Coding Theory Lecture Notes

Nathan Kaplan and members of the tutorial

September 7, 2011

These are the notes for the 2011 Summer Tutorial on Coding Theory. I have not gone through and given citations or references for all of the results given here, but the presentation relies heavily on two sources, van Lint's Introduction to Coding Theory and the book of Huffman and Pless Fundamentals of Error-Correcting Codes. I also used course notes written by Sebastian Pancratz from a Part II course given at Cambridge on Coding Theory and Cryptography given by Professor Tom Fisher, and my own course notes from a Cambridge Part III Advanced Combinatorics course given by Professor Tim Gowers. I also benefited from notes from Henry Cohn's MIT course, Applied Math for the Pure Mathematician. The last section of the notes is based on Nigel Boston's survey article, "Graph Based Codes".

All mistakes in these notes are my fault.

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Scott C. Dulebohn

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High-Dimensional Probability Roman Vershynin,2018-09-27 An integrated package of powerful probabilistic tools and key applications in modern mathematical data science **Recent Developments in the Inverse Galois Problem** Jointsummerresearchconf Onrecentdevel Intheinverse,1995-07-30 This book contains the refereed proceedings of the AMS IMS SIAM Joint Summer Research Conference on Recent Developments in the Inverse Galois Problem held in July 1993 at the University of Washington Seattle A new review of Serre s Topics in Galois Theory serves as a starting point The book describes the latest research on explicit presentation of the absolute Galois group of the rationals Containing the first appearance of generalizations of modular curves the book presents applications that demonstrate the full scope of the Inverse Galois Problem In particular the papers collected here show the ubiquity of the applications of the Inverse Galois Problem and its compelling significance The book will serve as a guide to progress on the Inverse Galois Problem and as an aid in using this work in other areas of mathematics This includes coding theory and other finite field applications Group theory and a first course in algebraic curves are sufficient for understanding many papers in the volume Graduate students will find this an excellent reference to current research as it contains a list of problems appropriate for thesis material in arithmetic geometry algebraic number theory and group theory *Coding Theory* Kit Tyabandha,2007-01-17 This book was written from the material I prepared for my teaching of a course Coding Theory at the Mathematics Department Mahidol University Thailand in the second term from end 2005 until early 2006 when I used to be a lecturer there **Coding Theory And Cryptology** Harald Niederreiter,2002-12-03 The inaugural research program of the Institute for Mathematical Sciences at the National University of Singapore took place from July to December 2001 and was devoted to coding theory and cryptology As part of the program tutorials for graduate students and junior researchers were given by world renowned scholars These tutorials covered fundamental aspects of coding theory and cryptology and were designed to prepare for original research in these areas The present volume collects the expanded lecture notes of these tutorials The topics range from mathematical areas such as computational number theory exponential sums and algebraic function fields through coding theory subjects such as extremal problems quantum error correcting codes and algebraic geometry codes to cryptologic subjects such as stream ciphers public key infrastructures key management authentication schemes and distributed system security Information Theoretic Learning Jose C. Principe,2010-04-06 This book is the first cohesive treatment of ITL algorithms to adapt linear or nonlinear learning machines both in supervised and unsupervised paradigms It compares the performance of ITL algorithms with the second order counterparts in many applications **Computational Optimization** Jong-Shi Pang,2012-12-06 Computational Optimization A Tribute to Olvi Mangasarian serves as an excellent reference providing insight into some of the most challenging research issues in the field This collection of papers covers a wide spectrum of computational optimization topics representing a blend of familiar nonlinear programming topics and such novel paradigms as semidefinite programming and complementarity constrained nonlinear programs Many new results are presented in these papers which are bound to inspire further research and generate new avenues for applications An informal categorization of the papers includes Algorithmic advances for special classes of constrained optimization problems Analysis of linear and nonlinear programs Algorithmic advances B stationary points of mathematical programs with equilibrium constraints Applications of optimization Some mathematical topics Systems of nonlinear equations

Mathematical Reviews ,2003 **Data Science and Analytics with Python** Jesus Rogel-Salazar,2018-02-05 Data Science and Analytics with Python is designed for practitioners in data science and data analytics in both academic and business environments The aim is to present the reader with the main concepts used in data science using tools developed in Python such as SciKit learn Pandas Numpy and others The use of Python is of particular interest given its recent popularity in the data science community The book can be used by seasoned programmers and newcomers alike The book is organized in a way that individual chapters are sufficiently independent from each other so that the reader is comfortable using the contents as a reference The book discusses what data science and analytics are from the point of view of the process and results obtained Important features of Python are also covered including a Python primer The basic elements of machine learning pattern recognition and artificial intelligence that underpin the algorithms and implementations used in the rest of the book also appear in the first part of the book Regression analysis using Python clustering techniques and classification algorithms are covered in the second part of the book Hierarchical clustering decision trees and ensemble techniques are also explored along with dimensionality reduction techniques and recommendation systems The support vector machine algorithm and the Kernel trick are discussed in the last part of the book About the Author Dr Jes s Rogel Salazar is a Lead Data scientist with experience in the field working for companies such as AKQA IBM Data Science Studio Dow Jones and others He is a visiting researcher at the Department of Physics at Imperial College London UK and a member of the School of Physics Astronomy and Mathematics at the University of Hertfordshire UK He obtained his doctorate in physics at Imperial College London for work on quantum atom optics and ultra cold matter He has held a position as senior lecturer in mathematics as well as a consultant in the financial industry since 2006 He is the author of the book Essential Matlab and Octave also published by CRC Press His interests include mathematical modelling data science and optimization in a wide range of applications including optics quantum mechanics data journalism and finance *Coding Theory* Jacobus H. van Lint,2013-12-11 **Introduction To Algebraic Coding Theory** Tzuong-tsieng Moh,2022-02-18 We live in the age of technology where messages are transmitted in sequences of 0 s and 1 s through space It is possible to make an error with noisy channels so self correcting codes become vital to eradicate all errors as the number of errors is small These self correcting codes are widely used in the industry for a variety of applications including e mail telephone remote sensing e g photographs of Mars amongst others We will present some essentials of the theory in this book Using linear algebra we have the salient Hamming codes The next level of coding theory is through the usage of ring theory especially polynomials rational functions and power series to produce BCH codes Reed Solomon codes and the classical Goppa codes Then we progress to the geometric Goppa code using Algebraic Geometry **University of California Union Catalog of Monographs Cataloged by the Nine Campuses from 1963 Through 1967: Authors & titles** University of California (System). Institute of Library Research,University of California, Berkeley,1972 **Introduction to Coding Theory and Algebraic Geometry** J. van Lint,G. van der Geer,2012-12-06 These notes are based on lectures given in the semmar on Coding Theory and Algebraic Geometry held at Schloss Mickeln Diisseldorf November 16 21 1987 In 1982 Tsfasman Vladut and Zink using algebraic geometry and ideas of Goppa constructed a seqeunce of codes that exceed the Gilbert Varshamov bound The result was considered sensational Furthermore it was surprising to see these unrelated areas of mathematics collaborating The aim of this course is to give an introduction to coding theory and to sketch the ideas of algebraic geometry that led to the new result Finally a number of applications of these methods of algebraic geometry to coding theory are given Since this is a new area there are presently no references where one can find a more extensive treatment of all the material However both for algebraic geometry and for coding theory excellent textbooks are available The combination ofthe two subjects can only be found in a number ofsurvey papers A book by C Moreno with a complete treatment of this area is in preparation We hope that these notes will stimulate further research and collaboration of algebraic geometers and coding theorists G van der Geer J H van Lint Introduction to CodingTheory and Algebraic Geometry PartI CodingTheory Jacobus H vanLint 11 1 Finite fields In this chapter we collect without proof the facts from the theory of finite fields that we shall need in this course **Graph Theory, Coding Theory, and Block Designs** Peter Jephson Cameron,Jacobus Hendricus van Lint,1975 These are notes deriving from lecture courses given by the authors in 1973 at Westfield College London The lectures described the connection between the theory of t designs on the one hand and graph theory on the other A feature of this book is the discussion of then recent construction of t designs from codes Topics from a wide range of finite combinatorics are covered and the book will interest all scholars of combinatorial theory Computers, Control & Information Theory ,1983

Different Aspects of Coding Theory Robert Calderbank,1995 The symposia in applied mathematics have been held under the auspices of the American Mathematical Society and others since 1967 This books connects coding theory with actual applications in consumer electronics and with other areas of mathematics It covers in detail the mathematical foundations of digital data storage and makes connections to symbolic dynamics linear systems and finite automata It also explores the use of algebraic geometry within coding theory and examines links with finite geometry statistics and theoretical computer science **Coding Theory** San Ling,Chaoping Xing,2004-02-12 Coding theory is concerned with successfully transmitting data through a noisy channel and correcting errors in corrupted messages It is of central importance for many applications in computer science or engineering This book gives a comprehensive introduction to coding theory whilst only assuming basic linear algebra It contains a detailed and rigorous introduction to the theory of block codes and moves on to more advanced topics like BCH codes Goppa codes and Sudan s algorithm for list decoding The issues of bounds and decoding essential to the design of good codes features prominently The authors of this book have for several years successfully taught a course on coding theory to students at the National University of Singapore This book is based on their experiences and provides a thoroughly modern introduction to the subject There are numerous examples and exercises some of which introduce students to novel or more advanced material **The Big Book of Colleges, 1997** Edward Custard,Princeton Review (Firm),1996-07-30 Lists more than 1 600 colleges and universities and provides information about admissions and academic programs Introduction to Coding Theory J.H. van Lint,2012-12-06 The first edition of this book was conceived in 1981 as an alternative to outdated oversized or overly specialized textbooks in this area of discrete mathematics a field that is still growing in importance as the need for mathematicians and computer scientists in industry continues to grow The body of the book consists of two parts a rigorous mathematically oriented first course in coding theory followed by introductions to special topics The second edition has been largely expanded and revised The main editions in the second edition are 1 a long section on the binary Golay code 2 a section on Kerdock codes 3 a treatment of the Van Lint Wilson bound for the minimum distance of cyclic codes 4 a section on binary cyclic codes of even length 5 an introduction to algebraic geometry codes Eindhoven J H VAN LINT November 1991 Preface to the First Edition Coding theory is still a young subject One can safely say that it was born in 1948 It is not surprising that it has not yet become a fixed topic in the curriculum of most universities On the other hand it is obvious that discrete mathematics is rapidly growing in importance The growing need for mathe maticians and computer scientists in industry will lead to an increase in courses offered in the area of discrete mathematics One of the most suitable and fascinating is indeed coding theory **Who's Who in Science and Engineering 2008-2009** Who's Who Marquis,Marquis Who's Who,2007-12 *Algebraic Geometric Codes: Basic Notions* Michael Tsfasman,Serge Vlăduţ,Dmitry Nogin,2022-04-15 The book is devoted to the theory of algebraic geometric codes a subject formed on the border of several domains of mathematics On one side there are such classical areas as algebraic geometry and number theory on the other information transmission theory combinatorics finite geometries dense packings etc The authors give a unique perspective on the subject Whereas most books on coding theory build up coding theory from within starting from elementary concepts and almost always finishing without reaching a certain depth this book constantly looks for interpretations that connect coding theory to algebraic geometry and number theory There are no prerequisites other than a standard algebra graduate course The first two chapters of the book can serve as an introduction to coding theory and algebraic geometry respectively Special attention is given to the geometry of curves over finite fields in the third chapter Finally in the last chapter the authors explain relations between all of these the theory of algebraic geometric codes

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