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Advanced Algorithms

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5.1

1. Suppose you could multiply two matrices using only 6 multiplications, but with 45 additions. How fast could you multiply two matrices? Your answer should give the order for both additions and multiplications.

A normal matrix multiplication involves n^3 multiplications for two n x n matrices. In the example shown we still need n^3 multiplications but need more additions than a normal matrix. I would say I could multiply in O(n^3) time (or constant time if that 6 multiplication stands forever) and then I would use the basic matrix multiplication format to add in regular O(n^2) time.

2. Is it possible, at some time in the future, that someone will discover an O (nlgn) algorithm for multiplying two matrices?

The current best solution puts the multiplication at n^~2.4 using coppersmith-winograd method or Strassen at n^~2.8 . However in the future I could see a nlogn algorithm for multiplying two matrices if someone comes up with an even better divide-and-conquer method. I think this may be possible but certainly hasn’t been discovered yet. Strassens is similar in that it works like divide and conquer but the algorithm would need to be improved to do less operations at each step.

3. The product of the two matrices will contain the product of the two original matrices in the upper left corner. The lower right corner will contain 1, and the remainder of the last row and column will contain zeros. Does this change the order of the algorithm? Show how you arrived at your answer.

The additional rows do not change the order of the algorithm because the order of the algorithm is determined by the multiplication part of the matrix multiplication and not the addition. By adding the zeros and padding the number of additions are increased but not the number of multiplications. Basically, the padding is useful for formatting but does not change the order of the algorithm just instead adds additional additions.