

ADA-A3 (Optimal Number of Multiplications Time Complexity Analysis)

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1 Introduction

This document provides an analysis of a C++ program that uses the dynamic programming paradigm to find the optimal number of multiplications required to multiply a chain of matrices. The program also extracts the optimal order in the chain of matrices. The sizes of the matrices are randomly selected, satisfying the constraint of multiplying any two matrices.

2 Program Analysis

Number of Matrices: 5

- **Optimal Multiplications:** 705480
- **Optimal Order:** (A1(((A2A3)A4)A5))
- **Execution Time (microseconds):** 2

Number of Matrices: 10

- **Optimal Multiplications:** 70904
- **Optimal Order:** ((A1(A2A3))
(((A4A5)A6)A7)A8)A9)A10)
- **Execution Time (microseconds):** 4

Number of Matrices: 15

- **Optimal Multiplications:** 25894
- **Optimal Order:** ((A1(A2(A3(A4A5))))
((((((((A6A7)A8)A9)A10)A11)A12)A13)A14)A15))
- **Execution Time (microseconds):** 10

Number of Matrices: 20

- **Optimal Multiplications:** 97206
- **Optimal Order:** ((A1(A2(A3(A4A5))))
((((((A6A7)A8)A9)
(((((((A10A11)A12)A13)A14)A15)A16)A17))A18)A19)A20)))
- **Execution Time (microseconds):** 34

Number of Matrices: 25

- **Optimal Multiplications:** 251264
- **Optimal Order:** (A1(A2(A3(A4(A5
(A6(A7(A8(A9(A10
(A11(A12(A13(A14(A15
(A16(A17(A18(A19(A20
(A21(A22(A23(A24A25))))))))))))))))))
- **Execution Time (microseconds):** 38

Number of Matrices: 30

- **Optimal Multiplications:** 78200
- **Optimal Order:** ((A1(A2(A3(A4(A5
(A6(A7A8)))))))
((((((((((((((((((A9A10)A11)A12)A13)
A14)A15)A16)A17)A18)A19)A20)A21)A22)A23)A24)
A25)A26)A27)A28)A29)A30)))
- **Execution Time (microseconds):** 56

3 Time Complexity

The time complexity of the matrix chain multiplication problem using dynamic programming is $O(n^3)$, where n is the number of matrices. This is because the program uses three nested loops to compute the optimal number of multiplications.

4 Execution Time Analysis

The execution time increases as the number of matrices increases. However, the actual execution time can vary depending on the specific dimensions of the matrices and the hardware on which the program is run.

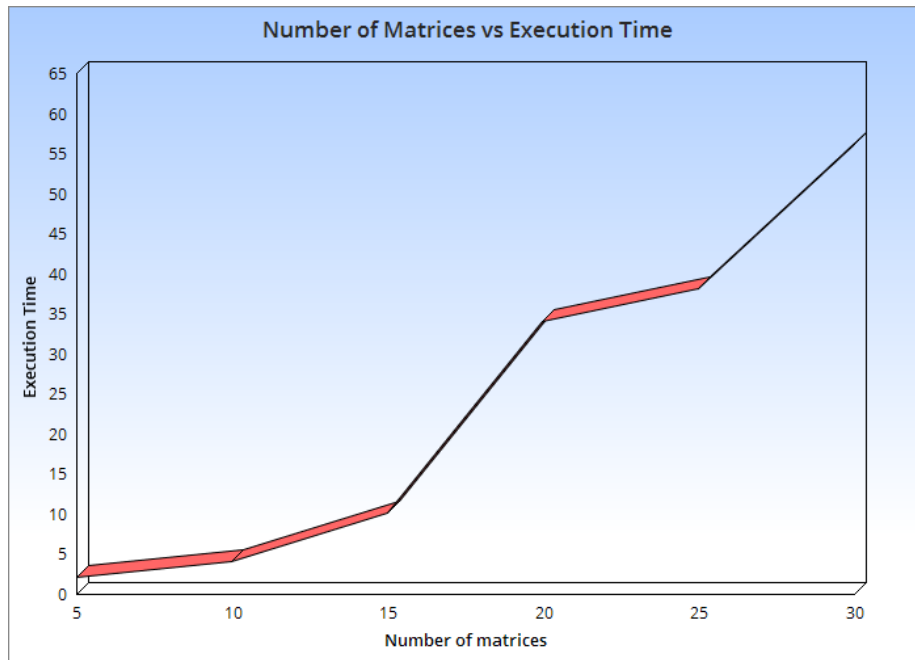


Figure 1: Caption of the image

5 Conclusion

The program successfully calculates the optimal number of multiplications and the optimal order for a chain of matrices using dynamic programming. The execution time increases with the number of matrices.