CS F364: Design & Analysis of Algorithm



Longest Common Subsequence



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Components of Dynamic Programming

1) Optimal substructure, 2) Overlapping subproblems

Let $X_m = < x_1, x_2, x_3, ..., x_m > X_n = < y_1, y_2, ..., y_n > Y_n = < y_1, y_2, ..., y_n > Z_k = < z_1, ..., z_k > \cos$

• If $(x_m = y_n)$ then $z_k = x_m$ and $Z_{k-1} = LCS(X_{m-1}, Y_{n-1})$

If $(z_k \neq x_m)$ then $Z_k = LCS(X_{m-1}, Y_n)$ If $(z_k \neq y_n)$ then $Z_k = LCS(X_m, Y_{n-1})$ $If (x_m \neq y_n) then$

LCS of two sequences contains within LCS of the prefix of the two sednences

$$c[i,j] = \begin{cases} 0 & \text{if } i = 0 \text{ or } j = 0 \\ c[i-1,j-1]+1 & \text{if } x_i = y_j \\ max(c[i-1,j],c[i,j-1]) & \text{otherwise} \end{cases}$$

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Longest common subsequence

Algorithm 1: LCS-Length(X, Y) if $c[f-f,j] \ge c[f,f-f]$ then c[f,j] = c[f+1,j] b[i,j] = fc[i,j] = q[i,j-1] $b[i,j] = \leftarrow$ = y, then c[i,j] = c[i-1,j-1]+1 b[i,j] = ^

Complexity? $O(n^2)$

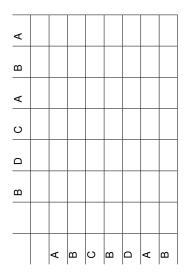
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Longest common subsequence

A subsequence of a sequence can be obtained by removing zero or more elements.

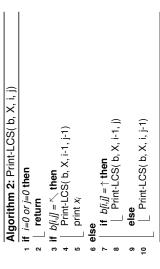
- In the longest-common-subsequence problem, we are given two sequences $X = \langle x_1 x_2 x_3 ... x_m \rangle$ and $Y = \langle y_1 y_2 y_3 ... y_n \rangle$ and wish to find a maximum-length common subsequence of X and Y.
 - Example: DNA sequence $\{A, T, C, G\}$
 - Time? exponential
- Prefix uses first few items

Solution Sketch



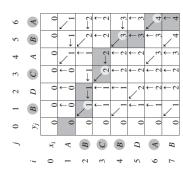
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Longest common subsequence



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Example



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Thank You!

Thank you very much for your attention! (Reference¹) Queries ?

111 Book - Introduction to Algorithm, By THOMAS H. CORMEN, CHARIES E. LEISERSON, RONALD L. RIVEST, CLIFFORD STEIN
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