Dynamic Programming | Set 2 (Optimal Substructure Property)

As we discussed in Set 1, following are the two main properties of a problem that suggest that the given problem can be solved using Dynamic programming.

1) Overlapping Subproblems
2) Optimal Substructure

We have already discussed Overlapping Subproblem property in the Set 1. Let us discuss Optimal Substructure property here.

2) Optimal Substructure: A given problems has Optimal Substructure Property if optimal solution of the given problem can be obtained by using optimal solutions of its subproblems.
For example the shortest path problem has following optimal substructure property: If a node x lies in the shortest path from a source node u to destination node v then the shortest path from u to v is combination of shortest path from u to x and shortest path from x to v. The standard All Pair Shortest Path algorithms like Floyd–Warshall and Bellman–Ford are typical examples of Dynamic Programming.
On the other hand the Longest path problem doesn't have the Optimal Substructure property. Here by Longest Path we mean longest simple path (path without cycle) between two nodes. Consider the following unweighted graph given in the CLRS book. There are two longest paths from q to t: q -> r ->t and q ->s->t. Unlike shortest paths, these longest paths do not have the optimal substructure property. For example, the longest path q->r->t is not a combination of longest path from q to r and longest path from r to t, because the longest path from q to r is q->s->t->r.

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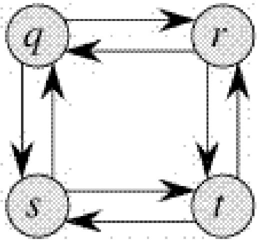

We will be covering some example problems in future posts on Dynamic Programming.

Please write comments if you find anything incorrect, or you want to share more information about the topic discussed above.

References:
http://en.wikipedia.org/wiki/Optimal_substructure
CLRS book

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Least-cost airline fare. (Using on online flight search, we will frequently find tha
airport B involves a single connection through airport C, but the cheapest flight
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Please can somebody clarify the difference between Greedy and Dp..solutions

i.e how to decide which technique to use when by providing examples. I think t
Thank u

Anand • 3 years ago

Here is blog that has all solved DP problem frequently asked in interviews.

http://anandtechblog.blogspot.com/2011/01/amazon-question-dynamic-progra

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As far as I know, most of the optimization problems have optimal substructure subproblem property that helps us in deciding to choose DP. Does anyone kn other than the longest path - that doesn't have the optimal substructure proper

shiwakant.bharti → tk • 9 months ago

Example from wiki where the substructure may not be optimal. http://en.wikipedia.org/wiki/O...

Least-cost airline fare. (Using on online flight search, we will frequently airport A to airport B involves a single connection through airport C, but airport C involves a connection through some other airport D.)

Venki • 3 years ago

The "Optimal Substructure Property" also called as "principle of optimality". In problem should satisfy principle of optimality. However, determining the Princi hope some of the upcoming examples will clarify.

For example finding optimal solution to one sub-instance may prevent choosin i.e. the optimal instances are not independent.

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