Introduction

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What They Are

- An **algorithm** is, broadly speaking, a *step-by-step* procedure for solving a problem or accomplishing some end.
- When it is meant for the computer, each step in an algorithm should be realizable by *well-defined*, limited *primitive* operations that the computer understands.
- Algorithm design is an important and usually the hardest part of programming (which consists in finding/devising a solution and translating it into a computer program).
- Better algorithms (designed once, used forever) save more time and money.

Development of an Algorithm

- We typically are given a problem statement, including input and output requirements, that is an abstract yet *accurate* and *precise* account of the problem to be solved and the properties of a satisfactory solution.
- The development of an algorithm involves the following tasks:
  1. Design (main subject of this course)
  2. Verification (or Proof of Correctness)
  3. Analysis
  4. Implementation

Main Concerns

- Why is algorithm design difficult?
  - Counterintuitive approaches may be needed, because of large problem scales.
  - Better solutions, if worthwhile, may be more complicated.
- How do we approach it?

Our Approach to the Subject

- Two distinct features:
  - Emphasis of the creative side
    - learning to create by trying to create
  - Induction as one central design method
    - to explain/understand the principles behind a design
    - to systematically guide the creation process
- What is the "design by induction" method?
  - draw analogies from proving theorems by mathematical induction
  - concentrate on *extending* solutions of smaller problems instances to solutions of larger ones
  - induction may not solve every problem, but is helpful