Pries: 467 Abstract Algebra II, Spring 2013
Information about project reports and presentations.

The project presentations and reports are an opportunity to learn something new in greater depth. They provide a good way to develop skills at speaking and writing mathematics. In addition, they will give us a chance to have an overview of many interesting topics in abstract algebra that we wouldn't see otherwise.

Deadline: 3/27 Hand in first two choices for topic

Presentations: 20 minutes long per person, during last two weeks of class.
Delivery method: dotcam, computer, or blackboard.
Make sure to practice - especially if you're using the blackboard.
Written report: 10 pages, due 5/13 at 10 am.

Things to include:

1. What: topic title, definitions needed for topic.
2. Where/When/Why: motivation for studying topic, history of topic, applications of topic.
3. **** Facts: important properties and theorems about topic.
4. *** Examples: by hand or using computer.
5. ** Visual: graph, data, picture.
6. Proofs or code (especially for written report).
7. References: (only for written report).

Possible topics The topic of your project should be connected to one of the central themes of this class: information theory or coding theory. LA=linear algebra, CS=computer science, NT=number theory, P=probability. R= Roman introduction to coding and information theory. R*=Roman coding and information theory.

Information theory topics

1. Huffman encoding: why it is the most efficient, implementation (CS) R2.3.
2. * Extensions of an information source and minimum average code length R3.3, R3.4.
3. Entropy of infinite probability distributions (P) R*1.3
4. Bernouilli trials and typical sequences (P) R*1.3.
5. ** Conditional entropy, mutual information, and channel capacity (P) R*3.1, R*3.2.
6. **** Noisy coding theorem R*3.3, R*3.4.

Topics about error-correcting codes

1. Encoding and decoding, Mixed error detection and error correction R4.4, R*4.2.
2. Extending, shortening, and direct sums of codes. Equivalent codes (LA) R4.6, R5.6.
3. **** Standard arrays: Efficient algorithms for finding the minimal distance, probability of correct decoding (CS) R5.3.
4. ** Burst errors R5.3.
5. ** Dual of a linear code, self-dual codes, simplex codes (LA) R5.4, R6.1.
6. * Parity check matrices: efficient computation of minimum distance and syndrome decoding, (LA,CS) R5.4, R5.5

Topics about bounds

1. * More on $A_r(n, d)$, the maximum number of codewords in a code of length n and minimum distance d. R*4.5
2. * Gilbert-Varshamov bound R5.4, Johnson bound and Elias bound R*4.5.
3. **** Weight distributions R*5.2 (uses characters) and linear programming bound.
4. Asymptotic bounds R*4.5.

Special kinds of codes

1. * Perfect codes and Golay codes R6.1
2. ** Cyclic codes (NT) R7.1, automorphism group of a code
3. ** BCH codes R6.3 R*4.3
4. * Projective plane codes, Fano plane, quadratic residue codes R*4.3, Latin squares R6.4
5. **** Goppa codes R*4.3.
6. Hadamard codes and Hadamard matrices R*4.5
7. * Maximum distance separable codes.