CSCI-550 Project 3 Dynamic Programming

Consider the following problem:

A string y is a *palindrome* if $y^R = y$, where y^R is the reverse of y. Given a text x a partitioning of x is a *palindrome partitioning* if every substring of the partition is a palindrome. For example, aba|bbb|a|bb|a|b|aba and aba|b|bbabb|ababa are two palindrome partitioning of x = ababbbabbababa. Design a dynamic programming algorithm to determine the coarsest (i.e., fewest cuts) palindrome partitioning of x. In the example, the second partition (3 cuts) is optimal. Remember to analyze the time complexity of your solution.

Answer: We need two tables for this problem. Define $P[i, j]$ = True if $a_i a_{i+1} \dots a_j$ and is a palindrome, for all $1 \leq i \leq j \leq n$. Let us also define $C[i]$ = number of cuts in the best palindrome partition $a_1 a_2 \dots a_i$. We have

$$P[i,j] = \begin{cases} a_i = a_j \text{ AND } P[i+1, j-1] & \text{if } i < j-1 \\ a_i = a_j & \text{if } i = j-1 \\ \text{TRUE} & \text{if } i = j \end{cases}$$

$$C[i] = \begin{cases} \min_{k \in [0,i-1]} \{C[k] + 1 : P[k+1, i] = \text{TRUE}\} & \text{if } i > 0 \\ 0 & \text{if } i = 0 \end{cases}$$

The algorithm first computes $P[i, j]$ and then $C[i]$. The complexity is $O(n^2)$.

Assignment:

You need to write a program inside the file ***proj3.cpp*** that reads in a string from the standard input (use ***cin***), and calculates the table P and C (described above) and a table for backtracking, B.

Your program will fill in B while filling in C table. For C table, you need to add one more condition (in addition to above conditions):

C[i] = 0 if P[0, i] = True, and in this case B[i] = 0.

B[i] holds the index k for the best choice of C[i] (k is defined above), and B[0] = 0.

Once tables P, C and B are filled in (you can call them some other names), you need to write a recursive function that backtracks the solution: finds where the cuts should be made to produce palindromes with minimum number of cuts. This function should print out the palindromes corresponding to the minimum cuts.

The output format is:

<palindrome2><endl>
<palindrome2><endl>

For example, if a string is ababbbabbababa

Then the output is:

a
bab
bbabb
ababa

Test your program using the test files inside of ***tests.tar***. There will be one hidden test that is not given to you.

Grading: Total grade will be calculated according to the passed tests and satisfaction of other requirements (have a couple of functions in your program, one that is a recursive function for backtracking, and just call those functions from main() function).

Submission: submit via ***turnin*** system in assignment called Project3.