



Second part report

DISCRETE OPTIMIZATION

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1 Introduction

2 Model

2.1 Datas

- $sl_k = \begin{cases} 1 & \text{if the key } k \text{ is on the left side,} \\ 0 & \text{otherwise.} \end{cases}$
- $sr_k = \begin{cases} 1 & \text{if the key } k \text{ is on the right side,} \\ 0 & \text{otherwise.} \end{cases}$
- fr_l : probability of the apparition of the letter l in the considered language.
- $vl = \begin{cases} 1 & \text{if the letter } l \text{ is a vowel,} \\ 0 & \text{otherwise.} \end{cases}$
- V : number of vowels in the language.
- $w_{i,j}$: probability that the letter j follows the letter i in a word.
- ks_k : strength of the finger associated to key k ($ks_k \in [0, 1]$).
- d_k : distance that the finger attributed to the key k has to cross to reach that key.

2.2 Variables

- $kb_{k,l} = \begin{cases} 1 & \text{if the letter } l \text{ is on the key } k, \\ 0 & \text{otherwise.} \end{cases}$
- $vl = \begin{cases} 1 & \text{if the vowels are on the left side,} \\ 0 & \text{otherwise.} \end{cases}$
- $a_{i,j} = \begin{cases} 1 & \text{if to type } i \text{ and then } j, \text{ it is not the same hand that is used,} \\ 0 & \text{otherwise.} \end{cases}$

2.3 Constraints

- $\sum_l fr_l \cdot (\sum_k kb_{k,l} \cdot (sr_k - sl_k)) \geq 0$
- $\sum_k kb_{k,l} = 1, \forall l$
- $\sum_l kb_{k,l} = 1, \forall k$
- $\sum_l vl \cdot (\sum_k kb_{k,l} \cdot sl_k) = V \cdot vl$
- $a_{i,j} = a_{j,i}, \forall i, j$
- $a_{i,i} = 0, \forall i$
- $a_{i,j} \leq \sum_k kb_{k,i} \cdot sl_k + \sum_k kb_{k,j} \cdot sl_k$
- $a_{i,j} \geq \sum_k kb_{k,i} \cdot sl_k - \sum_k kb_{k,j} \cdot sl_k$
- $a_{i,j} \geq \sum_k kb_{k,j} \cdot sl_k - \sum_k kb_{k,i} \cdot sl_k$
- $a_{i,j} \leq 2 - \sum_k kb_{k,i} \cdot sl_k - \sum_k kb_{k,j} \cdot sl_k$

2.4 Objective function

$$\min \left[\sum_l fr_l \cdot \left(\sum_k dif_k \cdot kb_{k,l} \right) + \sum_i \sum_j w_{i,j} \cdot (1 - a_{i,j}) + \sum_i \sum_j w_{i,j} \left(\sum_k d_k \cdot kb_{k,i} + \sum_l d_l \cdot lb_{k,i} \right) \right]$$

where

$dif_k = d_k \cdot ks_k$ is the difficulty to type the key k

3 Datas

4 Method

5 Results

6 Improvements