



ACE Presentation

Comparison with existing frameworks

Technical aspects

ACE 2.0 and future work

24 October 2009

ACE

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ACE Presentation



ACE Presentation

Framework for using and optimizing classifiers

 Experiments a variety of classifiers, classifier parameters, classifier ensembles and dimensionality reduction

Designed to facilitate classification

Meta-learning component

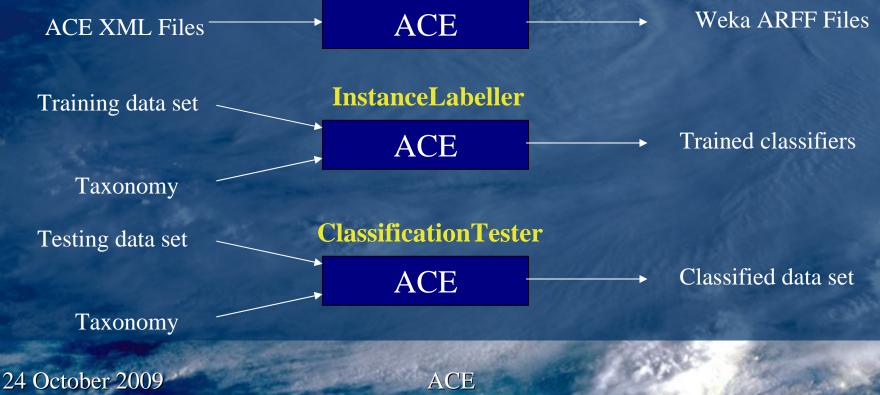
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ACE Configurations

• ACE 1.1 works with command line interface

• ACE 2.0 works with command line or GUI interface







(Devaney 2008)

DIMENSIONALITY REDUCTION: Genetic search using naive Bayesian classifier TIME TAKEN: 0.40363333333333334 minutes SELECTED FEATURES (12 of 24): Spectral_Centroid_Overall_Standard_Deviation Spectral_Rolloff_Point_Overall_Standard_Deviation Spectral_Flux_Overall_Standard_Deviation Compactness_Overall_Average Root_Mean_Square_Derivative_Overall_Average Zero_Crossings_Overall_Standard_Deviation Zero_Crossings_Derivative_Overall_Average Zero_Crossings_Derivative_Overall_Standard_Deviation Strongest_Frequency_Via_Zero_Crossings_Overall_Average Strongest_Frequency_Via_Spectral_Centroid_Overall_Average Strongest_Frequency_Via_Spectral_Centroid_Overall_Standard_Deviation Strongest_Frequency_Via_FFT_Maximum_Overall_Average

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(*Devaney 2008*)

BEST CLASSIFIER: AdaBoost with C4.5 Decision Trees **BEST AVERAGE ERRORRATE: 6.2080536% FOLDS: 10 CROSS-VALIDATION STATISTICS: CONFUSION MATRIX:** Correctly Classified Instances 1118 93.7919 % a b c d e <-- classified as $308 \ 0 \ 2 \ 0 \ 1 \ | a = kick$ Incorrectly Classified Instances 74 6.2081 % $0.263 \ 26 \ 0 \ 1 \ | b = open$ Kappa statistic 0.9204 Mean absolute error 0.0257 2 23 264 7 2 |c = closed $0 \quad 0 \quad 4 \quad 150 \quad 2 \quad | \ d = k$ -snare Root mean squared error 0.1553 2 1 0 133 | e = p-snare Relative absolute error 8.2325 % 1 Root relative squared error 39.3154 % Total Number of Instances 1192 Ignored Class Unknown Instances 49

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Comparison with existing frameworks

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Existing general frameworks

PRTTools (MATLAB Toolbox) – Van der Heijden et al. 2004

- Reliant upon a proprietary software
- Non redistributable
- Little portability
- Weka Witten and Frank 2000
 - Freely distributable
 - Open source
 - Relatively well documented
 - Good portability (implemented in Java)
- \rightarrow Basis of the ACE engine

Existing specific frameworks

Marsyas - Tzanetakis and Cook 1999

- C++ based system little portability
- No MIDI classification
- Designed as feature extractor

M2K - *Downie* 2004

Feature extraction and classification framework based on D2K

- License issues
- Not open source



Technical aspects



Feature file formats

(McKay et al. 2005)

 ACE is designed to be used with any feature extractor and data set correctly formatted

Weka ARFF file format

- \square 1 class = 1 instance
- Grouping of features
- Labeling or structuring of the instance
- Structure of class labels

<!ELEMENT feature_vector_file (comments, data_set+)> <!ELEMENT comments (#PCDATA)> <!ELEMENT data_set (data_set_id, section*, feature*)> <!ELEMENT data_set_id (#PCDATA)> <!ELEMENT section (feature+)> <!ATTLIST section start CDATA "" stop CDATA ""> <!ELEMENT feature (name, v+)> <!ELEMENT feature (name, v+)> <!ELEMENT name (#PCDATA)> <!ELEMENT v (#PCDATA)>

• ACE XML file format

- Easily readable (verbose format) and standardized
- 1 file = 1 task (features, feature definitions, classifications...) \rightarrow reusable
- Metadata storage \rightarrow full independence between extractors and classifiers

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Meta-learning - Classifier ensembles

Combine the answer of several classification models

Advantages (*Dietterich 2000*)

- Statistical performance
- Improved results for models working with local optima
- Can improve significantly results from a non adapted format classifier

Classifier ensemble methods

- Voting (merging the results)
- Dynamic selection (selecting in each case the best classifier)
- Stacking (weighted voting)
- Bagging (sampling all available training instances)
- Boosting (emphasize poorly classified trainings sets)

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ACE Classifiers

Feedforward neural networks

Support vector machines

Nearest neighbour classifiers

Decision tree classifiers

Bayesian classifiers

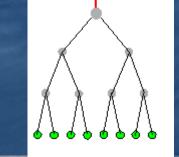
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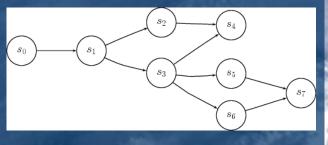
Feature dimension reduction

- ACE implements a variety of dimensionality reduction and feature weighting techniques
- Iterative evaluation of the techniques

Techniques used:

- Principal component analysis
- Genetic algorithms
- Tree searches
- Forward-backward algorithms





Feature weighting with GA's

(Fiebrink et al. 2005)

 Optimize a classification by assigned weights to the features according to their accuracy

GA software: JGAP (Java package)

Genes selection: leave-one-out cross-validation with k-NN classifier

Parallel computation (M2K/D2K or Grid Weka)

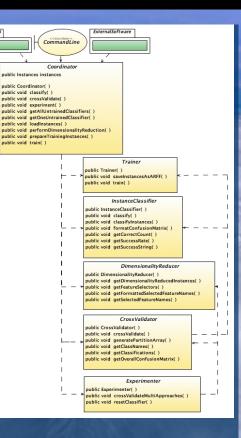


ACE 2.0 and future work



ACE 2.0

(Thompson et al. 2009) Architectural restructuring \rightarrow facilitate integration with other softwares **Redesigned cross-validation** \rightarrow Implemented in ACE rather using Weka \rightarrow More transparent processing ACE XML 2.0 Zip and Project files \rightarrow Combine the different ACE XML files Improved command-line interface Graphical User Interface \rightarrow viewing and editing ACE XML files



GUI ACE 2.0

(Thompson et al. 2009)

ACE File Help		
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V 🕒 Fusion		
Bossa Nova		Add New Sibling Category
 Jazz Soul Smooth Jazz 		
Ragtime		Add New Child Category
Swing		Delete Branch
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Blues

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26 features available, including 2 multi-dimensional features and 26 sequential features

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				 Display Feature Value Display Misc Info 				

3 classifications available, 3 feature values available

ACE

250 classifications available, 250 feature values available

Before You Accuse Me

Future Work on ACE

(*Thompson et al. 2009*)Fully functional GUI

Distributed work load

Expanding learning algorithms
HMM

Recurrent neural networks

Weka's unsupervised learning

Conclusion

- User-friendly and very complete framework
- Allows the user to test his/her own classifiers, data reduction techniques...
- Encourage experimentation in classification, in particular with classifier ensembles

Table 1. (McKay et al. 2005) ACE's classification success rate on ten UCI datasets using ten-fold cross-validation com-pared to a published baseline (Kotsiantis and Pintelas 2004).

Data Set	ACE's Selected Classifier	Kotsiantis Success Rate	ACE Success Rate
anneal	AdaBoost		99,6%
audiology	AdaBoost		85,0%
autos	AdaBoost	81,7%	86,3%
balance scale	Naïve Bayes		91,4%
diabetes	Naïve Bayes	76,6%	78,0%
ionosphere	AdaBoost	90,7%	94,3%
iris	FF Neural Net	95,6%	97,3%
labor	k-NN	93,4%	93,0%
vote	Decision Tree	96,2%	96,3%
Z00	Decision Tree		97,0%