People's Democratic Republic of Algeria Ministry of Higher Education and Scientific Research

University of Sciences and Technology of Oran – Mohamed Boudiaf Mathematics and Computer Science Faculty Computer Science Department

Course Handout

Algorithmic and Complexity

<u>Training Offer:</u> Common core Engineer

<u>Domain:</u> Mathematics and Computer Science

Study: Computer Science

Year: Second year

Developed by:

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Course objectives:

The main goal is to develop the ability to define and manipulate abstract data structures from the simplest (linear) to more complex data structures (trees, graphs).

One of the important concepts invoked throughout this course concerns the calculation of algorithm complexity. It's important to show the impact of the choice of data structures on the complexity. It's why we dedicate a chapter to sorting algorithms whose complexity is strongly influenced by the data structure used to store the information to be sorted.

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BIBLIOGRAPHIC REFERENCES

- D. Beauquier, J. Berstel, P. Chretienne, et al., "Eléments d'algorithmique", volume 8, Masson, 1992.
- G. Brassard, P. Bratley, "Fundamentals of algorithmics", ISBN: 0-13-335068-1, Prentice Hall, Inc. Upper Saddle River, NJ, USA, 1996.
- T. H. Cormen, C. E. Leiserson, R. L. Rivest, C. Stein, "Introduction à l'algorithmique", ISBN: 2-10-003922-9, 2ème édition, Dunod, 2002.
- S. Kannan, M. Naor, S. Rudich, "Implicit Representation of Graphs", SIAM J. on Discrete Math., volume 5, pages 596-603, 1992.
- A. D. Mishra, D. Garg, "Selection of best sorting algorithm", International Journal of Intelligent Information Processing, 2(2), 363-368, 2008.
- R. Sedgewick, P. Flajolet, "Introduction à l'analyse des algorithmes", ISBN: 2841809579, International Thomson Publishing, 1998.