Some references for the course
"Metodi Numerici per la Fisica" (modules 1,3,6)

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Some preliminary aspects on coding (C language)

For the purpose of this course practically any book about programming and coding is more than enough (just as any low-level programming language is practically equivalent: Fortran, C, C++). Some references with a more specific target are

- J. Gustedt "Modern C" Manning Publications
- L. M. Barone, E. Marinari, G. Organtini, F. Ricci-Tersenghi "Scientific Programming. C-Language, Algorithms and Models in Science" World Scientific
- R. E. Bryant, D. R. O'Hallaron "Computer Systems. A programmer's Perspective" Prentice Hall

The first reference is a book about C from the "standard" computer science point of view, but which also touches some less standard aspects. The second book introduces C together with some applications in computational physics, while the third book presents a more in-depth discussion of the underlying structures for people already acquainted with C coding.

Module 1. "Introduction to Markov Chain Monte-Carlo with applications to statistical mechanics"

- B. A. Berg "Markov Chain Monte Carlo Simulations and Their Statistical Analysis" World Scientific.
- K. Binder, D. W. Heermann "Monte Carlo Simulations in Statistical Physics. An Introduction" Springer.
- W. Krauth "Statistical Mechanics: Algorithms and Computations" Oxford University Press.
- D. P. Landau, K. Binder "A Guide to Monte Carlo Simulations in Statistical Physics" Cambridge University Press.
- M. E. J. Newman, G. T. Barkema "Monte Carlo Methods in Statistical Physics" Oxford University Press.
- A. D. Sokal *Monte Carlo Methods in Statistical Mechanics: Foundations and New Algorithms* in C. DeWitt-Morette, P. Cartier, A. Folacci (eds.) "Functional Integration. Basics and Applications" Springer.

Complements on pseudo-random number generatos

- D. E. Knuth "The art of computer programming. Vol 2 Seminumerical Algorithms" Addison Wesley.
- A. M. Ferrenberg, D. P. Landau, Y. J. Wong *Monte Carlo simulations: Hidden errors from "good" random number generators* Phys. Rev. Lett. **69**, 3382 (1992).

Complements on Markov chains

- W. Feller "An Introduction to Probability Theory and Its Applications. Vol 1" John Wiley & Sons.
- J. R. Norris "Markov Chains" Cambridge Univerisity Press.

Complements on Finite Size Scaling

- J. Cardy "Scaling and Renormalization in Statistical Physics" Cambridge University Press.
- A. Pelissetto and E. Vicari *Critical phenomena and renormalization group theory* Phys. Rept. **368**, 549 (2002) [arXiv:cond-mat/0012164 [cond-mat]].
- W. Janke *First-Order Phase Transitions* in B. Dünweg, D. P. Landau, A. I. Milchev "Computer Simulations of Surfaces and Interfaces" Springer.
- A. Pelissetto, E. Vicari *Scaling behaviors at quantum and classical first-order transitions* [arXiv:2302.08238 [cond-mat.stat-mech]].

Module 3. "Application of Monte-Carlo methods to the study of path-integral in quantum mechanics"

- K. Binder, D. W. Heermann "Monte Carlo Simulations in Statistical Physics. An Introduction" Springer.
- D. P. Landau, K. Binder "A Guide to Monte Carlo Simulations in Statistical Physics" Cambridge University Press.
- W. Krauth "Statistical Mechanics: Algorithms and Computations" Oxford University Press.
- M. Creutz, B. Freedman *A Statistical Approach to Quantum Mechanics* Ann. of Phys. **132**, 427 (1981).
- C. Bonati, M. D'Elia *Topological critical slowing down: variations on a toy model* Phys. Rev. E **98**, 013308 (2018) [arXiv:1709.10034 [hep-lat]].

Complements

- M. Lüscher, U. Wolff *How to calculate the elastic scattering matrix in two-dimensional quantum field theories by numerical simulation*, Nucl. Phys. B **339**, 222 (1990).
- D. M. Ceperley *Path integrals in the theory of condensed helium* Rev. Mod. Phys. **67**, 279 (1995).
- A. D'Alessandro, M. D'Elia, E. V. Shuryak *Thermal Monopole Condensation and Confinement in finite temperature Yang-Mills Theories* Phys. Rev. D **81**, 094501 (2010) [arXiv:1002.4161 [hep-lat]].

Complements on path-integral

- R. P. Feynman, A. R. Hibbs "Quantum Mechanics and Path Integrals" Dover Publications
- L. S. Schulman "Techniques and Applications of Path Integration" Dover Publications
- J. Zinn-Justin "Path Integrals in Quantum Mechanics" Oxford University Press

Module 6. "Simulation of path-integral for quantum field theories"

- M. Creutz "Quarks, gluons and lattices" Cambridge University Press.
- T. DeGrand, C. DeTar "Lattice Methods for Quantum Chromodynamics" World Scientific.
- C. Gattringer, C. B. Lang "Quantum Chromodynamics on the Lattice. An Introductory Presentation" Springer.
- C. Itzykson, J.-M. Drouffe "Statistical field theory" Vol. 1 ("From Brownian motion to renormalization and lattice gauge theory") Cambridge University Press.
- I. Montvay, G. Münster "Quantum Fields on a Lattice" Cambridge University Press.
- H. J. Rothe "Lattice gauge Theories. An Introduction" World Scientific.

Complements

- J. Engels, F. Karsch, H. Satz, I. Montvay *Gauge field thermodynamics for the SU(2) Yang-Mills system* Nucl. Phys. B **205**, 545 (1982)
- N. Cabibbo, E. Marinari, *A New Method for Updating SU(N) Matrices in Computer Simulations of Gauge Theories* Phys. Lett. B **119**, 387 (1982)
- A. D. Kennedy, B. J. Pendleton *Improved Heat Bath Method for Monte Carlo Calculations in Lattice Gauge Theories* Phys. Lett. B **156**, 393 (1985).
- S. Gottlieb, W. Liu, D. Toussaint, R. L. Renken, R. L. Sugar *Hybrid-molecular-dynamics algorithms for the numerical simulation of quantum chromodynamics.* Phys. Rev. D **35**, 2531 (1987).
- S. Duane, A. D. Kennedy, B. J. Pendleton, D. Roweth *Hybrid Monte Carlo.* Phys. Lett. B **195**, 216 (1987).
- J. Engels, J. Fingberg, F. Karsch, D. Miller, M. Weber *Nonperturbative thermodynamics of SU(N) gauge theories* Phys. Lett. B **252**, 625 (1990).
- A. D. Kennedy *Algorithms for dynamical fermions* [arXiv:hep-lat/0607038 [hep-lat]].
- J. Kiskis, R. Narayanan, D. Sigdel *Correlation between Polyakov loops oriented in two different directions in SU(N) gauge theory on a two dimensional torus* Phys. Rev. D **89**, 085031 (2014) [arXiv:1403.1770 [hep-th]]
- C. Bonati, P. Rossi *Topological susceptibility of two-dimensional $U(N)$ gauge theories* Phys. Rev. D **99**, 054503 (2019) [arXiv:1901.09830 [hep-lat]].