Assignment # 2.1 Key

Let L be a language over \{a,b\} where every string is of even length and is of the form WX, where |W|=|X| but W≠X. Design and present an algorithm that recognized strings in L using no unbounded amount of storage (no stacks, no queues). This means that any memory required must be of a fixed size independent of the length of an input string. Note: You cannot play the game of using unbounded recursion, as each call consumes stack space.

Proof:

You can attack this deterministically or non-deterministically. I will do deterministically. Consider any string z=WX, |W|=|X| but W≠X. Such a string need only have one transcription error when copying W as X to be in L. check fits the bill.

```c
int check(const char *z){
  int p = -1; int odd = 0; int mid;
  while (z[++p]) {
    odd = 1-odd;
  }
  if ( odd ) return 0;
  mid = p/2;
  for (p=0; p<mid; p++) if (z[p] != z[mid+p]) return 1;
  return 0;
}
```

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Present a language $L$ over $\Sigma = \{a\}$ where $L^4 = L^5$ but $L \neq L^2$, $L^2 \neq L^3$ and $L^3 \neq L^{34}$

Note: $L^k = \{ x_1x_2...x_k \mid x_1, x_2, ..., x_k \in L \}$. This is basically a giveaway, since I showed exactly how to do it.

Proof:

Consider $L = \{a\}^* - \{aa, aaa, aaaa\}$

$L^2 = \{a\}^* - \{aaa, aaaa\}$ since the presence of the empty string in $\{a\}^*$ means all strings in $L$ are in $L^2$. Additionally, $aa = a \circ a$ and so $aa$ is in $L^2$ but $aaa$ and $aaaa$ are not since they cannot be formed from any pair of members in $L$

$L^3 = \{a\}^* - \{aaaa\}$ since the presence of the empty string in $\{a\}^*$ means all strings in $L$ are in $L^3$. Additionally, $aaa = aa \circ a$ and so $aaa$ is in $L^3$ but $aaaa$ is not since it cannot be formed from any triple of members in $L$

$L^4 = \{a\}^*$ since the presence of the empty string in $\{a\}^*$ means all strings in $L^3$ are in $L^4$. Additionally, $aaaa = aaa \circ a$ and so $aaaa$ is in $L^4$

$L^4 = L^5$ since $L^4$ is already $\{a\}^*$ and so nothing new can be created and the presence of the empty string in $\{a\}^*$ means all in $L^4$ are in $L^5$