

ECE 8903 “Special Topics”

Spring 2022

Capacity limit: 6 students

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Deadline to apply to Dr. Luo: Wed Jan 12, 2022 by email

Accepted students will need to submit Special Problems documentation via <https://www.ece.gatech.edu/coursework-planning>.

Once they are issued the permit to register for the course, they will need to register by Fri Jan 14, 2022, 16:00 ET.

Select 1 topic from the following three. Depending on applicant’s background, students will be grouped into at least 2 person per topic.

Topic 1. General Problem Solving and Optimization Techniques with Python-Tensorflow

Many real world problems require complex ways to model and solve, while most of them eventually are intractable and rely on certain approximation in order to obtain any practical solutions. Recent advances in machine learning have opened the door for both modeling and solutioning techniques, while open source frameworks (such as Tensorflow) have been created and leveraged to provide progressive solutions.

This special topic will require students to

- a. Learn and quickly master Tensorflow;
- b. Learn how to use Tensorflow and other related tools to model real-world problems in telecom and financial industries;
- c. Learn and adapt certain algorithms to extend the power of Tensorflow: particularly, some prediction, optimization and stochastic modeling (Hidden Markov Chain, etc.);
- d. Prepare a set of documents (PowerPoint presentation, research paper) to summarize the learning, experimental models and algorithms, test results, conclusions, etc.

Weekly meetings will be scheduled to review the learning process, discuss issues, and find solutions.

Topic 2. Cloud Resource Management

Cloud computing is an essential part of enterprise technology that delivers ICT applications to end users with ease and efficiency. The 5G communication system has been commercialized in 2020. It can provide high speed, low latency and more flexible communication to the network service organization. Therefore, substantial shifts are bound to occur in designing, operating and distributing cloud computing resources.

Research indicated that machine type communication will increase dramatically in the next few years. Network providers that ought to consider delivering resources to clients from different domains securely efficiently and transmit short-packet data. So, instead of exclusively selling server equivalent virtual machines for relatively long periods of time, network companies provide individual resources by bundles of resources packaged (such as CPU, memory, and I/O resources) that is equivalent virtual machines for a shorter time period. This mode refers to resource-as-a-service (RaaS).

The RaaS cloud requires new mechanisms for allocating, distributing CPU, memory and I/O resources in insecure channel communication. It should also allow the resource balancer that differentiate service levels across entire cloud data centers.

Furthermore, the RaaS cloud should not only be constrained for single use scenario, it is able to accommodate various and more extreme situations, e.g. smart grids, and wireless industrial control.

The survey will start by briefly reviewing various research papers and industry publications in the past few years on the cloud computing as a service, SDN, virtualization and network resources management techniques. Then we will select most representative 50-100 papers for further review and analysis.

However, we will give priority to the RaaS Services in cloud computing field, we may summarize the matrix and Quality of Services (QoS) on evaluating the goods of mechanism of RaaS.

We may also categorize the matrix on evaluating the performance of scheduling, algorithms that proposed in the papers. It may be classified as the latency, power consumption, throughput, etc. Numerical analysis and simulation may be taken to

validate and test the performance of the proposed algorithms, protocols as well.

The survey is expected to conduct a comprehensive overview of numbers of resource management algorithms, protocols of RaaS that is highly demand in the industries. It will summarize the most uniform methods that can be implemented in various use case and investigate flexible methods that can be easily modified to provide more robust services. Furthermore, it is expected to summarize the existing trends and the gaps between the current research and industry needs and outline the promising techniques that researchers can have further investigation.

Topic 3. Recent advances in congestion and flow control in computer networks

The Internet has been evolved with new technologies for both fixed and mobile networks and devices that could match and take advantage of the capabilities of modern networks, with significant advances in terms of performance, ever-increasing data rates, reliability, and the ubiquity. This survey will focus on the main novelties related to transport protocols that have been recently (last 5+ years) proposed, identifying the main issues and research trends; the evolution of congestion and flow control algorithms, to target optimal performance in challenging scenarios, especially with the application of machine learning techniques; and the related newer proposals/protocols that have been developed correspondingly.

The survey will start by briefly reviewing various research/survey papers and industry publications (between 50 to 100 publications) in the past 5+ years on the congestion and flow control techniques.

We will categorize those approaches on the specific type of problems, models and assumptions, performance, applicability and adaptability, typical application scenarios, data and algorithms, etc. Numerical analysis and simulation may be taken to validate and test the performance of the proposed algorithms, protocols as well.

Weekly meetings and presentations will be scheduled. At the minimum, a PowerPoint presentation will be created based on the survey and preferably a publishable survey paper is desired as the outcome.