**Problem 7-2.** [70 points] **HG Fargo**

You have been given an internship at the extremely profitable and secretive bank HG Fargo. Your immediate supervisor tells you that higher-ups in the bank are very interested in learning from the past. In particular, they want to know how much money they *could* have made if they had invested optimally.

Your supervisor gives you the following data on the prices[1] of select stocks in 1991 and in 2011:

| Company | Price in 1991 | Price in 2011 |
|---|---|---|
| Dale, Inc. | $12 | $39 |
| JCN Corp. | $10 | $13 |
| Macroware, Inc. | $18 | $47 |
| Pear, Inc. | $15 | $45 |

As a first step, you decide to examine what the optimal decision is for a couple of small examples:

(a) [5 points] If you had $20 available to purchase stocks in 1991, how much of each stock should you have bought to maximize profits when you sell everything in 2011? Note that you do not need to invest all of your money — if it is more profitable to keep some as cash, you do not need to invest it.

(b) [5 points] If you had $30 available to purchase stocks in 1991, how much of each stock should you have bought?

(c) [5 points] If you had $120 available to purchase stocks in 1991, how much of each stock should you have bought?

Your supervisor asks you to write an algorithm for computing the best way to purchase stocks, given the initial money *total*, the number *count* of companies with stock available, an array *start* containing the prices of each stock in 1991, and an array *end* containing the prices of each stock in 2011. All prices are assumed to be positive integers.

There is a strong relationship between this problem and the knapsack problem. The knapsack problem takes four inputs: the number of different items *items*, the item sizes *size* (all of which are integers), the item values *value* (which may not be integers), and the size *capacity* of the knapsack. The goal is to pick a subset of the items that fits inside the knapsack and maximizes the total value.

(d) [1 point] Which input to the knapsack problem corresponds to the input *total* in the stock purchasing problem?

    1. *items*        2. *size*        3. *value*        4. *capacity*

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[1]Note that for the purposes of this problem, you should ignore some of the intricacies of the real stock market. The only income you can make is from purchasing stocks in 1991, then selling those same stocks at market value in 2011.