General

Read through the "Background" section below, then copy and paste the questions out of the "Assignment" section into your word processor and answer the questions. Turn in the questions using the instructions posted on the class web site.

At the top of the every document that you create (word processing or source files) include:

// Your name
// CS-160, Lab #X (replace the X with the Lab #)
// xxxx Term, 20xx (i.e. Winter Term, 2007)

For ALL Word processing documents, you must submit your documents in one of the following formats: MS-Word (NOT Works), RTF (most word processors can save in this format), or Open Document (used by the freely available Open Office suite). They will be returned ungraded if submitted in any other format.

Concepts

This lab continues our coverage of problem solving techniques and the basic concepts in the structure and use of programming languages. We will continue using "Scratch" for the programming part of this lab.

Background

Note: Original source of the background contained below is from the "CS160 Worksheets" by Daniel Balls of the CS department at Oregon State University; updated and revised by Mitch Fry (CS, Chemeketa Community College).

Problem-Solving by Greedy Methods

(local optimization approach)

The next problem-solving technique we will explore is called problem solving using *greedy methods*. A greedy method solves a problem by focusing on particular local aspects of the problem, making a choice that is best for the local sub-problem, and hoping that a series of locally optimal choices will lead to the best overall solution.

For example, suppose a department store clerk owes $17.68 in change to a customer who has just made a purchase. What is the fewest number of bills and coins (assuming the clerk has at his disposal only $20, $10, $5, and $1 bills and quarters, dimes, nickels and pennies) the clerk can give to the customer to provide proper change?

If we disregard the 'fewest number of bills and coins' phrase, there are a myriad of ways that this change-making process can be brought about. For example, the clerk could give the customer 1768 pennies, or 176 dimes and 8 pennies. However, if the greedy method is applied to this situation, the clerk will try to give the *greatest* monetary piece (bill or coin) at each 'phase' of the change-making process. First, he will place a $10 bill on the table, since that is the largest single piece that he can give without giving more than the amount owed. Next, a $5 bill will be given, followed by two $1 bills. At this point $17 of the customer's change has been paid and bills can no longer be given. The clerk will then give two quarters, a dime, a nickel and three pennies. This solution of four bills ($10 + $5 + $1 + $1) and six coins ($0.25 + $0.25 + $0.10 + $0.01 + $0.01 + $0.01) is the optimal one—there is no way of combining less than 10 of the specified monetary pieces so that their sum is exactly $17.86.

While this rather mundane example is one we are all familiar with, it is indeed an example of the greedy technique at work—the next piece of money to be given was always the largest one

that could be given at the time, and this series of 'local' optimal decisions led to a 'global' optimal solution.

However, there are situations—and some very similar to the one just described—in which the greedy method fails to provide the optimal global solution. For example, let's imagine a society whose monetary system consisted of the following coins: 10-krunk, 8-krunk, 5-krunk and 1-krunk. If a sales clerk is obliged to give a customer 17 krunks in change, the greedy method would yield the following solution: one 10-krunk coin, one 5-krunk coin, and two 1-krunk coins. This global solution of four coins is not optimal. Rather, it is possible to provide 17 krunks with only three coins—two 8-krunk coins and one 1-krunk coin.

This example illustrates the fact that greedy methods should be used with caution; and importantly that "local optimization" does not always equate to "global optimization". This lab should also help with your ability to understand why doing what is optimal or right for an individual does not always result in optimal or right answers for society; similarly why actions that produce the best short term results do not always produce the best long term results.