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

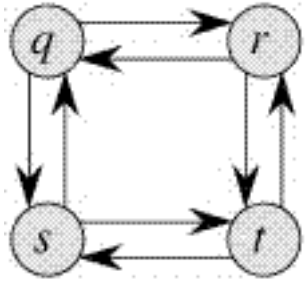
We have already discussed Overlapping Subproblem property in the Set 1. Let us discuss Optimal Substructure property here.

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.

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.



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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D. Pandey • 11 days ago

Hi,
Is it needed that for a problem to be solved by Dynamic Programm possessing Only One will be Enough? I think there exists some pr substructure and they can be solved By DP. Again, I think Longes Category, Is it?

^ | v • Reply • Share ›

Harshit Jain • a year ago

Consider finding a shortest path for travelling between two cities b substructure. That is, if the shortest route from Seattle to Los Ang Sacramento, then the shortest route from Portland to Los Angeles problem of how to get from Portland to Los Angeles is nested insi Angeles...

2 ^ | v • Reply • Share ›

shiwakant.bharti • 3 years 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 frequ airport B involves a single connection through airport C, but the ch connection through some other airport D.)

3 ^ | v • Reply • Share ›

SDK • 5 years ago

Please can somebody clarify the difference between Greedy and

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Someone ➔ SDK • 10 months ago

Greedy is about taking the options that looks the best (loca
DP is about a clever way to search over *the entire solutio
your problem exhibits other propieties) using some proper
S.).

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Anand • 5 years ago

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

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

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rajesh ➔ Anand • a year ago

In greedy algorithm we will solve the problem which are inc
problems are dependent like fibonic series

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tk • 5 years ago

As far as I know, most of the optimization problems have optimal
subproblem property that helps us in deciding to choose DP. Doe
other than the longest path , that doesn't have the optimal substru

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other than the longest path - that doesn't have the optimal substru

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shiwakant.bharti ➚ tk • 3 years ago

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

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

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pira ➚ shiwakant.bharti • 2 years ago

i didnt get the above example.
can anyone explain it ?

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Harshit Jain ➚ pira • a year ago

Consider finding a shortest path for travellin
likely to exhibit optimal substructure. That is
passes through Portland and then Sacrame
Angeles must pass through Sacramento to
to Los Angeles is nested inside the problem

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aj12009_3 ➚ pira • 2 years ago

lets say you wanna go from A to B, website

connection from point C. But if you think tha
might be costlier than the website is offerin
A to C is via a point D.

Thus you can't find cheapest possible fares
via connecting airports for that route.

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Vineel pira • 2 years ago

Go through the above article, to find the lon
problem, but it does not have a substructur
as longest path from A to C and from C to A

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Venki • 5 years ago

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

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

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rocky • 5 years ago

Nice Post! What about the Dijekstra Algorithm. Dijekstra also follo

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Jagat ➚ rocky • 4 years ago

In case of Disjkstra, you evaluate a specific decision that r and that is the property of a greedy algorithm.

On the other hand, when using DP, you've no idea what th solution to all the possible sub problems.

11 ^ | v • Reply • Share ›

Shiraj Pokharel ➚ rocky • 5 years ago

No its greedy my dear.

1 ^ | v • Reply • Share ›
