

# Design and Analysis of Algorithms

## 6.7 Multipop

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## 7.7.2

- Analyze running time for a sequence of  $n$  Push, Pop, MultiPop operations
- Standard Analysis:
  - Push takes  $O(1)$
  - Pop takes  $O(1)$
  - MultiPop takes  $O(k)$
  - Worst case:  $n$  MultiPop operations =  $O(n^2)$
- Calculate amortized running time for each algorithm.

Each push and pop costs 1 credit. In order to be able to pop, we have to have pushed onto the stack first. So when we push, we pay ahead using a credit for a very cheap operation. Then when we pop we have credit in the bank from pushing. Averaged over  $n$  elements of MultiPop, the runtime of MultiPop is  $O(k)/k$  since we average over the whole instruction set, from push to pop.

### Solution

- Push: \$1+\$1 to bank
- Pop: \$0 to bank, take \$1 from the bank
- MultiPop: \$0 to bank, take \$k from bank

$$\$2N$$