Middle East Technical University
Electrical and Electronics Engineering Department

Announcement to Graduate and Undergraduate Students
Research Opportunities Available

My name is Ahmed Hareedy, and I will start as an Assistant Professor with the Electrical and Electronics Engineering (EEE) Department at Middle East Technical University (METU) this spring. I am interested in questions in coding/information theory that are fundamental to opportunities created by the current, unparalleled access to data and computing. I received the Bachelor and M.S. degrees in Electronics and Communications Engineering from Cairo University in 2006 and 2011, respectively. I received the Ph.D. degree in Electrical and Computer Engineering from the University of California, Los Angeles (UCLA) in 2018. I worked with Mentor Graphics Corporation between 2006 and 2014. I worked with Intel Corporation in the summers of 2015 and 2017. I won the 2018-2019 Distinguished Ph.D. Dissertation Award in Signals and Systems from the Electrical and Computer Engineering Department at UCLA. I am a recipient of the Best Paper Award from the 2015 IEEE Global Communications Conference (GLOBECOM). I won the 2017-2018 Dissertation Year Fellowship (DYF) at UCLA. I won the 2016-2017 Electrical Engineering Henry Samueli Excellence in Teaching Award at UCLA. I am a recipient of the Memorable Paper Award from the 2018 Non-Volatile Memories Workshop (NVMW). I am a recipient of the 2018-2019 Best Student Paper Award from the IEEE Data Storage Technical Committee (DSTC).

We are living in the age of big data, and modern applications, such as Internet of Things (IoT) applications, access, process, and store ever-increasing amounts of data. In order to perform data storage and computing reliably, effective coding techniques are desperately needed. Coding, in brief, can be understood as a different representation, with redundancy, of the original data at the transmitting (writing) end such that errors can be either prevented or corrected at the receiving (reading) end. In addition to high reliability, there are other desirable properties in modern applications, such as low-latency. Consequently, developing a coding technique is a process that highly depends on the application of interest and its requirements.

The available research opportunities are focused on developing novel coding and signal processing techniques for modern and next generation storage and computing systems, addressing their requirements and exploiting their underlying properties. I will do that starting from the level of storage and computing devices, going through servers encompassing many devices, and up to the level of the cloud network itself. Here are the two research directions encompassing the available opportunities:

A- Coding to extend the lifetime and density of data storage devices: Coding is essential in storage devices to fortify data. Constrained codes prevent errors from occurring, while error-correction codes correct the errors that remain in the system. I have designed many classes of constrained and error-correction codes that result in remarkable lifetime and density gains in modern solid-state and magnetic storage devices, e.g., Flash memories and hard-disk drives, respectively. I want to develop coding techniques for next generation multi-dimensional and resistive storage devices as well. I also want to optimize the combination of constrained and error-correction codes to guarantee high reliability while meeting other system requirements. Moreover, I want to develop signal processing solutions for the promising in-memory computing framework.

B- Combining machine learning and coding in modern devices: I am interested in ways for machine learning and coding to help each other. Machine learning can help coding through breaking the barrier of channel modeling. Transmission channels underlying modern and next generation storage devices are very hard to model mathematically. Instead, I want to use machine learning to direct the reconfiguration of the constrained code and to guide the design of the error-correction code in order to increase the lifetime of such devices. Distributed machine learning promises lower latency, higher accuracy, and better scaling with datasets. Coding can help machine learning through speeding up its distributed computing. One novel framework to speed up processing is computational storage, in which distributed computing units are brought next to data storage units for devices at the network edge. I want to develop coding solutions that enable low latency computational storage without compromising the reliability.

Other research directions I am interested in include coding and signal processing schemes for cloud storage/computing, DNA data storage, and quantum computing systems. All of these research directions involve collaborators at top U.S. universities such as UCLA, the University of California, San Diego (UCSD), and Duke University. Other potential collaborators are at top Turkish and Egyptian universities in addition to companies such as Intel Corporation. The collaborators in these projects are some of the well-recognized and celebrated scholars in their respective fields.

There will be opportunities for academic internships at UCLA, UCSD, or Duke in addition to potential industry internships at Intel. Depending on the performance, this work can also open the door to undergraduate and particularly master students to go to one of these top U.S. universities for Ph.D. or joint Ph.D. with METU. Potential financial support (at least TA support for graduate students) will also be available. If you are interested in working with me, please email me at ahareedy@ucla.edu (until my METU email is set up), attaching your detailed CV with GPA and previous research activities (if any).

Sincerely,
Ahmed Hareedy