ENHANCEMENT OF NEW SMOOTH SUPPORT VECTOR MACHINES FOR CLASSIFICATION PROBLEMS

SANTI WULAN PURNAMI

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the degree of Doctor of Philosophy in Computer Science.

Signature :

Name of Supervisor : PROF. DR. JASNI MOHAMAD ZAIN

Position : DEAN, FACULTY OF COMPUTER SYSTEM AND SOFTWARE ENGINEERING UNIVERSITI MALAYSIA PAHANG

Date : 21 JUNE 2011

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is concurrently submitted for award of other degree.

Signature :
Name : SANTI WULAN PURNAMI
ID Number : PCC 07001
Date : 21 JUNE 2011

PREAMBLE

Say: Though the ocean became ink for the words of my Lord, verily the sea would be used up before the words of my Lord were exhausted, even if we added another ocean like it, for its aid *(Al Qur'an, Al Kahfi 18:109)*

And if all the trees on the earth were pens and the ocean (were ink), with seven oceans behind it to add to its (supply), yet would not the words of Allah be exhausted (in the writing). For Allah is exalted in power, full of wisdom. *(Al Qur'an, Lukman 31:27)*

Behold! In the creation of the heavens and the earth, and the alternation of night and day, there are indeed signs for men of understanding. Men who celebrate the praises of Allah, standing, sitting and lying down on their sides, and contemplate the (wonders of) creation in the heavens and the earth, (with the thought): "Our lord! Not for naught hast thou created (all) this! Glory to thee! Give us salvation from the penalty of the fire *(Al Qur'an, Ali Imron 3:190-191)*

Is one who worships devoutly during the hours of the night prostrating himself or standing (in adoration), who takes heed of the hereafter, and who places his hope in the mercy of his Lord- (like one who does not)? Say: "Are those equal, those who know and those who do not know? It is those who are endued with understanding that receive admonition. *(Al Qur'an, Az Zumar 39:9)*

Dedicated to my parents and my family

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TABLE OF CONTENTS

CHAPTER 6 CONCLUSION

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

A	Data points
A_+	Class positive
A_-	Class negative
D	Diagonal matrix with +1 or -1 along its diagonal to specify the membership of each point.
w	Normal vector of the hyperplane
γ	Distance hyperplane to the origin
y	Slack variable
e	Column vector of one of arbitrary dimension
v	Regularization parameter of SVM
u_i	The dual variable corresponds to a training point A_i
μ	Parameter of RBF kernel
$(x)_+$	Plus function
$p(x,\alpha)$	Integral of sigmoid function
$\Phi_\alpha(w\ ,\gamma\ )$	Objective function of SSVM
$\nabla\Phi_\alpha(w\ ,\gamma\ )$	Gradient of objective function
$\nabla^2\Phi_\alpha(w\ ,\gamma\ )$	Hessian of objective function
d	Newton direction
λ	Armijo stepsize
$K(A, A')$	Full kernel matrix
$K(A, \bar{A}')$	Reduced kernel matrix
$\bar{A}$	Reduced set from A
T(x, k)	Three order spline function with parameter k

$m(x,k)$	Multiple knot spline function with parameter k
C	Classifier
$S_k(x)$	First derivative of $m(x,k)$
$d(x,y)$	Number of mismatches
$P(W,Q)$	Cost function
$d_2(x,y)$	The dissimilarity between two mixed type object X and Y

LIST OF ABBREVIATIONS

ANFIS	Adaptive neuro fuzzy inference system
ANNs	Artificial neural network
CRSVM	Clustering Reduced Support Vector Machine
CV	Cross validation
DAGSVM	Directed Acyclic Graph Support Vector Machine
DOE	Design of experiment
ERM	Empirical risk minimization
FN	False negative
FNA	Fine needle aspirate
FP	False positive
FPSSVM	Forth polynomial Smooth Support Vector Machine
GA-AWAIS	Genetic algorithm weighted artificial immune system
GRNN	General regression neural network
GSVM	Generalized Support Vector Machine
K	Kernel
LOO	Leave one out
LS-SVM	Least square Support Vector Machine
MCLP	Multiple criteria linear programming
MKS	Multiple knot spline
MKS-SSVM	Multiple knot spline Smooth Support Vector Machine
MLNN	Multilayer neural network
OAA	One against all
OAO	One against one

PCA	Principal Component Analysis
PNN	Probabilistic neural network
PSSVM	Polynomial Smooth Support Vector Machine
QP	Quadratic programming
QPSSVM	Quadratic polynomial Smooth Support Vector Machine
RBF	Radial basis function
RS-MCLP	Rough set multiple criteria linear programming
RSVM	Reduced Support Vector Machine
SMO	Sequential Minimal Optimization
SRM	Structural risk minimization
SSRSVM	Systematic Sampling Reduced Support Vector Machine
SSVM	Smooth Support Vector Machine
SVM	Support Vector Machine
TN	True negative
TP	True positive
TSSVM	Three order spline Smooth Support Vector Machine
UD	Uniform design
VC	Vapnik-Chervonenkis
WDBC	Wisconsin diagnostic breast cancer
WPBC	Wisconsin prognostic breast cancer