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NPTEL ONLINE CERTIFICATION COURSE

Discrete Mathematics
Recurrence Relation

Recurrence relation for Binary search

By
Prof. S.R.S. Iyengar
Department of Computer Science
IIT Ropar

So assume there is this cool girl who is trying to search for the word procrastination in dictionary,
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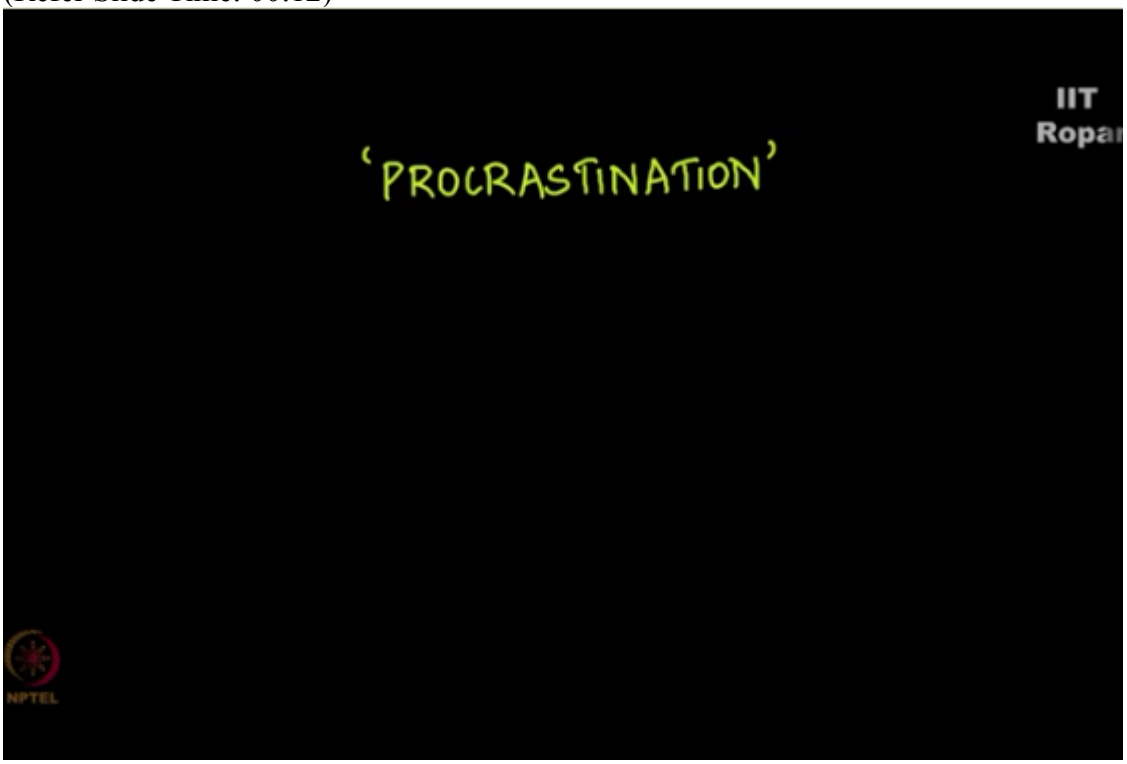

do you all know what the word procrastination means, it is delaying a job indefinitely, right, okay, so what she does, if she opens the dictionary in the middle she gets the letter L, and now she knows on the left side of L is words starting with the letters A, B, C, D, E, F, G, H, I, J, K
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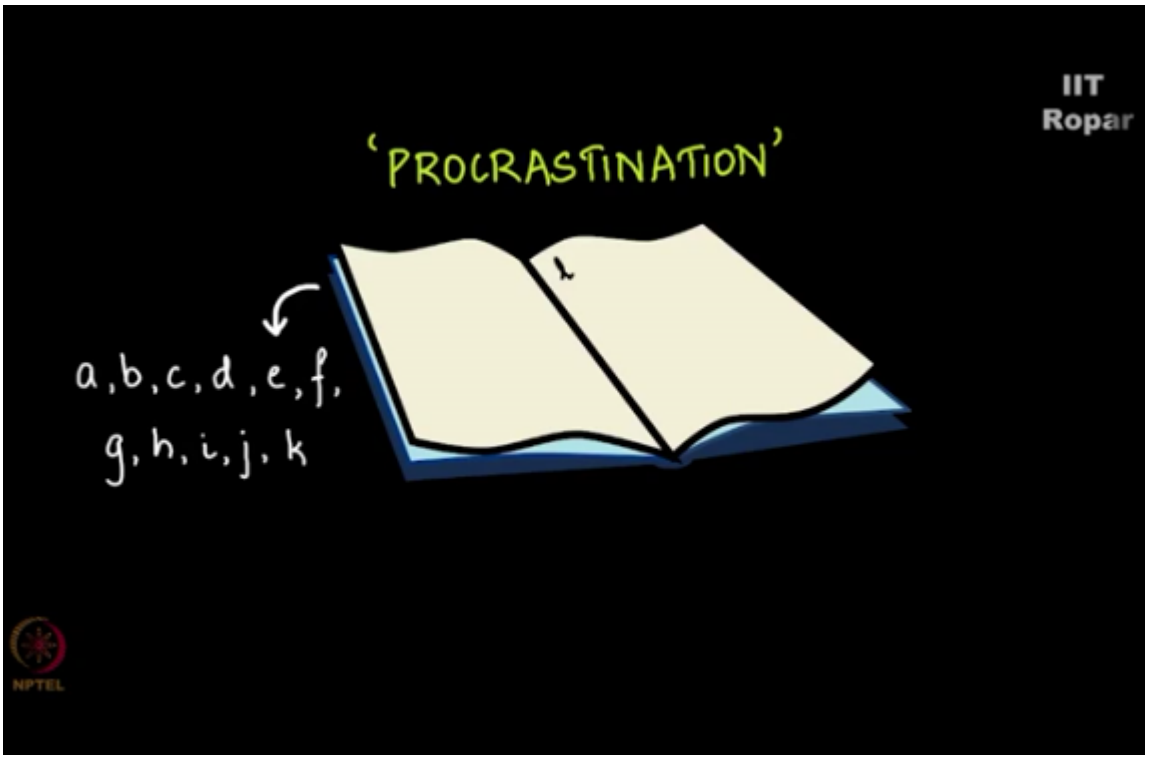

to the right side of L the that particular sheet are the words starting from L, M, N, O, P, Q, R, S, T, U, V, W, X, Y and Z right,

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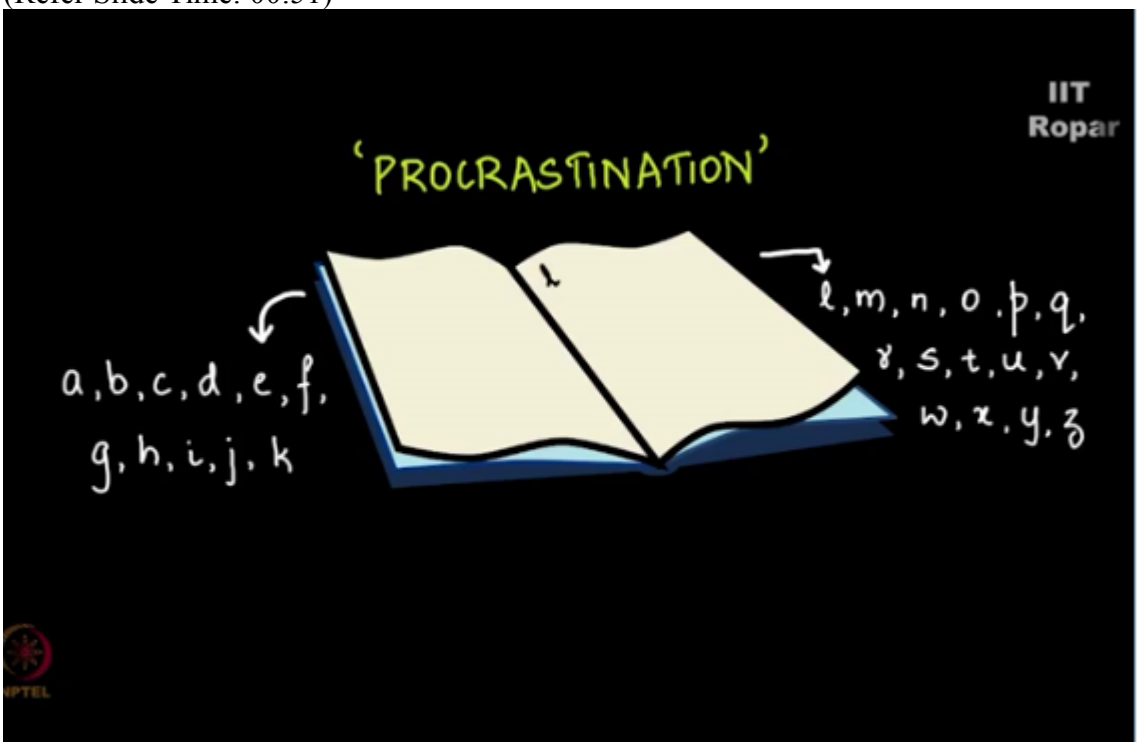

so she knows for sure that on the left side of L procrastination word cannot appear, because procrastination starts with P and hence it must be on the right side of L, so what she does is she has gone to the center of the dictionary, half the pages are on the left side of L, half the pages

are on the right side, what she does is she happily discards the first half of the dictionary, and looks at the word procrastination, rather she's in the hunt for the world procrastination in the second half of the dictionary.

And later on she goes to the center and she realizes she sees the word S,
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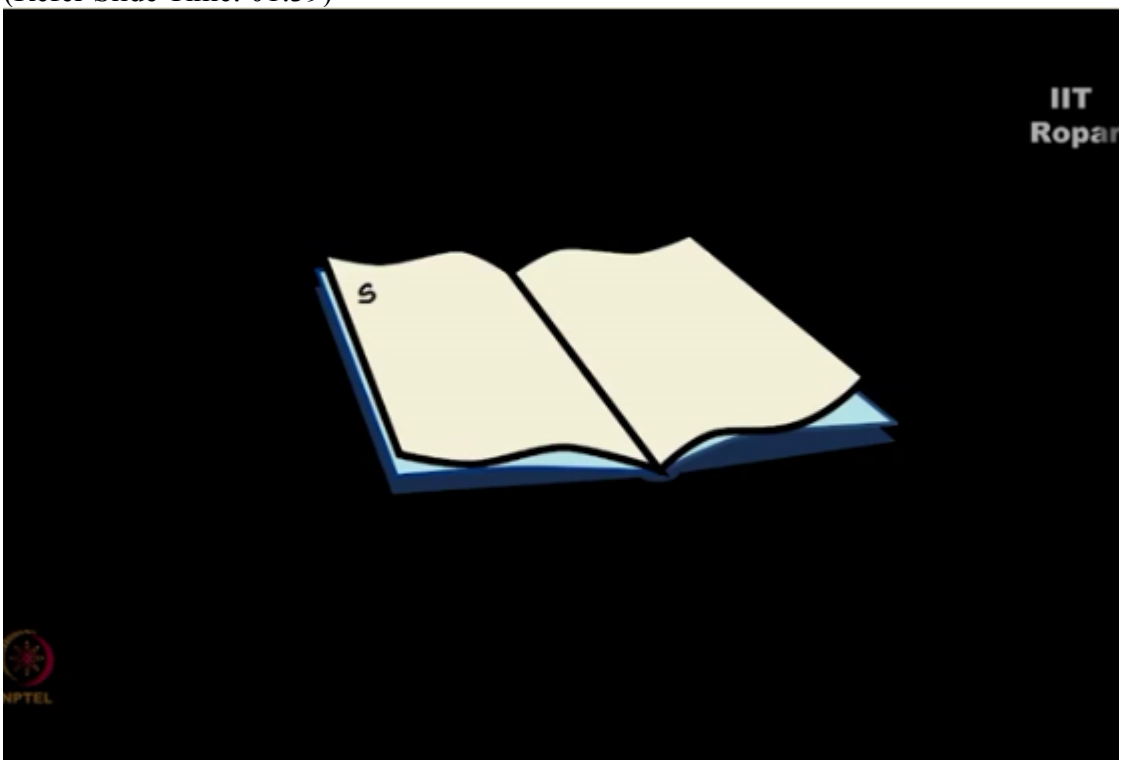

and hence now in this shortened version of the dictionary, the word procrastination should be towards the left of S, and towards the right of S whatever you have you discarded, now, now, now, now do you remember Towers of Hanoi? We said T(n) = 2 times T(n-1) + 1,
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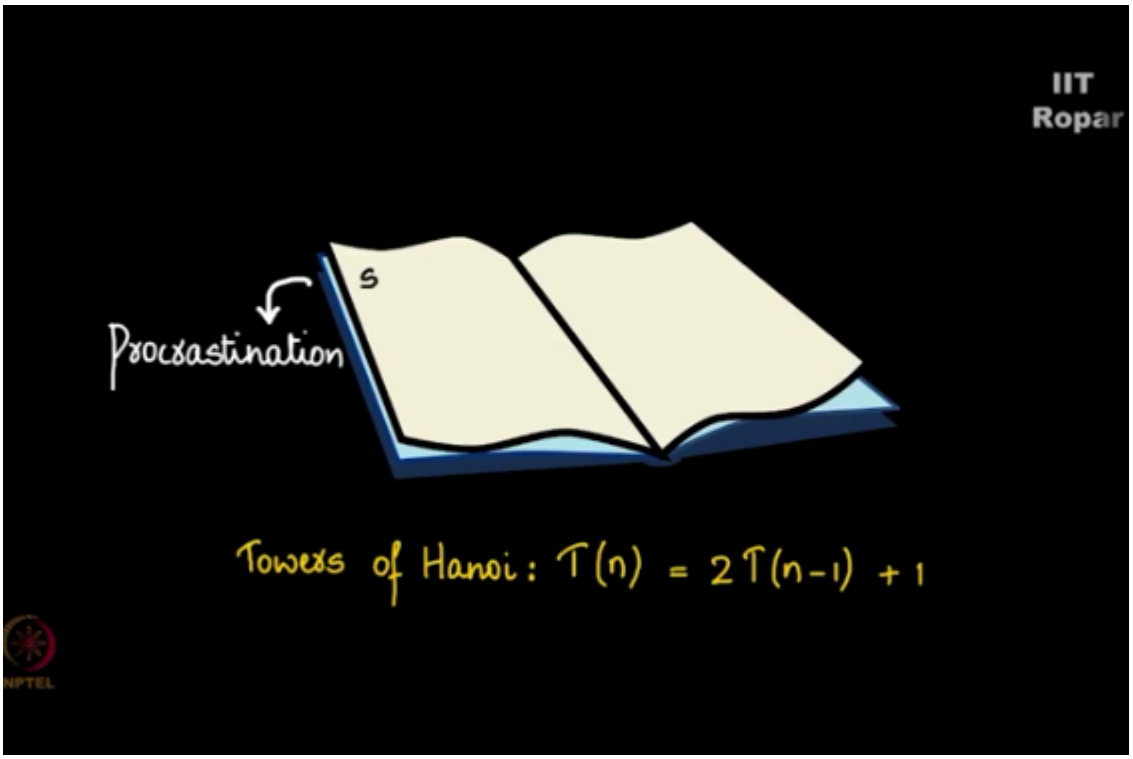

so the problem of shifting n discs boils down to the problem of shifting n-1 discs twice, similarly here in this dictionary example the girl does the task of opening the middle part of the dictionary and discarding one half, right, let us call this one transaction to go to the center of the dictionary and then remove one half of it knowing very well which side is the destination word, and hence removing the other side you see, so the recurrence relation here would be the effort that it takes to find a word in the dictionary with N pages is T(n), so T(n) is going to be equal to T(n/2) because you are discarding half the dictionary + 1 transaction you do, because you go to the center and you realize which half to discard, and later again T(n/2) becomes T(n/4) +1 and so on, and you see with a little bit of effort you will observe that this T(n) actually happens to be log N, let's see how?

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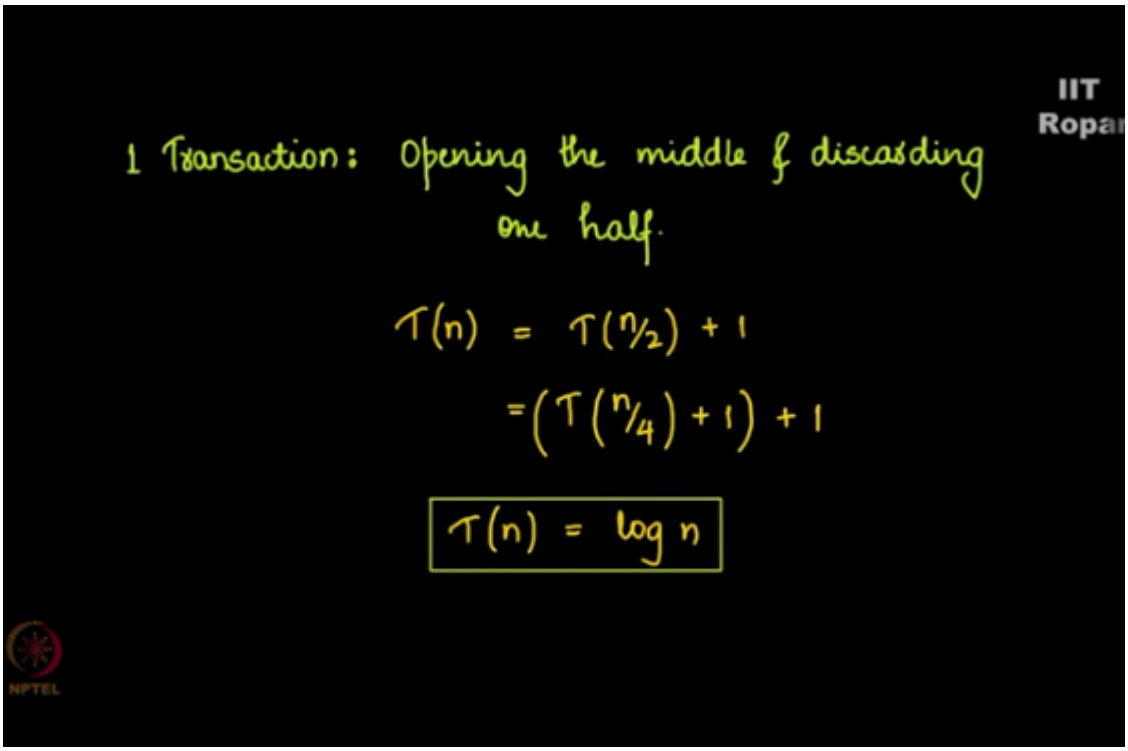

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