CS161 - Homework 6

Due: Wednesday August 12, before class (9am)

No late submissions

1. (8 points) In class, we mentioned including the "swap" operation in our edit distance function. The swap operation only swaps adjacent characters. For example, $\textsc{Edit}$('recieve','receive') $= 1$ if we allow the swap operation (swapping 'i' and 'e'), but we could not swap 'r' and 'e'.

   (a) Write the recursive subproblem relation for swap (e.g. for insert, it was $\textsc{Edit}(X, Y) = 1 + \textsc{Edit}(X_{1\ldots n}, Y_{1\ldots m-1})$ and for delete it was $\textsc{Edit}(X, Y) = 1 + \textsc{Edit}(X_{1\ldots n-1}, Y_{1\ldots m})$).

   (b) Describe how to change the $\textsc{Edit}$ procedure covered in class to include the swap operation. You may either edit the pseudocode directly or describe what needs to be added/changed.

2. (10 points) String matching algorithms

   (a) (5 points) In class, we discussed three different string matching algorithms: naive, FSA based and Rabin-Karp. For each of these three algorithms, list two things, 1) describe a situation where the algorithm would perform better than the other two algorithms 2) describe an application where this situation would occur.

   (b) (5 points) Many other string matching algorithms also exists besides those mentioned in class. Investigate a new string matching algorithm not discussed in the class or the book. Give a short summary (in your own words) of how the algorithm works and, as in part a) of this problem, state in what situation the new algorithm would perform better and an application where this would occur. Be sure to cite your sources!

3. (10 points) You are asked to write a new string class/data structure that must support the following operations and average case runtime restrictions:

   - length - $O(1)$
   - concatenate - $O(n+m)$
   - substitute - $O(j)$ where j is the number of characters changed in the string

   Describe a data structure that supports these string operations and describe how you would implement each of these operations. Note: you will need to keep around additional data besides the string itself. Be sure you are clear about how you are storing the string and this additional data.

4. (10 points) Pancakes are produced in Kansas and Mexico and consumed in New York and California. Kansas **produces** 15 tons of pancakes and Mexico 8. New York **consumes** 10 tons of pancakes and California 13. The transportation costs per ton are \$4 from Mexico to New York, \$1 from Mexico to California, \$2 from Kansas to New York and \$3 from Kansas to California.

   Write a linear program that decides the amounts of pancakes (in tons and fractions of tons) to be transported from each producer state to each consumer state so as to minimize the overall transportation cost assuming we must ship all pancakes produced.

Extra Credit

5. (5 points) Moe is deciding how much Regular Duff and how much Duff Strong to order each week. Regular Duff costs Moe \$1 per pint and he sells it for \$2 per pint; Duff Strong costs \$1.50 per pint and he sells it at \$3 per pint. However, as part of a complicated marketing system, the Duff company will only sell Moe one pint of Duff Strong for every two pints or more of Regular Duff that Moe buys. Furthermore, Duff will not sell Moe more than 3,000 pints per week. Assuming Moe can sell however much beer he has, write a linear program for deciding how much Regular Duff and how much Strong Duff to buy so as to maximize Moe's profit. Solve the program geometrically.