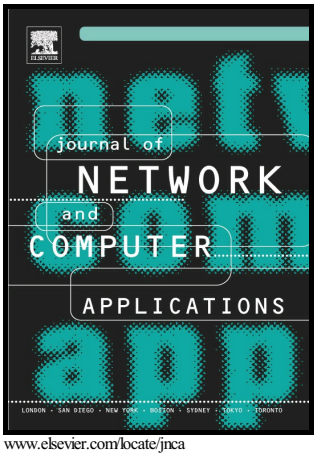
Failure Prediction by Relevance Vector Regression with Improved Quantum-inspired Gravitational Search

Jungang Lou, Yunliang Jiang, Qing Shen, Ruiqin Wang



www.elsevier.com/locate/jnca

PII: S1084-8045(17)30394-6
DOI: https://doi.org/10.1016/j.jnca.2017.11.013
Reference: YJNCA2016

To appear in: *Journal of Network and Computer Applications*

Received date: 31 May 2017
Revised date: 17 October 2017
Accepted date: 28 November 2017

Cite this article as: Jungang Lou, Yunliang Jiang, Qing Shen and Ruiqin Wang, Failure Prediction by Relevance Vector Regression with Improved Quantum-inspired Gravitational Search, *Journal of Network and Computer Applications,* https://doi.org/10.1016/j.jnca.2017.11.013

Failure Prediction by Relevance Vector Regression with Improved Quantum-inspired Gravitational Search☆

Jungang Lou[a,b], Yunliang Jiang*[a], Qing Shen[a], Ruiqin Wang[a]

[a] *Department of Computer Science, Huzhou University, 313000 Huzhou, China*
[b] *State Key Laboratory of Industrial Control and Technology, Zhejiang University, 310027 Hangzhou, China*

Abstract

Modern data centers coordinate hundreds of thousands of heterogeneous tasks aiming at providing highly reliable cloud computing services. Failure prediction is of vital importance in the analysis of cloud reliability. Recently, a novel kernel learning method called relevance vector machine (RVM) has been widely applied to solve nonlinear predicting problems and has been verified to perform well in many situations. However, it remains a great challenge for existing approaches to acquire the optimal RVM parameters. In this research, an artificial immune system is introduced into a Quantum-inspired Binary Gravitational Search Algorithm (QBGSA) in order to improve the convergence rate of standard QBGSA. In addition, a hybrid model of RVM with improved QBGSA called IQBGSA-RVM is proposed that aims to predict the failure time of cloud services. To evaluate the effectiveness of IQBGSA-RVM in failure prediction, its predicting performance is compared with that of the following algorithms, all of which employs RVM: chaotic genetic algorithms, binary gravitational search algorithms, binary particle swarm optimization, quantum-inspired binary particle swarm optimization and standard QBGSA. The experimental results show that the IQBGSA-RVM model is either comparable to the other models or it outperforms them, to say the least.

1. Introduction

With the rapid development of cloud computing technologies, an increasing number of companies have been deploying services and applications in the cloud computing environment. In today 's public cloud computing systems, reliability is provided as a fixed service parameter. New cloud computing systems of increasing complexity are being continuously developed. In response, an increasing amount of research is focused on the failure behavior of these types of systems. The ability to accurately predict and thus evaluate the reliability of cloud computing systems is extremely important to users [1-3]. Cloud computing reliability, which is similar to software reliability, is determined by

Email addresses: loujungang0210@hotmail.com (Jungang Lou), jyl@zjhu.edu.cn (Yunliang Jiang*), sq@zjhu.edu.cn (Qing Shen), angelwrq@163.com (Ruiqin Wang)