SEDiL: Software for Edit Distance Learning

http://labh-curien.univ-st-etienne.fr/SEDiL

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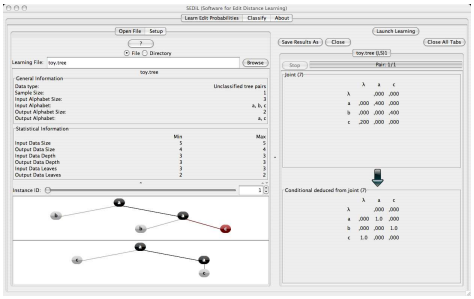
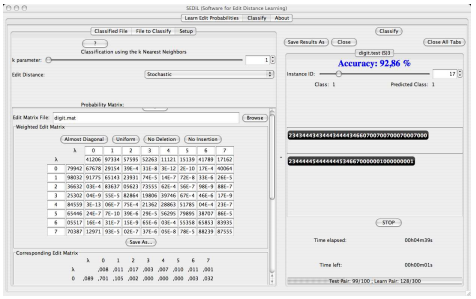


Standard Edit Distance

Context

- Structured data (Strings, Trees, Graphs)
- Recurrent need of similarity measures in Machine Learning
  - ↳ Edit Distance (ED)
- Theoretical framework
  - ↳ Probabilistic models (Pair-HMMs, transducers, PDFAs, ...)
- Aim
  - ↳ To provide a platform grouping together the state of the art algorithms for learning edit parameters

⇒ **SEDiL**



Probabilistic Edit Similarity

Definition

An **Edit script** is a sequence of edit operations (insertion, deletion, substitution) allowing the transformation of an input data X into an output data Y.

Definition

The **Standard Edit Distance (ED)** between X and Y is the cost of the less costly edit script.

Crucial step

Manual setting of the edit costs (depends on the domain).

Definition

The **Probabilistic Edit Similarity (ES)** between X and Y is defined as: ES(X,Y)=-log p(X,Y), where p(X,Y) is the (joint or conditional) probability of transforming X into Y, according to either the best script (Viterbi) or all the possible scripts (stochastic).

Crucial step

Learning of a distribution over the edit operations (automatic capture of the domain knowledge).

Example

pair of strings

input string a b
output string a a

Edit scripts = { (a → a , b → a) ; (a → λ , b → a , λ → a) ; (a → a , b → λ , λ → a) ; ... } where λ is the empty symbol

A priori fixed edit costs

c	λ	a	b
λ	-	2	3
a	3	0	1
b	1	2	0

ED(a b , a a) = c(a → a) + c(b → a)
= 0 + 2 = 2

Learned edit probabilities

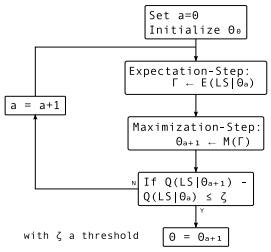
δ	λ	a	b
λ	—	0.2	0.1
a	0.05	0.0	0.1
b	0.05	0.2	0.3

p(a b , a a) = δ(a → λ) x δ(b → a) x δ(λ → a)
= 0.05 x 0.2 x 0.2 = 0.002

ES_λ(a b , a a) = -log(0.002)
≈ 2.69

ES learning algorithms in SEDiL

Expectation-Maximization-based algorithms



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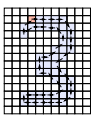
Features of the state of the art algorithms

[1]	[2]	[3]	[4,6]	[5]
strings	strings	strings	trees	trees
memoryless	non-memoryless	memoryless	memoryless	memoryless
Viterbi stochastic	stochastic	Viterbi stochastic	Viterbi stochastic	stochastic
generative	generative	discriminative	generative discriminative	generative discriminative

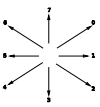
Applications

Original data | String representation | Tree representation | Learned parameters

Handwritten Character Recognition



Use of Freeman's codes



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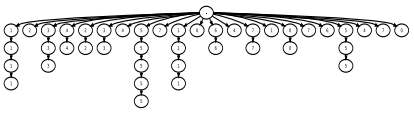
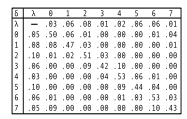
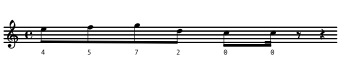




δ	λ	0	1	2	3	4	5	6	7
λ	—	.03	.06	.08	.01	.02	.06	.06	.01
0	.85	.50	.06	.01	.08	.00	.00	.01	.04
1	.08	.88	.47	.03	.08	.00	.00	.00	.01
2	.10	.01	.02	.51	.03	.00	.00	.00	.00
3	.06	.00	.00	.09	.42	.10	.00	.00	.00
4	.03	.00	.00	.00	.04	.53	.06	.01	.00
5	.10	.00	.00	.00	.00	.09	.44	.04	.00
6	.06	.01	.00	.00	.00	.01	.03	.53	.03
7	.05	.09	.00	.00	.00	.00	.00	.10	.43

Music Recognition



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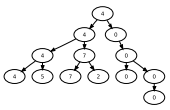

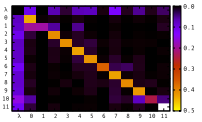

PASCAL2 Pattern Analysis, Statistical Modelling and Computational Learning
CNRS CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE
French ANR-05-MMSA-0016 Marmota project
Spanish research programme Consolider Ingenio-2010
Université Jean Monnet SAINT-ETIENNE
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