ADS HW 5

Problem 5.2

a) The brute force algorithm for the multiplication works by multiplying the bits of the second number from left to right with the first number and adding the results of the multiplication corresponding due to the shift of multiplication by 2. We iterate through every bit of the second number which in turn iterates through all bits of the first number giving us the time complexity of $O(n^2)$. Time Complexity = $O(n^2)$. for two large integers with "n" number of bits each.

b) Splitting the number into two halves using divide and conquer approach, using a_1, a_2 as the two halves, $a_1 = 2^{n/2} a_1 left + a_1 right$ (rightmost bit of $n/2$) and $a_2 = 2^{n/2} a_2 left + a_2 right$, multiply them and then,

$a_1 * a_2 = 2^n a_1 left * a_2 left + 2^{n/2}((a_1 left + a_1 right)(a_2 left + a_2 right)) - (a_1 left * a_2 left) - (a_1 right * a_2 right)) + a_1 right * a_2 right)$

explanation → ② see code