It's getting Cloudy

Farah Kandah, Joseph M. Kizza, Yu Liang

Computer Science and Engineering Department
University of Tennessee at Chattanooga
Chattanooga, Tennessee

Abstract

In the emerging world of technology, the term cloud computing has transformed the way users manage, process, distribute, and store data. Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, and applications) that can be quickly provisioned and released with minimal management efforts or service provider interactions. In these two pages, we propose ways in which CloudLab can help our research efforts and also advance our teaching efforts by utilizing CloudLab resources that are not currently available in our labs.

Our Research:

Our current research efforts that will benefit from the use of CloudLab are in four areas:

(1) A Secure Cost-effective Multi-Cloud Storage in the Cloud:

In this work, we focused on the user's concerns of storing his/her data in the cloud through three critical issues: confidentiality, integrity, and privacy preservation. To stand against the external attacks, internal attacks, and cloud service provider negligence we proposed the data localization scheme which aims to provide a user with high level of control over his/her stored data in the cloud while maintaining a well developed security in place. In the future, we intend to implement and broaden our data localization scheme to stand against other attacks that could harm the users' data stored in the cloud.

(2) Zero Knowledge-based Trust Propagation in Airborne Networks Using Matrix Factorization:

Zero Knowledge Protocol is a popular method to build trust relationship between pair entities without revealing secrecy and privacy from provers to verifiers. But it needs several rounds and long time to finish the trust-building process, which makes it hard to be applied and suitable for both P2P networks and Airborne Networks. In this study we are exploring new ways that combine the superiority of Zero Knowledge and goodness of matrix factorization to probe the characteristics of entity authentication via trust propagation. Any entity seeking access to airborne cluster resources must be authenticated by a majority of not all cluster entities. The authentication process is done within a narrow time band constraint because the outside entity, seeking authentication, is flying passed the cluster at high speed. Trust relationships scores are generated from a trust score derived from a Zero Knowledge authentication process by the cluster leader, the residual trust scores of every cluster entity and the distrust possessed by every cluster entity of each other. The trust scores generated by repeated trust computation passed from cluster entity to cluster entity to eventually cover all cluster entities is modeled by node-node trust matrix factorization modal-based algorithm, which predicts the final trust score. This trust prediction algorithm takes full and effective advantage of the history trust scores offered to and got from other nodes that have been built.

(3) Ultimate Control and Security over Data Localization in the Cloud:

The end of this decade will be marked by a paradigm shift of the industrial information technology towards a pay-per-use service business model known as cloud computing. Huge amounts of data being retrieved from geographically distributed data sources, and non-localized data-handling requirements, creates such a change in technological as well as business model. Along with these unprecedented advantages, cloud data storage also redefines the security issues targeted on customer's outsourced data (data that does not stored/retrieved from the costumers own servers). Since cloud service providers are separate market entities, data integrity and privacy are the most critical issues that need to be addressed in cloud computing. In this work we observed that, from a customer's point of view, relying upon a solo service provide for his outsourced data is not very promising. In addition, if the data is distributed among the available service providers in such a way that no less than a threshold number of service providers can take part in successful retrieval of meaningful data, this might provide better privacy as well as ensure data availability with a little more cost paid. In this work, we propose an economical distribution of data among the available service providers in the market, to provide customers with data availability as well as secure storage.

(4) The Spread of Epidemic Diseases and Its Implementation on a Cloud Computing Platform:

Mathematical models can be used to explore the transmission mechanism of epidemic diseases so that we can obtain insight into potential costs, benefits, and the effectiveness of prevention and control strategies. In this project, a multi-layered mathematical model about the spread of epidemic diseases is presented and its corresponding implementation on cloud computing platform is investigated as well. The referred model formulates epidemic transmission in three layers: inter-airport, inter-community, and intra-community. Each layer has featured with heterogeneous transmission mechanism and sub-population. The inter-airport layer indicates epidemic transmission through airline, the inter-community layer indicates epidemic transmission through ground transportation systems (i.e., road, highway, etc.), and the intra-community layer indicates epidemic propagation caused by individual contact within community. In this work, the inter-airport epidemic transmission will be formulated using hidden Markov method (HMM), the inter-community epidemic transmission will be formulated using time- and space-dependent partial differential equations, which is derived from distribution theory. Within a relatively insulated society, intra-community epidemic transmission will be formulated using a stochastic agent-based model, which is formulated using susceptible-infected-recovered (SIR) model, social network theory, and big-data analytics.

Our Teaching:

The Computer Science and Engineering Department at the University of Tennessee at Chattanooga (UTC) has been, over the years, developing courses to keep abreast of the latest technological development and trends. This effort to bring to the classroom new technologies helps our students to be familiar with the cutting edge technologies and acquire in-demand skills before they enter the workforce. Among the new courses, most fitting for CloudLab benefit, are CPSC 4910/5910: Big Data Analytics, CPSC 4240: Introduction to Data Analytics, CPSC 4620/5620: Computer Network Security, CPSC 4130/5130: Introduction to Could Computing. These courses are offered for both graduate and undergraduate students. With access to CloudLab, students in these courses, will no doubt greatly benefit from the many new technologies and processes in the CloudLab. We believe that the availability of CloudLab to our students will benefit not only students in these classes, but the UTC Computer Science and Engineering Department.