Brute Force Algorithm:

for(int i = 0; i < n1; i++){

for(int j = 0; j < m2; j++){

for(int k = 0; k < m1; k++){

multiplicationResult[i][j] = multiplicationResult[i][j] + matrix1[i][k] \* matrix2[k][j];

}

}

}

Operations with Execution Time:

|  |  |  |
| --- | --- | --- |
| Operation | Number of Executions | Time Taken |
| i = 0; | 1 | c1 |
| j = 0; | n | c2 |
| k = 0; | n2 | c3 |
| i < n; | (n+1) | c4 |
| j < n; | (n+1)2 | c5 |
| k < n; | (n+1)3 | c6 |
| i++; | n | c7 |
| j++; | n2 | c8 |
| k++; | n3 | c9 |
| matrix1[i][k] \* matrix2[k][j]; | n3 | c10 |
| multiplicationResult[i][j] + matrix1[i][k] \* matrix2[k][j]; | n3 | c11 |
| multiplicationResult[i][j] = multiplicationResult[i][j] + matrix1[i][k] \* matrix2[k][j]; | n3 | c12 |

Total Time Taken, T(n) = c1 + nc2 + n2 c3 + (n+1) c4 + (n+1)2 c5 + (n+1)3 c6 + n c7 + n2 c8 + n3 c9 + n3 c10 + n3c11 + n3c12

= n3(c6 + c9 + c10 + c11 + c12 ) + n2(c3 + c5 + 3c6 + c8 ) + n(c2 + c4 + 2c5 + 3c6 + c7 ) + (c1 + c4 + c5 + c6 )

Total Time Taken, T(n) = n3 c’ + n2 c’’ + n c’’’ + c’’’’

Calculating the Value of the Constants:

|  |  |
| --- | --- |
| Matrix | Time |
| 2\*2 | 15609 |
| 3\*3 | 17426 |
| 4\*4 | 38381 |
| 8\*8 | 42551 |
| 16\*16 | 1298250 |
| 32\*32 | 7869407 |
| 64\*64 | 29044560 |
| 128\*128 | 75158831 |
| 256\*256 | 252586345 |

We need 4 unknowns and we can have 4 equations:

15609 = 8c’ + 4c’’ + 2c’’’ + c’’’’

38381 = 64c’ + 16c’’ + 4c’’’ + c’’’’

42551 = 512c’ + 64c’’ + 8c’’’ + c’’’’

1298250 = 4096c’ + 256c’’ + 16c’’’ + c’’’’

Solving these equations we get:

C’ = -221.7742673992

C’’ = 11564.96840659339

C’’’ = -51794.13095238092

C’’’’ = 74711.5824175824

Hence the equation becomes:

T(n) = -221.77n3 + 11564.97n2 - 51794.13n + 74711.58 Nano Seconds

Total number of operations:

Total Operations, O(n) = 1+ n+ n2 + (n+1) + (n+1)2 + (n+1)3 + n + n2 + n3+ n3 + n3 + n3

Total Operations, O(n) = 5n3 + 7n2 + 8n + 4

|  |  |
| --- | --- |
| Matrix | Number Of Operations |
| 2\*2 | 88 |
| 3\*3 | 226 |
| 4\*4 | 468 |
| 8\*8 | 3076 |
| 16\*16 | 22404 |
| 32\*32 | 171268 |
| 64\*64 | 1339908 |
| 128\*128 | 10601476 |
| 256\*256 | 84346884 |