CS F364: Design & Analysis of Algorithm

Longest Common Subsequence



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Components of Dynamic Programming

1) Optimal substructure, 2) Overlapping subproblems

 $X_m = \langle x_1, x_2, x_3, ..., x_m \rangle$ $Y_{n}=< y_{1},y_{2},...,y_{n}> \\$ $Z_k = \langle z_1, ..., z_k \rangle$ LCS

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

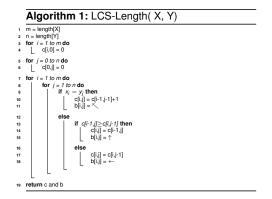
LCS of two sequences contains within LCS of the prefix of the two sequences

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

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Longest common subsequence



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

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Solution Sketch

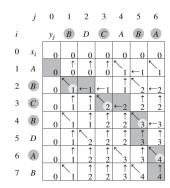
	В	D	С	Α	В	Α
Α						
В						
С						
В						
D						
Α						
В						

Longest common subsequence

Algorithm 2: Print-LCS(b, X, i, j)

1 if i=0 or j=0 then return 3 if $b[i,j] = \nwarrow$ then Print-LCS(b, X, i-1, j-1) print x_i if $b[i,j] = \uparrow$ then Print-LCS(b, X, i-1, j) Print-LCS(b, X, i, j-1)

Example



Thank You!

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

1[1] Book - Introduction to Algorithm, By THOMAS H. CORMEN, CHARLES E. LEISERSON, RONALD L. RIVEST, CLIFFORD STEIN

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