Week 10 – Outline of Dynamic Programming

50.004 Introduction to Algorithms

Dr. Subhajit Datta

ISTD, SUTD

Dynamic programming (DP)

- Dynamic programming, solves problems by combining the solutions to sub-problems
- Dynamic programming applies when the sub-problems overlap
  - That is, when sub-problems share sub-sub-problems
- A dynamic-programming algorithm solves each sub-sub-problem just once
  - Then saves its answer in a table
  - Thereby avoiding the work of re-computing the answer every time it solves each sub-sub-problem

Dynamic programming: Steps

1. Define sub-problems
2. Guess (part of the solution)
3. Relate sub-problem solutions
4. Recurse plus memoize
   - Or, Build table bottom up (if there are no circular dependencies)
5. Solve original problem by combining sub-problem solutions

Elements of dynamic programming

Optimal substructure

The solution to a problem can be obtained by solutions to sub-problems with no circular dependency

Overlapping sub-problems

A recursive solution contains a "small" number of distinct sub-problems (repeated many times)