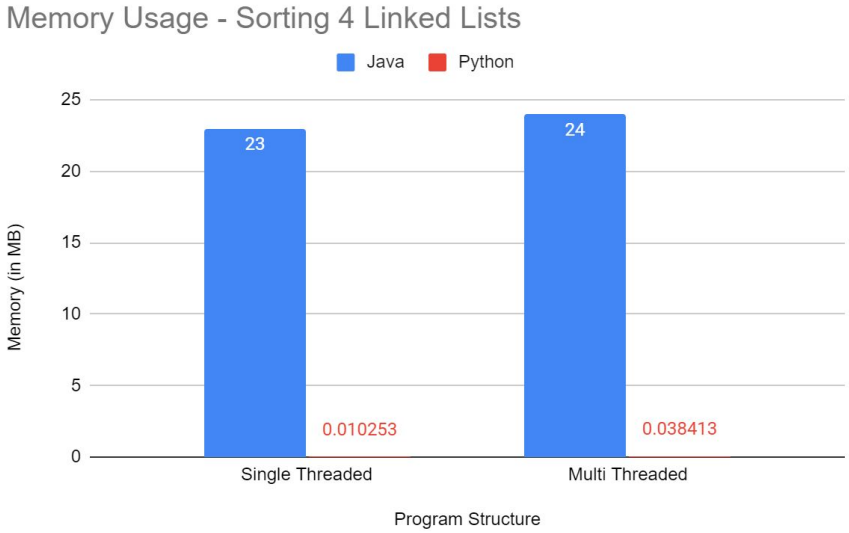
Programming style affects the performance of file processing

Python Program - uses inbuilt function readlines() - which returns all lines as string. Need a separate loop to convert all data to required data type.

Java Program - uses Scanner to read file contents line by line in the required data type (E.g nextLong())

Evaluation - Sorting Time And Memory





Java program is faster in execution

Java program takes more memory than python

Multithreaded python program take more time than single threaded python program?

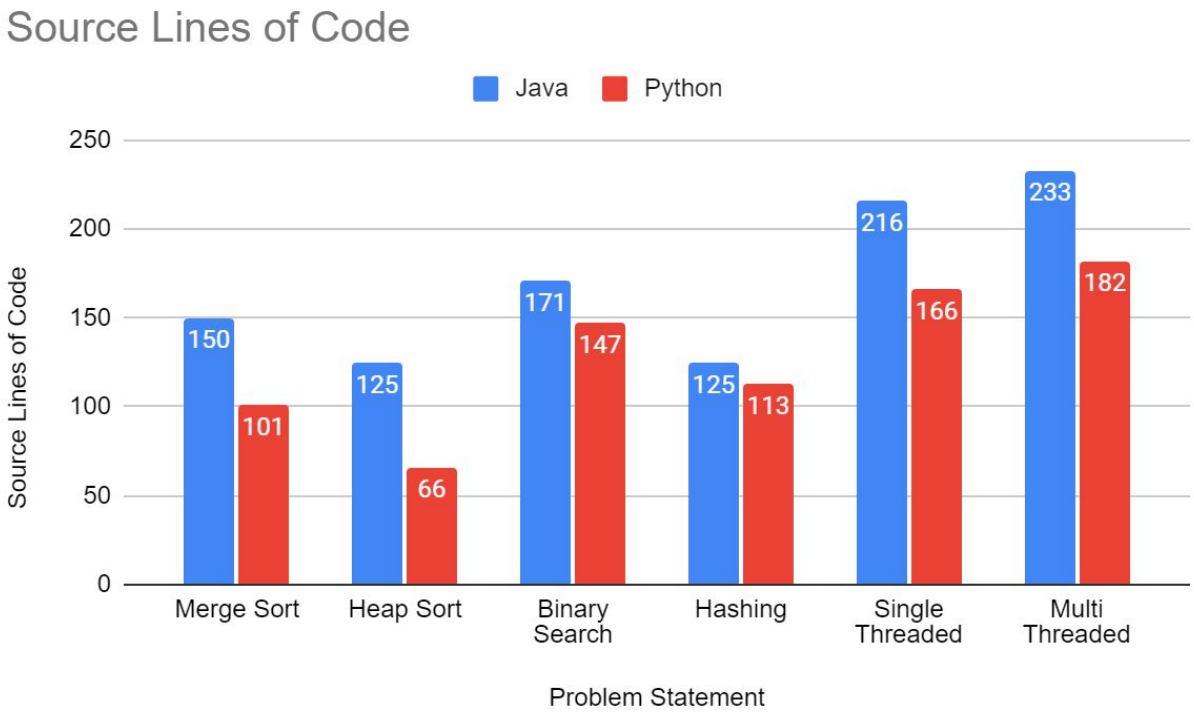
Python program uses CPU bound multi-threading which is slower in execution unless explicitly programmed for multi core processing.

Global Interpreter Lock is present in Python to prevent multiple threads to alter memory, at the same time thus preventing memory corruption by only executing a single thread at a time.

Solution ?

Run each thread in separate cores. Use multiprocessing.

Evaluation Source Lines of Code



Conclusion

Which language is better?

Java is performance oriented. For performance critical application java is preferred.

Java code is easier to debug due to its statically typed nature.

Java handles concurrency better than python.

Beginner friendly language, easy to learn. Good choice for learning programming.

Python code is shorter therefore reduces development time.

Best suited for data science and machine learning as lot of support available through external libraries.

Q&A