



Algorithms: Design  
and Analysis, Part II

# Dynamic Programming

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## Principles of Dynamic Programming

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Fact: our WS algorithm is a dynamic programming algorithm!

## Key ingredients of dynamic programming

- ① identify a small number of subproblems  
[e.g., compute the max-weight IS of  $G_i$ , for  $i=0,1,2,3,\dots,n$ ]
- ② can quickly + correctly solve "larger" subproblems given the solutions to "smaller subproblems" [usually via a recurrence such as  $AC[i] = \max \{ \underline{AC[i-1]}, \underline{AC[i-2]} + w_i \}$ ]
- ③ after solving all subproblems, can quickly compute the final solution  
[usually, it's just the answer to the "biggest" subproblem]

# Why “Dynamic Programming”?

“The 1950s were not good years for mathematical research. We had a very interesting gentleman in Washington named Wilson. He was Secretary of Defense, and he actually had a pathological fear and hatred of the word, research. I’m not using the term lightly; I’m using it precisely. His face would suffuse, he would turn red, and he would get violent if people used the term, research, in his presence. You can imagine how he felt, then, about the term, mathematical. The RAND Corporation was employed by the Air Force, and the Air Force had Wilson as its boss, essentially. Hence, I felt I had to do something to shield Wilson and the Air Force from the fact that I was really doing mathematics inside the RAND Corporation. What title, what name, could I choose? In the first place I was interested in planning, in decision making,... But planning, is not a good word for various reasons. I decided therefore to use the word, “programming”... [Dynamic] has a very interesting property as an adjective, and that is its impossible to use the word, dynamic, in a pejorative sense. Try thinking of some combination that will possibly give it a pejorative meaning. Its impossible. Thus, I thought dynamic programming was a good name. It was something not even a Congressman could object to. So I used it as an umbrella for my activities.”

Richard Bellman, “Eye of the Hurricane: an autobiography” 1984.