
APL


C++






Meetup

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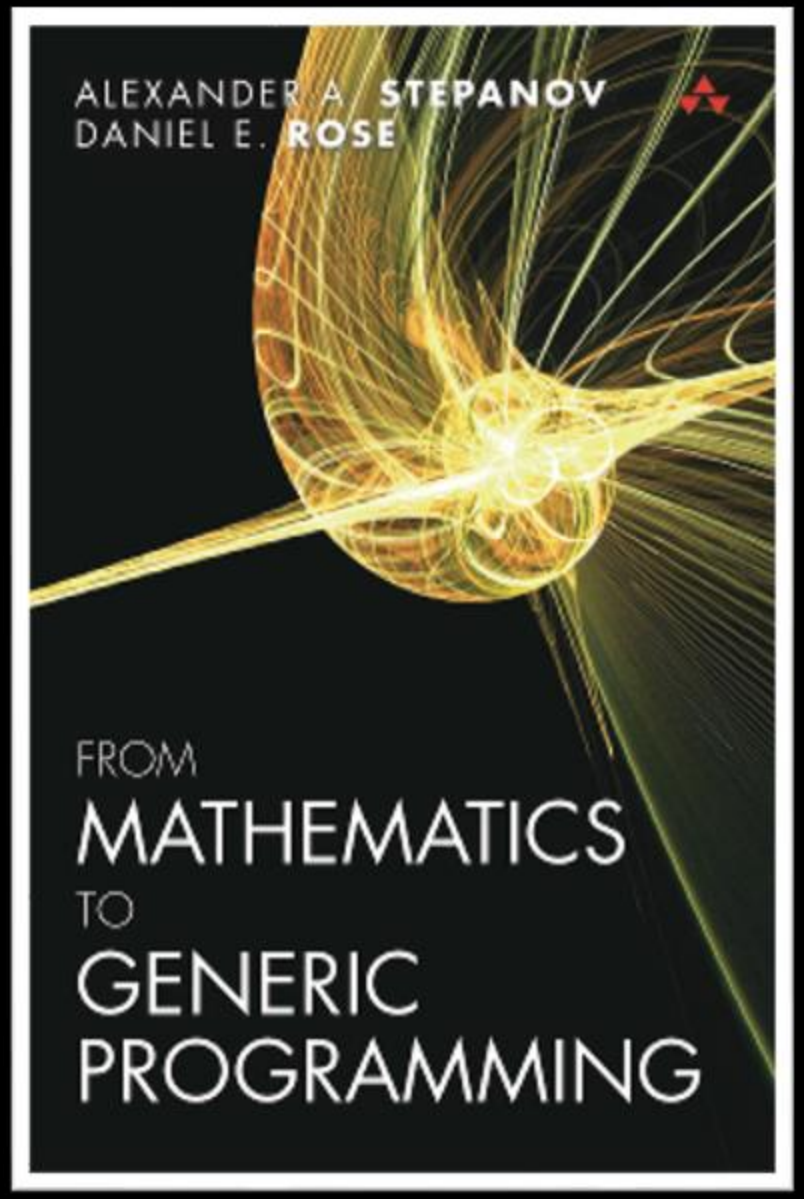

From Mathematics to Generic Programming

Chapter 7/3

1. What This Book Is About
2. The First Algorithm
3. Ancient Greek Number Theory
4. Euclid's Algorithm
5. The Emergence of Modern Number Theory
6. Abstraction in Mathematics
7. Deriving a Generic Algorithm
8. More Algebraic Structures
9. Organizing Mathematical Knowledge
10. Fundamental Programming Concepts
11. Permutation Algorithms
12. Extensions of GCD
13. A Real-World Application

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Reduction

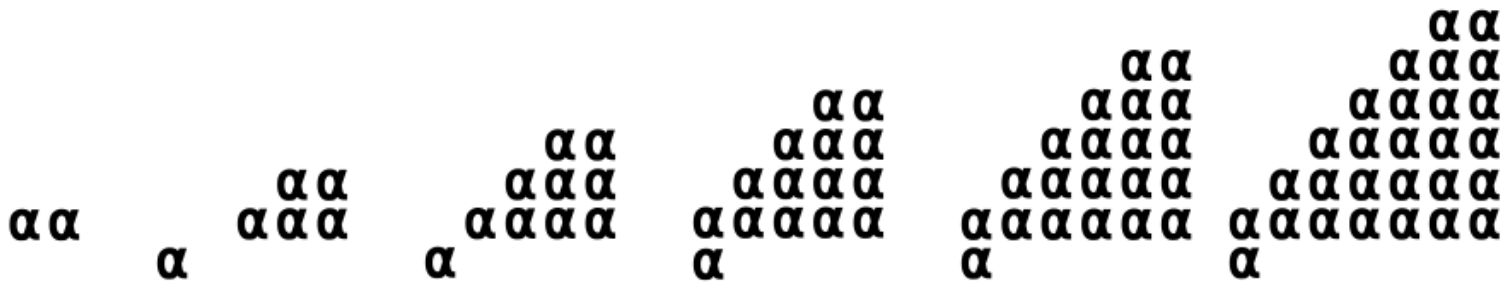
The power algorithm is not the only important algorithm defined on semigroups. Another key algorithm is *reduction*, in which a binary operation is applied successively to each element of a sequence and its previous result.

Two commonly seen examples of this in mathematics are the summation (Σ) function for additive semigroups and the product (Π) function for multiplicative semigroups. We can generalize this to an arbitrary semigroup.

This generalized version of reduction was invented in 1962 by computer scientist Ken Iverson in his language APL. In APL terminology, the / represented the reduction operator. For example, summation of a sequence is expressed as

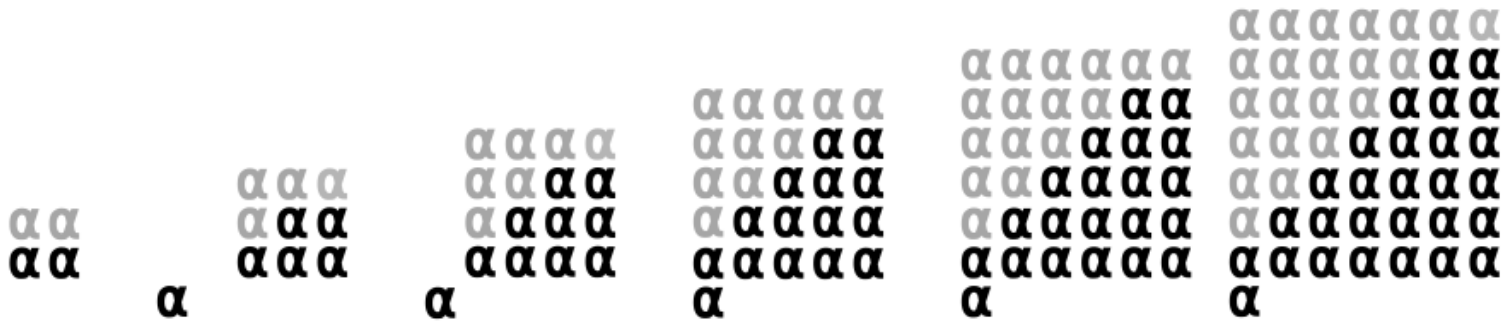
```
+ / 1 2 3
```

The idea of reduction has appeared in many contexts since then. John Backus, inventor of the first high-level programming language, included a similar operator called *insert* in his language FP in 1977. (He called operators "functional forms.") An early paper on generic programming, "Operators and Algebraic Structures," by Kapur, Musser, and Stepanov, extended the idea to parallel reduction in 1981 and clarified the relationship to associative operations. The language Common Lisp, popular in the 1980s for artificial intelligence applications, included a `reduce` function. Google's MapReduce system, and its open-source variant Hadoop, is a current practical application of these ideas.

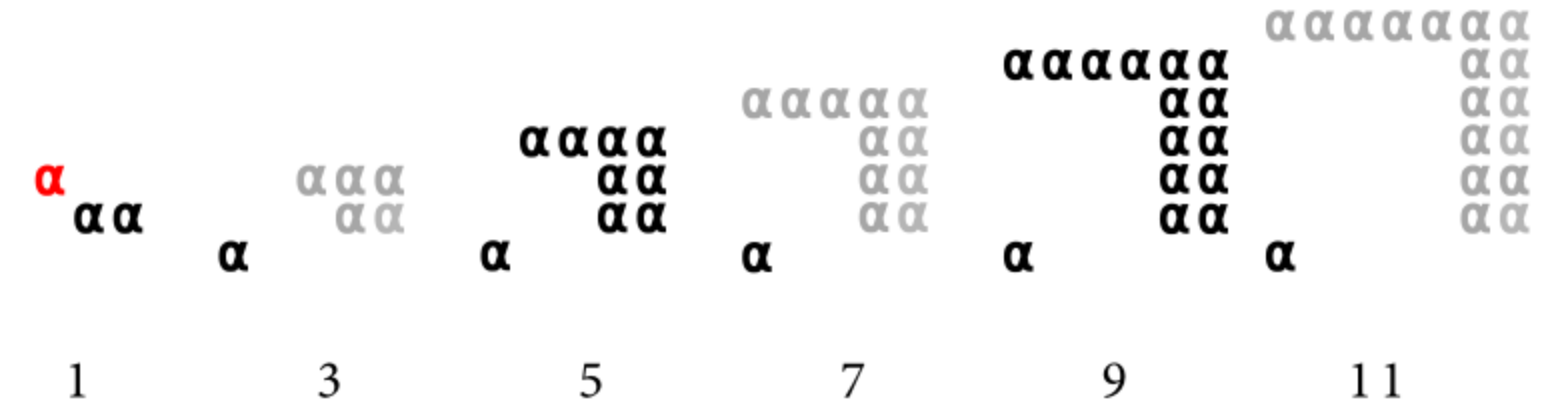


1 3 6 10 15 21

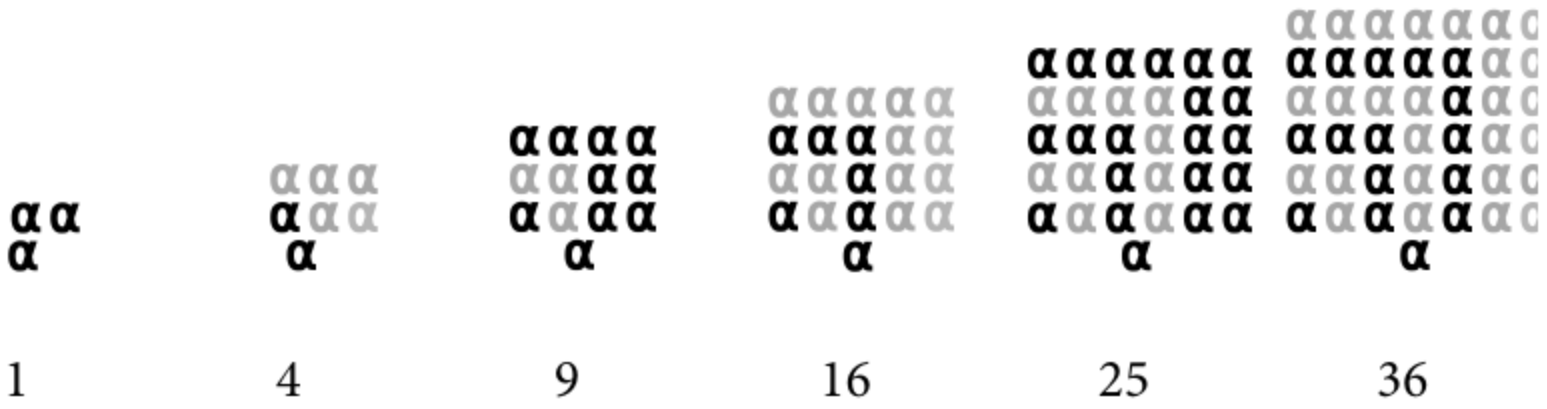
Oblong numbers are those that look like this:



2 6 12 20 30 42



Combining the first *n* gnomons creates a familiar shape—a square:



discussion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