Due February 13, 2012

Goals:

1. Understanding of binary search.

2. Understanding of subsequences.

Requirements:

1. Design, code, and test a C program to compute the maximum interleave factor i for a character sequence X such that the resulting interleaved sequence $X^{(i)}$ is a subsequence of another character sequence A. The input will be formatted as follows:

   a. Two integers giving the number of characters in sequences A and X (i.e. $|A|$ and $|X|$).
   b. Each symbol of A, one per line.
   c. The symbol $.
   d. Each symbol of X, one per line.
   e. The symbol $.

   The input will be read from standard input as one of 1) keyboard typing, 2) a shell redirect (<) from a file, or 3) cut-and-paste. Do NOT prompt for a file name!

   The *interleaved sequence* $X^{(i)}$ for a sequence X and an interleave factor $i \geq 0$ results from repeating each symbol in X exactly i times. So, if $X = $ abbcda, $X^{(2)}$ is aabbbbccddaa and $X^{(3)}$ is aaabbbbbbcccdddaaa. $X^{(0)}$ is always the empty sequence. (Aside for those with CSE 3315 background: X^i is the ith *power* of sequence X. So, if $X = $ abbcda, X^2 is abbcdaabbcda and X^3 is abbcdaabbcdaabbcda.)

   A sequence U is a *subsequence* of a sequence V if there is at least one way to delete $|V| - |U|$ symbols from V to leave sequence U. So, $U = $ cba is a subsequence of $V = $ abcabcabc by performing these deletions from $V = $ ~~abcabcabc~~.

   The output of your program is the *trace* of the successes and failures of a binary search (including "low", "mid", and "high") for determining the maximum interleave factor that satisfies the subsequence condition. The last line output should provide the maximum interleave factor.

2. Send your program (as an attachment or the message body) to yuanzhe.cai@mavs.uta.edu by 3:45 p.m. on February 13. The `Subject` should be your name as recorded by the University and you should `cc:` yourself to verify that you sent the message correctly.

Getting Started:

1. Assumptions about the input file:

   a. $|A| \geq |X|$

   b. The symbols in the two sequences will be letters and digits, nothing else.

2. Arrays must be dynamically allocated based on the first line of the input.

3. Thoroughly debug your subsequence testing code before attempting to call it from your binary search code. Subsequence testing is easily performed in $O(|A|)$ time.

4. Test cases are available on the course web page. The GTA may use other cases when checking your submissions.

5. Your program must take time in $O(|A| \bullet \log(|A|/|X|))$, i.e. the subsequence test function will be called a logarithmic number of times in the controlling binary search code.

6. Note that if $X^{(i+1)}$ is a subsequence of A, then $X^{(i)}$ is also a subsequence of A.