**Algorithmics Unit 4 Week 4 Submit Task**

1. Use the master theorem to find the time complexity of the following recurrence relations:

(a)

Answer:

(b)

Answer:

(c)

Answer:

1. An algorithm takes a matrix of size n x n and divides it into two matrices of size n/2 x n/2. These matrices are then recursively multiplied using the following standard approach:

Assume that n is a positive power of 2, and that addition/multiplication of integers can be done in constant time.

Use the Master Theorem to show that the time complexity of this algorithm is O(n3).

In this this problem, although we are starting with a matrix of size n x n, we effectively start with two matrices of size n/2 x n/2 (which is where the recursion starts). This problem of multiplying two n/2 matrices then is split into a problem of multiplying 8 matrices of size n/4 x n/4. This can be seen in the above standard approach to multiplying matrices, where the first matrix would be a of size n/2 and would be a matrix of size n/4. This is split into 8 multiplications, and hence 8 problems, all half the size of the initial problem. There are also 4 operations of addition happening for a 2 x 2 matrix, and hence the cost function occurs in quadratic time. This provides us with the following recurrence relation:

Using the master theorem (where a = 8, b = 2 and c = 2), we can recognise that and hence the time complexity is