

# ICFHR 2014 Tutorial:

## Handwritten Text Recognition: Word-Graphs, Keyword Spotting and Computer Assisted Transcription

### I - Introduction

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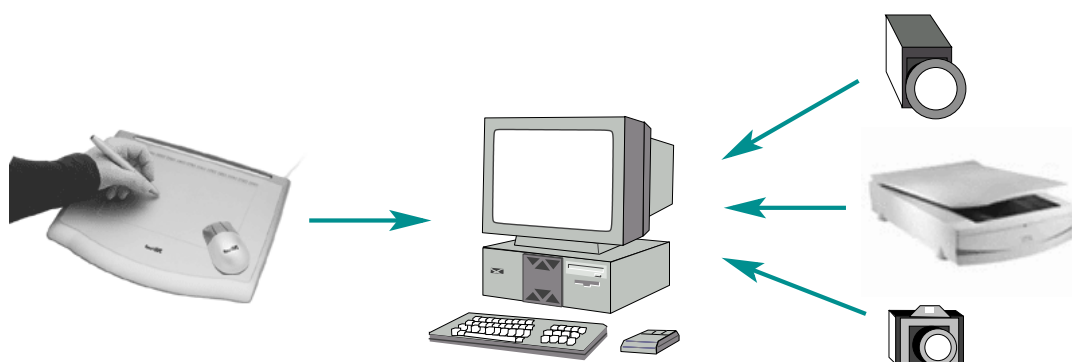
## Outline

- Introduction to Handwritten Text Recognition and Beyond ▷ 3
- Tutorial Outline ▷ 6
- Quick Overview of Statistical Concepts and Notation ▷ 7
- General bibliographphy ▷ 8

## Handwritten Text Recognition (HTR)

- ▶ Handwritten text and computers
- ▶ Text images: “*off-line*” HTR
- ▶ E-pen input (tablet, touchscreen, etc.): “*on-line*” HTR
- ▶ Block letter handwriting (“*OCR*”) vs cursive text “*HTR*”
- ▶ Interest in *off-line* HTR: Huge collections of historical manuscripts
  
- ▶ Architectures for HTR:  
Preprocessing, feature extraction and recognition
- ▶ Segmentation-based vs segmentation-free approaches: OCR/HTR
- ▶ Document layout analysis
- ▶ Beyond HTR: Interactive-Predictive HTR, Indexing & Search (KWS)

## Handwritten text and computers



### ON-LINE

Point sequence representation  
(digital pen, tablet, etc.)

### OFF-LINE

Bitmap (image) representation  
(camera, scanner, video, etc.)

## Examples of Handwritten Text Images



## Tutorial Program

- ▶ Introduction (*E. Vidal*)
- ▶ Handwritten Text Recognition (*J.A. Sánchez*)
- ▶ Basic HTR experiments (hands on) (*M. Pastor & A.H. Toselli*)
- ▶ COFFEE
- ▶ Basic HTR experiments (cont.)
- ▶ LUNCH
- ▶ Word-Graphs (WG) (*M. Pastor*)
- ▶ WG Applications: Computer-Assisted Transcription of Text Images (*E. Vidal*)
- ▶ WG Applications: Indexing & Searching in Large Manuscript Collections (“Written Term Detection” of “Key Word Spotting”) (*A. Toselli & E. Vidal*)
- ▶ COFFE
- ▶ WG Applications: Indexing & Searching in Large Manuscript Collections (Cont.)

## Notation and Basic Concepts in Statistics

- ▶ UNCONDITIONAL, CONDITIONAL AND JOINT PROBABILITIES:

$$P(X = x), \quad P(X = x | Y = y), \quad P(X = x, Y = y)$$

$$\text{Notation: } P(x), \quad P(x | y), \quad P(x, y)$$

- ▶ BAYES' RULE:  $P(x, y) = P(x | y) \cdot P(y) = P(y | x) \cdot P(x)$

- ▶ CHAIN RULE:

$$P(x_1, x_2, \dots, x_I) = P(x_1) \cdot P(x_2 | x_1) \cdots P(x_I | x_1, \dots, x_{I-1})$$

$$\text{Notation: } P(x_1^I) = P(x_1) \cdot P(x_2 | x_1) \cdots P(x_I | x_1^{I-1})$$

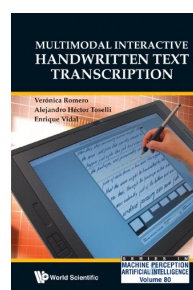
- ▶ MARGINAL:  $P(x) = \sum_y P(x, y)$

- ▶ MODE:  $\hat{x} = \arg \max_x P(x): P(\hat{x}) = \max_x P(x)$

- ▶ MODE APPROXIMATION:  $\sum_x P(x \dots) \approx \max_x P(x \dots)$

## Main references used in this tutorial

Two recent books on Interactive Pattern Recognition, Handwritten Text Recognition (HTR) and Interactive HTR:



- ▶ A.H.Toselli, E.Vidal, F.Casacuberta: “Multimodal Interactive Pattern Recognition and Applications”. Springer Verlag, 2011.
- ▶ V.Romero, A.H.Toselli and E.Vidal: “Multimodal Interactive Handwritten Text Transcription”, World Scientific, 2012.