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Applications of Conformal Predictors

Sergio González Sanz, Ph.D.

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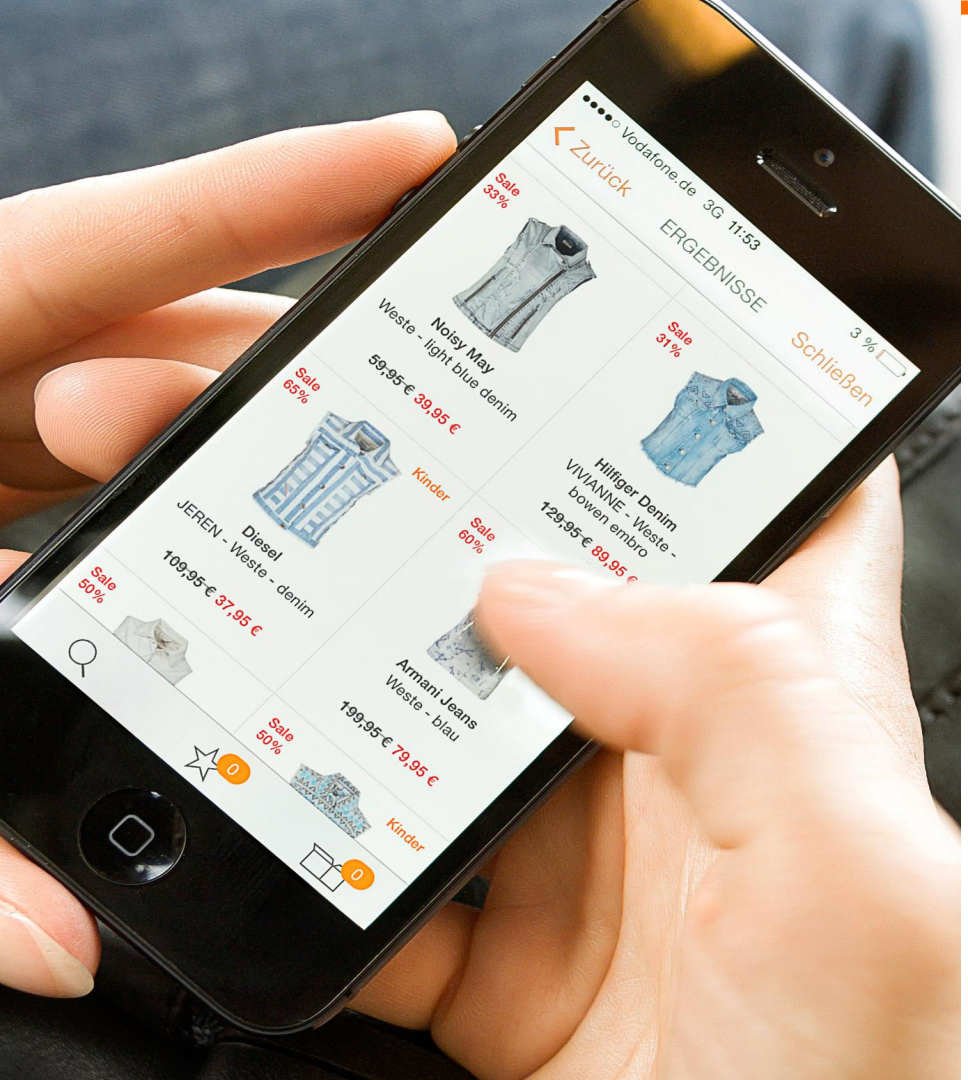

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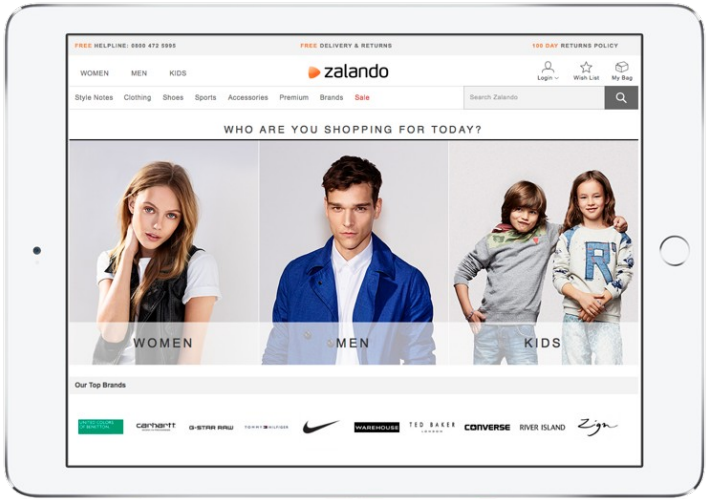

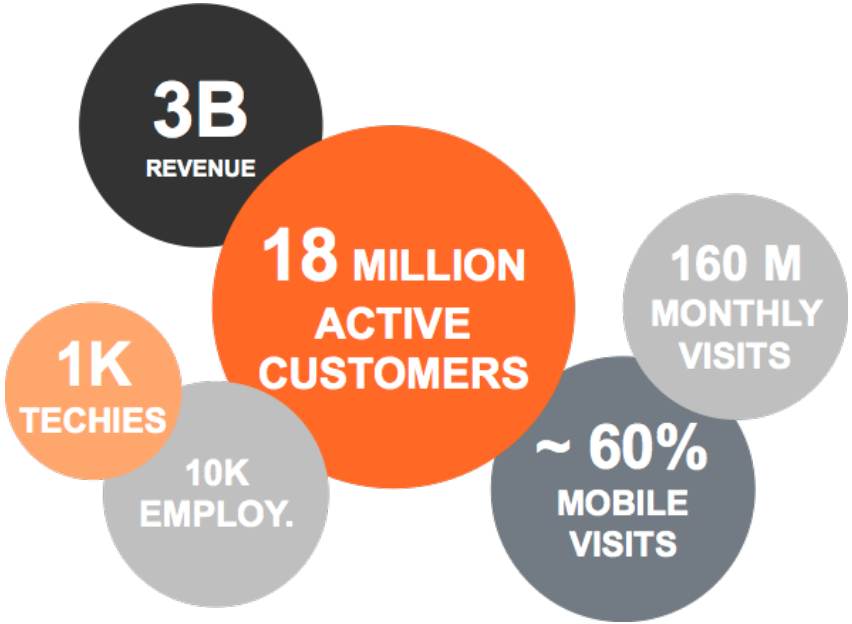

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1. CONFORMAL PREDICTORS INTRO

1. Brief history
2. Background
3. Conformal Predictors in a nutshell

1.1. BRIEF HISTORY

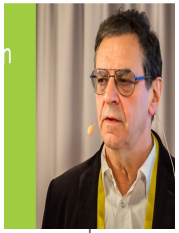
1963 - 1965
SVM introduced

1995
Support-Vector Networks
SVM standard

1998
Learning by transduction
Conformal predictors introduced

2007
Hedging predictions in Machine Learning
Conformal predictors standard

Gammerman



Vovk

Cortes

Vapnik

Chervonenkis

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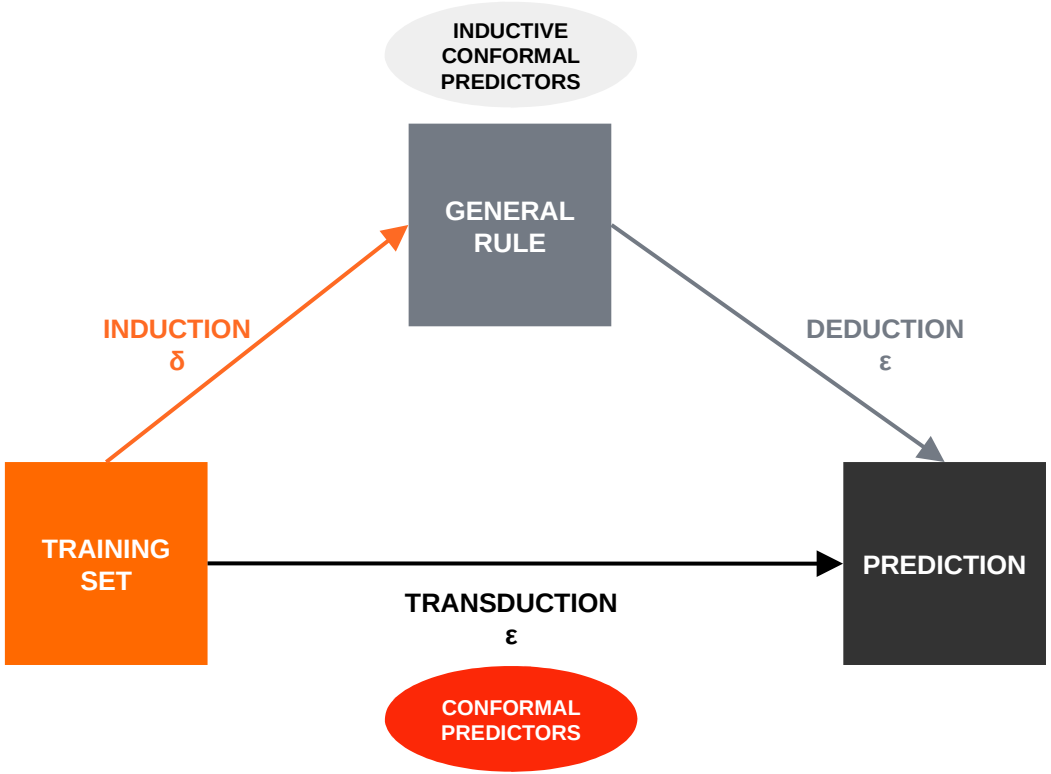
1.2. BACKGROUND



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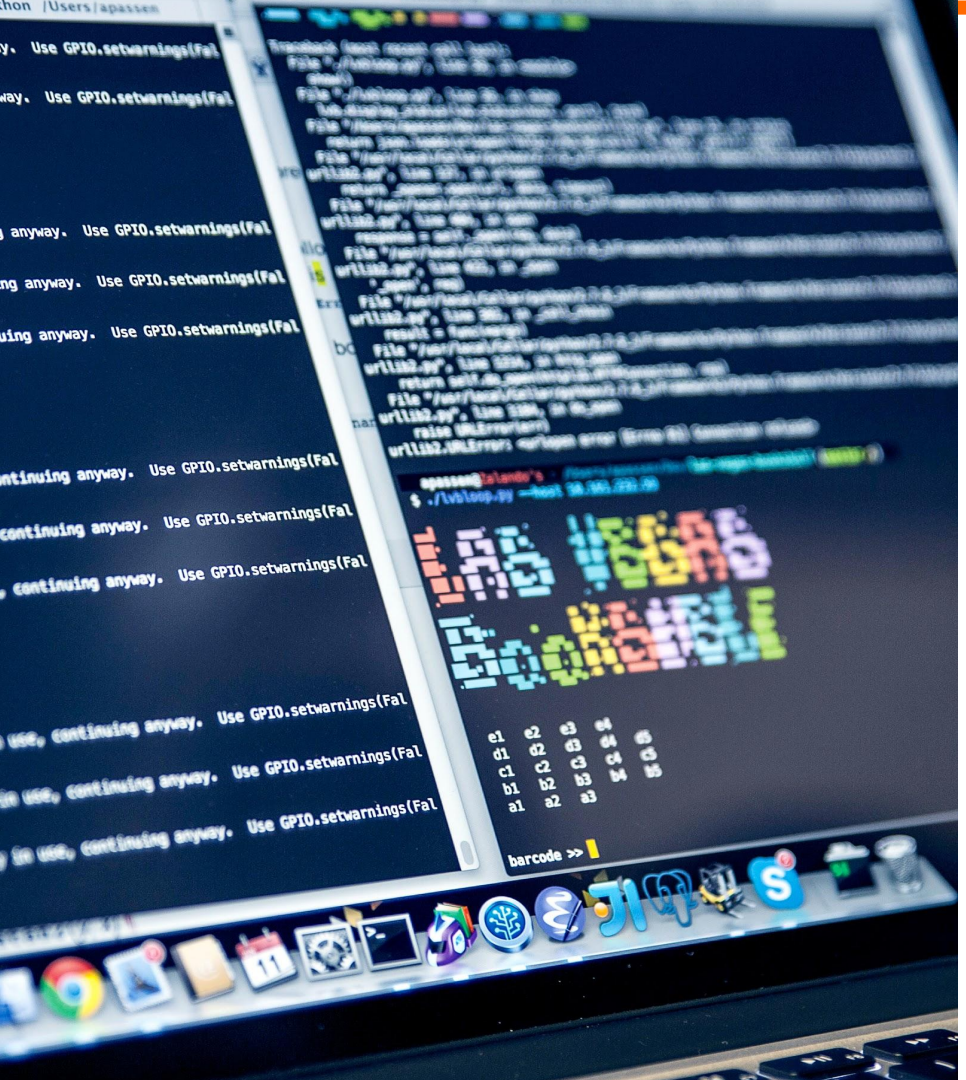
1.3. CONFORMAL PREDICTORS IN A NUTSHELL

Classifier, regressor or clustering alg	SVM, random forest, nearest neighbour, Ridge Regression, ...
Non-conformity measure (α): a real-valued function $\alpha(B, x)$ that shows how different the sample x is from the elements in the bag B.	$\alpha(B,x) = \frac{\{distance\ to\ x's\ nearest\ neighbour\ in\ B\ \hat{y}=y\} + 1}{\{distance\ to\ x's\ nearest\ neighbour\ in\ B\ \hat{y}\neq y\} + 1}$
p_{values}: they compare α_x with the non-conformity values of the samples in B.	$p\text{-}value = \frac{\#\{j = 1, \ldots, n : \alpha_j \geq \alpha_x\} + 1}{n + 1}$

Classification	Class of the largest p_{value}
Credibility	Largest p_{value}
Confidence	1 - 2nd largest p_{value}



2. APPLICATIONS OF CONFORMAL PREDICTORS

1. Iris dataset
2. Hand-written characters

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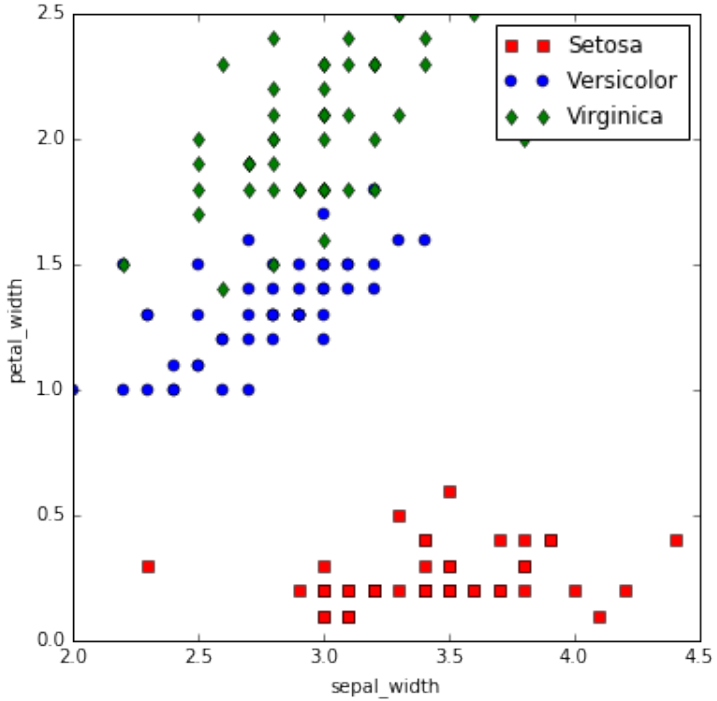
2.1. IRIS DATASET (I)

- Iris dataset
- Nearest neighbour
- Two dimensions: Sepal width & Petal width

$$\alpha(B,x) = \frac{\{distance\ \ to\ \ x's\ \ nearest\ \ neighbour\ \ in\ \ B\ \ \hat{y}=y\}\ +\ 1}{\{distance\ \ to\ \ x's\ \ nearest\ \ neighbour\ \ in\ \ B\ \ \hat{y}\neq y\}\ +\ 1}$$



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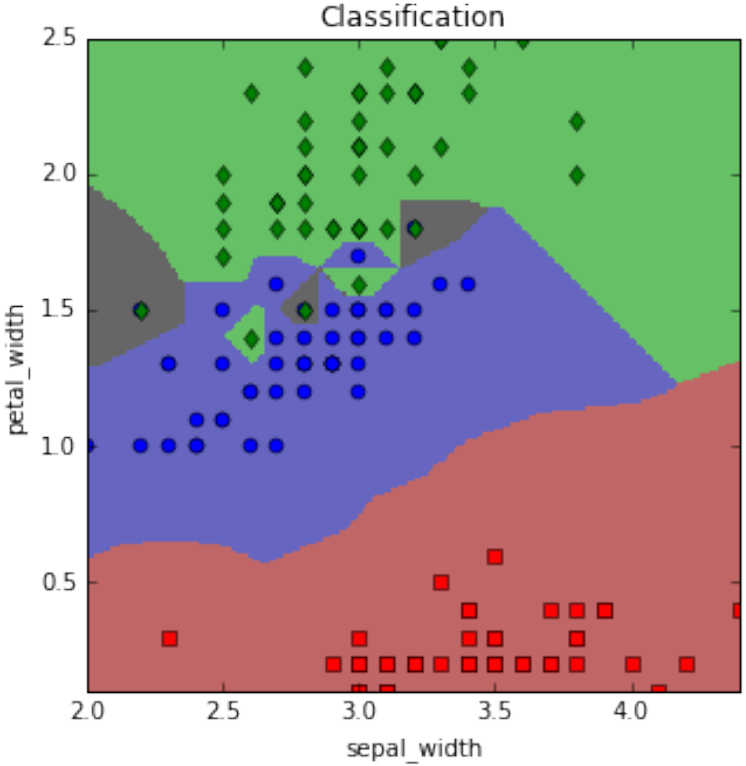
IRIS DATASET (II)



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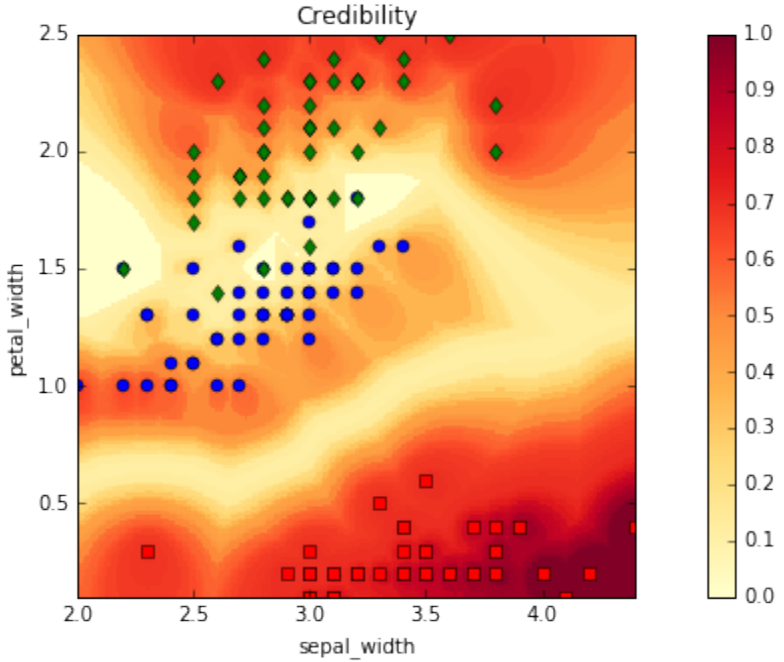
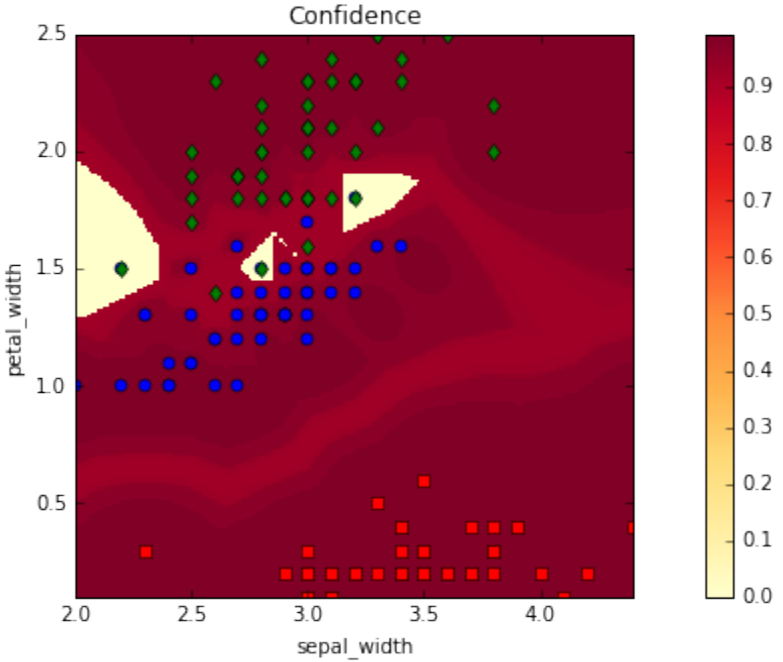
2.1. IRIS DATASET (III)





Largest p-value

1 - (2nd largest p-value)

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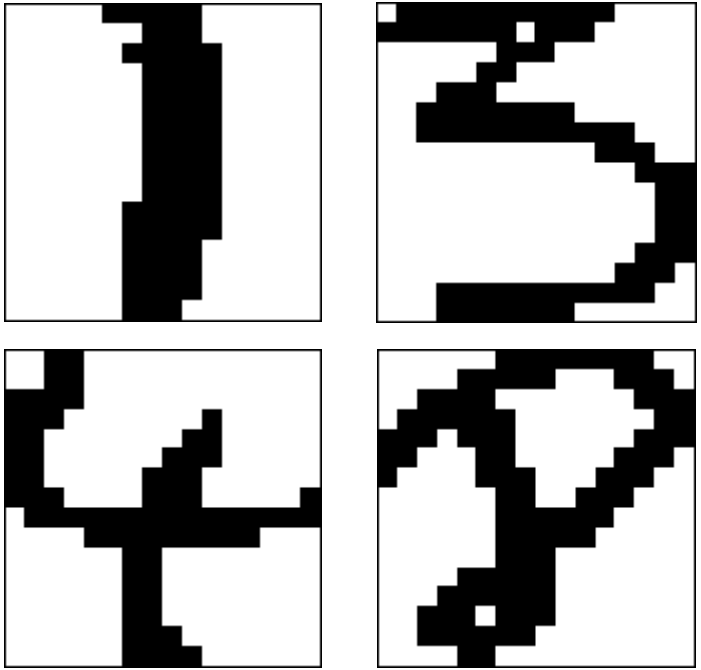
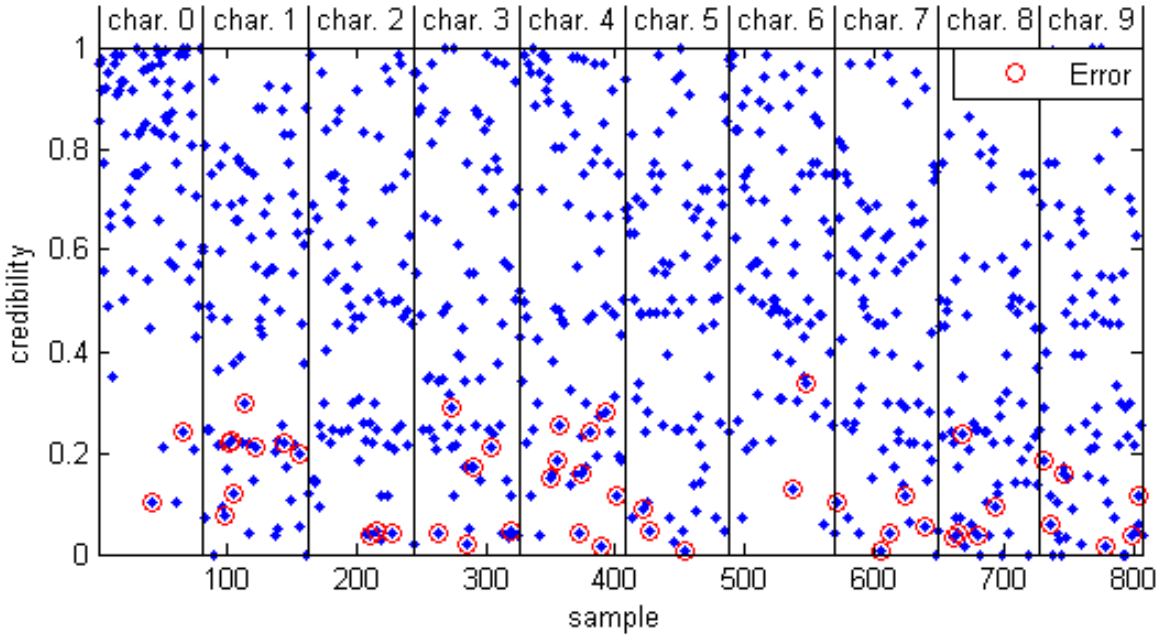
2.2. HAND-WRITTEN CHARACTERS (I)

- Semeion data set: 1,593 samples
- SVM

$$\alpha(B,x) = \begin{cases} -|distance(H,x)| & if \quad \hat{y} = y \\ |distance(H,x)| & if \quad \hat{y} \neq y \end{cases}$$



2.2. HAND-WRITTEN CHARACTERS (II)



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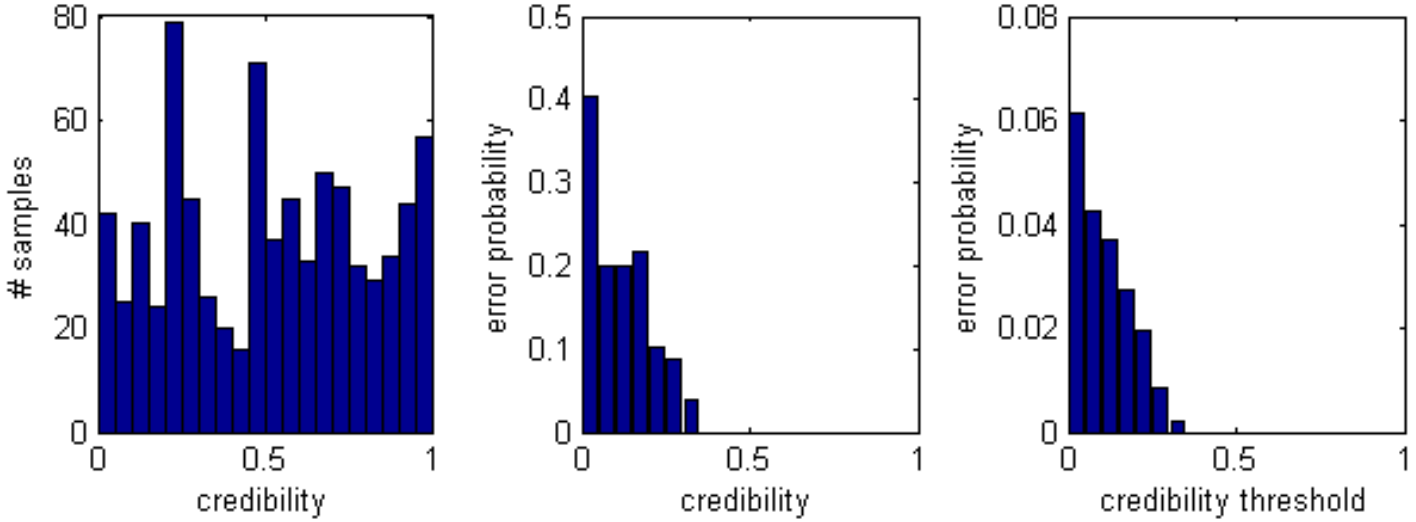
2.2. HAND-WRITTEN CHARACTERS (III)



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THANK YOU FOR YOUR ATTENTION!

Questions?

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