REGULAR PAPER

A compact multi-resolution index for variable length queries in time series databases

Srividya Kadiyala · Nematollaah Shiri

Abstract   We study the problem of searching similar patterns in time series data for variable length queries. Recently, a multi-resolution indexing technique (MRI) was proposed in (Kahveci and Singh, in proceedings of the international conference on data engineering, pp. 273–282, 2001; Kahveci and Singh, IEEE Trans Knowl Data Eng 16(4):418–433, 2004) to address this problem, which uses compression as an additional step to reduce the index size. In this paper, we propose an alternative technique, called compact MRI (CMRI), which uses adaptive piecewise constant approximation (APCA) representation as dimensionality reduction technique, and which occupies much less space without requiring compression. We implemented both MRI and CMRI, and conducted extensive experiments to evaluate and compare their performance on real stock data as well as synthetic. Our results indicate that CMRI provides a much better precision ranging from 0.75 to 0.89 on real data, and from 0.80 to 0.95 on synthetic data, while for MRI, these ranges are from 0.16 to 0.34, and from 0.03 to 0.65, respectively. Compared to sequential scan, we found that CMRI is 4–30 times faster and the number of disk I/Os it required is close to minimal. In terms of storage utilization, CMRI occupies 1% of the memory occupied by MRI. These results and analysis show CMRI to be an efficient and scalable indexing technique for large time series databases.

Keywords   Time series · Multi-resolution index · Variable length queries · Similarity search · Query optimization · Performance · Dimensionality reduction · R-trees

1 Introduction

A time series is a large sequence of real numbers, in which each term represents a value, at a particular time, of some attribute such as price, temperature, etc. The popularity of time

S. Kadiyala · N. Shiri (✉)
Department of Computer Science and Software Engineering,
Concordia University, Montreal, QC, Canada
e-mail: shiri@cse.concordia.ca

S. Kadiyala
e-mail: kadiyalasvidya@yahoo.com; s_kadiya@cse.concordia.ca