Data Visualization and Analysis BINF4245

Prof. Dr. Renato Pajarola
Visualization and MultiMedia Lab
Department of Informatics
University of Zürich

Organization BINF4235

- Lecture: Mo 16:15 - 18 in BIN 2.A.01
- Assistant: Gaudenz Halter (halter@ifi.uzh.ch), Haiyan Yang, Lizeth J. Fuentes
- Web page: http://www.ifi.uzh.ch/en/vmml/teaching/lectures/visual-analysis-hs20.html
- Exercises: Online on OLAT or integrated in lecture
- Standing assignment is to read book chapters corresponding to the topics covered in the lecture
  - In required textbooks, plus selected chapters from additional books
  - Plus any reading assignments

Literature

Required textbooks:

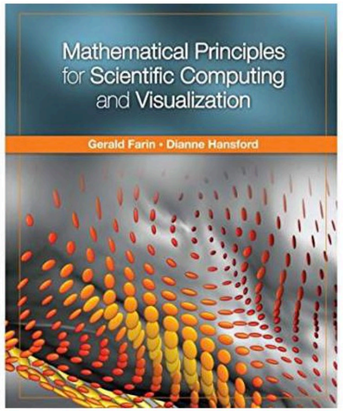
- [2] Gerald Farin and Dianne Hansford. ***Mathematical Principles for Scientific Computing and Visualization***. AK Peters, 2008.
  - Sampling, interpolation, data fitting, scientific data visualization, 2D and 3D raster and vector graphics

Selected chapters:

- [6] Rafael C. Gonzales and Richard E. Woods. ***Digital Image Processing***. Prentice Hall, 2008
  - Color models, image representation and image processing
- [7] Ze-Nian Li and Mark S. Drew. ***Fundamentals of Multimedia***. Pearson Prentice Hall, 2004
  - Sampling and quantization, color theory
- [8]Alexandru Telea. ***Data Visualization: Principles and Practice***. AK Peters, 2014
  - Scientific, data and vectorfield visualization

Further literature:

- Colin Ware, *Information Visualization: Perception for Design*. Morgan Kaufmann, 2012.
  - Information visualization, perception, presentation, interaction and design
- Edward R. Tufte, *The Visual Display of Quantitative Information*. Graphics Press, 2001.
  - History and example visualization, fundamental concepts of quantitative graphs and graphical excellence



Mathematical Principles for Scientific Computing and Visualization 21 Oct 2008 | Kindle eBook

by Gerald Farin and Dianne Hansford

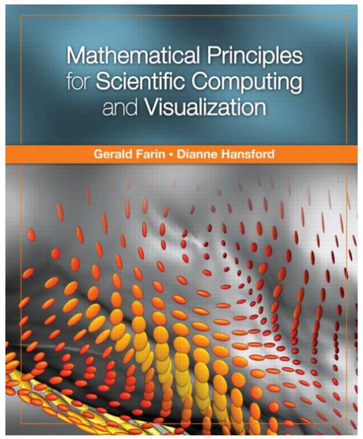
EUR 38.19 Kindle Edition

Includes VAT

Buy now with 1-Click®

Available for download now

Home / Mathematics / Mathematics for Engineering / Mathematical Principles for Scientific Computing and Visualization



Preview this Book

Mathematical Principles for Scientific Computing and Visualization

Gerald Farin, Dianne Hansford

Hardback	eBook	eBook Rental
£47.99	£33.59	from £20.00

eBooks are subject to VAT, which is applied during the checkout process.

What are VitalSource eBooks?

October 21, 2008 by A K Peters/CRC Press
Textbook - 280 Pages
ISBN 9781439865040 - CAT# KE01008

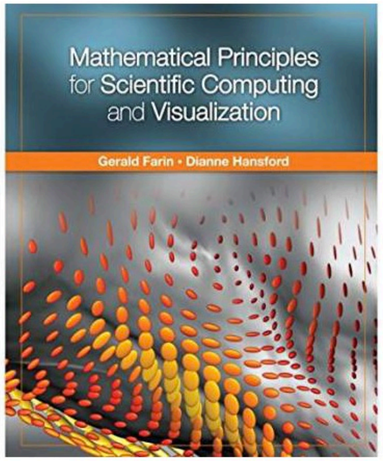
- **6 Month Rental - £20.00**
- **12 Month Rental - £25.00**

For Instructors	Request an e-inspection copy
For Instructors and Students	Companion Website >>
For Librarians	Available on CRCnetBASE >>

- Description
- Reviews
- Downloads / Updates

Summary

This non-traditional introduction to the mathematics of scientific computation describes the principles behind the major methods, from statistics, applied mathematics, scientific visualization, and elsewhere, in a way that is accessible to a large part of the scientific community. Introductory material includes computational basics, a review of coordinate systems, an introduction to facets (planes and triangle meshes) and an introduction to computer graphics. The scientific computing part of the book covers topics in numerical linear algebra (basics, solving linear system, eigen-problems, SVD, and PCA) and numerical calculus (basics, data fitting, dynamic processes, root finding, and multivariate functions). The visualization component of the book is separated into three parts: empirical data, scalar values over 2D data, and volumes.



Mathematical Principles for Scientific Computing and Visualization 21 Oct 2008 | Kindle eBook

by Gerald Farin and Dianne Hansford

EUR 38.19 Kindle Edition

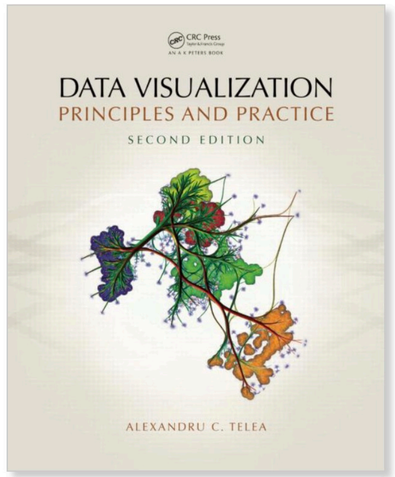
Includes VAT

Sold by: Amazon Media EU S.à r.l.

Buy now with 1-Click ®

Available for download now

Available to all UZH at: http://www.crcnetbase.com/isbn/9781568813219



2nd Edition

Data Visualization

Principles and Practice, Second Edition

By Alexandru C. Telea

Copyright Year 2015

Hardback £75.00 | **eBook** £67.50

ISBN 9781466585263

Published September 18, 2014 by A K Peters/CRC Press

617 Pages 224 Color & 224 B/W Illustrations

› Available on Taylor & Francis eBooks

1st Edition Available online https://1lib.eu/book/2696541/e554a1

Lecture Topics

• Data processing	
▸ Sampling and quantization	Theoretical foundations
▸ Data interpolation and fitting	Algorithms and techniques
▸ Image processing	Algorithms and techniques
• Data analysis	
▸ Statistical analysis	Algorithms and techniques
▸ Dimensionality reduction	Algorithms and techniques
▸ Clustering	Algorithms and techniques
• Vector graphics	
▸ 2D, 3D shapes	Principles and concepts
▸ Rendering	Principles and concepts
• Volume visualization	Visualization techniques and examples
• Vector field visualization	Visualization techniques and examples
• Color science	Theoretical foundations

Further Notes

- Complementary to the *Data Visualization Concepts* module
  - Some topical overlap with extended treatment
  - With added technical and mathematical details
- Compulsory reading includes chapters from the required textbook as well as selected book chapters from additional literature as indicated on the course's web page
  - Topics like sampling and interpolation, color science, image processing, data analysis, vector graphics, rendering …

Exercises

- Four practical exercises scheduled for out-of-class completion and online submission in OLAT
- In-class Q&A sessions during lecture slots

Final Exam

- Final exam includes all content from lecture slides *AND* corresponding textbook chapters as well as any selected book chapters from indicated readings

Programming Exercises

- Experience with hands-on implementation of data processing and analysis methods for visualization
- We expect you to be able to create and find solutions
  - Be flexible and inventive in case of project tasks with loosely defined targets
    - do not want to over-specify details, clearly indicate your assumptions
- Use of Python and its packages for its general data analytics and visualization purposes
  - Ability to (learn to) read and extract data out of CSV files or formatted text files is expected
  - Simple data cleaning or preprocessing may implicitly be needed as well
- Getting used to Python is expected, also exploiting add-on packages
  - Using appropriate packages is a skill to be trained
- Use the OLAT discussion forum to exchange experience and hints about programming problems and solution ideas

Exercise Schedule

- Exercises will be **distributed online in OLAT** without introducing them first in the lecture
- A **Question & Answer** (Q&A) session will be held during the lecture one week before the submission deadline
- Example schedule for the first exercise:
  - Handout: Monday, Oct. 5.
  - Q&A: Monday, Oct. 12.
  - Submission: Monday, Oct. 19.

Completion Requirements

- **All** programming exercises are **mandatory** and must be processed
  - Incomplete or partially working solutions are accepted but will not result in any points
- Every **fully solved** programming exercise will earn you **points, up to 15 in total**
- A **minimum of 7** points must be achieved to pass the module
  - Failure to achieve this minimum in the programming exercises will result in a failing grade irrespective of the outcome in the final exam
- The four exercises give rise to the following point distribution: 2 – 3 – 5 – 5
  - Hence at least two have to be fully solved
- If **more than 8 points** are achieved, the additional points on top of that will count as **bonus points** for the final exam
  - 7 is required, 8 is still normal passing, 9 and above will give 1 or more extra points