1 Introduction

Naive approach - exponential, we use dynamic instead and yata-yata-yata. We suppose that $\epsilon \notin D$.

2 Principle

We denote the initial Morse sequence by $m = (m_0 \ldots m_{L-1})$. $m[i,j]$ denotes the subsequence $(m_i \ldots m_{j-1})$. The proposed dynamic procedure is based on the following observation:
Let w be a word of the dictionary such that its unique translation into Morse alphabet w' of length $|w'|$ occurs in m at index $i > 0$ (i.e. $m[i, i+|w'|] = w'$). Then the number $C_{i,w'}$ of interpretations of $m[0, i+|w'|]$ where the last word is w, equals the number C_i of interpretations of $m[0,i]$.
This leads us to establish a recursive formula for C_i:

$$C_i = \sum_{\substack{w' \in \mathcal{D} \\ m[0,i] = \alpha w'}} C_{i-|w'|,w'} + F_i = \sum_{\substack{w' \in \mathcal{D} \\ m[0,i] = \alpha w'}} C_{i-|w'|} + F_i$$

where $C_0 = 0$, "$m[0,i] = \alpha w'$" means that w' is a strict suffix of $m[0,i]$ and

$$F_i = |\{w' \in \mathcal{D} \mid m[0,i] = w'\}| \quad (note\ that\ F_i = 0\ for\ i > 4 \times M)$$

3 Algorithm

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procedure $compute\_number\_sequences(m, L, \mathcal{D})$
  $C \leftarrow create\_array(L, 0)$;
  for $i = 1 \ldots L-1$ **do**
    for $w' \in \mathcal{D}$ **do**
      if $m[i - |w'|,\ i] = w'$ **then**
        if $|w'| = i$ **then**
          $C[i] + +$
        else
          $C[i] += C[i - |w'|]$
        end if
      end if
    end for
  end for
  return $C[L-1]$
end procedure

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4 Complexity analysis

5 Improvement