The demand for massive amounts of high-performance storage has driven the continuous scaling of fast non-volatile memory technologies. It has now become very challenging to continue the density scaling without significant compromises to performance. Therefore, there is great need to develop new schemes that will guarantee high density storage simultaneously with high performance.

An essential part of these schemes is coding, which optimizes the representation of data within the storage device to the performance requirements of the hosting systems. The strength of coding is that it can provide flexible and guaranteed performance parameters, and often show optimality of these parameters given the storage efficiency.

A few very promising coding techniques have emerged as having potential to improve real-world performance of non-volatile storage. The course will concentrate on these key research areas, in addition to techniques that are in a more preliminary stage of research.

Specific topics:
1) Re-write codes, WOM codes
2) Rank modulation and data representation with permutations
3) Error-correcting codes
4) Constrained codes
5) Memristor crossbar codes
6) Emerging performance-boosting codes
The course will combine lectures by the instructors with independent reading in a seminar format. The students will read important papers in the field, will reason about the results in a critical way, and will present them in class along with their own ideas for extending the results.

The course combines techniques from the fields of coding theory, information theory, combinatorial optimization, linear and abstract algebra, and algorithms. The recommended pre-requisite is at least one of the courses listed below:

236309 Introduction to Coding Theory
046205 Introduction to Coding Theory in Communication
236315 Algebraic Methods in Computer Science
046733 Information Theory
236520 Coding for Storage Systems
048934 Coded Communications

The course will survey recent literature with the state-of-the-art coding solutions. Articles representing the coding models and techniques are included below.

At the conclusion of the course, the student will be familiar with a variety of techniques for coding in non-volatile memories, and will understand the theoretical foundations driving these techniques. In addition to a breadth of techniques, the student will conduct deep independent work in at least two of the course topics. This work will include critical reading of articles, exploring directions for continued research, and presenting a lecture in class.
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The recommended pre-requisite is at least one of the courses listed below:

- Introduction to Coding Theory 236309
- Introduction to Coding Theory in Communication 046205
- Algebraic Methods in Computer Science 236315
- Information Theory 046733
- Coding for Storage Systems 236520
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