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CS 514

HW1

def factors(num):

    if(num == 1):

        return []

    if(num%2 == 0):

        return [2] + factors(int(num/2))

    # find all prime numbers that could be factors

    # Only have to search up to sqrt(num) because any number higher will not be a factor

    i = 3

    while(i\*i <= num):                           #sqrt(num)/2 times

        isprime = 0

        #check if i is prime

        # To determine if a number is prime, we only have to have to search

        # until the sqrt of the number because all other numbers will be a multiple

        # of a value already checked

        j = 3

        while (j\*j <= i):                        #sqrt(sqrt(n))/2 \* sqrt(n)/2 times

            #Check if i is a multiple of j

            if(i%j == 0):                        #sqrt(sqrt(n))/2 \* sqrt(n)/2 times

                isprime = 1

                #breaks when i is not prime

                break

            j+=2 #sqrt(sqrt(n))/2 \* sqrt(n)/2 times

        #if i is prime, check if it is a factor of num

        if(isprime == 0):

            if(num%i == 0):                      #sqrt(num)/2 times

                return [i] + factors(int(num/i))

        i+=2 #sqrt(num)/2 times

    #if num is prime, return

    return [int(num)]

2)

2. a) Derivation of the running time assuming that multiplications and additions take constant time

T(n) =

T(n) =

O(n) =

2. b) Derivation of the running time assuming multiplication and division of n-bit numbers take O(n^2) time and additions and subtractions take O(n) time

Number of bits = 2^N

T(n) = T(n/2) + O(n^2) + O(n^2) + O(n^2) + O(n^2) + O(n^2) + O(n^2) + O(n) + O(n)

T(n) = T(n/2) + 5O(n^2) + 2O(n)

T(n) =

3) Give a table T(n) vs n

|  |  |
| --- | --- |
| n | T(n) |
| 1 | 0:00:00.000002 |
| 11 | 0:00:00.000002 |
| 111 | 0:00:00.000006 |
| 1111 | 0:00:00.000004 |
| 11111 | 0:00:00.000007 |
| 111111 | 0:00:00.000005 |
| 1111111 | 0:00:00.000034 |
| 11111111 | 0:00:00.000018 |
| 111111111 | 0:00:00.000078 |
| 1111111111 | 0:00:00.000045 |
| 11111111111 | 0:00:00.009810 |
| 111111111111 | 0:00:00.000026 |
| 1111111111111 | 0:00:00.006192 |
| 11111111111111 | 0:00:00.001302 |
| 111111111111111 | 0:00:00.000342 |
| 1111111111111111 | 0:00:00.000515 |
| 11111111111111111 | 0:00:05.288088 |
| 111111111111111111 | 0:00:00.127748 |
| 1111111111111111110 | 0:00:00.165751 |
| 1111111111111111111 | Over 16 minutes before I gave up |
| 1111111111111111112 | 0:00:00.166283 |
| 22222222222222222222 | 0:00:00.000167 |