# The Algorithm

For our dynamic programming algorithm to solve this problem, we will need two m×m 2-dimensional arrays, of which we will only use one half.

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One of them is called M, which stores the minimum runtimes; the other is called S, which stores the multiplication orders.

Each matrix sequence multiplication can be broken down into a multiplication of two sequences. For example,

A1 ((A2 A3) A4)

can be broken down into the multiplication of the length one sequence A1 and the length 3 sequence ((A2 A3) A4). ((A2 A3) A4) can in turn be turned into the multiplication of (A2 A3) and A4. (A2 A3) at last will be the multiplication of two length one sequences A2 and A3.

We formulate our problem of multiplying a sequence of matrices starting at matrix i and ending at matrix j as

Opt(i, j)

. Opt(3, 6) means the optimal runtime and corresponding order of multiplying the sequence from matrix 3 to matrix 6. We want Opt(1,m) for this problem.

The rows of our two 2-dimensional arrays specify the starting matrix, the column specifies the ending matrix (e.g. M[3,6] means the least runtime possible for multiplying the sequence starting at matrix 3 and ending at matrix 6; S[3,6] means the corresponding optimal order of multiplication).