

Corso di laurea in Matematica - AA 2020/2021
GE460 - Teoria dei grafi - Argomenti per
seminari

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1. Argomenti di natura algebro-geometrica

- (i) Kirkhoff's matrix tree theorem. ([GR, 13])
- (ii) Chip-firing games. ([GR, 14])
- (iii) Divisor theory on graphs and the Riemann-Roch problem. ([BN07])

2. Argomenti legati a aspetti topologici

- (i) Knots and graphs. ([GR, ch. 16])
- (ii) Graphs in other surfaces. ([Die, App. B])

3. Argomenti legati a aspetti computazionali

- (i) Complexity of algorithms. ([BM1, ch. 8],[Gib, ch. 8])
- (ii) Network flows. ([Wil, 29])
- (iii) Graph algorithms. ([JNP, ch. 2])

4. Applicazioni varie

- (i) Simple applications of graph theory: the shortest path problem, the salesman problem and the Sperner Lemma. ([BM2, 1.8, 1.9])
- (ii) Shortest paths algorithms: tree search algorithms ([BM1, ch. 6])
- (iii) Colouring problems and the Kuratovsky theorem. ([Wil, ch. 5])
- (iv) Connectivity problems. ([JNP, ch. 5])
- (v) Applications to search in massive graphs (e.g. google search page rank).

5. Argomenti legati alla teoria delle Probabilità

- (i) Random walks on graphs. ([Bol, ch. IX])
- (ii) Markov chains. ([Wil, 24])

6. Aspetti legati alla teoria dei matroidi e ulteriori sviluppi

- (i) Characterization of graphic/cographic matroids. ([Wil, ch. 9])
- (ii) Planar matroids. ([Wil, ch. 9])
- (iii) Representability of matroids. ([Wil, ch. 9])
- (iv) Connectivity for matroids. ([Wil, ch. 9])
- (v) Oriented matroids

7. Temi di approfondimento vari

- (i) Directed graphs, orientable Eulerian graphs. ([Wil, 22,23])
- (ii) The marriage problem. ([Wil, 25,26])
- (iii) Menger theorem. ([Wil, 28])
- (iv) Ramsey theory. ([Bol, ch. VI])
- (v) Szemerédi's regularity lemma. ([Bol, iV.5])

Riferimenti bibliografici

- [BN07] M. Baker, S. Norine: Riemann-Roch and Abel-Jacobi theory on a finite graph. *Adv. Math.* 215 (2007), no. 2, 766–788. (<https://arxiv.org/abs/math/0608360>)
- [Big] N. Biggs: *Algebraic graph theory*, Cambridge University Press.
- [BM1] J. A. Bondy, U.S.R. Murty: *Graph theory*, Springer GTM 244.
- [BM2] J. A. Bondy, U.S.R. Murty: *Graph theory with applications*, North Holland.
- [Bol] B. Bollobás: *Modern Graph theory*, Springer GTM 184.
- [Die] R. Diestel: *Graph theory*, Springer GTM 173.
- [Gib] A. Gibbons: *Algorithmic graph theory*, Cambridge University Press.
- [GR] C. D. Godsil, G. Royle: *Algebraic Graph theory*, Springer GTM 207.
- [JNP] D. Joyner, M. V. Nguyen, D. Phillips: *Algorithmic Graph Theory* and Sage.
- [Oxl] J. G. Oxley: *Matroid theory*. Oxford graduate texts in mathematics, 3.
- [Wil] R. Wilson: *Introduction to graph theory*. Prentice Hall.