Major Collaborative Research Initiative

The Indian Ocean World: The Making of the First Global Economy in the Context of Human-Environment Interaction

Student Workshop

3 April 2013

Synchromedia Lab

Carl Hughes, McGill University

Geovisualization of Historical Data: The Indian Ocean World Mapping Tool

Utilizing tools from the geospatial web, historical databases can be mapped in an interactive and dynamic way that is useful to international researchers, students and the interested public. Geovisualization of the MCRI project can be hugely beneficial, practical, educational and accessible as an academic resource. This application allows for the user to specify what type of data will be visualized based on historical periods, geographical regions and research themes. A complete description of each event is clickable from within the map providing statistics, information on the people and groups involved or nature of the event, additional comments and data sources.

Jin Xing, McGill University

The Use of Databases and Bayesian Belief Networks to Study the Indian Ocean World

By combining the use of Bayesian Networks with geospatial principles one can analyze historical data from the Indian Ocean world. The objective is to model the relationship between climate change (mainly long periods of drought with consequent crop failures and associated disease) and economic change. Of particular interest is the comparison of historical data from three major periods hypothesized to be times of global economic upturn (200 BCE to 200 CE; 800-1300 CE; and 1800-1900) with periods of economic stagnation in between. In this study, geospatial principles are used to aggregate and clean the raw data used to train the Bayesian Networks. Bayesian Networks are used to model and visualize the complex relationships between migration, exchange, disease and natural disasters. This research shows the utility of using advanced machine learning, statistical tools, and geospatial principles for historical and archival data analysis.

Lukáš Tencer and Marta Režnáková, Synchromedia Lab

ICRA: An Intelligent Platform for Collaboration, Retrieval and Interaction

The ability to collaborate is essential to any team-based initiative. The internet has the ability to support group work, but it will only really enhance research collaboration if it meets all the collaborative needs of the project. With this in mind, Synchromedia Lab has created a platform, ICRA, that supports the collaborative and interactive needs of research teams. This presentation will elucidate the complex solutions ICRA offers and highlight its three main components, which are categorized by functionality into collaboration, retrieval and interaction.

Collaboration: The ICRA platform for collaborative sharing and manipulation of documents

An overview of the functionality and architecture of the platform, which includes the incorporation of multimedia data streams (such as video and audio) into a collaborative environment and the synchronized manipulation of user-uploaded documents, will be given. It will highlight parts of the architecture, such as streaming, object sharing and the object-role management system.

Retrieval: Emerging techniques of document retrieval

This section will focus on sketch-based document retrieval systems, word spotting systems and photo-based document retrieval systems. The main aspects of building a retrieval system will be examined, such as the feature descriptor and similarity measures; learning and indexing of data; and the retrieval/inference process. An in-depth discussion about the different techniques for improving retrieval systems using advanced machine learning techniques, such as graph transduction for neighbourhood-based similarity or learning of codebooks, will also be covered.

Interaction: Gesture-based interaction

The problem of incremental online learning will be introduced. This problem is highly challenging mostly because of the absence of prior data before the process of learning. After formulating the challenges, the presenters will focus on their solution, which includes advanced machine learning techniques specially adapted for incremental learning, specifically these are TS-Fuzzy classifiers and ART2A (adaptive resonance theory) neural networks.

Adolf Guoqiang Zhong, Synchromedia Lab

Adaptive Error-Correcting Output Codes

Error-Correcting Output Codes (ECOC) is a successful technique to combine a set of binary classifiers for multi-class learning problems. However, in the traditional ECOC framework, all the base classifiers (or called dichotomizers) are trained independently according to the defined ECOC matrix. In this paper, we present a novel and efficient model for the ECOC design, where the binary classifiers are learned in a common subspace of the data. To deal with complex data, we also present the kernel extension of our model. Our model can be considered as a method that optimizes the representation of data as well as the classifiers simultaneously. More importantly, it builds a bridge between the ECOC framework and multi-task learning for the multi-class learning problems. Our empirical study on 14 data sets from UCI machine learning repository and the USPS handwritten digits recognition application demonstrates the effectiveness and efficiency of our model.