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## Optimal Substructure Property in Dynamic Programming | DP-2

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

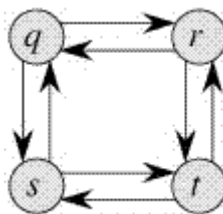
We have already discussed Overlapping Subproblem property in the [Set 1](#). Let us discuss Optimal Substructure property here.

**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  $t$ :  $q \rightarrow r \rightarrow t$  and  $q \rightarrow s \rightarrow t$ . Unlike shortest paths, these longest paths do not have the optimal substructure property. For example, the longest path  $q \rightarrow r \rightarrow t$  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  $q \rightarrow s \rightarrow t \rightarrow r$  and the longest path from  $r$  to  $t$  is  $r \rightarrow q \rightarrow s \rightarrow t$ .



We will be covering some example problems in future posts on [Dynamic Programming](#).

## Dynamic Programming | Set 2 (Optimal Substructure Property) | GeeksforGeeks



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](http://en.wikipedia.org/wiki/Optimal_substructure)

[CLRS book](#)

Improved By : [ASAJ RAWAT](#)

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