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This is a course intended for first year research students in Mathematics, provided for the London Taught Course Centre (LTCC). See the LTCC website for full details of the objectives and activities of the LTCC, and of other available courses. See here for general information about the course -- much of the information in the handout is repeated below. Teacher responsible: Peter Allen, Department of Mathematics, LSE Lectures: 13 January - 10 February 2020 in De Morgan House, London. General description Objectives Our aims in this course are twofold. First, to discuss some of the major results of graph theory, and to provide an introduction to the language, methods and terminology of the subject. Second, to emphasise various approaches (algorithmic, probabilistic, etc) that have proved fruitful in modern graph theory: these modes of thinking about the subject have also proved successful in other areas of mathematics, and we hope that students will find the techniques learnt in this course to be useful in other areas of mathematics. Reading material Below is a collection of books, including some that can be accessed online. Any one of these textbooks should give sufficient reading material. The code before each book will be used in the table of contents below. B&M J.A. Bondy and U.S.R. Murty, Graph Theory. Springer (2008). A thorough and well-written textbook covering most parts of modern graph theory. In many institutes you will be able to read this book online. Long ago, Bondy and Murty wrote one of the classic textbooks on graph theory: Graph Theory with Applications. North Holland (1976). This book is out of print (and has been out of print for ages). But the full text is available online for personal use. You can download it from here. Diestel Reinhard Diestel, Graph Theory (1st, 2nd, 3rd, or 4th edition). Springer-Verlag (1997, 2000, 2005, 2010). Although this book is still in print, the author has made sure that a restricted version is available online as well. See diestel-graph-theory.com/. All editions are suitable for this course. References in the notes will refer to the 4th edition (which is the same as the one you can download most parts of). Bollobás Béla Bollobás, Modern Graph Theory. Springer-Verlag (1998). This is another classic textbook aimed at students at this level, and is suitable for the course. Pre-requisites Many people attending the course will have taken an introductory course in graph theory or discrete mathematics before, and we assume a certain amount of basic knowledge in graph theory. Specifically, we expect students attending these lectures to be familiar with the following notions: graphs; trees; paths; cycles; vertex degree; connectedness; bipartite graphs; complete graphs; subgraphs. Those requiring a quick refresher are advised to look at the introductory chapter of any of the books listed above, before the course starts. Contents and notes Below is the rough schedule for this course, with notes. Some of these notes are from last year; they will be updated in due course. It is likely that there will be some small changes this year. Examination questions Here is the 2017 exam, with solutions. And here is the 2019 exam, of course also with solutions. And finally the 2019 exam, with solutions. Copyright © Jan van den Heuvel & London School of Economics and Political Science 2008 - 2016, minor hacks due to Peter Allen, 2017 New from 2021: There is now an inexpensive Standard eBook edition in freely installable PDF. New from 2020: The Professional Edition is now free on iPhones in all languages via the book's iOS app. The chapter links below will let you view the main text of the book. More features – index, links in the text, searchability – are included with the eBook editions linked to at the bottom of this page. All eBooks are offered here at a 80% discount off the Springer price. The Professional edition comes at a 25% discount off the print edition. It can be shared over several platforms, annotated, and has an additional appendix offering hints for all the exercises. Contents 1. The Basics 2. Matching, covering and packing 3. Connectivity 4. Planar graphs 5. Colouring 6. Flows 7. Extremal graph theory 8. Infinite graphs 9. Ramsey theory for graphs 10. Hamilton cycles 11. Random graphs 12. Minors, trees and WQO Appendices Hints for the exercises Powered by Lahnö, an unbelievably helpful ISP @book{citeulike:395714, abstract = {{The third edition of this highly successful textbook has been carefully revised and updated, and includes a new chapter on infinite graphs. The book covers all major, recent developments, and can be used both as a reliable textbook for an introductory course and as a graduate text: on each topic it covers all the basic material in full detail, and adds one or two deeper results (again with detailed proofs) to illustrate the more advanced methods of that field. From the reviews of the first two editions (1997, 2000): "This outstanding book cannot be substituted with any other book on the present textbook market. It has every chance of becoming the standard textbook for graph theory." Acta Scientiarum Mathematicarum "The book has received a very enthusiastic reception, which it amply deserves. A masterly elucidation of modern graph theory." Bulletin of the Institute of Combinatorics and its Applications "A highlight of the book is what is by far the best account in print of the Seymour-Robertson theory of graph minors." Mathematika ". . . like listening to someone explain mathematics." Bulletin of the AMS}}, added-at = {2007-04-02T13:41:45.000+0200}, author = {Diestel, Reinhard}, biburl = (. citeulike-article-id = {395714}), howpublished = {Hardcover}, interhash = {befcfe79e0a9160bc476335a92c96b68}, intrahash = {9e602f87536254e3d0cad676403c9f5}, isbn = {3540261826}, keywords = {info.refs.books.research.conceptual.graphs.science.math}, month = {August}, priority = {2}, publisher = {Springer}, timestamp = {2007-04-02T13:41:45.000+0200}, title = {Graph Theory (Graduate Texts in Mathematics)}, url = { year = 2005 } %0 Book %1 citeulike:395714 %A Diestel, Reinhard %D 2005 %I Springer %K info.refs.books.research.conceptual.graphs.science.math %T Graph Theory (Graduate Texts in Mathematics) %U %X The third edition of this highly successful textbook has been carefully revised and updated, and includes a new chapter on infinite graphs. The book covers all major, recent developments, and can be used both as a reliable textbook for an introductory course and as a graduate text: on each topic it covers all the basic material in full detail, and adds one or two deeper results (again with detailed proofs) to illustrate the more advanced methods of that field. From the reviews of the first two editions (1997, 2000): "This outstanding book cannot be substituted with any other book on the present textbook market. It has every chance of becoming the standard textbook for graph theory." Acta Scientiarum Mathematicarum "The book has received a very enthusiastic reception, which it amply deserves. A masterly elucidation of modern graph theory." Bulletin of the Institute of Combinatorics and its Applications A highlight of the book is what is by far the best account in print of the Seymour-Robertson theory of graph minors." Mathematika ". . . like listening to someone explain mathematics." Bulletin of the AMS %@ 3540261826 We've detected that JavaScript is disabled in this browser. Please enable JavaScript or switch to a supported browser to continue using twitter.com. You can see a list of supported browsers in our Help Center. Help Center MAC5770 Introdução à Teoria dos Grafos John Adrian Bondy, U.S. Rama Murty, Graph Theory with Applications, Macmillan, 1976. Clássico. Antigo, mas ainda muito bom. Murty visita o Brasil (especialmente a UNICAMP) com regularidade. Robin J. Wilson, Introduction to Graph Theory, 4th.ed., Addison-Wesley, 1997. Jonathan Gross, Jay Yellen, Graph Theory and Its Applications, CRC Press, 1998. Cláudio L. Lucchesi, Introdução à Teoria dos Grafos, IMPA, 1979. Livro do 12.o Colóquio Brasileiro de Matemática. Douglas B. West, Introduction to Graph Theory, 2nd.ed., Prentice Hall, 2001. Dizem que a primeira edição tinha muitos erros. Não sei se foram todos corrigidos na segunda. Gary Chartrand, Linda Lesniak, Graphs & Digraphs, 3rd. edition, Chapman & Hall, 1996. Por algum motivo, não gosto muito... Ronald J. Gould, Graph Theory, Benjamin/Cummings, 1988. Não gosto muito. Entre outras coisas, por causa dos erros. Jonathan L. Gross, Jay Yellen, Handbook of Graph Theory, CRC Press, 2003. Ainda não conheço. Claude Berge, The Theory of Graphs and Its Applications, Mathuen & John Wiley, 1962. Frank Harary, Graph Theory, Addison-Wesley, 1972. Harary nasceu em 1921 e faleceu em 4/1/2005. Narsingh Deo, Graph Theory with Applications to Engineering and Computer Science, Prentice Hall, 1974. Excelentes livros que vão além do nível de MAC5770: Reinhard Diestel, Graph Theory, 2nd. ed., (Graduate Texts in Mathematics, 173), Springer, 2000. Excelente. Usei na edição 2000 de MAC5827. Tenho uma cópia local. Béla Bollobás, Graph Theory: an Introductory Course, (Graduate Texts in Mathematics, 63), Springer-Verlag, 1979. Clássico. Tem caráter mais matemático que os outros. Béla Bollobás, Modern Graph Theory, (Graduate Texts in Mathematics, 184), Springer-Verlag, 1998. Edição ampliada do Graph Theory: an Introductory Course do mesmo autor. Discute muitas conexões da teoria dos grafos com outros ramos da matemática. László Lovász, Combinatorial Problems and Exercises, 2nd. ed., North-Holland, 1993. Aprenda teoria dos grafos fazendo exercícios! A segunda parte do livro traz as soluções de muitos dos exercicios. O livro foi escrito por um dos maiores matemáticos da atualidade. László Lovász, Michael D. Plummer, Matching Theory, (Annals of Discrete Mathematics, 29), North-Holland, 1986. Tudo sobre emparelhamentos e muito mais. Excelente! (Mas o índice remissivo poderia ser melhor...) Os livros da lista abaixo têm um caráter mais algorítmico que os outros. Alan Gibbons, Algorithmic Graph Theory, Cambridge University Press, 1985. Shimon Even, Graph Algorithms, Computer Science Press, 1979. T.H. Cormen, C.E. Leiserson, R.L. Rivest, C. Stein, Introduction to Algorithms, 2nd edition, MIT Press & McGraw-Hill, 2001. [Veja também o sítio dos autores.] Não é um livro de teoria dos grafos, mas as seções 5.4 e 5.5 e os capítulos 23 a 27 podem ser relevantes. Há uma edição em português (Algoritmos - Teoria e Prática, Campus, 2002), mas a tradução não é boa ("loop invariante" no lugar de loop invariant e outras bobagens). Software Os detalhes da implementação dos algoritmos não receberão muita atenção em MAC5770. Mas existe excelente material para os interessados no assunto: Robert Sedgewick, Algorithms in C, 3rd. edition, part 5: Graph Algorithms, Addison-Wesley, 2002. As figuras são excelentes. A organização do texto — nem tanto. O código dos programas tem um lamentável defeito: a documentação não diz o que cada função faz. • Copiei o código de todos os programas. Donald E. Knuth, The Stanford GraphBase, ACM Press e Addison-Wesley, 1993. O livro documenta o pacote de software Stanford GraphBase (SGB), que está instalado nas redes UNIX e Linux do IME. Veja o extended abstract [ps, pdf] que descreve o livro e o software. Veja também minha página sobre o SGB. LINK: A Software System for Discrete Mathematics. Desenvolvido no DIMACS. Uma das finalidades secundárias de MAC5770 é desenvolver a habilidade de argumentar com precisão, ou seja, a habilidade de escrever "provas matemáticas". Eis alguns livros que podem ajudar: Frank M. Steward, Introduction do Linear Algebra, Van Nostrand, 1963. Os apêndices do livro são muito bons! Daniel J. Velleman, How to Prove It, Cambridge University Press, 1994. Nicholas J. Higham, Handbook of Writing for the Mathematical Sciences, SIAM, 1993. Donald E. Knuth, Tracy Larrabee, Paul M. Roberts, Mathematical Writing, MAA, 1989. Norman E. Steenrod, Paul R. Halmos, Menahem M. Schiffer, Jean A. Dieudonné, How to Write Mathematics, AMS, 1973. E.W. 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