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Modeling Affective State using Learning Vector Quantization

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Modeling Affective State using Learning Vector Quantization

Gert-Jan de Vries

Cover design The cover design was created by composition of the learning dynamics of 3 by 2 by 3 RSLVQ prototypes on a simulated dataset consisting of 3 classes, where two classes (orange and green) are represented each by a single Gaussian cluster and a third class (blue) by a mixture of two smaller Gaussian clusters. Overlaid are mannequin-shaped heatmaps that indicate the location at which people feel the following emotions within their body (pair-wise top,bottom): Happiness, Love (orange); Surprise, Envy (blue); Pride, Anger (green). The green representations were created by exchanging the red and green color channels. The six mannequins were taken from Nummenmaa et al. (2013) and printed with permission of Prof. Nummenmaa.



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Modeling Affective State using Learning Vector Quantization

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Inhoudsopgave

Acknowledgements	xii
Abbreviations and Symbols	xiii
1 GENERAL INTRODUCTION	1
1.1 Scope of this study	2
1.2 Outline	2
2 PROBLEM DEFINITIONS AND METHODS	5
2.1 Definition of Affect	5
2.2 Measuring Affect	7
2.2.1 Cardiac activity	8
2.2.2 Galvanic skin response	10
2.2.3 Respiratory activity	10
2.2.4 Facial expressions	12
2.2.5 Cognitive processes	12
2.3 Classifiers	12
2.3.1 Learning Vector Quantization	13
2.3.2 Class-conditional means	19
2.3.3 k-Nearest Neighbors	19
2.3.4 Artificial Neural Network	19
2.3.5 Support Vector Machine	20
3 LEARNING DYNAMICS OF LEARNING VECTOR QUANTIZATION	21
3.1 Introduction	21
3.2 Model	23
3.3 Algorithms	23

3.3.1	LVQ 2.1	24
3.3.2	LFM-W	25
3.3.3	GLVQ	25
3.3.4	RSLVQ	26
3.4	Analysis	27
3.5	A simple case: two prototypes, two clusters	30
3.5.1	LVQ 2.1	31
3.5.2	LFM-W	32
3.5.3	GLVQ	33
3.5.4	RSLVQ	35
3.6	Optimal window schedules	37
3.7	Three-prototype systems	39
3.8	Conclusion	41
3.A	Statistics of the projections	42
3.A.1	First order statistics	43
3.A.2	Second order statistics	43
3.B	Form of the Differential Equations	44
3.C	Gaussian Averages	48
3.C.1	Two prototypes	48
3.C.2	Three prototypes	51
3.D	Generalization error	53
4	EMOTION FROM A BODILY PERSPECTIVE	55
4.1	Introduction	55
4.2	Affect and Stress Classification	57
4.3	Method	60
4.3.1	Participants	60
4.3.2	Design and procedure	61
4.3.3	Measurements	67
4.3.4	Classification analysis	73
4.4	Results	74
4.5	Discussion	79
4.6	Conclusion	80
5	EMOTION FROM A FACIAL PERSPECTIVE	83
5.1	Introduction	83
5.2	Cohn-Kanade database	85
5.3	Methods	89
5.4	Results	91

Inhoudsopgave

5.5	Discussion	96
5.6	Conclusion	98
6	EMOTION FROM A COGNITIVE PERSPECTIVE	101
6.1	Introduction	101
6.2	Appraisal Theory	103
6.3	Emotion Classification	105
6.4	Method	106
6.4.1	Lab Experiment	106
6.4.2	Web experiment	110
6.4.3	Classification Techniques	111
6.4.4	Data analysis	111
6.5	Results	115
6.5.1	Component analysis	116
6.5.2	Classification	121
6.6	Discussion	123
6.7	Conclusion	128
7	APPLICATIONS	129
7.1	Introduction	129
7.2	Vitality Bracelet	129
7.3	Facial Expressions	134
7.4	Empathic Photo-Frame	136
7.4.1	Mapping to dimensional model	136
7.4.2	Desired state selection and playlist adaptation	138
7.4.3	Realtime adaptation and optimization	140
8	SUMMARY	145
8.1	Outlook	147
	Publications	149
	Samenvatting	153
	Bibliography	157

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Abbreviations and Symbols

Nomenclature

$\xi_\sigma \in \mathbb{R}^d, y_\sigma$	d -dimensional input sample indexed by σ , representing class y_σ
y	label of input sample
$\mathbf{w}_S \in \mathbb{R}^d, c_S$	d -dimensional prototype indexed by S , representing class c_S
d_S	Euclidian distance between a sample ξ and prototype \mathbf{w}_S
N_c	number of classes
ϵ_g	generalization error

Acronyms

Psycho-physiology

ANS	Autonomous Nervous System
BP	Blood Pressure
BVP	Blood Volume Pulse
CNS	Central Nervous System
CPM	Component Process Model
ECG	Electrocardiogram
EDA	Electrodermal Activity
EEG	Electroencephalogram
EMG	Electromyogram
fMRI	functional Magnetic Resonance Imaging

GSR	Galvanic Skin Response
HF	High Frequency
HRV	Heart Rate Variability
IBI	Inter-Beat Interval
LF	Low Frequency
MRI	Magnetic Resonance Imaging
PAD	Pleasure, Arousal, Dominance
PNN50	Proportion of Inter-Beat Intervals (IBIs) > 50 ms
PNS	Peripheral Nervous System
PPG	Photoplethysmography
PSNS	Parasympathetic Nervous System
RMSSD	Root Mean Square of Successive Differences
RSA	Respiratory Sinus Arrhythmia
RSP	Respiration
SA	sinoatrial
SC	Skin Conductance
SCL	Skin Conductance Level
SCR	Skin Conductance Response
SDNN	Standard Deviation of IBIs
SDSD	Standard Deviation of Successive Differences
SNS	Sympathetic Nervous System
ST	Skin Temperature
VAD	Valence, Arousal, Dominance
VHF	Very High Frequency
VLF	Very Low Frequency

Machine learning

ANFIS	Adaptive Neuro-Fuzzy Inference System
ANN	Artificial Neural Network
ANOVA	Analysis of Variance
ARMA	Autoregressive-Moving Average
AUC	Area Under the Curve
BLD	Best Linear Decision
BN	Bayesian Network
DT	Decision Tree
FDA	Fisher Discriminant Analysis
GLVQ	Generalized Learning Vector Quantization

GMLVQ	Generalized Matrix Learning Vector Quantization
GRLVQ	Generalized Relevance Learning Vector Quantization
HMM	Hidden Markov Model
KFDA	Kernel Fisher Discriminant Analysis
KLDA	Kernel Linear Discriminant Analysis
kNN	k-Nearest Neighbors
KPCA	Kernel Principal Component Analysis
LDA	Linear Discriminant Analysis
LFM	Learning From Mistakes
LFM-W	Learning From Mistakes with a window
LVQ	Learning Vector Quantization
MRSLVQ	Matrix Robust Soft Learning Vector Quantization
NBN	Naive Bayesian Network
NKFDA	Non-linear Kernel Fisher Discriminant Analysis
NLP	Natural Language Processing
ODE	Ordinary Differential Equations
PCA	Principal Component Analysis
PNN	Probabilistic Neural Network
QDC	Quadratic Discriminant Classifier
RBF	Radial Basis Function
RF	Random Forest
ROC	Receiver Operating Characteristic
RSLVQ	Robust Soft Learning Vector Quantization
RT	Regression Tree
SVC	Support Vector Classifier
SVM	Support Vector Machine
VQ	Vector Quantization

Image processing

AU	Action Unit
FACS	Facial Action Coding System
HLAC	Higher-order Local Autocorrelation
HLACLF	HLAC-like features
LBP	Local Binary Patterns
LDP	Local Directional Patterns
SIFT	Scale-Invariant Feature Transform

