

**PhD Thesis from R.Descartes University – Paris V**  
**MATHEMATICS AND COMPUTER SCIENCE DEPARTMENT**  
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**Contributions to handwriting recognition with hidden Markov models**

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**Abstract:**

This work deals with offline handwriting recognition. This task consists in automatically reading cursive words from an image. The existing solutions are not yet good enough if they try to solve any kind of such problems. Nevertheless, when the document obeys a given format such as checks or formularies, the context allows us to build an application which gets satisfactory results. Obviously, it is easier to recognize a word if it is known to be a number written on a check, or a first name written on a formulary. The studied problem in this document is the recognition of words which are known to belong to a given vocabulary.

Most of recognition system include two main steps. First of all, the image source needs to be treated in order to extract the word --which has to be recognized-- and to segment it into letters or pieces of letter which are called graphemes. Then, this result is processed by mathematic models which analyse the grapheme shapes and their sequence. This probabilistic step often includes hidden Markov models and represents the recognition in a strict way. These models are indeed estimated on large databases in order to find their coefficients which can be considered as holding the knowledge.

The bibliographic study showed that the research in the handwriting recognition domain does not offer approaches which are far away from the hidden Markov models' formalism. This study was continued to build a precise description of the whole process from the image to the results. It finally offers a panorama of the actual state of research. The reached objectives are series of contributions which improve the performances without modifying the main scheme of the recognition system.

These local improvements explore three themes. The first one concerns a better way to take into account the unavoidable errors of the grapheme segmentation. The second theme is about decision which was accelerated in order to increase models complexity but also in order to keep low processing times (around a few second tenth). The last theme concerns image processing. The aim was to include some training steps instead of many heuristics which are usually used, by training a grapheme segmentation, by processing accents in a separate way or by restoring imperfect characters.